MARINE BIOLOGICAL LABORATORY
WOODS HOLE
LIBRARY
MASS.

PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES.

WEDNESDAY, MARCH 28TH, 1917.

The Forty-second Annual General Meeting, and the Ordinary Monthly Meeting, were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 28th, 1917.

ANNUAL GENERAL MEETING.

Mr. A. G. Hamilton, President, in the Chair.

The Minutes of the preceding Annual General Meeting (March 29th, 1916) were read and confirmed.

The President delivered the Annual Address.

PRESIDENTIAL ADDRESS.

The past year has been a sobering time for the serious-minded among us. We have had another year's enlightenment on various aspects of the terrible war—clearer ideas as to what led up to it, a better understanding of the great issues that are at stake, and of the spirit in which, on the side opposed to us, it was begun, and is being carried on; some inkling of its staggering financial import; and, not least, what nations can accomplish in the way of co-ordination and concentration, when the need for it becomes compulsory. Our soldiers and sailors, doctors and nurses, notwithstanding a much more severe winter than they are accustomed to, have maintained the fine reputation for courage, resourcefulness, cheerfulness amidst danger and difficulties, which characterised those who first entered the war-zone at Gallipoli, and co-operated so efficiently with their

comrades from other countries. At home, the efforts of those who have earnestly devoted themselves—and especially the women—to the tasks of providing for the reinforcement and support, for the encouragement and comfort of our splendid representatives in the trenches, in hospitals and training-camps, and, alas, in some cases in prison-camps, as well as for those who are getting ready to leave us to enter upon active service abroad, have been beyond praise. The War Loans have been well supported, and the response has been wide-spread. We are well aware that the critical stage of the gigantic struggle is approaching; and that though the Allies are now thoroughly awakened, resolute, and in earnest about settling it in the right way, the task may be expected to be arduous, and the cost heavy.

And yet here, in New South Wales especially, keeping all this in mind, when have we, in other respects, contributed so poor and sordid a chapter to our annals, as the record of the last twelve months? It has been said that the whole art of politics is the art of seeing, and that party is the dust which gets into the eyes of the politicians' understanding, and mars their intellectual vision. But politics cannot claim a monopoly of the art of seeing straight as the prelude to going straight and acting straight. Every other department of human activity is just as much in need of this accomplishment. The intrusion of the party-spirit, degenerating at times into the faction-spirit, has been responsible for a deplorable deterioration in the standards and methods of our public life, and has culminated in depriving Australia of representation on the Imperial War Conference. We have failed to rise whole-heartedly to important occasions in a very great crisis, apparently because we happen to be geographically situated on the outer edge of the outer war-zone, instead of inside the inner war-zone.

I would remind you of our absent Soldier-Members. Eight of those mentioned in my last address are still abroad on active service, and were all well when he heard last. At the Meeting in September, we had the pleasure of welcoming back Mr. C. F. Laseron, who had seen service in Gallipoli and elsewhere, and is

still suffering inconvenience from a wound. Another Member, Mr. C. O. Hamblin, B.Sc., left during the year for the front, and carries with him our good wishes. Mr. L. M. Harrison, B.Sc., some time ago suspended his studies at Cambridge, in order to join the British forces in Mesopotamia, as entomologist. May we have the pleasure of welcoming them all back in due time!

The 7th of December, 1916, was the twenty-fifth anniversary of the death of Sir William Macleay, who for the Members of this Society, should never be numbered with the "unremembered or forgotten dead." Twenty-five years have brought about considerable changes in the personnel of the Society, so that the number of those to whom Sir William was personally known has gradually diminished. As one of this minority, and also as this is our first Meeting since the date mentioned, I am glad of the opportunity of calling to remembrance the Society's indebtedness to the large-hearted, far-seeing man who made this Society possible in its present developed form. The Society of to-day, as compared with the Society at the time of its foundation in October, 1874, affords a very fair indication of the progressive development of the branches of Science, in which it is particularly interested, in the interval, in this State. Forty-two years ago, the University of Sydney was without a Medical School, and consequently there was no provision for the teaching of biology. The Australian Museum had no scientific staff other than the Curator. The Geological Survey Branch of the Department of Mines was the only Government Institution in Sydney with a scientific staff. The Department of Agriculture and the Technological Museum had not been established. The forerunner of the Department of Public Health was without a laboratory or scientific staff. Under scientific conditions of so rudimentary a character as that outlined, this Society was inaugurated, by men with faith in the future. The number of the original Members who were actively interested in Natural History was very small, but they were in earnest, and they were backed up by a very creditable number of sympathetic supporters desirous of seeing an advance in the status of Natural Science in New South Wales.

These conditions gave Sir William an opportunity, for which if he was not actually looking, he was quite ready to accept when it offered. For the rest of his life, he became forthwith, in the most unostentatious manner, "the head and the heart of the Society," as the late Dr. Norton, himself an original Member, and for many years a member of the Council, and Hon. Treasurer, on one occasion aptly described him. That is to say, in the capacity of Hon. Secretary, Sir William, privately and without at any time giving publicity as to the extent of his liberality, even to the Council, took upon himself the responsibility of providing the Society with a temporary home, until it was accommodated in the Garden Palace; of providing, out of his own resources, for the acquisition of the nucleus of a valuable library; of defraying so much of the office-expenses and of the cost of publishing the Proceedings as the limited income of the Society was unable to meet; and of taking charge of the whole of the executive work, except in the Hon. Treasurer's department. Soon after the conflagration, which completely destroyed the Garden Palace and its contents, in September, 1882, Sir William, at his own expense, placed at the Society's disposal, a more commodious and comfortable, rented house than it had ever before occupied; and then, without saying anything about it, he took the lead and contributed the largest share in remedying the damage and destitution caused by the fire, as well as in keeping the current work of the Society going, as if nothing had happened. His next important step was to provide the Society with a permanent home—the building in which we are now assembled—which it has occupied for more than thirty-one years; and also to make provision, of a permanent character, for the oversight of the executive work of the Society under the direction of the Council; meanwhile continuing his generous support in the way of financing the Society, of enlarging the library, and of improving generally its status. This part of his programme having been privately carried into effect, there remained the settlement of the questions of converting temporary into permanent conditions for securing a firm financial basis for the

Society, and the settlement of the details of his scheme for the future encouragement of research.

