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661ST ORDINARY GENERAL MEETING,

HELD IN COMMITTEE ROOM B, THE CENTRAL HALL, WESTMINSTER, S.W., ON MONDAY, FEBRUARY 18TH, 1924 AT 4.30 P.M.

WILLIAM DALE, ESQ., F.G.S., F.S.A., IN THE CHAIR.

The Minutes of the previous meeting were read and signed, and the Honorary Secretary announced that Pastor W. Percival-Prescott had been elected as a Member, and Major J. A. McQueen, D.S.O., the Rev. Canon F. R. Lawrence, Mr. Henry Walker, Dr. C. G. S. Baronsfeather, Miss L. C. Ord, Mr. H. C. W. Lewis, the Rev. R. J. H. McGowan, and the Rev. M. B. Ingle as Associates.

The CHAIRMAN, himself 50 years a Fellow of the Geological Society, then explained the absence of the Lecturer, Prof. G. McCready Price, and himself read the paper on "Geology and its Relation to Scripture Revelation."

GEOLOGY AND ITS RELATION TO SCRIPTURE REVELATION. By Professor GEORGE MCCREADY PRICE, M.A.

MANY English writers seem to be surprised, not to say amused, at the widespread discussion of the evolution doctrine now going on in America. This belated discussion of questions which they think were settled a generation ago seems to them but another proof of the verdant immaturity of American culture. I have no intention of trying to vindicate the culture of the people of the United States; but a closer view of the situation will show that this renewed discussion of the problems relating to the origin of things is, in reality, only the natural result of recent scientific discoveries which have come into prominence in America more than elsewhere. My friend Mr. William Jennings Bryan, with many teachers and ministers classed as "Fundamentalists," have usually been credited with reviving this discussion of ancient problems; when in reality there is a large body of scientific facts which have been the inciting cause of this renewal of the discussions of fifty years ago. Some of these scientific facts are very recent discoveries; others

are not exactly new, though they are now seen in a new light; and it is for a consideration of these matters that I would beg to have your charitable attention for a brief period.

I wish I might say a few words of a personal nature without appearing to be too egotistical. I wish I might tell you of the geological surroundings of my childhood's home in New Brunswick, Eastern Canada, not far from the birthplace of the Hon. Bonar Law; and of how I am still a British subject, though I have lived so many years in the United States. I wish I could take the time to tell you how, when I was invited to present this paper before the VICTORIA INSTITUTE, every nerve of my being thrilled at the honour of such an opportunity, and how my only regret was that my college duties would not permit me to present this paper in person.

But it would be too much of an imposition on your patience and good nature for me to indulge in further reminiscences, or to do more than suggest that possibly the half-dozen books which I have written along the line of my lifetime studies may be regarded as contributing to the present widespread agitation of these problems among the people of America. Rather is it in order for me to give very briefly the present status of those recent geological discoveries which have now shifted the point of interest in the problem of evolution from the biological to the geological phase. For while under the guidance of Charles Darwin the world has been exploring every nook and cranny of the field of biology for the past half-century, we are now beginning to realize that the future of this problem of origins must be worked out rather in the field of geology. The microscope, the seed-bed, and the breeding pen have been long consulted, and, seemingly, have nothing more to offer us in the way of hopeful clues regarding the great problem of origins. We must now turn to those tombstone inscriptions of the buried dead found so abundantly in the strata of every mountain side; for these epitaphs in stone, engraved by nature herself when she was in the very act of burying these myriads, contain the true record of the physical and the organic history of our world; and this record, when rightly translated, must throw some light on the problems we are trying to study. It was the geological problem of the fossils of South America which first started Darwin on the path of evolutionary investigation; and to the problem of the great fossil world we must now return for the final solution of those questions which we now see can never be solved by biological studies alone.

At the outset, it is important that we keep in mind some of the fundamental principles of all scientific investigation. For only as we follow true scientific methods can we be sure of our results.

Geology, like any other science, consists of two distinct parts, facts and conclusions. The facts are the raw materials with which science works; while the conclusions are the theories, or generalizations, by means of which the facts are organized with reference to one another, or with reference to other facts; that is, by means of which these facts are "explained."

Thus a theory is a vital part of any science; and there can be no science without many theories. Also, a theory is of little value unless it is to be used; and any theory in explanation of certain facts, when used to explain other facts, becomes an hypothesis. In other words, a theory put to work becomes an hypothesis. But hypotheses are always dangerous things. We put our intellectual freedom at stake whenever we adopt an hypothesis. We can make absolutely no progress in any line of scientific investigation without using them; yet they are more dangerous to use than dynamite. And the more we use an hypothesis, that is, the more familiar we become with its method of explaining nature, the more do we become its slaves, and the more hopelessly are we blinded to other facts all around us which may not happen to be easily understood in the light of our cherished explanation. For a cherished hypothesis always tends to blind the eyes of the observer, just as the good Book says that a gift will blind the eyes of a judge in court.

We all remember many examples of this blinding power of a brilliant theory which has long been used to explain other facts. In geological history we have the notorious onion-coat theory of Werner, which for many decades acted as a mentor to all the explorers on three continents; for the latter all thought they ought to find the rocks always occurring in the same relative order of sequence as Werner had taught them to expect.

Ultimately, of course, examples were bound to be found in various parts of the world sufficient to convince the geologists that Werner had not been gifted with any supernatural knowledge of how the rocks might be found occurring on the other side of the globe. Unfortunately, by this time the emphasis had been cleverly transferred from the lithic or mineralogical character of the rocks to their fossil contents. And, under the guidance of Cuvier and William Smith, of Sedgwick, and Murchison, and

Lyell, the world once more set forth on the quest of new discoveries, their key this time consisting of a much more elastic time-scale based on alleged successive types of life. The relative age of any newly discovered rocks in Greenland, in Tasmania, in Florida, or in Timbuktu, could always be told with the most charming facility by merely checking up their fossils with this standard time-scale. And in the rush after new discoveries in the field, nearly a century passed by before the eager explorers paused long enough to consider the logical basis for their method. Any rocks, in any corner of the globe, could be so easily and so positively classified according to the fossils they contained; accordingly, what more was needed? Did not the perfect ease with which this hypothesis worked prove its truthfulness? Thus, for two or three generations we have been working under the unquestioned mentorship of an organic onion-coat theory, instead of a mineralogical one; and it has required some real intellectual courage on the part of some of us to look this theory squarely in the face and question its logical right to dominate the thinking of this third decade of the twentieth century.

