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RESEARCHES

ON THE

FOSSIL OSTEOLOGY,

PARTICULARLY REDUCED AND BE ARRANGED

FROM THE FRENCH

OF

THE BARON CUVIER,

MEMBER OF THE [illegible]

&c. &c.

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PRELIMINARY DISCOURSE

ON THE REVOLUTIONS OF THE SURFACE OF THIS GLOBE, AND ON THE CHANGES WHICH THEY HAVE OPERATED IN THE ANIMAL KINGDOM.

In the following work on Fossil Osteology, my object has been to ascertain to what animals those osseous remains, which are found in the superficial strata of the globe in such abundance, belong. I have endeavoured to give a tolerable survey of a road in which but a few steps had previously been taken. Becoming an antiquary of a new kind, I was forced to learn both the method of restoring these monuments of past revolutions, and of deciphering their meaning. I was obliged to collect and arrange, in the primitive order, their component fragments; to remould the ancient animals to which these fragments belonged; to reproduce them with their proportions and characters; and, finally, to compare them with the animals which now exist: an art nearly unknown, and one which presupposes a science in which but a superficial progress has been made, that of the laws which regulate the co-existence of forms in the various parts of organized beings. For these researches, it was necessary to prepare myself, by labours of still greater length on existing animals. Nothing short of a general review of the present creation could impart a character of demonstration to the inferences which I drew from this one of more ancient date. But by this means I gained a great body of rules and affinities, and the entire animal kingdom could hardly fail to be in some measure subjected to new laws, from the circum-

stance of my attempting this Essay on comparatively but a small part of the theory of the earth.

I was encouraged and sustained, in this twofold task, both by the advantage which it promised to anatomical science in general (the only proper basis for all investigations concerning organized bodies), and also to the physical history of the globe, which is the foundation of mineralogy, of geography, nay, even of the history of mankind itself; and of all which it concerns us to know respecting ourselves and our species.

If we take an interest in following, in the infancy of mankind, the almost obliterated traces of so many nations now no more, shall we not derive some pleasure from investigating the traces of revolutions which took place in the infancy of the earth itself, anterior to the existence of every nation? We admire the power of the human mind, in measuring the movements of those heavenly bodies which nature seemed to have excluded for ever from our sight—Genius and Science have overleaped the bounds of space.

Certain simple observations, followed up by a train of reasoning, have unfolded the mechanism of the world. Would it not also reflect honour upon man to be enabled, in like manner, to overleap the bounds of time; and, by means of observation, to ascertain the history of the earth, and a series of events which have preceded the origin of his species? Astronomers, unquestionably, have proceeded faster than naturalists, and, as far as the theory of the earth is concerned, the present epoch is scarcely more enlightened than that in which philosophers believed the heavens to be of polished stone, and the moon no larger than the Peloponnesus. Yet, after Anaxagoras, the world has beheld Copernicus and Kepler pave the way for Newton, and why should not Natural History, in some future day, possess her Newton also?

The plan and the result of my labours on the fossil bones are what I peculiarly propose to lay before my readers in this

discourse. I shall also attempt to give a rapid view of what has hitherto been done to ascertain the history of the revolutions of the globe. The facts which I have been enabled to discover, form, it is true, but a small portion of this ancient history; but then they lead to very decisive conclusions, and the rigorous method which I have adopted in their verification justifies me in the belief that they will be regarded as points finally settled, and which must constitute an epoch in science. If I demand the principal attention of my readers for these same points, their novelty will form my best apology.

My first object will be to show how the fossil remains of terrestrial animals are connected with the theory of the earth, and how great the importance of the subject is in this point of view. I shall afterwards explain the principles by which these bones are to be ascertained, or the mode by which a genus may be discovered, or a species distinguished by a single fragment of bone; an art, on the certainty of which the value of my entire labour must depend. I shall give a rapid sketch of new species belonging to genera hitherto unknown, which I have discovered by the application of these principles, and also of the various kinds of strata in which such remains are concealed; and as the difference between the extinct and living species does not extend beyond certain limits, I shall demonstrate that those limits are considerably wider than those which distinguish varieties of the same species. I shall then explain how far these varieties may extend, from the influence of time, climate, or domestication. I shall then conceive myself justified in concluding, that the more considerable differences which I have discovered are the results of very important catastrophes. I shall afterwards explain the peculiar influence which my researches should exercise on the received opinions concerning the revolutions of the globe. I shall, finally, examine how far the civil and religious history of nations accords with the results of observation on the physical history of the

earth, and with the probabilities which these observations afford respecting the period when the communities of mankind were enabled to occupy fixed habitations, and grounds susceptible of culture, and when society could consequently assume a durable form.

When we traverse those fertile plains where tranquil waters cherish as they flow an abundant vegetation, and where the soil, trod by a numerous people, adorned with flourishing villages, rich cities, and superb monuments, is never disturbed save by the ravages of war or the oppression of power, we can hardly believe that nature has also had her internal commotions, and that the surface of the earth itself has been anarchized by revolution. But our opinions change when we dig into this apparently peaceful soil, or ascend its neighbouring hills. Our ideas are expanded with the view, they begin to embrace the extent and grandeur of these ancient events, when we climb the lofty chains of which the base is skirted by these hills, or, following the beds of the descending torrents, we penetrate into their interior structure.

The lowest and most level soils, even when we dig very deeply, present nothing to our view but horizontal strata, composed of substances more or less varied, but all containing marine productions to an innumerable extent. The hills, to a very considerable height, are composed of similar strata and similar productions. The shells are sometimes so numerous, as to form the entire mass of the soil: they are found at elevations far above the level of every sea, and where existing causes could carry no sea at present: they are not only involved in loose sand, but frequently incrusted by the hardest stones, which are interpenetrated by them throughout. All quarters of the globe, both hemispheres, all continents, and every island of any considerable magnitude, exhibit the same phenomenon. The time is past when ignorance could maintain that these remnants of organized bodies resulted from the caprice of

nature, and were productions formed in the bosom of the earth by its generative powers; and the attempts of certain metaphysicians to restore currency to those exploded opinions are not likely to be attended with all the success they anticipated. A scrupulous comparison of the forms of these remains, of their texture, and not unfrequently of their chemical composition, is insufficient to show the slightest difference between the fossil shells and those which are now found in the ocean. There is neither rupture nor detrition to be observed, nothing, in fact, which indicates a violent change of place. The smallest of them preserve their most delicate parts, their finest crests, and their minutest points. It is clear, then, that they have inhabited the sea, that they have been deposited by the sea, and that it was the sea which left them in those places where they are at present found: but it also follows that the sea has rested in those places, and that it has rested there long enough, and with sufficient tranquillity, to form places of deposition so regular, so dense, so vast, and in part so solid, as are filled by these remnants of aquatic animals. The reservoir, then, of the sea, has at least undergone some change, whether in extent or situation. Such is the conclusion warranted by our first excavations, and by the most superficial observation.

The traces of revolution become much more striking the higher we ascend, and the nearer we approach the basis of the larger chains of mountains.

There are still to be found there many banks of shells, and some even thicker and more solid than in less elevated situations. The shells are also equally numerous, and equally well preserved; but they are no longer of the same species. The strata which contain them are not so generally horizontal; they assume an oblique direction, and sometimes nearly a vertical one. In the plains and low hills it is necessary to dig deeply to ascertain the series of strata; but here their edges are clearly visible through the chasm, produced by accident or

time. At the foot of these declivities, round hills are formed by immense masses of their fallen ruins, the height of which is augmented by every thaw, and by every storm.

Even these inclined strata, which constitute the ridges of secondary mountains, are not placed upon the horizontal strata of those hills which form their first commencement: they are, on the contrary, situated beneath them, and the hills themselves rest on their declivities. When we pierce through the horizontal strata, in the neighbourhood of mountains with inclined strata, the inclined strata are again discovered in the depth below. Nay, sometimes when the inclined strata are not greatly elevated, we find their summits covered with the horizontal strata. The oblique then, or inclined strata, are of greater antiquity than the horizontal; and as at least the greater number of them must have been formed horizontally, it is evident that they must have been raised by some cause into their actual position, and that too previously to the horizontal strata having been formed above them *.

Thus the sea, previously to the formation of the horizontal strata, must have formed others which have been broken, inclined, and overturned in a variety of ways by some unknown causes; and as several of these inclined strata, which were more anciently formed, are elevated above the horizontal strata which have succeeded, and which surround them, the causes which produced their inclination must also have propelled them above the level of the sea, so as to form islands, or at least rocks and inequalities, either from the strata being raised by

* The idea maintained by some geologists, that certain strata have been originally formed in the oblique position in which they are at present found, is (supposing it to be true respecting some which would be crystallized, according to Mr. Greenough, like the depositions which incrust the whole interior of vessels in which gypsous waters have been boiled), quite inapplicable, at least to such as contain shells or smooth stones, which, suspended in such a manner, could never have attained to the formation of the cement necessary to agglutinate them.

one of their extremities, or from the subsidence of the waters in consequence of the depression of the opposite edge. This is a second consequence not less clearly demonstrated than the first, as any one who will take the trouble of studying the remains by which it is proved may be soon convinced of.

But the changes and revolutions to which the actual state of the earth is owing are not limited to this convulsion of the ancient strata, nor to the retreat of the sea after the formation of the new. When we compare more minutely the different strata, and the animal productions which they contain, we shall soon find that this ancient sea has not always deposited stones of a similar kind, or animal remains of the same species, and that each of its depositions is not extended over the entire surface which it must have covered. Successive variations took place, the first of which alone seem to have been nearly of a general description, the others much less so. The more ancient the strata, the more uniform and extensive is each of them; the more recent are more limited and more subject to variation at small distances. The dislodgements of the strata were accompanied and followed by changes in the nature of the liquid, and of the substances which it held in solution; and when certain strata, appearing above the waters, had divided the surface of the sea by islands, and projecting ridges, various changes must have taken place in many of the particular basins or reservoirs.

It is obvious that in the midst of variations like these in the nature of the fluid, the animals which inhabited it could not continue to be of the same kinds. Their species, and even genera, must change with the strata; and although there is sometimes a recurrence of the same species at moderate distances, yet it is generally true that the shells of the ancient strata exhibit a formation proper to themselves. They gradually disappear, and are no longer to be found in the recent strata, much less in the present seas, where their corresponding species are never

discovered, and even many of their genera do not exist. On the contrary, the shells, in the recent strata, resemble, as to their genus, those which exist in our seas; and in the last and loosest of these strata, and in certain recent and limited depositions, there are species which the most practised eye cannot distinguish from those which exist on the neighbouring coasts.

There has been, then, in animal nature, a succession of changes occasioned by those of the fluid in which the animals lived, or at least corresponding with them. These variations have conducted by degrees the classes of aquatic animals to their present state. Finally, when the sea quitted our continent for the last time, its inhabitants did not differ materially from those which exist in it at the present day.

We say, *for the last time*, because, if we examine with greater attention these wrecks of organic beings, we shall discover in the midst of the marine strata, even among the oldest, strata filled with animal or vegetable productions belonging to the earth or to the fresh water; and among the more recent strata, *i. e.* the most superficial, there are some where terrestrial animals are buried under accumulations of marine productions. Thus the various catastrophes which have removed the strata have not only caused the various parts of our continents to issue by degrees from the bosom of the waters, and the basin of the seas to diminish, but this basin has also been displaced in a variety of ways. It has often occurred, that lands left dry have been again covered by the waters, either from these lands being sunk below the waters, or the waters having risen above them. As for the soil which the sea has left free in its last retreat, namely, that which man and the other terrestrial animals inhabit at present, it had already been dried up once before, and was then the seat of quadrupeds, of birds, of plants, and of terrestrial productions of every kind. The sea then, which has quitted it, had made another and a previous encroachment on it. The changes in the elevation of the waters

did not merely consist in a retreat more or less gradual, more or less general; various irruptions and successive retreats took place, the final result of which has been a universal diminution of level.

But what is of equal importance to observe is, that these reiterated irruptions and retreats have not all been slow, nor all performed by degrees; on the contrary, most of the catastrophes which produced them have been sudden. This is easily proved in the instance of the last of these catastrophes, that which by a double movement has inundated and again left dry our present continents, or at least a considerable portion of the land which now composes them. It has left, in the northern countries, the carcasses of large quadrupeds which were frozen, and are preserved even to the present day, with their skin, hair, and flesh. Putrefaction must have decomposed them, had they not been frozen the instant they were killed: but, on the other hand, this intense frost could not have existed previously in the places where they are found frozen; for they could not have supported life under such a temperature. In the same instant, then, in which these animals perished, the climate which they inhabited must have undergone a complete revolution. This event, then, was sudden, instantaneous, and without gradation; nor is the character of this last catastrophe less clearly demonstrated than that of those which have preceded it. The ruptures, the inclinations, the overturnings of the more ancient strata, leave no doubt that their present situation is the result of sudden and violent causes. The mighty force which the mass of waters must have been subjected to is still attested by the heaps of ruins, and of round pebbles which are found interposed in many places between the solid strata. Animal life, then, has been frequently disturbed on this earth by these terrific catastrophes. Living beings, without number, have proved their victims. The inhabitants of the dry land have been ingulfed by deluges and inundations; and the tenants

of the water, deserted by their element, have been left to perish by drought, from the instantaneous elevation of the bottom of the ocean. Their very races have become utterly annihilated, leaving no memorial of their existence but a few shapeless wrecks, to puzzle the researches and exercise the ingenuity of the natural historian.

Such are the conclusions to which we are necessarily led by the objects which occur to us at every step, and we can verify them every moment in almost every country. These great and terrible events are every where written in legible characters to the eye, which can read their history in the monuments which survive them. What is more astonishing, however, though not less certain, is, that life itself has not always existed on the surface of the globe; and that it is easy for the observer to recognize the period at which animal productions began to be deposited.

Let us ascend still higher, let us ascend towards the lofty ridges, towards the shelvy summits of the grander chains of mountains; there remains of marine animals, there innumerable shells soon become more unfrequent, and finally disappear altogether. We arrive at strata of another character, which contain no vestiges of living beings; they show, however, by their crystallization, and even by their stratification, that they were likewise in a liquid state when originally formed: they prove, by their inclined situation and shelvy edges, that they have been overturned. The oblique manner in which they are sunk under the strata of shells shows that they have been formed before them; and the height to which their bristling and naked peaks are elevated far above the shelly strata shows that these summits had projected above the waters at a time when the shelly strata were yet in the process of formation.

Such are those celebrated primitive or primordial mountains, which, elevated above the clouds, intersect our continents in various directions, divide the basins of rivers, contain in their

eternal snows the reservoirs which supply the sources of those mighty streams, and form, as it were, the skeleton or coarser frame-work of this terrestrial globe.

From the indentations by which their ridges are broken, and the sharp bristling peaks which mark their summits, the eye can discover, at a very considerable distance, marks of the violence with which they have been raised to their present eminence. Very different is the case of those rounder mountains, and of those hills with long flat surfaces, whose recent mass has ever remained in the situation in which it was left quietly deposited, by the last retiring waters.

In proportion as we approach them, these marks become much more manifest. The valleys no longer exhibit these gentle declivities, these salient and re-entering angles opposed to each other, which appear to indicate the beds of some ancient currents: there is no general rule for their enlargement or contraction; their waters are sometimes expended in lakes, and sometimes precipitated in torrents. Sometimes their rocks, suddenly approximating to each other, form transverse dikes from which the same waters fall in cataracts. While the broken strata exhibit on one side their trenchant edges, they present obliquely, on the other, large portions of their surface. They do not correspond in height; but those which on one side form the summit of the precipice are ingulfed, as it were, on the other, and appear no more.

Notwithstanding, however, all this apparent disorder, eminent naturalists have discovered a certain order which reigns throughout. In these immense strata, broken and overturned as they are, a certain succession is observed, which is pretty nearly the same in all the loftier chains of mountains. The granite, they observe, of which the central ridges of most of those chains are composed, and which overtops all, is also the stone which is sunk below all the others. It is the most ancient of those which we can observe in the place assigned to it

by nature, whether it owes its origin to a general liquid which formerly held all things in solution, or whether it was the first substance that became fixed, from the cooling of a great mass of matter in a state of fusion or evaporation *. Foliated rocks rest upon its sides, and form the lateral ridges of these mighty chains. Schist, porphyry, granular quartz, and rocks of talc, are mingled in their strata; finally, granular marble and other calcareous rocks without shells, resting on the schists, form the exterior ranges, the lower steps, the foundations of these chains, and are the last work by which this unknown liquid, this uninhabited sea, appears to have prepared materials for the mollusca and zoophytes, which were soon to deposit on these beds the immense accumulation of their shells and corals. We see even the first productions of these mollusca and zoophytes, small in number, and at certain intervals in the last strata of these primitive soils, or in this portion of the external coating of the globe which geologists have named transition-rocks. Shelly strata are met with here and there, interposed between some granite more recent than the rest, among various kinds of schistus, and between some final beds of granulated marble. There appears in those early times to have been a struggle between life and inert inanimate matter, for the possession of that globe in which the latter had previously reigned without control: nor was it until after a considerable period that the former achieved a complete triumph, and appropriated to itself the right of continuing and of raising the solid covering of the earth.

Thus it is impossible to deny, that the masses which now

* The conjecture of the Marquis de Laplace, that the materials of which the globe is composed were at first of an elastic form, and successively assumed, in cooling, first a liquid consistence, and lastly a solid form, is strengthened by the recent experiments of M. Mitcherlich, who has completely composed and crystallized, by the heat of intense furnaces, many of the mineral species which enter into the composition of the primitive mountains.

constitute our highest mountains have been originally in a liquid state ; that for a long time they were covered by waters, which then supported no living beings ; that it is not only since the appearance of life that changes have taken place in the nature of the substances deposited, the masses formed before that time have varied, as well as those which have been formed since ; they have experienced similar violent changes of position, and a part of these changes occurred at a time when these masses existed alone, and were not yet covered by the shelly strata. The overturnings, the disruptions, the fissures observable in their strata, are sufficient proof of this, as are also similar phenomena in strata of more recent formation, which are even found in greater number, and more distinctly marked. But these primitive masses have experienced other revolutions since the formation of the secondary strata, and have perhaps occasioned, or at least partaken, some of the same which these strata themselves have undergone. There remain, in fact, considerable portions of these primitive strata uncovered, although in a lower situation than the secondary strata. How could this have happened, unless the primitive strata had appeared subsequently to the formation of the secondary? Numerous and immense blocks of primitive substances are found scattered over the surface of the secondary strata in some countries, and separated by deep valleys, and by arms of the sea from the peaks and ridges whence these blocks could have come. Either they must have been driven thither by violent eruptions, or the valleys which might have arrested their course did not exist at the area of their transportation, or, finally, the motion of the waters which hurried them along must have exceeded in violence any thing that we can imagine at the present day *.

* The travels of Saussure and Deluc supply an immense number of these kinds of facts ; and these geologists have determined that they could scarcely have pro-

Here then we have got an assemblage of facts, a series of epochs anterior to the present time, the succession of which may be verified without uncertainty, although the duration of their intervals cannot be marked with precision. These may be considered as so many points to serve as a rule and guide in this ancient chronology.

Let us now examine what is passing at this moment on the

ceeded except from tremendous eruptions. MM. de Buch and Escher have been employed more recently on this subject. The article of the latter inserted in the New Alpina de Stein-Muller, tom. i. exhibits the whole of them in a remarkable manner, which I here epitomize for the benefit of my readers. Such of these blocks as are scattered in the lower parts of Switzerland or Lombardy came from the Alps, and have descended along their valleys. They are to be found every where, and of all sizes, even to the magnitude of fifty thousand cubic feet, in the immense extent which separates the Alps from Jura, and on the declivities of Jura which look towards the Alps, some of them rise to the height of four thousand feet above the level of the sea; they are found on the surface, or in the superficial strata of *debris*, but not in those of granulated quartz (*grès*) of molasses, or of pudding-stone, which fill almost every where the interval in question. Sometimes they are found isolated, sometimes in accumulations. The height of their situation is independent of their bulk. The small ones alone appear sometimes to be a little worn; the large ones not at all so. Those which belong to the basin of each river are found on examination to be of the same nature as the mountains which surmount or flank the higher valleys, where the confluence of streams which constitute the river originate. Some of them are still visible in these valleys, and they are particularly accumulated in such places as precede certain contractions that have occurred. They even surpass the necks of the mountains, when these are no more than four thousand feet; and then they are visible on the reverses of the crests, in those cantons between Jura and the Alps, and upon Jura itself. The most elevated are beheld opposite to the openings of the Alpine valleys; those in the intervals are less high. In the chains of Jura, more distant from the Alps, they are only found in places situated opposite to the openings of the nearer chains.

From these facts the author derives the conclusion, that the transportation of these blocks took place since the deposition of the grès and pudding-stone, and in all probability was occasioned by the latest of the revolutions of the globe. He compares this transportation to that which has taken place on the side of the torrents; but the objection arising from the size of the blocks, and that of the deep valleys through which they must have passed, appears to us to make strongly against this part of his hypothesis.

surface of the globe. Let us analyze the causes which still act upon that surface, and determine the possible extent of their effects. This part of the history of the earth is of greater importance, inasmuch as the possibility of explaining anterior revolutions by causes actually existing has long been believed; in the same manner as in political history, past events may easily be explained when we are acquainted with the intrigues and factions of our own days. But it will appear that this conjecture is unhappily ill-founded, and that the supposed analogy between physical and political history has no existence. The thread of operations is broken, the march of nature is changed; and none of those agents which she now employs would have been adequate to produce her ancient works.

There are four active causes which now contribute to alter the surface of our continents. The rains and thaws which diminish and bring down portions of the precipitous mountains, and heap the debris at their feet. The running waters which carry on those debris, and proceed to depose them in those spots where the course of the stream is slackened. The sea, which saps the foundation of the more elevated coasts, forming steep cliffs, and throwing upon the flat coasts hillocks of sand; and finally, the volcanos which pierce through the solid strata, and elevate or extend on the surface the heaps of matter which they eject *.

Wherever broken strata exhibit their edges in abrupt crags, fragments of their materials are found to fall every spring, and even after every storm. These become rounded by rolling on each other, and the centre mass assumes a form determined by the laws of cohesion, and creates, at the foot of the crag, taluses of greater or less elevation, in proportion to the abundance of the fragments. These form the sides of the valleys

* On the changes of surface in the earth, known in history or tradition, and consequently owing to existing causes, see a work in German, by M. De Hof. in 2 vols. 8vo. Goth. 1822 and 1824. The facts are collected with equal care and erudition.

in all mountainous regions, and are covered with a rich vegetation, when the falls from above become less frequent. But their own want of solidity render them also liable to fall and break when sapped by the descending rivulets. Hence it happens that towns, and rich and populous districts, are often buried under the falling mountain. The course of rivers is interrupted, and lakes overspread the country which was once the abode of cheerfulness and fertility. But such tremendous falls are fortunately rare, and the principal influence of these hillocks of fragments is to supply materials for the ravages of the mountain torrent.

The waters which fall over the crests and summits of the mountains, the vapours which are there condensed, or the snows which are liquefied, descend by an infinity of little streams along their declivities. They carry off some portions of matter, and their passage is marked by slender furrows. These streams are soon united in the deeper channels on the surface of the mountains: they flow through the profound valleys at its foot, and finally compose those streams and rivers which restore to the sea those waters with which the sea had impregnated the atmosphere, at the melting of the snow or the approach of the storm. The volume of these mountain-streams being suddenly augmented, is precipitated with a velocity proportioned to the declivity by which it descends. They strike with violence the foundation of those taluses of fragments which cover the sides of all the more elevated valleys; they also drag with them the already rounded fragments of which these taluses are composed, which become still more rounded, and polished still more by the friction. But in proportion as the streams arrive at the more level valleys, or the force of their fall is diminished, or when they come to the larger basins where their waters are permitted to expand, they throw out on their banks the largest of those stones which they had rolled along. The smaller fragments are deposited lower

down; and in the grand channel of the river, nothing seldom arrives except the minutest particles of these fragments, or a mud scarcely perceptible. The course of these waters, before the grand river is formed lower down, is often forced to traverse a vast and deep lake, where their slime is deposited, and from which they issue in a limpid state. But the inferior rivers, and all the streams which spring from less elevated mountains and from hills, produce likewise, in the lands through which they flow, effects in some measure analagous to those of the torrents which rush from the loftiest mountains. Swelled by excessive rains, they dash against the foot of those earthy or sandy hillocks which would impede their course, and carry the fragments to the lower grounds which they inundate, and which are thus elevated by every successive inundation. Finally, when the rivers arrive at the mouths of large lakes, or of the sea, these particles of mud are there deposited, which had been hurried so far by the rapidity of the torrent, now suddenly arrested in its progress. These particles form new soils which lengthen the coast; and if this coast be so situated as to receive regularly from the sea its contributions of sand, provinces, and even whole kingdoms, are thus created, generally the most fertile, and speedily the richest in the world, if their government will but permit the people to enjoy the fruits of their industry in peace.

The effects which the sea alone produces, without the assistance of rivers, are infinitely less felicitous in the result. When the coast is low, and the bottom sandy, the waves impel this sand towards the shore. At every reflux it dries up a little, and is driven by the wind still farther on the coast. Thus are formed those downs, those sandy hillocks, which if not converted to the production of suitable vegetables by the industry of man, and thus arrested in their pernicious progress, proceed slowly but surely towards the interior of countries, and overspread the fertile fields, and the cheerful abodes of men. The

same wind which carried the sand of the shore to the formation of the downs would necessarily drive the sand still farther from the summit of the downs; and if the nature of the sand and the water which is raised with it be such as to form a durable cement, the shells and bones cast upon the shore will be incrusted by it. Thus are produced what may be termed hardened downs, such as are seen on the coast of New Holland. A clear idea of these may be derived from perusing a description of them, given by the late M. Peron in his voyage to Australasia.

When, on the other hand, the coast is elevated, the sea, though it casts forth nothing, does yet exercise a very destructive action. The waves biting as it were into its foundation, and, gradually undermining it, convert the entire of its elevation into precipitous and sloping cliffs. For the highest parts, being thus left without support, tumble perpetually into the water; there, from the constant agitation of the waves, their softer and more delicate particles soon disappear. But the harder portions, continually rolled about in opposite directions by the billows, form strands by an accumulation of rounded stones and pebbles, which finally serve as a rampart to the bottom of the cliff.

Such is the action of the waters on *terra firma;* and it is easy to perceive that this action consists in reducing the land to certain levels, but not indefinitely. The fragments of these mighty crests carried into the valleys; their particles, those of the hills and plains, transported to the sea; alluvial depositions extending the coasts at the expense of the elevated grounds, are all effects to which vegetation sets a certain limit, which, moreover, suppose the pre-existence of mountains, of valleys, and of plains; in a word, of all the inequalities of the globe, and which, consequently, could not have given rise to those inequalities. Downs constitute a phenomenon still more limited both in elevation and horizontal extent; they have no relation

with those enormous masses whose origin it is the peculiar office of geology to investigate.

Although it is impossible to attain so precise a knowledge of the action which the waters exercise in their own peculiar region, yet its limits may be ascertained within a certain degree.

Lakes, ponds, marshes and sea-ports, which receive the waters of rivulets, especially when these rivulets descend from neighbouring and precipitous hills, deposit on their own bottom a mass of mud, which would soon fill them entirely if not regularly removed. The sea, in like manner, is continually throwing into its bays and harbours, and indeed into every place where its waters are tranquil, accumulations of slime and sediment. The currents also collect together and cast upon their sides the sand which they wash up from the sea, and of which they compose banks and shallows.

Certain waters having dissolved calcareous substances by means of the superabundant carbonic acid with which they are impregnated, suffer them to crystallize when this acid is evaporated, and thus form stalactites and other concretions. There are strata confusedly crystallized in fresh water, but sufficiently extended to be comparable to some of those abandoned by the ancient sea. Every one is acquainted with those famous quarries of Travertino, in the neighbourhood of Rome, and the rocks of this stone increased by the river Teverone, and varying perpetually in figure from the same cause. These two different kinds of action may be combined; the depositions accumulated by the sea may be solidified by stalactite; when, by chance, sources abundant in calcareous matter, or containing some other substance in solution, have fallen into the places where these accumulations are formed, we then perceive collections where the productions of the sea and those of the fresh water are united. Such are the shores of Guadaloupe, which exhibit at once earth, and sea-shells, and human ske-

letons. Such also is the quarry near Messina described by Saussure, where the granular quartz (*grès*) is both formed by the sand cast there by the sea, and also consolidated in the place itself.

In the torrid zone, where the species of lithophytes are numerous, and are propagated with powerful rapidity, the stony trunks are intertwined into the form of rocks and reefs, and, rising to the surface of the water, close the entrance of the harbours, and lay terrible snares for navigators. The sea, casting forth sand and slime on the summits of these shelves, raises their surface at times above its own level, and forms islands which are soon animated and adorned with a rich and delightful verdure.

It is also possible that many of the shelly tribes may in dying leave their stony coverings behind them in certain places, and that connected together by slime of greater or less degrees of concretion, or by other cements, they may form extensive depositions or species of shelly strata. But we have no proof that the sea at present has the power of incrusting these shells with a paste as compact as that in marbles, calcareous sand, stones, or even in the coarse lime-stone in which we sometimes find shells enveloped. Still less do we find the sea casting forth any where those solid and siliceous strata which have preceded the formation of the banks of shells.

In short, all these causes united would not change in any perceptible degree the level of the sea, would not raise a single stratum above that level, and, above all, would not produce a single hillock on the surface of the earth.

It has been strongly maintained that the sea experiences a general diminution, and that that observation has been made in several parts on the shores of the Baltic*.

* It is a common opinion in Sweden that the sea lowers, and that one might now pass dry-foot, or at least ford, many places where this was not formerly practicable.

But whatever may be the causes of these appearances, it is certain that they do not take place generally. In the greater number of ports where it is an object of so much interest to observe the height of the sea, and where permanent and ancient erections present so many means of measuring its variations, the mean level is uniform and constant. There has been no universal lowering of the waters of the ocean, and no general encroachment. In other places, such as Scotland and many parts of the Mediterranean, it has been imagined, on the contrary, that a visible elevation of the sea took place, and that it covers at the present day shores which were formerly above its level *.

The action of volcanoes is still more limited and local than any of these which we have just mentioned. Although we have no clear idea of the means which nature employs to sustain these violent furnaces at such prodigious depths, we can judge clearly by their effects of the changes which they are able to produce on the surface of the globe. A volcano announces its presence by some shocks of an earthquake, and then makes an opening, stones and ashes are darted to a vast distance, and it vomits forth floods of lava. The more fluid

Many considerable philosophers have adopted this opinion of the vulgar. Among the rest, M. De Buch has carried it so far as to suppose that the entire soil of Sweden has gradually risen. It is singular, however, that no regular and precise observations should have been published, calculated to authenticate a fact stated so long ago, and which would leave no doubt whether, as Linnæus says, this difference of level amounts to four or five feet annually or not.

* Mr. Robert Stevenson, in his observations on the North Sea, maintains that the level has been continually and sensibly rising for three centuries. The same observation has been made by Fortis concerning some places in the Adriatic. But the example of the temple of Serapis, near Puzzuoli, proves that the shores of this sea are in many parts of a nature that enables them to rise and fall locally. There are, however, on the opposite side of the question, thousands of quays, high-ways, and other erections of the Romans, along the sea-side from Alexandria as far as Belgium, the relative level of which has never varied.

part of the lava escapes in long channels. The less fluid is arrested at the edges of the aperture from which it issued, and this forms a cone, terminated by a crater, by raising these edges all around. Thus volcanoes accumulate substances modified by themselves, and derived from the entrails of the earth upon its surface. They form mountains with which they have formerly covered some portions of our continent. They have suddenly pushed into existence islands in the midst of seas. But these mountains and islands were always composed of lava. All their materials had been submitted to the action of fire. They are disposed as all substances must be that flow from an elevated point. Volcanoes have never raised nor overturned the strata which traverse their apertures; and if some causes, operating from these depths, have in certain cases contributed to the formation of large and unvolcanic mountains, we may safely believe that they were not volcanic agents, such at least as exist in our days.

Thus we may repeat, by way of recapitulation, that none of the agents which now operate on the surface of the earth are adequate to the production of those revolutions, the traces of which we discover on its external crust. Nor will a recurrence to those constant external forces with which we have been hitherto acquainted yield us a more satisfactory solution of the problem.

The pole of the earth moves in a circle round the pole of the ecliptic, and its axis inclines more or less on the plane of this same ecliptic. But these two motions, the causes of which are at present understood, are performed in directions and within limits which are known, and bear no proportion to effects, the extent and importance of which we have just verified. Besides, their excessive slowness must ever prevent their being employed in explanation of catastrophes which we have clearly proved to have been sudden.

