Animals and Coral Islands," by Prof. W. C. Williamson, F.R.S.; "Assyrian Mythology," by Mr. George Smith; two on "The Education of the People," by Prof. W. K. Clifford; "Vitality in Men and in Races," by Dr. B. W. Richardson, F.R.S.; "A Night at Lord Rosse's Telescope," and "The Pendulum," by Prof. Ball, F.R.S.

THE following candidates have been successful in obtaining Royal Exhibitions of 50*l.* per annum, each for three years, and free admission to the course of instruction at the following institutions:—(1) To the Royal School of Mines, Jermyn Street, London: Charles W. Folkard, Lawrence J. Whalley, Alfred N. Pearson. (2) To the Royal College of Science, Dublin: Thomas Bayley, William Fream, Archibald N. McAlpine.

MR. RAMSAY WRIGHT, M.A., B.Sc., Assistant to the Professor of Natural History, Edinburgh University, has been appointed to the Chair of Natural History, University College, Toronto. Mr. Wright succeeds Prof. Alleyne Nicholson, now of the Newcastle College of Science.

PROF. E. S. HOLDEN, U.S. Navy, forwards us a letter from Mr. H. G. Wright, dated San Bernardino, Cal., Aug. 2, 1874, describing a small lake or pond in New Hampshire having two outlets, and with which he has been perfectly familiar from boyhood. "Neither of the outlets," the writer states, "ever dries up, and each of them discharges more water than enters through the only visible feeder. The pond covers, say, fifteen acres; it is shallow, with muddy bottom, with boulders in places, the surrounding land being largely made up of granite ledges and boulders. The outlets are at opposite ends of the pond—one descending rapidly 150 feet soon after leaving the pond, the other passing through a boggy swamp and then a meadow, after which it also descends rapidly. The only feeder is very small, and quite dries up in summer."

UNDER the title of "Society for the Publication of Tracts relating to the History and the Geography of the Latin East," an association has been formed in France to supplement the work of the Academy of Inscriptions. Notwithstanding the labours of the latter body, there still exists in the public depositories of various European countries, a large mass of unedited materials relating to the "Latin East,"—the kingdoms of Jerusalem, Cyprus, and Armenia, the principalities of Antioch and Achaia, and the Latin Empire of Constantinople. It is for the purpose of unearthing and publishing such material that the French society has been formed. It will be composed of forty titular members and 350 subscribing associates; from among the former a committee of publication will be selected, and the members of both classes may be either French or foreign. Two volumes will be published annually, along with a phototypographic reproduction of very rare or unique matter; to the latter titular members alone are entitled. The collection will be entitled "Bibliothèque de l'Orient Latin," and will consist of a Historic Series, a Geographical Series, and a Poetical Series. They will be published after the style of the "Chronicles and Memorials of Great Britain." Titular members pay fifty francs a year, and subscribers only fifteen.

THE additions to the Zoological Society's Gardens during the past week include a Serval (*Felis serval*) from West Africa, presented by Mr. Spencer Shield; a Cinereous Sea Eagle (*Haliaëtus albicilla*) from Norway, presented by Mr. W. J. Sadler; two Peregrine Falcons (*Falco peregrinus*) from Europe, presented by Mr. Herbert Wood; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. P. T. Wharton; a Crested Pigeon (*Ocyphaps lophotes*), two Graceful Ground Doves (*Geopelia cuneata*), hatched in the Gardens; two Green Fruit Pigeons (*Carpophaga sylvatica*) deposited.

NOTES ON THE NEW EDITION OF MR. DARWIN'S WORK ON THE STRUCTURE AND DISTRIBUTION OF CORAL REEFS (1874.)

MR. DARWIN, in the new and much improved edition of his work on Coral Reefs, mentions some points in the subject, on which he still finds reason to differ from the writer. I think that with regard to one or two of these points he has not fully understood my views; and, as to the others, that the arguments and facts which I have brought out have not received all the consideration they may deserve. A review of some statements in his work may, therefore, be profitable. I follow the order of his criticisms as briefly stated in the first half of his Preface.

I. The second sentence of the Preface is as follows:—

"In this work [Dana's Corals and Coral Reefs] he [the author] justly says that I have not laid sufficient weight on the mean temperature of the sea in determining the distribution of coral reefs; but neither a low temperature nor the presence of mud-banks accounts, as it appears to me, for the absence of coral reefs throughout certain areas; and we must look to some more recondite cause."

