

VINDICIÆ GEOLOGICÆ;
OR
THE CONNEXION OF GEOLOGY WITH RELIGION
EXPLAINED.

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VINDICIÆ GEOLOGICÆ;
OR THE
CONNEXION OF GEOLOGY WITH RELIGION
EXPLAINED,
IN
AN INAUGURAL LECTURE
DELIVERED
BEFORE THE UNIVERSITY OF OXFORD, MAY 15, 1819,
ON THE
ENDOWMENT OF A READERSHIP IN GEOLOGY
BY
HIS ROYAL HIGHNESS THE PRINCE REGENT.

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BY THE

REV. WILLIAM BUCKLAND, B.D. F.R.S. M.G.S

FELLOW OF THE IMPERIAL SOCIETIES OF MINERALOGY AND NATURAL HISTORY AT
PETERSBURG AND MOSCOW, FELLOW OF CORPUS CHRISTI COLLEGE, OXFORD,
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*Tantum absit, ut causæ physicæ homines a Deo et providentiâ abducant, ut contra potius philosophi illi qui in
iisdem eruendis occupati fuerunt, nullum exitum rei reperiant, nisi postremo ad Deum et providentiâ confu-
giant. Bac. De Augm. Scient. iii. 5*

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1820.

TO THE RIGHT HONORABLE
WILLIAM WYNDHAM, BARON GRENVILLE,

F.R.S.

CHANCELLOR OF THE UNIVERSITY OF OXFORD,

ETC. ETC. ETC.

FROM A FIRM CONVICTION OF HIS SINCERE REGARD FOR THE

INSEPARABLE INTERESTS OF SCIENCE AND RELIGION ;

AND FROM FEELINGS OF

GRATITUDE AND PERSONAL RESPECT ;

THIS ATTEMPT TO SHEW THAT THE STUDY OF GEOLGOY

HAS A TENDENCY TO CONFIRM THE EVIDENCES OF

NATURAL RELIGION ;

AND

THAT THE FACTS DEVELOPED BY IT ARE CONSISTENT WITH

THE ACCOUNTS OF THE CREATION AND DELUGE

RECORDED IN

THE MOSAIC WRITINGS,

IS,

WITH PERMISSION, HUMBLY DEICATED

BY HIS LORDSHIP'S

MOST OBEDIENT AND FAITHFUL SERVANT,

WILLIAM BUCKLAND.

P R E F A C E.

IF it should appear that, in the present Lecture, reference is made to many facts and phenomena of Geology which presuppose a knowledge of this subject; it may be sufficient to state, that although this inaugural Lecture was delivered subsequently to the endowment of the office of Reader in Geology in 1619, yet that Lectures had been annually given on this subject since the year 1814 by myself, and, prior to that period, by my friend and predecessor in the office of Reader in Mineralogy, Dr. Kidd, a gentleman whose scientific and classical labours in these subjects have been long known to the public through the medium of his works, and to whom we owe the foundation of that valuable collection of specimens in Geology which the University now possesses.

VINDICIÆ GEOLOGICÆ;

OR

THE CONNEXION OF GEOLOGY WITH RELIGION EXPLAINED.

HAVING recently received from the hands of the Vice-Chancellor an appointment to the office of Reader in Geology in this University, I should consider myself deficient in one of my first duties, were I to enter on the present Lecture without a public acknowledgment of that gracious encouragement which **HIS ROYAL HIGHNESS THE PRINCE REGENT** has been pleased to extend to this infant establishment in our University, by the grant of a stipend from His Majesty's Treasury, for the delivery of an annual Course of Lectures in Geology : or were I to forget, that the office of Reader in its kindred science, Mineralogy, had, on my appointment to it five years since, been favoured with a similar exercise of Regal Munificence, demonstrative on these, as on all other occasions, of the enlightened regard entertained by **HIS ROYAL HIGHNESS** for the interests of our Academical Institutions.

Nor should I do justice to my own feelings, were I to omit to mention the ardent zeal with which my applications to the Crown on both these occasions were fathered and supported by the Chancellor of the University, a Nobleman whose paternal soli-

citudes for the interests of every species of good learning in this place, it is impossible for us too highly to appreciate, and to whose active exertions in advancing the cause of science, the metropolis owes one of its most useful and splendid establishments ^a.

Of the kind and flattering approbation also with which my recent proposals for establishing a Lecture in Geology were received by the highest authorities in this place, it is impossible for me to speak with too much gratitude and respect.

Under such auspices have the foundations of geological knowledge been laid in Oxford; and from the general favour and approbation with which it is now regarded, from its intimate alliance with Physical Geography, and its national importance as connected with Statistics and Political Economy, we may henceforward consider Geology as exalted to the rank of sciences, the teaching of which forms a part of our established system of education.

This ingrafting (if I may so call it) of the study of the new and curious sciences of Geology and Mineralogy, on that ancient and venerable stock of classical literature from which the English system of education has imparted to its followers a refinement of

^a Whilst Lord Grenville was placed at the head of His Majesty's Government in the year 1806, he procured from Parliament a grant of money for building the Museum of the Royal College of Surgeons in Lincoln's Inn Fields, which, by its rich collections in Human and Comparative Anatomy, has contributed largely to advance the study of those subjects in our own country, and to raise the character and reputation of the nation in the eyes of men of science over the continent: it has also assisted in promoting the science of Geology, not only by its collection of Extraneous Fossils, but by the facilities it affords of comparing the structure of the Organic Remains of a former world with that of its present inhabitants; and of which I cannot quote a more convincing example than that of the highly interesting papers on the Fossil Remains of extinct animals lately published in the Philosophical Transactions, by my friend Sir Everard Home.

taste peculiarly their own, has obviously resulted from the rapid improvements in Physics, that during the last half century have dignified with the name Sciences many subjects, which had perhaps too long been considered only as Experimental Arts : and information on these and similar sciences of modern growth, that are intimately connected with them, has been now so generally diffused, even amongst the imperfectly educated classes of society, that if they had not been for their own sakes deserving our attention, it might to a certain degree have been imperative on us to admit them to a place in our Academical Establishments, in deference to the general feeling in their favour that now prevails, and to that knowledge of them which is so very rapidly diffusing itself through the scientific world.

For some years past, these newly created sciences have formed a leading subject of education in most Universities on the continent, and a competent knowledge of them is now possessed by the majority of intelligent persons in our own country ; and though it might on no account be desirable to surrender a single particle of our own peculiar, and, as we think, better system of Classical Education, there seems to be no necessity for making that system an exclusive one ; nor can any evil be anticipated from their being admitted to serve at least a subordinate ministry in the temple of our Academical Institutions.

Of the many subjects to which the attention of Modern Philosophy has been directed, Geology is perhaps the last which has been advanced to that perfection, which may entitle it to be called a Science: its elements have indeed been long accumulating, and in the accurate but limited observations of a few strong-minded individuals its seeds have been scattered irregularly on the field of knowledge ; but it is not till lately that the germ has quickened, and begun to advance towards maturity : nor can its full develop-

ment be traced back to a later period than that at which it first received its name.

