

Dawson

THE ANTIQUITY OF MAN AND THE ORIGIN  
OF SPECIES.

AMONG the numerous books and articles constantly inviting the attention of readers to the subjects of evolution and the antiquity and origin of man, some are rather of an argumentative and polemical character than of the nature of original investigation; others relate to new facts, and constitute actual contributions to the data of questions as yet too scantily supplied with fundamental truths. Of the former class many are interesting, able, and suggestive; but it is on work of the second class that the actual settlement of these disputes must depend, tho in the mean time this may be comparatively unknown to the general reader, whose ideas as to the present state of these questions are likely to be derived rather from the confident assertions and well-put arguments of popular writers than from the more solid tho less showy and far less startling and less assured conclusions of actual painstaking work.

Of works which may claim to contain results of original and useful investigation, the following, which are now in the hands of scientific men and embrace a very wide range of inquiry, may afford the material for profitable discussion in this REVIEW: Dawkins on "Early Man in Britain" is a work limited in its range, but embracing the results of the investigations of an acute observer, well up in the paleontology of the more recent formations. Barrande's "Brachiopodes," extracted from the great work on the Silurian System of Bohemia, is the production of the first paleozoic paleontologist of our age, and with regard to the group to which it relates, as well as to the cephalopods and trilobites previously treated by the author in the same manner, is an exhaustive inquiry as to what they have to say for and against evolution. "Les Enchaînements

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du Monde Animal," by Gaudry, may be regarded as a popular book; but it is the work of one of the most successful collectors and expositors of the Tertiary mammalia. "Le Monde des Plantes," by Saporta, is also in some degree popular in its scope, but is replete with scientific facts admirably put together by a most successful and able paleo-botanist. Of the above writers Barrande is an uncompromising opponent of evolution as ordinarily held. In other words, he finds that the facts of the history of life in the Paleozoic period lend no countenance to this hypothesis. The others are theistic evolutionists, holding the doctrine of derivation with more or less of modification, but not descending to the special pleading and one-sided presentation of facts so common with the more advanced advocates of the doctrine. Perhaps we may most clearly present the salient points brought out in these works by noticing first the successive Tertiary periods and their life, culminating in the introduction of man, and secondly the facts as to the introduction of those earlier creatures which swarmed in the Paleozoic seas.

The Tertiary or Kainozoic period, the last of the four great "times" into which the earth's geological history is usually divided, and that to which man and the mammalia belong, was ingeniously subdivided by Lyell, on the ground of percentages of marine shells and other invertebrates of the sea. According to this method, which with some modification in details is still accepted, the *Eocene*, or dawn of the recent, includes those formations in which the percentage of modern species of marine animals does not exceed  $3\frac{1}{2}$ , all the other species found being extinct. The *Miocene* (less recent) includes formations in which the percentage of living species does not exceed 35, and the *Pliocene* (more recent) contains formations having more than 35 per cent of recent species. To these three may be added the *Pleistocene*, in which the great majority of the species are recent, and the *Modern*, in which all may be said to be living. Dawkins and Gaudry give us a division substantially the same with Lyell's, except that they prefer to take the evidence of the higher animals instead of the marine shells. The Eocene thus includes those formations in which there are remains of mammals or ordinary land quad-

rupeds, but none of these belong to recent species or genera, tho they may be included in the same families and orders with the recent mammals. This is a most important fact, as we shall see, and the only exception to it is that Gaudry and others hold that a few living genera, as those of the dog, civet, and marten, are actually found in the later Eocene. In the case of plants, as we shall find, Saporta shows that modern genera of land plants occur before the Eocene, in the last great group of the preceding period, and we have abundant American evidence of the same fact. As in the Mosaic narrative of creation, the higher plants precede by a long time the higher animals. The Miocene, on the same mammalian evidence, will include formations in which there are living genera of mammals, but no species which survive to the present time. The Pliocene and Pleistocene show living species, tho in the former these are very few and exceptional, while in the latter they become the majority.