The first two clauses of this sentence are true—the *but* between them being removed, as it may lead some readers to suppose the alternative mine. Yet Mr. Darwin's work does not show that even now he appreciates the influence of oceanic temperature on the distribution of coral reefs. In his discussions on the distribution of reefs, and the causes limiting the same, this agency, the chiefest with marine life, both for depth and surface, according to all zoologists, is scarcely mentioned. There is one allusion to the subject on page 81. Mr. Darwin says: "I at first attributed this absence of reefs on the coasts of Peru and of the Galapagos Islands to the coldness of the currents from the south, but the Gulf of Panama is one of the hottest pelagic districts in the world;" and a note is added, giving some sea temperatures of the region referred to. Thus the cause is set aside even for the seas along the Peruvian coast, although the mean winter temperature of the water there is lower than exists in any reef region in the world, and is therefore sufficient of itself to exclude reefs. The fact that there are only small patches at Panama, where the temperature is tropical, does not annul the fact that the seas of Peru and the Galapagos are too cold for corals. Where temperature excludes, there is no use in discussing other unfavourable conditions.

The causes limiting the growth and distribution of reef-making corals and coral reefs, which I have discussed and applied in my work, are *seven* in number:—

(1.) Marine temperature.

(2.) Fresh and impure waters from the entrance of large rivers and muddy bottoms.

(3.) Deposition of sediment borne by rapid tidal currents.

(4.) The depth of water along coasts exceeding 100 feet, that is, exceeding the depth to which reef-corals may grow—a common condition along bold coasts, and often explaining, as I have found, the contrasts between the reef-bordered and open coasts of the same island.

(5.) Exposure to the heat of submarine volcanic eruptions (pp. 299, 317).

(6.) The progressing coral-island subsidence too rapid for the polyps to keep the reef well at the surface, if at all (p. 270): which cause may lead, in atoll seas, to very narrow fringing reefs; to small sizes in coral atolls, and a more or less complete obliteration of the lagoon; and to a submerging of the coral island beneath the surface; or finally, to a complete disappearance of the island (pp. 332, 369).

(7.) The direction and temperature of oceanic currents (p. 112): this cause accounting for the non-distribution of Central Pacific species of corals to the Panama coast, and the paucity of species there, with the absence of the large Astræa group and the Madrepores.

On this last point I say in explanation, on page 112: "Owing to the cold oceanic currents of the eastern border of the Pacific—one of which, that up the South American coast, is so strong and chilling as to push the southern isocryme [the line passing through points of equal mean oceanic temperature for the coldest month of the year] of 68°, the coral sea boundary, even beyond the Galapagos, and north of the equator—the coral-reef sea, just east of Panama, is narrowed to 20°, which is 36° less of width than it has in mid-ocean; and this suggests that these currents,

by their temperature, as well as by *their usual westward direction*, have proved an obstacle to the transfer of mid-ocean species to the Panama coast." For the same reason the transfer of corals —warm-water species—from the West Indies or the Bermudas, eastward, to *Western Africa*, is impossible. The width of the coral reef region on the African side of the Atlantic is only 15°, while it is 48° toward the American coast, and the tropical current is *eastward*.

A proper understanding of the action of the various causes influencing the growth and distribution of polyps and reefs, which have been mentioned in the preceding paragraphs, may leave much less than has been imagined for that "more recondite cause."

I did not think to include among the causes a too rapid *upward* change of level—on which Mr. Darwin lays much stress. But I recognised the fact that when a rise, like that which has occurred at the island of Oahu [putting an extended range of reef thirty feet out of water] takes place, and so divides the area of reef into an elevated and non-elevated portion, the latter will be, on this account, narrower than it would have been had the land been stationary. But the cause does not appear to me to have very many examples.

II. The third sentence of the Preface reads thus :—

"Professor Dana also insists that volcanic action prevents the growth of coral reefs much more effectually than I had supposed ; but how the heat or poisonous exhalations from a volcano can affect the whole circumference of a large island is not clear." And this is followed by the remark : "Nor does this fact, if fully established, falsify my generalisation that volcanoes in a state of action are not found within the area of subsidence, whilst they are often present within those of elevation."