The Society's history then is naturally divisible into two chapters—a first period of seventeen years, during the whole of which, except for the few months of the illness which ended his labours, Sir William voluntarily and without saying anything about it that he could avoid, personally undertook the responsibility of the management of the Society's affairs in the way I have indicated; and the subsequent period of a little more than twenty-five years to date, during which the service and the assistance which he voluntarily rendered during his lifetime, automatically, one may say, by means of trusts committed to the Council, became operant after his decease. Every member is in a position to know what these amount to, now that Sir William's plans have been realised completely. But the realisation did not come about quite so simply or so soon as he expected, the most important deterrent being the financial crisis of 1893. Just about the time that all difficulties had been overcome, the war broke out; and the Society's immediate future is likely to be affected as possible new conditions may arise and require. In 1925, only eight years ahead, the Society, if all goes well, will attain its jubilee; and this we may expect to be celebrated in an appropriate manner. It will also furnish occasion for a more detailed account of the Society's history than has hitherto been possible, and for an analysis of its fifty years' work. Just at present, what I wish to do is to call to mind an anniversary that is not without interest to us; to point out, to new Members especially, that the Society has a history that is, in large measure, bound up with that of a broad-minded, far-seeing, generous man, without whose fostering care and help there would have been no such Society as we know it, and whose memory should not be allowed to be dimmed by the lapse of time; and that, in addition to the material benefits which he conferred on the Society, it may be said to have inherited not only his example, but the spirit in which he did what he accomplished. Sir William was under no sort of obligation to do any-

thing that he did for the Society. He had evidently grasped the idea that, at bottom, Ignorance is the millstone round the neck of mankind, that it is primarily ignorance which retards human progress, and that mistakes, though made in ignorance, have to be paid for in some way or another. He had the knowledge, the leisure, and the resources; and he might have chosen the "safe disgrace" of being affluently idle. Instead, he chose to regard these as a trust to be used for the enlightenment of ignorance, and the advancement of knowledge; and so he served. This is his claim upon our unforgetfulness, upon our regard, and upon our co-operation. And we may say of him, as Lowell said of Jeffries Wyman,

> He widened knowledge, and escaped the praise,

for this was his twofold aim; and in so far as he was personally concerned, he accomplished it.

Notwithstanding the abnormal conditions which still prevail, the Society has been able to continue its work in the customary manner as well as circumstances have permitted. The serious effect of the war upon our exchange-relations with Societies in Europe, of course, continues. The total number of exchanges and donations received for the Session 1916-17 amounts to 1243 additions to the library (received from 146 Societies, Institutions, etc., and 12 private donors), as compared with 1028 for 1914-15, and 1285 for 1912-13 before the war. The apparent improvement on the receipts for 1914-15, however, is merely incidental, for our communications with over forty Societies or Institutions, from which, under normal conditions, we are accustomed to hear at least once during the year, remain in a condition of complete suspension. We have lost one lot of despatches for England by the sinking of the s.s. "Arabia," but fortunately a smaller lot than is often sent.

The concluding Part of the forty-first volume of the Proceedings for 1916 (945 pp., and fifty-nine Plates, besides numerous text-figures) is almost ready for issue. It comprises thirty-seven papers, of which eleven were contributed by Linnean Macleay Fellows of the Society, read at the Meetings during the Session.

Allowing for the distracting conditions under which the work it records has been carried out, it may fairly be considered to be an important addition to the Series.

Eleven Ordinary Members were elected during the Session, four resignations have been received, and one Corresponding Member and one Ordinary Member have been lost by death. Moreover, the names of eighteen Members, whose obligations have remained undischarged for unduly long periods, will be removed prior to the publication of a new issue of the List of Members. The effective membership of the Society, therefore, stands a little below the usual level.

Edgar Albert Smith, I.S.O., F.L.S., F.Z.S., the Society's senior Corresponding Member, was born in 1847, and entered the service of the British Museum in his boyhood. At the age of twenty, he was placed in charge of the conchological department, and rose to be Senior Assistant Keeper in Zoology. His life-work lay in the naming and arranging of the vast collection of more than forty thousand species under his charge. Though he made no large generalisations or startling discoveries, by patient industry he extended a knowledge of the Mollusca. His contributions to scientific literature range from brief notes to weighty monographs, and amount to nearly four hundred publications. A keen memory and long experience were ever at the disposal of others at home or abroad, so that his help and kindness are acknowledged by every conchological writer of the present generation. Mr. Smith retired from the British Museum in 1913. He was elected a Corresponding Member in the early days of the Society; and never failed to supply reprints of his papers. He died on July 22nd, 1916, aged 68 years.

Dr. J. H. May, a Member since 1901, died towards the end of the year at Bundaberg, Queensland, where he had long resided, and practised as a medical man.

