

over the whole country, cholera infection is spread. But all reported cases have, as yet, failed of corroboration. Nevertheless, the evidence of the facts produced cannot be weakened by the failure of the experiments on animals. With other infectious diseases, the same observation has been made; for example, in the case of typhoid fever and leprosy, — two diseases for which specific bacteria are known, without, as yet, its being possible to communicate them to animals; and yet the manner of the occurrence of the bacteria in these diseases is such, that, without doubt, they must be looked upon as the cause of the disease. The same holds true for the cholera bacteria. Moreover, the further study of the cholera bacteria has made known many of their peculiarities, which all agree with that which is known of cholera etiology, as well as further evidence of the correctness of the assumption of the bacteria as the cause of the disease.

In this connection it is well to state the often observed fact, that in the linen of cholera patients the bacteria increase in a most remarkable manner, when the clothes have been soiled with the evacuations, and then, for twenty-four hours, have been kept in a moist condition. This explains the known fact, that the people having to do with such affected linen are often attacked. On account of this, further experiments were instituted; and cholera evacuations, or the contents of the intestines of the dead, were spread on cotton, on paper, and especially on the damp surface of the ground. After twenty-four hours, the thin sheet of slime invariably changed into a thick mass of cholera bacilli.

Another peculiarity of the cholera bacteria is, that they die, upon drying, much more quickly than most others. Commonly all life is extinct after three hours' drying.

It has also been noticed that their development only takes place well in substances having an alkaline reaction. A very small amount of free acid, which would have little or no effect on other bacteria, puts a marked check on their growth.

In a healthy stomach they are destroyed, which is shown by the fact that neither in the stomach nor the intestines of animals which had been constantly fed on cholera bacilli, and then killed, were any found. This last peculiarity, together with the impossibility of their withstanding drying, gives an explanation of the every-day observation, that infection so seldom occurs from constant intercourse with cholera patients. Evidently, that the bacilli may be in condition to pass the stomach, and bring about the cholera in the intestines, peculiar conditions must be present. Perhaps, when the digestion is imperfect, the bacilli might be able to pass the stomach; and the fact observed in all cholera epidemics and in India, that those suffering from indigestion are especially subject to cholera, may bear out this view. Perhaps a peculiar condition, analogous to the period of inaction of other bacteria, would enable them to pass the stomach uninjured.

It is, on the whole, not probable that this change in the production of inactive spores exists: then such

spores, by observation, are known to remain months, or even years, capable of life, while the cholera poison remains active not longer than from three to four weeks. Nevertheless, it is conceivable that some other form of inactivity exists, in which the bacilli can retain their life in a dry state some weeks, and in which they withstand the destroying influence of the stomach.

The conversion into such a condition would correspond with that which Pettenkofer has designated as ripening of the 'cholera-infection material.' As yet, such an inactivity of cholera bacilli has not been discovered.

THE EXPLORING VOYAGE OF THE CHALLENGER.

(First notice.)

THE Challenger was a British man-of-war, a corvette of twenty-three hundred tons, equipped at the public expense with every appliance for the scientific study of the sea and of marine life, and carrying a faculty of six civilian specialists chosen by the Royal society, in addition to a staff of naval officers selected with reference to their scientific attainments.