With regard to the geological antiquity of man, no geologist expects to find any human remains in beds older than the Tertiary, because in the older periods the conditions of the world do not seem to have been suitable to man, and because in these periods no animals nearly akin to man are known. On entering into the Eocene Tertiary we fail in like manner to find any human remains; and we do not expect to find any, because no living species and scarcely any living genera of mammals are known in the Eocene; nor do we find in it remains of any of the animals, as the anthropoid apes for instance, most nearly allied to man. In the Miocene the case is somewhat different. Here we have living genera at least, and we have large species of apes; but no remains of man have been discovered, if we except some splinters of flint found in beds of this age at Thenay in France, and a notched rib-bone. Supposing these objects to have been chipped or notched by animals, which is by no means certain or even likely, the question remains, was this done by man? Gaudry and Dawkins prefer to suppose that the artificer was one of the anthropoid apes of the period. It is true that no apes are known to do such work now; but then other animals, as beavers and birds, are artificers, and some extinct animals were of higher powers than their modern

representatives. But if there were Miocene apes which chipped flints and cut bones, this would, either on the hypothesis of evolution or that of creation by law, render the occurrence of man still less likely than if there were no such apes. For these reasons neither Dawkins nor Gaudry, nor indeed any geologists of authority in the Tertiary fauna, believe in Miocene man.

In the Pliocene, as Dawkins points out, tho the facies of the mammalian fauna of Europe becomes more modern and a few modern species occur, the climate becomes colder, and in consequence the apes disappear, so that the chances of finding fossil men are lessened rather than increased in so far as the temperate regions are concerned. In Italy, however, Capellini has described a skull, an implement, and a notched bone supposed to have come from Pliocene beds. To this Dawkins objects that the skull and the implement are of recent type, and probably mixed with the Pliocene stuff by some slip of the ground. As the writer has elsewhere pointed out,<sup>1</sup> similar and apparently fatal objections apply to the skull and implements alleged to have been found in Pliocene gravels in California. Dawkins further informs us that in the Italian Pliocene beds supposed to hold remains of man, of twenty-one mammalia whose bones occur, all are extinct species except possibly one, a hippopotamus. This of course renders very unlikely in a geological point of view the occurrence of human remains in these beds.

In the Pleistocene deposits of Europe—and this applies also to America—we for the first time find a predominance of recent species of land animals. Here, therefore, we may look with some hope for remains of man and his works, and here, according to Dawkins, in the later Pleistocene they are actually found. When we speak, however, of Pleistocene man, there arise some questions as to the classification of the deposits, which it seems to the writer Dawkins and other British geologists have not answered in accordance with geological facts, and a misunderstanding as to which may lead to serious error. This will be best understood by presenting the arrangement adopted by Dawkins with a few explanatory notes, and then pointing out

<sup>1</sup> "Fossil Men," 1880.

its defects. The following may be stated to be his classification of the later Tertiary:

I. PLEISTOCENE PERIOD: the fourth epoch of the Tertiary, in which living species of mammals are more abundant than the extinct, and man appears. It may be divided into—

(a) *Early Pleistocene*, in which the European land was more elevated and extensive than at present (First Continental Period of Lyell), and in which Europe was colonized by animals suitable to a temperate climate. No good evidence of the presence of man.

(b) *Mid Pleistocene*. In this period there was a great extension of cold climate and glaciers over Europe, and mammals of arctic species began to replace those previously existing. There was also a great subsidence of the land, finally reducing Europe to a group of islands in a cold sea, often ice-laden. Two flint flakes found in brick earth at Crayford and Erith in England are the only known evidences of man at this period.

(c) *Late Pleistocene*. The land was again elevated, so that Great Britain and Ireland were united to each other and to the continent (Second Continental Period of Lyell). The ice and cold diminished. Modern land animals largely predominate, though there are several species now extinct. Undoubted evidences of man of the so-called "Paleolithic race," "River-drift and Cave men," "Men of the Mammoth and Reindeer periods."

II. PREHISTORIC PERIOD: in which domestic animals and cultivated fruits appear; the land of Europe shrinks to its present dimensions. Man abounds, and is similar to races still extant in Europe. Men of "Neolithic age," "Bronze age," "Prehistoric Iron age."