The death of Dr. Edward Pierson Ramsay, on 16th December, 1916, aged 74, well known in Sydney as Curator of the Australian Museum from 1874-1895, removed another interesting link with the past. He was a Foundation-Member of both the

Entomological Society of New South Wales and of this Society; and, as the only official representative of Zoology in this State in those early days, he was a most useful Member. As a Member of Council, a contributor of numerous papers, and as an exhibitor of zoological and other specimens of interest, he rendered most important aid in support of the Society, and in furthering its interests during the critical early stages of its history. He is well represented in the first fourteen volumes of the Proceedings (1875-1889). In 1892, shortly before his retirement from the Australian Museum on account of ill health, he gave up his membership, and ceased to take an active part in the studies in which he had taken an enthusiastic interest for so long. He was well acquainted with the fauna from his boyhood, especially with the birds. His early knowledge of it covered a very interesting period, when it had not been anything like so seriously interfered with by settlement as it unfortunately is now. His contributions to knowledge, in the branches in which he was particularly interested, are numerous and valuable, because he belonged to the era when local workers, with personal knowledge of the fauna, were beginning to study it. A record of his collecting experiences and of his knowledge of the gradual growth of Zoological Science, from very small beginnings, in this State, would be most valuable and interesting. It is to be hoped, that during the leisure of the later period of his life, he may have been moved to record his reminiscences from this point of view. It is not necessary for me to anticipate the historian of the Australian Museum by attempting to give a more detailed account of Dr. Ramsay's life and work.

In July last, in consequence of the threatened shortage of paper, the Council decided to suspend, for the present, the publication of the Monthly Abstract of Proceedings, after the issue of No.339 for the month named. This will result in the saving of the equivalent of 10,800 pages for the Session—a matter of some importance just now. The first of the series made its appearance in June, 1882, three months before the Garden Palace Fire; and the issue had continued uninterruptedly for just

over thirty-four years. The Society has one copy only of each of the first three numbers, and consequently only one complete set. The destruction of the Society's records up to September, 1882, has deprived us of any knowledge of the circumstances which led up to the adoption of the practice of publishing a Monthly Abstract; and the matter is not referred to in the address of the President, at the following Annual Meeting in January, 1883. It was doubtless intended to keep Members and Societies at a distance in touch with the Society's work; and this it certainly did, because the "Zoologischer Anzieger," up to the time of the outbreak of war, very kindly was accustomed to republish the zoological portion of each monthly number. "Nature," also, for many years has helped us in a similar manner by publishing the abstracts of the papers read. The Society's indebtedness to these two journals, for their co-operation in diffusing a knowledge of the work done by the Society, is considerable, and may here be gratefully acknowledged. When conditions again become normal, the question of the resumption of the publication of the Monthly Abstract may be expected to receive the consideration of the Council.

As regards the Proceedings, the Society's printer has been able to obtain the necessary amount of paper so far required, but at a substantial increase in cost. Printing paper is not manufactured in Australia and we are dependent on British supplies. Now that the nation is mobilised for war, and the Government has placed restrictions on the production of various commodities for the sake of economy in man-power and tonnage, we are likely to feel the effect; and, just at present, the Council does not know what are the prospects of being able to carry on our publishing work on the usual scale in the immediate future. At any rate, I take the opportunity of reminding Members of the Council's appeal for all possible curtailment in the size of papers and in the notices of exhibits, otherwise it may necessitate their being declined, or being subdivided, and taken in instalments. The ability to deal with long papers is deteriorating until conditions again approach the normal; and, meantime, economy in space is

becoming more and more pressing so that we may prepare for any stringent conditions that may arise.

The year's work of the Society's research-staff may be summarised as follows:—

Dr. R. Greig-Smith, Macleay Bacteriologist to the Society, has continued his investigation of the problem of soil-fertility. The fifteenth of his series of papers treating of this subject, as well as a short paper on the single cell cultivation of yeast, have been completed and handed in; and will be taken, in their turn, during the coming Session.

Dr. J. M. Petrie, Linnean Macleay Fellow of the Society in Biochemistry, has extended his observations on poisonous Solanaceous plants, and on the occurrence of hydrocyanic acid in plants. Two papers dealing with the alkaloids of Native Tobacco, and of *Solandra longiflora*, being Nos. ii. and iii. of the series on the Chemical Investigation of Poisonous Plants of the N.O. Solanaceæ, will be found in the Proceedings of last year. Nos. iv. and v. of the same series, which deal with the chemistry of the three species of *Duboisia*, together with No. iii. of the series on hydrocyanic acid in plants, have been completed and submitted for publication. These will be taken in their turn during the coming Session. Meanwhile, Dr. Petrie has in view the further elucidation of certain problems relating to cyanogenesis in plants.

Mr. E. F. Hallmann, Linnean Macleay Fellow in Zoology, completed his second contribution to a revisional knowledge of Australian Sponges early in the year. This, like its predecessor, was taken in three sections for convenience. Two of these appeared in Part 3 of last year's Proceedings; the third will be found in the concluding Part of the Volume. Mr. Hallmann has since been at work upon the Desmospongiæ collected by the Australasian Antarctic Expedition.

Mr. R. J. Tillyard, Linnean Macleay Fellow in Zoology, has successfully carried on his studies on Australian Neuroptera, and on the larval respiration, and the wing-venation of Odonata. Nos. ii., iii., and iv. of the series devoted to the Order Neuroptera,

together with a paper treating of the emergence of dragonfly larvæ from the egg, with special reference to the problem of respiration, and another recording important conclusions respecting the radial and zygopterid sectors in Odonata and the formation of bridge-veins, are contained in the Proceedings for 1916. In addition to these, three other important papers, including one upon fossil insects from Queensland, have been completed and submitted for publication. These will be taken in their turn during the coming Session. Mr. Tillyard purposes continuing his work on the Odonata and Neuroptera; and taking up also the study of the Orders Perlaria and Trichoptera on similar lines. In January, Mr. Tillyard visited Cradle Mountain, in N.W. Tasmania, and discovered there a remarkably rich alpine fauna, the greater part of which is new to science. The ancient Orders of the Trichoptera (Caddis-flies) and Perlaria (Stone-flies) are dominant in this region; about thirty new species of the former and twelve of the latter were obtained, besides a number of new and rare Lepidoptera and Diptera. Mr. Tillyard's book on "The Biology of Dragonflies" was published early this year by the Cambridge University Press. The volume is one of the Cambridge Zoological Series, edited by Dr. Shipley. Copies have not yet reached Australia, but may be expected in April or May.

