

## CHAPTER XI.

Theory of the successive extinction of species consistent with their limited geographical distribution—The discordance in the opinions of botanists respecting the centres from which plants have been diffused may arise from changes in physical geography subsequent to the origin of living species—Whether there are grounds for inferring that the loss from time to time of certain animals and plants is compensated by the introduction of new species?—Whether any evidence of such new creations could be expected within the historical era, even if they had been as frequent as cases of extinction?—The question whether the existing species have been created in succession can only be decided by reference to geological monuments.

WE have pointed out in the preceding chapters the strict dependence of each species of animal and plant on certain physical conditions in the state of the earth's surface, and on the number and attributes of other organic beings inhabiting the same region. We have also endeavoured to show that all these conditions are in a state of continual fluctuation, the igneous and aqueous agents remodelling, from time to time, the physical geography of the globe, and the migrations of species causing new relations to spring up successively between different organic beings. We have deduced as a corollary, that the species existing at any particular period must, in the course of ages, become extinct one after the other. "They must die out," to borrow an emphatical expression from Buffon, "because Time fights against them."

If the views which we have taken are just, there will be no difficulty in explaining why the habitations of so many species are now restrained within exceedingly narrow limits. Every local revolution, such as those contemplated in the preceding chapter, tends to circumscribe the range of some species, while it enlarges that of others; and as we have been led to infer that new species originate in one spot only, each must require time to diffuse itself over a wide area. The recent origin,

therefore, of some species, and the high antiquity of others, may be equally consistent with the general fact of their limited distribution, some being local, because they have not existed long enough to admit of their wide dissemination ; others, because circumstances in the animate or inanimate world have occurred to restrict the range which they may once have obtained.

As considerable modifications in the relative levels of land and sea have taken place, in certain regions, since the existing species were in being, we can feel no surprise that the zoologist and botanist have hitherto found it difficult to refer the geographical distribution of species to any clear and determinate principles, since they have usually speculated on the phenomena, upon the assumption that the physical geography of the globe had undergone no material alteration since the introduction of the species now living. So long as this assumption was made, the facts relating to the geography of plants and animals appeared capricious in the extreme, and by many the subject was pronounced to be so full of mystery and anomalies, that the establishment of a satisfactory theory was hopeless.

Some botanists conceived, in accordance with the hypothesis of Willdenow, that mountains were the centres of creation from which the plants now inhabiting large continents have radiated, to which Decandolle and others, with much reason, objected, that mountains, on the contrary, are often the barriers between two provinces of distinct vegetation. The geologist who is acquainted with the extensive modifications which the surface of the earth has undergone in very recent geological epochs, may be able, perhaps, to reconcile both these theories in their application to different regions.

A lofty range of mountains, which is so ancient as to date from a period when the species of animals and plants differed from those now living, will naturally form a barrier between contiguous provinces ; but a chain which has been raised, in great part, within the epoch of existing species, and around which new lands have arisen from the sea within that period, will be a centre of peculiar vegetation.

“ In France,” observes Decandolle\*, “ the Alps and Cevennes prevent a great number of the plants of the south from spreading themselves to the northward ; but it has been remarked that some species have made their way through the gorges of these chains, and are found on their northern sides, principally in those places where they are lower and more interrupted.” Now the chains here alluded to have probably been of considerable height, even since the era when the existing vegetation began to appear, and were it not for the deep fissures which divide them, they might have caused much more abrupt terminations to the extension of distinct assemblages of species.

Parts of the Italian peninsula, on the other hand, have gained a considerable portion of their present height since a majority of the marine species now inhabiting the Mediterranean, and probably, also, since the terrestrial plants of the same region, were in being. Large tracts of land have been added, both on the Adriatic and Mediterranean side, to what originally constituted a much narrower range of mountains, if not a chain of islands running nearly north and south, like Corsica and Sardinia. It may, therefore, be presumed, that the Apennines have been a centre whence species have diffused themselves over the contiguous *lower* and *newer* regions. In this and all analogous situations, the doctrine of Willdenow, that species have radiated from the mountains as from centres, may be well founded.