Let us, if possible (for with some the results will be only approximate), divest our minds of all theoretical prejudices in the way of theories, and consider that we have merely the entire body of geological facts before us demanding explanation. Profound changes in land and water, also profound changes in plant and animal life, are what we find recorded in the rocks in all parts of the world. How were these changes brought about? How shall we "explain" them?

I need not remind an English audience that we have had a variety of explanations; for one might almost say that all the leading theories of geology have originated somewhere in these islands. For a similar reason I need not say that many different methods have been attempted of "harmonizing" the supposed facts of geology with the Scriptural record of the early days of our world. All of these alluring subjects would make very interesting topics for discussion; but they would delay us too long. Two alternative explanations alone will concern us here, the uniformitarian and the catastrophic. And by the latter term I do not mean that burlesque, consisting of a long series of successive catastrophes and of a corresponding series of creations on the instalment plan, which the brilliant genius of Cuvier fastened on the scientific world for nearly a generation. The hypothesis of the New Catastrophism looks at the world as a whole, the world

in which man and his contemporary plants and animals have been living. It reverses the common method of beginning at the vanishing point of the vistas of a past eternity and working up to the present ; it begins with the present world of plants and animals and works by regression back into the past as far as it can go, and it ceases to theorize when it runs out of facts. Facing the fossil world as a whole, a unit, it says that the evidence seems to indicate some great world catastrophe as the most probable general explanation of the major part, but a quite indefinite and undefinable part, of the stratified deposits. But its attitude is not dogmatic ; it is teachable and willing to learn.

Of these two hypotheses, uniformity or catastrophism, I readily confess that it is very natural to adopt the uniformitarian explanation. Perhaps slow, gradual changes, such as are now going on, would be sufficient, granting time enough, to explain the geological record. Thus Lyellism is a perfectly natural hypothesis ; just as it would be perfectly natural and scientific to assume that everybody is honest and all are good, orderly citizens when we find a dead body by the roadside. The man very probably had heart-disease, and thus died what we call a natural death.

But we might be compelled to change our minds, and to say that the man under consideration had died a violent death. It would all depend upon the evidence. Our predilections in favour of good citizenship might be very reasonable and very strong ; yet we might have to yield before overwhelming evidence. Similarly, the geological question of uniformity or catastrophism is merely a matter of evidence. Geologists are only coroners at large. And whenever the facts are all in, or are sufficiently understood from all parts of the globe, our science, if it is good for anything, ought to be capable of settling very positively whether or not the tools of nature have always worked with that quiet regular order with which they have been observed to operate since the beginning of scientific observation. And no uniformitarian prejudices ought to be allowed to hinder us from bringing in a verdict that would be true because in full accord with the evidence.

But at the outset of our investigations we are confronted with a very serious difficulty. For uniformity and the new catastrophism cannot agree as to the proper method of procedure. Uniformity forbids us to consider the fossiliferous deposits as a whole ; we are told that we must take them a few at a time, and

in a very definite and precise order. It informs us in a lofty way that only certain deposits with certain types of life were formed at a certain time, and the other deposits were formed in a long succession thereafter. This appears very reasonable for any *local* deposit, because we can see with our eyes the plain record of successive events. And clearly this order of events could be spoken of as a world-order, or true for the whole world, providing these strata or formations could be spoken of as universal around the globe. But if these formations are merely *local*, and we do not dogmatically deny the possibility of zoological provinces and districts in the long ago, how are we to erect these local records into a time-scale for the whole world ? In other words, if we do not assume the onion-coat theory in its organic form, how are we to determine the precise order in which any world-series of events took place ? If we find some trilobites in Newfoundland and some ammonites in Texas, how are we to be sure that the former lived long ages before the latter ? If we find some coal beds in Pennsylvania, some more in Alberta equally good and equally consolidated, and some other coal-beds in Germany or in Australia, how are we to be certain that the plants represented by these various beds could not possibly have lived contemporaneously, but that while some were living in what is now Alberta, those in Pennsylvania had already been buried for millions of years, while those in Germany and Australia would not be alive for many more millions of years ? In short, if we must accept this scheme offered by uniformity of a succession of life in a definite order, and must accept it entire before we can consider the fossiliferous deposits at all, may we not ask for absolute and conclusive proof of the validity of this alleged historical succession ?

Obviously, then, before we can settle the case between uniformity and catastrophism, we shall have to look carefully into this matter of the geological time-scale marked off by successive groups of life.

Minds of the first order are characterized by a tendency to reduce a complex problem to its lowest terms, or to strip it of all non-essentials and to consider it in its most elementary form.

Dr. William Bateson, in his address at Toronto two years ago, an address which has already become historic, faced this problem which we are studying, and asked how we are to be sure that no mammals lived contemporary with the Paleozoic trilobites and

graptolites. He admitted it might be somewhat difficult to prove this point in the case of the animals ; but he thought that we can be absolutely sure about it in the case of the plants. He declared that the Angiosperms, or " higher " plants with protected seeds, could not have been living contemporary with the plants of the Carboniferous coal-beds ; because, if they had been contemporary, the two floras would have become intermingled in the deposits, and no clear example of this has yet been found. Hence, he argued that the Angiosperms must have appeared on earth subsequently to the existence of the Carboniferous flora.

However, so many other possible alternatives arise in the mind, that is, Dr. Bateson's conclusion is so obviously a *non sequitur*, that most of my hearers will conclude that if this is the best that can be done to prove the reality of the geological succession of life, the latter must have a very precarious foundation. But it will be worth our while to see what other men have said upon this same subject.