Dr. H. S. Halcro Wardlaw, Linnean Macleay Fellow in Physiology, has completed his first year's work. An important paper on the change of composition of alveolar air after the stoppage of normal breathing, was read at the last Meeting; and will be found in the concluding Part of the Proceedings for last year. Dr. Wardlaw has also been engaged upon a very promising investigation of the range of variation of the composition, and of the values of certain physical properties of the milks of individual cows.

I have now the pleasure of making the first public announcement of the Council's reappointment of Dr. J. M. Petrie, Mr. E. F. Hallmann, Mr. R. J. Tillyard, and Dr. H. S. H. Wardlaw to Linnean Macleay Fellowships for a period of one year from 1st

proximo; and, on behalf of the Society, of wishing them a successful and profitable period of important work.

In my address last year, I alluded to the many problems for the Australian field-biologist, and to the fact that the opportunities for research of this kind are every day becoming more restricted. The subject to which I directed attention particularly was the pollination of flowers by birds. But the whole question of the pollination-methods of Australian plants affords an opportunity for interesting and valuable field-work. It is remarkable, when the unique character of the endemic flora is considered, how little has been done; and on looking into what has been accomplished, I was impressed with the amount of supplementary work which still remains to be done in relation to the species examined by authors. In most of the papers on the pollination of Australian flowers, we find that the writers only examine the structure of the flowers, and conjecture what is the method of pollination, with perhaps a guess at the order of insects likely to supply the pollinators. In many instances, no field-work was attempted. Of course, in the case of authors like Darwin, Delpino, Hildebrand, and Henschel, field-observations on the plants in their natural habitats were quite out of the question. But for those of us who worked at the plants in Australia, there is less excuse. At the same time, workers who have paid some attention to this kind of research, know that, in most cases, it is rare to see native insects, except Lepidoptera, visit flowers. There are exceptions, such as *Angophora cordata*, and some of the tea-trees, which have very large numbers of visitants. I have found, however, that any of our flowers that have such a large number of visitors, are of a generalised type with large quantities of nectar freely exposed, and available alike to almost any insect. There is no special mechanism for securing cross-pollination. When we examine Knuth's Pollination of Flowers(1), and notice the huge lists of insects recorded as visiting a single species, it is evident that European, and especially Alpine, conditions differ very much from ours. One thing is certain, any one desiring to observe the insects at our plants,

must be an early riser. Both insects and birds go to work in the early morning, when their appetites are sharpest, and when, perhaps, a larger supply of nectar, secreted during the night, is available.

There are a good many general points which would reward research. There is some difference of opinion as to whether insects notice colour, or are attracted by it. But, personally, I consider that the point is beyond dispute. I believe that colour does undoubtedly act as a signal. On one occasion I saw two ladies on the lawn at the Sydney Cricket Ground, one of whom had some brilliant artificial flowers in her hat. They were followed up and down by two examples of *Papilio Sarpedon*, which hovered over the flowers for a considerable time. I have also repeatedly seen hawk-moths, which had flown into a room about dusk, approach the patterns of flowers on the wall-paper, and on cretonne-cushions, and extending their probosces, attempt to probe them. And, when collecting hawk-moths, I once succeeded in attracting numbers to a plant on which I had fastened pieces of coloured paper roughly tied to the shape of tubular flowers. Probably bees and butterflies have the colour-sense in a higher degree than any other insects, but I am convinced that most insects which frequent flowers are attracted by the colour.

Some days after writing the above, I saw a small electioneering ticket on a telegraph-pole, exhorting the electors to vote for Mr. So-and-so. It was green with red lettering, and a butterfly (*Papilio Sarpedon*) was hovering round it, touching it with its proboscis, and now and then alighting on it. It is, I think, quite safe to infer that the colour attracted the insect. It has been said that insects are guided more by form than colour, but I think an instance like this is a sufficient answer to that objection. The oblong shape in no way resembles the form of any flower.

It has been objected that we should not take for granted this purpose for colour, on the ground that we cannot conceive any other explanation. But I think the probabilities favour the theory. A species of *Brunfelsia* is cultivated in the Botanic Gardens. The leaves are bright green, but every leaf which

subtends the small blue flowers has its apical half pure white, thus throwing up the flowers by contrast. And again, while calyces are usually dull in colour, we often find that where there is no corolla, the calyx is brilliantly coloured: and where both calyx and corolla are wanting, bracts and spathes (as in *Bougainvillea* and Aroids) have conspicuous colours. I certainly think that the theory of colour-recognition by insects is supported by sufficient evidence.

In Darwin's Forms of Flowers(2), there is a list of fifty genera of plants having cleistogamous flowers. Fifteen of these genera extend to Australia, but, so far as I know, cleistogamous flowers have been recorded in only two of them, *Thelymitra*(3), and *Pavonia*, and in addition, in *Hypoxis*(4). Among the Orchids, there are one or two other genera which are either cleistogamous or chasmogamous (*Calochilus*). Are cleistogamous flowers found in any of our native species of *Eranthemum*, *Ruellia*, *Viola*, *Oxalis*, *Lespedeza*, *Glycine*, *Drosera*, *Juncus*, or *Commelyna*? I have not been able to find any in *Eranthemum* *Viola*, or *Oxalis*.