The establishment in the Metropolis of a distinct society, the object of whose labours is exclusively directed to its advancement, affords an important era in the history of Geology, and has diffused a general taste and communication of knowledge on subjects connected with it, equal at least to what has yet been accomplished in any other country. The Trustees also of that magnificent public repository the British Museum have shewn themselves anxious to keep pace with the progressive improvements that have been made in this science, and have added an extensive series of Rock Specimens and Fossil Organic Remains to their inestimable collection of Simple Minerals. County collections are forming and private cabinets accumulating by the zeal and industry of individuals in all parts of the country, whence a mass of valuable information has been brought together into a grand and useful common stock of national knowledge. Accurate physical maps have been constructed, expressing the nature and extent of the different strata of which our island is composed, and illustrating the history of many of its most important repositories of mineral treasure : England is considered as classic ground by the best Geologists of the continent, and the transactions of the Geological Society of London are quoted as standard authority, wherever this science has been admitted.

But notwithstanding this general expression of public opinion, it may be fairly demanded of the advocate for the admission of Geology to a place in our academical studies, what are its pretensions to this honor, and what its utility.

Now if by utility is meant subserviency to the common purposes of life, (though it may easily be shewn that Geology need shrink

from a comparison with few other sciences, even in this respect,) yet such views should be altogether objected to *in limine* as unworthy and unphilosophical. The claims of Geology may be made to rest on a much higher basis. The utility of science is founded upon other and nobler views than those of mere pecuniary profit and tangible advantage. The human mind has an appetite for truth of every kind, Physical as well as Moral ; and the real utility of Science is to afford gratification to this appetite. The real question then, more especially in this place, ought surely to be how far the objects of Geology are of sufficient interest and importance to be worthy of this large and rational species of curiosity, and how far its investigations are calculated to call into action the higher powers of the mind.

Now when it is recollected that the field of the Geologist's inquiry is the Globe itself, that it is his study to decipher the monuments of the mighty revolutions and convulsions it has suffered, convulsions of which the most terrible catastrophes presented by the actual state of things (Earthquakes, Tempests, and Volcanos) afford only a faint image, (the last expiring efforts of those mighty disturbing forces which once operated ;) these surely will be admitted to be objects of sufficient magnitude and grandeur, to create an adequate interest, to engage us in their investigation.

Nor can it be considered as a slight recommendation to these pursuits, that they necessarily lead us abroad amidst the most sublime scenery of nature, and that they lend even to that scenery an additional source of sublimity in the magnificence of the speculations which they associate with it. It is surely gratifying to behold Science, compelling the primeval mountains of the Globe to unfold the hidden records of their origin; and it has been well described by one of the most enlightened Philosophers, and the greatest Anatomist of this or any other age, to be a rational ob-

ject of ambition in the mind of man, “ to whom only a short space of “time is allotted upon this earth, to have the glory of restoring the “history of thousands of age which preceded the existence of his “race, that never were contemporaneous with his species ^b.”

The human mind has a natural tendency to explore what has passed in distant ages in scenes with which it is familiar ; hence the taste for National and Local Antiquities. Geology gratifies a larger taste of this kind ; it inquires into what may appropriately be termed the Antiquities of the Globe itself, and collects and decipheres what may be considered as the monuments and medals of its remoter eras.

There are few exercises of our reason more interesting than the examination of those cases, which, at their first view presenting to us the appearance only of disorder and confusion, terminate at length by the aid of scientific inquiry in a conspicuous display of the order and harmony of nature. Now Geology abounds with, or rather is entirely composed of cases of this kind : it sets out with placing before us a certain order and arrangement in the disposition of the mineral masses forming the earth’s surface, which at first appear to be huddled together in inexplicable confusion; and it constantly presents to us examples of regularity developed in the midst of all this seeming irregularity, of complicated phenomena reduced by the application of a few principles to a simple solution, of analogies unexpectedly extended, and of generalizations happily and successfully pursued. Now it is evident that a science of such a character is capable of affording employment to faculties of mind

^b Conclusion of Cuvier’s Essay on the Theory of the Earth.

of no mean order ; it calls forth habits of minute and patient investigation in the collection of the phenomena on which it depends, and it requires the large grasp and embodying powers of comparative genius to combine and generalize the details thus obtained.

Geology holds the keys of one of the kingdoms of nature; and it cannot be said that a science which extends our Knowledge, and by consequence our Power, over a third part of nature, holds a low place among intellectual employments.

And not only has it an entire kingdom of nature to itself, but it also furnishes what must be considered as necessary appendices to the knowledge of the vegetable and animal kingdoms, from the various species originally belonging to these kingdoms, which by inhumation have passed over to the mineral world, particularly Animal Remains. As these fossil species often differ entirely from any now known to exist, and are in many cases highly important and curious in their structure, the sciences relating to them must be considered as imperfect until this deficiency can be supplied ; and it is quite, obvious that a knowledge of these species is only attainable through the medium of geological researches. The following summary of the results of the labours of a single individual in that branch of this subject, which relates only to the fossil remains of quadrupeds, will give some idea of the importance of Geology to the science of Anatomy.

“ In this manner,” says Cuvier, “ we have ascertained and “classified the fossil remains of seventy-eight different quadrupeds. “Of these, forty-nine are distinct species, hitherto entirely unknown. “Eleven or twelve others have such entire resemblance to species “already known, as to leave no doubts whatever of their identity ; “and the remaining sixteen or eighteen have consider-

“able traits of resemblance to known species. Of the forty-nine new
 “or hitherto unknown species, twenty-seven are necessarily
 “referable to seven new genera ; while the other twenty-two species
 “belong to sixteen genera or sub-genera already known. The whole
 “number of genera and sub-genera to which the fossil remains of
 “quadrupeds hitherto investigated are referable, are thirty-six ^c.”

If we add to these the multitudes of fossil shells, zoophytes, and vegetables, which are sometimes accumulated in such quantities as to form entire mountains composed almost wholly of the organic remains of a former system, we see before us a vast field of inquiry, the limits of which are as yet wholly unexplored. But of its nature and contents we know enough to pronounce the sciences of Zoology and Botany to be wholly incomplete, till they shall have arranged and classified all the varieties of organized matter which Geology submits to their investigation, and shall have extracted from them all those useful illustrations and generalizations, which are the never-failing result of a combined and comprehensive view of the subordinate parts of every kingdom of nature.

Again, the botanical character of a country is in no small degree dependent on the nature of the strata of which it is composed, and a change in the specks of plants that occupy the surface, and in its capacity for the important purposes of agriculture, is the constant result of any decided alteration in the ingredients of the substratum. The sterile heath is no less frequent an attendant on strata of siliceous barren Sand, than a luxurious growth of fern and furze is indicative of a mould adapted for corn. The meagre and delicate herbage of the downs of chalk announces with no less

^c Cuvier's Theory of the Earth, sect. xxviii. p. 103, First edit.

certainty the poverty of the soil it covers, than rank luxuriance of the widely different plants which occupy the marsh lands of alluvial districts bespeaks the richness of the matrix in which their roots are fixed. A change also of the subjacent strata from the arid lime-stone to tenacious clay is no less strongly marked by the distribution of the native vegetables on each.

