

We have nothing to do here with their failure to teach Natural Science, and thus to mislead where they ought to have led. What we now ask the people of England, and especially the people of London, is to put Men of Science on their School Boards.

E. LANKESTER

### THE GLACIATION OF BRAZIL

*Thayer Expedition: Scientific Results of a Journey in Brazil, by Louis Agassiz and his travelling Companions. Geology and Physical Geography of Brazil.* By Ch. Fred. Hartt, Professor of Geology in Cornell University. With Illustrations and Maps. (Trübner and Co.)

THIS thick volume of 620 pages is the result of two visits to Brazil, the first with the Thayer Expedition, the second during a vacation holiday of "some months." The author has proposed to combine with his own personal observations all the information on this subject obtainable from other sources, and thus give a complete view of the present state of our knowledge of the geology and physical geography of this vast and interesting region. The design is an admirable one, but the execution of it is, in some respects, disappointing.

The first great fault of the book is, that it has been swelled by the introduction of much irrelevant matter. Mr. Hartt's own journeys were mainly along the coast, from Rio Janeiro to the Amazon, with occasional trips of a hundred miles or so into the interior, and he inflicts upon us pages of unimportant detail on the topography of small rivers, creeks, and harbours, which have no bearing on the geology or physical geography of the country. Detailed descriptions of the marine animals and fossils collected would also have been better in an appendix than in the body of the work where they are given. The arrangement of the book, too, is faulty, since it treats of the provinces of Brazil in succession, and makes no attempt to indicate the great physical divisions of the country, and there is not a single geological or physical map of Brazil, or of any part of it; the maps alluded to in the title-page being mere outline or sketch maps of small districts, or plans of harbours and mouths of rivers. Another strange defect is the absence of all measurement of heights. The author travelled without barometer or aneroid; he, consequently, everywhere roughly estimates his heights, and gives no sections, but a few "ideal" ones. Notwithstanding the bulk of this volume, it does not complete the geology of the voyage, for we are informed that Mr. St. John, another geologist attached to the expedition, who travelled more in the interior of the country, will give the results of his observations in a separate work.

But although we have thus plainly indicated the defects of the book, there is much valuable matter to be found in it. The author has been very diligent in examining all the chief authorities on Brazil, and has extracted from them most of their geological matter; and among the extracts from Spix and Martius, Prince NeuWied, Darwin, Gardner, Halford, and others, are to be found many interesting passages descriptive of the peculiarities of the scenery and geology of the country. The chapters on the coral

reefs of the Abrolhos and on the gold mines of Brazil, the account of the exploration of the bone-caves by Lund, and the appendix on the Botocudos Indians, will furnish some interesting matter for the general reader, while the student of science will obtain (though with some difficulty) a notion of the general physical and geological characteristics of an almost unexplored region.

The most striking geological feature of tropical South America east of the Andes is the enormous extension of gneissic rocks, which appear to form the whole foundation and much of the surface of the country, from the cataracts of the Orinooko to Paraguay and the southern frontier of Brazil. All the great mountain tracts of Brazil and Guiana, as well as the low plain which separates the watersheds of the Orinooko and Amazon, are of this rock, which is considered to be of Laurentian age. Its characteristic features are the great dome-like masses and the conical peaks or pillars, generally of more or less smooth and rounded outlines, a peculiarity dependent on the decomposition of all exposed surfaces, which fall away in concentric flakes. Great hemispherical domes up to a thousand feet in diameter are one of the results of this decomposition wherever a more resisting mass has occurred. Still more extraordinary are the vertical pillars of rock, that rise up at intervals out of the forest to some hundreds, or, in the case of the Pedra lisa, in the province of Rio de Janeiro, to more than three thousand feet high. Similarly formed peaks or pillars in Fernando, Noronha, and St. Helena have been formed by injections of fluid felspathic lava. What an enormous amount of denudation do these isolated pillars indicate!

In South Brazil a few tracts of Silurian and Carboniferous rocks occur, but the next formation of any extent is the Cretaceous, which consists of sandstones, generally upheaved and fractured. Other sandstones, which cover an immense extent of country, and form the ranges of flat-topped hills from one to nearly three thousand feet high, called *taboleiros*, are in perfectly horizontal strata, and as these lie unconformably on the cretaceous rocks they are presumed to be tertiary, although no fossils have yet been found in them.