A careful examination of all the scientific literature of the past century or so reveals the surprising fact that only a very few writers seem ever to have thought of this problem at all. Huxley has left us what occurred to him ; but he did not find any firm foundation on which to rest this wide and far-reaching dictum of the uniformitarian geologists that there has been a succession of various types of life on the globe in a well-defined and definite order. In his essay on " Homotaxis," as it is sometimes called, he points out how impossible it would be to prove that there may *not* have been biological provinces and districts in the long ago, just as there are to-day. Thus, as he says, a Devonian fauna and flora may have been contemporary with a Silurian life in North America and with a Carboniferous life in Africa. He adds : " *All that geology can prove is local order of succession* " ; and he goes on to say that, " the moment the geologist has to do with large areas, or with completely separated deposits," it is vicious and dangerous to affirm a relative chronology for these separated beds. And he concludes with these memorable words : " In the present condition of our knowledge and of our methods, one verdict—' *not proven and not provable* '—must be recorded against all grand hypotheses of the paleontologist respecting the general succession of life on the globe."

Several decades before these words of Huxley were uttered, Herbert Spencer left on record what he had thought out regarding this same problem. In his mind also this idea of a world-series

of successive life-forms appeared to be logically indefensible, because of this prime fact that the geological formations *are local and not universal.* But he pointed out that Lyell and his contemporary geologists kept on assuming that their geological formations were universal around the globe; and I have not observed any tendency on the part of the modern followers of Lyell to discontinue this assumption. But Spencer for ever pillories this organic onion-coat theory in the following words: "Must we not say that, though the onion-coat hypothesis is dead, its spirit is traceable, under a transcendental form, even in the conclusions of its antagonists?"

Throughout the literature of the science will be found several other scanty references to this general problem of how to prove in a logical and scientific manner the reality of these successive ages of the geologist. This abstract phase of the matter is itself capable of extensive treatment, and the present writer has considered it elsewhere ("The Fundamentals of Geology," Chap. I; "The New Geology: a Textbook for Colleges," Chap. XL). Without dwelling longer on this phase of the problem, it will be in order for us to consider more concrete facts. If we study the fossiliferous deposits in all their various relations, first with reference to the rocks below themselves and to those above, and second with reference to their relations toward one another, we may be able to decide whether they always occur in the same invariable order of sequence.

I must refrain from encumbering my paper with specific references to the various authorities for all my statements. Full references will be found in the two volumes already referred to; also in a paper in the *Princeton Theological Review*, October, 1922, pp. 585–615.

A.—When we consider the external relations of the fossiliferous rocks, with reference to the rocks below and also to the surface conditions, we recognize three general facts:—

(1) Any of them—that is, beds belonging to any of the "systems," or general divisions—may be found resting directly on the Archæan or Primitive, this position being apparently sufficient evidence to justify us in saying that they may all be of the same age.

Through a considerable part of Georgia, the Cretaceous beds rest on the Archæan or old crystallines. Over much of the Rocky Mountain region, the Triassic are in this position; and these conditions extend southward over the greater part of Mexico and

Central America. In Jamaica and Cuba, again, the Cretaceous are similarly situated; while the Mesozoic quite generally occur in this position throughout Saxony and Bohemia, and it was on this account that they were formerly called the "Secondary" rocks. Throughout much of California, the Tertiary formations (Eocene and Miocene) are also found resting directly on the old granites and gneisses.

If we judge these beds solely by their position with reference to the Archæan or Primitive, which of these sets of beds is the oldest? Or can any single one be said to be older than the others? And, in view of this general fact, that any formation may be found resting on the Primitive and extending over wide areas, where are we to go to *start* the geological succession? And where shall we go to find some fossil-bearing rocks which we can prove to be really older than all others?

(2) We also find that any of the fossiliferous formations, even the so-called "youngest," may be highly metamorphosed and crystalline.

The gold-bearing Jurassic slates of the Sierra Nevada range are of this character, as are also the Tertiary of the Coast Range and of other parts of California. The Eocene schists and gneisses of the Alps and the Eocene marbles of the Himalayas are also as distinctly crystalline as any of the Paleozoic rocks. Even the Pleistocene, the so-called "youngest" of all the fossiliferous deposits, is occasionally highly consolidated, as is seen in the Nagelfluh of Salzburg, Austria, where chapels and rooms underground have continued in splendid preservation since the third century. At Lewiston, on the Niagara, is a similar deposit of Pleistocene, so hard as to require a hammer to break it.

If judged by their degree of consolidation, which of these rocks should be spoken of as the youngest? And why are not any of them just as old, in all probability, as any of the Cambrian or Silurian of Wales or Scandinavia?

(3) Any of the fossiliferous rocks may not only constitute the surface beds over wide areas; they may also consist of loose, unconsolidated materials, in this respect resembling the "late" Tertiaries or the Pleistocene.

The Cambrian beds around the Baltic are in this condition. I quote from a standard authority: "The rocks still retain their original horizontality of deposition, the muds are scarcely indurated, and the sands are still incoherent" (J. A. Howe, "Encycl. Brit.," Vol. V, p. 86). The Cambrian beds in Wisconsin

could be similarly described, as could also the Penokee series near Lake Superior, usually called Algonkian.

Similar facts occur regarding the Ordovician, rated as next in age to the Cambrian. Again I quote: "Across Northern Russia, Ordovician rocks cover a great area; they consist of clays, bituminous and calcareous shales, sands, and marls . . . they lie flat and undisturbed . . . the sands and clays are as soft and incoherent as the similar rocks of Tertiary age in the south of England" ("Encycl. Brit.," Vol. XX, pp. 236, 237).

In Tennessee, Mississippi, and Alabama, the Cretaceous beds are equally unconsolidated. The list might be indefinitely extended.

Considered solely by the tests of common sense, which of these formations is the oldest? Or why should any of them be regarded as intrinsically any older than the chalk of Kent or the Tertiary of the Thames valley?

B.—Having now considered the various fossiliferous rocks in their external relations, with reference both to the rocks below them and to the surface conditions, let us now consider them in their internal relations, that is, with reference to one another. Do they always occur in at least the same order relative to each other?

(1) The first principle which we find under this head is that great gaps may occur in this relative sequence, the "younger" beds resting on strata alleged to be very greatly older, but resting *conformably*, as geologists express it, that is, with no physical evidence of any such alleged gap. There has been no disturbance of the lower beds, and not even any erosion of its upper surface, before the upper set were laid down upon them.

A brief word of explanation may be appropriate here. Ordinary conformity is easily understood; the one stratum has followed the other with only a slight interval of time intervening. In other words, real conformity between two successive strata represents substantial continuity of deposition.