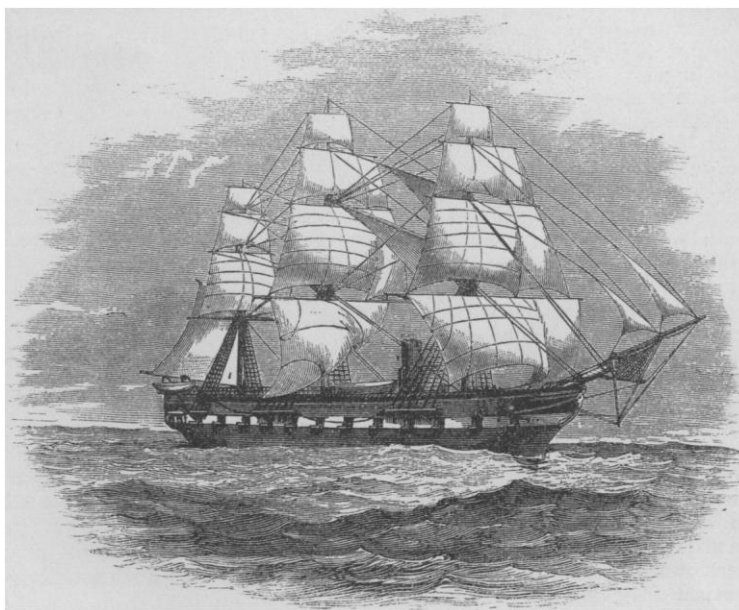
This floating laboratory was sent out in 1872 upon a voyage of discovery around the world, and, during an absence of three years and a half, visited every accessible sea and ocean, traversing a distance of nearly sixty-nine thousand miles. Three hundred and sixty-two observing-stations were established at sea, and over five hundred deep-sea soundings made, — a wonderful record of industry, when it is remembered how many weeks were necessarily spent at coaling-stations, and when we take into account the fact that the present methods of rapid work by means of thin-wire dredge-ropes had not then come into use, and that a dredge-haul from a depth of two thousand to twenty-five hundred fathoms, which the Blake or the Albatross now easily completes in four or five hours, took an entire day of the Challenger's time.

The collections, when finally assembled at Sheerness, after the return of the ship, were contained in 2,270 jars, 1,749 bottles, 1,860 glass tubes, and 176 tin cases of alcoholics, with 22 casks of specimens in brine, and 180 tin cases of dried specimens, besides large quantities of material already sent home from Bermuda, Halifax, Capetown, Sydney, Hong Kong, and Japan.

The Challenger long ago resumed her barbaric function as an engine of war. Her trawls and dredges, battered and torn, hang upon the stair-rails in the Museum of naval architecture in South Kensington. Their share in the work

is done, but the collections are only now beginning to yield up the treasures of fact which they contain. The first of the final reports appeared in 1880; and now ten massive quarto volumes, crowded with sumptuous lithographed plates, have been printed, eight of these in the natural history series, two in the 'narrative,' which includes also the results of the physical observations. The completion of the entire series is promised for 1887, but it can safely be predicted that the last of the row of twenty volumes will not be placed upon our bookshelves before 1890. Preliminary reports have appeared to the number of at least three hundred; and, since it has been decided that the

the subsequent important explorations by Norway, Sweden, and Germany, and the expeditions of the Italian *Washington* and *Violante*, the French *Travailleur* and *Talisman*, the Dutch *Willem Barents*, and the American *Blake*, *Fish Hawk*, and *Albatross*, would not all have been carried on by grants from public treasuries. What the several governments might have done in fitting out ships, it is impossible for us to know. No one can question, however, that naturalists in all countries have been inspired and stimulated in a most salutary way by the action of the British government in publishing every half-year one of these sumptuously printed *Challenger* volumes, — each a collec-



THE CHALLENGER.

biological section of the British association is to devote its attention at the Montreal meeting almost exclusively to pelagic life, we may expect a large addition to the *Challenger* bibliography during the present year.

The *Challenger* expedition was planned and executed solely in the interest of pure science, no utilitarian aims having ever been considered in its organization: it was the direct outgrowth of the previous expeditions of the *Lightning* and the *Porcupine*, inspired and conducted by Carpenter, Gwyn Jeffreys, and Wyville Thomson. The action of the British admiralty had, in consequence, a particularly salutary effect upon the policy of other nations; for it is highly probable, that, had there been no *Challenger*,

tion of monographs from the hands of master-workmen in natural history, not English only, but American, Scandinavian, Dutch, French, and Italian.

The history of the expedition, and the general nature of its discoveries, were long ago published to the world through Sir Wyville Thomson's '*The Atlantic*,'¹ Professor Moseley's '*Notes*,'² a work which should stand always on the same shelf with Darwin's '*Voyage of a naturalist*,' Lord George Campbell's '*Log letters from the Challenger*' (London, 1876),