In my discussion of this subject I have attributed the destruction here referred to about islands of active, or recently active, volcanoes, not to aërial eruptions, as might be suspected from Mr. Darwin's words, but to *submarine ;* and I happen to have said nothing about "exhalations." I have drawn my conclusions especially from four examples (pp. 302, 305, 306) : the island of Hawaii (Sandwich Islands), about which recent eruptions, and partly submarine, have taken place on the east, south-east, south, and west slopes of the island, or through more than half of its circumference ; Savaii, the largest of the Samoan or Navigator Islands, and the last of the group to become extinct, as its lava streams show ; the eastern half of Maui, whose great crater must have been recently in action, while the western half bears the fullest evidence of long extinction ; and the northern extremity of the Ladrones. I state that reefs often occur on favoured parts of even such volcanic islands, as they well might if submarine eruptions were the cause, and I mention examples ; thus agreeing with Mr. Darwin's criticism that "the existence of reefs, though scantily developed, and, according to Dana, confined to one part of Hawaii, shows that recent volcanic action does not prevent their growth." My statement about that Hawaiian reef is worded thus : "the only spot of reef *seen* by us was a submerged patch off the southern cape of Hilo Bay." Mr. Darwin cites an observation with regard to the occurrence also of reefs on the northern coast of Hawaii, which accords precisely with the principle I have laid down, since the northern part of the island is, as I state in my Geological Report of the island, that which was earliest extinct, and is oldest in all its features, and therefore that which would not have been reached by the submarine eruptions. The western peninsula of Maui, or the old part, has its coral reefs, while the eastern, or part recently active, has almost none. Savaii, in like manner, has coral reefs on its western and northern shores, while elsewhere without them.

I failed to find evidence in the case of either of these volcanic regions that they are situated within areas of elevation rather than subsidence. *Only ten miles* west of Savaii lies the large island of Upolu, having very extensive reefs—on some parts of the north side three-fourths of a mile wide ; and it has not seemed safe to conclude that, while Upolu thus bears evidence of no movement or of but little subsidence, Savaii was one of elevation ; or that the north and west sides of Savaii have differed in change of level from the rest of the island. In the island of Maui, having reefs on its old western half, it can hardly be that the eastern peninsula has changed its level quite independently of the western. In the near group of the Ladrones the active volcanoes are at the north end ; the islands of the group are very small at that end, without coral reefs, while large at the other, and with broad reefs. One of them, Assumption Island, near which our Expedition passed, is only a small, steep, cinder cone, the vent of a submerged volcanic mountain. Such facts afford, therefore, some reason for my statement that the Ladrones appear to have undergone their greatest subsidence at the northern extremity of the range ; and no observations yet made suggest the contrary view.

The general proposition, that active volcanoes are absent from areas of subsidence, appears to me to need better proof than it has received. As regards the Pacific Ocean, I have found nothing to sustain it. The subsidence of the coral island area of the ocean was one of so vast extent—the breadth 4,000 miles, according to Mr. Darwin—that the sinking could have been no obstacle to the existence and contemporaneous working of volcanoes.

III. The next point in the Preface is a right correction of a misunderstanding on my part of one of Mr. Darwin's statements. It says : "Professor Dana apparently supposes (p. 320) that I look at fringing reefs as a proof of the recent elevation of the land, but I have expressly stated that such reefs, as a general rule, indicate that the land has either long remained at the same level, or has been recently elevated. Nevertheless, from upraised recent remains having been found in a large number of cases on coasts which are fringed by coral reefs, it appears to me that, of these two alternatives, recent elevation has been much more frequent than a stationary condition."

When my work passes to a second edition, I shall make the needed correction.

