PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES.

WEDNESDAY, MARCH 30th, 1910.

The Thirty-fifth Annual General Meeting, and the Ordinary Monthly Meeting, were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 30th, 1910.

ANNUAL GENERAL MEETING.

Mr. C. Hedley, F.L.S., President, in the Chair.

The Minutes of the preceding Annual General Meeting (March 31st, 1909) were read and confirmed.

The President delivered the Annual Address.

PRESIDENTIAL ADDRESS.

Ladies and Gentlemen—

It is the duty and the privilege of your President to conclude his year of office by an Address at the Annual Meeting. Custom requires that these addresses should consist partly of a history of the Society during the past year and partly of a philosophical treatise intended for the delectation of members. To prepare an Address worthy of submission to so intellectual an audience is the heaviest responsibility of the Presidency. I crave your indulgence for an effort which falls below the high standard to which my predecessors have accustomed you.

The greeting "Ladies and Gentlemen" reminds you that at the instance of Prof. Wilson the Society early in the year resolved to break down the invidious distinction between the sexes and to extend full privileges of membership to women. As far back as 1885 women have been received by the Society as "Associates" but excluded from meetings and denied a vote. Eight lady Members joined us under these restrictions, half of whom continue to the present. This enfranchisement was a natural progress and was foreseen by my predecessor, President Stephens, who in his Annual Address of January 27, 1886, made the following reference to the admission of women :—"This enlargement of the Society's sphere is admittedly only tentative, and may probably be increased hereafter by the admission of all Members to full rights without distinction of sex, following the improved practice of the Sydney University in this respect." That the status of our women Members should be thus raised is also in harmony with the provisions of the Founder's will directing that women who are otherwise qualified should be eligible for election to the Linnean Macleay Fellowships.

In this reform you followed the example of our great namesake the Linnean Society of London. But whereas the English women had fairly earned their reward by several brilliant papers accepted and published by their Society, no such feminine contributions have been received from our Members. Neither have Australian ladies so far taken much advantage of the membership now open to them. Yet I anticipate that in the future we shall welcome many distinguished women of Science to our ranks and that their work will be an ornament to our Proceedings. And if not, "Because right is right," as Tennyson says, "to follow right were wisdom in the scorn of consequence."

These alterations necessitated the revision and issue of a new edition of the Rules in December last. Accompanying it was a list of Members, from which it appears that we commence the Session of 1910 with 130 effective Members on the roll.

On January 25th, 1875, this Society was inaugurated by 125 Members, and in 1890 only 24 of these foundation Members continued their association.* To-day but three of these pioneers remain to us—Sir Normand MacLaurin, Mr. H. H. B. Bradley, and Mr. George Masters—though seventeen others who have not maintained their membership are still happily alive. These survivors are Sir Philip Sydney Jones, Sir J. R. Fairfax, Professor Liversidge, Drs. Cox, Ramsay, and E. Chisholm, The Hon. H. H. Kater, Messrs. T. Brown, J. Brazier, A. Dodds, J. J. R. Gibson, H. A. Gilliat, W. H. Hargraves, C. W. Lloyd, F. Lark, H. Makinson, and G. Osborne.

During last Session eight elections added to us six effective Members, one Member resigned, and we mourn the decease of another. This year death had almost passed us by, but turned to snatch one of our younger brethren. Thomas Cahill Dwyer entered the Training College in 1902, and won the Departmental scholarship to the University, where he took his degree of Bachelor of Science in December, 1905. Next year he was appointed to the position of Resident Science Master in charge of the Bathurst Technical College, a post he filled with credit until failing health compelled his retirement. After a long illness he expired on August 23rd, 1909, at the early age of 30. His removal from Sydney to Bathurst deprived him of the opportunity of attending meetings, and so he was personally known to but few of us. Those who enjoyed the privilege of his acquaintance saw in him the promise, broken by his failing health, of scientific achievement.

After the above had gone to press, I heard with regret of the unexpected death of our ex-Member, Mr. G. W. Kirkaldy, of Honolulu, on Feb. 2nd of this year. He contributed to our Vol. xxxiii., a valuable "Catalogue of the Hemiptera of Fiji." In a previous article, Hawaiian Sugar Planters' Exper. Station, Ent. Bull. iii., 1907, Introduction, he offered a sketch of the Australasian zoogeographical divisions from an Hemiptera standpoint.

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*These Proceedings, xiv., p.1300.

For the last year the output of work has been well maintained. As new recruits we welcomed Drs. J. B. Cleland and E. W. Ferguson, Messrs. T. H. Johnston and A. F. B. Hull, while veteran Members continued their work on Bacteriology, Botany, Biochemistry, Comparative Anatomy, Conchology, Entomology, various branches of Invertebrate Zoology and Geology. Their writings advance Australian Science in these branches, and will, I trust, prove fruitful of further thought and deed.

Our Annual Volume, No. xxxiv., embodying these researches, was promptly completed and distributed. It contained about eight hundred and fifty pages, and was illustrated by sixty-nine plates. In bulk it equals the united annual product of other Australian scientific societies, and we may, I think, without conceit, regard it with satisfaction. The increasing demand abroad for our publications is accepted as a token of appreciation from those qualified to express it. Recently the standard of our volume has been visibly raised by the highly trained specialists now engaged by the Society.