But the advocates of the life-succession theory say that the cases which we are now considering are not of this nature. They look like cases of ordinary conformity; but they tell us that this appearance is deceptive, for the fossils in the two sets of beds are very, very different. Accordingly, such cases have been given the name of "deceptive conformities." For, according to this theory, there must have been millions of years between the two beds, perhaps many millions of years, although it may look

exactly like a case of ordinary conformity. There is no difference in dip between the two sets of strata above and below this alleged "hiatus," and no erosion on the surface of the lower beds. Moreover, in many cases, also, the two sets of strata are lithically alike; that is, a limestone in the lower set of strata may be followed by a similar limestone in the upper, or a shale may be followed by a similar shale. And yet the insignificant line between them, which it takes an expert to find, may represent a time interval, we are told, of many millions of years. No wonder uniformitarian geologists call it a case of "deceptive conformity."

Let us note some specific examples.

Near Banff, Alberta, Canada, Lower Cretaceous beds are found resting on Lower Carboniferous "without any perceptible break, and the separation of the one from the other," we are told, "is rendered more difficult by the fact that the upper beds of the Carboniferous are lithologically almost precisely like those of the Cretaceous [above them]. Were it not for fossil evidence, one would naturally suppose that a single formation was being dealt with" (Canadian Annual *Report*, N.S., Vol. 2, Part A, p. 8).

And these words which I have just quoted are the more significant when we remember that they are not the words of some youthful novice, but are the pronouncement of the Hon. A. R. C. Selwyn, one of the most illustrious men who ever held the office of Director of the Geological Survey of Canada.

In this instance, the Upper Carboniferous, the Permian, the Triassic, and the Jurassic are absent.

Further north, on the Athabasca, we have a Devonian limestone succeeded by a Cretaceous limestone. This example is also of very wide extent, covering what must be several hundred square miles of area. Here the entire Carboniferous, the Permian, the Triassic, and the Jurassic are absent. Are we to suppose that after this Devonian limestone was deposited, Nature served an injunction on any further action of the elements, and everything had to continue in the *status quo* for all these uncounted millions of years, until Nature was ready to spread out another very similar limestone over the first?

Surely a theory must be very sacred that can be adhered to in the face of such facts as these.

At Louisville, Kentucky, a coral limestone, classed as Middle Devonian, rests in perfect conformity upon an almost exactly similar-looking coral limestone which, because it carries different

fossils, is classed as Middle Silurian, the hiatus representing the last third of Silurian and the first third of Devonian time. And we are told by Charles Schuchert, that " the absolute conformability of the beds can be traced for nearly a mile," and that " the parting between these two zones is like that between any two limestone beds."

At Newsom, Tennessee, 200 miles away, exactly similar rocks occur in the very same position of deceptive conformity ; and it would not be at all unreasonable to suppose that the entire interval between these two outcrops, if exposed to view, would show that these conditions were continuous over all this area.

It would be tiresome to give further examples. One of the leading paleontologists of America, in a private conversation, recently told me that he thought he himself had seen a thousand examples of such deceptive conformity, some of them of sufficient area to equal one or more states.

As for other general statements, we might quote Charles Darwin to show that " many cases " of the sort were known in his day. Or we might quote A. Geikie, who says that these conditions are often " not merely local, but persistent over wide areas," and that " they occur abundantly among the European Paleozoic and secondary rocks " (" Textbook," p. 842). The latter author adds the significant words that " it is not so easy to give a satisfactory account " of these conditions—words with which we can all agree.

The late Eduard Suess speaks of " numerous examples " of this sort, where comparatively " young " rocks occur " in perfect concordance on much older beds, so that the stratigraphical relations between offer no hint of the great gap which occurs at the line of contact " (" Face of the Earth," Vol. II, p. 543). All of which, as he very pertinently expresses it, " may well be cause for astonishment."

However, the astonishment which I feel is rather directed towards the methods of reasoning adopted by these illustrious scientists in the face of these facts. We have sometimes been told that facts are stubborn things ; it seems that in this case it is the theory which is the stubborn thing. How is it that a mere *theory* regarding the relative sequence in which the fossils *ought* to be found, can hold the right of way over such facts as these ?

Surely, any unbiased mind, when confronted with these wide areas of strictly conformable strata—strata which are often lithically identical—must acknowledge that these long intervals

of time alleged to have intervened between them *never really existed.* If physical facts, or objective evidence, are to have the primacy over speculative theories, then surely there must be something radically wrong with that time-honoured theory which assigns successive periods of immense duration to only a *limited few* of the various plants and animals. Obviously, in the instances which we have been considering, and which are to be found literally by the thousand throughout the world, these various pairs of formations, instead of having been separated by millions of years, must have followed one another quite quickly. Probably the interval between two successive tides, or between a flow and an ebb, would be quite long enough to explain all the physical facts. At any rate, an interval much longer than this is flatly contradicted by these same physical facts. In short, if we are to take these facts for what they seem to mean, the entire theory of a definite historical value for the various groups of fossils must be given up.

(2) But another series of facts now demands our attention. For if the fossils have no intrinsic time-value, then we ought occasionally to find them in the reverse of the accustomed order. That is, we might reasonably expect to find Cambrian or Ordovician on top of Permian or Cretaceous or Tertiary. Nay, more, we might even expect to find them in this reverse order, but *conformably*, with every physical appearance of having been laid down in this " wrong " order, and in quick succession.

Do we have any such facts as these ? Yes ; plenty of them.

But the believers in the current theory have sought to provide beforehand for just such conditions. They warn the student to be careful, and not to trust to the physical evidence. Take the following from H. Alleyne Nicholson, the noted Scotch paleontologist : " It may even be said that in any case where there should appear to be a clear and decisive discordance between the physical and the paleontological evidence as to the age of a given series of beds, it is the former that is to be distrusted rather than the latter " (" Ancient Life History of the Earth," p. 40).

That is, the fossil evidence is to be held to, even when contradicted by plain physical facts. If we should find any similar directions in a textbook of physics, or chemistry, or astronomy, or botany, or zoology, it would not be difficult to make the author of such a statement a laughing-stock on both sides of the Atlantic. But the real humour of the situation in geology is that this rule of Nicholson's has actually been followed seriously by geologists

for over half a century, and still serves to settle all controversy about the age of any newly discovered deposits.