III. HISTORIC PERIOD: in which events are recorded in history.

I have given this classification fully, in order to point out in the first place certain serious defects in its latter portion, and in the second place what it actually shows as to the appearance of man in Europe.

In point of logical arrangement, and especially of geological classification, the two last periods are decidedly objectionable. Even in Europe the historic age of the south is altogether a different thing from that of the north, and to speak of the prehistoric period in Greece and in Britain or Norway as indicating the same portion of time is altogether illusory. Hence a large portion of the discussion of this subject has to be called by our author "the overlap of history." Further, the mere accident of the presence or absence of historical documents cannot constitute a geological period comparable with such periods as the Pleistocene and Pliocene, and the assumption of such a criterion

of time merely confuses our ideas. On the one hand, while the whole Tertiary or Kainozoic, up to the present day, is one great geological period, characterized by a continuous tho gradually changing fauna and series of physical conditions, and there is consequently no good basis for setting apart, as some geologists do, a Quaternary as distinct from the Tertiary period; on the other hand there is a distinct physical break between the Pleistocene and the Modern in the great glacial age. This in its arctic climate and enormous submergence of the land, tho it did not exterminate the fauna of the Northern Hemisphere, greatly reduced it, and at the close of this age many new forms came in. For this reason the division should be made not where Dawkins makes it, but at or about the end of his "Mid Pleistocene." The natural division would thus be:

I. PLEISTOCENE, including—

(a) *Early Pleistocene*, or First Continental period. Land very extensive, moderate climate.

(b) *Later Pleistocene*, or glacial, including Dawkins' "Mid Pleistocene." In this there was a great prevalence of cold and glacial conditions, and a great submergence of the northern land.

II. MODERN, or Period of Man and Modern Mammals, including—

(a) *Post-glacial*, or Second Continental period, in which the land was again very extensive, and Paleocosmic man was contemporary with some great mammals, as the mammoth, now extinct, and the area of land in the Northern Hemisphere was greater than at present. This represents the Late Pleistocene of Dawkins. It was terminated by a great and very general subsidence accompanied by the disappearance of Paleocosmic man and some large mammalia, and which may be identical with the historical deluge.

(b) *Recent*, when the continents attained their present levels, existing races of men colonized Europe, and living species of mammals. This includes both the Prehistoric and Historic periods.

On geological grounds the above should clearly be our arrangement, tho of course there need be no objection to such other subdivisions as historians and antiquarians may find desirable for their purposes. On this classification *the earliest certain indications of the presence of man in Europe, Asia, or America, so far as yet known, belong to the Modern period alone.* That man may have existed previously no one need deny, but no one can positively affirm on any ground of actual fact. I do not reckon

here the two flint flakes of Crayford and Erith already mentioned, because even if they are of human workmanship, the actual age of the bed in which they occur, as to its being glacial or post-glacial, is not beyond doubt. Flint flakes or even flint chips may be safely referred to man when they are found with human remains, but when found alone they are by no means certain evidence. The clays of the Thames valley have been held by some good geologists to be pre-glacial, but by others to be much later, and the question is still under discussion. Dawkins thinks they may be "Mid Pleistocene," equivalent to "Later Pleistocene" of the second table above, and that they are the oldest traces of man certainly known, but in the mean time they should evidently be put to what has been called "the suspense account."

Inasmuch, however, as the human remains of the post-glacial epoch are those of fully developed men of high type, it may be said, and has often been said, that man in some lower stage of development *must* have existed at a far earlier period. That is he must if certain theories as to his evolution from lower animals are to be sustained. This, however, is not a mode of reasoning in accordance with the methods of science. When facts fail to sustain certain theories we are usually in the habit of saying "so much the worse for the theories," not "so much the worse for the facts," or at least we claim the right to hold our judgment in suspense till some confirmatory facts are forthcoming.

