several years used the following arrangement for this purpose.

A small weight is suspended by an iron wire constituting a torsion pendulum. Direct current is sent through this suspending wire and through a magnetising coil which surrounds it. This direct current is reversed in the magnetising coil (or in the suspending wire) in rhythm with the free oscillations of the pendulum. This causes the outside portions of the suspending wire to be magnetised successively along right and left helical lines, and the accompanying changes of length along the lines of magnetisation cause the wire to twist slightly to right and to left with the reversals of current. After several reversals of current the oscillations of the torsion pendulum become easily perceptible. W. S. FRANKLIN.

Physical Laboratory, Lehigh University, South Bethlehem, Pa., April 6.

Wawo and Palolo Worms.

IN your interesting note on the palolo worm of Samoa (NATURE, March 31, p. 523) an error has crept in about the *wawo* of Rumphius, which is said to be doubtless the same as the Pacific palolo. Thanks to the kindness of Prof. Max Weber, the head of the Dutch Siboga Expedition, that explored the seas of the Malay Archipelago during the years 1899–1900, I had the opportunity of examining a cluster of these worms from Banda, where they are called *oelie* by the natives; especially in the months of March and April, the second and third nights after full moon they are swarming there in great numbers at the surface of the sea.

In the "Rumphius-gedenkboek," consecrated to the memory of the eminent naturalist of Amboyna, who died two hundred years before, which was edited by the Koloniaal Museum at Haarlem in 1902, I published a short description and some figures of this interesting worm. Though, like the Pacific palolo, a member of the family of Eunicidæ, the *wawo* or *oelie* belongs to the genus Lysidice, and is a rather small worm, measuring about 65 millimetres in length. Nearly all the specimens were in a state of sexual maturity, their bodies crammed with sperm or ova, but without showing any epitokal characters; the number of males and females appears to be nearly equal. In our preserved specimens nearly all the colour has vanished, but during lifetime males and females undoubtedly are differently coloured, probably green and red as stated by Mr. van Hasselt, the assistant-resident, who collected the worms. R. HORST.

Museum of Natural History, Leyden.

[THE writer of the notice merely followed the original author, Mr. Woodworth, in identifying the "wawo" with the palolo. On referring again to Mr. Woodworth's article, he finds the mode of expression somewhat ambiguous, so that it might possibly bear another interpretation.—EDITOR.]

The Base of Napier's Logarithms.

IN your issue of March 3 (p. 409) I read:—"The base of Bürgi's logarithms is nearly e, and that of Napier's nearly e^{-1}." In the "Encyklopädie der Elementaren Algebra und Analysis," by Heinrich Weber, Leipzig, 1903, p. 108, I read:—"Die Basis der Neperschen Logarithmen stimmt also sehr nahe mit der Zahl e überein."

Can your reviewer kindly explain on which side lies the truth? ADOLFO BOSSETTI.

Turin, Italy.

WHAT Napier actually gives in his table is a series of natural sines with a corresponding series of logarithms which diminish as the sines increase. If a Napierian logarithm is considered to be the logarithm of the sine opposite to which it stands, the base is approximately e^{-1}; but we may, if we like, regard the logarithms as logarithms of cosecants, and the base is then approximately e. Or again (as in "Encycl. Brit.," xvii., 179) we may take Napier's sines as actual integers, and use log Nap n for the logarithm placed opposite n in the table; then we have approximately

$$\log \text{Nap } n = 10^7 \log_e (10^7/n).$$

Thus opposite 5000000, which is entered as the sine of 30° to radius 10^7, we have a logarithm which, read as an integer, is approximately $10^7 \log_e 2$. Inspection of Napier's table gives more information than any brief description can do; as will be seen from what has been said, the definition of a Napierian logarithm and of its base depends to some extent upon how we translate his phraseology into modern notation. G. B. M.

BORINGS INTO A CORAL REEF.[1]

THE work before us consists of a series of reports by different authors in connection with the three expeditions that were sent to Funafuti in 1896, 1897 and 1898. Their object was to obtain by boring a vertical core of at least 100 fathoms from the rock of a typical atoll, to settle, if possible, the vexed question of its formation. Naturally the different parts of the work are of unequal value. Indeed, all must be regarded as of quite subsidiary importance to that on the core, and are of interest mainly in so far as they throw light on its composition.