In discharge of the trust imposed on us by the Founder, and mindful of these words by President Stephens, "on satisfactory proof being given to the Council that the holder has laboured during the preceding term with earnestness, perseverance and success," Dr. Petrie, Mr. Goddard, and Mr. Cotton were approved and re-appointed for the ensuing year as Linnean Macleay Fellows.

Though Dr. Jensen retired from a Fellowship two years ago, he has continued to enrich our Proceedings with geological information obtained during his term of office. It was a gratification to his fellow Members to learn that the Syme Prize for the encouragement of research work in natural science was last year awarded to Dr. Jensen by the University of Melbourne.

During the past year the Macleay Bacteriologist has investigated several problems connected with opsonic activity. The opsonins are those bodies, contained in the blood and body fluids, which assist the white blood corpuscles or phagocytes to absorb all microbes, including those which excite disease. They exist already formed in the body-fluids to a certain extent, and assist in the maintenance of health. An increased quantity of opsonin in the body may be produced by the injection of dead bacteria or by the consumption of yeast.

Since dead bacteria and yeast can increase the opsonic content of the blood, the question arises, are the opsonins produced directly from the bodies of these micro-organisms, or are they formed indirectly in response to a stimulus given by their products of digestion? Experiment showed that they are not formed directly, from which it follows that their products of digestion stimulate the activity of some opsonin-producing organ.

It is a curious fact about the action of opsonins that by diluting fresh blood serum we obtain an increase in its opsonic activity. The reason was not known until investigations were undertaken in the Society's laboratory. As a result of much experimentation, it appears that the cause of the phenomenon lies in the activity of the phagocytes. The salinity of normal blood serum is too high for a maximum phagocytosis, and therefore by weakening the percentage of salt, the gradual dilution brings the serum to a point at which the phagocytes can work best. From this point a further dilution lessens both opsonic content and phagocytic activity. Less important factors in controlling the phenomena are the relative abundance of bacteria to be ingested, the nature of the phagocytes, and the duration of the period of contact between opsonised bacteria and phagocytes.

In the domain of economic bacteriology, Dr. Greig-Smith investigated the cause of the thickening of condensed milk. In our climate it is not unusual to find that a thickening has taken place during storage. When the tins are opened by the public, the milk may be thick, lumpy, or like a stiff jelly. The cause of this condition was traced to a micrococcus which apparently obtains access to the milk either during cooling or canning, and slowly coagulates the casein by secreting a rennet-like ferment. The small quantity of air remaining in the tin probably assists the growth of the bacterium. The microbe is easily killed, and there appears to be no reason why greater care in the later stages of manufacture should not prevent the loss of thousands of tins of milk.

Turning to the work of the Linnean Macleay Fellows, Dr. Petrie during the past year has completed his research on the amount of arginin, histidin, and lysin in fowl's egg-white. During the process of separation of these bases, determinations of the quantity of nitrogen were made at each stage of the estimation. The figures obtained will be of value in showing the parts of the process of separation which require improvement.*

Since the conclusion of this research, Dr. Petrie has been engaged on the application of the precipitin test to the problem of the differentiation of the vegetable species. The valuable researches of Nuttall,† Graham-Smith and others have shown that in the animal kingdom the relationships indicated by the "biological method" are those which have been accepted on the ground of morphological similarity. In the plant kingdom it was thought that this method was unlikely to be useful as the early experiments of Kowarski‡ suggested no considerable difference in the proteins of plants. Employing an antiserum prepared against extracts of the seeds of *Acacia pycnantha*, it has been found that no reaction is given with the extracts of the seeds of any plant outside the Natural Order of the Leguminosæ, to which *Acacia pycnantha* belongs. Within the group of the Leguminosæ, extracts of some seeds react with the antiserum, while extracts of seeds of other species fail to react. The plants which thus appear to be related to *Acacia pycnantha* according to the biological method show so far no general morphological similarity. It may be possible, if sufficient data be obtained, to determine the value of morphological characters and to recognise a natural grouping of plants.

The attention of Mr. E. J. Goddard, Linnean Macleay Fellow in Zoology, has been devoted to the Hirudinea, Oligochaeta, and Polyzoa. The results of his study have appeared in one article

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* Chapman & Petrie, Journ. of Physiol., xxxix., 1909, p.341.

† Nuttall, Blood Immunity and Relationship. Cambridge. 1904.

‡ Deutsch. med. Wochenschr. xxvii., 1902, p.448.

on the Polyzoa and two on the Hirudinea. Two more parts on the Hirudinea are completed and await publication, while three more of the same series are far advanced and will be laid before you shortly. In addition to enlarging the anatomical and systematic knowledge of the group, Mr. Goddard has found in their metamerism fresh clues to the phylogeny of these leeches. Indeed the study of metamerism in his hands promises deductions which reach far beyond the group which first suggested them.

The Australian fresh-water annulates are now appearing as a rich fauna, and will afford new means for the solution of zoo-geographical problems. Mr. Goddard's progress in these obscure groups is watched with interest by our zoological members.