Geology is likewise inseparably allied to an extensive branch of Chemistry, inasmuch as the latter science derives exclusively from the mineral kingdom no small proportion of the materials which form the basis of its experiments : and on the other hand, it is itself so largely indebted to the results of chemical analysis, that without them its fundamental science Mineralogy could scarcely ever have existed. So close indeed is the alliance between them that it may be fairly stated, that no person can understand the elements of Mineralogy without a knowledge of Chemistry at least more than superficial ; nor can any man be considered a philosophical chemist who does not possess a certain acquaintance with Mineralogy.

Of the application of Pure Mathematics to this same science, it is impossible to quote a more convincing example than the Abbe Haüy's arrangement of minerals founded on the principles of Crystallography. From this it appears, that the results of the most accurate abstract reasonings are completely verified by the absolute identity in the form and measure of the minutest angles of every variety of crystallized mineral with those which had been obtained from the most exact mathematical calculations.

The consideration of the important phenomena of rivers, lakes, and seas, which continually requires the aid of Hydrostatics, establishes an intimate connexion between Geology and that branch of science ; whilst the regard it pays to the distribution of land

and water over the surface of the earth, and to the form, extent, elevation, and depression of mountains, plains, and valleys makes it nearly coextensive with Physical Geography.

And by its connexion with such subjects as the origin of Aerolites, calculations on the depth of the sea and mean density of the earth, and the investigation of the second causes that were employed in the gradual arrangement of the matter of which our planet is composed, and in producing the overwhelming conclusions that appear at distant intervals to have affected it, Geology becomes associated with Astronomical speculations. So that while she herself receives assistance from many sciences, she on the other hand imparts her light to others ; and by means of this constant and extensive reciprocation becomes intimately connected with them all.

But it is now admitted on all hands, that no man can be qualified to enter any of the highest walks of science, who is acquainted only with one branch of natural knowledge, and the mutual dependence of them all is now so positively demonstrated, that the philosopher of our days can no longer be allowed to remain satisfied with those inquiries which belong exclusively to any single branch, but must extend his investigations over the whole range of sciences, and illuminate his path by the varied combinations of them all. Newton was perhaps the first who carried his eye over this extensive and almost unbounded prospect : he has been since followed by D'Alembert, La Place, Biot, Playfair, Leslie, Brewster, and Wollaston. Of whom it may be said, that they have added to the highest attainments in Pure Mathematics such an extensive knowledge of the whole circle of the sister arts and sciences, as has led to the most important practical advantages to mankind.

But I pass on from these more general observations to the im-

mediate subject of this lecture. In this place it belongs peculiarly to the excellent course of studies which we pursue the highest attainments of abstract science and literature with the much more important purposes Religious Truth. And as any investigation of Natural Philosophy which shall not terminate in the Great First Cause will be justly deemed unsatisfactory, I feel no apology to be necessary for opening these Lectures with an illustration of the religious application of Geological science. “Hæc,” says the immortal Newton, “ Hæc de Deo ; de quo utique ex phenomenis “dissere ad Philosophiam Natnralem pertinet.”

In being introduced then to a new kingdom of nature, we can scarce fail to inquire, whether we shall here also find the same proofs of subserviency to final causes, which are so strikingly exhibited in the animal and vegetable creation. And the answer will be found in the affirmative. Such proofs, though, from the nature of the subject, less obvious than in the two former instances, are nevertheless plainly discernible and capable of demonstration. To enter at large into these proofs would require more ample space than can now be devoted to it, and presupposes a knowledge of the subject of which we are but beginning to treat ; but some few may be briefly alluded to.

A great majority of the strata having been formed under water, and from materials evidently in such a state as to subject their arrangement to the operation of the laws of gravitation ; had no disturbing forces interposed, they must have formed layers almost regularly horizontal, and therefore investing in concentric coats the nucleus of the earth. But the actual position of these beds is generally more or less inclined to the horizontal plane, though often under an angle almost imperceptible. By this arrangement many strata affording numerous varieties of mineral productions are made to emerge in succession on the surface of the earth ; whereas

the inferior must have been buried for ever beneath the highest, had their position been strictly horizontal ; and in such case we should have wanted that variety of useful minerals almost indispensable to the existence of man in a state of civil society, which this succession of different strata now presents to us.

Moreover, in the original formation and dispersion of the repositories of these minerals, and the relative quantities in which they are distributed ; in the provisions that are made to render them accessible at a certain expense of human skill and industry, and at the same time secure from wanton destruction or natural decay ; in the more general dispersion of those metals which are most important, and the comparatively rare occurrence of others which are less so ; and still further in affording the means whereby their compound ores may be reduced to a state of purity ; in the benevolent provision of almost inexhaustible stores of salt and fuel to supply the wants and reward the industry of man in these latter ages of the world ; and in causing the vast repositories of coal to be accumulated from the wreck and ruins of disturbances that affected our planet long before the existence of the human race ; in creating also a large proportion of the most valuable metallic ores at periods coeval with the most ancient revolutions that have affected the surface of the globe : in all these and a thousand other examples that might be specified of design and benevolent contrivance, we trace the finger of an Omnipotent Architect providing for the daily wants of its rational inhabitants, not only at the moment in which he laid the first foundations of the earth, but also through the long series of shocks and destructive convulsions which he has caused subsequently to pass over it.

In the whole machinery also of springs and rivers, and the apparatus that is kept in action for their duration, through the instrumentality of a system, of curiously constructed hills and val-

leys, receiving their supply occasionally from the rains of heaven, and treasuring it up in their everlasting storehouses to be dispensed *perpetually* by thousands of never-failing fountains ; we see a provision not less striking or less important. So also in the adjustment of the relative quantities of sea and land in such due proportions as to supply the earth by constant evaporation, without diminishing the waters of the ocean ; and in the appointment of the atmosphere to be the vehicle of this wonderful and unceasing circulation ; in thus separating these waters from their native salt, (which, though of the highest utility to preserve the purity of the sea, renders them unfit for the support of terrestrial animals or vegetables,) and transmitting them in genial showers to scatter fertility over the earth, and maintain the never-failing reservoirs of those springs and rivers, by which it is again returned to mix with its parent ocean : in all these we find such undeniable proofs of a nicely balanced adaptation of means to ends, of wise foresight and benevolent intention and infinite power, that he must be blind indeed, who refuses to recognize in them proofs of the most exalted attributes of the Creator ^d.

Nor is the unity of the Great First Cause less demonstrable from the structure of the earth, than the wisdom, power, and goodness of the Deity. That identity of design which has regulated the organization of animals and vegetables, and established in each link of the boundless chain of living beings a system of delicately proportioned laws of coexistence pervading its minutest parts, is equally discernible in the subserviency of the earth's structure to the necessities and comforts of the various millions of inhabitants which the Creator has placed upon it. It is the same hand-writing

^d For a good account of the mechanical structure employed by nature in the production and supply of springs in those portions of the earth's strata which are called secondary, I beg to refer to the chapter on springs, in the late Mr. Townsend's History of Moses.

that we read, the same system and contrivance that we trace, the same unity of object, and relation to final causes, which we see maintained throughout, and constantly proclaiming the Unity of the great divine Original.