This last reasoning is applicable to all the slow motions

which have been imagined as causes of the revolutions on the surface of the globe. These no doubt were chosen, in the hope that their existence could not be denied, inasmuch as it might always be maintained that their slowness rendered them imperceptible: but whether they be true or false is of little consequence; they explain nothing, since no slowly acting cause can have produced effects that were quick and sudden. Had there been a gradual diminution of the waters, had the sea transported solid substances from one place to another, had the temperature of the globe augmented or diminished, none of all these causes could have overturned our strata; could have incrusted with ice the larger quadrupeds with their flesh and skin; could have thrown shells on the dry land, as perfect at the present day as if they had been fished up alive, or could have destroyed many species and entire genera.

The greater number of naturalists have been struck by these arguments. Among those who have attempted to explain the actual state of the globe, there are scarcely any who have attributed it altogether to slowly acting causes, and still less to causes acting under our daily view. This necessity of seeking causes different from those we behold at present in operation has led to a thousand extraordinary suppositions and absurd and egregious errors and contradictions; insomuch, as I have said before, that the very name of geology has long been a subject of derision to the prejudiced, who see nothing in it but the systems to which it gave birth, and who forget the long and important series of facts which it has discovered and established *.

During a long time, but two events, two eras of the changes

* When I made this assertion, I only mentioned a fact of which we are daily eye-witnesses. But I by no means intended to express my own opinion, as some estimable geologists appeared to believe. If any thing equivocal in my language has occasioned their mistake, I here request them to accept my apology.

of the globe, were admitted to have existed; the creation and the deluge: and all the efforts of geologists were directed to explain the actual state of the earth from an imaginary primitive state, modified afterwards by the deluge; the causes, action, and effects of which each of these philosophers imagined in his own way.

Thus, according to one *, the earth had received in the beginning a uniform light crust, which caused the abysses of the ocean, and was broken to produce the deluge; the fragments of this crust constituted the mountains. Another † supposed the deluge to be occasioned by a momentary suspension of the cohesion of minerals. The whole mass of the globe was dissolved, and the soft part was penetrated by shells. A third ‡ would have it that God raised up the mountains to pour off the waters of the deluge, and selected the most rocky portions, because otherwise they would have been unable to sustain themselves. A fourth § created the earth with the atmosphere of one comet, and inundated it with the tail of another. The heat which remained from its origin excited all living beings to sin; accordingly they were all drowned, the fish excepted, whose passions were apparently less violent.

Though naturalists confined themselves within the limits prescribed by the book of Genesis, yet their range would be sufficiently extensive. They soon, however, found themselves within too narrow bounds; and when they had succeeded in representing the six days of the creation as so many indefinite periods, as whole ages cost them nothing, their systems took a flight proportionate to the spaces of time which they found at their disposal.

* Burnet. Telluris Theoria Sacra. Lond. 1681.

† Woodward. Essay towards the Natural History of the Earth. 1702.

‡ Scheuchzer. Mem. de l'Acad. 1708.

§ Whiston. A new Theory of the Earth.

Even the great Liebnitz, as well as Descartes, amused himself by imagining the earth to be an extinguished sun *, a vitrified globe, on which the vapours condensing when it cooled, formed seas which afterwards deposed calcareous strata.

Demaillet imagined the globe to have been covered with water for several thousand years. The waters gradually retired. All terrestrial animals had at first been marine. Even man himself began by being a fish; and our author assures us, that it is by no means uncommon to meet in the ocean fishes which are yet but half men, but will become entire human beings one of these days.

The system of Buffon is little more than a developement of that of Leibnitz, with the addition only of a comet, which, striking with a violent shock against the sun, separated the liquefied mass of the earth, at the same time with the masses of all the other planets. Positive dates or epochs are the result of this theory. By the actual temperature of the earth we may learn what period of time it took to cool; and, since the other planets proceeded from the sun at the same time, we may calculate how many ages the larger will yet take to cool, and how far the smaller ones are already frozen †.

In our days, more daring spirits than ever have taken up this mighty subject. Some writers have revived and very much extended the ideas of Demaillet: they assert that all was originally in a liquid state, that this liquid engendered at first animals of a very simple kind, such as monads, and other infusory and microscopic species; that in course of time, and by adopting different habits, the animal races became complicated and diversified to the degree in which we now behold them. All these races of animals have converted by degrees the waters of the sea to calcareous earth. The vegetables, of whose origin

* Leibnitz. Protogen. Dict. Lips. 1683. Gott. 1749.

† Theorie de la Terre, 1749, et Epocques de la Nature, 1775.

and metamorphoses these gentlemen give no account, on their part converted this water into clay. But these two earths, by being stripped of the characters which life had impressed upon them, were resolved, in the last analysis, into silex. This is the reason that the oldest mountains partake more largely of silex than the rest. Thus all the solid portions of our globe owe their existence to life, and without life the globe would be still entirely liquid *.

Other writers have given a preference to the notions of Kepler. Like this great astronomer they allow vital faculties to the globe itself. According to them it has a circulating fluid. Assimilation takes place within it as in animated bodies. Each of its parts is living. Even the most elementary molecules possess instinct and volition, and attract and repel each other by sympathies and antipathies. Each kind of mineral has the power of converting immense masses into its own substance, as we convert our aliments into flesh and blood. The mountains are the respiratory, and the schists the secretory organs of the globe. By means of the latter it decomposes the waters of the sea to engender volcanic eruptions. The veins are caries, abscesses in the mineral kingdom, and metals are a result of rottenness and disease; to this is owing the disagreeable effluvia of most of them †.

It must be owned, however, that we have now cited extreme examples, and that all geologists have not pushed their theories to the degree of hardihood now instanced. But even among those who have proceeded with the utmost caution, and have not looked for the means of explanation beyond the usual limits

* See La Physique de Rodig. p. 106, Leipsick, 1801, and Telliamed, page 169, tom. ii. as also an infinity of other German works. M. De Lamarck has given the principal developement to this system in modern times, and supported it with much sagacity in his Hydrogeologie and Philosophie Zoologique.

† The late M. Patrin has supported this system with much ingenuity in the Nouveau Dict. d' Histoire Naturelle.

of natural philosophy and chemistry, there still predominates a wonderful degree of diversity and contradiction.

According to one, every thing has been precipitated and deposited at all times in the usual manner: but the sea which covered all has retired by degrees *.

Another imagines that the materials of the mountains are constantly lowered and carried off by the rivers to the bottom of the ocean, there to grow warm under an enormous pressure, and form strata, which the heat that hardens them will one day raise with tremendous violence †.

A third supposes the original fluid to have been divided into a number of lakes, arranged like the benches of an amphitheatre, one above another, which, after having deposited our strata of shells, have successively broken their banks to fill the basin of the ocean ‡.

According to a fourth, tides of seven or eight hundred fathoms have from time to time carried away the bottom of the sea, and thrown it up in mountains or hills, in the valleys, or on the primitive plains of the continent §.

A fifth will have it that the various fragments of the earth fell successively from the sky, in the manner of meteoric stones, and that they bear with them the proof of their foreign origin in the exuviæ of unknown animals which they contain ||.

A sixth makes the globe to be hollow, and places there a nucleus of loadstone, which is carried by the attraction of comets from one pole to another, drawing with it the centre of gravity

* In his Geologie M. Delametherie admits crystallization as a principal cause.

† Hutton and Playfair. Illustrations of the Huttonian Theory, &c.

‡ Lamanon, in various places of the Journal de Physique, after Michaelis, &c.

§ Dolomieu. Ibid.

|| M. M. de Marschall, in researches respecting the origin and developement of the present state of the earth. Geissen, 1802.

and the mass of the waters, and thus alternately drowning the two hemispheres *.

We might quote twenty other systems equally contradictory and various as the foregoing: and to prevent mistake, we would have it understood that it is by no means our intention to criticise their authors. On the contrary, we are fully satisfied that these conceptions were formed by men of genius and of science, who were not ignorant of facts, which many among them had travelled far and wide for the purpose of ascertaining.

How then does it happen that there should be so much diversity in the solutions given by men, who proceeded from the same principles, to resolve the same problem?

It must be that all the conditions of this problem have never been taken into consideration. This it is which has caused it to remain undetermined to the present day, and susceptible of many solutions, all equally good when such and such a condition was abstracted; all equally bad when a new condition comes to be discovered, or it is found that an old one, though known, has been neglected.

To drop mathematical language, we may say, that almost all the authors of these systems, regarding only certain difficulties which struck them more than others, have applied themselves to the solution of these, in a manner more or less probable, without considering many others equally numerous and equally important. One, for example, saw only the difficulty of explaining the change in the level of the seas. Another, of accounting for the solution of all terrestrial substances in one and the same liquid. A third, that of animals which he believed to be natives of the torrid zone, being able to exist under the frigid. Exhausting all the powers of their mind on these questions,

* M. Bertrand, periodical renewal of the terrestrial continents. Hamburgh, 1799.

they believed that they had done every thing, when they had imagined a manner of replying to them. We may add, that while they neglected all the other phenomena, they did not always think of determining with precision the measure and limits of those which they ought to explain.

These observations peculiarly apply to the secondary stratifications, which, nevertheless, form the most important and most difficult part of the problem. It has scarcely ever been attempted carefully to determine the super-positions of their strata, nor the relations of these strata with the species of animals and plants, whose remains they contain. Are there certain animals and plants proper to certain strata, and not to be found in others? What are the species which appear first in order, and what are those which follow? Are there two kinds of species ever found together? Are there alternations in their appearances, or, in other words, do the first recur a second time, or do the second then disappear? Have these animals and plants lived in the places where we find their exuviæ, or have they been transported thither from another quarter? Do they all continue to live in some part of the earth, or have they been totally or partially destroyed? Is there a constant relation between the antiquity of the strata, and the similarity or dissimilarity of the fossil to the existing animals? Is there a relation, as to climate, between the fossil and those living beings which most resemble them? May we conclude that the transportation of these organized bodies, if it ever took place, proceeded from north to south, or from east to west, or in an irregular manner; and can the epochs of these transportations be distinguished by the strata which carry their impressions?

If these questions cannot be replied to, if their negative or affirmative cannot be established, how is it possible to explain the causes of the actual state of our globe? It is certain, so far from any of these points being yet divested of doubt, that they have not even been made the subject of investigation, or

their illustration thought at all necessary to the formation of a system.

The reason of this singular omission seems to be, that geologists have all been either mere naturalists in the closet, and never examined the structure of mountains; or mineralogists, who had not studied sufficiently in detail the innumerable variety of animals, and the infinite complication of their various parts. The first did nothing but make systems; the last have certainly given us some excellent observations; and, in fact, have laid the foundations of the science, but they have not been able to complete the superstructure.

That part of the grand problem of the theory of the earth which merely appertains to the mineral kingdom has been studied by Saussure with very laudable accuracy, and carried afterwards to a wonderful degree of developement by Werner and the numerous and accomplished pupils of his school.

The first of these celebrated men having traversed for twenty years the most inaccessible districts, and examined, in some measure, every side, and penetrated into every defile of the Alps, has unveiled to us the disorder of the primitive stratifications, and more clearly pointed out the limits which separate them from the secondary. The second, profiting by the numerous excavations made in the most ancient mining country in the world, has determined the laws which regulate the succession of strata; he has shown their respective antiquity, and investigated each of them in all their metamorphoses. It is from him, and from him alone, that geology can assume any date as a science, in all that concerns the universal nature of strata. But neither of these illustrious men have determined the organized fossil species in each description of strata, a precision in which is rendered absolutely necessary, since the number of known animals has arrived to such a prodigious extent.

Other naturalists, undoubtedly, have studied the fossil re-

mains of organised bodies; they have collected, and described, and figured them in many thousands. Their works are precious repositories of materials. But being more occupied with animals and plants, considered merely in their own proper nature, than with the theory of the earth, or regarding these petrifactions and fossils as curiosities rather than historical documents; or, in fine, contenting themselves with partial explanations concerning the relative situation of each particular specimen, they have, for the most part, neglected to investigate the general laws of position and relation between the fossils and the strata.

Still, one should imagine, that the necessity of such an investigation was very obvious and natural. How was it possible not to perceive that the theory of the earth owes its origin to the fossils alone? That without them it is probable that the notion of the different epochs in the formation of the globe, and of a series of different operations, would never have been started. They alone, in truth, inform us with any certainty that the globe has not always had the same covering, from the certainty that they must have lived upon its surface before they were buried in its depths. It is only by analogy that we have extended to the primitive strata the conclusions which the fossils directly furnish respecting the secondary. If there were strata only, without fossils, no one could maintain that these strata had not been formed altogether. Slight as our acquaintance has hitherto been with fossil remains, it is yet to that that we owe the little we do know respecting the nature of the revolutions of the earth. By them we are certified that the strata, at least such as enclose them, have been gently deposited in a fluid matter; that their variations have corresponded to those of the fluid; that their being set dry has been occasioned by the removal of this fluid, and that this fact has taken place more than once. There could be no certainty regarding any of these circumstances but for the fossils.

The study of the mineral part of geology, which is not less necessary than the other, and even for practical purposes is of much greater utility, is, however, much less instructive in relation to the present object of our investigation.

We are in the most absolute state of ignorance respecting the causes of those variations which have taken place in the substances of which the strata is composed. We are not even acquainted with the agents which have the power of holding certain of them in solution; and it is still a matter of controversy, in regard to many, whether they owe their origin to fire or water. Hitherto, in fact, philosophers have been at issue on every point but one, and that is, that the sea has changed its bed; and how could this have been known but for the aid of the fossils?

Fossil remains, then, which have formed the commencement of the theory of the earth, have, at the same time, furnished its principal illustrations, and the only ones which, to the present day, have been generally acknowledged and admitted.

From this consideration we have been induced to employ ourselves on this important subject. But the field is immense, and a feeble and partial survey of it is all that can be expected from a single hand. It was necessary then to make choice of a single department, which choice was very speedily made. The class of fossils which form the object of the present work was that which at the first glance attracted and fixed our attention, because we perceived that it was at the same time fruitful in accurate conclusions, and yet less known, and more abundant in novel objects of research *.

It is, indeed, most evident, that the fossil osteology of qua-

* This work shows, in fact, how new the subject is, notwithstanding the valuable labours of Camper, Pallas, Blumenbach, Merk, Soemmering, Rosenmüller, Fischer, Faujas, Home, and other philosophers, whose works I have cited with the utmost care, in those chapters where any reference to them was necessary.

drupeds must, for many reasons, lead us to more precise results, than any other exuviæ of organised bodies.

In the first place, they characterize, in a clearer manner, the revolutions by which they have been influenced. From shells we doubtless learn, that the sea has occupied those places in which they were found. But the changes in their species may proceed from very trifling changes in the nature, or even in the temperature of the fluid which they inhabited. They may have even been occasioned by accidental causes. We cannot even tell whether, in the bottom of the ocean, certain species, and even genera, have not been driven by others from particular tracts which they had occupied for a long period of time. But with regard to the quadrupeds all is precise and certain. The appearance of their bones, especially of entire carcasses, in certain strata, clearly announces that the strata which contain them had formerly been dry, or at least that a dry land had been formed in their vicinity. Their disappearance renders it certain that these strata had been inundated, or that this dry land had ceased to exist. It is from them that we learn with certainty the important fact of the repeated irruptions of the sea, an information which we could not have received from marine fossils and productions. It is only by a profound and accurate study of them, that we can hope to ascertain the number and the periods of these irruptions.

Secondly, the nature of the revolutions which have altered the surface of the globe must have exercised over the terrestrial quadrupeds a more complete influence than over the marine animals. As these revolutions have, in a great measure, consisted in displacing the bed of the sea, and as the waters must have destroyed every quadruped which they reached; if the irruption had been general, it must have destroyed the entire class; or, if it was only carried at once over certain continents, it must, at least, have annihilated the species peculiar to these continents, without having the same influence over the

marine animals. On the contrary, millions of aquatic animals have been stranded, or buried under new strata, and yet their race has been preserved in more tranquil quarters, to be propagated anew, after the agitations of the waters should have ceased.

Thirdly, the examination of this complete action is more within our grasp; it is more easy to demonstrate its effects. As the number of quadrupeds is limited, and as most of their species, at least the larger, are known, we have better means of assuring ourselves if the fossil remains belong to any of them, or to some species which are lost. As, on the other hand, we are very far from being acquainted with all the shells and fishes of the sea; as we are, in all probability, ignorant of the largest portion of those that dwell in the depths of the ocean, it is impossible to know with certainty whether a marine species, found in a fossil, does or does not yet exist somewhere in a living state. Thus we see some naturalists persist in giving the name of *Pelagian* shells, or shells of the ocean, to *belemnites*, *cornua ammonis*, and other testaceous exuviæ, which have not yet been found except in the ancient strata; meaning by this, that if they have not yet been found in a living state, it is because they inhabit depths of the ocean inaccessible to our nets.

Naturalists, it is true, have not yet traversed all the continents, nor are even acquainted with all the quadrupeds which inhabit the countries through which they have travelled. New species of this class of animals are discovered from time to time; and those who have not attentively examined all the circumstances of these discoveries may suppose that the unknown quadrupeds, whose bones are found in our strata, are still existing in some islands yet unexplored by navigators, or in some of the vast deserts which occupy the central parts of Asia, Africa, the two Americas, and New Holland.

Nevertheless, when we examine with attention what kind of quadrupeds have been recently discovered, and under what cir-

cumstances they have been discovered, we shall easily see that little hope remains of finding, at any future day, those species which have hitherto been observed only in a fossil state.

Islands of moderated extent, and situated at a considerable distance from continents, have but few quadrupeds, and the majority of them very small. Whenever they possess large ones, they have been brought from another quarter. Bougainville and Cook found nothing but pigs and dogs in the islands of the South Sea. The largest quadrupeds of the Antilles were the *agoutis*.

In fact, large tracts of country, like Asia, Africa, the two Americas, and New Holland, have large quadrupeds, and, generally speaking, species peculiar to themselves: insomuch, that when any of these lands have been discovered, isolated by their situation from the rest of the world, a class of quadrupeds have there been found different from all that existed elsewhere. When the Spaniards, for the first time, explored South America, they did not find there a single one of the quadrupeds of Europe, Asia, or Africa. The puma, the jaguar, the tapir, the cabiai, the lama, the vicugna, the sloths, the tatous, the sarigues, and all the sapajous, were, to them, animals entirely new, of which they had no idea. The same phenomenon was renewed in our days, when the coasts of New Holland and the adjacent islands were first examined. The various kanguroos. the phascolomys, the dasyuri, the perameles, the flying phalangers, the ornithorynchi, and the echidnæ, astonished naturalists by their singular conformations, which, departing from all rules before acknowledged, were reducible to no given system.

If, then, there remained some mighty continent still to be discovered, we might hope yet to become acquainted with some new species, some of which might be found, more or less, to resemble those whose exuviæ are enclosed in the bowels of the earth. But a glance at the map of the world is sufficient, a view

of the innumerable directions in which navigators have ploughed the ocean, is enough to enable us to judge that no large tract of land remains to be discovered, unless perhaps towards the southern pole, whence every trace of life must be banished by the everlasting tyranny of winter.

Thus we perceive, that it is only in the interior of large countries that unknown quadrupeds may be expected to exist. But a little reflection will soon convince us that this expectation is not better founded than the other.

It is certainly not easy for the European traveller to traverse vast extents of country, either deserted or inhabited by wild and ferocious hordes. This is especially true respecting the interior of Africa. But there is nothing to hinder the animals from traversing these countries in all directions, and appearing on the coasts. Even though there should be between the interior and the coasts large chains of mountains, yet they must be broken in some parts to leave a passage for the rivers, and in these burning deserts quadrupeds would in preference follow the courses of rivers. The hordes that inhabit the coasts frequently ascend these rivers, and, either personally or from commerce with the interior tribes, or from tradition, quickly learn every particular concerning all the remarkable species living near the sources of these rivers.

No long period of time could have elapsed before the civilized nations, which have frequented the coasts of a large country, became acquainted with all the animals therein, which were remarkable for any thing important in their size, structure, habits, or configurations.

Known facts are sufficient to establish this reasoning. Although the ancients did not pass the chain of Imäus and the Ganges, in Asia, and though they did not proceed very far in Africa to the south of Atlas, they were yet well acquainted with all the larger animals of those two quarters of the globe; and if they have not distinguished all the species, it was not be-

cause they had not seen or heard of them, but because their mutual similarity prevented a proper distinction of characters from being made. The only important exception that can be instanced against my argument is that of the tapir of Malacca, recently sent from the Indies by two young naturalists, pupils of my own, M. M. Duvaucel and Diard, and which is, in truth, one of the finest discoveries with which natural history has been enriched in modern times.

The ancients were perfectly well acquainted with the elephant; and the history of this quadruped by Aristotle is more precise than Buffon's. They were not altogether ignorant of the differences that distinguish the African elephants from those of Asia. They were acquainted with the two-horned rhinoceros, which modern Europe has never seen in a living state. Domitian exhibited some of them in Rome, and had their figures engraved on medals: Pausanias has left a very excellent description of them. The one-horned rhinoceros, notwithstanding the remoteness of its habitations, was equally well known to the ancients. Pompey exhibited one at Rome, and Strabo has given a very exact description of another at Alexandria.

The rhinoceros of Sumatra, described by Mr. Bell, and that of Java, discovered and sent over by M. M. Duvaucel and Diard, do not appear to inhabit the continent. Thus, it is not astonishing that the ancients were ignorant of them; though, perhaps, had they known them, they would have made no distinction between them and the other species.

The hippopotamus has not been so well described as the preceding species. But very exact figures of this animal are found on the monuments left by the Romans, representing things relative to Egypt, such as the statue of the Nile, the mosaic of Palestrina, and a great number of medals. In fact, the Romans had repeatedly seen the animal. It was exhibited

by Severus, Augustus, Antoninus, Commodus, Heliogabalus, Philip, and Carinus.

The Bactrian and the Arabian camel have been very well described and characterised by Aristotle.

The ancients were acquainted with the giraffe or camelopard. One was even exhibited alive at Rome, under the dictatorship of Julius Cæsar, in the year of the city 708. Ten were collected by Gordian III. which were afterwards killed at the secular games in the reign of Philip. Our moderns, who during the fifteenth century beheld but one of these animals, might well be astonished at this fact*.

If the descriptions of the hippopotamus given by Herodotus and Aristotle, supposed to be borrowed from Hecatæus of Miletus, are read with attention, it will be found that they must have been composed from two different animals, one of which was probably the true hippopotamus, and the other most certainly the gnou (*antilope gnu*, Gm.) a quadruped of which our naturalists do not appear to have heard until near the end of the eighteenth century. The same animal was the subject of certain fabulous relations under the name *catoblepas* or *tablepon*†.

The Ethiopian wild boar of Agatharcides, which had horns, was certainly the Ethiopian boar of the present day, whose enormous tusks deserved the name of horns almost as much as those of the elephant ‡.

The *bubalus* and the *nagor* are described by Pliny §; the *gazelle* by Elian‖; the *oryx* by Oppian¶; the *axis* was known

* This camelopard was sent to Lorenzo di Medicis by the Soldan of Egypt, and it is painted in frescos of Poggio-Cajano.

† Pliny, lib. viii. cap. 32. and Elian, lib. vii. cap. 5.

‡ Elian, Anim. 5. 27.

§ Pliny, lib. viii. cap. 15. and xi. 37.

‖ Elian, Anim. xiv. 14.

¶ Oppian, Cyneg. ii. 2. v. 445, &c.

in the times of Ctesias*; the *algazel* and the *corina* are perfectly well represented on the monuments of the ancient Egyptians†.

Elian gives a very good description of the *zak* or *bos grunniens* under the name of the ox having a tail which might serve to make fly-flappers ‡.

The buffalo was not domesticated by the ancients, but the Indian ox, of which Elian speaks, with horns large enough to hold three amphoræ, was certainly that variety of the buffalo called *arni* §.

Even the wild ox with depressed horns, which Aristotle places in Arachosia, must be the common buffalo ‖.

The ancients were acquainted with hornless oxen ¶; also with the African species, whose horns being only attached to the skin, are removeable with it**; with the Indian oxen, as swift as horses ††, and those which did not surpass the he-goat in size ‡‡; with the large-tailed sheep ‖‖, and those of India as large as asses §§.

Notwithstanding the fables which are mingled with the ancient accounts concerning the *aurochs*, the rein-deer and the elk, they still prove that some knowledge of these animals existed; founded, it is true, on the relations of barbarians, and not submitted to a judicious and critical examination.

These animals still inhabit the countries assigned to them by the ancients, and have disappeared only in quarters too highly cultivated to be suitable to their habits. The aurochs and the elk still exist in the forests of Lithuania, which formerly joined

* Pliny, lib. viii. cap. 21.
† See the great work on Egypt. Antiq. iv. pl. 49. and pl. 46.
‡ Ellan, Anim. xv. 14.
§ Idem, iii. 34.
‖ Arist. Hist. An. lib. ii. cap. 5.
¶ Elian, Anim. ii. 53.
** Idem, ii. 20.
†† Idem, xv. 24.
‡‡ Idem, ibid.
‖‖ Idem, Anim. iii. 3.
§§ Idem, iv. 32.

the Hercynian forest. Aurochs are to be found in the north of Greece, as in the time of Pausanias. The rein-deer still inhabits the snowy regions of the north, where it has always lived. It still changes its colour there according to the seasons. By a series of mistakes, scarcely excusable, it was supposed to inhabit the Pyrenees in the fourteenth century*.

The white bear was seen even in Egypt under the Ptolemies, as we read in Athenæus. Lions and panthers were commonly exhibited by hundreds in the Roman games. Even some tigers were seen there, as also the striped hyæna, and the crocodile of the Nile. Excellent representations of the rarest of these species are to be seen in the ancient mosaics preserved at Rome. Among others, the striped hyæna is perfectly represented in a piece of mosaic preserved in the museum of the Vatican. While I was at Rome, in 1809, a pavement in mosaic, composed of natural stones arranged in the Florentine manner, was discovered in a garden beside the arch of Gallienus, representing four Bengal tigers, in a very superior style.

The museum of the Vatican possesses a crocodile in basalt, done with an almost perfect exactitude, if we except the error of a claw too many on the hind foot. Augustus exhibited thirty-six of these animals.

It is not to be doubted that the *hippotigris* was the zebra, which is never found but in the southern parts of Africa. Caracalla killed one of them in the circus, according to Dion.

It would be easy to demonstrate that all the remarkable species of the simiæ have been distinctly noticed by the an-

* Buffon having read in Du Fouilloux a mutilated passage from Gaston-Phebus, Count de Foix, in which that prince describes the hunting of the rein-deer, imagined, that in Gaston's time this animal existed in the Pyrenees. The printed editions of Gaston were so incorrect, that it was difficult to ascertain his precise meaning. But having had recourse to the original manuscript, deposited in the royal library, I have ascertained that it was in *Xueden* and *Nourvègue* (Sweden and Norway), that he says he had witnessed the hunting of the rein-deer.

cients, under the names of *pithecus*, *sphinx*, *satyrus*, *cebus*, *cynocephalus*, and *cercopithecus**.

The ancients even knew and have described some very small species of rodentia, when they possessed any peculiar conformation or quality. The *jerboa* is engraved on the medals of Cyrene, and indicated by Aristotle under the name of the *two-legged rat.*

But the small species are of no importance in relation to the object we have in view; and it is sufficient to have shown that all the larger species which are at present known in Europe, Asia, and Africa, and which are remarkable for any striking character, were also known to the ancients; from which we may easily conclude, that if they make no mention of the small species, or do not distinguish those between which there is a close resemblance, like the various gazelles and others, they have been prevented from so doing by want of method and attention, rather than by any obstacles of climate. We may equally conclude, that if eighteen or twenty centuries, and the circumnavigation of Africa and India, have added nothing in this department to what the ancients had already taught us, it is not likely that ages to come will afford our posterity more information on the subject.

But perhaps an opposite argument may be employed, that the ancients, as we have just proved, were not only acquainted with as many of the larger animals as ourselves, but that they have described several which we do not possess; that we have been in too great a hurry to conclude that these animals were fabulous; that greater research is necessary to prove that the history of the existing creation is exhausted; and, finally, that among these pretended fabulous animals may be found, when they are better known, the originals of our unknown fossil

* See Lichtenstein, Comment. de Simiarum quotquot veteribus innotuerunt formis.

species. Some may even think that the various monsters, essential embellishments of the heroic history of almost every nation, are precisely those species which it was necessary to extirpate before civilization could be established. Thus Theseus and Bellerophon were more fortunate than those of modern times, who have certainly repulsed from among them all the noxious animals, but have not yet succeeded in exterminating any species.

This objection is easily replied to by examining the descriptions of these unknown animals, and tracing their origin.

The source of the most numerous of these animals is purely mythological, and their descriptions bear the most indelible marks of their origin. In almost all of them we can discover little more than a combination of the parts of animals already known, the result of an unbridled imagination, and at variance with all the laws of nature.

Those which have been invented or combined by the Greeks have grace at least in their composition; like those arabesques which decorate the remains of some ancient edifices, and which have been multiplied by the fruitful pencil of a Raphael, the forms which are united, though repugnant to reason, present agreeable forms to the eye. They are the playful productions of felicitous dreams: emblems, perhaps, in the oriental taste, where, under certain mystic images, were veiled some metaphysical or moral propositions. We may pardon those who devote their time to the discovery of the wisdom concealed under the sphinx of Thebes, the Thessalian pegasus, the minotaur of Crete, or the chimæra of Epirus; but let us hope that none will have the folly to look for such beings in nature: it would be as wise to seek there for the animals of Daniel, or the beast of the Apocalypse.

Nor can we with any greater success seek in nature for the mythological animals of Persia. These are the productions of an imagination still more heated and sublimed. We shall find

there the *martichore*, or destroyer of men, with a human head on the body of a lion, and terminating with a scorpion's tail; the *griffin*, or guardian of the hidden treasure, half eagle and half lion; and the *cartazonon*, or wild ass, armed with a long horn on the forehead *.

Ctesias, who describes these animals as positively existing, has been regarded by many authors as an inventor of fables, while, in fact, he did no more than bestow the attribute of reality on figures purely emblematical. These fantastic constructions have been found in sculpture in the ruins of Persepolis †; and what was their signification? This we shall probably never know; but, to a certainty, they were never meant as representations of real beings.

Agatharcides, another fabricator of animals, most probably derived his materials from a similar source. In the Egyptian monuments we still find numerous combinations of the parts of different species. The gods are there frequently represented with a human body, and the head of some animal. Animals are also seen there with the heads of men, which has given rise to the cynocephali, the sphinxes, and the satyrs of the ancient naturalists. The custom of representing in the same picture men of very different degrees of stature, such as the giant-king or conqueror, and the diminutive subjects or vanquished, may have given birth to the fable of the pygmies. In some corner of these monuments Agatharcides must have seen his carnivorous bull, whose mouth extending to each ear, devoured every other animal without mercy. But naturalists assuredly can acknowledge no such animal as this, for nature never combines horns and cloven feet with trenchant carnivorous teeth ‡.

* Plin. viii. 31; Arist. ii. 11. Phot. Bib. art. 72. Ctes. Ind. Elian. An. iv. 21. Elian. An. iv. 27. Idem, xvi. 20. Phot. Bib. art. 72. Ctes. Ind.

† See Corneille Lebrun. Voyage en Moscovie, en Perse et aux Indes, t. ii. and the German work of M. Heeren on the commerce of the ancients.

‡ Phot. bib. art. 250. Agatharc. excerpt. Hist. cap. 39. Elian. Anim. xvii. 45. Plin. viii. 21.

Other figures may have existed equally singular with those now mentioned, either in such of these monuments as have resisted the ravages of time, or in the temples of Ethiopia and Arabia, which the Mahometans and Abyssinians have destroyed from religious zeal. India swarms with such productions: but her combinations are too extravagant ever to have deceived any one; monsters with a hundred hands, and twenty heads, all different from each other, were absurdities too great even for human gullibility.

There is scarcely a nation of any celebrity upon earth which has not had its imaginary animals. The Japanese and Chinese had them, and represented them as real in their books on the subject of religion: so had the Mexicans. Such has been the custom, in fact, of every people, either before their idolatrous worship became more refined, or when the true meaning of these emblematical combinations was lost. But who shall dare pretend to discover in animated nature these monstrous productions of ignorance and superstition?

Travellers, from the desire of exalting their reputation, may have asserted that they have seen these fantastic beings, or from want of attention, and deceived by a trifling resemblance, may have taken real animals for them. The larger simiæ may well have appeared to be genuine cynocephali, sphinxes, or men with tails. It was thus that St. Augustin believed that he had seen a satyr.

Some genuine animals, ill-observed, and worse described, may have given birth to these ideas; monstrous indeed, but yet founded on some reality. Thus we cannot doubt of the existence of the hyæna, though this animal's neck is not supported by a single bone *, nor does it change its sex annually,

* I have even seen in the cabinet of the late M. Adrian Camper the skeleton of an hyæna, in which several of the vertebræ of the neck were cemented together. It is probable that from some individual similar to this, this character was attributed to all the hyænas. This animal must be more subject than others to such an accident, in consequence of the prodigious force of the muscles of its neck, and the frequent

as Pliny asserted *. Thus, perhaps, the carnivorous bull is only a two-horned rhinoceros misrepresented. M. de Weltheim considers, with some probability, that the auriferous ants of Herodotus are the *Corsac* foxes of modern naturalists.