Mr. Leo A. Cotton, Linnean Macleay Fellow in Geology, has now completed his first year's work. He has investigated the tin deposits of a part of the New England District, his description of which appeared in the last Part of our Proceedings. In that issue his observations in the field are presented, while his conclusions on the genesis of the deposits are reserved until a broader view shall have been obtained by a study of the whole district. During his visit he took the opportunity to investigate two interesting problems; one the Borah Creek ore deposits, and the other the occurrence and origin of the diamond deposits of Copeton. A description of the Borah Creek occurrence is now almost finished, and an account of the diamond deposits at Copeton is being prepared. Towards the end of last year, Mr. Cotton paid a short visit to the Emmaville District in New England, and intends to examine this area more closely in the near future.

On the 31st December last the total funds under the control of our Society amounted to £72,000. The amount to the credit of the Fellowships (capital) account was £38,400, and the annual income about £1,500. At the present rate of interest earned, the Society will be in a position about eight years hence to appoint a fourth Linnean Macleay Fellow—provided, of course, that there is in the meantime no sacrifice of income through difficulty in obtaining suitable investments.

Professor David entertained the Members and their friends in the geological theatre of the University at a lecture on November 10th, 1909, on the Scientific Results of the British Antarctic Expedition of 1908. A lavish display of maps, specimens, and lantern slides, supported by brief addresses on special subjects by Dr. Farr, Dr. Jensen, Dr. Woolnough, and Mr. Goddard, provided an instructive and agreeable evening.

Our association with Antarctic research has been deepened during the year by invitations accepted and fulfilled by several of our Members to contribute to the volumes published by Sir Ernest Shackleton on the Scientific Results of his Expedition.

As on the last Expedition several of our Members were honoured by a place, so we learn with pride and pleasure that on the next British Antarctic Expedition we shall be again represented, this time by our strenuous fellow Member, Mr. T. Griffith Taylor.

The Eighth International Zoological Congress will meet at Graz in Austria in August, 1910. The Committee have kindly invited this Society to send delegates, but unfortunately our distance from Enrope does not allow us to attend.

There is, however, a bright prospect that three years hence we may welcome to Sydney the British Association for the Advancement of Science. At the suggestion of the Melbourne University Council, a deputation representing the Universities and learned Societies of Australia waited on the Hon. the Prime Minister on December 16th last. Our Corresponding Member, Prof. W. Baldwin Spencer, kindly acted for us on this occasion. The deputation was sympathetically received, and it is hoped that the Commonwealth, the States, and the citizens will unite in a national invitation, so that the visit of the British Association to Australia in 1913 may be as successful as that to South Africa in 1905 and that to Canada in 1909.

For the scientific portion of this Address, I have elected a subject not hitherto discussed in our Proceedings, namely,

The Submarine Slope of New South Wales.

(Plates i. and ii.)

(1) *The Notonectian Current.*

First we discuss the current, because without a knowledge of it the continental shelf cannot be properly understood.

Past Sydney there flows south a warm and rapid current well known to sailors and fishermen. In the days before steam it sometimes happened that inward bound ships, if becalmed off the Heads, might be carried out of sight before the wind permitted them to regain their position. Now coasting steamers trading north hug the land to avoid the stream, while southward bound vessels keep a good offing to benefit by the current in their favour.

This great current is swung in and out by the on and off shore winds, retarded and even superficially reversed or submerged by southerly gales, and accelerated by northerly winds. I am informed by Capt. W. A. Bennett, a local Government pilot, that in exceptional circumstances, after the current has been "banked up" for several days by heavy southerly gales, it may attain a maximum velocity of four knots.

Neither its origin nor its conclusion has been satisfactorily determined. Two recent maps* give contradictory views of its course. It has been assumed, rather than proved, that this current is derived from the South Equatorial current, whose path after encountering the Melanesian Islands is indefinite. It is thought to vanish in the south of the Tasman Sea. Wilkes states that it frequently turns into Bass Strait, after which it is lost in the sea to the west of Tasmania or mingles with the Polar current. On the contrary, Hepworth† considered that this current is deflected from the Australian coast, between the 31st

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* Halligan, These Proceedings, xxxi., Pl. lii.; and Dannevig, Journ. Roy. Soc. N. S. Wales, xli., p.43.

† Hepworth, Journ. Roy. Soc. N. S. Wales, xxxii., 1898, p.122.

and 35th parallels, first to the east and then to the north-east by a current from the Indian Ocean passing through Bass Strait or round the south of Tasmania.

Probably the current runs south until it passes beyond the range of the north-easterly winds, whenever and wherever that may be. It is then likely to cool, to slacken and to split into diverging tongues, one of which may describe a spiral course in the Tasman Sea; the others, after encountering the opposition of Antarctic winds and currents, may finally plunge under the surface. The "Venus" appears to have felt it off the south-east of Tasmania on January 7th, 1839, in 45° 16′ S. lat.* In connection with the descending spiral, it is significant that "the isotherms of 40°, 45°, and 55° are found at greater depths on the New Zealand side" of the Tasman Sea than on the Australian.

It has been variously described as the Australian Current, the East Australian Current, and the Coastal Current of New South Wales. But as there are many Australian currents, a distinctive name would be useful. So I propose the name NOTONECTIAN (south swimming) to be applied to the stream running past the coast of New South Wales, without reference to its earlier or later history.