It is thus that Newton in his celebrated Scholium at the end of the Principia infers, from his researches into the regions of bound- less space, similar proofs of the Wisdom, Power, and Unity of the great Creator : “Elegantissima hæcce Solis, Planetarum, et Co- “metarum compages non nisi consilio et dominio Entis intelligentis “et potentis oriri potuit—et si Stellæ fixæ sint centra similium “systematum, hæc omnia simili consilio constructa suberunt *unius* “dominio.”

And in a similar tone of spontaneous and heartfelt piety, the acute and learned Paley sums up in the following beautiful and energetic language the results of the minute and elegant investigations pursued in his invaluable volume on Natural Theology. “ If “one train of thinking be more desirable than another, it is that “which regards the phenomena of nature with a constant reference “to a supreme intelligent Author. To have made this the ruling, the “habitual feeling of our mind, is to have laid the foundation of every “thing which is religious: the world thenceforth becomes a temple, “and life itself one continued act of adoration. The change is no less “than this, that whereas formerly God was seldom in our thoughts, “we can now scarcely look upon any thing without perceiving its “relation to him. Of the vast scale of operation through which our “discoveries carry us, at one end we see an intelligent power “arranging planetary systems, fixing for instance the trajectory of “Saturn, or constructing a ring of two hundred thousand miles “diameter to surround his body, and be suspended like a “magnificent arch over the heads of his inhabitants ; and at the “other bending a hooked

“tooth, concerting and providing appropriate mechanism for eth
 “clasping and reclasping of the filaments of the feathers of the
 “humming bird. We have, proof not only of both these works
 “proceeding from an intelligent agent, but of their proceeding from
 “the same agent ; for in the first place we can trace an identity of
 “plan, a connexion of system from Saturn to our own Globe, we can
 “in the second place pursue the connexion through all the
 “organized, especially the animated bodies which it supports : we
 “can observe the marks of a common relation as well to one another
 “as to the elements of which their habitation is composed :
 “therefore *one* Mind hath planned, or at least hath prescribed a
 “general plan for all these productions ; *one* Being hath been
 “concerned in all.”

Similar proofs in support of Natural Theology derived from a
 review of the physical structure of the earth, were not unobserved
 by the learned physician and naturalist, Dr. Woodward, more than
 a hundred years ago ; whose conviction of the high importance of
 the study of Geology induced him to establish a professorship for
 teaching it in our sister University, and who thus piously expresses
 the result of his own observations on the phenomena which it
 developes, and the origin of which he erroneously attributes to the
 exclusive operations of the Mosaic Deluge.

“ Though the whole, series of this extraordinary catastrophe may
 “seem at first view to exhibit nothing but tumult and disorder, and
 “nothing but hurry, jarring, and distraction of things ; yet if we
 “draw somewhat nearer, and take a closer prospect of it, if we look
 “into its retired movements and latent springs, we may trace out a
 “steady hand producing good out of evil, the most consummate
 “order and beauty out of confusion and deformity, acting with the
 “most excellent contrivance and wisdom

“throughout the whole course of this grand affair, and directing all
 “the several steps and periods to an end, and that a most noble and
 “excellent one, no less than the happiness of the whole race of
 “mankind ; the benefit and universal good of all the many
 “generations of men which were to come after ; which were to
 “inhabit this earth, thus modelled anew, thus suited to their present
 “condition and necessities.” *Woodward’s Nat. Hist. of the Earth,*
 p. 95. 3d edit. part 2.

Mr. De Luc also in his recent admirable work on the passage of Hannibal over the Alps, in which he has completely settled the long disputed question on this subject, concludes his examination of those mountains with observations on the escape of many rivers in Switzerland from their native valleys by vast chasms or gorges, the production of which is not referable to any causes now in action, and which indicate a series of different operations conducted at an ancient period of time, with a view to the welfare of the present inhabitants of the earth. He specifies cases of many considerable Alpine valleys ; the valley of Geneva also ; the great basin of Bohemia ; and that of the Diarbekir, from which proceed the upper branches of the Tigris : in all of which the waters escape from fertile regions, that would inevitably have been buried under extensive lakes, but for the operation of forces which have ceased to exist since the earth received its last touch from the moulding finger of its Creator. Many of these valleys and basins are drained by chasms and precipitous gorges of enormous depth ; which could not have been produced by the most violent torrents that now flow through them, but must be referred to the disruption of mountain masses at the epoch of ancient revolutions that have overturned the globe, not to establish thereon the kingdom of disorder and confusion, but to produce that variety of surface which should be most pleasant to the eye, and best adapted to the support of animal and vegetable life, and that disposition which is best

calculated to supply the various wants of those multitudes of beings that were destined to become its future inhabitants. He concludes his considerations on these striking marks of design and benevolence in the structure of the earth, with the following appropriate reflections.

“ Qui ne voit ici la main de Dieu, preparant d’avance, dans le sein de la mer, les nouvelles habitations des hommes? Sa toute-prevoyance n’attendit pas que les torrens eussent creuse les vallees, que les fleuves eussent creuse leur lits ; mais il traca a chacun d’eux la route qu’il devoit suivre dans ses moindres detours. Il dit au Rhin, il dit au Danube, ‘ Voila les contrees que tu arroseras de tes eaux, et auxquelles tu serviras des limites. Voila les montagnes ou tu prendras tes sources, et les vallees qui te fourneront des eaux abondantes. Le canal que doit les recevoir et les conduire a la mer, est prepare ; tu n’auras qu’a le suivre.’ ‘ Les montagnes se dresserent,’ dit le prophete David ^e; et les vallees s’abaissent au meme lieu que l’Eternel leur avoit etabli. C’est l’Eternel qui conduit les fontaines par les vallees ; c’est par lui qu’elles se promenant entre les monts. ”

Another valuable contrivance in the structure of the globe is, that nearly all its materials are such as to afford by their decomposition a soil fit for the support of vegetable life ; and that they are calculated to undergo and have undergone a superficial decomposition. Here is an instance of relation between the vegetable and mineral kingdoms, and of the adaptation of one to the other, which always implies design in the surest manner : for had not the surface of the earth been thus prepared for their reception, where would have been the use of all that admirable system of organization bestowed upon vegetables? And it is no small proof of

^e Pseaume civ. 8,10.

design in the arrangement of the materials that compose the surface of our earth, that whereas the primitive and granitic rocks at least calculated to afford a fertile soil, they are for the most part made to constitute the mountain districts of the world, which, from their elevation and irregularities, would otherwise be but ill adapted for human habitation ; whilst, the lower and more temperate, regions are usually composed of derivative or secondary strata, in which the compound nature of their ingredients qualifies them to be of the greatest utility to mankind by their subserviency to the purposes of luxuriant vegetation.