Substantially the same thing is given by Geikie, in telling how we can prove the reality of huge earth movements which would appear to be physically incredible. "We may even demonstrate," he says, with charming *naïveté*, "that in some mountainous ground the strata have been turned completely upside down, if we can show that the fossils in what are now the uppermost layers ought properly to lie underneath those in the beds below them" ("Textbook," p. 837, Ed. of 1903).

On another page we have a similar statement from this same illustrious leader in the science, when speaking of certain conditions in the Alps: "The strata could scarcely be supposed to have been really inverted, save for the evidence as to their true order of succession supplied by their included fossils . . . Portions of Carboniferous strata appear as if regularly interbedded among Jurassic rocks, and, indeed, could not be separated save after a study of their enclosed organic remains" ("Textbook," p. 678).

Why should I need to comment on the method of reasoning displayed in these three quotations just given? It seems to me that, if we have any faith at all in the continued progress of science, we must believe that the day will come when such statements as these two from Geikie and the former one from Nicholson will be regarded as among the literary curiosities in the history of scientific theories.

I have not the time to speak of the great numbers of minor examples of the fossils in the wrong order, where only a few formations are involved, that is, where the alleged differences in age are not very great. These cases are usually spoken of under the name of "pioneer colonies," or "recurrent faunas," or as "immigrant" groups which occur in places where they are not expected. Barrande, H. S. Williams, and E. O. Ulrich have devoted much space to such phenomena, in endeavours to maintain the scientific value of "index" fossils in spite of such conditions.

But for extreme cases, where, for example, Cambrian or Ordovician beds are found on top of Cretaceous or Tertiary, obviously some other explanation must be adopted. These extreme cases go under the name of "thrust faults," or "thrusts," or sometimes they are called "overthrust folds." Plenty of examples will be found listed in all the standard textbooks of the science, not to speak of the special monographs by such men as Heim, Lugeon,

Rothpletz, Bailey Willis, and many others. These conditions have also been discussed at some length by the present author in the two books already referred to. Here it must suffice to speak briefly of one or two examples.

We may begin with the large area involving the front ranges of the Rocky Mountains, which extends from about the middle of Montana some 500 miles north to the Yellowhead Pass in Alberta. It includes several parallel ranges of mountains, with all of the Glacier National Park, and the picturesque scenery around Banff, Alberta. On the American side of the international boundary line, the width of the area is some 30 or 40 miles, for it runs back to the Flathead River. To the north, the exact width is not well determined. But the total area would seem to be at least 20,000 square miles, perhaps more.

Throughout this whole area the underlying rocks are always Cretaceous; while the overlying rocks are classed as Algonkian or Pre-Cambrian on the American side, but to the north they are classed variously as Cambrian, Devonian, or Permo-Carboniferous, although throughout the whole area these upper rocks are strikingly uniform in their physical features and general appearance.

Over all this vast district the underlying Cretaceous beds are usually soft shales or sandstones, containing many good deposits of coal, as at the Bankhead Mines, near Banff, and at Coleman, near Crowsnest Mountain, also in the valley of the Flathead, west of the Glacier National Park. Resting on these soft Cretaceous shales are the Algonkian or other Paleozoic quartzites and crystalline limestones, while the line of contact between the two formations always exactly resembles an ordinary stratification plane. Also all the beds are approximately horizontal, with only a few disturbed points here and there. In scores of localities good exposures are shown, the border of the entire area being almost devoid of vegetation and showing these contacts most clearly, except where obscured by talus slopes. And in every single exposure that I am acquainted with throughout the entire area, the line of contact between the upper and the lower beds always resembles an ordinary stratification plane, and usually resembles a perfect example of natural conformity.

Many half-tone illustrations of these contacts will be seen in the author's "New Geology," recently published. Such picturesque outliers as Chief Mountain and Crowsnest Mountain are typical of the whole area. On the Canadian side, at about Lat. 51°,

there are some four parallel ranges of these Paleozoic mountains, made of horizontal strata, and resting in perfect conformity on the Cretaceous beds, which constitute the floors of the valleys and run under the base of the mountains, just as the soil runs under a building. Chief Mountain and the other outliers resemble Paleozoic islands floating on a Cretaceous sea.

The advocates of the prevailing theories try to explain these phenomena by assuming that these Paleozoic strata were once lifted up from enormous depths two or three miles down in the ground, and then thrust bodily forward over these soft shales, after which the upper strata were cut up by erosion into the forms as we now find them.

My contention is that all this is a quite unnecessary draft on our credulity. Why do we need to " explain " these phenomena, of Paleozoic mountains resting on Cretaceous ? Why not take them at their face value, for just what they seem to mean ? Is there a single valid reason why we should not do so ? This in essence is the entire difference between me and the uniformitarian geologists. It is clear that either these rocks are wrong, and terribly deceiving, or the entire theory of a definite historical order of the fossils is wrong. Many geologists seem to have such faith in their theory that they can give the lie to these rocks. I prefer to treat Nature with more respect, and to distrust any theory however time-honoured, rather than say, in the face of these physical facts, that Nature's record here has been written in code and can be deciphered only by means of a key which we possess. I think we can be better employed than in attempting to decode the plain statements of Nature according to any such key, no matter if this key is a precious heirloom which has been bequeathed to us by some of the most illustrious names in the history of science. The great discoveries in chemistry and physics and astronomy were not made while adhering to any such method of reasoning.

It would be asking too much of you to listen to a detailed description of the various other areas scattered over the globe which are more or less like the one already described. We have a dozen or so in various parts of America, several of them being 200 or more miles long. One famous case occurs in the Highlands of Scotland ; while the Alps give us many examples. Indeed, similar phenomena occur all over the globe wherever detailed study has been given to the rocks.

But it is now time to pause and to take a survey of our work. What have we accomplished ?

We set out to find an explanation of the geological changes, that is, to decide between the uniformitarian and the catastrophic explanations. But at the very outset we were held up over a method of procedure ; for the uniformitarians refused to allow us to look at the fossil world as a whole, and said that we must examine the fossils a few at a time, according to an exact chronological system which they had worked out. This chronological time-scale had to be examined ; but we have found it wanting under scientific tests. It will not bear close scientific scrutiny. We therefore conclude that we are now at liberty to resume our original inquiry. We wish to know how the geological changes took place ; but we do not now have to take the fossiliferous deposits a few at a time ; we may look at the fossil world as a whole. On this basis, we dare not affirm that the trilobites and the graptolites lived and died before the ammonites and the belemnites ; they may all have lived contemporaneously. The dinosaurs, also, may have been contemporary with the titanotheres, the mastodons, and the mammoths, and we are sure that the last two were contemporary with man.