Little, that is definite, is on record about the pollination of *Eucalyptus*, or, with one exception, of *Acacia*. I looked up both Orders in Hermann Müller's and Knuth's books, and was greatly astonished to find that neither book has any reference at all to the Myrtaceæ. The Order seems to have been passed over by inquirers into pollination-methods. And very few observations are recorded on *Acacia*. In the case of *Eucalyptus*, we know that the flowers are visited by the brush-tongued lories, and by some of the honey-eaters. In a paper by Mr Swinnerton(5) "On Short Cuts by Birds to Nectaries," being observations made in South Africa, he mentions *E. ficifolia* as being visited by Sunbirds, and also by other birds, as well as insects. He believes that, in South Africa, this species is chiefly pollinated by hive-bees, and Sphingidæ. The Eucalyptus flower being of a shallow, open type, with much nectar, it seems rather extraordinary that it should be pollinated by Sphinges. The lories, having a short tongue, are certainly well adapted for the work, but I should have thought that slender-billed birds, and long-tongued moths would not be likely to pollinate the flowers.

Nowadays, introduced hive-bees are usually the most conspicuous visitors, both to garden-plants, and, in localities not too remote from settlement, also to native plants, including Eucalypts, Banksias, and Grevilleas Bee-keepers are glad to have Eucalypt forest in proximity to their apiaries. In some cases, doubtless, the hive-bees are instrumental in effecting pollination. But in others, they merely deprive the flower-frequenting birds of their birthright, without accomplishing anything for the benefit of the plants.

The only observation on the pollination of Acacia that I have been able to discover, is a paper on *A. celastrifolia* (6), by Mr. O. Sargent. There is a reference in Hermann Müller to an Acacia in which the central flower of the head is converted into a great nectary; and some observations on the relation between extra-floral nectaries and the flowering period of several of our Acacias, are recorded in the Australian Naturalist (7).

The earliest references I can trace to the pollination of Australian flowers are those of Henschel, 1820 (8), Hildebrand, 1867-70 (9), and Delpino, 1868-73 (10). They appear to have contained references to the fertilisation of the Proteaceæ and Goodeniaceæ; but as I cannot consult these, I am unable to speak definitely about them. It is tolerably certain, however, that they were merely observations on the mechanisms of the flowers as seen in cultivated plants. In R. Brown's (not *the* R. Brown) Manual of Botany (11), there is a very good account of indusiate stigmas in the Goodeniaceæ. He says, "This arrangement of the stigma . . . . favours fecundation. The five anthers are in the form of an arch under which lies the indusiate stigma. Accordingly, when the anthers dehisce introrsely, the pollen falls directly into the cup-shaped indusium, and there performs its functions towards fecundation." Brown falls into the trap, as several of us did, of supposing that, when the pollen was in the cup, the process was at an end.

In 1867, Bentham read a paper before the Linnean Society on the Stigmatic Apparatus in Goodenovieæ, in which he says, "It is in order to call to the subject the attention of any observers who may have any species in cultivation, and still more of those

of our Fellows who may be resident in Australia, that I lay before the Society the peculiarities which I have observed." And he follows this up in the Flora Australiensis (Vol. iv.) by saying: - "Goodenovieæ are readily known by the remarkable indusium, which evidently, together with the peculiar surrounding hairs of the style or of the corolla, acts a considerable part in assisting the proper impregnation of the stigma. The contrivances by which this impregnation is impeded, retarded, or promoted, appear to be very different in different genera, as, for instance, in *Goodenia*, *Leschenaultia*, and *Dampiera*, and are well worthy of careful observation on the part of botanists resident in Australia, where the flowers can be observed subject to the natural operations of insects, as well as of climatological and other external influences." His account of the mechanisms in the former paper is extremely good, really wonderful when we consider that he saw only dried specimens of the great majority of the species. Notwithstanding the very curious nature of the floral arrangements, his pious aspirations were many years without fulfilment.

It was natural that Darwin should be attracted by the unusual floral mechanism described, and, in 1860, he had the opportunity of observing *Leschenaulta formosa*, publishing a short paper in 1871. The part of the Gardener's Chronicle in which it appeared does not seem to be in any of the Sydney libraries.

The next attempt to solve the riddle is due to the late Mr. E. Haviland, who, in 1882, began a series of papers on plants in the neighbourhood of Sydney. Among them was one on the fertilisation of *Goodenia ovata* (**13**). In this paper, Mr. Haviland gave an account of the floral mechanism, but missed one or two of the most important points. In the buds, the anthers are arranged arching over the open mouth of the indusium, at the bottom of which is the immature stigma. The bud is then in an upright position, and the style lengthens very rapidly. The membranous edges of the petals are folded so as to keep the anthers closely pressed over the style and indusium; and, as the latter grows up, the anthers dehisce and shed their pollen into the indusium. Then the indusium closes, the flower changes to a horizontal

position, and the style takes up such a position that the open mouth of the indusium is behind the two upper petals At this time, the stigma begins to grow up from the bottom of the indusium, and pushes the pollen out through the fringe of hairs on its edge. An insect (and, so far as I have seen, only beetles visit the flowers) pushing its way into the flower, causes the two upper petals to part, and the elasticity of the style causes it to bend downwards, the mouth touching the back of the insect, and depositing the pollen thereon. At a later stage, the stigma emerges from the cup, and then matures; and when a pollen-dusted visitor arrives, the pollen is taken up in the same way by the now sticky stigma.

Mr. Haviland does not seem to have seen the pollen packed in the indusium, nor the emergence of the stigma I followed up Mr. Haviland's paper by one on another species (**14**), in which I gave an account of the process up to the closing of the indusium; and came to the not inexcusable conclusion that it was a case of self-pollination. Mr. Haviland wrote a note criticising my paper, and reiterating his opinion that pollination was effected by insects receiving pollen from the anthers, and afterwards placing it on the stigma. But in two later papers (**15**), I gave my experience of a large number of flowers of *Scævola*, *Selliera*, *Brunonia*, and *Dampiera*, in all of which the process is just as I have described above, although there are minor differences in details. Since then, Archdeacon Haviland, Mr. E. Haviland's son, has described the pollination of *Goodenia cycloptera* (**16**). His observations, in the main, agree with what I have stated, but he found that, at the stage when the pollen ripened in the indusium, the mouth of the latter opened. This is a feature that I have not observed in any of the species examined by me. One of the conclusions in my first paper was, that *G. hederacea* was self-pollinated. Evidently, in the later papers, I have not made it quite plain that I had abandoned that idea, for Archdeacon Haviland, knowing that *G. hederacea* was a decumbent species while *G. ovata* was an erect species, cross-pollinated, looked into the question as to whether the erect species might be cross- and the decumbent species self-pollinated.

