PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

QUEENSLAND.

VOLUME XV.

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1900.

THE

Royal Society of Queensland.

Patron:

HIS EXCELLENCY THE RIGHT HONORABLE LORD LAMINGTON, K.C.M.G.

OFFICERS, 1900.

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JOHN THOMSON, M.B.

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A. J. TURNER.

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PROCEEDINGS

OF THE

Annual Meeting of Members,

HELD ON SATURDAY, 20th JANUARY, 1900.

The Annual Meeting of the Society was held on Saturday, 20th January.

The President (Mr. J. W. Sutton) occupied the chair.

The Minutes of previous Annual Meeting were read and confirmed.

The Hon. Secretary (Mr. J. F. Bailey) read the following report of the Council for the 1899 Session.

To the Members of the Royal Society of Queensland.

Your Council have pleasure in submitting their report for the year 1899 :—

In February the Society removed from Wakefield's Buildings to the rooms now occupied in the Technical College, Ann Street, where every accommodation is afforded for lectures and demonstrations, the use of the lecture theatre being granted when required. In obtaining these rooms the Society is greatly indebted to the President, who, as soon as he was elected to that position, endeavoured to secure more commodious rooms for the Society, with the above result.

Thirteen Council Meetings have been held during the year. The attendance of officers will be found in Appendix A.

Ten Ordinary Meetings of Members have been held, and the attendance has been very satisfactory. A list of the papers read at these meetings is given in Appendix B.

In former years one of the most interesting features of these meetings was the exhibition of specimens, models, etc., but the Council regret that during the past two sessions very little has been done in this direction, and would urge members to endeavour to renew this instructive custom.

In July last, instead of the Ordinary Meeting, a Scientific Conversazione was held, to which one thousand invitations were issued, resulting in an attendance of between 700 and 800 persons. The whole of the rooms of the College were occupied for lectures and displays of scientific apparatus. It proved a complete success, and reflected great credit on all those who assisted and on the Committee of Management.

In March last, Vol. XIV. of the Proceedings, containing the papers read during the 1898 session, was published and distributed.

A list of the new members (33) will be found in Appendix C. This number has not been reached for many years past. The Council regret that since the last Annual Meeting death has deprived the Society of two members, viz.: Mr. Othman Blakey, who died about a month after his election as a member; and Mr. James Thorpe, a very old member, who did valuable work as Hon. Secretary of the Philosophical Society of Queensland, with which this Society was incorporated in 1884.

The Queensland Volume of the International Catalogue of Scientific Literature which was in course of preparation when the last report was submitted, has been completed; and, through the courtesy of the Hon. the Chief Secretary of Queensland (Hon. J. R. Dickson), copies were distributed in July last to those who were members of the Society at that time, as well as to a number of Institutions with which the Society exchanges publications. The Council wish to record their appreciation of the manner in which the compiler, Mr. J. Shirley, B.Sc., performed this work. The copy of a letter to the Agent General for Queensland, given in appendix D., shows that Professor Armstrong, F.R.S., the Chairman of the International Catalogue Committee, was pleased with the publication.

A large number of donations to the Library have been received during the year from kindred societies, &c., in various parts of the world. It is to be hoped that the funds this year will permit the setting apart of a sum for binding the many papers thus received.

The Hon. Treasurer's statement is given in appendix E. It will be seen that the balance in the Bank is £6 19s. 3d., while the outstanding accounts amount to £19 4s. 3d. These, however, will be easily met, as the sum of about £88 in subsidy is due this month.

The Council desire to express their thanks to the Hon. the Chief Secretary (Hon. J. R. Dickson), for his generous action in placing the sum of £50, together with an allowance of £1 for every £1 subscribed up to £100, at the disposal of the Society.

In accordance with the rules, all the officers retire, but, with the exception of the President and Vice-President (neither of whom, according to Rule 16, can hold the same office for two years in succession), are eligible for re-election.

J. W. SUTTON,
President.

J. F. BAILEY,
Hon. Secretary.

Brisbane, 8th January, 1900.

APPENDIX A.

Attendance of Officers at the Thirteen Council Meetings during the 1899 Session.

Office.	Name.	Number attended.
President ..	J. W. Sutton	12
Vice-President ..	A. Jefferis Turner, M.D.	2
Hon. Treasurer ..	Hon. A. Norton, M.L.C.	11
Hon. Secretary ..	J. F. Bailey	10
Hon. Librarian ..	Rowland Illidge	10
Members of Council	F. M. Bailey, F.L.S.	11
	W. J. Byram	7
	C. J. Pound, F.R.M.S.	7
	John Shirley, B.Sc.	10
	S. B. J. Skertchly	4

APPENDIX B.

List of Papers Read during 1899 Session.