As the Gulf Stream influences western Europe, so does the Notonectian control the meteorology of our coast. The enervating climate of Sydney in midsummer is due to the warm moisture absorbed by the sea breezes from the surface of the Notonectian and immediately precipitated on the town.

Under favourable circumstances, animate or inanimate objects might drift in a couple of weeks from the tropics to Sydney. The attention of the Society has often been directed to tropical products, messages from reef and palm, cast on beaches around Sydney. In our Proceedings mention is made of pumice (xxx., p.351), seeds of *Aleurites*(xx., p.210), and of *Barringtonia*(xxv., p.542), *Nautilus* shells(xviii., p.239), living Hawksbill turtles (xxii., p.254), a sea snake(xiv., p.633), *Bonellia*(xxxi., p.462), and

* Du Petit-Thouars, Voy. Venus, Histoire iii., 1841, p.437-8.

Pocillopora(xxiv.,pp 192,413) drifted from the north. The dugongs on which the Blacks of Botany Bay and the Macleay River once feasted* had a similar origin. Tropical fish which journey down the stream are cited by Waite.† Further south stranded Nautilus shells were noticed at Twofold Bay by Dr. Cox,‡ and at Flinders Island in Bass Strait by Dr. Milligan.§

The investigation of this current is the largest, most fruitful, and fascinating problem within the reach of the Sydney marine biologist.

Perhaps the first observation of the Notonectian was made by Bass and Flinders on March 25th, 1796. They stood out to sea from Port Jackson Heads, and when they steered back again towards the land in the afternoon expected to fetch Cape Solander. To their surprise they sighted Mt. Kembla instead, and realised that a strong current had carried them some twenty miles beyond their reckoning. ||

The day after leaving Sydney on his way to Cook Strait, New Zealand, Capt. Dumont D'Urville of the "Astrolabe" found on December 21, 1826, a current running to the south-east at the rate of twenty-four miles in as many hours.¶

Commodore Wilkes of the American Exploring Expedition traversed this current several times, his tender the "Peacock" observing it seventy miles off the land. He found it variable in breadth and strength, but running at certain seasons of the year with great rapidity, reminding him of the Gulf Stream. On his first arrival in Sydney in November, 1839, he found its temperature to be 73°, which on his return from the Antarctic in March, 1840, had risen to 75°.**

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* Etheridge, Rec. Austr. Mus., vi., 1905, p.17.
† Waite, Mem. Austr. Mus., iv., 1899, p.16.
‡ Cox, The Nautilus, xi., 1897, p.43.
§ Proc. Roy. Soc. V. D. Land, i., 1850, p.292.
|| Flinders, Voy. Terr. Austr., i., 1814, p.xcviii.
¶ D'Urville, Voy. Astrolabe, Histoire ii., 1830, p.4.
** Wilkes, Narrative U. S. Explor. Exped., 1845, ii., p.362; iii., p.37; v., p.472.

Sailing out of Sydney with the "Erebus" and "Terror," in August, 1841, Sir James C. Ross was surprised to find the temperature of the surface of the sea rise from 55° in the harbour to 63° immediately outside the Heads. From subsequent observations he concluded that the breadth of the warm current running to the southward at the rate of about twenty miles a day along the coast of New South Wales does not much exceed three hundred miles.*

We still owe the best description of the Notonectian to the "Challenger" Expedition. In June, 1874, the survey directed by Sir George Nares found the current in reduced circumstances. After a continuance of westerly winds, it was developed as a stream thirty miles broad running at an average rate of one and a half miles an hour, its inner edge twenty miles from the land. The temperature stood at 69° to 70·7°, whereas the ocean traversed by the current was only 63°. In the previous April the same expedition found the current in a more vigorous condition running close in shore with a higher temperature of 72°.†

In an interesting study of local atmospheric conditions, Mr. H. C. Dannevig has discussed this current in relation to the dispersal of fish ova. From data collected by steamers running between Sydney and New Zealand, he considered that the centre of the warm current lies normally from a hundred to a hundred and fifty miles east of Sydney. During stormy blows from the west, the current is pushed bodily seawards, but in easterly weather its western border brushes along the headlands.‡

(2) *The Continental Shelf.*

The continental shelf may be defined as that area extending outwards from the land to a depth of about one hundred fathoms. This distinction is not arbitrary, for at or about this point the sediment alters to finer and the slope of the sea-floor to steeper.

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* Ross, Voy. Discovery Antarctic Regions, ii., 1847, p.5.

† Chall. Report, Narrative, i., 1885, p.464.

‡ Dannevig, Journ. Roy. Soc. N. S. Wales, xli., 1907, p.43.