One of the most celebrated of these animals of the ancients was the *unicorn*. Even to the present day it is obstinately sought after, or at least arguments are sought for to maintain its existence. Three animals are frequently mentioned as having but a single horn in the middle of the forehead. The *oryx* of Africa, with cloven hoofs, hair growing the contrary way, of considerable size, being as large as the ox or the rhinoceros†, and approximating in form to the deer or goat ‡. The *wild ass* of the Indies, which is solipede; and the *monoceros*, properly so called, whose feet are sometimes compared to those of the lion §, sometimes to those of the elephant ||, and which of course is considered as having divided feet. The horse ¶ and bull-unicorn are doubtless both of them referable to the Indian ass, for even the bull is described as solipede **. I ask, if these animals existed as distinct species, should we not at least possess their horns in our cabinets? and what solitary horns do we possess but those of the rhinoceros and the narwal?

How is it possible, after these considerations, to give any credit to rude figures traced by savages upon rocks ††? Ignorant of perspective, and wanting to represent an antelope, with straight horns, in profile, they could only give it one horn,

use it makes of them. When the hyæna has seized an object, it is more easy to drag them both along than to make it let go its hold. This has occasioned the Arabs to adopt the hyæna as the emblem of invincible constancy.

* It does not change sex: but there is an orifice at the perinæum, which might give rise to the opinion of its being an hermaphrodite.

† Arist. Anim. ii. i. iii. i.; Plin. xi. 46. Herod. iv. 192. Oppian. Cyneg. ii. vers. 551.

‡ Plin. viii. 53. § Philostorge. iii. ii. || Plin. viii. 21.

¶ Onesicrit, ap. Strab. lib. xv. Elian. Anim. xiii. 42. ** Plin. viii. 31.

†† Barrow, Voy. au Cap. trad. fr. ii. 178.

and thus we have at once an oryx. The oryxes of the Egyptian monuments are, in all probability, nothing but productions in this stiff kind of style, a labour imposed on the artists of the country by their religious institutions. Many of their profiles of quadrupeds exhibit but one leg in front and one behind; and upon the same principle they exhibited but a single horn. Perhaps they might have taken in the chase some individuals deprived by accident of one horn, as is frequently the case with the chamois and saiga, and this would be quite sufficient to confirm the mistake. It is probably in this way that the unicorn was lately imagined to have been discovered in the mountains of Thibet

Moreover, all the ancient writers are not agreed in describing the oryx with a single horn. Oppian expressly gives him several *, and Elian mentions oryxes that had four †; and, in fact, if this animal was ruminant, and cloven-footed, it must have had the os frontis divided into two, and could not, according to the very just remark of Camper, have a horn growting from the suture.

But perhaps it may be asked, what animal with two horns could give us an idea of the oryx, and exhibit the peculiar conformation attributed to it, independently of the single horn? I reply, with Pallas, the straight-horned antelope, improperly named *pasan* by Buffon. (*Antilope oryx*. Gm.) It inhabits the African deserts, and most likely often approaches the confines of Egypt. It appears to be the animal represented in the hieroglyphics. Its form is pretty nearly that of the stag; its height equals that of the ox. The hair of the back is directed towards the head. Its horns constitute very formidable weapons, as sharp as arrows, and as hard as iron. Its hair is whitish, and on its face it has black spots and streaks. Such is the description that naturalists give of this animal; and as for

* Opp. Cyneg. lib. ii. v. 468, 471. † De An. lib. xv. cap. 14.

the fables of the Egyptian priests, which have caused the adoption of its figure in the hieroglyphics, it is not necessary that they should be founded in nature. An oryx, then, may have been seen deprived by some accident of one of its horns, and taken for an unmutilated animal, a type of an entire species. This mistake adopted by Aristotle may have been copied by his successors. All this is possible, and even natural, but it proves nothing for the existence of a one-horned species.

As to the Indian ass, concerning the anti-poisonous virtues of whose horn we read in ancient writers, we shall find that they are precisely the same as those attributed by the orientals of the present day to the horn of the rhinoceros. When this horn was first imported into Greece, the animal to which it belonged could not have been known to the inhabitants of that country. Aristotle, in fact, makes no mention of the rhinoceros, which was first described by Agatharcides. In a similar way, the ancients were acquainted with ivory long before the elephant was known to them. Some of their travellers may have named the rhinoceros the *Indian ass*, with as much justice as the Romans called the elephant the *Lucanian bull*. Every thing reported of the strength, size, and ferocity of this wild ass is perfectly applicable to the rhinoceros. In after times, those who knew the rhinoceros better, finding in former authors this denomination of Indian ass, may have taken it, for want of proper examination, for the name of a distinct animal, and from this name concluded it to be solipede. There is a rather detailed description of the Indian ass by Ctesias *, but we have already observed that it was taken from the basso-relievos of Persepolis : it can therefore pass for nothing in the positive history of the animal.

When, at last, descriptions were given of an animal with one horn, but several toes, a third species was formed under

* Ælian. An. iv. 52; Phot. Bib. p. 154.

the name of *monoceros*. These different descriptions of the same animal in reality, but taken for descriptions of different species, are the more common among ancient writers, inasmuch as most of their works on the subject of natural history are but mere compilations; as even Aristotle himself has mingled borrowed facts with his own observations; and, finally, as the practice of critical investigation was as little attended to then by naturalists as by historians, a point of more consequence than many may imagine to the subject in question.

It will follow from the preceding train of argument and illustration, that the larger animals known at the present day in the old continent were likewise known to the ancients. It will also follow that such animals as they have described, but which are unknown to us, were the fabulous creations of fancy or of error; and, finally, we may conclude from the same premises, that but a short period was required for the larger animals of the three first quarters of the globe to become known to the people who frequented the coasts.

We may also come to the conclusion that none of the larger species remain to be discovered on the continent of America. Did any exist there, there is no reason why we should not be acquainted with them, and, in fact, one hundred and fifty years have elapsed without any new one of them being discovered. The tapir, the jaguar, the puma, the cabiai, the lama, the vicunna, the red wolf, the buffalo, or American bison, the sloths, the armadillos, are all contained in the works of Margrave and Hernandez, described as well as in Buffon; indeed we may say better, for Buffon has perplexed the natural history of the ant-eaters, confounded the jaguar with the red wolf, and the bison of America with the urus of Poland. Certainly Pennant was the first naturalist who properly distinguished the small musk ox; but it had been noticed by travellers long before his time. The horse with cloven feet, described by Molina, is not mentioned by any of the first Spanish travellers, but the justly

suspected authority of that writer renders the existence of such an animal more than doubtful. The American and Indian deer might certainly be better characterized and distinguished than they are; but it is with them as with the various species of antelopes, in the works of the ancients on natural history: it is more for want of a proper method of classification, than for want of opportunities of observation, that they are not better known. We may aver with safety, that the mouflon of the Blue Mountains is the only American quadruped of any considerable size, the discovery of which is altogether modern; and perhaps it is nothing but an argali, which had come from Siberia over the ice.

How is it possible to believe, after this, that the enormous mastodon, the gigantic megatherium, whose bones have been discovered beneath the soil in both Americas, still exist in that quarter of the globe? How could they have escaped the notice of those wandering hordes continually traversing the country in all directions, and who themselves acknowledge their non-existence by the invention of a fable concerning their destruction by the Great Spirit to prevent them from annihilating the human race? But it is easy to see that this fable was occasioned by the discovery of those bones, like that other fable propagated by the Siberians concerning their mammoth, which they pretend lives under ground, after the manner of the moles; and the case is similar with the tales of the ancients respecting the tombs of giants, which they always placed wherever the bones of elephants happened to be found.

Thus we may conclude, that if, as we shall see presently, some of the larger kinds of quadrupeds, whose bones are found imbedded in the regular rocky strata, resemble the living species that are known, it is by no means the effect of mere chance; nor is it because these species, of which we possess the fossil remains, are still concealed in woods or deserts where travellers have as yet been unable to penetrate. On the contrary,

this phenomenon must be regarded as appertaining to general causes, and its study is one of the best adapted to enable us to trace the nature of these causes.

But if this study be more satisfactory in its results than that of any other fossil remains of the animal kingdom, it is also beset with difficulties far more numerous. The fossil shells are generally found in a complete state, possessing every character that can approximate them to the analogous existing shells in the collections or works of naturalists. The skeletons even of the fossil fish are more or less complete; the general form of the body can almost always be distinguished in them, and most frequently the generic and specific characters, which are derived from their solid parts. On the other hand, even when complete skeletons are met with, it is difficult to attach characters to them, drawn for the most part from hair, colours, and other marks, which must have vanished previously to the incrustation. It is even extremely rare to find a fossil skeleton approaching to an entire state. Isolated bones, scattered here and there, almost always broken and reduced to fragments, constitute all which is furnished by our strata in this class, and form the only resource of naturalists. Accordingly we may aver, that the generality of observers, deterred by these difficulties, have given but a superficial consideration to the fossil remains of quadrupeds. They have either classed them in a vague manner, according to slight resemblances, or have not even ventured to bestow upon them a name; and thus, this portion of the natural history of fossils, the most important and most instructive of all, has been the least cultivated of any *.

* I do not mean by this remark, as I have already observed above, to detract from the merit of the observations of MM. Camper, Blumenbach, Soemmering, Merk, Faujas, Rosenmuller, Home, &c.; but their estimable labours, which have been very useful to me, and which I constantly quote, are only partial, and many of them were not made known to the world until the earlier editions of this discourse were published.

Fortunately there is a principle in comparative anatomy, which, when properly developed, will enable us to surmount all these obstacles. This is the mutual relation of forms in organized bodies, by means of which every species may be correctly known by every fragment of each of its parts.

Every organized being constitutes a whole, a complete and compact system, between the parts of which there is a mutual correspondence, and all concur to produce one definite end by a reciprocal reaction. None of these parts can be changed without occasioning a change in the others also; and consequently each of them taken separately indicates all the rest.

Thus, as I have said elsewhere, if the intestines of an animal are organized so as to digest nothing but flesh, and recent flesh, its jaws must likewise be constructed for the devouring of prey; the claws for seizing and for tearing it; the teeth for cutting and dividing it; the entire system of the organs of locomotion to pursue and overtake it; the organs of sense for perceiving it at a distance. Nature must also have endowed the brain of such animals with the necessary instinct for concealing themselves, and laying snares for their victims. Such are the general conditions of the carnivorous regimen. They must infallibly be united in every animal destined by nature for that regimen, for the race could not otherwise subsist. Under these general conditions, however, there are certain particular ones which relate to size, to the species, the peculiar situation of the prey, for which each animal is disposed. From each of these particular conditions result certain modifications of a minor character in the forms, derived from the general conditions. Thus, not only the class, but the order, the genus, and even the species, are expressed in the form of each part. In fact, in order to enable the jaw to seize with facility, a certain form of the condyle is necessary; a certain relation between the position of the resistance and the moving power with the fulcrum or resting point; a certain degree of volume in the crotaphite muscle,

which requires a certain extent in the fosse or hollow that receives it; and a certain convexity in the zygomatic arch under which it passes. This zygomatic arch must also possess a certain degree of force, to support the action of the masseter muscle.

To enable the animal to carry off its prey, there must be a corresponding vigour in the muscles which elevate the head, from whence results a determinate form in the vertebræ to which these muscles are attached, and in the occiput where they are inserted.

To enable the teeth to cut flesh they must be trenchant, and they must be so more or less, according as their employment in cutting flesh is more or less exclusive. Their base must be the more solid in proportion as they have more bone and more solid bone to break. All these circumstances must also be influential on the development of all the parts which serve to set the jaw in motion.

In order that the claws may seize the prey, a certain degree of mobility in the toes, and vigour in the nails, will be necessary, from whence result determined forms in the phalanges, and necessary distributions of muscles and tendons. It is necessary that the fore-arm should possess a facility of rotation, from which circumstance determinate forms will result in the bones of which this member is composed. But as the bones of the fore-arm are articulated to the humerus, they cannot change their forms without producing a corresponding change in that part. The bones of the shoulder must have a certain degree of firmness in those animals that employ their arms for seizing objects, and the result of this is a peculiar conformation in those bones. The play of all those parts will require certain proportions in all their muscles, and the impressions of these muscles so proportioned will determine still more particularly the forms of the bones.

It is almost superfluous to observe that similar conclusions may be drawn relatively to the posterior extremities which con-

tribute to the rapidity of the general motions ; to the composition of the trunk and the forms of the vertebræ, which are influential on the facility and flexibility of these motions ; to the forms of the nasal, orbital, and auricular bones, the relations of which, with the senses of smell, sight, and hearing, are evident. In a word, the form of the tooth necessitates the form of the condyle, of the shoulder-blade, and of the claws, just as the curve of an equation necessitates all its other properties ; and as, by taking any single property separately for the basis of any particular equation, we find both the equation and all the other properties whatever, so in the same manner, the claw, the shoulder-blade, the condyle, the femur, and all the other bones taken separately will give the tooth, or from a consideration of the tooth can themselves be each of them deduced. In this manner any one who is scientifically acquainted with the laws of organic economy may re-construct the entire animal.

This principle is sufficiently evident, in the general acceptation, to require no ampler demonstration ; but when its application is necessary, there are a number of cases in which our theoretic knowledge of the relations of forms would be insufficient for our purpose if not assisted by observation.

It is easy to perceive, for instance, that hoofed animals must be all of them herbivorous, since they are possessed of no means of seizing prey. It is also obvious that as the only use of their fore-feet is to support the body, they have no occasion for a shoulder so vigorously organized. From this results the want of clavicle and acromion, and the narrowness of the shoulder-blade. As rotation of the fore-arms is unnecessary, the radius is ossified to the ulna, or at least articulated by gynglymus to the humerus. Their herbivorous regimen requires teeth with flat coronals, to bruise the buds and herbage on which they feed. These coronals must also be unequal, and this inequality is produced by an alternation of enamel with the bony parts. As this sort of coronal necessarily produces horizontal motions

for the purpose of trituration, the condyle of the jaw cannot form the close hinge, as it were, that it does in the carnivorous tribes. It must be flattened, and correspond to a socket of the os temporalis, which is itself more or less flattened. The fossa temporalis, also, having but a small muscle to contain, must have little breadth or depth. All these arrangements are derived one from the other, according to their greater or less generality, and in such a manner that some are essentially and exclusively peculiar to hoofed animals, while others, though equally necessary, are not exclusively peculiar to them, but may be found in other tribes, where other conditions will permit them to exist.

If we proceed afterwards to the orders or subdivisions of the class of hoofed animals, and inquire into the nature of those modifications which the general conditions undergo, or, more properly speaking, the particular conditions which are conjoined with them, according to the respective characters of these orders, the reasons of these subordinate conditions become less clear and evident. It is easy to conceive the necessity of a more complicated system of digestion where the dentition is less perfect. Thus we may presume, that those animals must be ruminant in which certain kinds of teeth are wanting. We may also deduce from hence a certain conformation of the œsophagus, and corresponding forms in the vertebræ of the neck, &c. But I doubt much whether, without the aid of observation, it would have been possible to divine that ruminant animals should all have cloven feet, and that they should be the only animals which have them; that horns on the forehead should be found in this class only; and that such of these animals as possess sharp canines should for the most part be found to want horns.

Nevertheless, since these relations are constant and invariable, it is certain that they must have a sufficient cause: but, as we are ignorant of this cause, we must supply the de-

fects of theory by the assistance of observation. Observation serves to establish experimental laws, which are nearly as certain as those which are derived from a chain of reasoning; but then, the observation must be frequently and carefully repeated. Thus, for instance, any person at present who meets with the track of a cloven hoof knows perfectly well that the animal which left such an impression was one of the ruminant tribe; and this conclusion is equally certain with any other either in physics or in morals. This single track is sufficient to announce to the observer both the form of the teeth and jaws of the vertebræ; of all the bones of the legs and thighs; of the shoulders and pelvis of the animal which has passed that way. It is a mark more certain than any of Zadig.

Observation, independently of the general principles of philosophy, is sufficient to show that there are secret reasons for all these various relations.

In fact, when we form a synopsis of these relations, we discover not only a specific constancy, if I may so express myself, between certain forms of certain organs, and certain other forms of different organs; but we also perceive a classified constancy and a correspondent gradation in the development of these two sets of organs, which demonstrate their mutual influence nearly as well as the most effective reasoning.

For example, the dentition of hoofed animals, which do not ruminate, is in general more perfect than that of the cloven-footed or ruminant animals, because the first possess incisors or canine teeth, and most usually both of these in each jaw. The structure of their feet is in general more complicated, as they have more toes, or their phalanges are less enveloped in the hoof, or there are more distinct bones in the intercarpus and metatarsus, or the bones of the tarsus are more numerous, or the fibula is more distinct from the tibia, or in fine, all these circumstances are found united. It is impossible to give any

reason for these relations; but that they are not the effect of chance is evident from this, that whenever a cloven-hoofed animal exhibits in the arrangement of its teeth any tendency to approximate to those other animals of which we have been speaking, it also exhibits a similar tendency in the arrangement of its feet. Thus the camels, which have canine teeth, and even two or four incisors in the upper jaw, have an additional bone in the tarsus, the scaphoid and culeoïd bones not being united into one, and have also very small hoofs with corresponding phalanges. The musk animals, whose canines are considerably developed, have a distinct fibula as long as the tibia, while the other cloven-hoofed animals have no other fibula than a small bone articulated to the lower part of the tibia. Thus we perceive a constant harmony between two organs, apparently very different from each other; and the gradations of their forms continually correspond, even in instances where we can give no reason whatever for such relations.

Now, if we adopt thus the method of observation as a supplementary aid when theory fails, we shall arrive at results of the most astonishing kind. The least fragment of bone, the slightest apophysis, has a determinative character in relation to the class, the order, the genus and species to which it may belong. This is so true, that if we have only a single extremity of bone well preserved, we may with application, and a skilful use of analogy and exact comparison, determine all those points with as much certainty as if we were in possession of the entire animal. I have tried this method repeatedly with portions of known animals, before I confided in it completely for the examination of fossils. But its success has been always so infallible, that I have no longer the slightest doubt of the certainty of its results.

It is certain that I have enjoyed every advantage which could be necessary for my purpose, and that my fortunate situation, and an assiduous research of nearly thirty years,

have procured me skeletons of all the genera and sub-genera of quadrupeds, and even of many species in certain genera, and several individual varieties in some species. By such means I have been enabled to extend my comparisons with facility, and to verify in their minutest details the applications which I made of the laws I had laid down.

We cannot at present enter into much detail concerning this method, but must refer our readers to the great work on Comparative Anatomy, which we are on the point of publishing, and in which all these rules will be fully developed. An intelligent reader, however, may deduce many of them from a perusal of the subsequent work on Fossil Osteology, if he will take the pains to pursue attentively the applications which we have made of them. He will perceive that we have guided ourselves by this plan alone, and that it has almost always been sufficient to enable us to refer each bone to its proper species, when that species was a living one; to its genus, when the species was unknown; to its order, when it was of a new genus; and finally, to its class, when it belonged to an order not yet established; to assign it also, in these three last cases, the characters which are proper to distinguish it from the orders, the genera, or the species which are most similar. Before our time, naturalists had done no more than this respecting animals that were found in an entire state. In this manner we have determined and classified the remains of more than one hundred and fifty mammalia, or oviparous quadrupeds.

Considered in relation to species, more than eighty-six of these animals have been to the present day unknown to naturalists. Eleven or twelve have so complete a resemblance to species that are known, that no doubt of their identity can be entertained. Others exhibit many traits of similarity to known species; but a sufficiently scrupulous comparison has not yet been made to remove every doubt from the subject.

Considered with regard to genera, there are nearly sixty of

these hitherto unknown species that belong to new genera. The other species are referable to genera or subgenera already known.

It may not be useless to consider those animals in relation to the classes and orders to which they belong.

Of three hundred and fifty species, about a fourth are oviparous quadrupeds, and all the others are mammiferous. Among these last more than one half belong to the hoofed animals not ruminant.

It would, however, be presumptuous to establish from these numbers any conclusion relative to the theory of the earth, because they cannot be considered to bear any necessary proportion to the numbers of genera and species that may be yet imbedded in the strata of the earth; for we find that the bones of the larger species have hitherto been collected in the greatest abundance, as they would more naturally attract the attention of labourers, while those of the smaller kind have generally been neglected, except when they fell by chance into the hands of some naturalist, or when some peculiar circumstance, their extreme abundance, for instance, in certain places, might have attracted the attention of the vulgar.

The most important point, which constitutes the most essential object of my labour, and establishes its connexion with the theory of the earth, is to ascertain in what strata each species is to be found, and if there are any general laws relative either to the zoological subdivisions, or the greater or less degree of resemblance between these species and those living at the present day.

The laws which are acknowledged in relation to these points are very clear and admirable.

First of all, it is satisfactorily ascertained that the oviparous quadrupeds appear of an earlier date than the viviparous. They are more abundant, more strong, and more various in the ancient strata, than on the actual surface of the globe.

The ichthyosauri, the plesiosauri, many tortoises, and many

crocodiles, are found below in the chalk in the territory (commonly so called) of the Jura. The monitors of Thuringia would be still more ancient, if, according to the Wernerian school, the copper slate which covers them, and so many fish, supposed to have belonged to the fresh water, constituted the most ancient strata of the secondary formation. The immense alligators and great tortoises of Maëstricht are even found in the chalk formation; but these are marine animals.

This early appearance of fossil remains seems to indicate the existence of dry lands and fresh waters previous to the formation of the chalk strata. But neither at this epoch, nor while the chalk strata were being formed, nor even long after, did any incrustation take place of the bones of terrestrial mammalia: or at least, if it did take place, as has been alleged, it was to so small an extent, that it forms an exception of no consequence whatsoever.

We begin to find the bones of marine mammalia, *i. e.* of the lumantins and seals, in the coarse shell limestone which covers the strata in the environs of Paris. But no bones of terrestrial mammalia have been found there.

In spite of the most careful researches, I have found it impossible to discover any distinct trace of this class previous to the strata deposited over the coarse limestone. Lignites and molusses undoubtedly contain remains of such animals. But I doubt much whether all such strata are anterior, as is imagined, to this limestone. The parts of them in which bones are found are too limited and too few in number not to argue some irregularity in their formation. On the contrary, as soon as we arrive at the strata which surmount the coarse limestone, we find the bones of terrestrial quadrupeds in great abundance.

Thus, as it is reasonable to believe that shells and fishes did not exist at the formation of the primary strata, we must also believe that the oviparous quadrupeds commenced to exist along with the fishes, and from the earliest periods of the

formation of secondary strata. But the land quadrupeds did not appear, at least in any considerable number, for a long time after, when the coarse limestone was deposited, which contains most part of our genera of shells, though of quite a different species from any now existing.

It is remarkable that this coarse limestone, which is used in Paris for building, composes the last strata which indicate a long and tranquil continuance of the sea upon the surface of our continent. After them we find plenty of strata filled with shells and other marine productions; but these are loose strata, composed of sand, marle, sand-stone, or clay, which rather indicate transportations which have taken place with more or less violence, than any gentle precipitation; and if there are any regular rocky strata above these alluvial formations, of any little extent, they generally present the marks of having been deposited in fresh water.

Almost all the known bones of viviparous quadrupeds have been found either in those depositions from the fresh water, or in the alluvial strata just mentioned; and, consequently, there is every reason to believe that these quadrupeds had not commenced to exist, or at least to leave their remains in the strata which we can fathom, until after the last retreat of the sea but one, and during that state of things which preceded its last irruption.

But there is also an order in the relative disposition of these bones, which indicates a very remarkable succession in the appearance of the different species.

All the genera unknown at the present day, the palæotheria, the anoplotheria, &c. with whose situation we are thoroughly acquainted, belong to the most ancient of those strata of which we are treating, to those which are placed directly over the coarse limestone. It is they which principally fill the regular strata deposited from fresh water, or certain alluvial beds very anciently formed, composed of sand and rounded pebbles, and

which were probably the earliest formations of the kind in the ancient world. We also find along with them some lost species of known genera, but few in number, and likewise some oviparous quadrupeds, and fishes which appear to belong to the fresh water. The strata which contain them are always more or less covered by alluvial beds, filled with shells and other marine productions. The most celebrated of the unknown species which belong to known genera, or to genera closely approximating to such as are known, as the fossil elephant, rhinoceros, hippopotamus, and mastidon, are never found along with the more ancient genera. It is only in the alluvial strata that they are to be found, sometimes with sea, sometimes with fresh water shells, but never in regular rocky strata. Every thing found along with these species is either like themselves unknown, or at least doubtful.

Lastly, the bones of species which appear the same as ours are never found except in the very latest alluvial depositions, formed on the banks of rivers, or on the bottoms of ancient lakes and marshes now dried up, or in the substance of beds of peat, or in the clefts and caverns of some rocks, or, in fine, at small depths below the surface of the earth, where they were either buried under debris, or deposited by the hand of man. Their superficial position occasions these bones, although the most recent of all, to lie in the worst state of preservation. It must not, however, be thought, that this classification of depositions is as certain as that of the species, or capable of the same degree of demonstration: there are numerous reasons why this cannot be the case.

First of all, all my demonstrations of species have been made from the bones themselves, or from good figures. But I have had by no means the opportunity of personally examining all the places where these bones were discovered. I have often been forced to trust to vague and ambiguous reports, made by persons who were themselves unacquainted with the particulars most worthy of observation, and indeed indispensably neces-

sary to be observed: it has still more frequently occurred, that I was unable to procure any information at all.

Secondly, there is much more difficulty and liability to error in discriminating the character of strata, than in determining the fossil bones. The same formation may seem recent in those places where it is superficial, and ancient where it is covered by succeeding strata. Ancient strata may have been transported into other places by partial inundations, and have covered recent bones. They may have been carried over them by debris, and surrounded and mixed them with the productions of the ancient sea. Ancient bones may have been washed out of their position by the waters, and afterwards taken up by recent alluvial formations. And, lastly, recent bones may have fallen into the clefts and caverns of ancient rocks, and been enveloped there by stalactites or other incrustations. These are circumstances to be analyzed and appreciated in every case, as otherwise they may conceal from us the true origin of the fossil remains. The persons who collected the bones very seldom thought of the necessity of such investigation, and consequently the true characters of the depositions in which the fossils were found have almost invariably been neglected or misunderstood.

In the third place, there are some doubtful species, which will diminish more or less the certainty of our results until they shall have been clearly determined. Thus the horses and buffaloes which have been found with the elephants have as yet exhibited no sufficiently distinct and specific characters; and geologists who do think proper to adopt my different epochs for the various fossil remains may for many years employ this argument against me, which is so much the more convenient as it is drawn from my own work.

But granting that these epochs are liable to some objections in the minds of persons who consider superficially some particular case, I am not the less persuaded, that those who shall

take a comprehensive survey of all the phenomena will not be stopped by these little partial difficulties, but will agree with me that there has been one succession, and very probably two successions in the class of quadrupeds, previous to that which exists at the present day on the surface of the earth.

I now expect another objection, and, in fact, it has been already started against my opinion.

Why, it may be asked, may not the present existing races of land quadrupeds be modifications of the ancient races now found in a fossil state,—modifications produced by local circumstances and change of climate, and carried to the present extreme difference by the long succession of ages?

This objection must appear particularly strong to those who believe in an indefinite possibility of alteration in the forms of organized bodies; and who think that ages, and changes of habit, may finally convert all the species into one another, or that all the species may have originated from one. However, we may reply to these persons in their own way, that if the species have changed by degrees, traces of these gradual modifications ought to be found. Some intermediate forms should be found between the palæotherium and the species of our days: a discovery which we have been as yet very far from making.

Why have not the bowels of the earth preserved some monuments of this curious genealogy, unless because the species were formerly as permanent as our own; or at least because the catastrophe which destroyed them did not afford them sufficient time to branch out into these wonderful varieties?

In reply to those naturalists, that animal varieties are restrained by nature within certain limits, it is necessary to examine how far these limits extend: a curious inquiry, and in itself most interesting in various points of view, yet one that to the present day has been very little attended to.

This inquiry presupposes an accurate definition of the word

species: species, then, comprehends all the individuals which descend from each other, or from a common parent, and those which resemble them as much as they resemble one another. Thus, we call varieties those races which, though more or less different, have proceeded from one common origin in the way of generation. Our observations on the differences between the ancestors and descendants constitute the only rational rules by which we can be guided in our investigation of this subject: every other mode of considering it is hypothetical, and destitute of proof.

Now, taking the word *variety* in this sense, we shall find that the differences which constitute it depend upon determinate circumstances, and that their extent increases in proportion to the constant and efficient action of these circumstances.

Thus, the most superficial characters are the most variable. Colour depends considerably on light; thickness of hair upon heat; size upon abundance of nutriment: but in a wild animal these varieties are extremely limited by its natural habits, which do not lead it to wander voluntarily from those places where it finds, to a sufficient degree, the means of supporting its species, nor to extend its haunts to any great distance unless it finds all such necessary conditions united. Thus, though the wolf and the fox are inhabitants of every climate from the torrid to the frigid zone, they hardly deviate, in this immense interval of space, into any greater variety than a little more or less shortness in their fur. I have compared the skulls of the foxes of the north, and those of Egypt, with the skulls of our French foxes, and found no differences but what were purely individual.

The more savage animals, especially the carnivora, which are confined within more limited spaces, vary still less. A thicker mane constitutes the only difference between the hyenas of Persia and Morocco.

The wild herbivorous races suffer a little more extensively the influence of climate, because that of food is added to it in

the relations both of quantity and quality. Thus elephants will be found larger in one forest than in another. Their tusks will be a little longer in places which are favourable to the production of the substance of ivory. The same may take place respecting the horns of the rein-deer and the stag. But take two elephants, ever so unlike in outward appearance, and you will not find the slightest difference between the number and articulations of the bones, structure of the teeth, or any other essential specific character.

Besides, the herbivorous species, in a wild state, are more restrained in regard to dispersion than the carnivora, inasmuch as the nature of their nourishment unites its influence with that of climate to arrest their progress.

Nature also is careful to prevent any alteration of species which might result from intermixture, by the mutual aversion which she has created between animals of different kinds. It requires all the cunning and all the power of which man is master to accomplish such unions even between the species which are most similar. And when the products of these unions are fruitful, a thing which rarely occurs, their fecundity seldom extends beyond a few generations, and probably would not go so far but for the cause which at first produced it. Thus we never see in our woods intermediate individuals between the hare and the rabbit, the stag and the doe, the marten and the weasel.

But this order of nature is changed under the empire of man: he gives developement to all the variations of which each type of each species is susceptible, and thus gives birth to productions which would never have existed if the species had been left to themselves.

Here, again, the degree of variation is in proportion to the intensity of its cause, namely, the subjection of these animals to man. It does not go any great extent in the half-domesticated breeds, as the cat: softer hairs, more lively colours, greater

or less size, constitute all the varieties observable in this species. The skeleton of the Angora cat differs in no character of constant occurrence from that of a wild cat in these countries.

Among the domesticated herbivora which we transport into all climates, and subject to all kinds of treatment, and to which we measure out various proportions of nourishment and labour, the variations are certainly greater, but still they are only superficial. Greater or smaller size, horns more or less long, and sometimes their entire absence, a lump of fat larger or smaller on the shoulder, constitute the differences of oxen; and these varieties are preserved for a long time, even in races transported out of the country where they were first produced, when care is taken to hinder a crossing of breeds.

Of this description, also, are the innumerable varieties of sheep which are principally referable to the quality of the wool, because this has been the chief object of man's attention. The varieties are not so numerous, though still very sufficiently marked in the horse species.

In general the forms of the bones vary but little—their connexions and articulations, and the form and structure of the grinding teeth, never vary.

The small developement of the tusks in the domestic hog, and the union of its cloven hoofs into one in some races, are the extreme point of the differences we have produced among the domestic herbivora.

The most marked effects of the influence of man exhibit themselves on the animal over which he has achieved the most complete conquest—I allude to the dog, a species so peculiarly devoted to ours, that its individuals appear to have sacrificed themselves, their interests, their very instinct and natural feelings, to our service. Transported by man into every climate of the world—submitted to every cause which can prove influential on their developement—regulated in their unions by the will of their masters—dogs present to the view varieties far beyond those

of every other species in number. They differ in colour, in length, and quantity of hair, which is sometimes entirely wanting; in their natural disposition and instincts; in their size, which varies in linear dimensions as one to five, which, in some instances, makes more than a hundredfold in bulk; in the form of the ears, nose, and tail; in the relative height of the limbs; in the progressive developement of the cerebrum in the domesticated varieties, from which even the form of the head is derived, that being sometimes narrow, with a slender muzzle and flat forehead, and sometimes full with a short muzzle and convex forehead. This is carried so far, that the apparent differences between a mastiff and a water spaniel, between a greyhound and a pug-dog, are greater than any which exist between the wild species of any natural genus. Finally—and this is the maximum of any variation known as yet in the animal kingdom—there are races of dogs which have an additional toe on each hind foot, with corresponding tarsal bones, just as we see, among the human species, some families with six fingers.