We now come to a very wide-spread, yet recent and superficial deposit, which is at once the most puzzling and the most interesting feature in Brazilian geology. This is a layer of clay or loam, varying in thickness from a few feet to one hundred, and wrapping in its folds hill and valley, over vast tracts of country, including the steep slopes and summits of some of the highest mountains. All Rio de Janeiro, and all the coast provinces visited by our author, were thus covered. It has been described in Minas Geraes and San Paulo, and Prof. Agassiz has observed it in all the northern provinces as far as the Amazon valley. It covers alike the gneiss and the tertiary formations. This clay is of a red colour, and is evidently formed of the materials of the adjacent and under-lying rocks, but ground up and thoroughly mixed. There is never the least sign of stratification throughout its mass, although it very frequently rests on a thin layer of quartz pebbles. It contains, scattered through it, rounded and angular boulders of quartz, gneiss, and other rocks, and the surfaces upon which it rests are always more or less smooth and rounded. Our author always speaks of this formation as "drift," and he agrees with

Prof. Agassiz that its peculiarities are such as unmistakably to indicate its glacial origin.

This is truly a startling conclusion, and one which has hitherto been received in this country with some incredulity. Prof. Agassiz was thought to be glacier-mad; but if we separate his theories from his facts, and if we carefully consider the additional facts and arguments adduced by Mr. Hartt in this volume, we shall be bound to conclude that, however startling, the theory of the glaciation of Brazil is supported by a mass of evidence which no unprejudiced man of science will ignore merely because it runs counter to all his preconceived opinions.

Mr. Hartt's facts and deductions have the more weight, because he is evidently not very enthusiastic on the subject, and because he fairly states the sources of error in observation, and fully discusses such other modes of explaining the facts as have been proposed. He acknowledges that in some cases the decomposed gneiss cannot be distinguished from the "drift," but he shows that in the former the materials remain *in situ*, especially the quartz veins, while in the latter all are mixed and ground up together; and wherever the two are seen in contact for any distance, the sudden cutting off of the quartz veins at the drift, and other well-marked characters, render it impossible to confound them. He also adduces several other phenomena which are strongly indicative of a glacial origin. Both in the Orang Mountains and in Bahia there are valleys with no outlet, and in Alagoas there are many deep lakes in rock-basins. In the province of Bahia there are extensive bare, elevated, rocky plains, thickly strewn with angular blocks of stone, some of which are erratics, and *exactly resembling the drift-covered plains of the north*. On similar elevated plains, far removed from any higher land, Mr. J. A. Allen (another member of the Thayer Expedition) found numerous deep and smooth pot-holes worn in solid gneiss. They were of various sizes, the largest seen being elliptical, eighteen feet long by ten wide, and twenty-seven feet deep. Similar pot-holes are known to be formed by glacial waterfalls, and they are found over the glaciated regions of New Brunswick and Nova Scotia. Heaps of débris, exactly resembling glacial moraines, have also been found both in the south and north of Brazil. Mr. Hartt is satisfied of their resemblance to true moraines in the valley of Tijuca near Rio, and Prof. Agassiz has described others still more perfect in Ceara, only four or five degrees south of the equator. After describing these in detail, he concludes: "I may say that in the whole valley of Hasli there are no accumulations of morainic materials more characteristic than those I have found here, not even about the Kirchet; neither are there any remains of the kind more striking about the valleys of Mount Desert in Maine, where the glacial phenomena are so remarkable; nor in the valleys of Loch Fine, Loch Awe, and Loch Long, in Scotland, where the traces of ancient glaciers are so distinct." It can hardly be maintained that the discoverer of glacial phenomena in our own country, and who has since lived in such a pre-eminently glaciated district as the Northern United States, is not a competent observer; and if the whole series of phenomena here alluded to have been produced without the aid of ice, we must lose all confidence in the method of reasoning from similar effects to similar causes which is the very foundation of modern geology. The

only objection of any weight that has been made to this interpretation of the phenomena, is the fact of the absence of glacial striæ; but Mr. Hartt states that no striæ or polished surfaces have yet been found even in the extreme south of the continent where the glacial phenomena are undisputed. It is at best a negative argument, and as such cannot neutralise those of a positive nature. We must also remember that we have no indication of the age of the Brazilian or southern glacial epoch. It may have occurred much earlier than that of the northern hemisphere, and the greater lapse of time, combined with the powerful decomposing and denuding agency of tropical rains, may have obliterated most of such marks.