These features indicate the approaching limit of sediment. Wherever the profile of the New South Wales coast be examined, a terrace is found to project from the beach to the hundred-fathom line, whence the ground quickly changes to a steeper grade. Compared with most other coasts, the continental shelf is here exceptionally narrow, resembling in this respect that of Western South America. Off Cape Dromedary the shelf contracts to a dozen miles, and off Newcastle it broadens to thirty-four. This narrowness of the shelf renders it impossible that extensive trawling grounds may be discovered in the waters of our State. The continental shelf of New South Wales is described and contrasted with that of Queensland by Dr. H. B. Guppy.*

Working across the shelf with dredge or trawl, the bottom proves rough and rocky upon the shallower inshore half. Outside Sydney the projecting reefs are the favourite resort of the schnapper, and their positions are known to the fishermen by cross bearings. But in the outer portion the rocks disappear and the bottom is found to be a smooth even floor of sand and mud, a plain of sedimentation. Geologists have collected convincing evidence of recent submergence of this coast.† So that it is likely that the rough inshore part of the shelf within forty or fifty fathoms represents an old denuded land surface, including perhaps the stumps of sea cliffs of a former coast-line. In Western Europe river-beds have been traced into the Atlantic for a hundred miles beyond their present estuaries.‡ Thus we might expect to find submarine gorges crossing the Australian shelf in continuation of present valleys. But I am unable to distinguish traces of such among the soundings on the chart, and conclude that if in existence they have been obliterated by sediment. There are indeed some irregularities of the contour lines outside Port Jackson and Port Stephens, but these may result from the ebb tide eddying from those harbours.

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* H. B. Guppy, Journ. Vict. Inst. xxiii., 1890, p.59.

† David and Halligan, Journ. Roy. Soc. N.S. Wales, xlii., 1908 (1909), p. 229.

‡ Hull, Trans. Victoria Institute, xxx., 1897 (1898), p. 311.

It is now suggested that the continental shelf of this State owes its profile to the Notonectian current. A bank so regular in depth and so extensive in length must be of recent geological date. Otherwise differential crustal movements, lowering in one place and hoisting in another, would have disturbed its uniformity. It is again a fair inference to deduce that, however it is made, this bank is still in the making. Since recent depression of the coast is an accepted fact, it has been deposited since the last subsidence and an older or even a succession of shelves may lie buried beneath the present one. The sudden angle of the shelf seems to have suggested faulting to Mr. C. S. Wilkinson, who wrote: "[At] a line about 20 miles east from the precipitous coast . . . the bed of the ocean probably . . . has been faulted to a depth of over 12,000 feet."*

On the Kosciusko Range, long wreaths of snow stretch along the eastern mountain brow through the summer and after all the rest of the winter's fall has melted away. The cause of this snow wreath is the prevailing westerly wind which sweeps off the winter's snow falling on the mountain top and drops it on the sheltered slope where it packs in a talus to a great depth. In such a manner I imagine that the current sweeps sediment along the continental shelf till it is tipped over the edge into quiet waters. A section of the bank thus formed is shown in the Ulladulla profile; the sedimentary deposit being separated from its conjectured continental base by a white line.

Neither the irregularities of the land above nor of the base beneath disturb the sweep of the 100-fathom line upon the chart. But east and south of Newcastle and Broken Bay, whence issue the Hunter and Hawkesbury Rivers, the shelf broadens considerably so that Sydney is past before the shelf retreats to its ordinary breadth. Where the shelf is carried out farther the talus slope beyond is correspondingly longer, just as would be the case in a railway embankment carried along a mountain side. Thus in the model of the coast off Sydney,

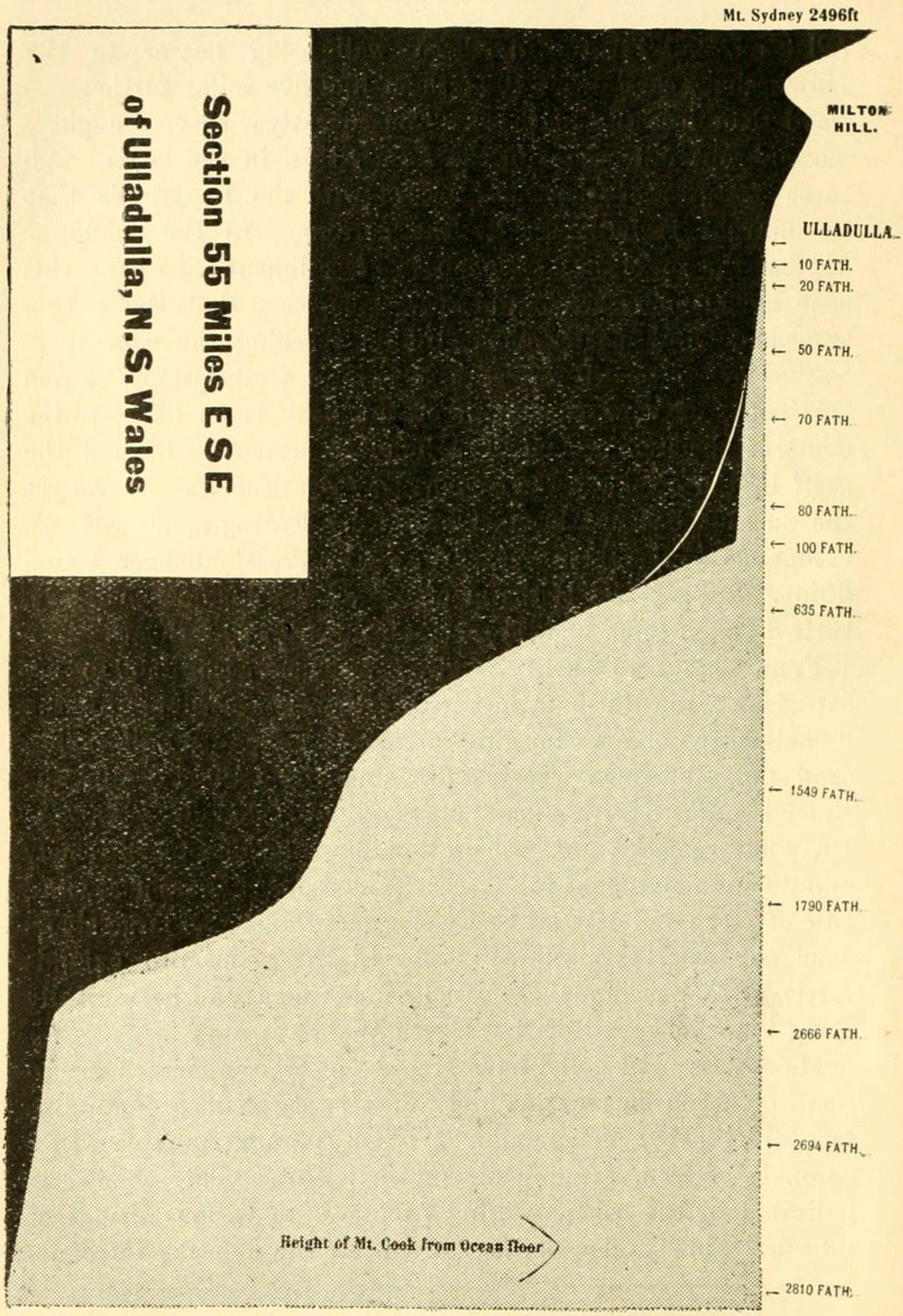
* Wilkinson, Notes on Geology of N. S. Wales, 1887, p. 70.