But in all these variations, the relations of the bones remain the same, and the form of the teeth is never altered in any obvious degree. At the most, we observe in some individuals an additional false molar sometimes on one side, sometimes on the other *.

There are, then, certain characters in animals which resist every influence either of nature or of man; nor is there any proof that time exercises a greater influence in this respect than climate and domestication.

I am aware that some naturalists lay great stress upon the thousands of ages which are so easily created by a stroke of the pen; but in such matters we can only judge of the effects produced by a long period of time, by multiplying such as a shorter

* Consult the Memoir by my brother, in the Annals of the Museum of Natural History, on the varieties of Dogs. This labour was executed at my request, from the skeletons of all the varieties of dogs prepared by me expressly for the purpose.

period has produced. I have, therefore, endeavoured to collect the most ancient documents I could procure respecting the forms of animals. There are none, whether for antiquity or abundance, equal to those which Egypt presents to our inspection. She affords to our investigation not only representations of animals, but the animal bodies themselves, embalmed within her catacombs.

I have examined with the utmost attention the figures of animals and birds engraven on the numerous obelisks which came from Egypt to ancient Rome. These figures altogether present the most perfect resemblance to the species they were intended for, such as we see them at the present day.

It is in the power of every one to examine the copies of these figures given by Kirker and Zoega: they do not, indeed, preserve the accuracy of the originals in many points, but still they are very easily distinguishable. There we can recognize the ibis, the vulture, the owl, the falcon, the goose of Egypt, the lapwing, the land-rail, the asp, the cerastes, the Egyptian hare, with long ears, even the hippopotamus; and in the monuments which are engraved in the Grand Work on Egypt, we sometimes find the rarest animals, such as the algazel, for instance, which was seen in Europe only a few years ago*.

My learned colleague, M. Geoffroy St. Hilaire, penetrated with the importance of this research, took the pains of collecting, in the tombs and temples of Upper and Lower Egypt, all the mummies of animals he could possibly procure. He has brought back cats, ibises, birds of prey, dogs, apes, crocodiles, and the head of a bull embalmed. It is not possible to observe any more difference between these animals, and those of the same species now existing, than between the human mummies and the skeletons of men of the present day. Some slight difference is found between the mummy of the ibis, and the ibis as

* The first figure of this animal, taken from nature, is in the Description of the Menagerie, by my brother. It is perfectly represented in Descript. de l'Egypte Antiq. tome iv. plate xlix.

hitherto described by naturalists: but I have removed all doubts on this point, in a Memoir appended to this discourse on the ibis, in which I have proved that the bird is the same now as in the days of the Pharaohs. I am aware that I only instance individuals of two or three thousand years back; but this is as high as it is possible to go.

There is nothing, then, in known facts, to support the opinion that the new genera which I have discovered and established among the fossils, nor those that other naturalists have established, such as the *palaotherium*, *anoplotherium*, *megalonyx*, *mastodon*, *pterodactylus*, *ichthyosaurus*, &c. have been the sources of any of our present animals, which only differ so far as they are influenced by time and climate. Even if it should prove true (which I am far from believing) that the fossil elephant, rhinoceros, elk, and bear, do not differ more from the existing species than the races of dogs differ from each other, identity of species could not be presumed from that circumstance, because the races of dogs have been submitted to the influence of a domestication, which these other animals neither did nor could have suffered.

For what remains, when I assert that the rocky strata contain the bones of several genera, and the loose strata those of many species which exist no longer, I do not mean to say that a new creation was necessary to produce the species which now exist; I only say, that they did not exist in the places where we see them at present, and that they must have come from some other quarter.

Let us suppose, for instance, that a great irruption of the sea should cover the continent of New Holland with an accumulation of sand or other debris, it would overwhelm the carcasses of *kanguroos*, *phascoloma*, *dasyuri*, *perameles*, *flying phalangers*, *echidnæ*, and *ornithorynchi*, and totally destroy the species of all these genera, since none of them now exist in any other country.

Let this same revolution dry up the little numerous straits which separate New Holland from the continent of Asia, it would open a road for the elephants, the rhinoceroses, the buffaloes, the horses, the camels, the tigers, and all the other Asiatic quadrupeds, which would then come and people a country where they had been hitherto unknown.

Then let any naturalist in that country, after an accurate study of these existing species, think proper to dig into the soil whose surface they peopled, he would find there the remains of beings of a totally different kind.

What New Holland, under such a supposition, would be, Europe, Siberia, and a great part of America, actually are at this moment; and, perhaps, at some future period, when other countries, and New Holland itself, come to be examined, it will be found that they are in a similar predicament, have experienced similar revolutions, and undergone, I might almost say, a mutual interchange of productions. To push this supposition still farther, admit that a second revolution should destroy Asia, after the transportation of these animals from their primitive country: those who should observe them in New Holland, their second country, would be as much puzzled to find out whence they came, as we are at present to discover the original habitations of our fossil animals.

To apply this mode of reasoning to the human species—

It is certain that no human bones have as yet been found among the fossil remains. This is an additional proof that the fossil races were not varieties, as they could not have been subjected to the influence of man.

When I say that human bones have not yet ever been found among fossils, I mean among fossils properly so called, or, in other terms, in the regular strata of the surface of the globe. In turf bogs, in alluvial beds, as well as in ancient burying grounds, human bones are as abundantly disinterred as those of horses, or any other of the common species. They may also

be found in the clefts of rocks, and in grottoes, where stalactite is accumulated upon them. But in those strata which contain the ancient races, among the palæotheria, and even among the elephants and rhinoceroses, not the least fragment of a human bone has yet been discovered. There are few workmen about Paris who do not believe that the bones found in such abundance in the gypsum quarries are for the most part the bones of men; but as I have seen many thousands of these bones, I may be permitted to assert, that there is not one among them belonging to our species. I have examined at Pavia the groups of bones brought back by Spallanzani from the island of Cerigo, and notwithstanding the assertion of that celebrated observer, I also affirm that there is not one of them which can be proved to be human. The *homo diluvii testis* of Scheuchzer has been referred in my first edition to its true genus, which is that of the salamanders; and in an examination which I have since made in Haerlem, which was permitted me by the politeness of M. Von Marum, who even allowed me to uncover the parts concealed in the stone, I received the completest proof of what I had already asserted. Among the bones found at Cronstadt, a fragment of a jaw and some human works were discovered; but it is well known that the soil was removed without due precaution, and that no memorandum was made of the different levels at which each article was found. Every where else, the fragments which were put forth as human were found, on examination, to belong to some animal, either when they were examined in the natural state, or even in figures. Very lately at Marseilles, some were pretended to have been discovered in a rock which had been for a long time overlooked*: these, however, have proved to be the prints or impressions of the *tubulus marinus*†.

* See the Journal de Marseille et des Bouches du Rhone, 27th of September, 25th of October, and 1st of November, 1820.

† Of this I was assured by the drawings which were sent me by M. Cottard, professor of the college of Marseilles.

The genuine human bones which have been found were those of bodies which had fallen into the clefts of rocks, or had been left in the ancient galleries of mines, or covered up by incrustation; and I extend this assertion to the human skeletons discovered at Guadaloupe, in a rock formed of pieces of madrepores thrown up by the sea, and cemented by calcareous matter*. The human bones found near Kæstriz, and

* These skeletons, in a more or less mutilated state, were found near the Port de Moule, on the north-west coast of the high land of Guadaloupe, in a kind of glacis or slope resting upon the steep edges of the island, which the sea at high water in a great measure covers, and which is nothing else than a tuff, formed and daily augmented by very small debris of shells and corals which the waves detach from the rocks, and whose mass acquires a great degree of cohesion in those places which are most frequently left dry. On examining them with a convex lens, we find that many of these fragments have the same red tint as a part of the corals contained in the reefs of the island. These kinds of formations are common in all the Archipelago of the Antilles, where the negroes term them *Maçonne-bondieu*. Their augmentation is rapid in proportion to the violence of the motion of the waters. They have extended the plain of Cayes to St. Domingo, the situation of which has some analogy with the shore near Port de Moule; and we sometimes find there the debris of earthen vessels, and other human works, to a depth of twenty feet. A thousand conjectures have been made, and events even imagined, to explain these skeletons of Guadaloupe; but after all, M. Moreau de Jonnès, correspondent of the Academy of Sciences, who has been on the spot, and to whom I am indebted for the above detail, thinks that they are merely the skeletons of persons who have perished by shipwreck. They were discovered in 1805 by M. Manuel Cortes Y Campomanès, at that time a staff-officer in the service of the colony. General Ernouf, the governor, caused one of them to be drawn out with much difficulty, to which the head and almost all the upper extremities were wanting. It was deposited at Guadaloupe, and a more complete one was expected to be procured, that both might be sent together to Paris, when the island was taken by the English. Admiral Cochrane having found this skeleton at the head-quarters, sent it to the English Admiralty, who presented it to the British Museum. It is at present in this collection; and M. Kœnig, keeper of the natural history department, has described it for the Philosophical Transactions of 1814, and I have seen it in 1818. M. Kœnig observes, that the stone in which it was engaged seems to have been simply inserted in the surrounding mass. The skeleton in it is so superficial, that its presence must have been immediately perceived by the projection of some of the bones. They still contain some of the animal parts, and all their phosphate of lime. The rock being altogether formed of pieces of coral and compact calcareous stone, will readily dissolve in nitric acid. M. Kœnig observed in it

pointed out by M. de Schlotheim, were announced as being taken out of very ancient strata; but this estimable philosopher is anxious to make known how much this assertion is yet a matter of doubt. The same has been the case with all articles * of human fabrication. The pieces of iron found at Montmartre are the tools which the workmen employed for putting in the powder, and which sometimes break in the stone †.

Nevertheless, human bones preserve equally well with those of animals, when placed in the same circumstances. In Egypt, no difference is observable in this respect between human mummies and those of quadrupeds. I have collected from the excavations made some years ago in the ancient church of St. Genevieve human bones interred below the remains of the first race, which may have even belonged to some princes of the house of Clovis, and which still completely preserve their forms ‡. We do not observe in fields of battle that the skeletons of men are more wasted than those of horses, if we allow for the difference of size; and we find among the fossils animals as small as the rat, still in a state of preservation.

Every thing, then, leads us to believe that the human species

fragments of *millepora miniacea*, of some madrepores and of shells, which he refers to *helix acuta* and *turbo pica*. More lately General Douzelot has caused another of those skeletons to be extracted, and of which we give a figure, plate 1st. It is a body which has the knees bent back. There remain a small fragment of the upper jaw, the left moiety of the lower, nearly one whole side of the trunk and pelvis, and a great part of the upper and lower extremities. The rock is evidently transition, in which some shells of the neighbouring sea, and some land shells which still exist in the island are lodged, and particularly the *bulimus guadalupensis* of Ferussac.

* See M. de Schlotheim's Treatise on Petrifications, Gotha, 1820, page 57; and his letter in the Isis, 1820. Supplement, No. 6.

† It is certainly not necessary to mention those fragments of *grès*, concerning which some noise was attempted to be made last year, 1824, and when it was pretended that the petrifications of a man and horse were discovered. The simple circumstance that the supposed man and horse were found preserved with their flesh and skin proves that it was a mere *lusus naturæ*, and no genuine petrifaction.

‡ The late M. Fourcroy has given an analysis of these bones. (Annales du Muséum, tome x. page 1.)

did not exist in the countries where the fossil bones have been discovered, at the period of that revolution which overwhelmed these bones. There cannot be any reason assigned why man should have escaped altogether from catastrophes so general; nor why, if he did not escape, no remnant of his race should be found among the bones of other animals which were destroyed by these catastrophes. I do not mean to conclude that man did not exist at the period I allude to. He might have inhabited some countries of small extent, from whence he repeopled the earth after these terrible events. Perhaps, also, the places which he then inhabited may have been covered by the waters, and his bones may have been buried under the existing seas, with the exception of a small number of individuals who have continued the species. Be that, however, as it may, the establishment of mankind in those countries where the fossil remains of land animals have been found, that is, in a great part of Europe, Asia, and America, must of necessity be posterior, not only to the revolutions which overwhelmed these bones, but also to those by which the strata which contained those bones have been laid bare, and which are the last which this globe has suffered. From all this it is clear that, neither from these bones themselves, nor from the greater or less accumulations of stones and earth which cover them, is it possible to deduce any argument in favour of the antiquity of the human race in these different countries.

On the contrary, in examining with attention what has passed upon the surface of the globe, since it has been left dry for the last time, and the continents have assumed their actual form, at least in their more elevated situations, it is easy to see that this last revolution, and consequently the establishment of our present societies, cannot be very ancient. This result is one of the best established and the least attended to in rational geology. It is also the more valuable, as it connects in one uninterrupted chain natural and civil history.

When we measure the effects produced in any given time by causes actually efficient, and compare them with those which these causes have produced since they commenced to operate, we may determine within a little that period in which their action commenced. This, of necessity, must be the epoch in which our continents assumed their present form, and also that of the last sudden retreat of the waters. In fact, we must date from this retreat the moment in which the acclivities of our mountains began to fall, and to form at their feet little hills or slopes of debris; that our present rivers have commenced to flow and form alluvial depositions; that our present vegetation has commenced to expand and produce vegetable soil; that our present cliffs or sloping coasts have begun to be worn away by the sea; that our present downs or sand-hills have begun to be thrown up by the wind. And it is from this epoch that human colonies have begun to extend and to form establishments in such places as nature has permitted. I say nothing of volcanoes, not only in consequence of the irregularity of theireruptions, but also because it is not proved that they do not exist under the sea, and on that account they cannot serve to measure the time which has elapsed since its last retreat.

M.M. Deluc and Dolomieu have most carefully examined the progress of the formation of new grounds; and although greatly opposed on a number of points in the theory of the earth, they agree on this. These formations augment with great rapidity. They must have augmented with more rapidity in the commencement, when the mountains furnished more materials to the rivers; yet, notwithstanding this, their extent is yet considerably limited.

The memoir of M. Dolomieu on Egypt* tends to prove that in the time of Homer the tongue of land on which Alexander built his city did not exist; that it was possible to navigate directly from the island of Pharos into the gulf called

* Journal de Physique, tom. xlii. p. 42, &c.

afterwards Lacus Mareotis ; and that this gulf at that period had the length indicated by Menelaus, namely, from about fifteen to twenty leagues. Nine hundred years only, then, which elapsed between the time of Homer and Strabo, were sufficient to place things in the state which the latter has described, and to reduce the gulf to the form of a lake six leagues in length. What is still more certain is, that since that period a still greater alteration has taken place. The sands which the sea and wind have thrown out have formed between the island of Pharos and the ancient town a tongue of land two hundred toises (four hundred yards) in breadth, on which the modern city has been built. These collections of sand have stopped up the nearest mouth of the Nile, and reduced the lake Mareotis nearly to nothing. During this time the alluvial depositions of the Nile have been forming along the rest of the shore, and extended it immensely.

The ancients were not ignorant of these changes. Herodotus tells us, that the priests of Egypt regarded their country as a present from the Nile. It is, says he, only because the Delta has made its appearance within a short time. Aristotle observes, that Homer speaks of Thebes as if it had been the only city in Egypt, and makes no mention of Memphis ; that the Canopic and Pelusiac mouths of the Nile were formerly the principal ones ; and that the coast extended in a right line from one to the other. It is still so represented in the maps of Ptolemy. Since then the water has thrown itself into the Balbitine and Phatnitic mouths. At their issues are formed the largest increases of land, which have given the coast a semicircular form. The cities of Rosetta and Damietta, built on the shore of the sea near these months less than a thousand years ago, are now two leagues distant from the sea. According to Demaillet, twenty-six years alone are necessary to extend a cape for half a league in front of Rosetta.

The elevation of the Egyptian soil operates at the same

time as the extension of its surface; and the bottom of the bed of the river is elevated in the same proportion as the adjacent plains; which occasions the inundation every period to surpass considerably the marks which it left after preceding periods. According to Herodotus, a space of nine hundred years was sufficient to establish a difference of level from seven to eight cubits. At Elephantina the inundation at the present day rises seven feet above the highest limits it attained under Septimius Severus, at the commencement of the third century. At Cairo, that it may suffice for the waterings, it must exceed by three feet and a half the height which was necessary in the ninth century. The ancient monuments of this celebrated country are all more or less sunk, or rather covered at their bases. The slime brought by the river covers even by many feet the artificial mountains on which the ancient cities stand *.

The bottom of the Rhone is not less remarkable for its augmentations. Astruc gives a detail of them in his natural history of Languedoc; and by a careful comparison of the descriptions of Mela, Strabo, and Pliny, with the state of these places at the commencement of the eighteenth century, he proves, by the authority of many writers of the middle age, that the arms of the Rhone are prolonged three leagues within eighteen hundred years; that similar new formations of land have taken place at the west of the Rhone; and that numbers of places situated about six or eight hundred years ago on the shore of the sea or of lakes are at present many miles within terra firma.

We may learn in Holland and Italy with what rapidity the

* See the observations on the lower grounds of Egypt, and the regular raising of the soil which covers it, by M. Girard (Grand Ouv. sur l'Egypte, et Mod. Mem. tom. ii. p. 343); on which we may still remark, that Dolomieu, Shaw, and other respectable writers have estimated these elevations much higher than M. Girard. It is a pity, that it has never been any where examined what may be the thickness of these strata above the primitive soil and the natural rock.

Rhine, the Po, the Arno, which are now confined within dikes, elevate their beds; how much their mouths advance into the sea, and form long promontories on its coasts: and we may judge from these facts, how few centuries were necessary to deposit the low alluvial grounds through which they flow.

Many cities which, at the epochs of the most authentic history, were flourishing sea-ports, are at present some leagues within land. Many have even been destroyed in consequence of this change of position. Venice with difficulty preserves the lagunes which separate her from the continent; and, in spite of all her efforts, she will be one day inevitably united to terra firma *.

We learn from the testimony of Strabo that in the time of Augustus Ravenna lay among lagunes, as Venice does at the present day; and at present Ravenna is a league from the coast. Spina had been founded on the sea-shore, by the Greeks; it was removed thence ninety stadia in the time of Strabo; at the present day it is destroyed. Adria, in Lombardy, which gave its name to the sea, of which, about twenty centuries ago, it was the principal port, is now six leagues from it. Fortis has even rendered it probable that up to a more ancient epoch the Euganian hills might have been islands.

My learned friend, of the Institute, M. de Prony, inspector-general of bridges and highways, has communicated to me some very valuable information to explain the changes of the *Littoral* or flat shores of the Adriatic †; having been

* See the memoir of M. de Forfait on the Lagunes of Venice (Mém. de la Classe Physique de l'Institut, tome v. page 213.

† Extract from the Researches of M. DE PRONY on the hydraulic system of Italy.

Displacement of that part of the shore of the Adriatic occupied by the mouths of the Po.—The part of the shore of the Adriatic comprehended within the southern extremities of the lake or lagunes of Commachio and the lagunes of Venice has suffered very

charged by the government to examine what remedies could be applied to check the devastations occasioned by the in-

considerable changes since the times of antiquity. These changes have been admitted by the evidence of writers worthy of the utmost credit; and the natural state of the soil in the countries situated near this shore will not permit us to entertain a doubt on the subject. But it is impossible to give exact details on the successive progress of these changes, and more especially precise measures for the epochs anterior to the tenth century of our æra.

We are nevertheless certain that the town of Hatria, now Adria, was formerly on the sea shore. This is a fixed and well known point of the primitive shore, from which to the present shore the shortest distance, taken at the mouth of the Adige, is twenty-five thousand metres, and it will be seen that the point formed by the alluvial promontory of the Po is more advanced into the sea by nearly ten thousand metres than the mouth of the Adige. The inhabitants of this city have formed in many points very exaggerated pretensions to its antiquity. But it cannot be denied that it is one of the most ancient in Italy. It has given its name to the sea which once washed its walls. By having dug into the interior of the soil and its environs, the existence of a stratum of earth was ascertained, mixed with fragments of Etruscan pottery, with nothing of Roman fabrication. The Etruscan and the Roman are found mixed together in a superior stratum on which the vestiges of a theatre have been found. Both these strata are considerably below the actual soil; and I have seen at Adria curious collections from them in which the monuments which they contained were separately classed. The Prince Viceroy, to whom I observed, some years ago, how interesting it would be, both for history and geology, to make a thorough search into these remains at Adria, and to determine the different levels in relation to the sea, both of the primitive soil and the successive alluvial strata, very much approved of my ideas; but I know not if my propositions were carried into effect.

Following the coast after leaving Hatria, which is situated at the bottom of a small gulf, we find to the south a branch of the Athesis or Adige, and the Fossa Philistina, the traces of which correspond to what might have been the Mincio and Tartaro united, if the Po had still flowed to the south of Ferrara. Then comes the Delta Venetum, which appears to have occupied the space where the lagune of Commachio is now found. This Delta was traversed by seven mouths of the Eridanus, also called Vadis, Padus, or Podicinus; which river, at the point of the diramification of these mouths, had a town named Trigopolis, the position of which could have been but a short distance from Ferrara. Seven lakes enclosed within the delta were called Septem Maria, and Hatria is sometimes called Urbs Septem Marium. In proceeding up the coast on the northward side, we find the principal mouth of the Athesis, called also Fossa Philistina, then Estuarium Altini, an interior sea separated from the gulf by a

crease of the Po; he proved that this river, from the epoch in which it was enclosed by dikes, had so considerably ele-

chain of islets called Rialtum. It is on this little archipelago that Venice is now situated. The Estuarium Altini is the lagune of Venice which communicates with the sea only by five passages, the islets having been united to form a continuous dike.

To the east of the lagunes, and north of the city of Este, lie the Euganian mounts, forming in the midst of a vast alluvial plain an isolated and conspicuous group of rounded hillocks, in the environs of which the celebrated fall of Phaeton is fabled to have occurred. Some authors maintain that enormous masses of ignited matter ejected by some volcanic explosion into the month of the Eridanus may have given rise to this fable. It is certain that in the vicinities of Padua and Verona many volcanic irruptions are to be found.

The information which I have been able to procure concerning the situation of the coast of the Adriatic at the mouths of the Po only commences to be authentic and precise in the twelfth century. At this epoch all the waters of the Po flowed to the south of Ferrara in the Po di Volano and Po di Primaro, branches which enclosed the space occupied by the lagune di Commachio. The two mouths into which the Po has since made an irruption to the north of Ferrara were named, one, Fiume di Corbola, or di Longola, or del Mazorno, the other Fiume Foi. The first, which was the most northern, received the Tartaro near the sea, or the canal Bianco. The second was augmented at Ariano by one branch derived from the Po, called Fiume Goro.

The sea-coast was evidently directed from south to north to a distance of ten or eleven thousand metres from the meridian of Adria. It passed to the point where we now find the western angle of the enclosure of Mesola; and Loreo, to the north of Mesola, was only distant from it two hundred metres.

Towards the middle of the twelfth century, the great waters or flood-waters of the Po passed through the dikes which contained them on their left bank by the little town of Ficarolo, situated about nineteen thousand metres to the north-west of Ferrara; then spread themselves over the northern part of the territory of Ferrara, and into the Polesine of Rovigo, and then flowed into the two canals above-mentioned, those of Mazorno and Foi. It appears very certain that the labours of man have greatly contributed to this diversion of the waters of the Po.

The historians who have mentioned this remarkable fact differ from each other only in a few trifling details. The tendency of the river to follow the new channels which were traced for it becoming every day more energetic, the two branches of the Volano and Primaro were rapidly impoverished, and reduced, in less than a century, very nearly to their present state. The chief direction of the river was established between the mouth of the Adige and the point called at the present day Porto di Goro. The two canals which it occupied at first becoming insufficient, new ones were dug;

vated its level, that the surface of its waters is at present higher than the roofs of the houses in Ferrara. At the same time

and at the commencement of the seventeenth century, its principal mouth, called *Sbocco di Tramontana*, approaching very closely to the mouth of the Adige, the Venetians became alarmed, and in 1604 dug the new bed called *Taglio di Porto Viro*, or *Po delle fornaci*, by means of which the *Bocca Maestra* was diverted from the Adige towards the south.

During the lapse of four centuries, from the end of the twelfth to the end of the sixteenth century, the alluvial depositions of the Po have gained a very considerable extent upon the sea. The northern mouth, which had occupied the canal of *Mazorno*, and formed the *Ramo di Tramontana*, was, in 1600, distant twenty thousand metres from the meridian of Adria; and the southern mouth, which had invaded the canal Toi, was, at the same epoch, seventeen thousand metres from this meridian. Thus the shore was extended nine or ten thousand metres to the north, and six or seven thousand metres to the south. Between these two mouths, of which I have just spoken, there was a bay, or part of the shore less advanced, which was called *Sacca di Goro*. The great embankments of the river, and a considerable part of the clearings of the southern slopes of the Alps, took place in this interval, between the thirteenth and seventeenth centuries.

The *Taglio di Porto Viro* ascertains the progress of the alluvial depositions in the great promontory now formed by the mouths of the Po. In proportion as the entrances to the sea were removed, the annual quantity of depositions was increased in an alarming degree, as well by the diminution of the slope of the waters (a necessary consequence of the elongation of the bed), as by the imprisonment of these waters between the dikes, and the facility which the clearing of the lands gave to the torrents which were flowing in, to draw down the mountain soil into the plain. Very speedily the bay of *Sacca di Goro* was filled up, and the two promontories formed by the two first mouths were united into one, the actual point of which is distant thirty-two or thirty-three thousand metres from the meridian of Adria. So that during two centuries, the mouths of the Po have gained about fourteen thousand metres on the sea. From the facts of which I have just given a rapid exposition, the following results may be drawn :—

1. That at certain ancient epochs, the precise date of which cannot be assigned, the walls of Adria were washed by the Adriatic.

2. That in the twelfth century, before a road was opened for the waters of the Po, at Ficarolo, on their left bank, the sea-shore was distant from Adria nine or ten thousand metres.

3. That the points of the promontories formed by the two principal mouths of the Po were, in 1600, before the excavation of the *Taglio di Porto Viro*, at a

the alluvial additions have advanced into the sea with such rapidity, that by comparing old charts with the present state, we find that the shore has gained no less than fourteen thousand yards since the year 1604. This makes a hundred and fifty, or a hundred and eighty, and, in some cases, two hundred feet yearly. The Adige and the Po are at present higher than all the land which intervenes; and it is only by opening new beds in the low grounds which they have formerly deposited that the disasters which are now threatened can be prevented.

The same causes have produced the same effects along the branches of the Rhine and the Meuse. Thus it is, that the richest cantons of Holland have continually the frightful spectacle of rivers suspended at a height of twenty or thirty feet above the level of the soil.

M. Miebeking, director of bridges and highways in the kingdom of Bavaria, has written a memoir of the progress of matters of this kind, so important to be known by governments and people, in which he proves, that this property of elevating their beds belongs more or less to all rivers.

The increase of alluvial land along the coasts of the North Sea proceeds as rapidly as in Italy. It may easily be traced in Friezeland, and the neighbourhood of Groningen, as the epoch in which the first dikes were constructed is known, namely 1570, when they were made by order of the governor,

mean distance of eighteen thousand, five hundred metres from Adria, which, from the year 1200, gives a yearly increase of alluvial land of twenty-five metres.

4. That the point of the single promontory formed by the present mouths is distant thirty-two or thirty-three thousand metres from the meridian of Adria; whence we may conclude, that the average yearly progress of the alluvial formations is about seventy metres during these two last centuries; a progress which, considered in reference to epochs not long past, is wonderfully increased in rapidity *.

DE PRONY.

* N. B. The French metre may be considered as 39·37 English inches.

Gaspard Robles. One hundred years after, three quarters of a league of alluvial land was gained in some places beyond these dikes; and the town itself of Groningen, built in part upon the ancient soil, on a calcareous earth, which has no connexion with the present soil, and in which the same sort of shells are found as in our coarse limestone in the neighbourhood of Paris, is but six leagues from the sea. Having been on the spot, I can confirm, by my own testimony, facts otherwise well known, and of a great number of which M. De Luc has given a very satisfactory development. The same phenomenon may be observed, occurring with the same degree of precision, all along the coasts of East Friezeland, of the countries of Bohemia and Holstein, because the epochs are known when the new alluvial formations were encircled for the first time, and it is easy to measure what has been gained since.

These alluvial lands, of the most admirable fertility, are a gift to these countries—so much the more precious, as the ancient soil, covered with heaths and peat-mosses, is almost every where incapable of culture. The alluvial formations alone are sufficient for the subsistence of the populous cities constructed along this coast since the middle ages, and which probably never would have arrived to their degree of splendour without the rich alluvial beds which were prepared for them by the rivers, and which those rivers constantly augment.

If the size which Herodotus attributes to the sea of Azof, which he makes almost equal to the Euxine, was not expressed in such vague terms, and if we knew exactly what he meant by the *Gerrhus*, we should there find strong additional proofs of the changes produced by the rivers and their rapidity. For the alluvial depositions of these rivers were sufficient*, in the

* This supposed diminution of the Black Sea, and the sea of Azof, has been attributed to the rupture of the Bosphorus, which is said to have taken place at the

space of two thousand and two or three hundred years, to reduce the sea of Azof to its present size, to stop the course of the Gerrhus, or that branch of the Dnieper which disembogued into the Hypacyris, and then, with the water of this last river, discharged itself into the gulf Carcinites, or Olu-Degnitz, and to reduce the Hypacyris itself to nothing*. We should have other proofs, not less strange, if it was certain that the Oxus, or Sihon, which now falls into the lake Aral, fell formerly into the Caspian Sea. But there are on this subject a sufficient number of demonstrated facts to prevent us from having recourse to any that are doubtful, or making the ignorance of the ancients in geography the basis of our physical propositions †.

pretended epoch of the deluge of Deucalion; and, nevertheless, to establish this fact itself, the persons who maintain this opinion rest for proof on the successive diminutions of extent attributed to these seas by Herodotus, Strabo, &c. But it is too evident, that if this diminution proceeded from the rupture of the Bosphorus, it would have been completed long before the time of Herodotus, and from the very epoch in which Deucalion lived.

* See the geography of Herodotus by M. Rennel, page 56 and following, and a part of the work of M. Dureau de Lamalle, entitled Physical Geography of the Black Sea, &c. At present there is only the little river of Kamenoipost which can represent the Gerrhus and Hypacyris, as described by Herodotus.

N. B. M. Dureau, p. 170, supposes that Herodotus makes the Borysthenes and the Hypanis flow into the Palus Meotis. But Herodotus simply says (Melpom. LIII.) that these two rivers flowed together into the same lake, *i. e.* into the Liman, as at the present day. Herodotus does not carry the Gerrhus and Hypacyris any further.

† For example, M. Dureau de Lamalle, in his Physical Geography of the Black Sea, quotes Aristotle (Meteor. l. 1. c. 13.) as informing us that in his time many proofs existed of there having formerly been a canal conducting from the Caspian Sea into the Palus Meotis. Now, in fact, the words of Aristotle simply are, "From the Paropamisus descend, among other rivers, the Bactrus, the Choaspes, and the Araxes, from which the Tanais, which is a branch of them, flows into the Palus Meotis." Who does not see that this nonsense, founded on no dates or records of navigation, was only a strange notion of the soldiers of Alexander, who took the Iaxartes or Tanais of Transoxiana for the Don or Tanais of Scythia? Arrian

We have spoken heretofore of downs, or those sand-hills which the sea throws up on the low coasts when its bottom is sandy. Every where, where the industry of man has not succeeded in fixing them, these downs advance into the land as irresistibly as the alluvial depositions of rivers proceed into the sea. They push before them great pools of water formed by the rain which falls on the neighbouring grounds, and hinder their communication with the sea; and in many they proceed forward with the most terrific rapidity. Forests, houses, cultivated fields, are overwhelmed by them. Those of the Bay of Biscay* have already covered a great number of villages mentioned in the records of the middle ages; and at this moment, in the single department of Landes, ten villages are menaced with destruction from the same cause. One of these, the village of Misiman, has struggled against them for twenty years, and at present a sand-hill, of more than sixty feet of elevation, is palpably approaching towards the town.

In 1802, the pools invaded five fine farm-houses in the neighbourhood of St. Julian†. They have covered, for some time, an ancient Roman way which led from Bourdeaux to Bayonne, and which was still visible about forty years ago, when the waters were low‡. The Adour, which at known epochs passed Old Boucaut, and discharged itself into the sea at Cape Breton, is now turned more than two thousand four hundred yards.

and Pliny make the distinction, but it does not appear to have been made in the time of Aristotle. It is absurd to derive geological documents from such geographers.

* See the report on the downs of the Bay of Biscay, by M. Tassin, Mont-de-Marsan. An X.

† See Denon.

‡ Memoir on the means of fixing the downs, by M. Bremontier.

The late M. Bremontier, inspector of bridges and highways, who made many great works against these downs, estimated their progress at sixty feet every year, and in certain places at seventy-two. Two thousand years, according to his calculation, would carry them as far as Bourdeaux; and, according to their actual extent, it could be little more than four thousand years since they commenced their formations.

