THURSDAY, FEBRUARY 8, 1872

THE FOUNDATION OF ZOOLOGICAL STATIONS

WHOEVER contemplates a little closely the state of Science at the present time, must be struck with the fact that, whilst in almost every other branch of public and private life co-operation has been established, and has worked out great results, its influence on the life of Science is but small and insignificant.

This may sound strange to all those who know the number of Scientific Societies, Academies, and Unions to be found in England, Germany, America, Italy, France, in short, everywhere where Science is cultivated at all. But if one looks into the life of these societies, there is not much co-operation to be found in them. They publish periodicals; but there are publishers who do quite as well as societies, and sometimes even better. They meet and talk science; but this does does not add much to the real progress of science. Sometimes they found museums or cabinets, and this is a better service; they establish a library for the use of their members, and this is perhaps the best they do altogether. A man may be fellow of twenty different societies, but that will not affect much the progress of the scientific work he does; if he is member of certain academies his reputation may be raised in the eyes of the outside public, but no essential help is afforded by that either to him or to his work, except in the case where such academy has some influence on the Government, as, for instance, the Royal Society. The Menagerie in the Regent's Park, established by the Zoological Society, is one of the solitary instances in which, the initiative being taken by a scientific body, an institution has been evolved, drawing immense revenue from the public pocket, which is for the most part spent upon scientific objects. It is the application of this method of securing support which will be strongly advocated in the present paper, as a practicable path for the future progress of biological research.

There is also another great society in Britain which does, perhaps, better work for science than any other. This society is the British Association for the Advancement of Science. Not only does its great and well-deserved reputation make it powerful and influential, but also the large sum of money it distributes annually for the direct progress of science. This influence is due principally to the fact that the best men in British Science participate with great eagerness in the meetings of the Association and lend to it all their personal authority and reputation. The considerable sum of money to be distributed is due to the great number of scientific and lay people that take part in its meetings.

The combination of these two elements ought to be imitated in every special branch of science. The times are past when great scientific men did not condescend to speak to a general public, and happily nobody believes any longer that science must be lowered and lost, because the general public looks at and hears a little of its inner life. Great scientific men have an immense influence upon the public, and that is an immense benefit to the public; on the other hand, the general public takes interest in, and pays money for the progress of science, and that is a great benefit for science.

The meetings of the British Association therefore are an essential step in the right direction for lending science the great help of co-operation. But a great deal more of it is needed if that element is to supersede by-and-by the old lines and ways of mere individual and disorganised action. Especially is co-operation wanted in the single sciences. Every one knows how great is the progress in meteorology and astronomy brought about by the possession of special laboratories and observatories. Even if all the universities were extinct at once, these sciences would go on perfectly well by the help of the observatories. Chemistry is aided by innumerable laboratories, erected for practical purposes. Mechanics governs the world and finds itself at home everywhere, involving by its special character many elements of co-operation.

Other sciences do not enjoy these privileges, though they want them perhaps even more than some of those that are in possession of them. Amongst the number of these sciences, perhaps the most neglected in the way of co-operation is Biology, that science which occupies at present such an eminent place in the public interest, and yet the most neglected, in so far as no other science feels at present the necessity of co-operation and organisation so much as biology. The reason is a very obvious one. Biology has undergone a complete revolution by Mr. Darwin's great work. This revolution has augmented the number of special problems in such enormous proportions that biology is now completely at a loss to solve all these problems by the aid of the means placed hitherto at its disposal, and looks pretty much like a boy who has suddenly grown in one year out of all his clothes, presenting the ridiculous aspect of a man in a child's dress. The thing which a father would do for his boy would be to go and buy another dress. This obviously was also the idea of Prof. Carl Vogt, who long since began an agitation for the establishment of a zoological laboratory at the sea-coast, of which agitation he wrote me in a letter the following account:—

"During the years 1844—1847 the plan for the establishment of an expedition was worked out at Paris by Milne-Edwards, and I participated in it. The object was the investigation of a coral-island, and the establishment of a station upon it for at least several years. The ship and the station should be furnished with all possible things, especially for dredging-work. The scheme fell to pieces owing to a question of etiquette. The commander of a man-of-war of the Royal Navy would not submit to the direction of a naturalist.

