full grant would be earned, and nothing could be obtained from other subjects. It seemed to him, however, that the passes in reading and writing ought not to be made so difficult, but that three-quarters of the children should pass. No wonder that under those circumstances the Duke of Devonshire's Commission had reported that the present system had "unfortunately narrowed the instruction given in elementary schools, and, together with the lower standard consequently adopted in the training and examination of pupil-teachers, and the curtailment of the syllabus of the training colleges, exercises a prejudicial effect on the education of the country."

As to the question of expense for apparatus, Sir John Lubbock showed that this need be no obstacle; fully recognising that the kind of science to be taught must be no word knowledge, but a practical acquaintance with the actual facts of nature.

Schoolmasters had on more than one occasion said to him that it was impossible for them to teach science, because they had not the funds necessary to purchase apparatus, set up a laboratory, &c. Now, no doubt, much money might be profitably laid out in this way, but it was not necessary to do so. Mr. Tuckwell, who spoke from personal experience, said in a paper read before the British Association in 1871, that "it ought to be more widely known for how very small a sum sufficient apparatus can be obtained to teach natural history and experimental science. A laboratory can be fitted up for twenty boys at a cost of little more than 20*l.*, while each boy's private stock of glass and test solutions need not cost more than 8*s.* per annum. Botanical flower-trays, containing eighteen bottles, may be bought for half-a-crown; electrometers, telescopes, polariscopes, models of pumps, and pulleys, may be made, by a little instruction, by the boys themselves, who will learn in their construction far more of the principles which they involve than could ever be instilled into their minds by the choicest products of the shop."

After quoting the opinions of the late Prof. Faraday, Prof. Henslow, Dr. Hooker, and Prof. Huxley on the importance of early scientific education, Sir John said it was often urged that in science the very methods of teaching were still under discussion. This, however, was an unavoidable incidence of a commencement. It would be remedied by experience, and could be remedied by experience only. Mr. Arnold truly said that "when scientific physics have as recognised a place in public instruction as Latin and Greek, they will be as well taught."

Sir John Lubbock also referred to the miserable pittance which has as yet been allotted to research in science by our Universities; but as we have referred to this point so recently, we need not dwell upon it here. Altogether, we hope that this moderate and wise, but uncompromising address may give one more strong impulse to the already widespread feeling that we cannot with safety delay much longer in giving to science the place which it ought to hold in the educational system of the country.

*THE NATURAL HISTORY OF SPITZBERGEN AND NOVA ZEMBLA**

SO much public attention is now directed to the polar regions and their inhabitants, that we do not hesitate to bring before the notice of our readers the important contribution to our knowledge of Spitzbergen and Nova Zembla, recently published by Von Heuglin as the third part of his "travels" in those countries in 1870 and 1871.

In it will be found a complete *résumé* of the present state of our knowledge of the zoology and botany of those distant and inhospitable regions, and a chapter on what is known of their geology.

The mammals of these northern climes are few in number, consisting chiefly of seals and whales. The terrestrial mammal-fauna comprehends only two species of lemming (*Myodes torquatus* and *M. obensis*): the arctic fox, common fox, and wolf and sea-bear among the carnivores, and a single ruminant—the reindeer—seven species in all. The birds are more numerous, though here again the marine species far predominate, the land-birds being only ten in number out of a total of fifty. Amongst the former we are surprised to see recorded as an accidental visitor the Hoopoe, usually considered as rather an inhabitant of the tropics, but of which a single straggler was captured in Southern Spitzbergen by a merchant-vessel in August 1868. Reptiles are conspicuous only by their absence in Spitzbergen and Nova Zembla, but of fishes thirty species are recorded as having been obtained on various parts of the coast, all belonging to known forms either of the Atlantic or of the waters of Northern Asia.

The invertebrates of Spitzbergen are treated of more concisely by Herr v. Heuglin; but lists are given of the species of the different orders, and many references to previously published papers and works bearing upon this subject are added.