(Plates i. and ii.) the northern wall being nearer to the Hawkesbury carries the 100-fathom line five miles further seaward than does the southern. Consequently a sharper angle, a more abrupt fall occurs in the former than in the latter. All these features of the shelf accord with the hypothesis that its margin is built up by the current. In the shallower depths the rocks are swept bare of sediment: perhaps this zone even suffers erosion; deeper, I suppose, that the stream sweeps detrital matter about till on reaching the edge it is washed over into still water, there to form a talus slope. From this point of view the depth of the bank is an index to the depth of the stream, namely, a hundred fathoms. Beyond the shelf in the open sea, the current may run deeper still. As yet the current has not been plumbed by hydrographers, if we except the temperature section drawn by the Challenger Expedition. Taking the isotherm of 65° as the current boundary, their diagram (opp. p. 467) carries it down to 70 fathoms.

From eighty to three hundred fathoms according to my experience, and in four hundred fathoms according to the "Challenger" observations, there extends a deposit of glauconite sand and mud. On washing dredgings from those depths, the water is suffused with a green cloud which is slow to settle. As Dr. Flint remarks, this colouration must be due to extremely minute and amorphous particles.* These deposits are characteristic of steep and exposed coasts like ours, where no large rivers pour out detrital matter. Probably the glauconite extends vertically from a hundred to a thousand fathoms and horizontally along the whole coast of New South Wales.

Messrs. Lee and Collet have traced out a complicated evolution for this curious marine mineral. Empty shells of foraminifera fill with clay, the alumina of which is gradually replaced by peroxide of iron, forming an internal cast. This change is indicated by the colour passing from grey to various shades of brown. Finally, glauconitisation ensues through the introduc-

* Flint, Bull. 55, U.S. National Museum, 1905, p. 14.



Mt. Sydney 2496ft
MILTON HILL.
ULLADULLA.
10 FATH.
20 FATH.
50 FATH.
70 FATH.
80 FATH.
100 FATH.
635 FATH.
1549 FATH.
1790 FATH.
2666 FATH.
2694 FATH.
2810 FATH.
Section 55 Miles E S E of Ulladulla, N.S. Wales
Height of Mt. Cook from Ocean floor

tion of potassium, converting the whole to a hydrated potassic ferric silicate, and the characteristic greenish hue is assumed.*

(3) *The Continental Base.*

In illustration of the slope below the shelf, here termed the continental base, a profile is selected extending seventy† miles east-south-east of Ulladulla, and produced backwards to include the coast range. Your attention is first drawn to the insignificant proportions of a lofty hill upon the left, 2,500 ft. high, compared with the depths of the ocean abyss of more than three vertical miles. As a more forcible illustration, the point is marked to where Mt. Cook, N.Z. (12,359 ft.) would reach if it could be torn from its roots and sunk in the Tasman Sea. Then note the abrupt angle of the continental shelf already discussed. Between sixteen and eighteen hundred fathoms, another irregularity occurs in the curve, which is also repeated in the model of the section off Sydney (Plates i. and ii.). This latter inflexion possibly continues the curves shown in Professor David's section across the Blue Mountains and Sydney coal field.‡ So that the Ulladulla irregularity probably represents a subfold rather than a fault or a drowned continental shelf.