Before leaving this part of the subject it may be well to remark the grand procession of mammalian life, beginning with the marsupial and semi-marsupial beasts of prey and low-browed and small-brained but gigantic ungulates of the Eocene and ending with man. There is here unquestionable elevation in rank, by whatever means effected. Gaudry inclines to some form of evolution, tho he piously refers it to the operation of the Creator. He thinks he can see traces of such evolution in the carnivorous animals, as derived from marsupials, and in the antelope and deer tribe, more especially in the development of horn and antler; and he traces the horse through a supposed ancestry of hipparia, etc., differing, however, from English and American evolutionists in making the *Paleotherium* the initial

link. This is, however, a matter of taste, as these genealogies may usually be traced with equal probability or improbability through any one of half a dozen lines. But in the case of some groups of animals, and these of the highest importance, he freely admits that derivation is at fault. The elephants and their allies the deinotheres and mastodons, for example, appear all at once in the Miocene period and in many countries, and they only dwindle in magnitude and numbers as they approach the modern. Gaudry frankly says: "D'où sont-ils venus, de quels quadrupèdes ont-ils été dérivés? Nous l'ignorons encore." The edentates, the rodents, the bats, the manatees are equally mysterious, and so are the cetaceans, those great mammalian monsters of the deep, which leap into existence in grand and highly developed forms in the Eocene, and which surely should have left some trace of their previous development in the sea. "We have," says Gaudry, "questioned these strange and gigantic sovereigns of the Tertiary oceans as to their progenitors, but they leave us without reply," and he goes on to refer to several things in connection with their habitat, their reproduction, and their dentition or want of it, which make their sudden appearance still more inscrutable. It is refreshing to find a naturalist who, while honestly and even enthusiastically seeking to establish the derivation of animals, gives due prominence to the facts which, in the present state of knowledge at least, refuse to be explained by his theory. The reader may note here that the appearance of man fully developed in the Modern period is parallel with that of the elephantine animals in the Miocene and the whales in the Eocene, as well as with a vast multitude of other cases which meet the paleontologist in every direction.

In the world of plants, Saporta has a strangely different story to tell, tho its general plan evidently harmonizes with the history of mammalian life. If we keep out of view the few species of small marsupials that exist in the Mesozoic period, mammalian life in all its grandeur comes into existence at a bound in the Eocene. But it had been preceded for at least one great geological period by a vegetation similar to that now living. It can scarcely be questioned that the vegetation of the older geological periods, however rank and abundant, was



not well suited to sustain the higher herbivorous animals. Accordingly no such animals are known in these periods. But in the cretaceous age we find in the lower beds of that series some coniferous plants of living genera, and in the upper cretaceous modern generic forms come in, both in Europe and America, in great force. We have magnolias, oaks, beeches, ivies, ginsengs, plane-trees, poplars, palms, and a host of familiar forms, and some of these so closely resembling existing species that it scarcely requires the eyes of an evolutionist to see in them the ancestors of our modern trees. Thus an ample and long-continued preparation was made not only for the introduction of mammalian life, but even for giving to the landscape its existing features. It seems indeed strange that no precursors of the Eocene mammals have yet been found in connection with these plant remains of the newer cretaceous. There is a gap here in animal life which we may expect at some time to be filled. There seems, however, notwithstanding the great changes in climate and physical geography, to have been much less change from the cretaceous onward in the plant world than in the world of higher animal life, so that Saporta can figure series of leaves of plants of modern genera from the Eocene upward, showing so little modification that they may in some cases be regarded as scarcely more than varietal forms, while some of the species have undoubtedly survived without change through all the long ages extending from the beginning of the Kainozoic to the present day. Plant-life is in this analogous to the lower animal life of the sea, which presents the same unchanged characteristics in Eocene and Modern species.

To return to primitive man and the date of his appearance in Europe, an important question is raised by Dawkins in the attempt which he makes to discriminate between two races of men supposed to have existed successively in Europe in post-glacial times or in the Second Continental period. These he calls respectively "men of the river gravels" and "cave men." The idea of such distinction seems to have arisen in his mind from the fact that in certain caverns in England the lowest stratum containing human remains affords only rude implements, while an upper stratum appears to testify to improved manufacture of stone tools and weapons, both strata being of