Date.	Title.	Author.
February 18	The History of Tin	S. B. J. Skertchly
March 18	Notes on the Entomology of a Tea-tree Swamp	R. Illidge
,,	Stone Cooking-holes of the Australian Aborigines ..	R. H. Mathews
April 22 ..	The Beginnings of Life and Differentiation	W. J. Byram
May 13 ..	Some Problems regarding the Nature and Origin of Life ..	A. Jefferis Turner, M.D.
,,	List of Minerals of the Walsh and Tinaroo Districts ..	J. S. Berge and J. H. Brownlee
June 17 ..	Mosquitoes and Malaria ..	John Shirley, B.Sc.
,,	Life History of the Mosquito ..	W. R. Colledge
August 19 ..	Reply to Some Critical Notes on the Queensland Volume of the International Catalogue of Scientific Literature ..	John Shirley, B.Sc.
,,	A Method by which a Pure Water Supply could be obtained for Brisbane ..	T. L. Bancroft, M.B.
,,	Account of a Visit to some Caves near Camooweal	T. P. Keys
Sept. 16 ..	Insects and Flowers	John Shirley, B.Sc.
October 30	Tuberculosis	C. J. Pound, F.R.M.S.
Nov. 18 ..	The larval Structure of Hepialus virescens	Ambrose Quail, F.E.S.
,,	The Transvaal	John Shirley, B.Sc.
Dec. 16 ..	Public Abattoirs and the Prevention of Tuberculosis ..	Hon. W. F. Taylor, M.D., M.L.C
,,	Odd Notes on the History and Transformation of various Insects	R. Illidge
,,	Some New Species of Queensland Lepidoptera	T. P. Lucas, M.R.C.S., Eng.

APPENDIX C.

Members Elected during the Year, 1899.

Date.	Name.	Address.	Proposer.
Jan. 21 ..	Nott, F. Lan. ..	Agric.Col. Gatton	J. F. Bailey
Feb. 18 ..	Blakey, O. ..	Stafford-Kedron	S. B. J. Skertchly
,,	Lees, William ..	Coorparoo ..	,,
March 18	Gaden, E. A. ..	Ashgrove ..	Hon. A. Norton M.L.C.
,,	Green, L. C. ..	Geo. Survey Dep.	S. B. J. Skertchly
,,	Hall, T. M. ..	Brisbane ..	J. W. Sutton
,,	Lyons, D. T. ..	Clayfield ..	,,
,,	Tonks, T. ..	Brisbane ..	,,
April 22 ..	Almond, Capt. T. M.	,, ..	,,
,,	Pickburn, G. H. ..	South Brisbane	G. Watkins
,,	Horsfall, Wm. ..	Petrie Ter., Bris.	J. Shirley, B.Sc.
May 13 ..	May, Dr. T. H. ..	Bundaberg ..	James Keys, F.L.S.
,,	Jackson, A. G. ..	Brisbane ..	J. W. Sutton
,,	Zoeller, Carl ..	,, ..	,,
June 17 ..	Whitton, Miss I. D.	,, ..	Mrs. R. Edwards
,,	Smith, Havelock ..	,, ..	S. B. J. Skertchly
,,	Colledge, J. C. ..	,, ..	J. W. Sutton
,,	Watson, C. A. H. ..	Ipswich ..	J. Shirley, B.Sc.
August 19	Ferguson, C. D. ..	Brisbane ..	J. W. Sutton
,,	Pinnock, P. ..	,, ..	J. F. Bailey
Sept. 16 ..	M'Queen, Rev. W. S.	Clayfield ..	Mrs. R. Edwards
,,	Carter, H. R. ..	Brisbane ..	,,
,,	Allom, S. R. F. ..	,, ..	G. Watkins
,,	Blackboro, E. A. ..	,, ..	C. J. Pound
,,	Wright, A. E. ..	,, ..	,,
,,	Hesketh, John ..	,, ..	J. W. Sutton
,,	Greenfield, A. P. ..	,, ..	A. G. Jackson
,,	Kaye, A. ..	,, ..	J. Shirley, B.Sc.
,,	Owens, T. H. ..	,, ..	R. Illidge
,,	Davis, Sept. ..	,, ..	T. Tonks
Nov. 18 ..	Berge, J. S. ..	Herberton ..	J. F. Bailey
,,	Brownlee, J. H. ..	,, ..	,,
Dec. 16 ..	Trimble, Wm. ..	South Brisbane	J. W. Sutton

APPENDIX D.

Copy of Letter received by the Agent-General for Queensland from Prof. H. E. Armstrong, F.R.S., Chairman Royal Society of London International Catalogue Committee.

"55 Granville Park,
"Lewisham, London, S.E.,
"October 6th, 1899.

"Dear Sir,

"During the vacation your letter of August 30th has been received at the Royal Society, advising that Mr. Shirley has prepared a Catalogue of Scientific Literature published in Queensland, and enclosing a copy of the publication.

"It is a most admirable piece of work, and the Colony is to be congratulated on possessing such a man.

"If you will send 100 of the 200 copies which you say are available to the Royal Society, I shall be obliged. It will be of great value in showing what may and should be done."

(Signed) H. E. ARMSTRONG."

APPENDIX E.

THE ROYAL SOCIETY OF QUEENSLAND.

Dr. Financial Statement for the Year 1899. Cr.