Now this does not mean that all the fossiliferous deposits are of the same age, or that they were all deposited simultaneously. Not by any means. All the other common-sense tests of age are still left us ; but the myth of a life-succession in a definite and precise order is now gone for ever in the mind of any person acquainted with the facts who has had enough mental training to know when a conclusion is scientifically established.

But what is the precise bearing of all this upon our prime problem of having to decide between uniformity and catastrophism ?

It may be that someone will have the courage to defend a uniformitarian interpretation of the rocks, even with the life-succession theory utterly discredited ; but I hardly think so. Just consider the problem of the extinction of those species found in the Pleistocene alone, and merely from North America. As O. P. Hay expresses it : " Genera and families, even orders, were wiped out of existence, and these included some of the noblest animals that have graced the face of the earth, the elephants, the mastodons, tapirs, many species of bison, horses, sabre-tooth cats, huge tigers and gigantic wolves " (" The Pleistocene of North America," p. 5, 1923). To these he adds also the huge ground-sloths, the glyptodons, various species of camels, and the rhinoceros. Now, if to this formidable list we have to add the

great army of the dinosaurs, with the many bizarre mammals of the Tertiary beds, who will have the courage to talk about geological uniformity, if we admit the possibility, nay the probability, that these all actually lived contemporaneously together in various parts of the ancient world? In fact, I feel that it would be a reflection on the intelligence of my audience to suppose that anyone would seriously defend a uniformitarian interpretation of the rocks, with the extinction of hundreds of species of animals, unless we allow him to arrange for these extinctions a few at a time, *à la* Cuvier and William Smith. If we find a hundred people all dead at once, it would be hard to persuade a coroner that they had all died natural deaths.

One further word in closing. I consider that some very vital parts of the uniformitarian dogma have already been disposed of by others. I consider that Sir Henry H. Howorth, one of the Vice-Presidents of this Institute, has effectually disposed of the myth of a great ice age, or, as he would prefer to call it, the "glacial nightmare." Equally conclusive is the work of Prof. Eduard Suess, of Vienna, in disposing of the long popular fable that the coasts of all the continents are constantly on the see-saw up and down, and that by projecting this imaginary exchange of land and water back into the past we can explain all the transgressions of the ocean recorded in the strata. His gigantic work, "The Face of the Earth," has settled this matter once for all. The work of the "Challenger" Expedition, with that of other subsequent similar enterprises, has also dissipated many other fables inherited from the early days of the science when the ocean was wholly unknown and the lands were only partially explored.

The days of a narrow provincialism in geology are past. Whatever explanation we adopt must be based on a knowledge of the world as a whole. We must also discard all uniformitarian prejudices and be willing to decide the matter honestly by induction alone, and according to the evidence. Above all, we must renounce all dogmatisms about the relative ages of the various "index fossils." In this way, by building only on facts, we may hope to construct a science of geology comparable somewhat in its reliability and its finality with any of the other sciences, such as chemistry, or physics, or astronomy.

Just how far backward in our world's history we may be able to go while adhering to a strict scientific method, or how large an induction we may be able to make with safety, I do not know.

But a strictly scientific system of geology is the next great advance in the physical and biological sciences. And when it is established, I am confident that it will reveal to us nothing which will be out of harmony with that sublime record of the early days of our world which has been furnished us by the only Being capable of knowing all the facts.

Discussion.

Mr. Theodore Roberts considered the title of the paper a misnomer, as the scriptural account was not dealt with. The testimony of the rocks set forth God's everlasting power and divinity that men might be without excuse (Rom. i, 20), and was called by Dr. Joseph Cook, of Boston, "the oldest testament." Believers in the accuracy of the Genesis account were assured that there was no real discrepancy between this oldest testament and the Old Testament. If there was any divergence it was between the readers of the respective testaments, and he thought the readers of Genesis were not without fault, as they had usually failed to appreciate that, being written by a man, it must use human language, and adopt the standpoint of a supposed observer upon this earth in describing creation. He considered that the theories of geologists were more reliable than those of biologists, as these latter had no "oldest testament" to read.

He was glad that both the lecturer and the chairman discredited the uniformitarian theory, which was as old as those mockers who said "All things continue as they were from the beginning of the creation" (2 Pet. iii, 4), or the novelist who coined the phrase "Miracles do not happen." For himself he believed that the greatest catastrophic interference by God with the course of the present world was found in the death and resurrection of our Lord Jesus Christ.

Pastor W. Percival-Prescott said: Personally, I entirely agree with Professor McCready Price that "a strictly scientific system of Geology . . . will reveal to us nothing which will be out of harmony with the Sublime Record of the early days of our world."

It would appear from this paper that "the notorious onion-coat

theory," of orthodox geologists, was based upon a very limited examination of the earth's surface and substance. The theorists who held the view that by a process of evolution the different strata of the earth had taken millions of years to form had now to face the facts of recent stratigraphical discoveries.

It is said that Professor McCready Price, for the last twenty-six years, had travelled about the world, with pick and shovel, getting first-hand knowledge of his subject, and in his two standard books—*New Geology* and *Fundamentals of Geology*—he clearly proves that the case for uniformity cannot be sustained by mineralogical evidence. Rocks belonging to various systems or formations give us fossils in such a state of preservation that we are forced to the conclusion that they must have been swallowed up in some world-catastrophe. Then there is the evidence of a sudden change from the fossil age to the modern age.

Because Professor McCready Price had taken the view of Catastrophism against that of Uniformity someone had said that he was a geological heretic, but he (the speaker) would remind the Institute that Professor McCready Price was not the only scientist who took this unorthodox view of geology.

Professor A. H. Sayce (Oxford University) had written that "Sir H. Howorth's arguments from the presence of herds of mammoths, etc., in places where they must have been overwhelmed by a sudden catastrophe, have always seemed to me very strong, and have never yet been answered by orthodox geology."