"As you know, I lived from 1850 to 1852 at Nice. The instruments for observation, which I bought by the money earned by literary work, consisted of a microscope, a surface net, and some large sugar-bottles. I tried at the time by the help of two deputies, my friends Valerio and Dunico, to bring about the foundation of a zoological station at Villafranca, asking only for some rooms in the empty buildings of the Darsena, and the establishment of some tanks in them. Nevertheless I had not the least success.

"In the year 1863 my friend Matteucci became Minister of Public Instruction in the kingdom of Italy. With him, as a physicist who especially dealt with physiological subjects, and who, understanding the necessities and wants

of physical science, intended to make important reforms, I easily arrived at a mutual understanding. It was his idea to elevate the studies in Italy by introducing foreign, especially German, scientific men into the chairs at the universities, who should teach the new generation of Italian students. I worked out for him a project for the erection of a zoological station at Naples, the most suitable place in Italy. The Casino Reale at Chiatamone was to be transformed and fitted up for such a purpose, and a little steam yacht for dredging was to be placed at the disposal of the station. The latter was in the meantime intended for a sort of school, connected with the whole system of public instruction, to form teachers of natural history for the whole kingdom. The plan was completely worked out and adopted by Matteucci and several others among the first scientific men of Italy. They applauded it heartily; Filippo de Filippi especially did everything he could to bring it into play, and talked about it, as he told me, to King Victor Emmanuel during a hunting-party. Matteucci afterwards left the ministry—Filippi and he are dead—the fate of the project is easily to be understood.

"Thus I had got round the Mediterranean. In January 1871 I was at Trieste delivering public lectures. On January 8 I published in the *New Free Press* two letters on 'Some Necessities and Wants of Scientific Investigation,' the subject of which presented itself to my mind when viewing some of the Austrian arrangements for public instruction. I may be allowed to say that my article met with universal approval; and some Triestian friends, amongst whom I may mention especially Field-Marshal Lieutenant v. Möring, at the time Governor of the Coast District, talked with me on it, and agreed that Trieste would be a very good place for the execution of my project. Möring himself directed my attention to some small buildings at Miramare, lying outside the park; we visited them together and talked about the necessary arrangements to be made. I worked out a fresh project, made rather special calculations on the money necessary for executing it, and sent all this to the Austrian Minister of Public Instruction, Herr v. Stremayr, with whom I spoke on the subject afterwards, when I passed through Vienna. As you know, I addressed at the same time Gegenbaur, Haeckel, and you, to approve my views and assist me. You sent me besides a letter from Darwin, who applauded much your own plan for erecting a station, and had even offered a subscription for it. I added all these letters to my memorial, which unfortunately had the same fate as the Italian: Stremayer left the ministry before he could do the least thing for the realisation of a plan which he thought exceedingly valuable."

Though Prof. Vogt did not succeed in carrying out his plan, there can be no doubt that his idea is the very one wanted for the present state of biology. A great number of other zoologists entertained it, but nobody knew how to execute it.

In the winter of 1868-69 I found myself at Messina, occupied with the investigation of the embryology of Crustacea. Together with my friend Miclucho-Maclay I often spoke of the necessity of establishing a zoological station on the coast of the Mediterranean, and we agreed to leave a considerable quantity of instruments, amongst which was a small aquarium furnishing a constant stream of water, to our successors in Messina. An Austrian squadron, just sailing round the globe with a considerable number of naturalists, amongst whom were Herr v. Scherger and others, stopped several days in the harbour of Messina, and caused me many thoughts about the great advantage such and other expeditions would derive from a net of scientific stations stretched over the whole globe.

But how to get anything like such stations built and kept up for years? I did not know at that time that Prof. Vogt had already tried to get assistance from several great governments, and had failed to succeed. But I did not even try to do anything like this, knowing beforehand that it would be useless. Zoology is at present in a rising condition, it has still to conquer the place it ought to occupy in the attention of the public by making itself indispensable to intellectual progress. As it is, governments will not easily be induced to sacrifice much money for the progress of this science.