The covering of the fertile lands of Egypt, by the steril sands of Lybia, carried thither by the west wind, is a phenomenon of the same nature as the downs. These sands have overwhelmed a number of towns and villages, the ruins of which still appear, and that since the conquest of the country by the Mahometans, for the summits of the minarets of some mosques are visible through the sand. In a progress so rapid they must undoubtedly have filled up the narrow parts of the valley, if so many ages had elapsed since they began to be thrown up, and nothing more would remain between the Lybian chain and the Nile. This would form an additional chronometer, of which it would be equally easy and interesting to obtain the measure.

The peat-mosses, so generally produced in the North of Europe by the debris of *sphagnum*, and other aquatic mosses, also give a measure of time. They are elevated in determinate proportions in every place. They envelope the little knolls of earth on which they are formed, and many of these knolls have been covered up within the memory of man. In other places, the peat-mosses descend along the valleys: they advance like the glaciers; but the glaciers melt every year at their lower edges, while the progress of the mosses is arrested by nothing. By sounding their depth down to the solid ground, we may form some estimate of their antiquity; and it will be found that these mosses, like the downs, cannot be referred to an indefinitely remote epoch. It is the same way with regard to those

slips or fallings which take place with prodigious rapidity at the foot of all steep slopes, and which are yet very far from having covered them; but as no precise measures have yet been applied in these cases, we shall not insist on them any longer*.

We see, then, that nature speaks every where the same language. She even tells us that the present order of things is not of any very remote antiquity. It is also remarkable that man speaks to us in the same language as nature, whether we consult the genuine traditions of nations, or examine their moral and political situation, and the degree of intellectual development at which they had arrived at the commencement of their authentic history.

In fact, although at the first glance the traditions of some ancient people, who remove their origin back to many thousands of ages, seem strongly to contradict the recentness of the present world; yet when those traditions are more nearly examined, it is soon apparent that there is nothing genuine or historical about them. We are soon convinced that true history, and every authentic document which we possess con-

* These phenomena are very well explained in the letters of M. de Luc to the Queen of England, in the places where he describes the peat-mosses of Westphalia, and in his letters to Lametherie, inserted in the Journal de Physique of 1791, &c.; also in those which he has addressed to M. Blumenbach, and which were printed in French, in one volume, Paris, 1798. We might also add those interesting details which he gives in his Geological Voyages, vol. I. on the islands of the west coast of the duchy of Sleswick, and the manner in which they are connected either with each other or the continent by alluvial formations and peat-mosses, as well as his observations on the irruptions which from time to time have destroyed and separated some parts of them.

As to the slips or fallings, Mr. Jameson, in a note on the English translation of this discourse, cites a remarkable example taken from those steep rocks called *Salisbury Craigs*, near Edinburgh. Although but of moderate height, their abrupt and vertical face is not yet covered by the mass of debris, accumulated at their foot, and which, nevertheless, is augmenting every year.

cerning the first establishment of nations, confirm all that natural monuments had previously announced.

The chronology of none of our western nations goes farther back, by any connected series, than three thousand years. None of them, previously to this epoch, nor even for two or three centuries after, can present us with a record of facts connected together in any probable way. The north of Europe had no history before its conversion to Christianity. The history of Spain, of Gaul, and of Britain, only commences to date from the conquests of the Romans. That of northern Italy before the foundation of Rome is at this day nearly unknown. The Greeks confess their ignorance of the art of writing, before they were taught it by the Phœnicians, thirty-three or thirty-four centuries ago. Even since that period their history is full of fables, and they do not carry back the first traces of their union into states more than three hundred years beyond it. We have only some contradictory accounts of the history of Western Asia, which, with any thing of connexion and probability, go no farther back than twenty-five centuries*; and even admitting what is reported with any historical detail concerning the more ancient periods, we shall with difficulty gain forty centuries †.

Herodotus, the first profane historian whose works remain to us, is of no greater antiquity than two thousand years ‡: historians prior to his time, whose works he might have consulted, are not above a century older §.

We may even judge of their character by the extravagant

* To Cyrus, about 650 before Christ.

† To Ninus, about 2348 years before Christ, according to Ctesias and his followers, but only 1250 according to Volney after Herodotus.

‡ Herodotus lived 440 years before Christ.

§ Cadmus, Pherecydes, Aristæus of Proconnesus, Acusiläus, Hecatæus of Milatus, Charon of Lampascus, &c. Consult Vossius de Hist. Græc. lib. i. and especially his fourth book.

stories which remain extracted from Aristæus of Proconnesus, and some others.

Before these we have only poets: and Homer the most ancient which we possess, Homer the master and eternal model of all the west, has preceded our age only by two thousand seven hundred or two thousand eight hundred years.

When these early historians speak of ancient events, whether occurring in their own or in neighbouring nations, they only cite oral traditions, and not public works. It was a long time after they flourished that pretended extracts were given from the Egyptian, Babylonian, and Phœnician annals. Berosus did not write until the reign of Seleucus Nicator, Hieronymus until that of Antiochus Soter, and Manethon until the reign of Ptolemy Philadelphus, all three of them having lived only in the third century before Christ.

That Sanchoniathon was a real or pretended author was not known until Philo of Byblos had published a translation of him under Adrian in the second century after Christ; and in his account of the early ages, nothing is to be found but a puerile theogony, or a system of metaphysics so disguised under allegory as to be perfectly unintelligible. One people alone has preserved annals written in prose before the time of Cyrus. This is the Jewish people. That part of the Old Testament called the *Pentateuch* existed in its present form at least from the time of the schism of Jeroboam, since the Samaritans received it as well as the Jews, and this proves to a certainty that it is more than two thousand eight hundred years old.

There is no reason for not attributing the composition of Genesis to Moses himself, which gives it an antiquity of five hundred years more, making a lapse to our present time of thirty-three centuries. Its perusal is sufficient to convince us that it was composed in part with extracts from anterior works. We can by no means hesitate to believe that this is the oldest writing of which our western nations are at present in possession.

Now this work, and all which have been since composed, however ignorant their authors might be of Moses or his people, represent to us the nations on the borders of the Mediterranean as very recent. They represent them as half savages a few centuries before. Moreover, they all tell us of a general catastrophe, an irruption of the waters, which occasioned an almost total regeneration of the human race, the epoch of which they do not remove to any very ancient date.

The texts of the Pentateuch which prolong this interval the most do not place it more than twenty centuries before Moses, nor consequently more than five thousand four hundred years before us *.

The poetical traditions of the Greeks, which are the sources of our profane history for remote ages, have nothing contradictory to the annals of the Jews ; on the contrary, there is a very remarkable accordance between them in the epoch which they assign to the Egyptian and Phœnician colonies which brought into Greece the first germs of civilization. We find there, that about the same time in which the children of Israel quitted Egypt, to carry into Palestine the sublime doctrine of the unity of God, other colonies proceeded from the same country to carry into Greece a religion less pure, at least in its external forms, whatever secret doctrines it might reserve for the initiated. At the same time, other colonies issued from Phœnicia, and taught the Greeks the art of writing, and every thing which related to navigation and commerce †.

* The Septuagint, 5345 years ; the Samaritan text, 4869 ; the Hebrew, 4174.

† We know that chronologists vary by many years on each of these events. Still, these migrations, taken on the whole, form the specific and remarkable character of the fifteenth and sixteenth centuries before Christ. Thus, following the calculations of Usserius, Cecrops came from Egypt to Athens about 1556 before Christ ; Deucalion established himself on Parnassus about 1548 ; Cadmus arrived from Phœnicia to Thebes about 1493 ; Danäus came to Argos 1485 ; Dardanus established himself on the Hellespont about 1449. All these chiefs of nations were nearly contemporary

The Greeks are certainly very far from possessing a connected history even after this period, since they place after the founders of these colonies a crowd of mythological events, and adventures in which gods and heroes are concerned; and these chiefs are linked to their history by genealogies clearly factitious *.

But what is still more certain is, that previously to their arrival, nothing is preserved concerning events but very obscure and confused traditions, and that this want of genuine history could only have been supplied by pure fictions, similar to those invented by our monks of the middle ages respecting the origin of the nations of Europe.

Thus, we should not be astonished that even in ancient times so many doubts and contradictions existed respecting the epochs of Cecrops, Deucalion, Danäus, and Cadmus. It would not only be puerile to attach any importance to any opinion on the precise dates of Inachus † and Ogyges ‡; but if any thing surprises us it should be, that a much more remote antiquity was not assigned to those personages. It is impossible that in this case there should not have been some influence exercised by those received traditions, from which the inventors of fables have not been able entirely to withdraw themselves. One of the

with Moses, whose emigration took place in 1491. Consult further on the synchronism of Moses, Danäus and Cadmus, Diodor. lib. xi., and Photius, p. 1152.

* Every one is acquainted with the genealogies of Apollodorus, and the advantage which the late Clavier has sought to derive from them to establish a sort of primitive history of Greece; but when we read the genealogies of the Arabs, the Tartars, and those which our own old chronicling monks have invented for the different sovereigns of Europe, and even for private persons, we must be convinced that the Greek writers have only done for the early ages of their nation what has been universally done for others at those periods when criticism threw no light upon history.

† 1856, or 1823 years before Christ, or other dates still, but always about 350 before the principal Phœnician or Egyptian colonies.

‡ The common date of Ogyges, after Acusiläus, followed by Eusebius is 1796 years before Christ, consequently many years after Inachus.

dates assigned to the deluge of Ogyges accords so much with one attributed to that of Noah, that it is almost impossible that it should not have been derived from some source connected with the accounts of this latter deluge *.

As to Deucalion, whether this prince be considered a real or fictitious personage, the slightest attention to the manner in which his deluge has been introduced into the Greek poems, and to the various details with which it was successively enriched, are sufficient to prove that it was a tradition of the great cataclysm, altered and placed by the Hellenians in the epoch of Deucalion, because he was regarded as the founder of their nation ; and his history is confounded with that of all the chiefs of the renewed nations †.

* Varro places the deluge of Ogyges, which he calls the *first deluge*, 40 years before Inachus (*a priore cataclismo quem Ogygium dicunt ad Inachi regnum*), and, consequently, 1600 years before the first Olympiad. This would carry it to 2376 years before Christ, and the deluge of Noah, according to the Hebrew text, is 2349, there being only twenty-seven years in difference. This testimony of Varro is related by Censorinus, *de Die Natali*, cap. xxi. ; in fact, Censorinus wrote only 238 years after Christ, and he appears, according to Julius Africanus, to be the first author who placed a deluge under the reign of Ogyges, making this prince contemporary with Phoroneus, which would come very near the first Olympiad. Julius Africanus makes only an interval of 1020 years between the two epochs. There is even in Censorinus a passage in conformity with this opinion. Accordingly, some would read in Varro *Erogitium*, instead of *Ogygium ;* but this appears absurd.

† Homer and Hesiod say nothing of the deluge of Deucalion, nor of that of Ogyges.

The earliest remaining author in which the mention of the first is found is Pindar. He makes Deucalion land on Parnassus, build the city of Protogenes, and renew the people with stones. In a word, he relates, but applies only to a single nation, the fable which Ovid has generalized for the whole human race.

Plato, in the Timæus, says but a few words of the deluge, as well as of Deucalion and Pyrrha, to introduce the recital, according to the priests of Sais, of the grand catastrophe which destroyed the Atlantis. But in these few words he speaks of the deluge in the singular number, as if it was the only one. He says, more expressly, a little farther on, that the Greeks were acquainted with only one deluge. He places the name of Deucalion immediately after that of Phoroneus, the first of men, without

Each horde of Greece which has preserved any isolated traditions always commenced them by a particular deluge, because each of them had preserved some remembrance of a general deluge, which was common to every nation ; and when in the sequel these various traditions were tried by the test of one common chronology, different events were supposed, be-

making mention of Ogyges. Thus, according to him, it was only a general event, a true universal deluge, and the only one which happened. He, then, regards it as identical with that of Ogyges.

Aristotle appears to have been the first who considered this deluge as a mere local inundation, and places it near Dodona and the river Achelöus, but near the Achelöus and Dodona in Thessaly.

In Apollodorus, the deluge of Deucalion resumes all its grandeur and mythological character. It occurs at the epoch in which the age of brass passes into that of iron. Deucalion is the son of the Titan, Prometheus, the fabricator of men: he creates anew the human race with stones ; and yet Atlas his uncle, Phoroneus, who lived before him, and several other anterior personages, preserved a long posterity.

In proportion as we come to more recent writers, many circumstances are added in detail, which bear a stronger resemblance to the relation of Moses.

Thus, Apollodorus gives Deucalion an ark as a means of safety ; Plutarch speaks of doves, by means of which he endeavoured to ascertain whether the waters had retired; and Lucian, of the animals of all kinds which he had embarked along with him.

As to the combination of tradition and hypothesis by which recent writers have endeavoured to prove that the rupture of the Bosphorus was the cause of the deluge of Deucalion, and even of the opening of the pillars of Hercules, in occasioning the waters of the Euxine Sea to discharge into the Archipelago, which waters were considerably more elevated and extended previously to that epoch than at present, it is quite unnecessary to enter into any detail on the subject. The observations of M. Olivier have established, that if the Black Sea had been as high as was supposed, it would have an easier exit by the hills, and less elevated plains, than by the borders of the Bosphorus. M. le Comte d' Andreossy has also proved that if this sea fell suddenly into a cascade by this new passage, the small quantity of water which could have escaped by this narrow passage not only would have spread over the immense extent of the Mediterranean without occasioning a swell there of more than a dozen feet, but the simple natural inclination which such a flowing off of the waters must cause would have reduced to nothing their overplus of elevation on the coast of Attica. See the note which I have published at the head of the third volume of Ovid, in the collection of M. Lemaire.

cause different dates, altogether uncertain, perhaps all false, though regarded authentic in their own country, could not be made to agree. Thus, as the Hellenians had a deluge of Deucalion, because he was regarded as the founder of their nation, so the Autochthones of Attica had one of Ogyges, because it was with him they commenced their history. The Pelasgi of Arcadia had also one, which, according to their later writers, compelled Dardanus to betake himself towards the Hellespont *. The island of Samothracia, one of those where was most anciently formed a succession of priests, a regular worship, and connected traditions, had also a deluge, considered the most ancient of all †, and which was attributed to the rupture of the Bosphorus and the Hellespont. Some notion of a similar event was preserved in Asia Minor ‡, and in Syria §, to which, in the sequel, the Greeks attached the name of Deucalion ||.

But none of these traditions fix this cataclysm at a very remote period. There are none of them which cannot be explained, as to date and other circumstances, by the variations to which recitals not fixed by writing are invariably subject.

Those who are desirous of attributing to our continents, and to the establishment of nations, a very remote antiquity, are obliged to refer to the Indians, the Chaldeans, and the Egyptians, three nations who certainly appear to have been the most anciently established of the Caucasian race ; but also three nations which bear a strong similarity to each other not only in temperament, climate, and the nature of the soil which they inhabit, but also in their religious and political constitution, and whose testimony this very constitution should render more

* Dion. of Halicar. Antiq. Rom. lib. i. cap. lxi.

† Diodor. of Sicil. lib. x. cap. xlvii.

‡ Stephen of Byzant. verb. Iconium. Zenodot. Prov. cent. vi. No. 10. et Suidas.

§ Lucian. de Dea Syria.

|| Arnob. contra Gent. lib. v. p. m. 158, speaks of a rock of Phrygia, whence they pretend Deucalion and Pyrrha to have taken their stones.

suspected *. Among all these three an hereditary cast was exclusively charged with the care of religion, laws, and sciences: among all three this cast had its allegorical language and secret doctrines; among all three it reserved the privilege of reading and expounding the sacred books in which all knowledge had been revealed by the gods themselves.

It is easy to perceive what history must become in such hands. But without using any reasonings on the subject, we may satisfy ourselves of the fact, by examining what it has become in the only one of those nations yet existing, namely, the Indians.

The fact is, that it does not exist among them at all. In the midst of the infinity of works which the Bramins possess on mystical theology and abstruse methaphysics, nothing remains which can inform us, with certainty, on the origin of their nation, or the vicissitudes of their society. They even profess that their religion forbids them from preserving the memory of what passes in the present age, which is their age of misfortune †.

According to the Vedas, the first revealed books, and the foundation of all the faith of the Hindoos, the literature of this people, like that of the Greeks, commences by two grand epic poems, the Ramayan and the Mahâbarat; much more monstrous in their miracles than the Iliad and the Odyssey, although even traces of a metaphysical doctrine, which it has been fashionable to term sublime, appear there. The other poems which, with the two first, consitute the grand body of the

* This resemblance of institutions proceeded so far as to argue one common origin. We should not forget that many ancient authors have supposed that the Egyptian institutions came from Ethiopia, and that Syncellus tells us expressly that the Ethiopians came from the borders of the Indus, in the time of King Amenophtis.

† See Polier, Mythology of the Hindoos, tom. i. p. 89, 91.

Puranas, are only legends or romances in verse, written in different times and by different authors, and not less extravagant in their fictions than the grand poems. Some have imagined that they could discover in these writings facts or names of men similar to those of which the Greeks and Latins have spoken. It is chiefly after these resemblances that Mr. Wilfort has endeavoured to extract from these Puranas a sort of concordance with our ancient chronology of the West, a concordance which betrays, at every line, the hypothetical nature of its basis, and which, moreover, cannot be admitted but by reckoning as nothing the dates given by the Puranas themselves. The lists of kings, which the Pundits or Indian* doctors have professed to have compiled after these Puranas, are nothing but simple catalogues, without details, or embellished with details, like those of the Chaldeans and Egyptians, or such as Saxo, the grammarian, or Trithemius, have given for the people of the North †. These lists are very far from according with each other. None of them are founded either on history, registers, or records of any kind; the actual foundation on which they rest has been only the invention of the poets, whose works have been their source. One of the Pundits, who had furnished Mr. Wilfort with the accounts, confessed that he filled the spaces between celebrated kings with arbitrary names ‡, and he owned that his predecessors had done the same. If this be true concerning the lists which the English can procure at the present day, how should it be otherwise with those

* See the great work of Mr. Wilfort on the chronology of the kings of Magadha, emperors of India, and on the epochs of Vicramaditja, or Bikermadjit, and Saliwhanna. Mem. de Calcutta. tom. ix. in 8vo. p. 82.

† See Johnes on the chronology of the Hindoos. Mem. de Calcutta, edition in 8vo. tom. ii. p. 3. French translation, p. 164. See also Wilfort on the same subject, tom. v. p. 241. and the lists which he gives in his work above cited, ix. 116.

‡ Wilfort, Mem. de Calcutta, in 8vo. tom. ix. p. 133.

published by Abou Fazel, as extracted from the annals of Cachemire *, which, moreover, are full of fables, as they do not go farther back than four thousand three hundred years, and more than one thousand two hundred are filled with the names of princes, the duration of whose reigns remains undetermined.

The very era from which the Indians reckon their years at the present time, which commences fifty-seven years before Christ, and bears the name of a prince called Vicramaditjia, or Bickermadjit, is only so termed by convention; for we find, according to the synchronisms attributed to Vicramaditjia, that there must have been at least three, perhaps eight or nine princes of this name, concerning whom similar legends are related, and all of whom made war with a prince named Saliwahanna; we do not even know whether this year fifty-seven before Christ is that of the birth or death of Vicramaditjia, whose name it bears †.

In fine, the most authentic books of the Indians belie, by their intrinsic and obvious characters, the antiquity which these people attribute to them. Their Vedas, or sacred books, revealed, according to them, by Brama himself, from the origin of the world, and arranged by *Viasa* (a name which signifies nothing but collector), at the commencement of the present age,—if we are to judge from the calendar which we find annexed to them, and to which they refer, as well as by the position of the colures indicated by this calendar,—may extend to three thousand two hundred years, which would be pretty near the epoch of Moses ‡. Perhaps, too, those who give credit to the assertion of Megasthenes, that in his time the Indians were

* In the Ayeen Ackbery, vol. ii. p. 138 of the English translation. See also Heeren, Commerce of the Ancients, first volume, second part, p. 329.

† See Bentley on the astronomical systems of the Hindoos, and their connexion with history. Mem. of Calcutta, vol. viii. p. 243 of the edition in 8vo.

‡ See the Memoir of Mr. Colebrooke on the Vedas. Mem. of Calcutta, vol. viii. of the edition in 8vo. p. 493.

ignorant of the art of writing *; those who reflect that none of the ancients have made any mention of those superb temples, those immense pagodas, such remarkable monuments of the religion of the Bramins; those who are aware that the epochs of their astronomical tables have been calculated backwards, and badly calculated, and that their treatises on astronomy are modern and antedated, will be inclined to diminish still more this pretended antiquity of the Vedas.

Yet, even in the midst of all the Braminical fables, we discover certain points, the agreement of which with the historical monuments of more western nations is very astonishing.

Thus their mythology consecrates the successive devastations which the surface of the globe has undergone, and is yet to undergo; and the last they remove back only to a period of somewhat less than five thousand years †. One of these revolutions, which is certainly placed much farther from our time, is yet described in terms precisely corresponding with those employed by Moses ‡.

Mr. Wilfort even assures us that in another event of this mythology a person figures who resembles Deucalion in his origin, name, and even in the name and adventures of his father §.

* Megasthenes apud Strabon, lib. xv. p. 709. Almel.

† The period which gave birth to the present age (*Cali Yug*), the age of earth, 4927 years before the present day, or 3102 before Christ. See Legentil, Voyage to India, vol. i. p. 235. Bentley, Calcutta Memoirs, vol. viii. 8vo. edition, p. 212. This period is only fifty-nine years farther back than the deluge of Noah, according to the Samaritan text.

‡ The person named Satyavrata plays the same part as Noah, by saving himself with fourteen saints. Consult Sir William Jones, Calcutta Memoirs, 8vo. edit. vol. i. p. 230, and the French translation in 4to. p. 170, and the Bagavadan, or Bagvata, translated by Fouchè d'Obsonville, p. 212.

§ *Cala-Javana*, or in common language, *Cal Yun*, to whom his followers have given the epithet Deva, *Deo* (god), having attacked *Chrishna* (the Indian Apollo), at the head of the northern nations (the Scythians, of whom Deucalion was, according to Lucian), was repulsed by fire and water. His father *Garga* had for one of his

A fact equally worthy of remark is, that in these lists of kings, notwithstanding their barrenness of historical detail, the Indians place the commencement of their human sovereigns (those of the race of the sun and moon) at an epocha which is nearly the same as that in which Ctesias, in exactly such another list, begins his kings of Assyria, about four thousand years before the present time *.

This deplorable state of historical knowledge is a necessary consequence, wherever the hereditary priesthood of a religion, monstrous in its external rites, and cruel in many of its precepts, has alone the privilege of writing, preserving, and explaining the books. Some legend, for the purpose of rendering popular a place of pilgrimage, inventions calculated to produce a deeper reverence for their cast, must have interested these priests more than any historical truths. Among the sciences they would cultivate astronomy, which would raise their credit as astrologers; mechanics, which would assist them to raise monuments, signs at once of their own power, and objects of the superstitious veneration of the people; geometry also, the basis both of astronomy and mechanics, an important auxiliary to agriculture in these vast plains of alluvion, which could not be drained and rendered fertile but by the aid of

surnames *Pramathesa* (Prometheus), and according to another legend he is devoured by the eagle *Garuda*. These particulars have been extracted by Mr. Wilfort, in his Memoir on Mount Caucasus, in the Calcutta Memoirs, vol. vi. p. 507, 8vo. edit. from a Sancrit drama, entitled *Hari Vansa*.

Mr. Charles Ritter, in his Introduction to the History of Europe, before Herodotus, concludes that the whole fable of Deucalion is of foreign origin, and was brought into Greece with the other legends of that part of the Grecian worship which came by the North, and which had preceded the Phœnician and Egyptian colonies. But if it be true that the constellations of the Indian sphere are also the names of Grecian personages, that we find Andromeda there under the name *Antarmadia*, Cepheus under that of *Capiia*, &c. we should be tempted, with Mr. Wilfort, to draw a conclusion entirely the reverse. Unfortunately, learned men begin very much to doubt the authenticity of the documents quoted by the latter writer.

* Bentley, Calcutta Memoirs, 8vo. edit. vol. viii. p. 226. Note.

numerous canals: they would encourage the mechanical arts and chemistry, which would support commerce, and contribute to their luxury and the magnificence of their temples; but history, by which men are enlightened on the subject of their mutual relations, must ever be an object of terror to a privileged cast of this kind, whose interest, nay whose very existence, depends on the ignorance and stupidity of their nation.

What we see take place in India, we shall find to be universally the case wherever sacerdotal races, constituted like that of the Bramins, and established in similar countries, arrogate the same empire over the mass of the people. The same causes must produce the same effects; and we find, on the slightest examination of the fragments which remain of Egyptian and Chaldean traditions, that there is no more genuine history in them than in those of the Indians.

To judge of the nature of the chronicles which the Egyptian priests pretended to possess, it is sufficient to call to mind the extracts which have been given by themselves at different times and to different persons.

Those of Saïs, for example, told Solon, about five hundred and fifty years before Christ, that Egypt, not having been subject to deluges, had preserved not only her own annals, but those of every other nation. That the city of Athens, and that of Saïs, had been built by Minerva; the first nine thousand years before, and the second only eight thousand. To these dates they added the well known fables concerning the Atlantis, on the resistance which the ancient Athenians opposed to their conquests, as well as the whole romantic description of the Atlantis *; a description in which events and genealogies similar to those of all mythological romances are to be found.

A century later, towards 450, the priests of Memphis gave totally different relations to Herodotus †.

* See the Timæus and Critias. † Euterpe, chap. 99, et seq.

According to them, Menes, the first king of Egypt, had built Memphis, and enclosed the Nile within dikes; as if such operations could be possible to the first king of a country. From that period they had 330 other kings down to Mœris, who reigned, according to them, 900 years before their own period, 1350 years before Christ.

After these kings came Sesostris, who pursued his conquests as far as Colchis *; and altogether there were, to the time of Sethos, 341 kings and 341 chief priests in 341 generations, during a space of 11,340 years. In this interval, as if to guarantee the truth of their chronology, those priests assured him that the sun rose twice where he sets, without any change in the climate or its productions, and without any god, during that time, having made his appearance or reigned in Egypt.

To this tale, which, in spite of all pretended explanations, proves the grossest ignorance of astronomy, they added other stories, equally worthy of the source from which they emanated, concerning Sesostris, Pheron, Helenus, Rhampsinites, the kings who constructed the pyramids, and Sabacos, an Ethiopian conqueror.

The priests of Thebes managed better; they showed Herodotus, as they had before shown Hecatæus, 345 colossal figures of wood, representing 345 chief priests, who succeeded each other from father to son; all men, all descended one from the other, but who had been preceded by gods.

Other Egyptians told him that they had exact registers not only of the reigns of men, but also of gods. They reckoned

* Herodotus thought he discovered relations of figure and colour between the Colchians and Egyptians; but it is infinitely more probable that those dark Colchians of which he speaks were an Indian colony, attracted by the commerce anciently established between India and Europe, by the Oxus, the Caspian Sea, and the Phasis. See Ritter, Introduction to the History of Europe before Herodotus, chap. 1.

17,000 years from Hercules to Amasis, and 15,000 from Bacchus: Pan had even preceded Hercules.

It is evident that these gentlemen considered as historical some allegory relative to pantheistic metaphysics, which, without their knowledge, formed the basis of their mythology. It is only from Sethos that Herodotus commences to be somewhat rational in his history; and, what is most important to remark, this history begins with a fact which agrees with the Hebrew annals, namely, the destruction of the army of Sennacherib, king of Assyria; and this agreement continues under Necho, and under Hophra, or Apries.

Two centuries after Herodotus, about 260 years before Christ, Ptolemy Philadelphus, a prince of foreign race, was desirous of becoming acquainted with the history of the country which events had called him to govern. A priest called Manethon undertook to write it for him. He did not pretend to derive it from registers or archives, but from the sacred books of Agathodæmon, son of the second Hermes, and father of Tât, who had copied it from pillars erected before the flood by Tôt, or the first Hermes, in the Seriadic land; and this second Hermes, this Tât, this Agathodæmon, are persons never mentioned before, no more than the Seriadic land, with its columns. The deluge itself was a fact entirely unknown to the Egyptians before this period, and one of which Manethon takes no notice in what remains to us of his dynasties.

The product resembles the source; not only is the whole full of absurdities, but of peculiar absurdities, quite irreconcilable with the nonsense uttered by the ancient priests to Solon and Herodotus.

The series of divine kings commences with Vulcan. He reigned 9000 years. The gods and demigods who succeeded him reigned 1985 years. Neither the names, nor the successions, nor the dates of Manethon resemble what was published both before and after his time; and he must have been as

obscure and confused in his own narrative as he was discordant with other authorities; for it is impossible to reconcile to each other the extracts given from his work by Josephus, Julius Africanus, and Eusebius. They do not agree even on the number of years of human kings. According to Julius Africanus, they amount to 5101; according to Eusebius, to 4723: Syncellus makes them 3555. The differences of names and figures might be thought the fault of copyists; but Josephus quotes a passage, at full length, the details of which are in manifest contradiction with the extracts of his successors. A chronicle* called the *ancient*, which some think anterior, some posterior to Manethon, presents us with other calculations: the entire duration of the reigns of its kings is 36,525 years, of which Sun reigned 30,000, the other gods 3984, the demigods 217, so that there remained for the men but 2339 years. Thus they reckon but 113 generations, instead of the 340 of Herodotus.

A learned man, of a different description from Manethon, the astronomer Eratosthenes, discovered and published, under Ptolemy Euergetes, about 240 years before Christ, a particular list of thirty-eight kings of Thebes, commencing with Menes, and continuing during 1080 years. We have an extract from this which Syncellus has copied from Apollodorus. Scarcely any of the names found there correspond with the other lists.

Diodorus went into Egypt under Ptolemy Auletes, about sixty years before Jesus Christ, consequently two centuries after Manethon, and four after Herodotus.

He also learned, from the mouth of the priests, the history of Egypt, and has compiled it in a manner altogether different from his predecessors.

According to him it was not Menes who built Memphis, but Uchoreus. A long time before him Busiris II. had built Thebes.

* Syncellus, p. 51.

The eighth ancestor of Uchoreus, Osymandyas, was master of Bactriana, and suppressed revolts there. A long time after him Sesostris made conquests much more remote. He proceeded even beyond the Ganges, and returned by the way of Scythia and the Tanais. These names of kings are unknown to all preceding historians, and none of the conquered nations preserve the slightest recollection of them. As for the gods and heroes, they, according to Diodorus, reigned 18,000 years, and the human sovereigns 5000; 466 kings were Egyptians, four Ethiopians, without counting the Persians and Macedonians. The tales of which the whole account is made up do not yield, in point of puerility, to those of Herodotus.

In the eighteenth year A. D., Germanicus, the nephew of Tiberius, attracted by the desire of becoming acquainted with the antiquities of this celebrated country, went into Egypt at the risk of displeasing a prince of such a suspicious temper as his uncle. He went up the Nile as far as Thebes. It was no longer of Sesostris or Osymandyas that the priests told their stories, but Rhamses. At the head of 700,000 men he had invaded Lybia, Ethiopia, Media, Persia, Bactriana, Scythia, Asia Minor, and Syria.

Finally, in the famous article of Pliny, on the obelisks, we again find the names of kings not mentioned before—Sothies, Mnevis, Zmarheus, Eraphius, Mestires; and Semenpserteus, contemporary with Pythagoras: a Ramises, who may be the same with Rhamses, is in this account placed at the era of the siege of Troy.

I know that an attempt has been made to reconcile these lists by supposing that the kings have borne many names; for myself, who not only consider the contradiction in the various recitals, but who am also more considerably impressed by this intermixture of real facts attested by remarkable monuments, with puerile extravagancies, it appears to me infinitely more

natural to conclude that the Egyptian priests had no history whatsoever; that, inferior even to the Indian priests, they had not even connected and consistent fables; that they only preserved lists, more or less faulty, of their kings, and some recollections of the principal among them, especially of those who took the trouble of inscribing their names on the temples and other great works which adorned their country; but that those recollections were confused, that they rested on little but the traditional explanations which were given to representations in painting or sculpture on the monuments—explanations founded only on hieroglyphic inscriptions, expressed, like one of which we have a translation, in such general terms, that passing from mouth to mouth must occasion many alterations with regard to detail, according to the capacity or inclination of those who communicate them to strangers. It is consequently impossible to settle any problem on the actual antiquity of our continents on the fragments of those traditions, so incomplete in their own time, and now become almost completely unintelligible, from the errors of those who have transcribed them, and transmitted them to us. If this assertion needed other proofs they might be found in the list of the sacred works of Hermes, which the Egyptian priests were in the habit of carrying in their solemn processions. Clemens Alexandrinus gives us their names to the number of forty-two; and there is not even among them, as with the Bramins, an epic poem, or any book which has the least pretensions to be a narrative, so as to fix in any way any action or event of consequence.