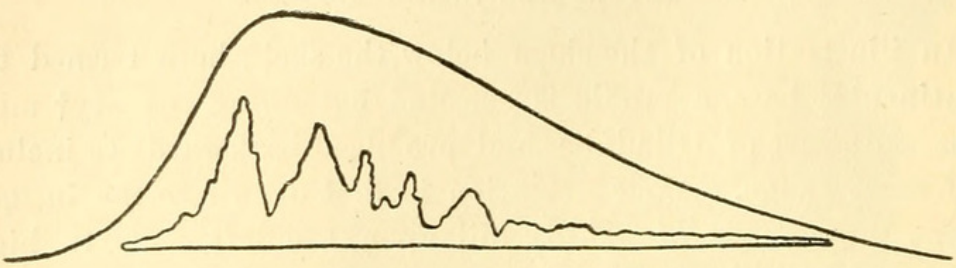
Without excluding faulting as a minor agent, it is suggested that the whole sweep of the diagram portrays an earth-fold of the first magnitude; *that it represents the further wall of a pressure-trough driven by a thrust from the east,* a gigantic buckle which is bending down the whole eastern coast of Australia. If so it must be a component of a vast system. The uniform and recent subsidence which extends from Torres Strait to Tasmania is in harmony with this suggestion. For all Eastern Australia and Tasmania is to be regarded as a geographical unit. Absence of earthquakes may indicate a temporary equilibrium, but if this

* Collett & Lee, Proc. Roy. Soc. Edinburgh, xxvi., 1906, pp. 238-278.

† Not fifty-five, as inadvertently stated on the diagram. Mt. Sidney of the Admiralty charts is Talaterang of the Lands Department maps. Milton Hill is the north end of Kingiman Range.

‡ David, Journ. Roy. Soc. N. S. Wales, xxx., 1896, Pl. ii.

movement is renewed or continued, as seems probable, then it may be the fate of the site of Sydney to sink under the sea.



Section across New Zealand, in the latitude of Mt. Cook.

Continuing the Ulladulla section eastwards across the Tasman Sea, the ocean floor rises very gradually till the South Island of New Zealand is reached. Mark how South New Zealand conforms in shape and motion to a westward rolling wave as in the above diagram. Not only does the steep face front Australia, the hogs-back slope behind and the crest advance before the centre, but the forefoot sinks under the sea in drowned land valleys and the rear rises in elevated Tertiary plains.

Again, New Caledonia may be pictured as another earth-wave of the first magnitude, rolling in upon the Australian continent. Its south-west coast, bordered by the narrowest shelf and plunging into deep water, represents the face, and the broad shelf upon which the recently elevated Loyalty Islands stand, the rear. Further north, the elevated reefs of British New Guinea are contrasted with the subsidence of the Great Australian Barrier Reef on the opposite coast. Professors Haddon, Sollas and Cole "distinctly see in Australia and its islands" . . . "the vast folds of the earth's crust roll slowly inwards upon the central continental mass."*

This rolling wave of New Zealand is complementary to the trough of the Tasman Sea, forced down against the resistance of the continent. Thus the trough is distorted by the resistance it has encountered from the regular zeta-curve of a trough moving between rolling waves.

* Trans. Roy. Irish Academy, xxx., 1894 p.473.

While the subaërial crest is hacked by denudation, the submarine trough lies undisturbed. Had the upper limb remained intact, it might have reared a noble arch eighteen thousand feet high, the symmetrical counterpart of the three thousand fathom trough off Ulladulla. It was considered by Rev. W. B. Clarke that Australia and New Zealand were "separated by a synclinal curve of the rock formations forming the sea channel between them."* But an ordinary syncline would have its maximum depth in the centre, not close to one side as it is in the Tasman Sea.

For comparison with the pressure trough, we will glance at another type of coast. The whole contour of the Great Australian Bight appears to be governed by the Jeffreys Deep, a linear depression of three thousand fathoms, whose axis nearly corresponds to the steamer track from Melbourne to Cape Leeuwin. Bass Strait, it is now suggested, may owe its origin to an extension of this furrow. Recent surveys by Mr. H. C. Dannevig on the Fisheries Investigation vessel, "Endeavour," show the sea-floor in and east of the Bight to descend from the coast in a flight of broad steps suggestive of block faulting. The western shore of the Bight extends in a wall of cliffs, truncated Tertiary beds, which may be held the topmost step, unless indeed the concentric mountain ranges of the interior be so regarded.

Below and beyond the continental shelf, the soundings off Sydney exhibit great irregularity, which, it is now suggested, may indicate a range of deep sea volcanic cones. From a study of the basaltic dykes which intrude the Triassic strata around Sydney, it appeared to Mr. G. A. Waterhouse that the radii of one system would converge to a focus about a point twenty-three miles east of Botany Heads. This focus is marked by a star under the centre of the continental shelf on Plates i. and ii. The radiation of these dykes has been thus plotted in the "Geological Sketch Map of the country in the vicinity of Sydney," Mines Department, 1903. Their occurrence shows a centre of great

* Clarke, Trans. Roy. Soc. N.S.W., ix., 1875, 1876, p 23.

volcanic energy to have existed thereabouts in Post-Triassic and probably Tertiary times.*

No soundings are available about this focus of the Sydney dykes. But further out to sea, viz., 46 miles east by south from Bondi, the "Challenger" recorded a sounding (Station 164) of 960 fathoms. The position of this important sounding was accurately fixed by astronomical observations. Five miles south-west by west of Station 164 she made another sounding (Station 164A) of 1,200 fathoms. This is supported by yet another sounding, not of the "Challenger," of 1,100 fathoms, at a point 13 miles to the south-west of Station 164.