The account of the flora of Spitzbergen is mainly founded on Malmgren's paper, published in 1862, in the Proceedings of the Royal Academy of Sciences of Stockholm, to which, however, additions have since been made by Anderson, Fries, and Nyström. The Phanerogams enumerated are 117, the Cryptogams upwards of fifty. The botany of Nova Zembla and Waigatsch Island is separately treated of. Our knowledge of this subject is based upon the excellent researches of Von Baer and Trautvetter, published at St. Petersburg, and a paper of Blytt's, of Christiania. On these islands 146 Phanerogams and 144 Cryptogams have been discovered. Among the latter a certain number of new species are described in the present work by Prof. Ahle, of Stuttgardt.

The geological chapter, which concludes the volume, is based upon the well-known researches of the Swedish naturalists Lovén, Torell, Blomstrand, and Nordenskiold, who have laboured so long and so diligently upon this subject.

We can recommend Herr v. Heuglin's work as a very convenient handbook for the use of future visitors to the Northern Seas, and of explorers of those newly discovered lands of which we are now hearing so much.

* "Reisen nach dem Nordspolarmeer in den Jahren 1870 und 1871," von M. Th. von Heuglin. In drei theilen. Dritter Theil: Beiträge zur Fauna, Flora, und Geologie. (Braunchsweig, 1874.)

*HÆCKEL'S DEVELOPMENT OF MAN**

Anthropogenie oder Entwickelungsgeschichte des Menschen; gemeinverständliche wissenschaftliche Vorträge, von Ernst Hæckel. (Leipzig: Engelmann, 1874.)

II.

IN tracing the genealogy of our race, Prof. Hæckel, while availing himself of the gradual changes in the fauna of the earth during geological periods, and of the

* Continued from p 5.

gradation of living animal forms, takes as the most important clue in his difficult task the facts of human embryology. This close connection is constantly kept in view, and by its aid not only does he trace, as in the twenty-second chapter of his "Schöpfungsgeschichte," the philogeny of man as a compound organism (*Person*), but extends the same process to the separate organs of the human body and the faculties of the human mind. The chapters which are occupied by this investigation are the most interesting in the book, full of ingenious suggestions, and well repaying the reader who brings a sound knowledge of embryology and comparative anatomy to their study.

The genealogical tree here constructed is briefly as follows:—First, a Cythode (*Moner*), itself the product of inorganic matter, passed in the Laurentian ages from being a component of primordial sea-slime (*Plasson*, represented by existing *Bathybius*) to a separate unicellular or amœboid form. Several of these plastids next formed a colony by cell-division (*Morula*), which in subsequent ages became covered with cilia, differentiated into an ectoderm and entoderm, and provided with a mouth (*Gastræa*), a form represented in sponges and other invertebrates and in Amphioxys, but omitted in the ontogenesis of man, or represented by the Blastosphere. Each of the primitive layers subdivided into two, and between the latter was formed the *cœlum*, or body cavity (vermiform stage, protuchous or aproctous). Next was developed the notochord in a form related to the existing ascidian and amphioxous larvæ. The vertebral character being thus attained, our ancestors passed through stages now represented by the lampreys and the sharks, during the ages which ended the archæolithic period. While the Devonian, Carboniferous, and Permian formations were taking place, the Amphibian stage was passed, and the succeeding development in the Trias epoch was from this to a protamniotic form, distinct from that which gave birth to the sauropsidan stem, and leading directly to the mammalian. When the last strata of chalk had been laid down, a marsupial form was changing into one now represented by the lemurs. Lastly, the Tertiary period witnessed the development of various gradations of catarrhine Primates, from one of which the earliest men directly sprung.

The genealogy thus constructed (which is almost exactly the same as those Prof. Hæckel has before published) is plausible enough, and if such speculations come under what the late M. Elie de Beaumont called "la science mousseuse," they certainly have their use in directing and stimulating inquiry. But is this the way to introduce the results of biology to a popular audience?

In the first place, the theory of evolution itself is neither so certain nor so complete as persons who take their knowledge from these lectures alone would be led to suppose. Our author is astonished at Rütimeyer's comparison of "Darwinism" to a religion. But as held by its illustrious author and by the ablest biologists both in Germany and England, it is very much like a rational theology: for it is a theory which only pretends to be a more or less probable explanation of facts, which is held liable to correction from fresh facts and with tolerance for less probable explanations. But in these lectures evolution is no longer a reasonable belief, but a fanatical and intolerant *Aberglaube*.