But I still hold that, while barrier reefs, as Mr. Darwin urges, are proofs of subsidence, small or fringing reefs are in themselves no certain evidence of a stationary level, and are often evidence of subsidence, even a greater subsidence than is implied by barrier reefs. I have already stated that one cause limiting distribution of reefs is bold shores, a wall of rock of even a hundred and fifty feet producing a complete exclusion. If Tahiti were to subside two thousand feet, it would be an island of precipitous shores all around, and with deep indentations, like the Marquesas, instead of one with broad shore planes. Such bold shores are evidence of subsidence ; and as only very small reefs, if any, could find footing about such an island, the narrow reef would be another consequence of the subsidence, and no evidence of a stationary condition. Again, the gradual sinking of an atoll, like the Gambier group, or of a Tahiti with its barrier reefs, at a rate a little fast for the growing corals, would necessarily contract the reef region, reduce the barrier reefs of a Tahiti to narrow fringing reefs ; and make an atoll, however large, a small atoll with the reef-border narrow and the lagoon perhaps obliterated. An atoll thus reduced to a sand-bank is an example of the effects of subsidence, and affords no evidence of elevation or of a long stationary condition of the region : and the same may be true of a region of narrow fringing reefs. I landed on two of the small coral islands of the equatorial Pacific which are in just the condition here described ; and my book contains descriptions of others from a good observer—J. D. Hague—who resided on them several months "for the purpose of studying the character and formation of the guano deposits."* I found the depression of the old lagoon, in one case partly, in the other wholly, dry ; and I found also that the living reefs around were narrow. Mr. Darwin inclines to regard islands of this kind as either evidence of no movement, or, of elevation. On the contrary, since the coral islands of the South Pacific diminish in size toward the region of these small islands, and since the region just beyond, to the north and north-east, is free from islands, and since all the features are such as would come to them from a continuation of the coral-island subsidence to its nearly fatal end, I believe still that I was right in considering the ocean bottom in this part to have undergone a general subsidence greater than that to the south, south-west, and west, where the atolls and barrier reefs are large.

Again, if submarine eruptions are destructive, narrow reefs may exist about volcanic islands that are undergoing a subsidence. Making a reef is slow work ; and, judging from the eruptions of the present century about Hawaii, reefs would have had a poor chance in the past to form, except along the coasts that were out of reach of the submarine action.

With so many causes for the existence of narrow or fringing reefs, or of small patches of corals, it is assuredly unsafe to make them, without other corroborating testimony, evidence of a stationary condition of a region, or of an elevating movement rather than a subsiding.

IV. The next point in the Preface is stated as follows :—

* His article is contained in the *American Journal of Science*, 2nd series, xxxiv. 224 ; 1862.

"Prof. Dana further believes that many of the lagoon islands in the Paumotu or Low Archipelago and elsewhere have recently been elevated to a height of a few feet [elsewhere stated, two or three feet] although formed during a period of subsidence; but I shall endeavour to show, in the sixth chapter of the present edition, that lagoon islands which have long remained at a stationary level often present the false appearance of having been slightly elevated." And, in the body of the work, where the subject is taken up (p. 168), Mr. Darwin remarks that my belief in these small local elevations is grounded chiefly on the shells of Tridacnas embedded, in their living positions, in the coral rock at heights where they could not now survive.

The catalogue of such elevations which I give (p. 345)—after a dozen pages devoted to a discussion of the evidence respecting each—is as follows:—

Paumotu Archipelago	Honden	2 or 3
,, ,,	Clermont Tonnerre	2 or 3
,, ,,	Nairsa or Dean's	6
,, ,,	Elizabeth	80
,, ,,	Metia or Aurora	250
,, ,,	Ducie's	1 or 2?
Tahitian Group	Tahiti	0?
,, ,,	Bolabola	?
Hervey and Rurutu Groups	Atiu	12?
,, ,, ,,	Mauke	somewhat elevated.
,, ,, ,,	Mitiaro	,, ,,
,, ,, ,,	Mangaia	300
,, ,, ,,	Rurutu	150
,, ,, ,,	Remaining Islands	0?
Tongan Group	Eua	300?
,, ,,	Tongatabu	50 to 60
,, ,,	Namuka and the Hapaii	25
,, ,,	Vavau	100
Savage Island		100
Samoan or Navigator Islands		0
North of Samoa	Swain's	2 or 3
,, ,,	Fakaafo, or Bowditch	3
,, ,,	Oatafu, or Duke of York's	2 or 3
Scattered Equatorial Islands	Washington	2 or 3?
,, ,, ,,	Christmas	?
,, ,, ,,	Jarvis's	8 or 10
,, ,, ,,	Malden's	25 or 30
,, ,, ,,	Starbuck's	?
,, ,, ,,	Penrhyn's	35
,, ,, ,,	Flint's and Staver's	?
,, ,, ,,	Baker's	5 or 6
,, ,, ,,	Howland's	?
,, ,, ,,	Phœnix and McKean's	0
,, ,, ,,	Enderbury's	2 or 3?
,, ,, ,,	Newmarket	6 or 8?
,, ,, ,,	Gardner's, Hull's, Sydney, Birnie's	0?
Feejee Islands	Viti Levu and Vanua Levu, Ovalau	5 or 6?
	Eastern Islands	0?
North of Feejees	Horne, Wallis, Ellice, Depeyster	0?
Sandwich Islands	Kauai	1 or 2
,, ,,	Oahu	25 or 30
,, ,,	Molokai	300
,, ,,	Maui	12
Gilbert Islands	Taputeuea	2 or 3
,, ,,	Nonouti, Kuria, Maiana, and Tarawa	3 or more.
,, ,,	Apamama	5
,, ,,	Apaiang or Charlotte.	6 or 7
,, ,,	Marakei	3 or more.
,, ,,	Makin	?
Carolines	McAskill's	60
Ladrones	Guam	600
,,	Rota	600
Feis		90
Pelews		0?
New Hebrides, New Caledonia, Salomon Islands		none ascertained.