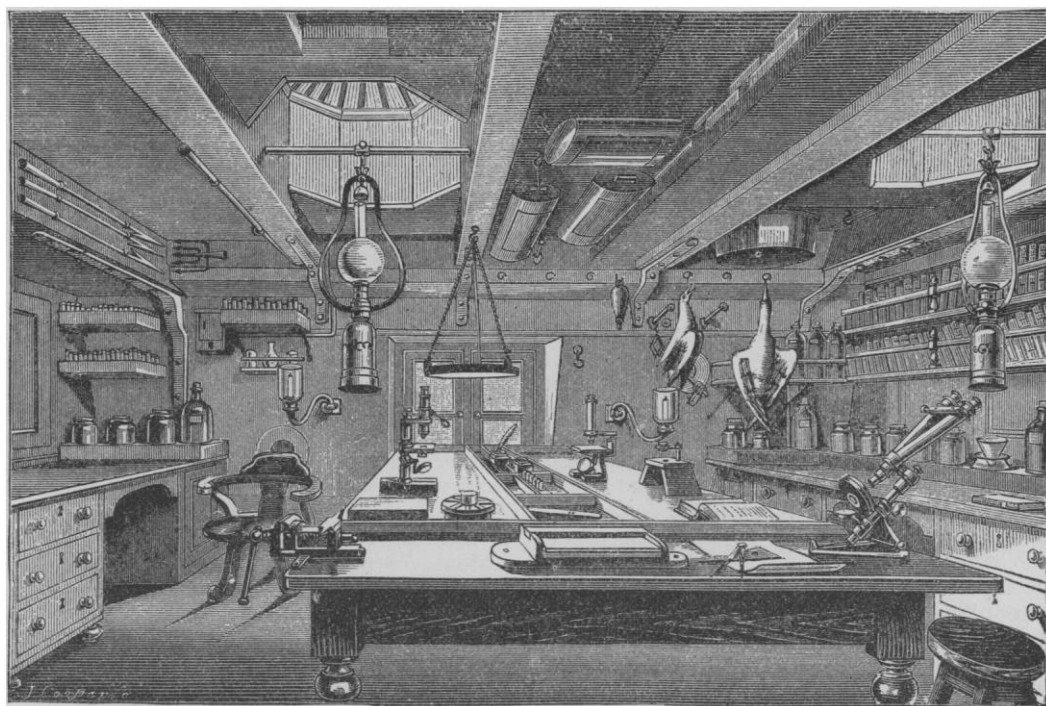
¹ The voyage of the *Challenger*, — the *Atlantic*; a preliminary account of the exploring voyage of H. M. S. *Challenger*. 1878. 2 vols. 8°.

² Notes by a naturalist on the *Challenger*. London, 1879. 620 p. 8°.

Engineer Spry's illustrated journal in folio, with its hundreds of graphic sketches of scenery and incident,¹ and Mr. J. J. Wild's suggestive little books, 'Thalassa' and 'At anchor.'

The first-mentioned work, being semi-official in character, has been made the subject of much criticism, on account of the loose and inaccurate way in which many of the discoveries are announced. It is, in fact, a reprint of a series of letters to *Good words*, a family magazine, which were written by the director during the latter part of the voyage to satisfy

also been severely criticised for his policy in withholding the collections from the British museum, establishing the office of the expedition in Edinburgh, and refusing to ask the direct co-operation of the authorities of the British museum in working up his results. It is quite probable, to be sure, that a certain amount of additional support might have been gained by pursuing a different policy, but it is difficult to imagine whence it would have come. The British museum, like our own National museum, is the legal and proper place of deposit for government collections which have



NATURAL HISTORY WORKROOM ON BOARD THE CHALLENGER.

public curiosity as to what had been done during its beginning. While it is undoubtedly open to criticism, it is probably as scholarly a piece of work as most landsmen would have been able to accomplish in the midst of the depressing influences of ship-life; and it is so much more satisfactory than any other official attempts at narratives which have yet appeared in connection with similar expeditions, that one cannot help regretting that the Pacific was not written up by the same hand and in the same manner. Sir Wyville Thomson has

¹ The cruise of her Majesty's ship Challenger. London, 1876.

been worked up and reported upon, and the Challenger collections are gradually being sent there. The director of the expedition was, however, better fitted, both through experience and interest, to administer upon the collections brought together by his staff, than the officers of the natural history section of the British museum, no matter how much they may have excelled him as masters of special branches of work. Then, too, these men were already so overburdened with official routine that they could not have given the prominence to the Challenger work which it for the time de-

served. The policy laid down by Professor Thomson, when called upon by the admiralty to propose a plan for the disposal of the Challenger collections, was in principle exactly consistent with that for many years pursued by our government geological survey, fish-commission, and bureau of ethnology, in relation to the national museum, though the heads of these organizations generally find it more convenient to use the organization of the museum to facilitate the administration of their own work.