The physical difficulty of the conception of tropical glaciers may be resolved into the question of whether a subsidence to the extent of ten or twelve thousand feet may not have subsequently occurred; since a greatly increased elevation at a time when a severe glacial epoch reigned in the south temperature zone, would probably lead to the glaciation of the southern tropics down to what is now the sea-level.

A much more serious objection seems to be the biological one. If the whole surface of what is now Brazil was recently covered with a sheet of ice, whence has arisen the wonderfully rich and varied, and, in many respects, peculiar flora and fauna that now inhabit it? Judging from the map of the Atlantic given in Maury's "Physical Geography of the Sea," a rise of twelve thousand feet would only add a belt of about four hundred miles in width to tropical America; but a great part of this might have enjoyed a truly tropical climate, just as the valleys of Switzerland have a warm summer though in the immediate vicinity of glaciers. It seems probable, also, that the glaciation was a southern one, and did not extend far north of the equator, if it even reached so far, so that the whole of Venezuela and Guiana, with the additional belt of land due to elevation, might have been even more luxuriant and more densely populated than at present. There would thus have been an ample surface to support the ancestors of the existing fauna and flora of Brazil during the glacial epoch, just as there was sufficient land in Europe to support the ancestors of the existing European fauna and flora even when so much of the present surface was covered by a thick mantle of ice.

It must be stated that Mr. Hartt does not accept Prof. Agassiz's extraordinary hypothesis (which rests on a very slender basis of fact) of a great Amazonian glacier. He believes that the wide-spread beds of clays and sandstones, which Prof. Agassiz classes as glacial, are marine, and states that they agree perfectly with the tertiary beds in other parts of Brazil. The patches of drift, with erratics in the Amazon valley, may well have been produced by detached masses from the glaciers of the Andean and Brazilian highlands, which melted and deposited their load of drift in the warm waters of the ancient Amazon.

We have devoted so much of our space to this question of the Glaciation of Brazil, in the hope of attracting the attention of geologists to a country which offers such an interesting subject of inquiry, and which it is so easy and agreeable to explore. The facts, as stated by two careful observers, both thoroughly experienced in glacial phenomena, are undoubtedly such as to warrant the main conclusion drawn by them; and it is to be hoped that geolo-

gists will not ignore the facts because the conclusions seem improbable, as they so long ignored facts proving the antiquity of man for no other reason.

A. R. WALLACE

### MODERN ANGLING

*The Modern Practical Angler. A complete Guide to Fly-Fishing, Bottom-Fishing, and Trolling.* By H. Cholmondeley-Pennell, Inspector of Fisheries. Illustrated by Fifty Engravings of Fish and Tackle. 16mo, pp. 286. (London: Fred. Warne and Co., 1870)

TO those readers of NATURE who are not acquainted with Mr. Pennell, the following quotation may serve as an introduction: "Fishing has been in a special sense my mistress—the fairest and most loving wife—in many a wild and lonely spot where, but for her gentle companionship and solace, I should have felt myself in every sense of the word alone;" whilst those of us who have for some time had an acquaintance with his writings, know that in making this confession he is perfectly sincere, and that he is one of the most devoted disciples of Izaak Walton; so that we cannot help wishing he were an "Inspector of Fisheries" (as he describes himself on the title-page), instead of being appointed by the Government to investigate the causes of failure and possibilities of improvement of our oyster fisheries. His book has only a partial resemblance to Walton's "Complete Angler." Those passages of pleasing simple eloquence, those fine sentiments, those virtuous precepts, in short, all those characteristics which have rendered Walton's book immortal, must not be looked for in Mr. Pennell's "Modern Angler." To imitate Walton successfully, would, indeed, require a genius of no common order; and Mr. Pennell is contented himself with giving a mere manual of the piscatorial "art" and "science" (we must not be too severe with enthusiasts about terms); and judging of it as such, we can sincerely say that it is the best and most useful handbook we have yet seen.