Little modern scientific work shows a better record of determination and thoroughness than this. The first expedition under Prof. Sollas was a failure, but the experience gained in its two borings of 105 and 72 feet made possible the subsequent success of the later expeditions, and the reports of its members threw a flood of light on the atoll itself, its fauna and flora. The most valuable direct result was the production of a chart giving a more thorough and detailed survey of an atoll than had ever before been attempted. The great care exercised by Captain Field and the officers of H.M.S. *Penguin* in this work has made feasible, by a re-survey of the atoll in a few decades, a comparison to show the changes that are at present in progress. To it we owe the possibility of the detailed geological survey of the atoll by Prof. David and Mr. Sweet (Section v.), which will be of material assistance for the same purpose. The magnetic survey, too, worked out by Captain Creak (Section iii.), by pointing out in the areas of greatest disturbance the probable positions where magnetic rocks might nearest approach the surface, suggested the idea of driving a boring down through the bottom of the lagoon, subsequently brilliantly carried out by Mr. Halligan with the aid of the captain and officers of H.M.S. *Porpoise* (Section vii.), Fig. 1.

The second expedition carried the bore to 698 feet, but was unsatisfactory in view of the small amount of core obtained. It, however, completed the geological survey of the islets. Finally, the third expedition drove the same boring beyond 1100 feet, the greater part of its core being almost continuous, and put down a second in the lagoon to a depth of 245 feet from the surface. Collections were also made from the outer slopes to 200 fathoms, and the biology of the atoll was studied by Mr. Finckh (Section vi.).

The latter section is, perhaps, the least satisfactory part of the whole report, mainly because the examination of the core suggests so many questions to which no answer is given. Its most interesting observations are those on the rates of growth of various organisms, a mass of Halimeda three inches in height and thickness in six weeks being quite remarkable. Attention is directed to the barrenness of the eastern or windward reef as compared with the western or leeward reef. No explanation beyond that of an "epidemic" is afforded, though whether any is necessary beyond the known effects of sediment on coralline life and the undercurrents on exposed reefs, both far more important to windward, is doubtful. The section gives

[1] "The Atoll of Funafuti." Being the Report of the Coral Reef Committee of the Royal Society. Pp. xiv+428; illustrated, and with 19 geological maps. (Published by the Royal Society.)

the idea that the Funafuti reefs are now very different from what they were when the core was being formed. Practically Lithothamnion, Halimeda, Heliopora, Millepora, Porites, Madrepora and Pocillopora are stated to be the only sedentary organisms of importance at the present day, the section being little more than an essay on them. We look in vain for precise accounts of upgrowing shoals more than two or three fathoms deep, of the silting up of the lagoon, and of the outward extension of its encircling reefs. Does the boring alga Cliona occur in the living reef corals, and do boring worms affect them?

The detailed account of the collections from the outer slope is not included in the present report, a matter of regret when one considers their importance in connection with the depth of formation of the core and with certain theories of coral reef construction. As it is, the general report on them forms one of the most interesting sections of the volume, and it is greatly to be hoped that the specimens will subsequently be deposited with the core. The face of the cliff, 40 to 140 fathoms, is apparently composed mainly of the remains of the same organisms as form the shelf above, while the area at its base, from 140 to 200 fathoms, is covered by a talus of the same. A few true corals and some Halimeda (one piece 86 fathoms) were obtained below 40 fathoms, but this depth is considered to be about their true limit. Lithothamnion and Polytrema grew in abundance from the surface to 200 fathoms, while Cycloclypeus, a foraminiferan sparingly present in the core between 570 and 1070 feet, was found from 30 to 200 fathoms. In addition some deep-sea corals and other organisms were secured, but the dredgings were evidently too few—the naturalists had only an open row boat—for deductions to be drawn as to the occurrence of individual species and genera.

The main part of the work, that on the boring, appropriately commences with a general introduction by Prof. Judd, in whose hands its supervision was placed. From the main hole, 1114½ feet, about 384 feet of core was obtained. It was carefully labelled, and boxes of sand collected at intervals to fill up its gaps. From the middle of each piece of rock a slice was taken longitudinally, the total length of these being the total length of the core. These slices were then examined, and from all portions which presented difficulty microscopic sections were ground. The corals of much of the core being in the form of casts, a set of wax impressions of recent forms was made for comparison. Prof. Judd personally contributes a most valuable article on the chemical composition of the core (Section xiii.), while to Dr. Hinde we owe its detailed examination and the elucidation of the nature of its organisms, with the exception of the Foraminifera, assigned to Mr. Chapman (Section xi.). Lastly Dr. Cullis gives a full report on its mineralogical changes (Section xiv.).