As a rule, eastwards the depth increases very rapidly, but in this exceptional case a hill actually projects some 720 feet above the level of a point several miles to the westward or shoreward of it. And as it is improbable that the "Challenger" chanced to strike on the exact summit of Station 164, the elevation of the peak may be greater still.

Since "Challenger Station 164" is an awkward and inexpressive appellation, I propose, with the permission of the Society and of Dr. Walter G. Woolnough, to name this submerged cone Mount Woolnough, after our valued fellow member.

Beyond Mt. Woolnough the floor is covered with globigerina ooze, and sinks down gradually to the red mud abyssal plain. No tract of the terrestrial surface extends in so level, so monotonous an expanse as do these great abyssal plains. East from Sydney the northern end of one of these plains is traversed for about four hundred miles, after which the ground rises in a succession of undulations to New Zealand.

Prof. Milne writes, "the home of the earthquake is at the base of the steep sub-oceanic slopes where most deformation is in progress."† But our slopes have not troubled us much in this respect, telling that for the present there is a cessation of pressure movement.

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* Morrison, Rec. Geol. Survey, N. S. Wales, vii., 1904, p.261.
† Milne, Journ. Geogr. Soc. 1897, p.135.

The bottom temperature at 2,100 fathoms was found by the "Challenger" to be 34·5°. This probably indicates that a body of cold and heavy water, two and a half degrees above freezing, here creeps north from the Antarctic.

Looking backwards, I remind you that the Society now celebrates its thirty-fifth anniversary, and that twenty-five of such Meetings have been held in this Hall. During this existence we hope that not only have we advanced abstract science, but that we have also done the State some service in economic science. Looking forward, I conclude with the Presidential Amen

FLOREAT SOCIETAS LINNEANA !

EXPLANATION OF PLATES I.-II.

Plate i.

Full face view of model of the submarine slope off Sydney from Deewhy on the north to Cronulla on the south twenty-three miles, and extending east by south for sixty-six miles down to two thousand one hundred fathoms. Above is seen the entrance to Port Jackson on the right and to Botany Bay on the left. The cliffs of the coast are roughly expressed as a continuous wall three hundred feet high. Below the cliffs the sea floor is steep and broken, exposures of bare rock prevail. Beyond this again the rough bottom is buried under a nearly level expanse of sand and mud. Here the contour lines are emphasised to show bays opposite the harbour mouths and a cape running out between them. The limit of the continental shelf is determined by the steep slope reached after passing the hundred fathom line. On the right the shelf is carried out further and ends on a more sudden fall than on the left. This is associated with its proximity to the estuary of the Hawkesbury. The focus of the Sydney dykes is marked by a star. Various soundings on the Admiralty chart upon which the contours are calculated are shown by beads at 290, 650, 960, 1100 and 1200 fathoms respectively. The most important are the 960 and 1200 fathoms points on which Mount Woolnough is modelled. About this horizon the boundaries swell in an intermediate curve which may refer to other volcanoes, but is compared with a similar subfold below Ulladulla. The slope below Mt. Woolnough is gentler and continues beyond the area mapped. It is carpeted with globigerina ooze.

Plate ii.

Another view of the same model foreshortened and seen from a lower plane to express the relation of the continental shelf to the continental base. Here the disproportion of the vertical to the horizontal scale exaggerates the steepness of the slope as seen in profile.

Mr. J. H. Campbell, Hon. Treasurer, presented the balance sheet for the year 1909, duly signed by the Auditor, Mr. F. H. Rayment, F.C.P.A., Incorporated Accountant; and he moved that it be received and adopted, which was carried unanimously. The Society's income for the year ended December 31st, 1909, was £985 18s. 9d.; the expenditure £1,065 11s. 6d.; with a credit balance of £43 19s. 5d. from the previous year, leaving a debit balance of £35 13s. 4d. The income of the Bacteriological Department was £547 6s. 8d.; and the expenditure £532 6s. 7d.; with a credit balance of £507 0s. 4d. from the previous year, leaving a credit balance of £522 0s. 5d. Macleay Fellowships' Account: the income was £1,490 13s. 6d.; and the expenditure £1,101 15s.; leaving a credit balance of £388 18s. 6d. to be carried to Capital Account.

No nomination of other Candidates having been received, the President declared the following elections for the current Session to have been duly made:—

President: C. Hedley, F.L.S.

Members of Council (to fill six vacancies): R. H. Cambage, F.L.S., J. H. Campbell, H. G. Chapman, M.D., B.S., T. Storie Dixson, M.B., Ch.M., Alex. G. Hamilton, and Professor J. T. Wilson, M.B., F.R.S.

Auditor: [To be appointed at a Special General Meeting to be held on 3rd November, 1910.]

On the motion of Mr. W. S. Dun, seconded by Mr. J. E. Carne a very cordial vote of thanks was accorded to the President, by acclamation.