There is the evidence, also, of a great climatic change. Mammoths had been found in the Arctic Regions with tropical vegetation in their mouths. How had these animals come into these regions? Would not these discoveries prove that the Arctic Regions at some time in the past, probably before the Flood, had had a warm climate, and that through a sudden change, from warmth to extreme cold, these mammoths had become instantly entombed in the ice where they had rested until found by their discoverers thousands of years afterwards?

Professor McCready Price, in his *Fundamentals of Geology*, says: "Who has not read of their untainted meat, now making food for dogs and wolves? Their stomachs are well filled with undigested food, showing that they were quietly feeding when the

crisis came. Dr. Hertz recently reported one not only with its stomach full of food, but with its mouth full, too."

The Biblical record is that out of chaos God made the earth in its ordered and organized form, and placed plant and animal life upon it by a special creation. Afterward, because of the corrupt practices of the earth's inhabitants, God destroyed "the world that then was" by a huge catastrophe called the Flood. The strata of the earth that now is marvellously corroborate the Bible record.

God did not use the process of Evolution, covering millions of years to form the earth as we see it to-day, but ordained Christ to be the active creative principle and dynamic power to produce and sustain the world. "All things were made by Him." "For by Him were all things created," and He upholds "all things by the word of His power."

Mr. HOSTE said: Though unqualified to criticize the geology of this paper, I am surprised at the sparse references it contains to the Bible. Or are we to conclude that the relations of geology to the Bible are practically nil? When the question was mooted one day as to how far Gen. i was in harmony with science, Huxley made the sage remark that we must first know exactly what Gen. i teaches and what science teaches. It is too easily taken for granted that the subject of the whole chapter is the creation of the world; it would be more correct to say the renovation of the world. In verse 1 we have the original creation, "In the beginning (whenever that was) God created (however that was) the heavens and the earth." Then follows a gap which the geologists may make as long as the physicists will allow them—a gap during which the great geological strata had ample time to be deposited. The Dover cliffs took rather more than six days, or even the period of the Flood, to be deposited. Call it "onion-coat theory" if you will, though I never knew till now that the coats of an onion were deposited in that way. Then in verse 2 we have a description of the earth's condition, "without form and void," in which it was when the Spirit of God took in hand to prepare it as a habitation for man. The heavens are not referred to now, but the earth.

The Hebrew "tho-pu ravohu," in the only other places, I believe, in the Old Testament where they occur together (Isa. xxxiv, 11, and Jer. iv, 23), describe a desolation effected by judgment. Many

believe that the same words in Gen. i describe not the original, but an induced condition. Why we are not told. Isa. xliv, 18 (R.V.), tells us explicitly, "God created not the world a waste" (thohu). Not unlikely the Ice Age had preceded verse 2 for many hundreds of years (I do not say it came then to an abrupt conclusion), and what organic life could survive such a condition of things? Distinguished Hebraists affirm that the form of the Hebrew in verse 2 is precisely that which detaches verse 2 from verse 1, though it describes a condition which had existed prior to verse 2. The "and" at the beginning of verse 2 would prove besides that verse 1 is not a summary of the chapter. Canon Fausset mentions above as "one of the three leading views of the most eminent geologists." Dr. C. Wordsworth says it had been adopted, among others, by Buckland and Sedgwick. Dr. Pusey, in his book on Daniel, p. 86, second edition, strongly upholds this view. The elder Delitzsch, in his *Commentary on Genesis,* Ed. 3, p. 92, maintains the same view. See also speaker's commentary *in loco.* If you make "the days" of Gen. i ("evenings and mornings") geological periods, you must read Exod. xx, 11, "For in six geological periods," etc.—from which one might argue for a similar length of the Sabbath.

Mr. W. E. LESLIE writes: The author has shown that the formations to which he calls attention present marked difficulty on the theory of orthodox geologists. But is this enough?

If, after making allowance for local variations, there has been no general progression of living forms, how are we to explain the widespread evidence of such development which exists in regular formations? We are presented with a choice between two difficulties of which that created by the hypothesis of the author appears to me to be much the greater.

From Rev. JOHN TUCKWELL, M.R.A.S.: What the writer is aiming at in this paper it is difficult to see. He seems rather like the proverbial bull in the china shop. With one horn he has destroyed the science of Geology and with the other that of Palæontology, and then, standing among the ruins, he tells us to put the fragments together and construct a new system of Geology. The title of his paper led one to hope that I should find something in it in "relation to Scripture Revelation," but until his closing sentence no reference

is made to the testimony of Scripture, and then only to express the confidence that the new Geology will "reveal nothing which is out of harmony with it." Reading between the lines, one cannot help the suspicion that he is harking back to the childish theory that the Almighty having made the world smashed it all up by a great catastrophe and then made it all over again in 144 hours. To come to particulars. The author does not seem to use the terms "conformable" and "unconformable" as geologists generally use them. He says "conformity" (p. 106) means that "one stratum has followed the other with only a slight interval of time intervening." Then he proceeds to say that "real conformity between two successive strata represents substantial continuity of deposition." Now the term means nothing of the kind. It has no reference to "time" or "continuity of deposition." It simply means that two strata have been laid down one upon the other, the lower surface of the upper one following the same line of formation as the upper surface of the lower. Like two planks of wood or two sheets of paper which may be bent or folded or lying flat. The upper one may have been laid down ages after the lower.

Similarly the writer does not seem to understand that the old controversy between "uniformitarianism" and "catastrophism" is as dead as Queen Anne. We are all uniformitarianists and catastrophists. Geological processes have in the past gone on for ages with the same uniformity of method, although not always at the same pace as they are proceeding to-day, but catastrophies have occurred like that of the recent earthquake in Japan—more or less local, or more or less general. But it seems that the author will not have it so. He *appears* to insist—but can it be so?—on viewing "the fossil world as a whole, a unit," and then supposing "some great world catastrophe" as churning the whole mass into an "anti-onion-coat" mess "as the most probable general explanation of the major part, but a quite indefinite and undefinable part of the stratified deposits" (p. 101). So that after the catastrophe some "indefinite and undefinable part" of the "onion-coat" formation was left or came back again! But he assures us that the attitude of the modern catastrophist "is not dogmatic—it is teachable and willing to learn," and very much need it has of it.