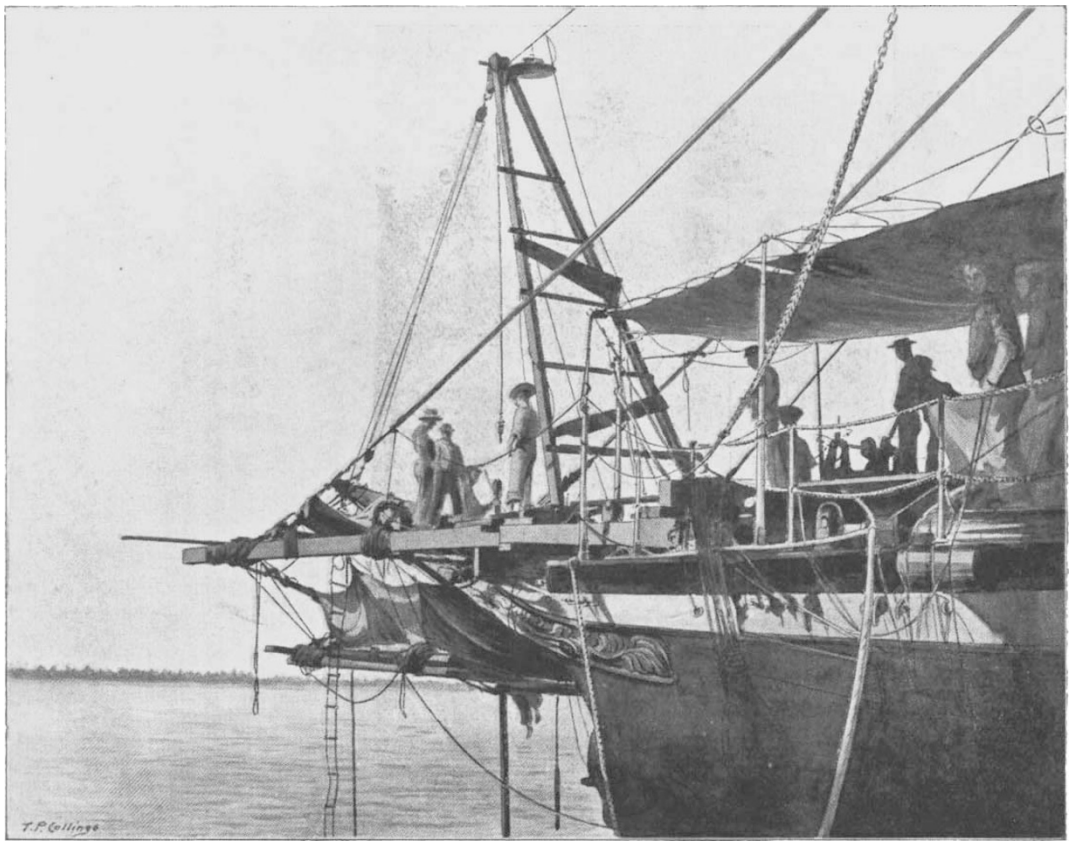

FIG. 1.—The Lagoon Boring Apparatus on H.M.S. *Porpoise*.

From the surface to a depth of 748 feet only 72¾ feet of core were brought up. The first 150 feet gave 26 feet, consisting mainly of corals and the regular reef organisms very little changed in any way. Deeper the aragonite of the corals was found to have been gradually dissolved, other organisms of more resistant structure persisting, until at about 400 feet such core as there is consists of cavernous limestone, formed

largely of Foraminifera with casts of corals, the whole cemented together by crystalline calcite. Foraminifera predominate still more between 637 and 748 feet, where the rock becomes soft and chalky looking, crystalline dolomite largely replacing calcite as the cementing material. From this depth to the bottom, 366½ feet, the core was 311½ feet long, the rock being a hard dolomitic limestone, with frequent cavities where organisms had been dissolved out. Corals are only represented by casts, and these are generally very badly preserved, though in some places protected by incrustations of Polytrema or Lithothamnion. Here and there occurs a disposition to form alternate bands of corals and Foraminifera mixed with detritus, the thickness of the latter considerably exceeding that of the former.