It appears from Mr. Brown’s remarks on the vegetation of New Holland, that there are two groups of plants occurring between the thirty-third and thirty-fifth degrees of southern latitude, and principally at the two opposite extremities of this tract, that is, near the eastern and western coasts. These points have been termed the two principal *foci* of Australian vegetation, each of them possessing certain genera which are almost peculiar to it †. If, when this continent has been more tho-

\* Essai Élémentaire, &c., p. 46.

† Brown’s Appendix to Flinders’s Voyage, and Prichard, Phys. Hist. of Mankind, vol. i., p. 31.

roughly investigated, we do not discover some physical barriers, such as a great marsh, or a desert, or a lofty mountain-chain, now intervening between these districts, there may, perhaps, be geological evidence hereafter discovered, that a sea was interposed up to a modern period separating two large islands. Sufficient time may not have elapsed since the union of such isles, to allow of a complete intermixture by mutual immigrations.

If the reader should infer, from the facts laid before him in the preceding chapters, that the successive extinction of animals and plants may be part of the constant and regular course of nature, he will naturally inquire whether there are any means provided for the repair of these losses? Is it part of the economy of our system that the habitable globe should, to a certain extent, become depopulated both in the ocean and on the land; or that the variety of species should diminish until some new era arrives when a new and extraordinary effort of creative energy is displayed? Or is it possible that new species can be called into being from time to time, and yet that so astonishing a phenomenon can escape the observation of naturalists?

Humboldt has characterized these subjects as among the mysteries which natural science cannot reach; and he observes, that the investigation of the origin of beings does not belong to zoological or botanical geography. To geology, however, these topics do strictly appertain; and this science is only interested in inquiries into the state of the animate creation as it now exists, with a view of pointing out its relations to antecedent periods when its condition was different.

Before offering any hypothesis towards the solution of so difficult a problem, let us consider what kind of evidence we ought to expect, in the present state of science, of the first appearance of new animals or plants, if we could imagine the successive creation of species to constitute, like their gradual extinction, a regular part of the economy of nature.

In the first place it is obviously more easy to prove that a

species, once numerously represented in a given district, has ceased to be, than that some other which did not pre-exist has made its appearance—assuming always, for reasons before stated, that single stocks only of each animal and plant are originally created, and that individuals of new species do not suddenly start up in many different places at once.

So imperfect has the science of Natural History remained down to our own times, that within the memory of persons now living, the numbers of known animals and plants have been doubled, or even quadrupled, in many classes. New and often conspicuous species are annually discovered in parts of the old continent, long inhabited by the most civilized nations. Conscious, therefore, of the limited extent of our information, we always infer, when such discoveries are made, that the beings in question had previously eluded our research ; or had at least existed elsewhere, and only migrated at a recent period into the territories where we now find them. It is difficult even in contemplation to anticipate the time when we shall be entitled to make any other hypothesis in regard to all the marine tribes, and to by far the greater number of the terrestrial ;—such as birds, which possess such unlimited powers of migration ; insects which, besides their numbers, are also so capable of being diffused to vast distances ; and cryptogamous plants, to which, as to many other classes, both of the animal and vegetable kingdom, similar observations are applicable.

What kind of proofs, therefore, could we reasonably expect to find of the origin at a particular period of a new species ?

Perhaps it may be said in reply, that within the last two or three centuries some forest tree or new quadruped might have been observed to appear suddenly in those parts of England or France which had been most thoroughly investigated ;—that naturalists might have been able to shew that no such being inhabited any other region of the globe, and that there was no tradition of anything similar having before been observed in the district where it had made its appearance.

Now although this objection may seem plausible, yet its

force will be found to depend entirely on the rate of fluctuation which we suppose to prevail in the animate world, and on the proportion which such conspicuous subjects of the animal and vegetable kingdoms bear to those which are less known, and escape our observation. There are probably more than a million, perhaps two millions of species of plants and animals, exclusive of the microscopic and infusory animalcules, now inhabiting the terraqueous globe. The terrestrial plants, it is supposed, may amount, if fully known, to about one hundred thousand, and the insects to four times that number. To these we have still to add for the remainder of the terrestrial classes, many of the invertebrated and all the vertebrated animals. As to the aquatic tribes, it remains at present in a great degree mere matter of conjecture what proportion they bear to the denizens of the land; but the habitable surface beneath the waters can hardly be estimated at less than double that of the continents and islands, even admitting that a very considerable area is destitute of life, in consequence of great depth, cold, darkness, and other circumstances. In the late polar expedition it was found that in some regions, as in Baffin's Bay, there were marine animals inhabiting the bottom at great depths, where the temperature of the water was below the freezing point. That there is life at much greater profundities in warmer regions may be confidently inferred. We have before stated that marine plants not only exist but acquire vivid colours at depths where, to our senses, there would be darkness deep as night.