so-called "paleolithic" age; that is, belonging to the time when certain mammalia now extinct survived. Such facts, however, would rather seem to testify to local improvement in the condition of certain tribes than to any change of race. Such local improvement would be very likely to occur wherever a new locality was taken possession of by a small and wandering tribe, which in process of time might increase in numbers and in wealth, as well as in means of intercourse with other tribes. A similar succession would occur when caves used at first as temporary places of rendezvous by savage tribes became afterward places of residence, or were acquired by conquest on the part of tribes a little more advanced, in the manner in which such changes are constantly taking place in rude communities. Yet on this slender foundation he builds an extensive generalization as to a race of river-drift men, in a low and savage condition, replaced after the lapse of ages by a people somewhat more advanced in the arts, and specially addicted to a cavern life; and this conclusion he extends to Europe and Asia, finding everywhere and in every case where rude flint implements exist in river gravels, evidence of the earlier of these races. But his own statements are sufficient to show the baselessness of the distinction. He admits that no physical break separates the two periods; that the fauna remained the same; that the skulls, so far as known, present no differences; and that even in works of art the distinction is invalidated by grave exceptions, which are intensified by the fact, which the writer has elsewhere illustrated, that in the case of the same people their residences in caves, etc., and their places of burial are likely to contain very different objects from those which they leave in river gravels. Perhaps one of the most curious examples of this, referred to by our author, is the cave of Duruthy in the western Pyrenees. On the floor of this cave lay a human skull covered with fallen blocks of stone. With it were found forty canine teeth of the bear and three of the lion, perforated for suspension, and several of these teeth are skilfully engraved with figures of animals, one bearing the engraved figure of an embroidered glove. This necklace, no doubt just such a trophy of the chase as would now be worn by a red Indian hunter, tho more elaborate, must have belonged to the owner of the skull,

who would appear to have perished by a fall of rock, or to have had his body covered after death with stones. In the deposit near and under these remains were flint flakes. Above the skull were several feet of refuse, stones, and bones of the horse, reindeer, etc., and "paleolithic" flint implements, and above all were placed several skulls and skeletons with "beautifully chipped" flint implements. After the burial of these the cave seems to have been finally closed with large stones. The French explorers of this cave refer the lower and upper skulls to the same race; but Dawkins, in consistency with his theory, has to consider the upper remains as "Neolithic," tho there is no conceivable reason why a man who possessed a necklace of beautifully carved teeth should not have belonged to a tribe which used well-made stone implements, or why the weapons buried with the dead should have been no better than the chips and flakes left by the same people in their rubbish-heaps.

The reasoning by which the author supports this distinction is throughout scarcely worthy of his reputation, and implies great carelessness as to modern analogies. The same remark may be made as to his identification of the cave men with the Esquimaux. What he says on this head would serve quite as well to identify them with other hunting and fishing people; with the Haidas of the Queen Charlotte Islands, for example, the Micmacs of Nova Scotia, or even the Fuegians. He exposes, however, the folly of the minute distinctions made by some French archæologists as to the ages of the remains in different caves, and which, as Lyell and others have insisted, prove no more than slight differences of wealth and culture among contemporary or immediately successive tribes.

Another point on which he well insists, and which he has admirably illustrated, is the marked distinction between the old paleocomic men of the gravels and caves and the smaller race with somewhat differently formed skulls which succeeded them, after the great subsidence which terminated the Second Continental period and inaugurated the Modern epoch. The latter race he identifies with the Basques and ancient Iberians, a non-Aryan or Turanian people who once possessed nearly the whole of Europe, and included the rude Ugrians and Laps of the north, the civilized Etruscans of the south, and the Iberians

of the west, with allied tribes occupying the British Islands. This race, scattered and overthrown before the dawn of authentic history in Europe by the Celts and other intrusive peoples, was unquestionably that which succeeded the now extinct paleocosmic race and constituted the men of the so-called "Neolithic period," which thus connects itself with the modern history of Europe, from which it is not separated by any physical catastrophe like that which divides the older men of the mammoth age and the widely spread continents of the post-glacial period from our modern days. This identification of the Neolithic men with the Iberians, which the writer has also insisted on, Dawkins deserves credit for fully elucidating, and he might have carried it farther to the identification of these same Iberians with the Berbers, the Guanches of the Canary Islands, and the Caribbean and other tribes of eastern and central America. On these hitherto dark subjects light is now rapidly breaking, and we may hope that much of the present obscurity will soon be cleared away.