The book is divided into four parts, treating minutely of tackle, fly-fishing, trolling or pike-fishing, and bottom-fishing. The author takes credit for several inventions or improvements. Thus, for instance, he describes or figures the "Pennell-hook," in which "the medium between theoretical and practical requirements" is believed to be hit. We are glad to see him advocating a reduction in the number of artificial flies used at present; he proposes to substitute six typical flies, three for salmon and grilse, and three for trout, grayling, &c. We feel sure that these flies, together with those which are especially used at certain localities, will be quite sufficient for all purposes. Mr. Pennell has thought a great deal at the river-side; he is never satisfied with simply describing what, according to his experience, has proved to be the most successful method or the deadliest instrument; he always gives the reasons. Thus, in one of the chapters, we find expounded the "true theory of trout-flies," in a second the "theory of salmon-flies," and in a third, of white trout-flies; however, we are afraid that in expounding theories he will not be more successful in convincing his readers than the majority of theorists. For instance, to the question, For what does the salmon take the artificial fly? he gives

the answer, "For its beauty and tempting appearance; probably it has an appetising effect." Let Mr. Pennell once watch a prawn (one of the principal articles of food of salmon in the sea) swimming in jerks through the water, and he will at once perceive that by means of our rod we impart to the fly the peculiar motion of the prawn, whilst the iridescence of the real creature is reproduced by the colours of the fly, which must vary according to the physical changes of the sky and water. No two things can be more unlike than a prawn and a dry artificial fly; no two things are more alike than a swimming prawn and that same fly in the water worked by a skilful hand.

But we must conclude our notice of this book, welcome and useful to every class of anglers. It is illustrated by numerous well-executed woodcuts, which are more instructive than the best descriptions. Lithographic plates of some of the more common freshwater fishes are evidently reproductions from the *Fisherman's Magazine*.

A. GÜNTHER

### LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.]

#### The Government and the Eclipse Expedition

WE are now within two months of the date fixed by Nature, whose name you so worthily wear, for a total Eclipse of the Sun, and it is not probable that she will postpone her appointment for a period sufficient to enable the joint committee of the Royal and Astronomical Societies to renew and succeed in their endeavour to teach the Government what such a phenomenon may, if duly observed, contribute to human knowledge. It may be taken for granted that no encouragement will be afforded by our thrifty rulers to an expedition of sixty-eight astronomers, projected for the quixotic purpose of collecting intelligence not calculated to increase the revenue.

This well-timed and praiseworthy frugality reminds me of some imputations which were, not long ago, cast at the Government by two eminent men of science, one of whom, the Astronomer Royal, lives to repent his injustice; the other, the late Dr. W. A. Miller, alas! can speak no more.

On the 31st March last, I read at a Society of Arts' conference, by request of the Council, a paper on the subject of the Relations of the State to Science. A discussion followed, in the course of which the Astronomer Royal remarked that "having had a somewhat long connection with the Government, he was quite competent to say that there had never been any unwillingness, as far as instances occurred to him, to promote liberally the purpose of speculative science when brought before the Government, with a good cause shown, and upon the responsibility of some person in whom they placed confidence."

Here Mr. Airy lays down, with his usual clearness, the conditions necessary to induce our Government to promote liberally speculative science, namely, "a good cause shown, and on the responsibility of some person in whom they placed confidence." Our failure, then, to obtain aid on the occasion in question must have been due to one of three things—either a good cause was not shown, or the Government had no confidence in the persons showing it, or the Government differs considerably from Mr. Airy's portrait of it. Who were the persons whose worthiness of confidence is thus doubtful? The Astronomer Royal himself, the President of the Royal Society, and the President of the Astronomical Society; and these untrustworthy beguilers of our too liberal guardians of the public purse were the accredited representatives of a select joint committee of the two first scientific societies in the kingdom. As to the goodness of the cause, that is to be inferred from the character, requirements, and position of the three personages above indicated, who had the presumption to advocate it. To these two causes it is evident that the failure is due, and not to any want of liberality in statesmen, for whose readiness to promote speculative science Mr. Airy himself, one of the unsuccessful petitioners, has vouched.