I took another line. After some unsuccessful attempts to get money by collecting small sums, I combined the idea of founding a scientific station with the plan of building a great public aquarium at Naples. My calculation was, that by the entrance-fee of that aquarium the sums necessary for keeping up the station could easily be obtained, and that perhaps more than that would come out of it. I saw at a certain distance even the possibility of erecting other stations with the surplus of the Naples income, and of giving in such a way quite a new development to biological science, just that development which biology wanted after the great event of the Darwinian theory.

As soon as I had got a hold at Naples, I began to spread my ideas in letters and conversations. I the pleasure of finding almost everybody in England and Germany quite ready to assist as much as possible. I brought the subject before the meeting of the British Association in Liverpool, and succeeded so far that a committee was appointed by Section D, composed of Prof. Rolleston, Dr. Sclater, and myself as secretary, under the name of "The Committee for the Foundation of Zoological Stations in Different Parts of the Globe."

This was during the war between Germany and France. While it lasted it was almost impossible to do anything in favour of the scheme I had got into my head, except thinking and meditating upon it as much as possible. But as soon as peace was made I proceeded again, as well with the negotiations at Naples as with agitation in other countries.

As secretary of the above-named committee, I gave a report to the meeting of the British Association at Edinburgh. I stated in that report that the establishment at Naples was now quite safe, so far as the permission of the Town Council was concerned; and that, in all probability, the station would be seen there in working order in January 1873. I added that I had got the assistance of my own Government, and I may add here that the Italian Government also assists me greatly. I proposed further in my report that the British Association might consider the opportunity given by the cessation of the annual grant to the Kew Obervatory, of building a zoological station at one of the most favourable places on the British coast. My idea in proposing this was based on the same considerations which had made me go to Naples. I thought it very convenient and very practicable to build a small station, for example, at Torquay or Plymouth, and to combine in such a station, in the same way as at

Naples, a laboratory with a larger aquarium for the public. The income of the latter in a place like Torquay, where there are so many residents and visitors at all times of the year, would completely suffice to keep up the laboratory, and pay a modest sum to a naturalist, who would be charged with the management of the station. Being unable to attend personally the meeting at Edinburgh, I could not give all the reasons which induced me to make this proposition. All the more I shall avail myself of the present opportunity to do so.

The present state of zoology requires, as stated above, new means of investigation. Systematism and simple faunistic researches fall very far short of the problems now ripe for solution. Two great departments of biological science go much ahead of all others, and these two are embryology and the study of the life of animals in relation to all those conditions which regard the struggle for existence and the action of natural selection.

If we speak first of the latter chapter, it is clear that past times have done much more in promoting knowledge about it than the present generation. It is rather out of fashion to study the habits and conditions of life of an animal. Systematism, the making of genera and species, have so much exceeded their legitimate grounds, that they have almost completely suppressed that other branch of natural history. We owe it to Mr. Darwin that he completely upset this one-sidedness, in proving, by his admirable treatises on the Domestication of Animals and Plants, on Sexual Selection, on the Fertilisation of Orchideæ by the Interference of Insects, of what fundamental importance these studies of the habits and conditions of animal life can be. He added not only an enormous number of hitherto unknown facts to the storehouse of science, but he showed what immense importance these facts gained by deriving from them the great principle of natural selection—a principle as grand as any in modern science. Very few zoologists (in naming Mr. Wallace and Mr. Bates, I do justice to these eminent men as two of those who promoted these studies independently of Mr. Darwin) have followed Mr. Darwin's lines in these departments. Nevertheless this must happen: it constitutes one of the most urgent necessities of biological study in our time, and it must not only be done for our domestic animals, and those that live most closely around us, but wherever animals are to be found, and so above all in that enormous field of animal life which occurs in the sea.

Every one will agree with me that we know scarcely any of the secrets of the life of the sea bottom. We have short notices on the habits of some fishes; but this is altogether insignificant compared with the immense bulk of things unknown to us in the same department. And of echinoderms, cuttle fish, jelly fish, polyps, &c., &c., our knowledge simply amounts to nothing.