The ocean teems with life—the class of *polyps* alone are conjectured by Lamarek to be as strong in individuals as insects. Every tropical reef is described as bristling with corals, budding with sponges, and swarming with crustacea, echini, and testacea; while almost every tide-washed rock is carpeted with fuci and studded with corallines, actiniae, and mollusca. There are innumerable forms in the seas of the warmer zones, which have scarcely begun to attract the attention of the naturalist; and there are parasitic animals without

number, three or four of which are sometimes appropriated to one genus, as to the *Balæna*, for example. Even though we concede, therefore, that the geographical range of marine species is more extensive in general than that of the terrestrial, (the temperature of the sea being more uniform, and the land impeding less the migrations of the oceanic than the ocean those of the terrestrial,) yet we think it most probable that the aquatic species far exceed in number the inhabitants of the land.

Without insisting on this point, we may safely assume, as we before stated, that, exclusive of microscopic beings, there are between one and two millions of species now inhabiting the terraqueous globe; so that if only one of these were to become extinct annually, and one new one were to be every year called into being, more than a million of years would be required to bring about a complete revolution in organic life.

We are not hazarding at present any hypothesis as to the probable rate of change, but none will deny that when we propose as a mere speculation the *annual* birth and the *annual* death of one species on the globe, we imagine no slight degree of instability in the animate creation. If we divide the surface of the earth into twenty regions of equal area, one of these might comprehend a space of land and water about equal in dimensions to Europe, and might contain a twentieth part of the million of species which we will suppose to exist. In this region one species only would, according to the rate of mortality before assumed, perish in twenty years, or only five out of fifty thousand in the course of a century. But as a considerable proportion of the whole would belong to the aquatic classes, with which we have a very imperfect acquaintance, we may exclude them from our consideration, and thus one only might be lost in about forty years among the terrestrial tribes. Now the mammiferous quadrupeds in Great Britain are only to other terrestrial species of organic beings, both plants and animals, in the proportion of about one to two hundred and eighty; and taking this as a rude approximation to a general

standard, it would require more than eight thousand years before it would come to the turn of this conspicuous class to lose one of their number even in a region of the dimensions of Europe.

It is easy, therefore, to conceive, that in a small portion of such an area, in countries, for example, of the size of England and France, periods of much greater duration must elapse before it would be possible to authenticate the first appearance of one of the larger plants and animals, assuming the annual birth and death of one species to be the rate of vicissitude in the animate creation throughout the world.

The observations of naturalists may, in the course of future centuries, accumulate positive data, from which an insight into the laws which govern this part of our terrestrial system may be derived ; but, in the present deficiency of historical records, we have traced up the subject to that point where geological monuments alone are capable of leading us on to the discovery of ulterior truths. To these, therefore, we must now appeal, carefully examining the strata of recent formation wherein the remains of *living* species, both animal and vegetable, are known to occur. We must study these strata in strict reference to their chronological order as deduced from their superposition, and other relations. From these sources we may learn which of the species, now our contemporaries, have survived the greatest revolutions of the earth's surface ; which of them have co-existed with the greatest number of animals and plants now extinct, and which have made their appearance only when the animate world had nearly attained its present condition.

From such data we may be enabled to infer whether species have been called into existence in succession or all at one period ; whether singly, or whether by groups simultaneously ; whether the antiquity of man be as high as that of any of the inferior beings which now share the planet with him, or whether the human species is one of the most recent of the whole.



To some of these questions we can even now return a satisfactory answer; and with regard to the rest, we have some data to guide conjecture, and to enable us to speculate with advantage: but it would be premature to anticipate such discussions until we have laid before the reader an ample body of materials amassed by the industry of modern geologists.

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