But he found that this was untenable for *G. cycloptera*. I, for my part, am confident that all species of Goodeniaceæ are cross-pollinated. Archdeacon Haviland also observed that a native bee was the pollinating agent in this species.

Mr. E. Haviland's papers included observations on *Lobelia* and *Wahlenbergia*, and I also worked out the pollination of these, and of three species of *Candollea* (*Stylidium*). Comparing the methods of pollination in these three families and Compositæ, (the four being closely related and placed together in the series Campanulatæ of the Sympetaleæ), we find that a very similar arrangement of the stamens and pistil is so modified in each family as to secure cross-pollination in very different ways. The Cucurbitaceæ, belonging to the same series, having separate staminate and pistillate flowers, necessarily do not present the peculiarities which follow. In all the families, at some stage of flowering, the stamens form a close ring or rather tube, enclosing the style. In Compositæ, they are higher than the closed stigma, which grows out through the tube, pushing the pollen before it. Insects visiting the flower-heads remove the pollen; later on, the stigma opens and curls back, and is then likely to be pollinated by visitors. But if not, it always has the chance of getting its own pollen or that of neighbouring flowers when the stigmatic lobes curl round, as they do later.

In Lobeliaceæ, the stamens also form a tube, with the closed stigma at the base of the tube. When the anthers are about to dehisce, the style lengthens rapidly, and the pollen is pushed out of the anther-tube, a process assisted by the fact that the outside of the stigma is covered with delicate, beaded hairs. When the closed stigma finally emerges from the tube, the hairs wither and drop off, carrying any adherent pollen, and then the bifid stigma opens, and is ready to receive pollen from visitors. In this case, there is no provision for self-pollination if cross-pollination does not ensue, and the ovaries, in that case, do not develop.

In *Wahlenbergia*, the stamens are arranged so that the anthers dehisce, and leave the pollen attached to the style, which is provided with sticky glands. The trifid stigma is, at this time,

closed. Insects making their way down the tube, gradually remove all the pollen. Then the stigma opens, exposing the stigmatic surface, and pollen-laden insects are certain to deposit some of it on that surface.

In the Goodeniaceæ, the stamens again form a ring round the style, having the open indusium on a level with the base of the anthers. The style grows rapidly upwards, and, aided by its rim of stiff hairs, brushes out all the pollen which falls into the cup. The indusium then closes tightly, after which the style and indusium take up a position in the tube of the flower, so that when an insect forces its way into the tube of the flower, the indusium comes down on its back. Later, the enclosed pollen is forced out through the hairs, which act like a sieve, by the upward growth of the stigma in the cup. Finally, the stigma comes out, matures, and is ready to receive pollen.

In the Candollaceæ, the ring of stamens is no longer found; they unite with the style, so that the stigma and anthers form a disc on the end of a long, bent arm, which is sensitive. The anthers mature first, and cover the stigma, which is then very minute, and immature. When insects visit the flower, the arm flies over and deposits pollen on their backs. When all the pollen is exhausted, the anthers shrivel, and the stigma grows rapidly and matures. In this stage, when visited by a pollen-bearing visitant, the stigma picks it up when it reflexes.

Another family—the Proteaceæ—is well worthy of attention, not only because it is largely Australian, but also on account of the peculiarities of the floral structure. Bentham(**17**) recognised that the structure was significant, and drew attention to it in the vain hope that local observers would investigate the subject. Delpino, in the same year(**10**), gave some account of the mechanism, and hazarded the opinion that, in several species, honey-sucking birds are the pollinators. Hildebrand also refers to the subject(**9**). There are several distinct types of floral mechanism. In the Suborder Nucamentaceæ, the flowers are simple and regular, and pollination is effected both by birds and by insects.

In Conospermum, the flowers are small, but clustered together. The anthers burst open when touched, and fling the pollen on

the visitor, which, in this case, is always an insect—mostly a fly or a bee. At the same time, the style takes up a new position. In Grevilleæ, Embothrieæ, and Banksiæ, the flowers are mostly irregular and generally bird-pollinated, *Lomatia* being an exception in the second of those tribes. (*Lomatia*, by the way, makes a poor recompense to insect-workers. Some years ago, I recorded the fact that flies feeding on the nectar died in numbers, and Dr. Petrie thought that hydrocyanic acid was the cause. Recently a correspondent has drawn Mr. Maiden's attention to a similar case. It is only at certain stages of flowering, that the insects are killed). Among these, there is considerable diversity, although the general plan is the same in all—the pollen is deposited in the bud-stage on the disc surrounding the stigma. Then the style pulls itself free, and stands up. Birds visiting the flowers remove the pollen and transfer it to the minute stigmas of other flowers. Mr. Fletcher has drawn attention to a very interesting case of crossing between *Grevillea laurifolia* and *G. acanthifolia*; but he has not yet completed his observations. Hybrids among the Proteaceæ are only possible when both parents have flower-heads of such a kind that the pollinators approach them in the same way, and styles of such a length that the style-summit of each touches the bird in the same place. Thus a species with a secund raceme would not be likely to be pollinated from a species with a round head of flowers. The only observations on Australian Proteaceæ by local botanists that I have been able to trace are by Dr. Shirley(**18**), and a note on Telopea and Stenocarpus by myself (**19**). Mr. W. M. Carne favoured me with some MS. notes on *Grevillea robusta*, of which the following is a précis. The flowers grow in a long, horizontal raceme, and the basal ones open first. At the tip will be found(1) unopened flowers, or partly open, but with the stigma still attached to the perianth. Proceeding towards the base of the raceme, we find (2) the style free, with the pollen attached all round the small, central stigma, which is not yet mature. Then follow (3) flowers with the perianth bent away from the style, pollen becoming dry, and a drop of nectar appearing in the angle between the perianth and the stipes of the ovary. The

stigma is now probably receptive. Near the base, (4) the perianths have fallen, nectar is present, and the stigma mature, and ready for pollen. The last stage (5) is the setting of seed, or the fall of the flower if pollination has not taken place.