The whole core was divided into 1065 lengths, each of which has been separately examined and described by Dr. Hinde. The core from the borings of the first expedition was similarly treated, as was also that from the lagoon boring, though the latter was largely fragmentary in its nature. It was situated about one and a half miles from the middle of the eastern rim of the lagoon, and commenced at a depth of 101 feet. Two borings were made, the deeper reaching a depth of 144 feet below the floor of the lagoon. To a depth of 70 feet an uncemented material was obtained consisting mainly of Halimeda fronds and a few Foraminifera. Below, this was gradually replaced by a porous, rubbly limestone formed of the same genera of corals as now live in the lagoon, together with Foraminifera, the whole cemented by calcite into a hard rock.

In our opinion it is unfortunate that Prof. Judd and Dr. Hinde have not clearly expressed their opinions on the formation of the atoll, really the sole question which the various expeditions were sent out to solve. Their matured judgment, after examining the whole core, could not but have been of great value. It is quite clear, however, that they consider the whole core, running through nearly 200 fathoms, to consist of the same materials and to have been formed in the same way. Lithothamnion, Polytrema, and certain Foraminifera extend through the whole of it, but also live down to 200 fathoms. Unfortunately our knowledge of the bathymetrical limits of corals is less certain, but, so far as it at present goes, they cannot have grown at a greater depth than 50 fathoms. The characteristic sedentary organisms of 50 to 200 fathoms are stated to be absent from the core, and, if this be the case, it seems almost certain that Funafuti in its upper 200 fathoms owes its formation to some change or changes of level in the sea floor.

Had there been such a subsidence practically *all* the corals of the core should be in their positions of growth. Corals are frequently stated in the report to be so, but the question as to whether they are or are not is such an important one that the full evidence should have been given. Coral colonies differ largely in different parts of their surfaces, but that any conclusions could be drawn from casts as to their positions of growth seems doubtful. Again, the relatively small size of the corals found in the core—five or six or more corals per foot—does not agree with the usual descriptions that have been given of coral growth *in situ*, and seems better explained by the consolidation of a heap of dead corals. If the rock were formed by a growing reef in shallow water it should be observed that no reef similar in its constitution was found by Mr. Finckh. However, the authors evidently consider that they have proved a vertical thickness of nearly

FIG. 2.—Ocean Side of Funafuti Island, from the living Lithothamnion Reef to the Hurricane Beach, opposite the Site of the main Boring.

200 fathoms of rock not showing organisms other than live in the upper 50 fathoms, and in that case the conclusion can hardly be avoided that subsidence has taken place.

The analysis of the core rock shows that down to about 640 feet it is a limestone, between 10 and 35 feet containing more than 10 per cent. of magnesium carbonate with two maxima of about 16 per cent., but below this averaging about 4 per cent. Still deeper it becomes dolomitic, containing upwards of 40 per cent of magnesium carbonate, but in one area, 820 to 870 feet, averaging less than 15 per cent., with further falls at 1061 and 1080 feet. The presence of 4 to 5 per cent. of magnesium carbonate is explained by the leaching out (solution) of the more soluble calcium carbonate, while the magnesium carbonate is left to enrich the rock. This factor will not serve to explain either the large amount near the surface or the enormous increases at certain depths, but the reader should carefully consider for himself Prof. Judd's discussion of the chemical changes.

Considered in its entirety, the work has been well and carefully done. It adds immensely to our knowledge of the possible means of the formation of coral reefs, and shows that subsidence may have at any rate played a dominant part in the formation of Funafuti. The illustrations are well chosen and all that could be desired. The geology is illustrated by an admirable series of maps. Indeed, the work reflects immense credit on all who have been connected with it, and cannot but be of great permanent value.

THE FORTHCOMING CAMBRIDGE MEETING OF THE BRITISH ASSOCIATION.

THE fourth meeting of the British Association at Cambridge will be held this year from August 17 to August 24. In 1833, the third year of its existence, the association met at Cambridge under the presidency of Prof. Adam Sedgwick; Sir J. F. W. Herschel presided over the second meeting in 1845, and the third Cambridge meeting was held in 1862 under the presidency of Prof. Willis.