I have no wish, however, to minimize real difficulties. The case he presents on p. 107 needs much further explanation. Under what

local conditions a carboniferous stratum could be laid down or now found upon a cretaceous it would be difficult to say without further information than the writer has supplied. And so with the other similar examples. Geologists are not unaware of these facts, and in some cases, as, for instance, in the formation of the Alps, the stupendous forces of nature at some great catastrophic period have, as Prof. Geikie says, turned some of the strata "completely upside down," and it is not inconceivable that at a later period these masses may have been thrown back again upon strata more recently formed. But I submit that these few exceptional local anomalies do not afford sufficient evidence for the writer's gesture in rejecting the whole system of stratigraphical geology built up after more than a century's painstaking observation and collection of facts by thousands of competent observers and workers in all parts of the world. Take the case of the coal measures. These strata occur nearly all over the world. The palæontologist finds in them the same orders of plant life everywhere. They follow and are succeeded by similar strata, and their position in the Palæozoic period of the scientific story of creation corresponds precisely with the position of plant life as the predominant feature of the "third day" in the story of Gen. i. Take again the Mesozoic period. The enormous saurians—40 feet, 50 feet and 100 feet long—belong practically to that period and to that period alone, and their position in the scientific story corresponds precisely with their position as the predominant feature of creative power on the fifth day of the Scripture story. If Prof. Price destroys the geological evidence for the historical accuracy of the Creator's work he will destroy the accuracy of the Scripture record also. The two are in such perfect agreement that he cannot destroy the one and retain the other. Each is, as he fitly says in his concluding sentence, the "sublime record of the early days of our world which has been furnished us by the only Being capable of knowing all the facts."

Mr. H. O. WELLER writes: As a scientific member of the Institute, I am much disappointed in Prof. Price's communication. The title led me to suppose that he was presenting for our publication a paper that could be read profitably along with such a work as that, for instance, of Sir Bertram Windle, LL.D., F.R.S., &c., in his *The Church and Science*. In place, however, of an ordered

discussion and comparison of Geology as we understand it with revealed Truth as we receive it, Prof. Price has given us an almost incoherent account of some unaccepted theories of his own without relating them, except in the thinnest way, with the Scriptures. This very thin connection is, I take it, his reference to " some great world catastrophe," meaning, I suppose, the Deluge.

All this is disappointing for several reasons, the chief being that it leads our non-scientific members and associates to suppose that current Geology is irreconcilable with Scripture. This is not so: and, consequently, I suggest that anyone who wishes to show the relation of the two would be advised either to concentrate his attention on the science as thrashed out by a succession of trained workers (not all of them heathen !) than to accept blindly the enthusiastic material of some newly-inspired amateur just because they suppose him to be upholding Scripture. I say " suppose " because, so far as I can see by a second glance through the paper, the only reference to the Bible is under the name " the good Book " (p. 99) and the only reference to God the Creator is under the name " the only Being " (p. 115). Are these sufficient references for the Victoria Institute of 1924 ?

There is only one of the questions discussed in the paper that I wish to comment on—the alleged disposal of " the myth of a great Ice Age," by Sir Henry Howorth. I was not aware that this " myth " had been disposed of; but if it has, I, for one, am sorry, because I regard the great northern and southern ice-caps—in some places measured as two miles thick—as an argument for a world-covering Deluge. If the whole world were actually covered by water, this water would naturally be ice to latitudes closely approaching the tropics, north and south, and would take years to retreat. It may be mentioned that the date of the great ice-caps is placed by at least one reputable writer, not in any remote time, but " while the civilization of Babylon was in its hey-day."

Author's Reply.

I do not think that I ought to take the valuable space of this report to answer objections which are clearly due to the fact that my objectors have not given proper attention to what my paper actually says. However, I may have made a mistake in assuming

that these matters in dispute between me and the evolutionary geologists are as familiar to the people of England as they undoubtedly are to most of the people in America who are interested in these questions, for my books have had no considerable circulation across the Atlantic. The friends of the Bible here in America seem to have no difficulty in seeing the bearings of these geological facts upon the older views regarding the first chapters of Genesis. In proof of the latter I may mention the fact that in the recent Fundamentalist-Modernist Debate, held in Carnegie Hall, New York City, the Rev. John Roach Straton rested substantially his whole geological argument on what I have worked out in my *New Geology : a Textbook for Colleges*, this part of his argument occupying nearly six pages in the published report.

There are only two interpretations of the rocks now before the world. The first is the evolutionary, which is highly speculative in its methods, and extremely dogmatic in the presentation of its teachings. In fact, it is largely occupied with dogmatisms about the relative ages of the various stratified deposits, and assures us that it has worked out an infallible system of chronology of all the various types of life.

The other system of geology I have called the New Catastrophism. This is not dogmatic ; for it is inductive. Also it is non-evolutionary, for a strict inductive and objective study of the rocks does not reveal any ascertainable world-chronology which is decipherable from the strata. It endeavours to keep facts and hypotheses clear and distinct, in this way eliminating dogmatic assertions and speculative theories. In short, it is an endeavour (perhaps imperfectly carried out) to reform the methods of the science of geology, and an attempt to place the facts of this science on the same objective basis as is now employed in such sciences as physics and chemistry.

It is unfortunate that this method of handling geological facts is so new that it appears " disappointing " and " almost incoherent " to some of the honourable members of the Institute. Have we been so long accustomed to dogmatisms and theorisings in this science that a severely objective treatment of the facts should bring out such criticisms ? If so, I fancy that this condition only indicates that a reform in this science is long overdue.

The evolution theory has so long been intrenched in the science

of geology that to some it may seem like iconoclasm to question its chief theory—the chronological arrangement of the fossils. *But no adequate discussion of the theory of organic evolution is possible until this alleged chronological arrangement of the fossils has been evaluated by strictly scientific methods.* This I have tried to do. That I did not go further has been due to the limitations of time and space in these reports. But I flatter myself that the bearings of these geological facts, as presented in the foregoing pages, ought to be self-evident to every thoughtful reader.

At any rate, I could not well trace out in detail the connection between such a system of geology and the Bible without being in danger of departing from that strictly objective treatment and inductive method which it has been my chief endeavour to follow.