The valuable researches of M. Champollion the younger, and his astonishing discoveries in the language of the hieroglyphics*, confirm these conjectures instead of destroying them. This ingenious antiquarian has read, in a series of hieroglyphic

* See the Epitome of the Hieroglyphic System of the ancient Egyptians, by M. Champollion the younger, and his letter to the Duke de Blacas.

pictures in the temple of Abydos *, the prænomina of a certain number of kings, placed one after the other; and a part of these prænomina being found again on various other monuments, accompanied with the proper names, he concluded that they belonged to those kings who bore these proper names; and in this way he obtained nearly the same kings, and nearly in the same order as those of which Manethon composed his eighteenth dynasty that expelled the Shepherds. The concordance, however, is not complete. Six of the names on the list of Manethon are wanting in the bas-relief at Abydos. There are some not resembling his. Finally, there is unfortunately a gap before that of Rhamses, the most remarkable of all, who appears to be the king represented on such a number of fine monuments with all the attributes of a mighty conqueror. He, according to M. Champollion, must be the Sethos of Manethon's list, head of the nineteenth dynasty, who, in fact, is indicated as being powerful in fleets and cavalry, and as having carried his arms into Cyprus, Media, and Persia. M. Champollion thinks, with Marsham and many others, that this Rhamses, or Sethos, is the Sesostris, or Sesoosis, of the Greeks. This opinion seems probable, inasmuch as the representations of the victories of Rhamses, gained most likely over the neighbouring hordes that wandered on the Egyptian borders, or at the farthest in Syria, may have given rise to those fabulous stories of the immense conquests attributed, by some confusion, to a Sesostris. In Manethon, however, it is in the twelfth, not the eighteenth dynasty, that a prince, named Sesostris, is inscribed and marked as the conqueror of Asia and of Thrace. Accordingly Marsham mentions that this twelfth and eighteenth dynasty are one and the same. Manethon himself, then, did not comprehend the lists that he copied. In fine, if we admit, upon the whole,

* This remarkable bas-relief is engraven in the Voyage to Meroë of M. Caillaud, tom. ii. plate 32.

the historical truth of this bas-relief at Abydos, an its agreement with the part of the lists of Manethon which appears to correspond with it, or with the other hieroglyphic inscriptions, it will follow, that the pretended eighteenth dynasty, the first on which the ancient chronologists begin to agree a little, is also the first which has left on the monuments any traces of its existence. Manethon was enabled to consult this document, and other similar ones. But it is not less obvious, that a list, or series of names or portraits, is far from being a history.

What is proved and known concerning the Indians, and what appears so excessively probable concerningthe inhabitants of the valley of the Nile, may also be presumed respecting the inhabitants of the valleys of the Euphrates and Tigris. Established like the Indians*, and like the Egyptians, on a grand highway of commerce, in vast plains through which they had been obliged to cut numerous canals—instructed, like them, by an hereditary priesthood—pretended guardians of secret books—privileged possessors of sciences—astrologers—constructors of pyramids, and other great monuments, should they not also resemble them in other essential points? Must not their history be in like manner reduced to fabulous legends?—I may venture to say, that this is not only probable, but demonstrated by the fact.

Neither Moses nor Homer mentions any extensive empire in Upper Asia. Herodotus attributes but five hundred and twenty years' duration to the supremacy of the Assyrians, and refers their origin no farther back than eight centuries before his own time. After having been at Babylon, and having consulted the priests, he did not even learn the name of Ninus, as king of the Assyrians, and only speaks of him as father of Agron, the

* All the ancient mythology of the Bramins refers to the plains through which the Ganges flows, and it is evidently there where they formed their first establishments.

first king of Lydia, of the race of Hercules: nevertheless, he makes him the son of Belus; so great was the confusion which prevailed in the traditions and recollections of the period. If he speaks of Semiramis as one of the monarchs who left magnificent monuments at Babylon, he only places her seven generations before Cyrus.

Hellenicus, contemporary of Herodotus, is so far from attributing any of the monuments of Babylon to Semiramis, that he expressly declares that Chaldæus, fourteenth successor of Ninus, was the founder of that city.

Berosus, a Babylonian and a priest, who wrote scarcely one hundred and twenty years after Herodotus, imputes to Babylon a most astonishing antiquity: but yet it is to Nabuchodonosor, a prince comparatively of modern date, that he attributes its principal monuments.

With respect to Cyrus himself, so remarkable a prince, whose history should be so well known and so popular, Herodotus, who lived but one hundred years after him, confesses that three different accounts of this monarch existed; and, in fact, sixty years later, Xenophon gives a biography of this prince altogether opposite to that of Herodotus.

Ctesias, almost contemporary with Xenophon, pretends to have derived from the royal archives of the Medes a chronology which removes back more than eight hundred years the origin of the Assyrian monarchy, having, however, at the head of its kings this same Ninus, son of Belus, whom Herodotus has made one of the Heraclides. At the same time he attributes to Ninus and Semiramis conquests towards the west, utterly incompatible with the Jewish and Egyptian history of the same period.

According to Megasthenes, it is Nabuchodonosor who made these incredible conquests. He extended them as far as Lybia, and even into Spain. We find that from the time of Alexander, Nabuchodonosor had entirely usurped all the honours

which Semiramis had quietly enjoyed from the time of Artaxerxes: but, no doubt, Semiramis and Nabuchodonosor conquered Ethiopia and Lybia much in the same manner as Sesostris and Osymandyas among the Egyptians conquered India and Bactriana.

What would be the case if we should now examine the different reports concerning Sardanapalus, in which a celebrated writer believed that he had discovered proofs of the existence of three princes of this name, all victims of similar misfortunes *; just as another learned man finds among the Indians three Vicramadityias, all of them the heroes of similar adventures?

It was apparently in consequence of the dicordance of all these narratives that Strabo thought himself justified in asserting that the authority of Herodotus and Ctesias was not equal to that of Homer or Hesiod. Ctesias also has not been much more fortunate in copiers than Manethon; and it is exceedingly difficult to reconcile the extracts given from him by Diodorus, Eusebius, and Syncellus. When we meet with such uncertainties in the fifth century before Christ, how can we imagine that Berosus was able to clear them up in the third; and can we give any more credit to the four hundred and thirty thousand years which he reckons up before the deluge, and to the thirty-five thousand years which he places between the deluge and Semiramis, than to the registers of one hundred and fifty thousand years which he boasts of having consulted?

Works are mentioned, erected in distant provinces, which bear the name of Semiramis. It is also pretended that columns have been seen in Asia Minor and Thrace, erected by Sesostris †; but it is thus in Persia at the present day that the ancient

* See in the Memoirs of the Academy of Belles Lettres, vol. v. the Memoir of Fréret on the History of the Assyrians.

† N. B. It is very remarkable, that Herodotus says that he has only seen the monuments of Sesostris in Palestine, and speaks of those of Ionia only on the report of another, adding that Sesostris is not named in the inscriptions, and that those who have seen these monuments attribute them to Memnon.

monuments bear the name of *Rustan*, and that in Egypt or Arabia they bear the name of Solomon or Joseph. This is an ancient custom of the Orientals, and probably of all ignorant people. Our peasants give the name of Cæsar's camp to all the ancient Roman entrenchments.

In a word, the more I think upon the subject, the more I am persuaded that at Babylon, and Ecbatana, there was no more ancient history than in Egypt and India; and instead of reducing mythology to history, like Evhemère and Bannier, I am rather of opinion that a great portion of what is called history must be reduced to mythology.

It is only at the era of what is usually termed the second Assyrian kingdom, that the history of the Assyrians and Chaldeans begins to be at all clear; the same in which that of the Egyptians also begins to be clear; when the kings of Nineveh, of Babylon, and of Egypt began to meet and combat on the theatre of Syria and Palestine.

It would appear, however, that the writers of these countries, or those who had consulted their traditions, Berosus, Hieronymus, and Nicholas of Damascus, have all agreed in speaking of a deluge. Berosus even describes it with circumstances so much resembling those mentioned in the book of Genesis, that it seems almost impossible but that he should have drawn them from the same sources, although he removes the epoch of that event so many ages. This we may be allowed to gather even from the confused and contradictory quotations from his works preserved by Josephus, Eusebius, and Syncellus; but we ought to remark, and with this observation we shall close our discussion concerning the Babylonians, that these numerous ages, and grand series of kings, placed between the deluge and Semiramis, are quite novel, and entirely peculiar to Berosus; for Ctesias and his followers entertained no such idea, nor was it adopted by any profane writer posterior to Berosus. Justin and Velleius Paterculus considered Ninus as the first of conquerors;

and those writers who, contrary to all probability, place him the highest, do, nevertheless, remove him no farther back than forty centuries from the present era.

The Armenian writers of the middle ages agree very nearly with one of the texts of Genesis, when they refer the deluge to a period of four thousand nine hundred and sixteen years. And we might imagine that having collected old traditions, and probably made extracts from the ancient chronicles of their country, they form an additional authority in favour of the recentness of nations; but when we reflect that their historical literature dates no farther back than the fifth century, and that they were acquainted with Eusebius, we may easily believe that they would accommodate themselves to his chronology, and to that of the Bible. Moses of Chorene professes expressly to have followed the Greeks, and he obviously pursues the track of Ctesias in his ancient history.

Nevertheless, it is certain that a tradition of the deluge existed in Armenia long before the conversion of the inhabitants to Christianity; and the city which, according to Josephus, was called the Place of the Descent, still exists at the foot of Mount Ararat, and bears the name of Nachidchevan, which means the same thing.

We may aver of the Arabs, the Persians, the Turks, the Mongoles, the Abyssinians of the present day, the same as of the Armenians. Their ancient books, if they ever had any, exist no longer. They have no ancient history but such as they have recently fabricated and modelled on the Bible; thus, what they say of the deluge is borrowed from Genesis, and adds nothing to the authority of that book. It would be curious to inquire into the opinions of the ancient Persians on this subject, before they had been modified by the Christian and Mahometan faiths. They are preserved in their *Boundehesh* or cosmogony, a work of the period of the Sassanides, but evidently extracted or translated from more ancient works, and which was dis-

covered by Anquetil du Perron among the Parsees of India. According to it, the total duration of the world will be twelve thousand years; thus, it cannot yet be very old. The appearance of the first man *Cayoumortz* (man-bull, first man) is preceded by a great deluge *. For the rest, it would be useless to expect from the Parsees a serious history of ancient times any more than from the other Orientals. The Magi have left as little of this as the Bramins or Chaldeans. I would desire no other proof of this than the uncertainty which exists concerning the epoch of Zoroaster. It is even asserted, that the little history which they might have had respecting the Achemenides, the successors of Cyrus down to Alexander, was expressly altered by an official order from one of the Sassanides †.

In order to discover authentic dates of the commencement of empires, and traces of a grand cataclysm, it will be necessary to proceed beyond the great deserts of Tartary. Towards the east and the north dwell a race of men, differing from us not less in their institutions and manners, than in their figure and temperament: they speak in monosyllables; they write in arbitrary hieroglyphics; they have a system of moral policy without religion; for the superstitions of Fo have come to them from India. Their yellow skin, prominent cheeks, narrow and oblique eyes, and ill-furnished beard, render them so different from us, that one is tempted to believe that their ancestors and ours escaped from the grand catastrophe by two different sides: however that may be, they date their deluge very nearly from the same epoch as ourselves.

The *Chou-King* is the most ancient of the Chinese books ‡. It is said to have been compiled by Confucius from fragments of more ancient works, about two thousand two hundred and

* Zendavesta d'Anqüetil, tom. ii. p. 354.

† Mazoudi, ap. Sacy. In MSS. from the Royal Library, t. vii. p. 161.

‡ See M. de Guigne's Preface to his edition of the Chou-King.

fifty-five years ago. Two hundred years after, there was a persecution, it is said, of the learned men, and a destruction of their books under the emperor Chi-Hoangti, who was desirous of destroying the traces of the feudal government established under the dynasty anterior to his own. Forty years later, under the dynasty which overthrew his, a part of the Chou-King was restored, from memory, by an old man of letters, and another part was found in a tomb, but nearly one half was lost for ever. Now, this book, the most authentic of China, begins the history of this country with an emperor named Yao, whom it represents as employed in drawing off the waters, *which having been elevated even to the skies, still bathed the feet of the highest mountains, covered the less elevated hills, and rendered the plains impracticable.* This Yao dates, according to some, four thousand one hundred and sixty-three, and according to others, three thousand nine hundred and forty-three years before the present time. The variation of opinion concerning this epoch proceeds even to two hundred and eighty-four years. Some pages after, we find one Yu, a minister and engineer, re-establishing the course of the waters, raising dikes, digging canals, and regulating the imposts of each province in all China, *i. e.* in an empire of five hundred leagues in extent in all directions. But the improbability of such operations after such events clearly proves that this account is only a moral and political romance.

More modern historians have added a series of emperors before Yao, but with a crowd of fabulous circumstances, without venturing to assign to them any fixed epochs, varying also perpetually from each other even respecting their number and names; nor is the authority of these historians by any means respected by all their countrymen. Fohi, with the body of a serpent, head of an ox, and teeth of a tortoise, and his successors not less monstrous, are as absurd and destitute of reality as Enceladus and Briareus.

It is not possible that it could be mere chance which gives

us so striking a result, and which thus removes within a little the traditional origins of the Assyrian, Indian, and Chinese monarchies to about forty centuries back. The notions of people who have so few relations in common, whose language, religion, and laws are different, could not agree in this point if truth was not their basis.

We cannot expect precise dates from the Americans, who had no proper writing, and whose most ancient traditions do not extend farther back than some centuries previous to the arrival of the Spaniards: nevertheless, it is believed that some traces of a deluge may be found in their rude hieroglyphics. They have their Noah or Deucalion as well as the Indians, the Babylonians, and the Greeks *.

The negroes, the most degraded of the human race, who approach in form the nearest to the brutes, and whose intelligence never extended so far as the formation of any regular government, nor the least appearance of connected knowledge, have nowhere preserved any annals or tradition. They can give us no information on the point in question; although all their characters clearly prove, that they must have escaped from the great catastrophe on a different side from the Caucasian and Altaïc races, from which they had probably been a long time separated when this catastrophe occurred.

But it may be said, if the ancient people have left us no history, their long existence as nations is not the less attested by their progress in astronomy; by observations, the date of which is easily to be assigned; and even by monuments still subsisting, and which bear their own dates.

Thus, the length of the year, such as the Egyptians are supposed to have determined it, according to the heliacal rising of Sirius, is found correct, for a period comprised between the year three thousand and the year one thousand before Christ,—a

* See the excellent and magnificent work of M. de Humboldlt on the Mexican Monuments.

period within which also occur the traditions of their conquests, and of the great prosperity of their empire. This correctness proves to what a degree they had carried the exactness of their observations, and makes it obvious that they had devoted themselves for a long time to similar labours.

To enable the reader to appreciate this reasoning, it is necessary that we should enter into some explanation in this place.

The solstice is that time of the year in which the increase of the Nile commences, and that, of course, which the Egyptians must have observed with the greatest degree of attention. A civil or sacred year of three hundred and sixty-five days exactly being first established on imperfect observation, they were desirous of preserving it, from superstitious motives, even after they perceived that it could not accord with the natural or tropical year, and did not bring back the seasons to the same days *; nevertheless, it was this tropical year that it was of the greatest importance for them to mark, to direct them in their agricultural operations. They were, then, obliged to seek in the heavens for some apparent sign of its return; and they imagined that they discovered this sign when the sun should return to the same position in relation to some remarkable star. Thus they applied themselves, like all nations who commence such an investigation, to observe the heliacal rising and setting of the stars. We know that they particularly chose the heliacal rising of Sirius; at first, without doubt, from the beauty of the star, and especially because in ancient times this rising of Sirius very nearly coincided with the solstice, and announced the inundation of the Nile, and was therefore to them a phenomenon of the first importance. From this circumstance it occurred, that Sirius, under the name of Sothis, plays a most important part in all their mythology and religious rites. Supposing, then, that the return of the heliacal rising of Sirius and that

* Geminus, a contemporary of Cicero, explains their motives at full length. See the edition given by M. Halma, at the end of his Ptolomy, p. 43.

of the tropical year were of the same duration, and believing, in fine, that this duration was of three hundred and sixty-five days and a quarter, they imagined a period after which the tropical and the ancient and sacred year of three hundred and sixty-five days only must return to the same day : a period which, according to these somewhat erroneous data, was necessarily a thousand four hundred and sixty-one sacred years, and one thousand four hundred and sixty of those more perfect years to which they gave the name of the years of Sirius.

They took, then, as a starting point of this period, which they called the *Sothiac* or great year, a civil year, the first day of which was that in which also occurred the heliacal rising of Sirius ; and we know, by the positive testimony of Censorinus, that one of these great years ended in the hundred and thirty-eighth year of Christ ; consequently it commenced one thousand three hundred and twenty-two years before Christ, and that which had preceded it, two thousand seven hundred and eighty-two. In fact, by the calculations of M. Ideler, we perceive that Sirius rose heliacally the 20th of July of the Julian year one hundred and thirty-nine, a day which corresponds on that year to the first of Thôt, or the first day of the Egyptian sacred year*.

But not only the position of the sun, in relation to the stars of the ecliptic, or the sidereal year, is not the same as the tropical year, in consequence of the precession of the equinoxes ; but the heliacal year of a star, or the period of its heliacal rising, differs again from the sidereal year, and differs variously, according to the latitude of the places from whence observations are taken. What is singular enough, however, and what Bainbridge and what Father Petau have already observed, it happens, by a singular concurrence in the positions, that in the latitude of Upper Egypt, at a certain epoch, and during a certain number of years, the year of Sirius was really within a

* Ideler, Historical Researches regarding the Astronomical Observations of the Ancients.

very little of three hundred and sixty-five days and a quarter; so that the heliacal rising of this star recurred, in fact, on the same day of the Julian year, *i. e.* on the 20th of July, in 1322 before, and in 138 after Christ*.

From this actual coincidence, at this remote period, M. Tousier, who has confirmed all these accounts by great labour and new calculations, concludes, that since the length of the year of Sirius was so perfectly known to the Egyptians, they must have determined it by observations made during a long period, and with great exactness—observations which must be referred at least to 2500 years before our era, and which could not have been made either long before or long after this interval of time†.

This result would certainly be very striking, if it had been directly and from observations made on Sirius himself that they had fixed the duration of his year. But experienced astronomers affirm that it is impossible that the heliacal rising of a star could have served for the basis of exact observations on such a subject, especially in a climate where *the circumference of the horizon is so constantly loaded with vapours, that in fine nights the stars of the second or third magnitude are never seen within some degrees of the verge of the horizon, and that the sun itself is completely obscured at its rising and setting.* They maintain that if the length of the year could not be otherwise ascertained, an error of two or three days must have taken place. They do not doubt, then, that this duration of three hundred and sixty-five days and a quarter is that of the tropical year, badly determined by the observation of the shadow or of the point where the sun rose each day, and identified, through ignorance, with the

* M. Ideler asserts that this concurrence of the heliacal rising of Sirius also took place in 2782 before Christ; but for the Julian year 1598 of Jesus Christ, which is also the last of a grand year, Petau and Ideler differ much. The latter places the heliacal rising of Sirius on the 22d of July, the former on the 19th or 20th of August.

† Consult Grand Work on Egypt, &c.

heliacal year of Sirius ; so that it must have been mere chance which had fixed with so much exactness the duration of the latter for the epoch in question.

Perhaps we might also say that men capable of such exact observations, and who could have continued them for so long a period, would not have attached so much importance to Sirius as to constitute him an object of worship. They would have seen that the relations of his rising with the tropical year and the increase of the Nile were only temporary, and only took place in a certain determinate latitude. In fact, according to the calculations of M. Ideler, Sirius, in 2782 before Christ, was seen in Upper Egypt the second day after the solstice ; in 1322, the thirteenth ; and in 139 after Christ, the twenty-sixth. At present it rises heliacally more than a month after the solstice. The Egyptians, then, would have preferred finding the epoch which would bring back the coincidence of their sacred year with that of the true tropical year, and then they would have known that their grand period must be 1508 sacred years, and not 1461. Now, we certainly find no traces of this period of 1508 years in antiquity.

In general, it is not possible to believe, that if the Egyptians made so long a series of observations, and of exact observations, their disciple Eudoxus, who studied thirteen years among them, would not have brought a more perfect system of astronomy, and maps of the heavens less rude and more coherent in their various parts.

How comes it that the precession was not known to the Greeks but through the works of Hipparchus, if it had been enumerated in the works of the Egyptians, and written in such manifest characters upon the ceilings of their temples? In fine, how is it that Ptolomy, who wrote in Egypt, never condescended to make use of any of the observations of the Egyptians?

Moreover, Herodotus, who had lived so long among them, says nothing of these six hours which they added to the sacred

year, nor of the grand Sothiac period which resulted. He, on the contrary, positively affirms, that the Egyptians making their year three hundred and sixty-five days, the seasons returned to the same point; so that in his time they had no idea of the necessity of the addition of a quarter of a day. Thales, who had visited the priests of Egypt in less than a century after Herodotus, makes known to his countrymen no other year than that of 365 days; and if we reflect that the colonies which emigrated from Egypt fourteen or fifteen centuries before Christ, the Jews and the Athenians, brought with them the lunar year, we may, perhaps, be inclined to believe that even the year of 365 days was not known in Egypt in those remote ages.

I am aware that Macrobius attributes to the Egyptians a solar year of 365¼ days; but this comparatively modern writer, who lived long after the establishment of the year of Alexandria, might easily have confounded the epochas. Diodorus and Strabo attribute such a year only to the Thebans; they do not say that it was in general use, and they themselves flourished a long time after Herodotus.

Thus the grand, or Sothiac year, must have been a tolerably recent invention, since it results from a comparison of the civil year with this pretended heliacal year of Sirius; and accordingly it is never mentioned except in works of the second and third centuries after Christ, and Syncellus alone, in the ninth, seems to quote Manethon as having spoken of it *.

The same sentiments, in spite of all that may be said to the contrary, must hold good respecting the astronomical science of the Chaldeans. It is natural to believe that a people inhabiting vast plains, always under a serene sky, would be led to observe the course of the stars, even from the epoch in which they were wandering shepherds, and when the stars alone could direct their courses during the night: but how long had they

* See, on the probable recentness of this period, the excellent dissertation of M. Biot, in his researches on many points of the Egyptian astronomy, page 148, &c.

been astronomers, and how far had they carried the science? These are the questions. It is pretended that Callisthenes sent to Aristotle observations made by them, which might refer to a period of 2200 years before Christ. But this fact is only related by Simplicius after Porphyry, and six hundred years after Aristotle. Aristotle himself says nothing of it. No creditable astronomer has mentioned it. Ptolomy relates, and makes use of the observations of eclipses made by the Chaldeans; but they go no farther back than Nabonassar, 721 years before Christ. They are erroneous; the time is only expressed in hours and half-hours, and the shadow only in halves or fourths of the diameter; nevertheless, as they had fixed dates, the Chaldeans must have had some knowledge of the true duration of the year, and some means of measuring time. They seem to have known the period of eighteen years, which brings back the eclipses of the moon in the same order, and which the simple inspection of their registers would promptly furnish them with; but it is clear that they could neither explain nor predict eclipses of the sun.

In consequence of not understanding a passage in Josephus, Cassini, and after him Bailly, have pretended to find a luni-solar period of 600 years, which had been known to the first patriarchs *.

Thus every thing leads us to believe, that this great reputation of the Chaldeans was given them at a more recent period by their unworthy successors, who, under the same name, sold throughout the Roman empire horoscopes and predictions, and who, to procure themselves greater credit, attributed to their rude ancestors the honour of the discoveries of the Greeks.

As for the Indians, it is well known that Bailly, believing that the epoch which serves as a point of departure for some of their astronomical tables, had been actually observed, was

* See Bailly, Hist. of Anc. Ast. by Delambre.

desirous of deriving from this an argument of the highest antiquity of the science among this people, or at least in the nation from whom their knowledge was obtained. But all this system, so painfully elaborated, falls of itself to the ground, now that it is proved that this epoch has been adopted but of late, on calculations made backwards, and the result of which was false *.

Mr. Bentley has discovered that the tables of Tirvalour, on which M. Bailly's assertion principally rests, have been calculated about 1281 after Christ (about 540 years back), and that the *Surya-Siddhanta*, which the Bramins regard as their most ancient scientific treatise on astronomy, and which they pretend was revealed more than twenty millions of years ago, cannot have been composed more than 760 years †.

The solstices and equinoxes indicated in the Puranas, and calculated according to the positions which the signs of the Indian zodiac appeared to attribute to them, such as they are thought to be understood, were considered as of most enormous antiquity. A more attentive study of those signs, or *Nacshatras*, has recently satisfied M. de Paravey, that reference is only made to solstices of 1200 years before Christ. This writer, at the same time, allows that these solstices are so inaccurately fixed, that no reliance can be placed on their determination for two or three centuries back. They are just like those of Eudoxus, and those of the Tcheoukong ‡.

It is correctly asserted that the Indians make no observations, nor possess any instruments to make observations with. M. Delambre certainly grants, with Bailly and Legentil, that they have processes of calculation which, without proving the

* See La Place, Syst. du Monde. The Memoirs of Mr. Davis, Calcutta. Mem. on the Astronomical Calcul. of the Hindoos.

† See the Memoir of Mr. Bentley on the Antiquity of Lurya-Liddhanta. Mem. of Calcut. on the Astronomical Systems of the Indians.

‡ MSS. Memoirs of M. Paravey, on the Sphere of Upper Asia.

antiquity of their astronomy, show at least its originality*. This conclusion, however, cannot be extended to their sphere; for, independently of their twenty-seven Nacshatras or lunar houses, which much resemble those of the Arabs, they have the same twelve constellations in the zodiac as the Egyptians, Chaldeans, and Greeks †; and if we trust to the assertions of Mr. Wilfort, their extra-zodiacal constellations are also the same as those of the Greeks, and bear names which are but slight alterations from the Greek ones ‡.

The introduction of astronomy into China is attributed to the Emperor Yao. He sent, says the Chou-king, astronomers towards the four cardinal points of his empire, to examine what stars presided over the four seasons, and to regulate what was to be done in each period of the year, as if their dispersion had been necessary for such an operation. About 200 years later, the Chou-king speaks of an eclipse of the sun, but accompanied with ridiculous circumstances, as in all fables of the kind. It makes a general, and the whole Chinese army, march against two astronomers, because they had not predicted it

* See the profound Essay on the Astronomy of the Indians, by M. Delambre, in his Hist. of Ancient Astronomy.

† See the Memoir of Sir William Jones, on the Antiquity of the Indian Zodiac. Calcutta Memoirs.

‡ The words of Mr. Wilfort are these, in his Memoir on the Testimonies of Ancient Hindoo books regarding Egypt and the Nile, (Calcutta Mem.) "Having desired my pundit, who is a learned astronomer, to point out in the heavens the constellation of *Antarmada*, he directed me immediately to Andromeda, which I had taken care not to show him as a constellation which I knew. He afterwards brought me a very rare and curious book in Sanscrit, in which there was a particular chapter, on the *Upanacshatras*, or extra-zodiacal constellations, with sketches of *Capeya*; of *Caysyape* seated, and holding a lotus flower in her hand; of *Antarmada* chained with the fish beside her; and of *Parasica* holding the head of a monster, which he had killed, and which had scales instead of hair.

Who does not recognise, in this description, Perseus, Cepheus, and Cassiopea? But let us not forget that this pundit of Mr. Wilfort is become rather a suspected authority.

correctly; and yet it is well known that, more than 2000 years after, the Chinese astronomers possessed no means of calculating eclipses of the sun with precision. In 1629 of our æra, at the time of their dispute with the Jesuits, they did not even know how to calculate the shadows.

The real eclipses recorded by Confucius, in his chronicle of the kingdom of Lou, commence only 1400 years after this, 770 years before Christ, and scarcely half a century sooner than those of the Chaldeans, related by Ptolomy. So true it is that the nations which escaped about the same time from the general destruction arrived, when circumstances were similar, to the same degree of civilization. Now it might be thought, from the identity of names in the Chinese astronomers under different reigns (they appear, according to the Chou-king, to have all been called *Hi* and *Ho*), that at this remote epoch their profession was hereditary in China, as it was in India, Egypt, and Babylon. The only Chinese observation more ancient which does not carry with it the proof of its own falsity is that of the gnomon made by Tcheou-Kong, about 1100 years before Christ; and even it is very inaccurate *.

Thus our readers may easily judge that the inferences drawn from the high perfection of the astronomy of the ancient nations are not more conclusive in favour of the excessive antiquity of these people, than the testimonies given by themselves.

But suppose this astronomy had been more perfect, what would it prove? Has the progress been calculated which one science ought to make in a nation which cultivated no other? in which the serenity of the sky, the necessities of the pastoral

* See in the Connaissance des Temps of 1809, and in the History of Ancient Astronomy, by M. Delambre, the extract of a Memoir of P. Gaubil, on the Observations of the Chinese.

and agricultural life, and the influence of superstition made the stars the object of general contemplation ; where colleges of the most respected men were employed to keep a register of interesting phenomena, and to transmit the memory of them to posterity ; where an hereditary profession occasioned the infants from the cradle to be brought up in the knowledge acquired by their fathers. Let astronomy be the sole employment of a number of individuals, and let one or two geometrical geniuses spring up among them, and all that these people are acquainted with may be discovered in a few centuries.

Since the time of the Chaldeans, genuine astronomy has had only two eras, that of the school of Alexandria, which lasted 400 years, and our own, which has not yet lasted so long. The age of the Arabs has not added much to it; and the other ages of the world have been nothing in regard to it. Three hundred years have not elapsed between Copernicus and the author of the *Mécanique Celeste*, and yet the Indians must have had thousands of years to arrive at their defective theories *.

Arguments of another description have been resorted to. It is said, that, independently of their knowledge, these people have left monuments which bear, by the state of the heavens which they represent, a certain date, and are extremely remote ; and the zodiacs, sculptured in two temples of Upper Egypt, appeared, some years ago, not only to countenance this opinion, but to furnish demonstrative proofs of its truth. They exhibit the same figures of zodiacal constellations which we employ, but distributed after a particular fashion. It was imagined that this distribution was a representation of the actual state of the heavens at the time when these monuments were

* The English translator of this discourse has adduced the example of the celebrated James Fergusson, who in his infancy was a shepherd, and who, while keeping his flocks during the night, conceived the idea of making a map of the heavens, and executed it, probably, better than any Chaldean astronomer. Something very similar is related of Jamerey Duval.

planned, and it was thought possible to conclude from this the date of the construction of the edifices which contained them*.

* Thus at Dendera (the ancient Tentyris), a city below Thebes, in the portico of the great temple which faces the north, there are seen on the ceiling the signs of the zodiac, marching on two bands, one of which extends along the eastern, the other on the opposite side. Each of them is embraced by the figure of a woman of the same length, the feet of which are towards the entrance, the head and arms towards the end of the portico; consequently the feet are to the north, and the head to the south.

The Lion is at the head of the band, which is on the western side. He looks towards the north, or towards the feet of the figure of the woman, and has his feet towards the eastern wall. The Virgo, the Scales, the Scorpion, the Sagittary, the Capricorn follow him, marching on the same line. This last is towards the bottom of the portico, and near the hands and head of the large female figure. The signs of the eastern band commence at the extremity, where those of the other band finish, and are consequently directed towards the bottom of the portico, or towards the arms of the large figure. Their feet are towards the lateral wall on their side, and their heads exactly contrary to those of the opposite band. Aquarius marches at the head, followed by the Fishes, the Ram, the Bull, and the Twins. The last of the series, which is the Crab, or rather the Scarabæus, for it is by this insect that the Cancer of the Greeks is represented in the Egyptian zodiacs, is thrown aside on the legs of the great figure. In the place which it should have occupied is a globe placed on the top of a pyramid, composed of small triangles, which represented a sort of rays, and before the base of which is a large female head with two small horns. A second Scarabæus is placed aside and crosswise on the first band, in the angle formed by the feet of the great figure with the body, and in front of the space, where the Lion marches, which is a little behind. At the other end of the same band, the Capricorn is close upon the bottom of the portico, or the arms of the great figure; and on the band to the left the Aquarius is equally distant; the Capricorn, however, is not repeated like the Cancer. The division of this zodiac, at the entrance, takes place, therefore, between the Lion and the Cancer; or if the repetition of the Scarabæus be considered as marking a division of the sign, it takes place at the Cancer itself; but that of the bottom is made between the Capricorn and Aquarius. In one of the inner halls of the same temple, there is a circular planisphere inscribed upon a square, where the signs of the zodiac occur again among many other figures which seem to represent the constellations. The Lion corresponds with one of the diagonals of the square; the Virgin, which follows next, corresponds with a perpendicular line directed towards the last: the other signs march in the order described, until we arrive at the Cancer, which, instead of completing the chain by corresponding with the level of the Lion, is placed beneath him nearer the centre of the circle, in such a manner that the signs are upon a line,

But to arrive at the high antiquity which is pretended to be deduced from this, it would be necessary first to suppose that their division has a determinate relation with a certain

having somewhat of a spiral form. The Cancer or Scarabæus marches in a direction contrary to that of the other signs. The Twins correspond with the north, the Sagittary with the south, and the Fishes with the east; but not with absolute exactness. On the eastern side of this planisphere is a great figure of a woman, having the head directed towards the south, and the feet towards the north, like that in the portico. Some doubt might hence also arise, in the case of this second zodiac, regarding the point which ought to be considered as the commencement of the series of signs. It depends on whether one of the perpendiculars, or one of the diagonals, be taken, or the place where one part of the series passes over the other part, that the division may be considered as made by the Lion, or rather between the Lion and the Cancer, or, lastly, by the Twins.