Here an aquarium, under scientific guidance and superintendence, can work immense good and progress. And such an aquarium will do double service; first, it will attract the public and yield money; and then it will serve immediately and directly the progress of science, by giving the only possibility of knowing something about the habits and the life of marine animals.

But a zoological station with an aquarium will serve equally as much for the progress of embryology. Whoever looks at the development of biological science must see that, during the last ten years, embryology has made very important progress, not only in accumulating facts, but in rendering them serviceable to the progress of ideas and principles.

An offspring of the theory of descent is the maxim that the ontogenetical development is an abbreviated recapitulation of the phylogenetical development. This maxim, or law, if we choose to call it a law, gives enormous importance to embryology. By the help and application of it we may succeed in getting a deep insight into the history of animal life long before the geological record. The Cambrian and Silurian systems yield us already a fauna of so high perfection, and so complete a series of representatives of almost every great class of animals, that we could easily be led to believe in a waving up and down of animal creation, not in a constant progress, so comparatively small are the differences between the present fauna of the earth, and those which the geological record of all the strata makes known to us. Embryology, on the contrary, starts at the very beginning of organic life, tells us how out of simple organic matter cells became formed, how these cells took different functions, thus differentiating and organising the being that possessed them. Embryology further tells us how out of one form, one single form, whole classes came forth, and renders it possible for us to trace the lines of origin of every member of these classes, down to the common ancestor of all of them.

Systematists, looking out anxiously for the "natural system" of the animal kingdom, and turning to mere anatomical differences, may be compared to Sisyphus rolling his stone. They cannot succeed without taking to embryology. But embryological studies are among the most difficult in the whole range of biological science. Not only the interpretation of the facts, and the conclusions to be drawn from observation, require an immense amount of circumspection, caution, and critical ability; but even the simple statement of a fact, the mere act of observation, is often exceedingly difficult. How many monographs on the embryology of the chicken have been written since Caspar Friedrich Wolff published his immortal book against the doctrines of Haller. Pander, Baer, Remak, His, and many others, have treated the same subject, and still to-day there is uncertainty on the most fundamental questions. This is above all to be attributed to the mechanical difficulties of observation. And these difficulties do not exist only in the case of birds' eggs; they are the same for the eggs of almost all animals, especially for those of marine animals. These require a constant stream of salt water to keep them alive, a stream which is only to be had by the help of an aquarium. It is principally due to the absence of such aquariums that our knowledge of the development of fishes is still so rudimentary; for, though the works of Baer, Rathke, Vogt, Lereboullet, Kupffer, and others have taught us a good deal, nevertheless the essential parts of fish-embryology are still wanting. And this is the more to be regretted as it cannot be doubted that the eggs of fishes are, in many regards, preferable as objects for the investigation of general embryological facts to those of the birds. Considering only the fact that all other vertebrata have proceeded from fishes, most likely from shark-like animals, it will be of the greatest importance to acquire

convenient methods for investigating the embryology of these animals.

Besides, the enormous mass of other marine animals waits equally for the establishment of laboratories provided with aquariums, before the study of their embryology can safely, and with due prospect of success, be taken in hand. And that the common ancestors of all the higher animals have lived in the sea, and must have left the traces of their nature still in the embryos of marine animals, is more than likely. Every attempt, therefore, to get back to these ancestors, and to build up scientific genealogy, must lead to the investigation of the embryology of marine animals, must cause, in consequence, the desire of having laboratories near the coast, provided with tanks and continual streams of sea water, to overcome the mere mechanical difficulties of the study.

These are reasons of the most imperious nature to move all those who can do something, to combine their exertions for the foundation of zoological stations near the sea-coast.