The flowers are freely visited by Hymenoptera and Diptera. Owing to the height of the stigma, however, it is only rarely that insects pollinate the flowers. Silver-eyes and sparrows also visit the flowers. The former cling to the lower side of the raceme, inserting the tip of the beak in the nectary at the base of the ovary, pulling the flower over on its stalk. In pulling the flowers down, the stigmas of stages 3 and 4 are sometimes rubbed against those in stages 2 and 3, and thus cross-pollination may ensue. Sparrows alight in the middle of the raceme, and, in moving about, probably cause pollination. Observation of seeding racemes shows that, as a rule, the flowers near the base only are pollinated, probably from the other flowers near by. Those near the tip, if pollinated at all, receive the pollen from the flowers of other racemes.

In Dr. Shirley's paper, he mentions that, in Grevillea (species not mentioned) the tube of the style appears first at the base, and develops upwards. It is lined with cells resembling those of the stigmatic tissue, and it is only when the tube-development reaches the tip of the style, that a true stigma is formed. The interior of the tip of the style is lined with peculiar, large, thick-walled, dotted cells, probably a nutritive tissue absorbed by the living tissue of the style-tube. A. S. Wilson(**20**) has speculated on the likelihood of the loose, cellular substance of the interior of styles, acting like a plug of cotton-wool in a culture-flask, in keeping out fungus-spores from the cavity of the ovary.

Enough has been said, however, to show that both field- and laboratory-work well worth while can be found in this thoroughly Australian Order.

I have already alluded to the want of systematic observations on the method of pollination in Acacia and Eucalyptus. It is a very lamentable thing that no one has taken these genera up. Here we have two very large and, from either the scientific or the economic points of view, very important and characteristic

genera, and yet no one seems to have attempted to solve these important problems. Certainly some observations have been made in America and South Africa, but it is obvious that these are of little value from an Australian point of view. The agents of pollination are not the same, though of course we may get suggestive hints which will assist the local worker when he arrives.

Dr. Brandis(**21**) has recorded some interesting notes on the flowering-season of *Acacia dealbata* in India. Trees planted in 1845, up till the year 1850, flowered in October, corresponding with the Australian flowering-time. About 1860, they were observed to flower in September, in 1870 in August, in 1878 in July, and, in 1882, they began to flower in June, the spring month there, and corresponding with October in Australia. Dr. Brandis goes on to say : – "Having watched the flowering of these trees for nearly forty years, there cannot be any doubt in the matter, and it is a curious fact that it should have taken the trees nearly forty years to regain their habit of flowering in the spring. . . . I have tried to see if any similar change of season can be traced at Kew." Plants there are grown under glass, and flower in early spring or towards the end of winter, say February. "The evidence then, so far as it goes, would seem to indicate that the flowering-time had also progressively worked back in England, though under more artificial conditions."

Mr. Howard Fox, of Falmouth, writing on January 29th, 1883, reported that several trees of *Acacia dealbata*, 30 ft. high, in the open air, had been in flower for ten days, but not so fully as they might be expected to be in a fortnight's time(**22**).

This bears only indirectly on pollination-problems. A large majority of our plants flower in winter, and it is possible that the scarcity of insects at that season may have resulted in the modification of the flower towards bird-pollination. An interesting observation connected with this is recorded by Mr. J. G. Cooper(**23**), who states that the nesting-season of the Anna humming-bird (*Calypte anna*) had altered from March 15 to Feb. 15-20 since the extensive cultivation of Eucalypts in California. "The extensive cultivation of Australian trees, perhaps, may

have helped to make this early nesting more general, as in this climate, such trees, as well as other subtropical garden-plants, are covered with flowers, supplying winter-food for these humming-birds more plentifully than the native plants formerly did. But whether or not, my boy (eight years old) found three nests of this species within a stone's throw of our house, all on low branches of Eucalyptus (or Australian blue-gum) between February 15th and 20th. The trees are covered most of the winter with large flowers, in which there is much honey, and the Acacias of several species, also blooming at this season (like most antipodal trees) have been very attractive to the hummers as well as to the minute insects on which they feed. They have likewise utilised the long, silky stamens of some Acacias in building their nests, though still using chiefly the down from various native plants." He mentions having found young birds of the species mentioned, which must have been hatched as early as March 1st.

In any review of work on the pollination of Australian plants, one cannot omit that done by Mr. R. D. Fitzgerald on the Australian Orchids. In this work, begun in 1875, there are many references to the pollination of Australian species. I would like to say here that I think it is a distinct loss to science that the publication of this work has been discontinued. I had the honour, and the very great pleasure of knowing Mr. Fitzgerald, and of collecting orchids for him for many years. I know that his work was a labour of love, and that a large part of it still remains unpublished. Every one who has studied the orchids knows how valuable his book is, particularly for its clearing up the confusion which arose from the description and naming of plants from dried specimens. Any description of an orchid which is not based on the examination of fresh specimens is not of much value. I would urge that the question of the continuation of Mr. Fitzgerald's great work, as a State undertaking of a special character, should not be lost sight of.