Thus Geology contributes proofs to Natural Theology strictly in harmony with those derived from other branches of natural history ; and if it be allowed, on the one hand, that these proofs are in this science less numerous and obvious, it may be contended, on the other, that they are calculated to lead us a step farther in our inferences. The evidences afforded by the sister sciences exhibit indeed the most admirable proofs of design and intelligence originally exerted at the Creation ; but many who admit these proofs still doubt the continued superintendence of that intelligence, maintaining that the system of the Universe is carried on by the force of the laws originally impressed on matter, without the necessity of fresh interference or continued supervision on the part of the Creator. Such an opinion is indeed founded only on a verbal fallacy ; for “ laws impressed on matter” is an expression, which can only denote the continued exertion of the will of the Lawgiver, the prime Agent, the first Mover : still however the opinion has been entertained, and perhaps it nowhere meets with a more direct and palpable refutation, than is afforded by the subserviency of the present structure of the earth’s surface to final causes for that structure is evidently the result of many and violent convulsions subsequent to its original formation. When therefore we perceive that the secondary causes producing these con-

vulsions have operated at successive periods, not blindly and random, but with a direction to beneficial ends, we see at once the proofs of an overruling Intelligence continuing to superintend, direct, modify, and control the operations of the agents, which he originally ordained ^f.

^f Examples of this kind are perhaps nowhere more strikingly afforded than in the instance of those fractures or disturbances called *faults*, which occur in the alternating beds of coal, slaty clay, and sand stone, which are usually associated under the name of Coal Measures.

The occurrence of such *faults*, and the *inclined position* in which the strata composing the coal measures are usually laid out, are facts of the highest importance as connected with the accessibility of their mineral contents. From their *inclined position* the thin strata of coal are worked with greater facility than if they had been horizontal but as this inclination has a tendency to plunge their lower extremities to a depth that would be inaccessible, a series of faults, or traps, is interposed, by which the component portions of the same formation are arranged in a series of successive tables, or stages, rising one behind another, and elevated continually upwards towards the surface from their lowest points of depression. A similar effect is often produced by undulations of the strata, which give the united advantage of inclined position and of keeping them near the surface. The basin-shaped structure, which so frequently occurs in coal fields, has a similar tendency to produce the same beneficial effect.

But a still more important benefit results from the occurrence of *faults*, or *fractures*, without which the contents of no deep coal mine would be accessible. Had the strata of shale and grit stone that alternate with the beds of coal been continuously united without fracture, the quantity of water that would have penetrated from the surrounding country into any considerable excavations that might have been made in the porous grit beds would have been insuperable by the powers of the most improved machinery : whereas by the simple arrangement of a system of faults, the water is admitted only in such quantities as are within control. Thus the component strata of a coal field are divided into numberless insulated masses, or sheets of rock of irregular form and area, not one of which is continuous in the same plane over any very large district, but each is separate from its next adjacent mass, or sheet, by a dam of clay impenetrable to water, and filling the narrow cavity produced by the fracture which caused the fault.

If we suppose a thick sheet of ice to be broken into fragments of irregular area and these fragments again united after receiving a slight degree of irregular inclination to the place of the original sheet, the reunited fragments of ice will represent the appearance of the component portions of the broken masses, or sheets, of coal measures we are describing, whilst those intervening portions of more recent ice by which they are

The consideration also of the evidences afforded by Geological phenomena may enable us to lay more securely the very foundations of Natural Theology, inasmuch as they clearly point out to

held together represent the clay and rubbish that fill the faults, and form the partition walls that insulate these adjacent portions of strata, which were originally formed like the sheet of ice in one continuous plane. Thus each sheet or inclined table of coal measures is inclosed by a system of more or less vertical walls of broken clay, derivative from its argillaceous shale beds at the moment in which the fracture and dislocation took place ; and hence have resulted those joints and separations, which, though they occasionally interrupt at inconvenient positions, and cut off suddenly the progress of the collier, and often shatter those portions of the strata that are in immediate contact with them, yet are in the main his greatest safeguard, and indeed essential to his operations.

These same faults also, whilst they prevent the water from flowing in excessive quantities in situations where it would be detrimental, are at the same time of the greatest service in converting it to purposes of utility, by creating on the surface a series of springs along the line of fault, which often give notice of the fracture that has taken place beneath.

A similar interruption of continuity in the masses of the primitive rocks, and rocks of intermediate age between these and the coal formation, is found to occur extensively in the working of metallic veins. The vein is often cut off suddenly by a fault or fracture crossing it transversely, and its once continuous portions are thrown to a considerable distance from each other. This line of fracture is usually marked by a wall of clay consisting of the abraded fragments of the rock, whose adjacent portions have been thus dislocated. Such faults are universally known in the mines of Cornwall by the term *flukan*, and they produce a similar advantage to those that traverse the coal measures in guarding the miner from inundation, by a series of natural dams traversing the rocks in various directions, and intercepting all communication between that mass in which he is conducting his operations, and the adjacent masses on the other side of the flukan or dam.

It is probable that the greater number of springs, that issue from those rocks which are unstratified, are kept in action through the instrumentality of the faults by which they are intersected.

It may be added also, that the faults of a coal field, by interrupting the continuity of the respective beds of coal, and causing their truncated edges to abut against those of unflammable strata of shale or grit, afford a preservative which prevents the ravages of accidental fire from extending beyond the area of that sheet in which it may take its beginning, but which, without the intervention of such a provision, might lead to the destruction of entire coal fields. It

us a period antecedent to the habitable state of the earth, and consequently antecedent to the existence of its inhabitants. When our minds become thus familiarized with the idea of a beginning and first creation of the beings we see around us, these proofs of design, which the structure of those beings affords, carry with them a more forcible conviction of an intelligent Creator, and the hypothesis of an eternal succession of causes is thus at once removed. We argue thus—it is demonstrable from Geology that there was a period when no organic beings had existence : these organic beings must therefore have had a beginning subsequently to this period ; and where is that beginning to be found, but in the will and *fiat* of an intelligent and all-wise Creator ?

With what acuteness of argument, and what obstinacy of perseverance, the extraordinary notion of an eternal succession was maintained in ancient times, even by some of the greatest philosophers, it is quite unnecessary here to state : and if some writers on Geology in later times have professed to see in the earth nothing but the marks of an infinite series of revolutions, without the

It is impossible to contemplate a disposition of things so well accommodated, and indeed so essential to the various uses which the materials of the earth are calculated to afford to the industry of its inhabitants, and even to the supply of some of their first wants, and entirely to attribute such a system to the blind operation of fortuitous causes. Although it is indeed dangerous hastily to introduce final causes yet since it is evident that in many branches of physical knowledge, more especially those which relate to all organized matter, the final causes of the subjects with which they are conversant from perhaps that part of them which lies most obviously open to our cognizance, it would surely be as unphilosophical to scruple at the admission of these causes when the general tenor and evidence of the phenomena naturally suggest them, as it would be to introduce them gratuitously unsupported by such evidence. We may surely therefore feel ourselves authorized to view, in the Geological arrangement above described, a system of wise and benevolent contrivances prospectively subsidiary to the wants and comforts of the future inhabitants of the globe, and extending itself onwards, from its first formation through all the subsequent revolutions and convulsions that have affected the surface of our planet.

traces of a beginning; it will be quite sufficient to answer, that such views are confined to those writers who have presumed to compose theories of the earth, in the infancy of the science, before a sufficient number of facts had been collected ; and that, if possible, they are still more at variance with the conclusions of Geology, (as a science founded on observation,) than they are with those of Theology.