Another curious point illustrated by Dawkins, with the aid of the recent rediscovery of the tin-mines of Tuscany, is the connection of the Etruscans with the introduction of the bronze age into central Europe. This, when viewed in relation to the probable ethnic affinities of the Etruscans with the "Neolithic" and Iberian races, remarkably welds together the stone and bronze ages in Europe, and explains their intermixture and "overlap" in the earlier lake habitations of Switzerland and elsewhere.

We are also indebted to our author for a suggestion as to the linguistic connection of the Neocosmic and Modern periods, which is deserving the attention of philologists. He quotes from Abbé Inchaupé, the following Basque words:

<i>Aizcora</i>	= Axe	= Stone lifted up or handled.
<i>Aitzurra</i>	= Pick	= Stone to tear asunder.
<i>Aiztoa</i>	= Knife	= Stone, little or small.
<i>Aizturac</i>	= Scissors	= Little stones for tearing.

He remarks that all these words are derived from the word *aitza*, *atcha*, stone, tho now applied to implements of metal. The same thing occurs in many American languages, in which the word for stone, with appropriate additions, is applied to different kinds of tools. It is also curious that in some of the American languages the word for stone is almost identical with

that in Basque; but this applies to some other Basque roots as well. Still it is not unlikely that the onomatopoetic sounds, *itz*, *aitz*, and the like, applied to stones and cutting instruments in many languages, in all cases arose from the use of sharpened stones in cutting and rending.

A still more important speculation arising from the facts recently developed as to prehistoric men is the possible equivalency with the historical deluge of the great subsidence which closed the residence of paleocosmic men in Europe, as well as that of several of the large mammalia. Lenormant and others have shown that the wide and ancient acceptance of the tradition of the deluge among all the great branches of the human family necessitates the belief that, independently of the biblical history, this great event must be accepted as an historical fact which very deeply impressed itself upon the minds of all the early nations. Now, if the deluge is to be accepted as historical, and if a similar break interrupts the geological history of man, separating extinct races from those which still survive, why may we not correlate the two. The misuse of the deluge in the early history of geology, in employing it to account for changes that took place long before the advent of man, certainly should not cause us to neglect its legitimate uses, when these arise in the progress of investigation. It is evident that if this correlation be accepted as probable, it must modify many views now held as to the antiquity of man. In that case, the modern gravels spread over plateaus and in river valleys, far above the reach of the present floods, may be accounted for, not by the ordinary action of the existing streams, but by the abnormal action of currents of water diluvial in their character. Further, since the historical deluge cannot have been of very long duration, the physical changes separating the deposits containing the remains of paleocosmic men from those of later date would in like manner be accounted for, not by slow processes of subsidence, elevation, and erosion, but by causes of more abrupt and cataclysmic character. This subject the writer has referred to in previous publications,<sup>1</sup> and he is glad to see that prominence has recently been given to it by so good a geologist as the Duke of Argyll, in a late number of the *Contemporary Review*.

<sup>1</sup> "Origin of the World." "Fossil Men."

It is a great leap backward to pass from the bronze age of Europe to the Paleozoic brachiopods of Bohemia; but both may furnish illustrations of the same natural laws, as both belong to the same long-continued creative work. Barrande, like some other eminent paleontologists, has the misfortune to be an unbeliever in the modern gospel of evolution, but he has certainly labored to overcome his doubts with greater assiduity than even many of the apostles of the new doctrine; and if he is not convinced, the stubbornness of the facts he has had to deal with must bear the blame. In connection with his great and classical work on the Silurian fossils of Bohemia, it has been necessary for him to study the similar remains of every other country, and he has used this immense mass of material in preparing statistics of the population of the Paleozoic world more perfect than any other naturalist has been able to produce. In previous publications he has applied these statistical results to the elucidation of the history of the oldest group of crustaceans, the trilobites, and the highest group of the mollusks, the cephalopods. In his latest memoir of this kind he takes up the brachiopods, or lamp-shells, a group of bivalve shellfishes, very ancient and very abundantly represented in all the older formations of every part of the world, and which thus affords the most ample material for tracing its evolution, with the least possible difficulty in the nature of "imperfection of the record."