Before closing, I would like to once more draw attention to the subject of bird-destruction. Consideration of the problems of pollination of Australian plants shows that many of the most

characteristic species, particularly of the Proteaceæ, depend entirely on birds, chiefly the Meliphagidæ and the honey-eating lories. The former birds are particularly confiding, and so are easily destroyed; and the lories have always been considered fair game, and also are very liable to be slaughtered because of their gregarious habits. The consequence may be that, if these birds die out, many of our endemic trees and plants will cease to produce seeds, and in time will become extinct. I would ask our Members to become active propagators of the "Spare the Birds" doctrine.

In conclusion, I would like to express the wish, in which all of us may join, that the Linnean Society of New South Wales may continue to flourish, and do as good work in the future, as it indubitably has in the past.

BIBLIOGRAPHY.

(1). Knuth, A.—Handbook of Flower-Pollination (1909).

(2). Darwin, C.—The Different Forms of Flowers (1877).

(3). Fitzgerald, R. D.—Australian Orchids, 1875.

(4). Tate, R.—"On a Winter-flowering State of *Hypoxis pusilla* J. Hooker." Trans. Roy. Soc. S. Aust., Vol. v., p.76 (1882).

(5). Swinnerton, C. F. M.—"Short-Cuts by Birds to Nectaries." Journ. Linn. Soc., Bot., Vol. xliii.

(6). Sargent, O. H.—"Biological Notes on *Acacia celastrifolia*." Proc. Nat. Hist. Soc. West Australia, 1907.

(7). Carne, W. M.—"The Secretion of Nectar in Extra-floral Glands of Acacia." Aust. Nat., 1915.

(8). Henschel.—Von der Sexualität der Pflanzen (1820).

(9). Hildebrand, F.—Delpino's "Weitere Beobachtungen" (1870).

(10). Delpino, F.—Ulteriori Osservazioni sulla dichogamia nel regno vegetale (1869).

(11). Brown, R., Campst.—A Manual of Botany (1874).

(12). Bentham, G.—"Note on the Stigmatic Apparatus of *Goodenoviea*." Journ. Linn. Soc., Bot., Vol. x., p.203.

(13). Haviland, E.—"Occasional Notes on the Inflorescence and Habits of Plants indigenous in the immediate neighbourhood of Sydney." Proc. Linn. Soc. N. S. Wales, vii.-x.

(14). Hamilton, A. G.—"On the Fertilisation of *Goodenia hederacea*." Proc. Linn. Soc. N. S. Wales, ix.

(15). ———————"Notes on Methods of Fertilisation of Goodeniaceæ," Pts. i.-ii. *Op. cit.*, ix.-x.

(16). HAVILAND, Archdeacon F. E.—"The Pollination of *Goodenia cycloptera*." *Op. cit.*, xxxix. (1914).
(17). BENTHAM, G.—"Notes on the Styles of Australian *Proteaceæ*." Journ. Linn. Soc., Bot., Vol. xiii., p.58 (1873).
(18). SHIRLEY, Dr. J.—"Peculiarities of Flowers of *Proteaceæ*." Report Aust. Assoc. Adv. Science, Vol. vii.
(19). HAMILTON, A. G.—"The Fertilisation of some Australian Plants." Report Aust. Assoc. Adv. Sci., Vol. vi.
(20). WILSON, A. E.—Abstract of Paper "On the closed condition of the Seed Vessel in Angiosperms." Nature, xxviii. (1883).
(21). BRANDIS, Dr.—"Influence of 'Environment' upon Plants." Nature, xxvii., p.82 (1882).
(22). FOX, H.—Nature, xxvii., p.315 (1883).
(23). COOPER, J. G.—"Early History of the Anna Humming-bird." American Naturalist, Vol. x.

Mr. J. H. Campbell, Hon. Treasurer, presented the balance sheets for the year 1816, duly signed by the Auditor, Mr. F. H. Rayment, F.C.P.A., Incorporated Accountant; and he moved that they be received and adopted, which was carried unanimously. The income accounts are summarised in the following table:—

Heads of Expenditure.	General.	Bacteriology.	Fellowships.	Total.
	£	£	£	£
Administration ...	514	33	2	549
Maintenance	102	28	—	130
Publication	239	—	197	436
Research (Salaries) ...	—	400	1,600	2,000
Capital Accounts ...	616	—	300	916
Totals	1,471	461	2,099	4,031
Income (all sources) ...	1,241	533	2,099	3,873

No nominations of other Candidates having been received, the President declared the following elections for the Current Session to be duly made:—PRESIDENT: Dr. H. G. Chapman, B.S. MEMBERS OF COUNCIL (to fill six vacancies): Mr. J. E. Carne, F.G.S., Prof. T. W. E. David, C.M.G., D.Sc., F.R.S., Mr. W. S. Dun, Prof. W. A. Haswell, D.Sc., F.R.S., Messrs. A. H. S. Lucas, M.A., B.Sc., and J. H. Maiden, I.S.O., F.R.S. AUDITOR: Mr. F. H. Rayment, F.C.P.A.

On the motion of Mr. A. H. S. Lucas, a very cordial vote of thanks to the retiring President, was carried by acclamation.

Hamilton, A G. 1917. "Presidential Address." *Proceedings of the Linnean Society of New South Wales* 42, 1–25. https://doi.org/10.5962/bhl.part.4845.

View This Item Online: https://www.biodiversitylibrary.org/item/30101
DOI: https://doi.org/10.5962/bhl.part.4845
Permalink: https://www.biodiversitylibrary.org/partpdf/4845

Holding Institution
MBLWHOI Library

Sponsored by
MBLWHOI Library

Copyright & Reuse
Copyright Status: NOT_IN_COPYRIGHT

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at https://www.biodiversitylibrary.org.

This file was generated 1 February 2024 at 04:04 UTC