THE GALÁPAGOS ISLANDS.

BY GEORGE BAUR.

It was by an accident that my attention was directed to a study of the Galápagos Islands. On the 9th of January, 1889, when assistant of Prof. O. C. Marsh of New Haven, a big land-tortoise from the miocene of Nebraska was unpacked at the Yale University Museum. This tortoise resembled very much the gigantic forms of the Galápagos Islands. The question at once arose: How did these large *land*-animals come to the *islands?* In the evening of the same day I wrote in my diary: "What is the origin of the Galápagos fauna? It is not introduced, but left there; the Galápagos originated through subsidence of a larger area of land; they do not represent oceanic islands, as generally believed, but are continental islands."

From this date I began to study the different works and notes, which had been written on the islands, becoming more and more convinced that my opinion was correct, and that an examination of the group would be of the greatest interest, not only in the question of the origin of continents and oceans but also in that of the origin of species. No other group of islands afforded such a splendid opportunity for the examination of these questions. They had never been inhabited by man before their discovery by the Spaniards in the sixteenth century; the first small colony was established on Charles Island in 1832, but does not exist to-day. Now a settlement is found only on Chatham Island. It was to be expected, therefore, that nearly all the islands presented their original condition,

only influenced in a small degree by man. After I had resigned my position with Professor Marsh, in January, 1890, it occurred to me that it might, perhaps, be possible to bring together the necessary funds for an expedition to the islands. In February, I worked out a plan for an expedition, which was presented, through Prof. v. Kupffer, to the Royal Academy of Berlin. The matter was discussed by the Academy but it was concluded that the high sum of 20,000 marks, which I had considered necessary for a complete biological and physiographical survey of the islands would probably not be in accordance with the results obtained. After this the matter was laid before various institutions in this country, but with the same negative result. During this time, I published two papers on the Galápagos; one about the gigantic tortoises, and one about the variation of the lizard Tropidurus. It was in the latter paper that I expressed, for the first time in print, my opinion of the continental origin of these islands.

After I had been appointed to Clark University, I took up the matter again, more and more convinced of its great importance. On the 10th of December, 1890, a paper was read before the Biological Club of the University: "Ideas on the origin of the Galápagos Islands and the origin of species." A trial to interest Clark University failed, however. Later on I spoke about the importance of the expedition at Boston, New York and Princeton. Everywhere I found great interest, but it seemed impossible to bring together the necessary funds. At last I sent my paper to the printers. At that moment, Mr. Stephen Salisbury came forward and offered a sum which seemed large enough, with other amounts contributed by the Elizabeth Thompson Fund of Boston and my friend Prof. H. F. Osborn, to secure the success of an expedition. In Mr. C. F. Adams of Champaign, Ill., who had great experience through his collecting trips in Borneo and New Zealand, I found a most useful companion. We left New York on the *City of Para*,

on which steamer, through the great courtesy of Mr. George J. Gould, we had received free passage. We arrived at Panama, May 9th, and at Guayaquil, May 13th, but it was not before June 1st that we could leave Guayaquil for the islands on a small sloop. Chatham, the most eastern of the islands and the only one inhabited, was reached in the evening of June 9th. Mr. Manuel Cobos has established there an extensive sugar plantation with great success. Besides coffee, many other tropical fruits are cultivated. Wild cattle exist there in abundance as in some of the other islands. We remained at Chatham, making extensive collections, until one of Mr. Cobos's sloops arrived from Guayaquil. This was engaged, and on June 27th, we left Chatham to visit the other islands. The rent we had to pay for the sloop was higher than anticipated; and I have again to acknowledge the liberality of Mr. Salisbury and Mr. Gould, without which the successful accomplishment of the expedition would have been impossible. During the two months following, all the islands south of the equator with the exception of Narborough, were visited. It was intended on the second trip to examine the other islands, but unfortunately this plan could not be carried out completely. When we reached Chatham, I found news from home necessitating an immediate return. Therefore only Tower, Bindloe and Abingdon were visited. Wenman and Culpepper, two small, rocky islands to the northwest were not touched at. Notwithstanding the programme could not be followed entirely, the expedition proved to be a great success. The collections made are the most extensive. I may mention for instance, that on Albemarle, where so far only four species of birds had been collected, more than forty were obtained. Animals which had not been found since Darwin's visit in 1835 were again secured. A peculiar gull which had been considered exceedingly rare, only five specimens being in existence in all the museums of the world, was found to be quite common, and to show a very

much more extensive distribution than was supposed. Of the gigantic tortoises, a large collection was made, notwithstanding the many hardships which were experienced. Some of these tortoises had a weight of more than four hundred pounds; one of them is the largest ever carried from the islands, so far as I know, the carapace having a length of four feet in straight line.

The collections and observations made on the islands seem to prove without doubt, that the opinion of the continental origin of the islands is the correct one. These volcanic islands are nothing but the tops of volcanic mountains of a greater area of land, which has sunken below the level of the ocean. This is proved by the absolutely harmonious distribution of the organisms. We do not find the same animals on the islands, but nearly every island has its own races. This important fact was for the first time noted by David Porter, who pointed out that the different islands contain different races of the tortoise. This view was fully supported by Darwin, who states that the inhabitants of Charles Island could tell from the aspect of the tortoise from which particular island it came. The same is true for many of the land birds, for the lizards, the land shells, and for some of the insects.

Now let us suppose for a moment, that the opinion generally believed to-day, that the Galápagos are oceanic islands lifted out of the ocean, is correct. In this case there must have been a time when not a single organism existed on the islands. Only by accidental introduction from some other part of the earth could the islands be populated; but on such a supposition we are absolutely unable to explain the harmonious distribution, we cannot explain why every, or nearly every, island has its peculiar race or species, not represented on any other island. If some animals could be carried over hundreds of miles to the islands, why are they not carried from one island to the other? But besides that, how could we make plain the

presence of such peculiar forms as the gigantic land-tortoises for instance? According to the elevation theory, we can only think of an accidental importation of these tortoises by some current, because they are unable to swim. After the islands had been elevated out of the sea, it happened once, by a peculiar accident, that a land-tortoise was carried over. Alone it could not propagate. This was only possible after a similar accident imported another specimen of *the same species*, of *the other sex*, to *the same island*. Or we could imagine that at the same time animals of both sexes were thus accidentally introduced. By this we could at least explain the population of a single island. But how did all the other islands become populated? To explain this we would have to invoke a thousand accidents.

The most simple solution is given by the theory of subsidence, however. All the islands were formerly connected with each other, forming a single large island; subsidence kept on and the single island was divided up into several islands. Every island developed, in the course of long periods, its peculiar races, because the conditions on these different islands were not absolutely identical.

That it has been made probable, that the Galápagos are of continental origin, I consider one of the most important results of the expedition. If the Galápagos originated through subsidence, we can believe the same of the Sandwich Islands, which also show harmony in the distribution of their organisms. It is not at all improbable that formerly large continental areas spread where we find to-day the Pacific Ocean; that an Atlantis, a Lemuria, so often demurred at, existed after all. New, extensive and methodical explorations of the different groups of islands in the Pacific, Atlantic and Indian Oceans, which have to be made, will be able to decide this interesting question.

Another great result will, I feel certain, come to light after the collections have been fully worked up. The change of the species can be followed, stage by stage, on

the different islands; so far as I can anticipate, it will be shown that variation goes on in definite lines determined by the surroundings; that the surroundings and time are the most important and principal factors of variation, and that *natural selection* plays only a secondary role, and very often none at all.