A much more serious complaint has been based upon the policy of the director in claiming a right to control the results of the studies of his assistants during the voyage, and to announce their discoveries in his official capacity, without giving credit to the observers. It is, of course, impossible to say to what extent this policy was put in practice; but it is certain that the efficiency of the staff was to some extent impaired by it, and that some of the men felt called upon to protect themselves by writing their journals in languages unknown to the director. The subject has, of course, had no public discussion in England, and is referred to in this review simply on account of the general principle involved, which has already affected the efficiency of many institutions and expeditions in the United States. For the benefit both of science and of the workers in science, it is exceedingly important that there should be established some exact understanding of what constitutes literary or scientific property, and how much control over the results of the labors of his pupils or assistants a teacher or director justly may exert.

Whatever may have been the obstacles to the success of the expedition, its final results cannot fail to be satisfactory to every one who examines them. The highest praise is due to the late Sir Wyville Thomson, by whom it was organized and so successfully carried on. The liberal spirit with which he invoked the co-operation of foreign specialists was one of the many noteworthy features of his administration. Since his death, in March, 1882, the administration has been admirably carried on by Mr. John Murray, who was Professor Thomson's first assistant in natural history from the very start.

As has been already stated, eight volumes of zoological reports have already appeared. These contain the zoological monographs up to No. xxiv., thirty more still remaining to be published, together with two botanical reports, several concluding parts of papers already begun, and Mr. Murray's final summary of results. In discussing the publications of the

expedition, the monographs will be taken up in systematic sequence. Their present order is arbitrary and temporary, it being understood that this will be abandoned in the final arrangement and combinations of the volumes of the report.

The mammal collections were assigned to Professor William Turner of the University of Edinburgh, whose paper upon the human crania is announced to be nearly ready, but whose final report on the marine mammalia will, it is feared, be long delayed. An installment of the latter is, however, already in type, in the form of a report upon the bones of Cetacea (vol. i., 43 p., 3 pl.). This paper is a curious illustration of how many important facts may be derived from the study of a collection of objects of the most heterogeneous and miscellaneous character, such as the series of whale-bones gathered by such an expedition must necessarily be. The descriptions of the skeletons of *Mesoplodon Layardi*, and other whales obtained at the shore-stations, are valuable to the cetologist; but the greatest interest is in the account of the hundreds of separate bones dredged from the abyssal depths. At one station in the middle of the South Pacific, at 2,335 fathoms, there were obtained about ninety tympanic bullae, as well as numerous other ear-bones, the remains of nearly as many individual whales, most of them ziphioids. From the evidence of such fragments, Professor Turner concludes that the genus *Mesoplodon* is particularly abundant in the South Pacific, and *Ziphius* in the South Atlantic, though but few of these animals have been observed in those regions. Strange as it may seem, there were found no bones of the sperm-whale, so abundant in all the waters traversed by the ship. In the localities where bones were found, — none of which, it may be noted, were north of the equator, — the deposit at the bottom was a red clay, containing, besides the ear-bones, many hundreds of sharks' teeth, belonging to the genera *Carcharodus*, *Oxyrhina*, and *Lamna*, and apparently to extinct species. The question naturally arises, whether the associated cetacean remains belong to recent or extinct species. The occurrence of the teeth of tertiary sharks, lying so loosely upon the bottom that they may be scraped up by the dredge, indicates to the writer of this review that tertiary sharks have probably existed in these waters within comparatively recent times, and that the ear-bones, which cannot be referred to living species already known, in all likelihood belong to living species of whales not yet discovered. That interesting gener-

alized type of selachian from Japan recently announced by Garman under the name *Chlamydoselachus* is but one of the many signs that our knowledge of pelagic and abyssal life is still very incomplete.