When I therefore proposed, in the name of the Committee for the Foundation of Zoological Stations, the erection of such a station at Torquay, my principal object was to create a greater facility for English zoologists to execute scientific works of the above-mentioned nature. Without denying one moment the immense benefit zoology has always derived from English naturalists, one may justly lament that embryology has not found so many students in a country which has such great opportunities of following the study as, for example, has been the case in Germany. England abounds in splendid localities for the study of marine animals; the innumerable harbours, firths, and bays yield an immense material for the scientific observer. Students at the universities would have the easiest access to these localities, and would gain a great mass of information from them; but circumstances have directed almost the whole scientific spirit in another direction—almost all the biologists are occupied with the completion of the faunistic records of the English seas. The existence of a zoological station at Torquay must lead to a greater cultivation of the other branches of marine zoology by Englishmen, and must open also for foreign zoologists the opportunities yielded by the fauna of the south coast of England for carrying in studies in comparative anatomy and embryology.

It will be essential, not only for the progress of zoology in general, but also for the development of the whole scheme for the foundation of zoological stations, that those countries which contribute by their natural position most to the progress of marine zoology should be provided first with zoological stations. If zoological stations in other parts of the world outside Europe are to be founded, they will require above all zoologists to conduct them. Where are these at present to be found? Nowhere, I believe. If, therefore, the great object of my plan is to be attained, it will only be by gradually and consistently developing its base—the foundation of stations in Italy, Britain, France, Norway, and perhaps Spain or Portugal. With the help of these stations, zoologists may be educated who would be inclined to go to remoter places, such as, for instance, Capetown, Ceylon, Japan, or Australia, and conduct or work only for a couple or more years in the stations built in those countries. There can be no doubt that the benefit for science would be enormous if there existed efficient working stations in these countries; but to make them efficient the principal means is to give them well-instructed naturalists at their head, and this is at present not possible.

Therefore I take the opportunity of repeating once more that it seems to be essential to proceed with the foundation of a zoological station at Torquay, and to head that station by a young, laborious zoologist, who is already experienced in histological and embryological work. It cannot but be that science, and especially British science, will derive considerable benefit from such a proceeding.

Naples, Jan. 2 ANTON DOHRN

THE NATURAL HISTORY OF EGYPT AND MALTA

Notes of a Naturalist in the Nile Valley and Malta. By Andrew Leith Adams, M.B. (Edinburgh: Edmonston and Douglas, 1871.)

FEW men have better opportunities for furnishing valuable contributions to the Natural History of foreign parts than surgeons attached to the Army and Navy; an education in at least the rudiments of natural science, combined with abundant leisure, presenting means which are not at the disposal of all travellers. As a rule, we fear that this class of men have done but little for Science compared with what might have been expected of them. There are, however, some honourable exceptions, among them our present author, whose "Wanderings of a Naturalist in India" has been already given to the public, and who now publishes the results of the labours of his leisure hours and vacation rambles in the investigation of the archæology and natural history of the Lower Nile and Malta.

The most interesting portion of Dr. Adams's researches in Egypt and Nubia relates to the evidence as to the period when the northern portion of the African Continent became elevated above the sea. On this point he says:—

"The discovery of the common cockle and other marine shells far inland, and over vast tracts of Algeria and the desert of Sahara, even up to height of more than 900 ft. above the present level of the Mediterranean, and at a depth of 300 ft. below it, fully establishes the fact that a large portion of North Africa was, at no very distant period, covered by the ocean; moreover, that the highlands of Algeria, Tunis, Morocco, and Barbary, were at this period separated from Africa by sea, and that the submergence occurred during the modern or post-tertiary period. Further researches have also proved that the same description of phenomena are to be observed along the borders of the Red Sea. A question therefore suggested itself to me in 1863, whether or not Egypt and Nubia had participated in the same continental movements. Accordingly, no opportunities were omitted during our short sojourn in Lower Egypt in searching for similar evidences of upheaval and depression, but, owing to the flatness of the country, drifting of the desert sands, and great expanse of cultivation on the river's banks, and our rapid movements, I was unable to discover any traces. It was not until we approached the frontier of Nubia, and passed the first cataract, that favourable opportunities were presented. The Nile, now contracted by the porphyritic and sandstone rocks, flows between steep banks, and creating accumulations of alluvium and bendings and openings in