Barrande, in the publication before us, discusses the brachiopods with reference, first, to the variations observed within the limits of the species, eliminating in this way mere synonyms and varieties mistaken for species. He also arrives at various important conclusions with reference to the origin of species and varietal forms, which apply to the cephalopods and trilobites as well as to the brachiopods, and some of which, as the writer has elsewhere shown, apply very generally to fossil animals and plants. One of these is that different contemporaneous species, living under the same conditions, exhibit very different degrees of vitality and variability. Another is the sudden appearance at certain horizons of a great number of species, each manifesting its complete specific characters. With very rare exceptions, also, varietal forms are contemporaneous with the normal form of their specific type, and occur in the same localities. Only in a very few cases do they survive it. This

and the previous results, as well as the fact that parallel changes go on in groups having no direct reaction on each other, prove that variation is not a progressive influence, and that specific distinctions are not dependent on it, but on the "sovereign action of one and the same creative cause," as Barande expresses it. These conclusions, it may be observed, are not arrived at by that slap-dash method of mere assertion so often followed on the other side of these questions; but by the most severe and painstaking induction, and with careful elaboration of a few apparent exceptions and doubtful cases.

His second heading relates to the distribution in time of the genera and species of brachiopods. This he illustrates with a series of elaborate tables, accompanied by explanation. He then proceeds to consider the animal population of each formation, in so far as brachiopods, cephalopods and trilobites are concerned, with reference to the following questions: (1) How many species are continued from the previous formation unchanged? (2) How many may be regarded as modifications of previous species? (3) How many are migrants from other regions where they have been known to exist previously? (4) How many are absolutely new species? These questions are applied to each of 14 successive formations included in the Silurian of Bohemia. The total number of species of brachiopods in these formations is 640, giving an average of 45.71 to each, and the results of accurate study of each species in its characters, its varieties, its geographical and geological range, are expressed in the following short statement, which should somewhat astonish those gentlemen who are so fond of asserting that derivation is "demonstrated" by geological facts:

1. Species continued unchanged.....	28.	per cent.
2. Species migrated from abroad.....	7	"
3. Species continued with modification, ..	0	"
4. New species without known ancestors.	65	"

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100 per cent.

He shows that the same or very similar proportions hold with respect to the cephalopods and trilobites, and in fact that the proportion of species in the successive Silurian faunæ, which can be attributed to descent with modification is absolutely *nil*. He may well remark that in the face of such facts the origin of

species is not explained by what he terms "les élans poétiques de l'imagination."

The third part of Barrande's memoir, relating to the comparison of the Silurian brachiopods of Bohemia with those of other countries, tho of great scientific interest and important in extending the conclusions of his previous chapters, does not concern so nearly our present subject.

I have thought it well to direct attention to these memoirs of Barrande, because they form a specimen of conscientious work, with the view of ascertaining if there is any basis in nature for the doctrine of spontaneous evolution of species, and, I am sorry to say, a striking contrast to the mixture of fact and fancy on this subject which too often passes current for science in England, America, and Germany. Barrande's studies are also well deserving the attention of our younger men of science, as they have before them, more especially in the widely spread Paleozoic formations of America, an admirable field for similar work. In an appendix to his first chapter, Barrande mentions that the three men who in their respective countries are the highest authorities on Paleozoic brachiopods, Hall, Davidson, and De Koninck, agree with him in the main in his conclusions, and he refers to an able memoir by D'Archiac in the same sense, on the cretaceous brachiopods.

It should be especially satisfactory to those naturalists who, like the writer, have failed to see in the paleontological record any good evidence for the production of species by those simple and ready methods in vogue with most evolutionists, to note the extension of actual facts with respect to the geological dates and precise conditions of the introduction of new forms, and to find that these are more and more tending to prove the existence of highly complex creative laws in connection with the great plan of the Creator as carried out in geological time. These new facts should also warn the ordinary reader of the danger of receiving without due caution those general and often boastful assertions respecting these great and intricate questions, made by persons not acquainted with their actual difficulty, or by enthusiastic speculators disposed to overlook everything not in accordance with their preconceived ideas.

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