Of the cases of elevation here included, in *only two* are shells of Tridacnas mentioned; these are Honden Island and Clermont Tonnerre, in the Paumotus. It is not necessary to go over the evidence for the several cases, as it is stated at length in my work.

Mr. Darwin, while speaking on the subject of local elevations, on p. 176, and discussing the facts as regards the Samoan (Navigator) Islands, adds that "in another place he [Mr. Dana] says (p. 326) that some of the [Samoan] islands have probably subsided." From the remark the reader would infer that this Samoan subsidence was a local subsidence, like the elevations under consideration. But in fact my statement is in a chapter on the general coral-island subsidence, and, on the page there referred to (p. 326), I cite Mr. Darwin's conclusions as to the Gambier Island subsidence, and put with it my own from the width of the reefs of Upolu and other reef-bordered islands. At the same place I allude to the greater subsidence of Tutuila—the island next to the west, as proved by its bold shores and small reefs.

In conclusion, if I differ widely, for the reasons above stated, from Mr. Darwin, as to the limits of the areas of subsidence and elevation in the Pacific, and believe that the new edition of his work shows little appreciation of some of the most important causes that have limited the distribution of coral reefs, I have, as I say in my work, the fullest satisfaction in his theory for the origin of atoll and barrier forms of reefs, and in the array of facts of his own observation which illustrate the growth of coral formations.

JAMES D. DANA

THE BRITISH ASSOCIATION

REPORTS

Report of the Committee on the Teaching of Physics in Schools, by Prof. G. C. Foster.

In view of the very great diversities in almost all respects of the conditions under which the work of different schools has to be carried on, the committee considered that in any suggestions or recommendations that they might make it would be impossible for them, with any advantage, to attempt to enter into details. They have therefore, in the recommendations which they have agreed upon, endeavoured to keep in view certain principles which they regard as of fundamental importance, without attempting to prescribe any particular way of carrying them out in practice.

They have assumed as a point not requiring further discussion, that the object to be attained by introducing the teaching of physics into general school-work is the mental training and discipline which pupils acquire through studying the methods whereby the conclusions of physical science have been established. They are however of opinion that the first and one of the most serious obstacles in the way of the successful teaching of the subject is the absence from the pupil's mind of a firm and clear grasp of the concrete facts and phenomena forming the basis of the reasoning processes they are called upon to study.

They therefore think it of the utmost importance that the first teaching of all branches of physics should be, as far as possible, of an experimental kind. Whenever circumstances admit of it, the experiments should be made by the pupils themselves and not merely by the teacher, and though it may not be needful for every pupil to go through every experiment, the committee think it essential that every pupil should at least make some experiments himself. For the same reasons they consider that the study of text-books should be entirely subordinate to attendance at experimental demonstrations or lectures, in order that the pupil's first impressions may be got directly from the things themselves, and not from what is said about them. They do not suppose that it is possible in elementary teaching entirely to do without the use of text-books, but they think they ought to be used for reviewing the matter of previous experimental lessons rather than in preparing for such lessons that are to follow.

With regard to the order in which the different branches of physics can be discussed with greatest advantage, considering that all explanation of physical phenomena consists in the reference of them to mechanical causes, and that therefore all reasoning about such phenomena leads directly to the discussion of mechanical principles, the committee are of opinion that it is desirable that the school teaching of physics should begin with a course of elementary mechanics, including hydrostatics and pneumatics, treated from a purely experimental point of view. The committee do not overlook the fact that very little progress can be made in theoretical mechanics without considerable familiarity with the processes of mathematics, but they believe that by making constant appeal to experimental proofs the study of mechanics may be profitably begun by boys who have acquired a fair knowledge of arithmetic, including decimals and proportion,