Again, granting that evolution by some means has taken place, and that natural selection is a true cause of evolution, it is not the only cause. Modifications of it, like the so-called "Mimicry" of Bates and Wallace, have already been discovered, and no doubt others will be. The effect of Sexual selection, a struggle for existence of the race as distinct from the individual, would not have been guessed had not Mr. Darwin himself proved it: and it often modifies the working of Natural selection.

Lastly, if we accept evolution and so-called materialism in its widest sense, the logical results will not be what Prof. Hæckel assumes. For these, like all other scientific theories, deal only with secondary causes; and when we have traced back mind and matter alike to cosmic vapour, the question still recurs, to what was that matter with its potential functions due? In *Protogenes*, or in the impregnated human ovum,

> The thread of Life untwisted is
> Into its first consistences.

Yet the mysteries of growth, of movement, and of generation are not less but more mysterious than when less nakedly exposed in higher organisms. Scientific investigation, in the hands of Darwin, Fritz Müller, Dohrn, and Hæckel, has told us much and will tell us more of how this world has come about; but when men cease to inquire into its final cause, the human race will have made a step back towards its primordial slime.

Leaving these general considerations, one is reminded by Prof. Hæckel's attempt at a human philogeny of the many fallacies which beset the application of the general theory of evolution to this particular instance.

When the dogma is accepted that "ontogeny is a recapitulation of philogeny," we find that the individual development of man and his ancestors is far from completely known. The embryology, for instance, of Monotremata and the Ganoids, including *Ceratodus*, is a blank. Only the other day Mr. Balfour's admirable observations on the development of sharks came to disturb what seemed to be a universal law of vertebrate embryology, and the origin of the urogenital organs is still confessedly obscure. Yet Prof. Hæckel, while candidly admitting this last difficulty, practically assumes one and not the best-supported view to be correct. On the strength of it he teaches that the kidneys are homologous with sebaceous glands, with the segmental organs of Annulata,* and with the water-vascular canals of other worms; and that sperm-cells belong to the exoderm, germ-cells to the endoderm. Again, the placental classification which forms the basis of the genealogical tree on p. 493 has been always open to grave objection, and has now been decisively contradicted by the researches of M. Alphonse Milne-Edwards and Prof. Turner.

Again, even when the development of an animal is fully made out, it is often so abridged and distorted an epitome of its ancestry, that we may easily interpret it wrongly, and we have at present no signs to tell us when the clue begins to fail.

But a third and still more serious difficulty in constructing philogenies is the well-known incompleteness

* Whether this ingenious hypothesis of Gegenbaur will be confirmed on other grounds is, of course, a different question.

of the geological record; and, unluckily for the genealogy of man, the very chapter we most need, that of the Worms and primitive Tunicata, is the one most hopelessly lost.

All this does not prove that no attempt should be made to trace back the descent of man and other animals by such lights as we have, but it does seem to show that the results are too uncertain to be set forth as ascertained facts in popular lectures.

Strange as it now seems, a generation ago many of the best zoologists spent their time in arranging animals according to various systems of metaphysical origin. The speculations of Oken and Geoffrey St. Hilaire, of Forbes and Macleay, read now like the controversies of the schoolmen. The archetypal skeleton was drawn in many forms (and often in several colours), and almost as many compound terms were invented as those of Prof. Hæckel; but all these fancied systems have passed away, or only exist as relics to encumber the ground. Does not their fate suggest misgivings as to the fate of the genealogical trees which are now so luxuriant?

In conclusion I will quote the words of one who will not be suspected of sharing the prejudices of those ecclesiastical newspapers which appear to be responsible for many of the defects in Prof. Hæckel's lectures.

"Of all kinds of dogmatism the materialistic is the most dangerous, because it denies its own dogmatism, and appears in the garb of science; because it professes to rest on fact, when it is but speculation; and because it attempts to annex territories to the domain of Natural Science before they have been fairly conquered."*

P. H. PYE-SMITH

ISMAILÏA

Ismailïa: a Narrative of the Expedition to Central Africa for the suppression of the Slave Trade, organised by Ismael, Khedive of Egypt. By Sir Samuel W. Baker, Pacha, F.R.S., &c. &c. Two vols. (London: Macmillan and Co., 1874.)