The arrangements are already sufficiently advanced to admit of a preliminary forecast of the programme of the meeting next August. The invitation to the association to visit Cambridge in 1904 was presented by the university and the town, and by the county councils of Cambridgeshire and the Isle of Ely, and these bodies are all represented on the various committees entrusted with the local arrangements. The Mayor and Corporation have kindly consented to the use of the Guildhall for the purposes of a reception room; the Corn Exchange will be utilised for the president's address on August 17, and the lectures will be given in the new theatre.

The sectional meetings will in most cases be held in the buildings of the several science departments. The sections are the following:—A, mathematical and physical science, president, Prof. Horace Lamb, F.R.S.; B, chemistry, president, Prof. Sydney Young, F.R.S.; C, geology, president, Mr. Aubrey Strahan, F.R.S.; D, Zoology, president, Mr. William Bateson, F.R.S.; E, geography, president, Mr. Douglas W. Freshfield; F, economic science and statistics, president, Prof. William Smart; G, engineering, president, Hon. Charles A. Parsons, F.R.S.; H, anthropology, president, Mr. Henry Balfour; I, physiology, president, Prof. C. S. Sherrington, F.R.S.; K, botany, president, Mr. Francis Darwin, F.R.S.; L, educational science, president, the Right Rev. the Lord Bishop of Hereford.

A "Handbook to the Natural History of Cambridgeshire," specially written for the meeting under the editorship of Dr. J. E. Marr and Mr. A. E. Shipley, will be published by the University Press; the syndics of the Press have decided to present a copy to each ticket-holder, provided that the number to be supplied for the purpose does not exceed 2000 copies. A special edition of Mr. J. W. Clark's "Guide to the Town and University" will be presented to each member of the association, also a series of excursion guides, together with a coloured map of East Anglia supplied by the Director-General of the Ordnance Surveys.

Emmanuel College has agreed to entertain the secretaries of sections. The majority of the colleges have expressed their willingness to entertain free of charge a limited number of distinguished guests, and some of the colleges have agreed to place rooms at the disposal of members of the association, making a charge for meals and attendance. Girton and Newnham Colleges, and the Ladies' Training College, have also agreed to extend hospitality and lodging accommodation to British and foreign visitors.

A considerable number of favourable replies have been received in answer to invitations issued to American and foreign men of science; it is expected that at least 100 visitors from abroad will be present.

The master and fellows of Trinity College have kindly granted the use of the college for a conversazione and reception to be held on Thursday, August 18. The Lord-Lieutenant of Cambridgeshire and the Mayor of Cambridge will entertain the members and associates at a garden-party in the Botanic Garden on Monday, August 22. The High Sheriff of Cambridgeshire has also expressed his intention of giving a garden-party during the meeting.

It is hoped that a *table d'hôte* lunch will be served on week-days in certain college halls. Light refreshments will be served each day (including Sunday) in the Masonic Hall, adjoining the museums and close to the reception room, from 12 to 8 p.m. It has also been arranged to have an open-air café and beer-garden on ground adjoining the museums, which will be open on week-days from 11 to 6.

The committee has provisionally arranged eleven excursions for Saturday, August 20. These include Audley End and Saffron Walden, Brandon and Didlington Hall (flint-knapping industry and Lord Amherst's collection of Egyptian antiquities), Cromer (geological), the Dykes of Cambridgeshire; Ely, Hatfield and St. Albans, Lincoln, Lynn, Castle Rising and Sandringham, Norwich, Wicken Fen, Wisbech and Woad Works.

On Thursday afternoon, August 18, the registrary of the university, Mr. J. Willis Clark, will deliver a lecture on "The Origin and Growth of the University." The evening lecture on Friday, August 19, will be on "Ripple-marks and Sand-dunes," by Prof. George Darwin, and on Monday, August 22, the second evening lecture will be delivered by Prof. Osborne, of New York, who will give an account of "Recent Explorations and Researches on Extinct Mammalia." On Saturday, August 20, Dr. J. E. Marr will lecture to the operative classes on "The Forms of Mountains."

On Friday, August 19, a garden-party will be given by the principal of Girton College, and on Tuesday afternoon, August 23, members of the association will be entertained at Newnham College.

A classified list of lodgings and hotel accommodation is now being prepared for the use of intending visitors. Information in regard to lodgings may be obtained from Mr. A. Hutchinson, Pembroke College. General inquiries should be addressed either to the local secretaries, British Association, or to Mr. A. C. Seward, Emmanuel College, Cambridge.