Prof. D. J. Cunningham of the Royal college of surgeons, Ireland, contributes an essay upon the anatomy of certain marsupials and upon the mammalian *pes* (vol. v., 192 p., 13 pl.). The first part of this paper is descriptive, and devoted to *Thylacine*, *Cuscus*, and *Phascogale*; but its preparation led to a general investigation of the foot of mammals, involving the dissection of forty-five species distributed through all the orders. Professor Cunningham's conclusions as to the relations of the intrinsic muscles and nerves of the *pes* in different genera are of great interest, but, being merely incidental to the work of the Challenger, must be passed by with simple mention.

Vol. ii. is chiefly devoted to the report on birds, which is the eighth in the zoological series. This is a compound paper in thirteen parts, prepared by the standard British authorities, *Sclater*, *Salvin*, *Saunders*, *Forbes*, *Tweeddale*, and *Garrod*; one paper being also supplied by *Salvadori* of Turin, and one by *Finsch* of Bremen. The report on the anatomy of the petrels (*Tubinares*), by the late *W. A. Forbes* (vol. iv., 64 p., 7 pl.), is important as throwing much new light on the classification of these remarkable birds. It is based upon collections from the stores of the zoological society and the U. S. national museum as well as of the Challenger. The affinities of the petrels are shown to be with the *Steganopoda* and the storks and herons, rather than with the gulls. The most extensive anatomical monograph is that of the penguins, by Professor *Morrison Watson* of Owens college, Manchester, of which the first part has been printed (vol. vii., 244 p., 19 pl.). The publication of the second part will complete the ornithological work of the expedition. This essay is full of interest to the general reader as well as to the ornithologist; since, although structural minutiae are fully discussed, each detail is brightened by some allusion to function, origin, or habit. The conclusions of Professor Watson, concerning the affinities of the *Spheniscidae* to each other and to other birds, are worthy of much fuller discussion. Many and appreciative allusions are made to Dr. *Elliott Coues*' monograph of the *Spheniscidae*, which is frequently quoted.

Professor *W. Kitchen Parker*'s report on the development of the green turtle (vol. i., 58 p.,

13 pl.) is an exceedingly weighty contribution to morphology, and concludes with a page of most suggestive generalizations upon the phylogeny of the *Chelonia* and *Reptilia*. This investigation was based upon a series of embryos obtained at Ascension Island, in compliance with Professor *Parker*'s particular request, and is one of the most important of the side issues of the expedition.

Dr. *Albert Günther*'s report on the shore fishes (vol. i., 82 p., 32 pl.) contains the identifications of fourteen hundred specimens, representing five hundred and twenty species, of which ninety-four were new. It consists of a series of faunal and regional lists, some of which, particularly those for remote oceanic islands, cover fields hitherto unexplored by ichthyologists; such as *St. Paul's Rocks*, *Ascension*, *Kerguelen Island*, and *Juan Fernandez*, and also *Magellan Straits* and the *Arafura Sea*. The systematic arrangement is all that can be desired: it is to be regretted, however, that the author has been satisfied to publish such brief and cursory diagnoses, and that he gives no tables of proportional measurements, thus causing serious embarrassment to students who have no access to his types. The report upon deep-sea fishes by the same author, at one time announced for vol. iii., is now so far down upon the official list of 'memoirs to follow in subsequent years,' that it is not likely to come to view for a long time. This is all the more to be regretted, since the fishes of the abyssal region are more peculiar, and more generally instructive, than perhaps the members of any other group. Much unstudied material in Italy, France, Austria, and America, is being held until these collections, now eight years in the author's hands, can be made known to the public. The preliminary descriptions published in 1878 are so meagre as to be nearly useless to any one except their author; and the type specimens themselves will, of course, be inaccessible for comparison until the final report is in type. Dr. *Günther*'s success in re-organizing the natural history section of the British museum has been very great, yet it seems unfortunate that administrative work should so entirely monopolize the time of so eminent an ichthyologist.

RAIN IN BELGIUM.

La pluie en Belgique. Par A. LANCASTER. Bruxelles, Hayez, 1884. [Extract from the *Annuaire de l'Observatoire royal de Bruxelles*.] 113 p. 16°.

THE completion of a fifty-years series of uninterrupted observations of rainfall at Brussels