At Esne, the ancient *Latopolis*, a city above Thebes, there are zodiacs on the ceiling of two different temples. That of the great temple, whose entrance faces the east, is upon two bands, which are contiguous and parallel to each other, along the south side of the ceiling. The female figures, by which they are embraced, are not in the direction of their length, but of their breadth, in such a manner that the one is placed across near the entrance, or at the eastern end, with the head and arms towards the north, and the feet towards the side wall, or towards the south; while the other is at the bottom of the portico, placed across like the former, and looking towards it. The band which is nearest to the axis of the portico, or to the north, presents first, on the side next the entrance, or the east, and towards the head of the female figure, the Lion, placed a little behind, and marching towards the bottom, with his feet towards the side wall; behind the Lion, at the commencement of the band, are two smaller Lions; before him is the Scarabæus, and then the Twins, marching in the same direction; next to the last are the Bull, the Ram, and the Fishes, close upon each other, placed crosswise on the middle of the band; the Bull with his head towards the side wall, while that of the Ram is towards the axis. The Aquarius is further off, and observes the same direction as the three first signs. In the band, which is nearest to the side wall and the south, the first that occurs, but at a considerable distance from the wall, at the bottom or west, is the Capricorn, which marches in a direction contrary to that of the Aquarius, and looks towards the east, having the feet turned towards the side wall. Before it is the Sagittary, which thus corresponds with the Fishes and the Ram; it also marches towards the entrance, but its feet are turned towards the axis, and in a contrary direction to those of the Capricorn. At a certain distance before the last, and placed near each other, are the Scorpion, and a woman holding the scales. Lastly, a little farther on, but still at a considerable distance from the anterior or eastern extremity of the portico, is the Virgin, with a Sphinx placed

state of the heavens, depending on the precession of the equinoxes, which causes the colures to make the tour of the equinox in 26,000 years; that it indicates, for example, the position of the solstitial point, and that we learn by it that the state of the heavens there represented was precisely that in which they were at the time in which the monument was constructed, two suppositions which, as is obvious, tend to involve a great number of others.

In fact, are the figures of these zodiacs constellations, genuine groups of stars, which bear the same names at the pre-

before it. The Virgin and the woman holding the scales have also their feet towards the wall; so that the Sagittary is the only one which has its head in a direction contrary to the other signs.

To the north of Esne is a small isolated temple, similarly directed towards the east, in the portico of which there is also a zodiac upon two lateral and separated bands. That which is along the south side commences with the Lion, who marches towards the bottom of the portico or west, with his feet turned towards the wall or south; he is preceded by the Scarabæus; and this last by the Gemini, marching in the same direction. The Bull, on the contrary, faces the east; but the Ram and the Fishes resume the direction towards the end of the portico, or towards the west. In the band of the northern side, the Aquarius is near the bottom or west, and marches towards the entrance or east, with his feet turned towards the wall. He is preceded by the Capricorn and Sagittary marching on the same direction. The other signs are lost; but it is evident that the Virgin has been placed at the head of this band.

Of the additional figures of this small zodiac, the most remarkable are two winged Rams placed crosswise; one between the Bull and the Twins, the other between the Scorpion and the Sagittary, each about the middle of its band; the second, however, somewhat nearer the entrance.

It was at first thought that in the great zodiac of Esne, the division of the entrance takes place between the Virgin and the Lion, and that of the bottom between the Fishes and Aquarius; but Mr. Hamilton and Messrs. de Jollois and Villiers have imagined that they saw in the Sphinx, which precedes the Virgin, a repetition of the Lion, analogous to that of the Cancer, in the great zodiac of Dendera; so that, according to them, the division is made by the Lion. In fact, without this explanation, there would be only five signs on one side, and seven on the other. It is not known whether some figure, analogous to this Sphinx, had existed in the small zodiac to the north of Esne, this part being defaced *.

* See Great Work on Egypt. Antiq. vol. i. Plate lxxxvii. and British Review, Feb. 1817, p. 135.

sent day? or are they simply what astronomers call signs, that is, divisions of the zodiac proceeding from one of the columns, whatever place this column may occupy?

Is the point at which these zodiacs have been separated into two bands necessarily that of a solstice?

Is the division of the side of the entrance necessarily that of the summer solstice?

Does this division even indicate in general a phenomenon dependent on the precession of the equinoxes?

May it not relate to some epoch, the rotation of which was less; for instance, to that moment of the tropical year, in which any given year of the sacred years of the Egyptians commenced, which being shorter than the tropical year by nearly six hours, would make the tour of the zodiac in one thousand five hundred and eight years? Lastly, whatever meaning it may receive, was it intended to mark the time in which the zodiac was sculptured, or that in which the temple was constructed? Has not the idea been to recall some anterior state of the heavens, at some epoch interesting for religion, whether this was ascertained by actual observation, or by a retrograde calculation?

From the mere expression of such questions, we may perceive that they are very complicated, and how much any solution which may be adopted must be liable to controversy, and how little calculated to serve as a solid proof for the solution of such another problem, as the antiquity of the Egyptian nation. Accordingly we may observe that, among those who have endeavoured to draw any dates from these premises, there is as great a number of opinions as of authors.

That learned astronomer, M. Burkard, after the first glance, decided that at Dendera the solstice was in the Lion, consequently it was two signs less backward than at present, and that, therefore, the temple must be 4000 years old *.

* Description of the Pyramids of Gija, by M. Grobert, p. 117.

Griffith. sc.

Skeleton of the Ibis.

from a Mummy found at Thebes in Egypt.

one third the natural size.

Griffiths sc.

Numenius Ibis.

The true Ibis of the Egyptians?

one third the natural size.

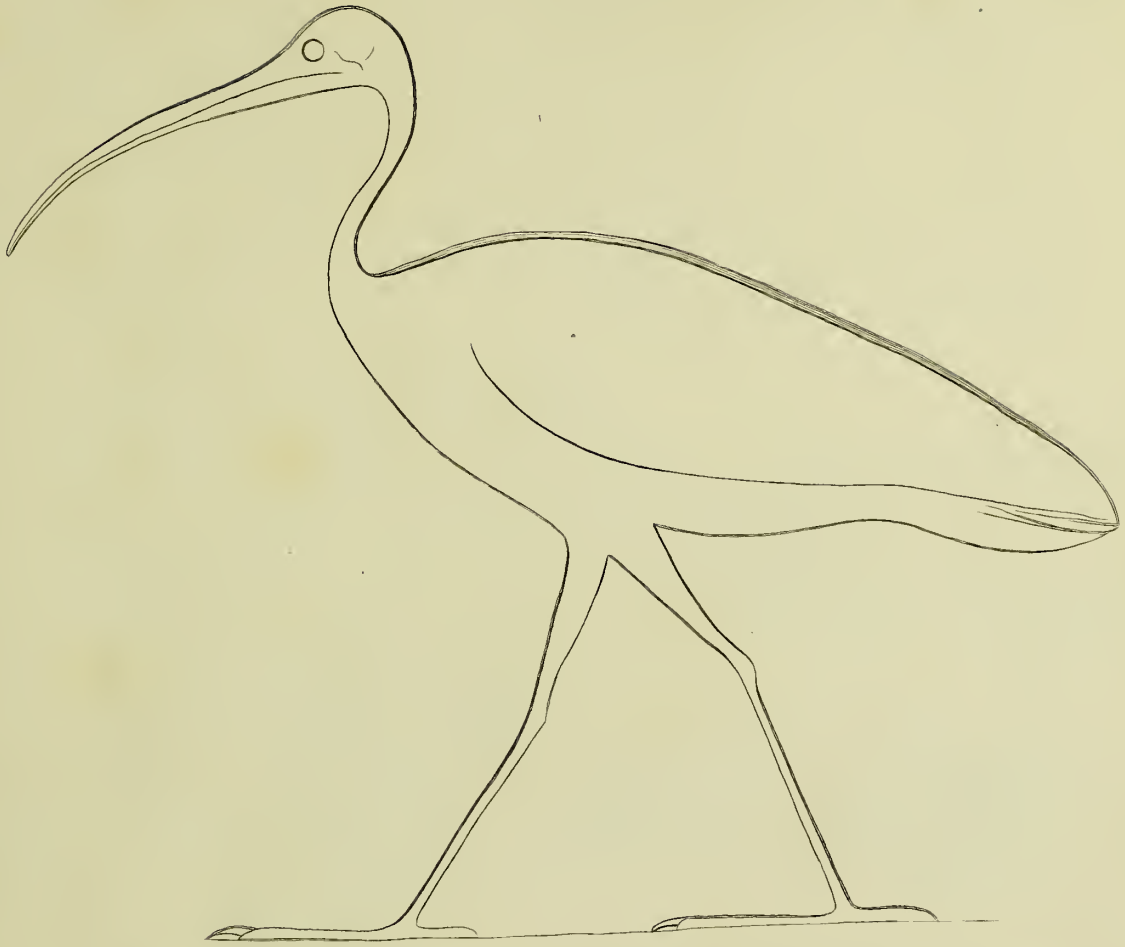
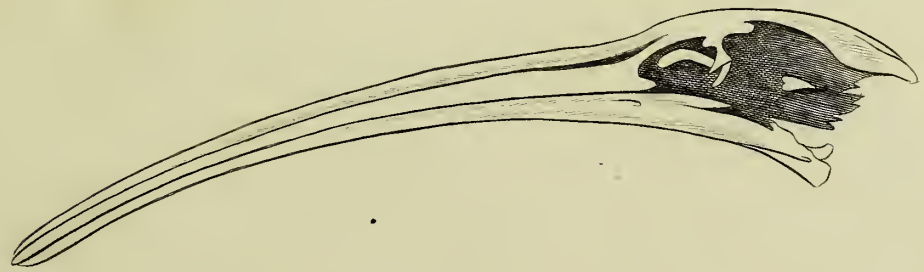


Figure of the Ibis copied from one of the Temples in Upper Egypt.



Beak drawn from the mummy of an Ibis by Mr. Olivier — half the size.

Fig. 2. 3/16

F

I

A

Fig. 1.
El. Ind.
7/16.

F

f

Fig. 3.
7/12

I

c

A

Fig. 4.
A 7/12

c

d

Fig. 4.
I 7/12

a

b

c

Fig. 4.
F 7/12

Fig. 1.

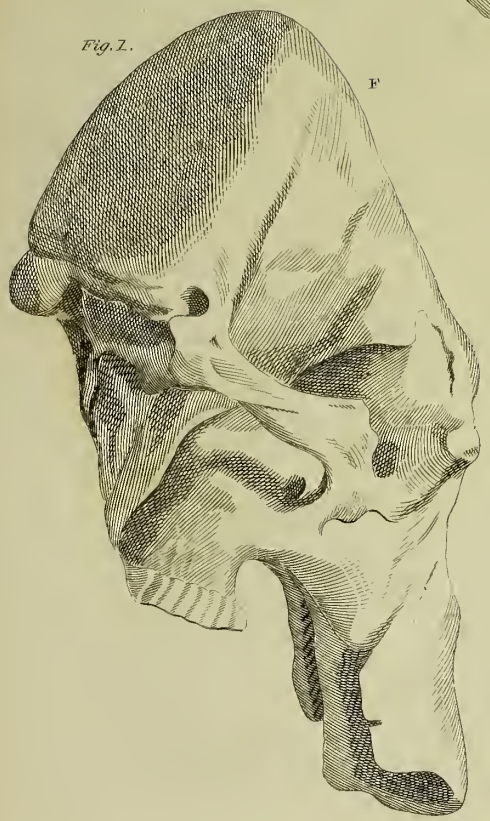


Fig. 8.

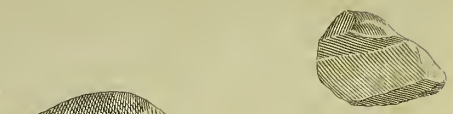


Fig. 2. 1/7

Fig. 9.

Fig. 10.

Fig. 3. 1/7

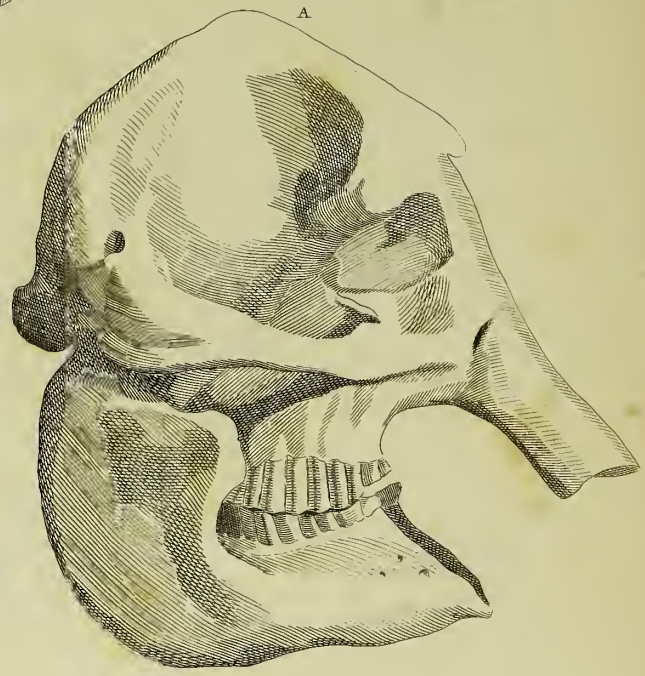


Fig. 4.

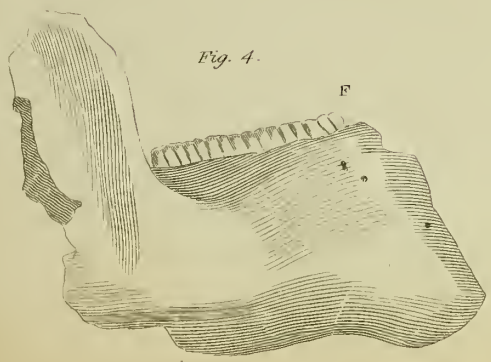


Fig. 5. F.

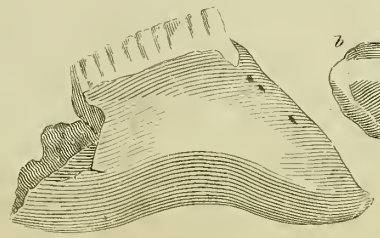


Fig. 6. 2/16 I

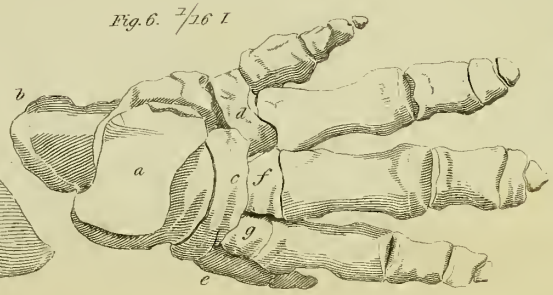
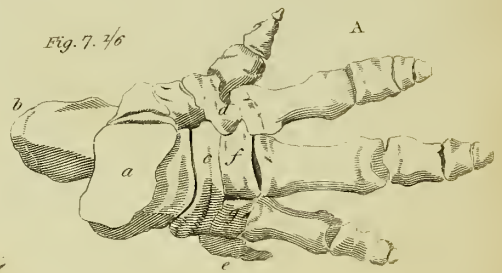
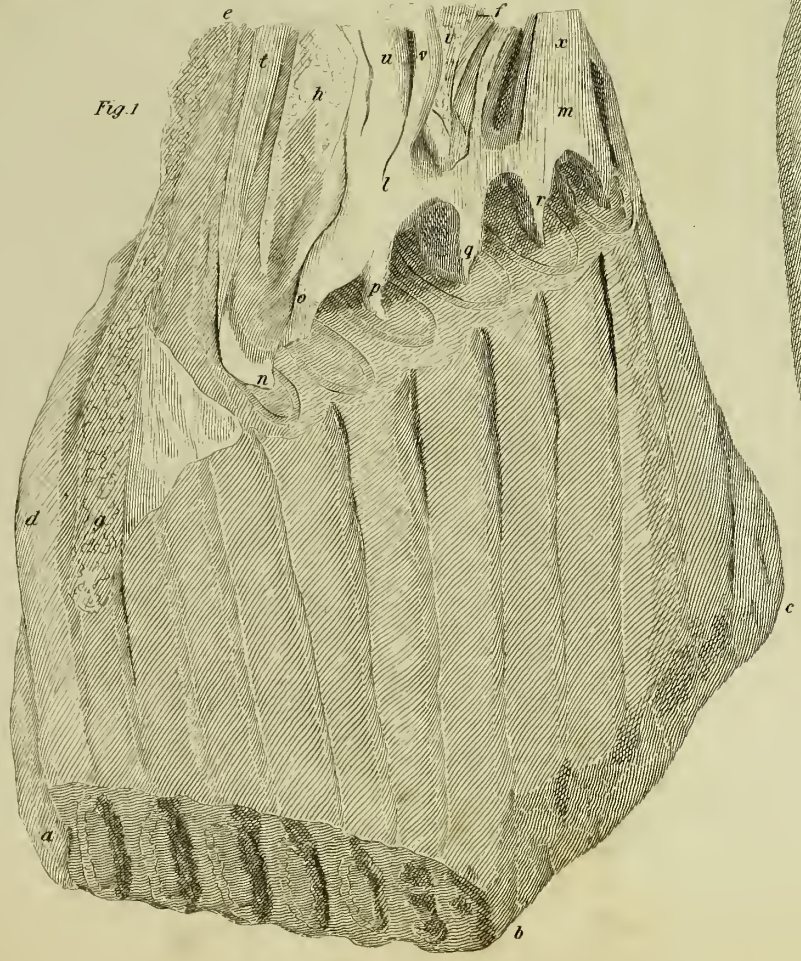
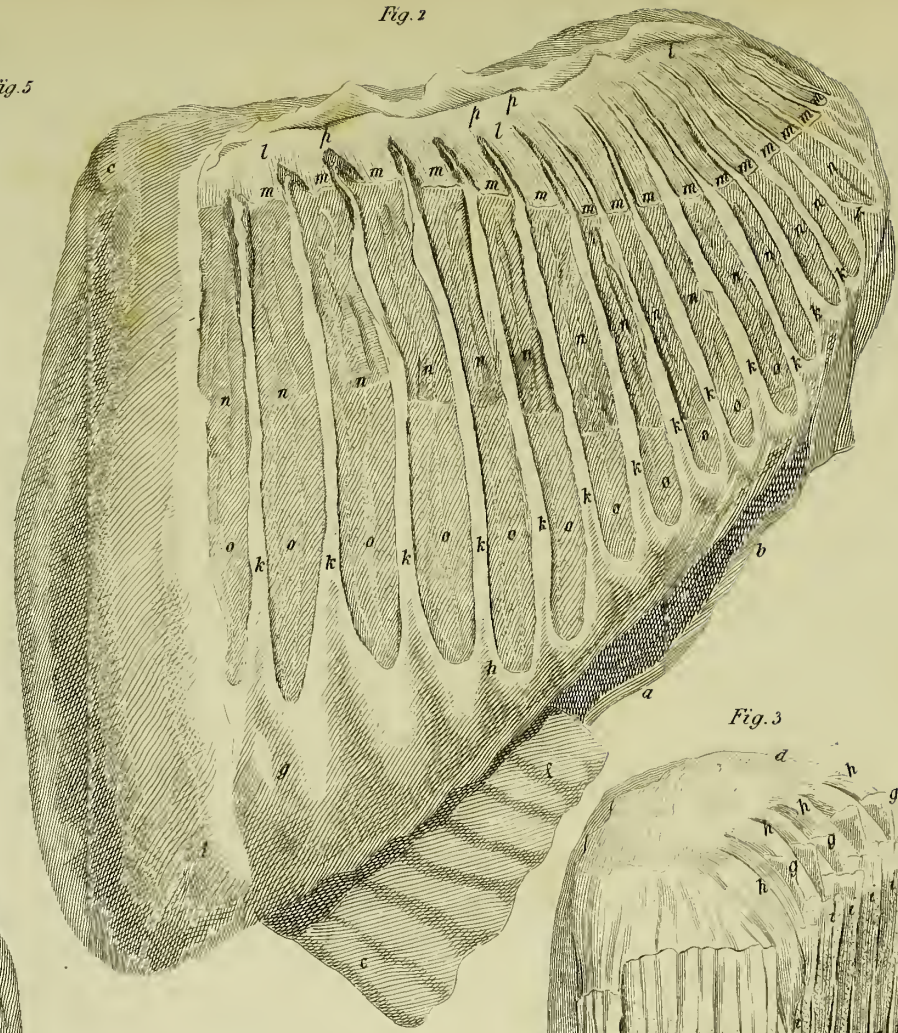


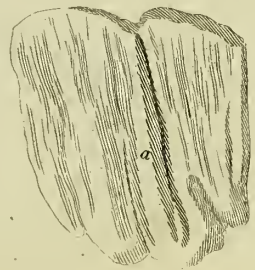
Fig. 7. 1/6



ELEPHANTS. Pl. II.







ELEPHANTS. Pl. III. ⅔

Fig. 1. 1/25.

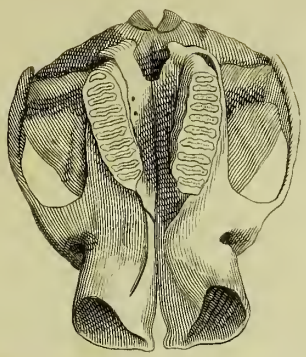


Fig. III. F.

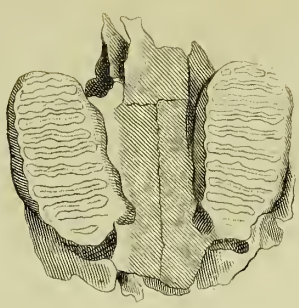


Fig. 5. I. 1/7.

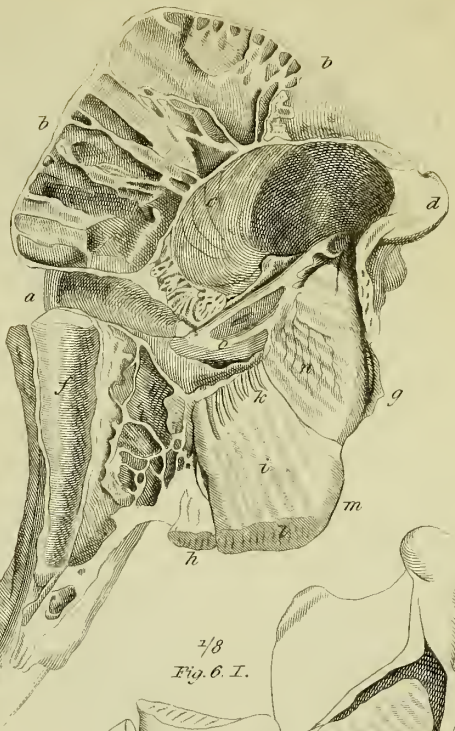


Fig. 2. A. 1/15

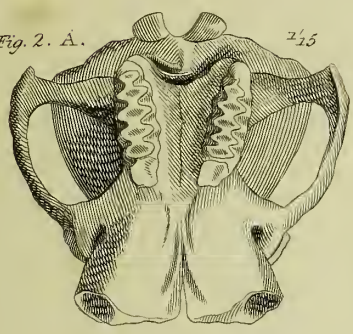
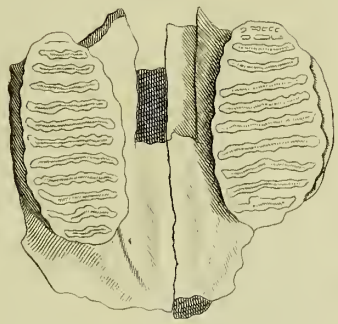
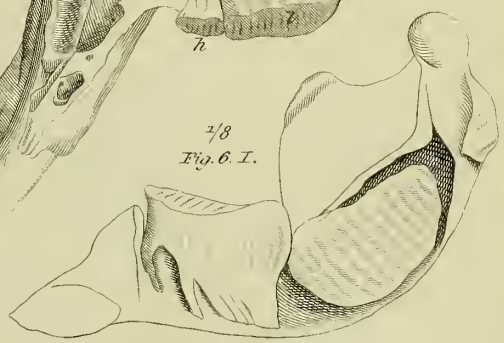


Fig. 4. F.



1/8

Fig. 6. I.



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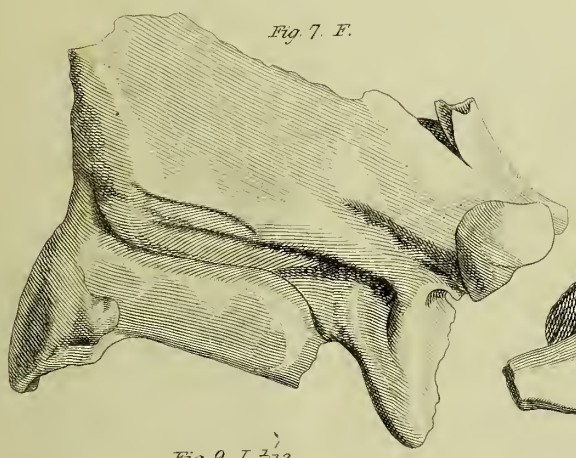


Fig. 8. F.

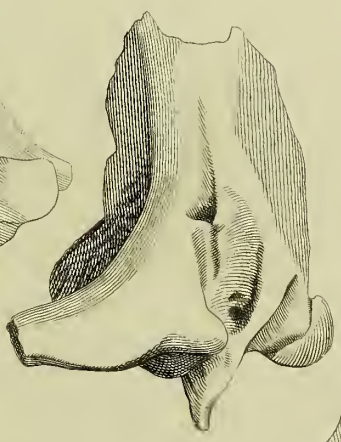


Fig. 11. F.

Fig. 9. I. 1/12.

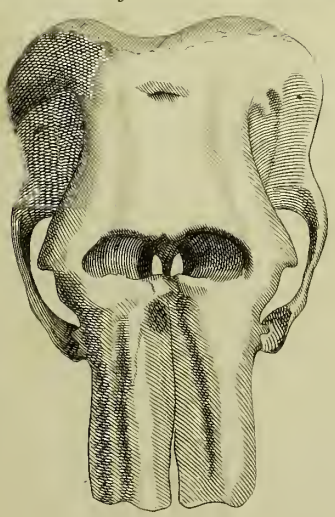
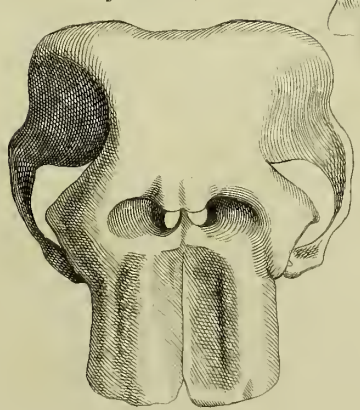


Fig. 10. A. 1/12.



ELEPHANTS. Pl. IV.

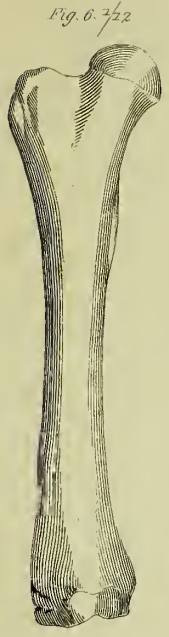
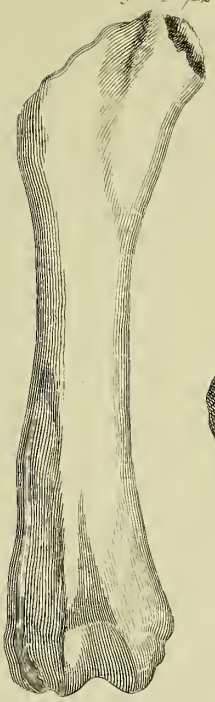


Fig. 6. 1/12


Fig. 7. 1 1/12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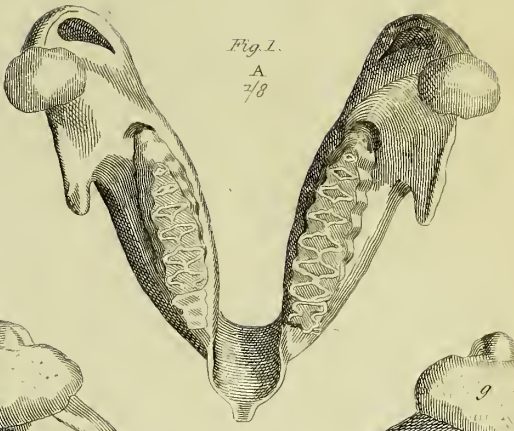
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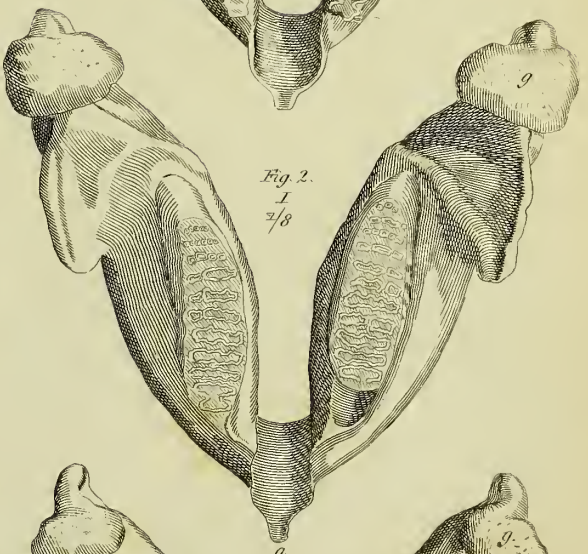


Fig. 2. I 1/8

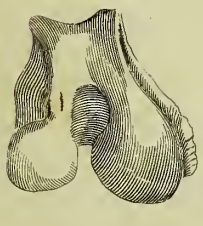


Fig. 9. A 1/6

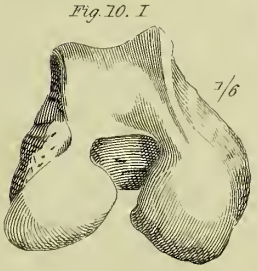


Fig. 10. I 1/6

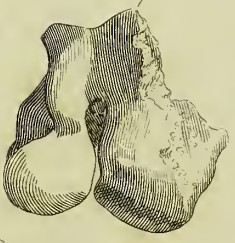


Fig. 11. F 1/6

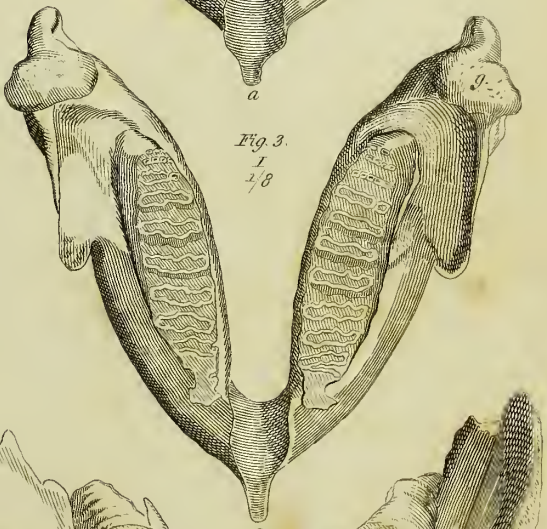


Fig. 3. I 1/8

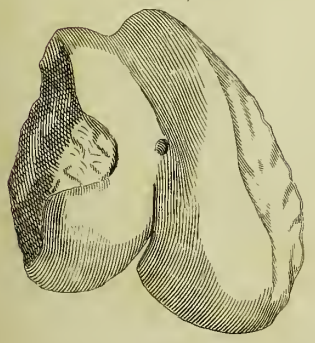


Fig. 12. F 1/6

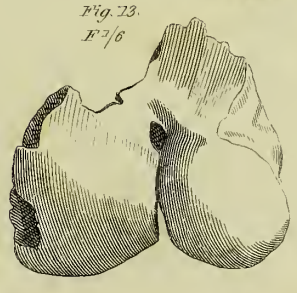


Fig. 13. F 1/6


Fig. 14. F 1/6

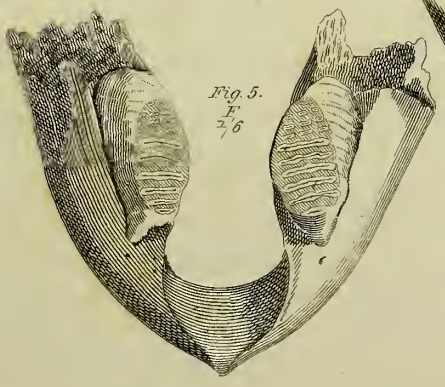


Fig. 5. F 1/6


Fig. 4. F 1/8

ELEPHANTS Pl. V.