Let us now proceed to the second part of our inquiry, and examine in what degree the results of Geological investigations appear to have affected the evidences of revelation, by bringing to notice facts, which may seem at first sight to be inconsistent with the literal interpretation of the Mosaic records.

Unfortunately for the interests of philosophy, it has happened that a minute examination of the structure and composition of the earth has given rise to a difficulty from an apparent nonconformity of certain Geological phenomena with the literal and popular account of the creation, as it is presented to us in the book of Genesis, and in which the truth of that record seems at first sight to be implicated. If the fact I now allude to were not so generally notorious, that a recent Author ^g in one of our northern Universities has thought the subject of sufficient importance to devote a chapter of his work on the Evidences of Christianity to what he calls the scepticism of Geologists ; it might have been superfluous to introduce the mention of this subject before those who know the strength of the irrefragable moral evidence, on which the general authority of the sacred writings is established, and which cannot be invalidated by occasional differences touching minute details of historical

^g The Rev. Dr. Chalmers

events, or by objections on grounds so hypothetical and uncertain, as those afforded by the yet imperfect science of Geology. But to many who have not examined the detail of these evidences, and who look only to natural phenomena, an apparent inconsistency of tangible facts with the popular and literal interpretation of Scripture history presents difficulties, which have been supposed, however inconsiderately, to invalidate the truth of the Mosaic records.

Though it cannot be denied that some slight difficulties may exist, it is satisfactory to find that the evidence of facts unequivocally confirms the statement of these records in all points of most essential importance; and that our science stands on the same ground which astronomy occupied on the first publication of the system of Copernicus. It has added largely to the evidences of natural religion in that kingdom of nature, where proofs of design and order are most obscurely developed to the ordinary observer, and have been most frequently overlooked, and even denied ; and with respect to those points, on which the declaration of Scripture is positive and decisive, as, for instance, in asserting the low antiquity of the human race ; the evidence of all facts that have yet been established in Geology coincides with the records of Sacred History and Profane Tradition to confirm the conclusion, that the existence of mankind can on no account be supposed to have taken its beginning before that time which is assigned to it in the Mosaic writings.

Again, the grand fact of an universal deluge at no very remote period is proved on grounds so decisive and incontrovertible, that, had we never heard of such an event from Scripture, or any other authority, Geology of itself must have called in the assistance of some such catastrophe, to explain the phenomena of diluvian action

which are universally presented to us, and which are unintelligible without recourse to a deluge exerting its ravages at a period not more ancient than that announced in the Book of Genesis.

It is highly satisfactory to find the following strong statement on this subject, published by one who deservedly ranks in the very first class of natural observers, and in the very centre of continental philosophy. “ It may be seen,” says Cuvier, “ that nature every “where distinctly informs us that the commencement *of the present order of things cannot be dated at a very remote period* ; and it is “remarkable that mankind every where speak the same language “with nature.” And in another place he adds, “ I am of opinion “with M. Deluc and M. Dolomieu, that if there is any circumstance “thoroughly established in Geology, it is that the crust of our globe “has been subjected to a great and sudden revolution, the epoch of “which cannot be dated much farther back than five or six “thousand years ago; and that this revolution had buried all the “countries *which were before inhabited by men and by the other animals that are now best known.*” Theory of the Earth, §. 34.

The two great points then of the low antiquity of the human race, and the universality of a recent deluge, are most satisfactorily confirmed by every thing that has yet been brought to light by Geological investigations ; and as far as it goes, the Mosaic account is in perfect harmony with the discoveries of modern science. If Geology goes further, and shews that the present system of this planet is built on the wreck and ruins of one more ancient, there is nothing in this inconsistent with the Mosaic declaration, that the whole material universe was created in the beginning by the Almighty : and though Moses confines the detail of his history to the preparation of this globe for the reception of the human race, he does not deny the prior existence of another system of things,

of which it was quite foreign to his purpose to make mention, as having no reference to the destiny or to the moral conduct of created man.

The true state of the question respecting the difficulties that arise from the periods of time in which the creation is said to have taken place, has been set forth with much ability and fairness by Mr. Sumner, a divine whose rational and sober piety no person will venture to dispute, and whose admirable work on the Records of Creation, from its originality of sentiment, accuracy of argument, and elegance of writing, ranks amongst the most able productions of the present day.

“Any curious information as to the structure of the earth “ought not,” he says, “to be expected by any one acquainted with “the general character of the Mosaic records. There is nothing in “them to gratify the curiosity or repress the researches of mankind, “when brought in the progress of cultivation to calculate the “motions of the heavenly bodies, or speculate on the formation of “the globe. The expressions of Moses are evidently accommodated to “the first and familiar notions derived from the sensible “appearances of the earth and heavens; and the absurdity of “supposing that the literal interpretation of terms in Scripture “ought to interfere with philosophical inquiry would have been as “generally forgotten as renounced, if the oppressors of Galileo had “not found a place in history. The concessions, if they may be so “called, of believers in Revelation on this point have been amply “remunerated by the sublime discoveries as to the prospective “wisdom of the Creator, which have been gradually unfolded by the “progressive improvements in astronomical knowledge. We may “trust with the same confidence as to any future results from “Geology, if this science should ever find its Newton, and break “through the various obstacles peculiar to

“that study, which have hitherto precluded any general solution of its numerous and opposite phenomena.”

After following up these general remarks with a more detailed exposition of the harmony which subsists between the facts observable in the structure of the earth, and a fair and liberal interpretation of the Mosaic account of the creation, Mr. Sumner concludes his statement with the following satisfactory result of his investigations.

“All that I am concerned to establish is the unreasonableness “of supposing that Geological discoveries, as far as they have “hitherto proceeded, are hostile to the Mosaic account of the “creation. No rational naturalist would attempt to describe either “from the brief narration in Genesis or otherwise, the process by “which our system was brought from confusion into a regular and “habitable state. No rational theologian will direct his hostility “against any theory which, acknowledging the agency of the “Creator only attempts to point out the secondary instruments he “has employed. It may be safely affirmed, that no Geological theory “has yet been proposed, which is not less reconcileable to “ascertained facts and conflicting phenomena than to the Mosaic “history.”

“According to that history, we are bound to admit, that only “one general destruction or revolution of the globe has taken place “since the period of that creation which Moses records, and of “which Adam and Eve were the first inhabitants. The certainty of “one event of that kind would appear from the discoveries of “geologists, even if it were not declared by the sacred historian. *But “we are not called upon to deny the possible existence of previous “worlds, from the wreck of which our globe was organized, and the “ruins of which are now furnishing matter*

“to our curiosity. The belief of their existence is indeed consistent with rational probability, and somewhat confirmed by the discoveries of Astronomy, as to the plurality of worlds^h.”

A similar exposition of the acceptation in which we ought to receive the opinions expressed or implied in the sacred writings on subjects connected with the discoveries of modern Physics, has been still more strongly given by the illustrious Bishop Horsley in many of his sermons, and more especially in that preached before the Humane Societyⁱ.

Buffon also, in the results which were continually arising from his endless investigations into natural history, declares that he discovered no inconsistency between these phenomena and the statements of the Mosaic records^k.