IT must be difficult for any unhardened critic to keep his wits about him in reading this fascinating narrative, and we are sure no reader will wish that it had been shorter.

There is not much in the book of directly scientific interest. Sir Samuel went over very nearly the ground he had traversed before, and which he has so well and fully described in his "Albert N'yanza" and "Nile Tributaries of Abyssinia;" and he kept so faithfully and unswervingly in view the noble errand on which he set out, that he had little opportunity to attend to the interests of science. The heroic Lady Baker, however, made large botanical collections throughout the journey, which she presented to the Khedive on her arrival in Cairo, and Sir Samuel informs us that Lieut. Baker made considerable topographical observations. Moreover, although the expedition had no scientific object in view, its purpose was eminently conducive to the interests of science, seeing that until the demoralising traffic in slaves is suppressed, we can never hope to obtain a thorough knowledge of the interesting region around the Upper Nile—of its geography, its ethnology, and its natural history; and therefore, although the great object which Baker had in view seems to have been thwarted through the pusillanimity of the Egyptian Government, he deserves the greatest credit for having proved that with skill, determination, and adequate means—and his means were very inadequate—the journey from Cairo to the Albert N'yanza might be accomplished in a very short time.

We think it would be difficult to conceive of a leader better fitted than Sir Samuel Baker to accomplish the task which the Khedive commissioned him to do. His work is a practical commentary on the vigorous and truthful lines of Tennyson:—

> "O well for him whose will is strong!
> He suffers, but he will not suffer long;
> He suffers, but he cannot suffer wrong:
> For him nor moves the loud world's random mock,
> Nor all calamity's hugest waves confound,
> Who seems a promontory of rock,
> That, compass'd round with turbulent sound,
> In middle ocean meets the surging shock,
> Tempest-buffeted, citadel-crown'd."

Sir Samuel estimates that at least 50,000 persons are annually captured to be sold as slaves, and it would be safe to say that several thousands more are massacred in effecting the capture of these; the atrocities practised by the slave-hunters are almost incredible. It was to suppress this lamentable state of matters that Sir Samuel Baker was commissioned, on April 1, 1869, by the well-intentioned and enlightened Khedive of Egypt, who gave him full powers as to equipment. To accomplish this purpose it was necessary to annex the whole Nile basin, and to establish a legitimate trade in the barbarous countries which had hitherto been scourged with this infamous traffic. So far as Sir Samuel could carry out his plans, the equipment of the expedition was admirable in every detail, down to the magic lantern, the wheels of life, and the magnetic battery, which last was in constant requisition among the tribes of the Upper Nile, and was a perpetual source of amusement to the members of the expedition and of wonder to the natives.

It would be impossible, in the space at our disposal, to give any adequate idea of the work of the expedition. From the very first Sir Samuel met with obstructions and delays that would have induced any less patient and less determined man to abandon it altogether. The Egyptian Government had undertaken to furnish a large number of boats, besides steamers and an adequate military force, for the expedition, which, it was arranged, would start in June 1869. It was with the greatest difficulty that a start was made on the 29th of August, when two of the parties proceeded up the Nile, one to go direct by river to Khartoum, and the other to land at Korosko and march across 400 miles of desert to the same place; with the latter was the heavy machinery and sections of steamers carried by a regiment of camels. Sir Samuel himself set out from Suez on Dec. 11 for Souakim, thence to Berber on the Nile, and in a diahbeeah to Khartoum. Here, in accordance with orders which had been sent on months before, he expected a fleet of vessels to be ready

* I have endeavoured to represent the sense of the following passage from Virchow ("Gesammelte Abhandlungen," p. 18):—"Es giebt einen materialistischen Dogmatismus so gut wie einen kirchlichen und einen idealischen, und ich gestehe gern zu dass der eine wie die anderen reele Objecte haben können. Allein sicherlich ist der materialistische der gefährlichere weil u. s. w."