Fig. 1 ⅛

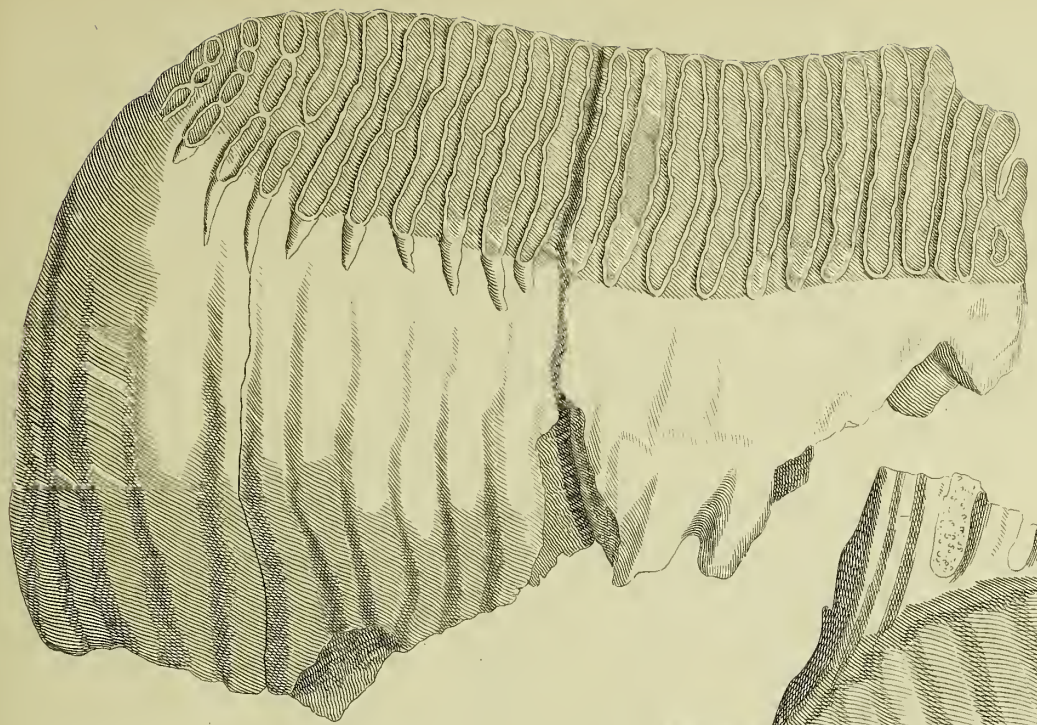


Fig. 2

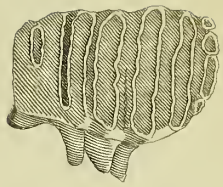


Fig. 3 ¼

Fig. 4

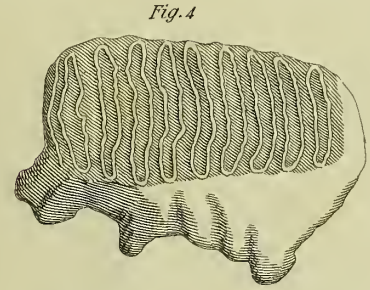


Fig. 5 ¼

ELEPHANTS. Pl. VI.

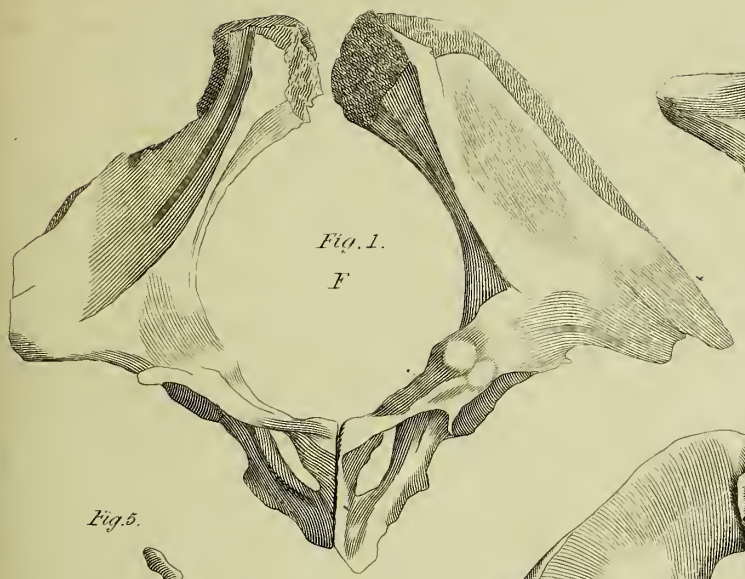


Fig. 1.
F

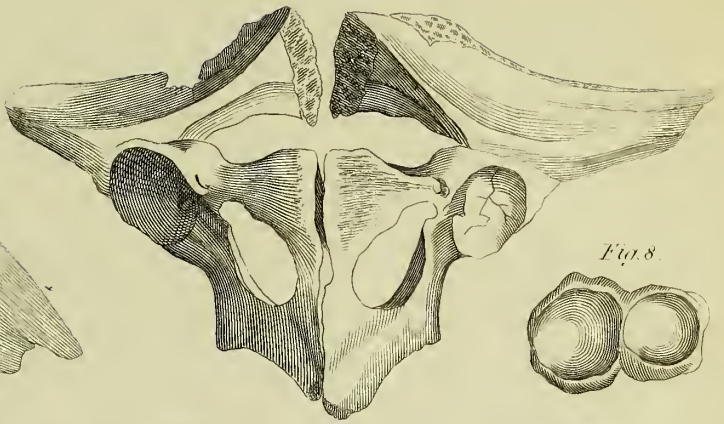


Fig. 2 F

Fig. 8


Fig. 5.

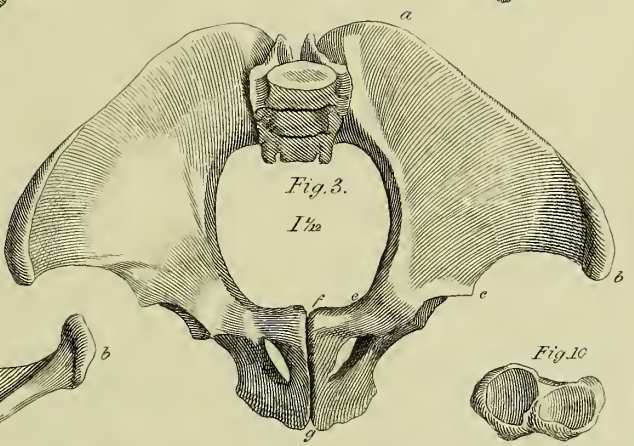


Fig. 3.
1½

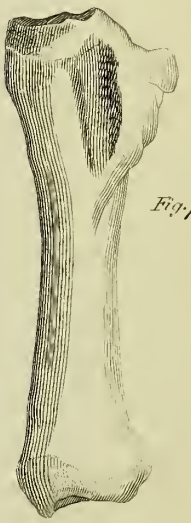


Fig. 7. F

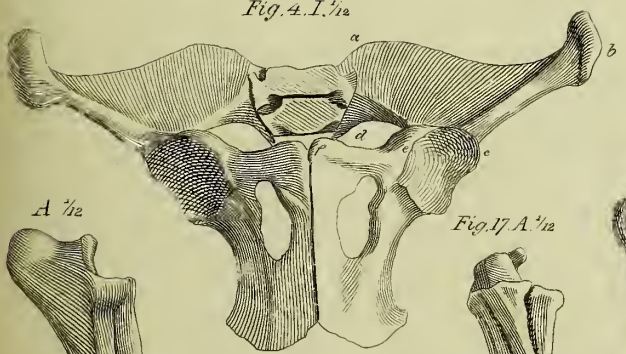


Fig. 4. I. ½

Fig. 10

Fig. 21. I. ½

Fig. 20. I ½


Fig. 11. I. ½


Fig. 9

A ½

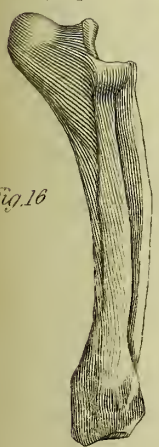


Fig. 16

Fig. 17. A. ½

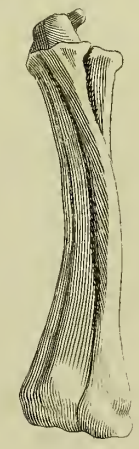


Fig. 6. F. ½

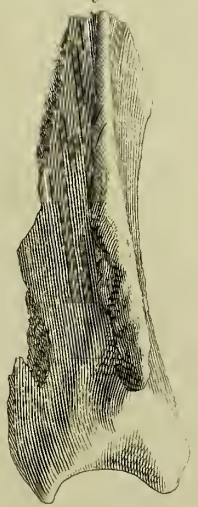



Fig. 14


Fig. 12

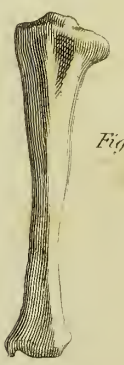


Fig. 13. A. ½

Fig. 22

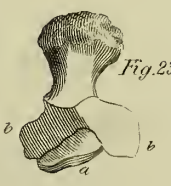


Fig. 23. 1 ⅛

Fig. 15


Fig. 18


Fig. 19. A. ⅜

ELEPHANTS. PL. VII.

Fig. 1. F. 1/6

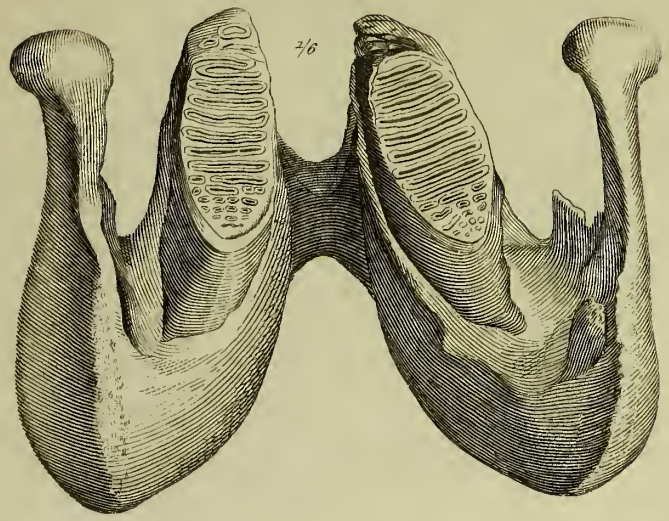


Fig. 4. F.

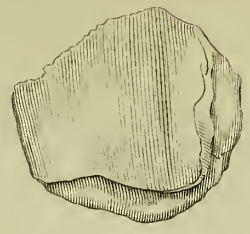


Fig. 5. F

Fig. 6. 1 1/12.

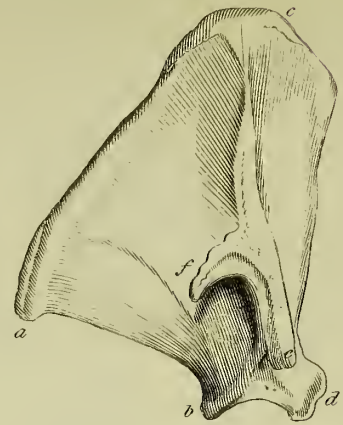


Fig. 7. A. 1/12.

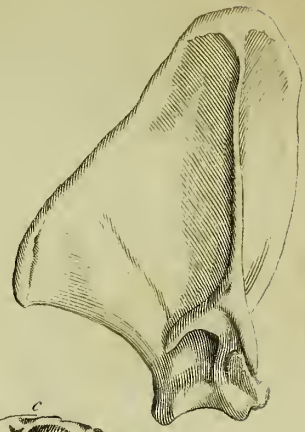


Fig. 8. F. 1/12.

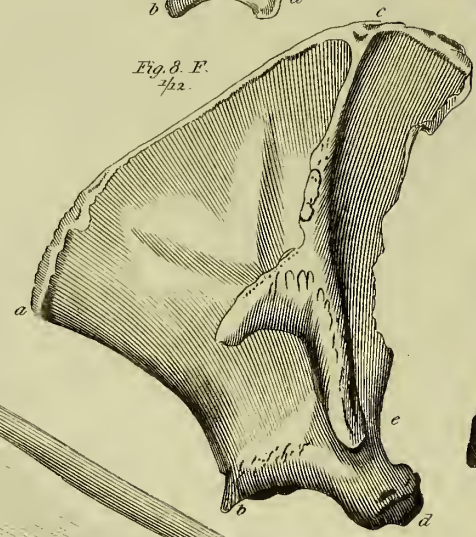


Fig. 10. F.

Fig. 2. F 1/6.

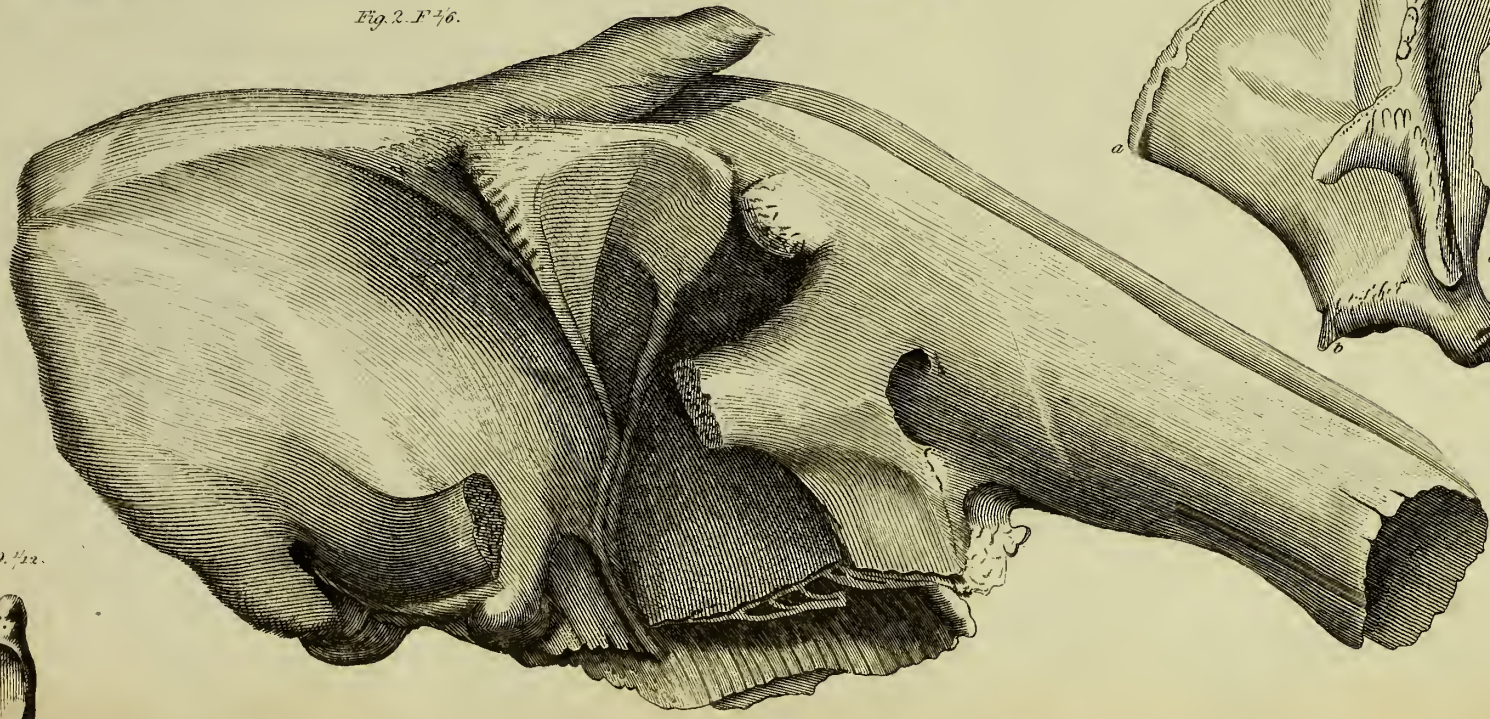


Fig. 9. 1/12.

Fig. 11. F.

ELEPHANT. Pl. 8.

Fig. 3. 1/6.

Fig. 1. 1/8.

Fig. 4. 1/2.

Fig. 2. 1/8.

Fig. 5. 1/6.

Fig. 6. 1/6.

Fig. 9. 1/6.

Fig. 8. 1/6.

Fig. 7. 1/12.

Fig. 10. 1/12.

Fig. 12. 1/20.

Fig. 11. 1/6.

ELEPHANTS. Pl. IX.

Fig. 25 a.

1/8

Fig. 25 b.

Fig. 26

1/6

Fig. 27

Fig. 22.a

Fig. 22.b

Fig. 22.c

Fig. 22.d.

Fig. 23.a
1/8

Fig. 23.b

Fig. 24. a
1/8

Fig. 24. b

Fig. 20. a

Fig. 20. b

Fig. 20. c

Fig. 20. d

Fig. 20. e

Fig. 21.a

Fig. 21. b

Fig. 21.c

Fig. 21.d

Fig. 18.a

Fig. 18.b

Fig. 18. c

Fig. 18.d

Fig. 19.a

Fig. 19. b

Fig. 19.c

Fig. 19.d

Fig. 15. 1/12

Fig. 16. 1/12

Fig. 17

Fig. 13 bis 1/12

Fig. 14 1/12

Fig. 2

Fig. 11. 1/6

Fig. 12 1/12

Fig. 13

Fig. 1

1/8

Fig. 8. 1/12

Fig. 9 1/12

Fig 10 1/12

Fig. 5. 1/12

Fig. 6 1/12

Fig. 7. 1/12

Fig. 3
1/12

Fig. 4. 1/12

J.e Barrois sc.

ELEPHANTS. PL. X.

Fig. 1.

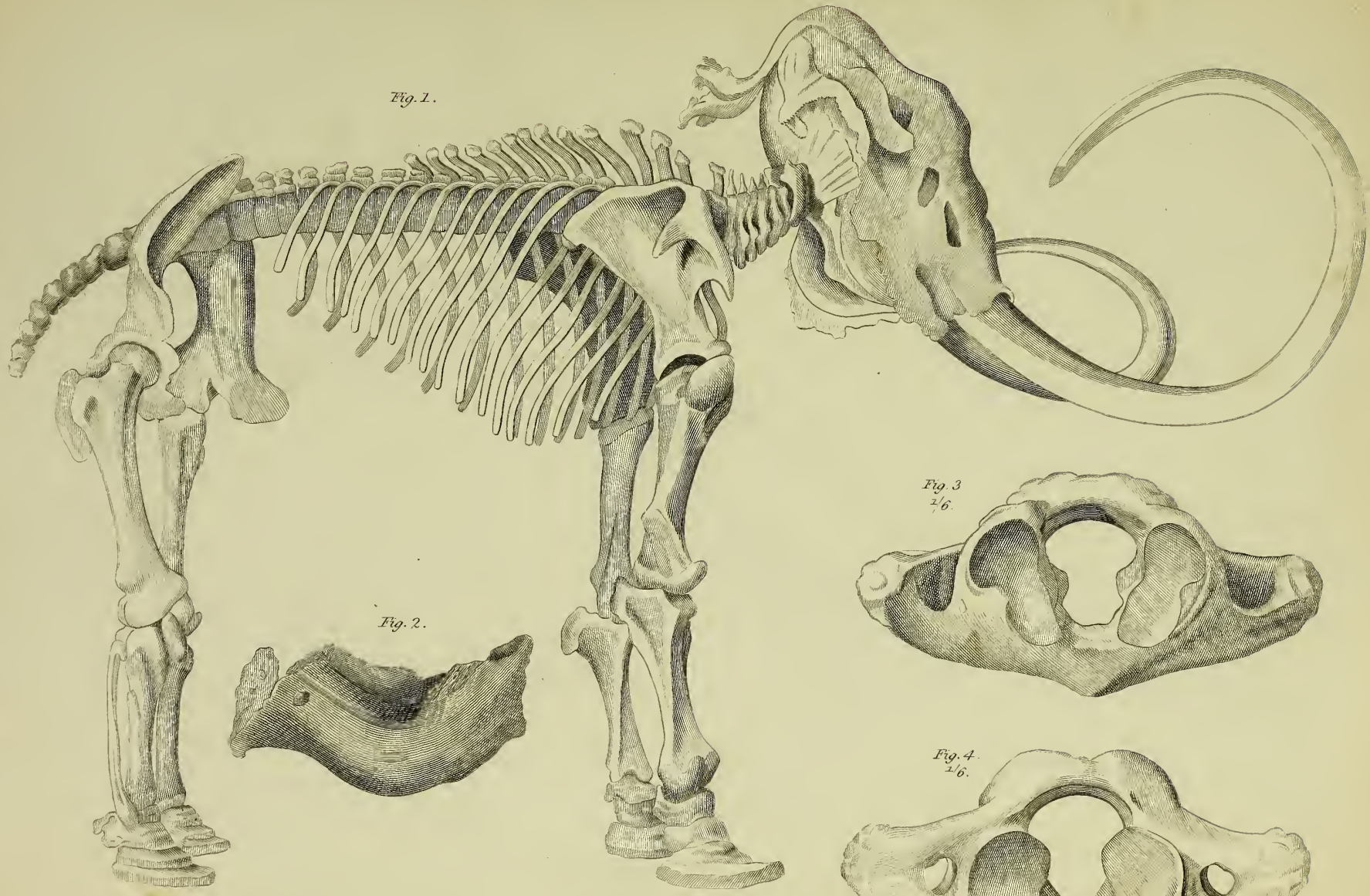
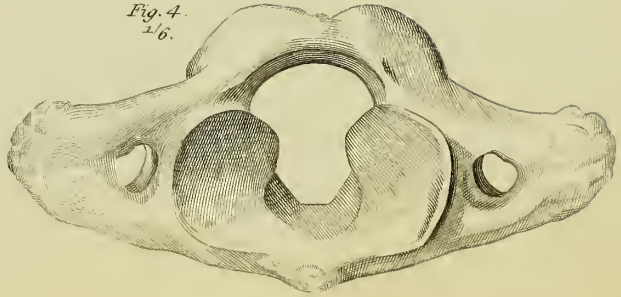


Fig. 2.

Fig. 3
1/6.

Fig. 4
1/6.



ELEPHANTS. Pl. XI.

Fig. 1. 1/6. I.

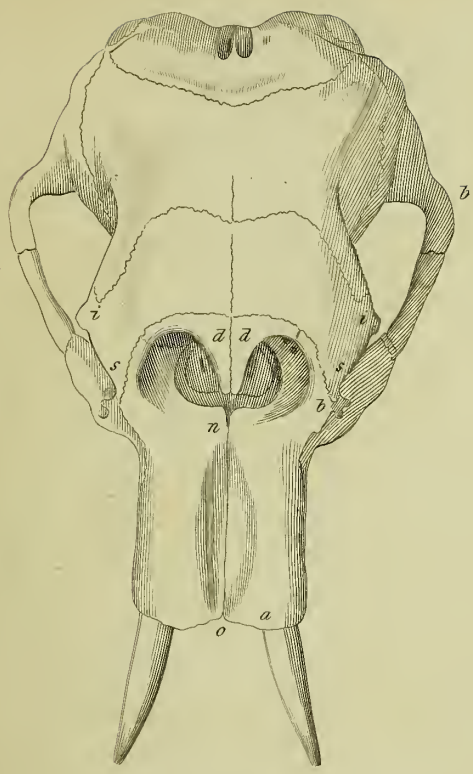


Fig. 3. 1/9. I.

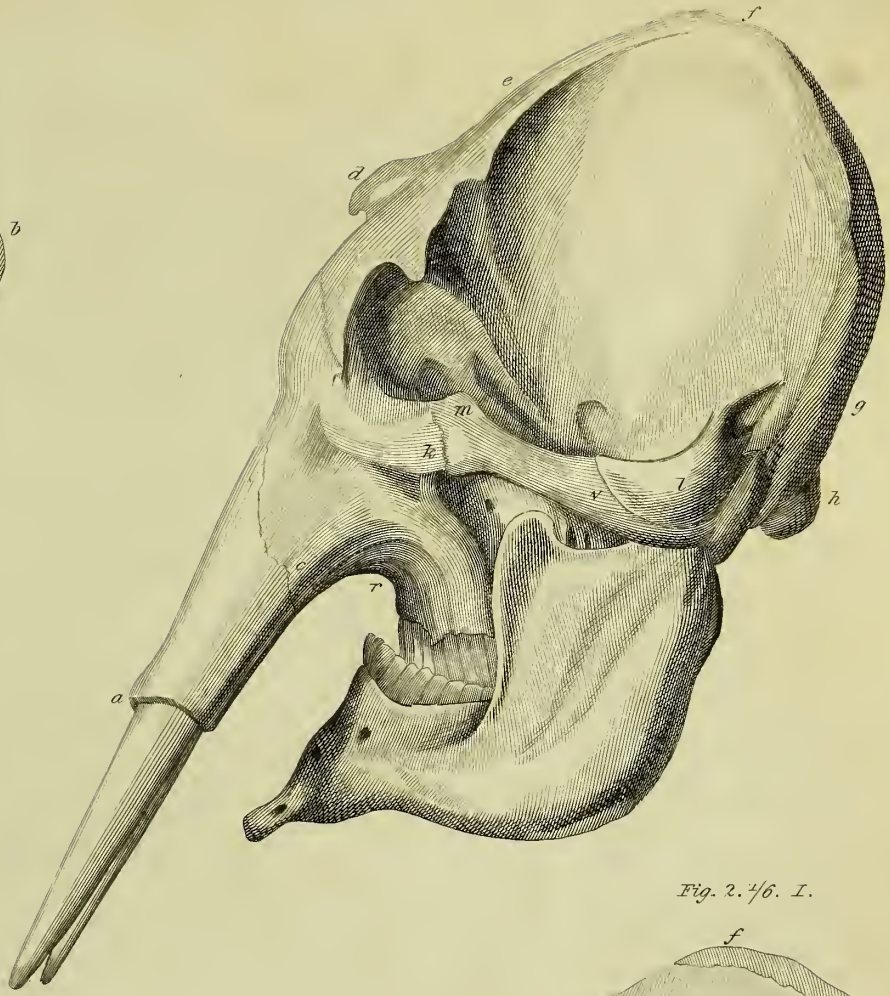


Fig. 4. 1/12. I.

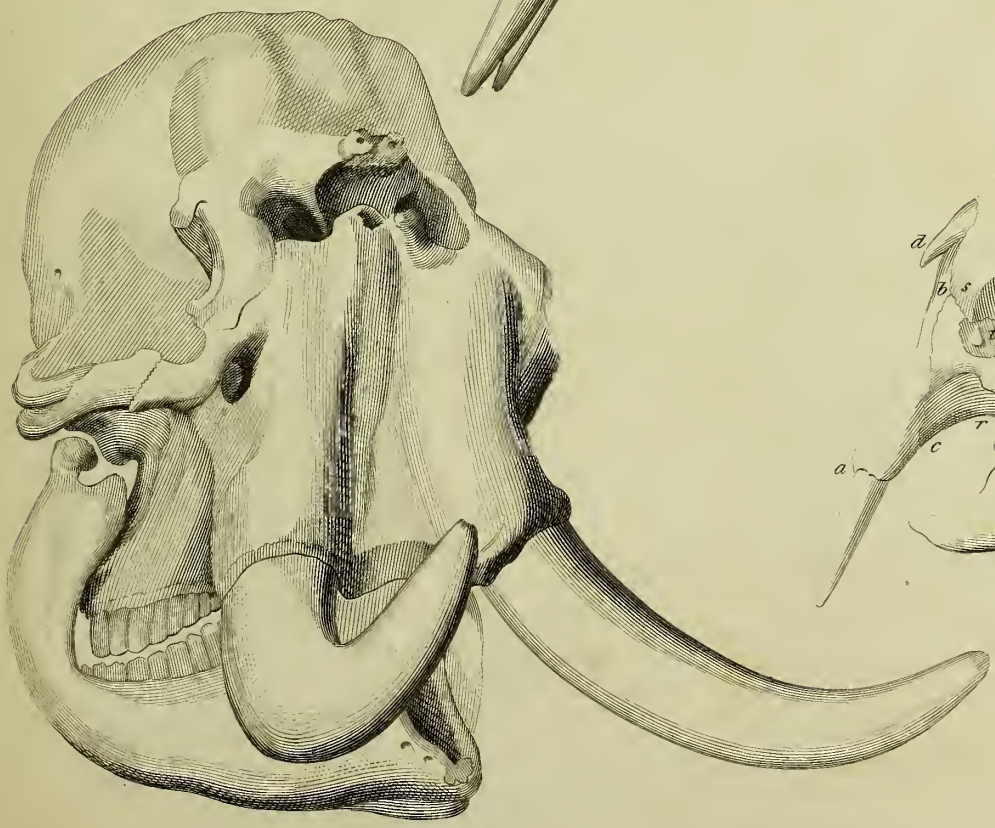
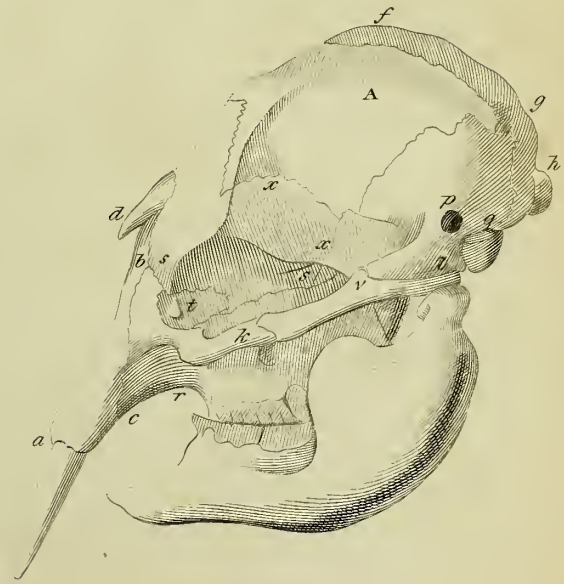


Fig. 2. 1/6. I.



ELEPHANTS. Pl. XII.

Fig. 1. ½

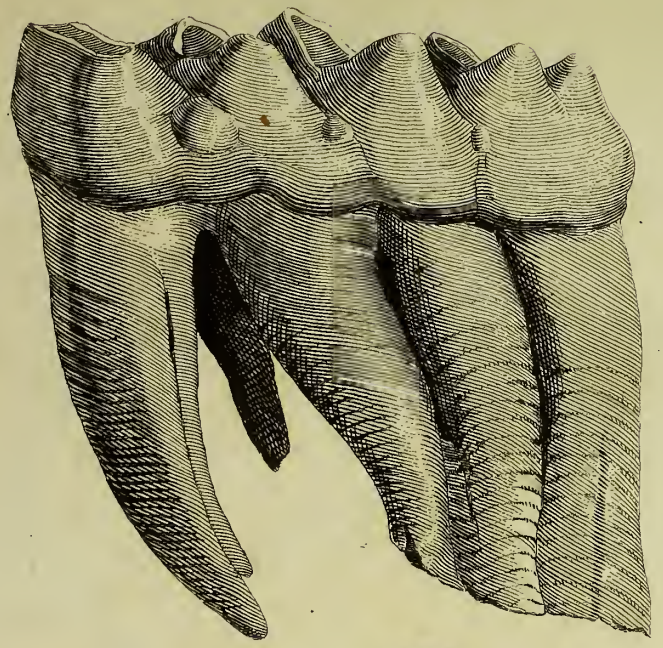


Fig. 2. ½

Fig. 4. ½

Fig. 5. ½

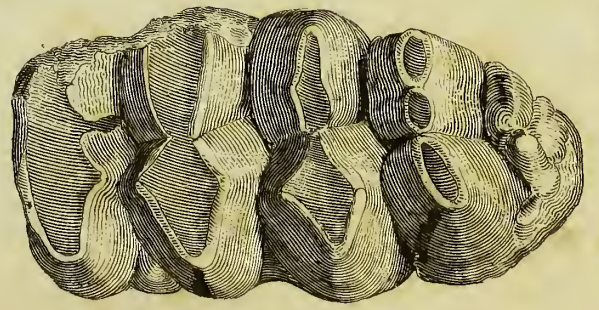


Fig. 5. ½

ADVERTISEMENT.

It was originally intended to have published a complete Translation of this celebrated Work; but the apprehension that a book of so great extent at the present period of general depression might not find a demand adequate to its expense, added to the conviction that a slight curtailment and re-arrangement of the original Work might be made, so as to render an abridgment scarcely less useful to the man of science, and perhaps more interesting to the public in general, has induced a departure from the original intention.

The French work contains five volumes, two of them in seven distinct parts, and upwards of three hundred plates; a large number of which are double, so as to render the expense of re-engraving nearly equal to five hundred quarto plates. A complete English translation, with all these engravings, could not be published under nine pounds to five-and-twenty pounds; it is therefore proposed, by a slight abridgment and partial re-arrangement of the matter, and a reduction of about one half the plates, to publish an English Version of the Work quarterly, in eight Numbers, at twenty-four shillings each.