It cannot however be denied, that examples of its abuse have for a long time caused the study of the Physical sciences, and in later days more particularly the pursuit of inquiries into Geology, to lie under the imputation of being dangerous to Religion. When it was attempted to explain every thing by the sole agency of second causes, without any reference whatever to the first ; when nature was set up as an original source of being, distinct and independent of the Almighty ; when it was taught that matter possessed an existence which he never gave it, and that the elements had differences and qualities independent of him : these surely were grounds sufficient to excite alarm in all persons who were zealous for the cause of religion, and the preservation of the

^h Vid. Records of Creation, vol. 2. p. 856.

ⁱ Horsley's Sermons, 8vo. 1816, vol. 3. Sermon. 39.

^k Histoire Naturelle, tom. 12. Des Epoques de la Nature.

best interests of mankind. But the doctrines which gave Philosophy its formidable aspect have now been almost utterly abandoned : and if we will calmly allow reason to subdue the first alarm which excessive zeal excites in good and pious minds, it will teach us, that nothing can be more unjust than the apprehension lest the study of nature, when rightly pursued, or in other words, the contemplation of the attributes of the Creator, as they are displayed through the medium of his works, should in anyway be destructive of the credibility of those things, which he has disclosed to us in the revelation of his will.

The existence of this feeling of unnecessary alarm, and the injustice and unreasonableness of entertaining it, have been admirably marked out by the great master of modern science, where he is describing the obstacles which in his time were opposed to its advancement, and shewing the absurdity, if not impiety of dissolving that union, by which Philosophy becomes associated in its natural and just office, as the faithful auxiliary and handmaid of Religion. “ *Naturalem eiiim Philosophiam, (post verbum Dei certissimam superstitionis medicinam,) eandem probatissimum fidei alimentum esse. Itaque mérito religioni, tanquam fidissimam et acceptissimam ancillam, attribui, cum altera voluntatem Dei altera potestatem manifested.*”

It was seen distinctly, and felt experimentally by that great Philosopher whose words I have now quoted, that the illustration of the divine attributes, and the advancement of Religion, are the great objects which stamp value upon natural knowledge, and that it is something very different from fair investigation that will conduct its followers to infidelity ; and I cannot better conclude this part of my subject, than in his own impressive words : “ Let no man upon a weak conceit of sobriety or ill applied moderation think or maintain that a man can search too far, or be too well

“studied ‘ in the Book of God’s Word,’ or the ‘ Book of God’s Works ’ ; but rather let men endeavour an endless progress and “proficiency in both : only let them beware that they apply both to “charity, and not to swelling ; to use, and not to ostentation ; and “again, that they do not unwisely mingle or confound these “learnings together ¹.”

Having premised thus much as to the general state of the question, let us proceed to view the case before us, and examine how far the phenomena developed by Geological investigations can be shewn to be in no way inconsistent with the true spirit of the Mosaic cosmogony.

We find the primitive rocks on the greater portion of the earth’s surface, (i. e. rocks which contain no remains of animal or vegetable life, or fragments of other rocks,) covered by an accumulation of derivative or secondary strata, the greatest perpendicular thickness of which cannot be estimated at less than two miles. These strata do not appear to have been deposited hastily and suddenly ; on the contrary, the phenomena attendant on them are such as prove that their formation was slow and gradual, going on during successive periods of tranquillity and great disturbance; and being in some cases entirely produced from the destruction of more ancient rocks, which had been consolidated, and again broken up by violent convulsions antecedent to the deposition of those more modern or secondary strata which are sometimes in great measure derivative from their exuviae.

The differences also of the organic remains both of animals and

¹ Advancement of Learning, lib. 1

vegetables, contained in the different strata successively deposited upon each other, and again their non-agreement with now existing species, seem to indicate that great changes have taken place in animated nature, and that new races of organized beings have successively arisen and become extinct during the periods at which these strata were formed ; and thus to point out a series of revolutions, to the last of which the present system of the earth and its inhabitants belongs ^m.

It seems therefore impossible to ascribe the formation of these strata to a period so short as the single year occupied by the Mosaic deluge ; which was an opinion at first naturally adopted by those who observed the occurrence of marine shells in inland countries at great elevations above the present ocean, but who were ignorant of the enormous masses, and subdivisions of distinct secondary strata, above alluded to, and of the facts which prove their slow, gradual, and successive deposition. The deluge has indeed left traces of its operation deeply sculptured on every stratum of the earth, but they are such as differ most essentially from those we are now considering ; and prove the deposition of these strata to have been antecedent to that catastrophe ; which as it is recorded in Scripture merely as a work of destruction, so has it left behind it undeniable evidences that its tendency was only to destroy. But the strata we have been considering, although they bear on their surface unequivocal marks of the agency of that convulsion, were evidently not produced, but partially destroyed by it, and must be referred for their origin to periods of much higher antiquity.

^m For a concise and able statement of the leading phenomena as yet observed, which prove that numerous revolutions have affected the surface of the earth, both before and since the creation of living beings ; and of the successive changes that have taken place in animal nature, during the progress of these revolutions ; see Cuvier's admirable Essay on the Theory of the Earth.

It has been supposed therefore by others, with greater plausibility, that these strata have been formed at the bottom of the antediluvian ocean during the interval between the Mosaic Creation and the Deluge; and that, at the time of that deluge, portions of the globe, which had been previously elevated above the level of the sea, and formed the antediluvian continents, were suddenly submerged with their inhabitants, while the ancient bed of the ocean rose to supply their place. This hypothesis, it has been said, has the advantage of explaining the cause why the remains imbedded in the strata are principally those of marine animals : but it labours under considerable objections. It should rather appear from the little that is said in Scripture, that the antediluvian continents were the same with the present : and a similar conclusion is to be derived from the universal diffusion of the bones of land animals in those superficial depositions of gravel, which seem to have resulted from the deluge, in almost every valley of the earth that has been made the subject of geological investigations. As these bones are remarkably perfect, and seldom have signs of having been much rolled, or transported from a distance, they appear to have belonged to animals that lived and died near the spots where they are now found : those places consequently must have formed parts not of the ocean of the antediluvian world, but of its continents.

A third hypothesis may be suggested, which supposes the word “beginning” as applied by Moses in the first verse of the Book of Genesis, to express an undefined period of time which was antecedent to the last great change that affected the surface of the earth, and to the creation of its present animal and vegetable inhabitants; during which period a long series of operations and revolutions may have been going on, which, as they are wholly unconnected with the history of the human race, are passed over in silence by the sacred historian, whose only concern with them

was barely to state, that the matter of the universe is not eternal and self-existent, but was originally created by the power of the Almighty.

A fourth hypothesis is that which follows the opinion previously adopted by many learned and pious men, on grounds very different from those of Geology, that the days of the Mosaic creation are not to be strictly construed as implying the same length of time which is at present occupied by a single revolution of our globe, but Periods of a much longer extent. And Bishop Horsley, while he insists that the day in the Mosaic account could only signify a revolution of the earth round its axis, still adds these remarkable words, which do, in fact, admit the whole of this hypothesis ; “ That this revolution was performed in the same space of time in the beginning of the world and now, I could not over-confidently affirm ⁿ.”

To the first and second of these solutions there seem to be, as I have already stated, some considerable objections.

The first is both at variance with the Sacred Records, and still more inconsistent with the phenomena of Nature.

The second, and I say it with diffidence, as it has received the countenance of very high authority, while it derives assuredly no support from the Sacred Records, is also, on the side of natural appearances, liable to objections not yet sufficiently removed.

And if, by the assistance of either of the two last, (and perhaps more particularly of the third,) we may be enabled to remove the leading difficulties which the infant state of Geology as yet can-

ⁿ Vol. ii. Semi. 23. On the Sabbath

not but present to us ; it from these conjectures no detriment can be shewn to arise to the faith of the most pious individual ; if they have, in tact, been maintained by some of the ablest divines and writers of the English Church, men uninterested in Geology, but interested in Religion ; no danger surely can be apprehended from their admission : nor shall we think it necessary to discard them, until some stronger reason shall be brought for their rejection, or until some happier Genius shall have arisen to shed new light upon our inquiries.

Difficulties indeed will still present themselves, but difficulties by which neither will the ardor of science be discouraged, nor the full confidence of religious faith be shaken; difficulties such as those of which the whole moral and material world is full, and without the existence of which, in the opinion of the celebrated Pascal, it were not easy to believe that this world which we inhabit is the production of that mysterious Being, “ whose ways are “unsearchable, and his works past finding out.”

APPENDIX,

Containing a brief Summary of the Proofs afforded by Geology, of the Mosaic Deluge.

I HAVE been induced to draw up the following Appendix in consequence of an article which appeared in the Quarterly Review of May 1819, on Mr. Gisborne's Testimony of Natural Theology to Christianity.

With the learned writer of this Review I fully coincide in every sentiment of the highest respect for the character of Mr. Gisborne, and in every opinion which he has expressed with so much ability on the Geological errors which his work contains.

There is, however, one point of vital importance, on which it is sufficiently apparent, from the preceding Lecture, that I entirely differ from the writer of this Review, namely, in the belief he entertains, on the authority of Linnæus, that Geology affords no proofs of the Mosaic Deluge : and this difference may be the more securely stated, as the general attachment of the Quarterly Review to the cause of Revelation is so decided ; and as the very paper in question contains the strongest assertions of the truth of the Mosaic History : it is simply therefore a matter of science, on which our opinions are at variance.

That Linnæus himself should have held such opinions at a period when Geology was in its first infancy, and many of its most important phenomena were totally unknown ; and when it was impossible for him to distinguish those effects which are attributable simply to the action of the Mosaic Deluge, from the more numerous cases of analogous disturbances

which the earth appears to have undergone before the creation of man ; is a circumstance which can excite in us no surprise. But I am at a loss to conceive how any person who has evidently read the works of Cuvier with so much attention as the writer of this Review, and who reproaches Mr. Gisborne for want of knowledge of this author, could have been induced to revert to the premature opinion of so infantine a Geologist as Linnæus, and have overlooked that most important conclusion which I have before quoted, in which Cuvier himself sums up the results of his own valuable observations ^a.

In every thing that I have been able to observe myself, or to collect from others whose opinions on such subjects I most highly respect, I find a series of numerous and widely varied facts ; a certain class of which bears as unequivocal evidence to the existence of a Deluge, at or near the period assigned to it by Moses; as the phenomena of stratification afford, on the other hand, of a succession of different and more ancient revolutions affecting our planet before the existence of the human race. And it is from want of accuracy in distinguishing between these facts that errors have prevailed, such as those into which Linnæus fell.

On the detail of those evidences of a recent diluvian action which are afforded in the neighbourhood of Oxford, and in some of the central parts of England, I have recently spoken more at large in another place, to which it seems more peculiarly adapted ^b. It may be sufficient here to state very summarily the main reasons which confirm me in the opinion which I have always entertained. The proofs then of the Mosaic Deluge presented by natural phenomena are in my opinion these.

^a See p. 2-1. of the above Lecture, and Sect. 34. of Jameson's translations of Cuvier's Theory of the Earth.

^b See paper on the evidences of a recent Deluge afforded by the gravel beds and state of the plains and valleys of the central parts of England, presented to the Geological Society by myself in November 1819 ; and also another memoir laid before the same Society by the Rev. W. D. Conybeare and myself, on the coal districts of Somerset and S. Gloucestershire, in which the decisive evidences of diluvian action presented in those counties are given in considerable detail.

1. The general shape and position of hills and valleys; the former having their sides and surfaces universally modified by the action of violent waters, and presenting often the same alternation of salient and retiring angles that mark the course of a common river. And the latter, in those cases, which are called valleys of denudation, being attended with such phenomena as shew them to owe their existence entirely to excavation under the action of a retiring flood of waters.

2. The almost universal confluence and successive inosculation of minor valleys with each other, and final termination of them all in some main trunk which conducts them to the sea; and the rare interruption of their courses by transverse barriers producing lakes.

3. The occurrence of detached insulated masses of horizontal strata called outliers, at considerable distances from the beds of which they once evidently formed a continuous part, and from which they have been at a recent period separated by deep and precipitous valleys of denudation.

4. The immense deposits of gravel that occur occasionally on the summits of hills, and almost universally in valleys over the whole world; in situations to which no torrents or rivers such as are now in action could ever have drifted them.

5. The nature of this gravel, being in part composed of the wreck of the neighbouring hills, and partly of fragments and blocks that have been transported from very distant regions.

6. The nature and condition of the organic remains deposited in this gravel, many, though not all of them, being identical with species that now exist, and very few having undergone the smallest process of mineralization. Their condition resembles rather that of common grave bones, than of those fossil bones which are found imbedded in the regular strata, being in so recent a state, and having undergone so little decay, that if the records of history, and the circumstances that attend them, did not absolutely forbid such a supposition, we should be inclined to attribute them even to a much later period than the Mosaic Deluge : and certainly there is, in my opinion,

no single fact connected with them, that should lead us to date their origin from any more ancient era.

7. The total impossibility of referring any one of these appearances to the action of ancient or modern rivers, or any other causes, that are now, or appear ever to have been in action since the last retreat of the diluvian waters.

8. The analogous occurrence of similar phenomena in almost all the regions of the world, that have hitherto been scientifically investigated, presenting a series of facts that are uniformly consistent with the hypothesis of a contemporaneous and diluvian origin.

9. The perfect harmony and consistency in the circumstances of those few changes that now go on, (e. g. the formation of ravines and gravel by mountain torrents ; the depth and continual growth of peat bogs; the formation of tufa, sand-banks, and deltas ; and the filling up of lakes, estuaries, and marshes,) with the hypothesis which dates the commencement of all such operations at a period not more ancient than the Mosaic Deluge.

All these, whether considered collectively or separately, present such a general conformity of facts, tending to establish the universality of a recent Deluge, as no difficulties or objections that have hitherto arisen are in anyway sufficient to overrule.

In the full confidence that these difficulties will at length be removed, however slowly, by the gradual progress and extension of science, we may for the present rest satisfied with the argument, that numberless phenomena have been already ascertained, which, without the admission of a recent and universal Deluge, it seems not easy, nay, utterly impossible to explain.

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