RECEIPTS.	£	s.	d.	DISBURSEMENTS.	£	s.	d.
Balance from last Report	4	8	7	Rent	21	3	10
Subscriptions	98	14	0	Advertising	2	19	6
Rent	1	6	0	Printing	23	6	8
Deposit on Gas Meter returned	1	0	0	Cartage	1	2	6
				Furniture	4	10	0
				Insurance	1	8	6
				Lantern Hire	2	16	0
				Music (Conversazione)	2	10	0
				Refreshments (Conversazione)	12	15	0
				Bank Fees and Cheque Book	0	12	6
				Carpentery	6	10	4
				Postage and Petty Cash	17	12	6
				Sundries	1	2	0
				Balance in Bank	6	19	3
	£105	8	7		£105	8	7

Liabilities : Printing, £19 4s. 3d.

Examined and found correct.—Alex. J. Turner, *Hon. Auditor.* A. Norton, *Hon. Treasurer.*

Brisbane, 3rd January, 1900.

The adoption of the Report was moved by Mr. A. J. Turner, seconded by Mr. F. Whitteron, and carried.

The President then delivered the following address : —

PRESIDENTIAL ADDRESS, JANUARY, ~~1899~~. 1900.

Ladies and Gentlemen,—

It has been your good fortune for some years past to listen to Presidential Addresses, delivered by men of ability and learning, to which I make no claim—and it was with the greatest reluctance that I allowed myself to be placed in the Presidential Chair, knowing that there were many members of this Society better fitted for such a responsible position, so that the members have only themselves to blame, for any deficiencies and short-comings on my part during my term of office. However, it is satisfactory to learn by the Council's report, that our roll of membership has largely increased, but I regret to say that the active members are decreasing gradually, by death and other causes, so I take this opportunity of appealing to the members to throw more interest into the Society, by coming forward and filling those places. Our financial position is good, and last but not least, the Society is comfortably housed in suitable quarters, for which the members are largely indebted to the Council of the Technical College. I also take this opportunity of thanking the members of our Council for the able assistance and advice received from them during the past year.

The selection of a subject for my retiring address this evening, I can assure you, was no easy task, because on looking back for some past years, I find that your past Presidents have all given addresses on special subjects, particularly in their own professional line, and which they were well qualified to handle. I, having no special subject, have therefore, to ask your kind indulgence this evening, if I should somewhat weary you. As I have said before, for some years past your Presidential addresses have been on special subjects, diverting from the time-honoured custom of reviewing the progress of science, in its various branches, and as the world has made such marvellous progress and development of late, I felt that I could not but revert again to the old custom, by making some brief allusions to the advancement and progress of science.

Workers, in all branches of science, labour under great disadvantages when they are located at great distances from the centres of scientific research and thought, and out of reach of seeing experiments and hearing discussions of the various learned societies, or of even getting access to what has been published in the various journals. Scientific books on all subjects of course reach us in due time, but books in these times are out of date almost as soon as they leave the publishers' hands, therefore, for one to be up to date in the march of progress, it is absolutely necessary to have access to all scientific publications which are published, both in our own and all foreign languages. No doubt the question will at once suggest itself to you, why does not this society supply that want? The answer is, we have not sufficient funds; and unfortunately our Society does not include in its membership workers in all branches. Therefore I think this is a matter well worth the consideration of those entrusted with the management of our Public Library, and let us hope that therein will be found all monthly publications of scientific interest, both of pure and applied science, no matter in what language they appear. A long felt want has lately been put forth, under the joint direction of the Physical Society and the Institution of Electrical Engineers of London, in the form of science abstracts, the abstractors being men of well known scientific ability. It contains short extracts from all recognised scientific journals and publications, with a concise reference and index, which at once points out to the reader where he can see the full detailed article or paper. But as I have already inferred, they are at present entirely beyond our reach. Of course, there are societies here, devoted to special subjects, that no doubt are able to place before their members up to date literature in their own particular branch, but this, for the Royal Society, embracing as it does all sciences, is simply out of the question. In fact there are too many societies for such a small community as Brisbane, and I think much better and more work would result if a number of these would throw in their lot with us and work with one common end—the general advancement of science. Each could have its own section, its special meetings if necessary, also, as now, its own president and secretary. Such an arrangement would go a long way towards securing a good financial position, better attendance at meetings, and above all, tend to bring about a closer intercourse of followers of various scientific works and thought, which is the object and aim of this society.

Various attempts have been made from time to time to classify the sciences ; but, without success. Herbert Spencer classifies them thus—Abstract Science, Logic and Mathematics, Abstract Concrete Sciences, Mechanics, Chemistry, Physics and Concrete Science, Astronomy, Biology, Geology, Sociology, etc. It was Sir J. Herschell who said in connection with this subject, "Science is a whole, whose source is lost in infinity, and which nothing but the imperfectness of our nature obliges us to divide. We feel our nothingness in our attempts to grasp it, and bow with humility and adoration before the Supreme Intelligence, who alone can comprehend it." No science rests on a firmer basis than mathematics, which, being founded on demonstrative evidence, may be accepted as absolutely true. The results in logic, which, like mathematics, being a deductive science, are much less certain ; still logic is essentially the science of the art of proof. All other sciences are to a large extent inductive, these resting on probable evidence, and continually approaching nearer and nearer to it, as scientific methods improve. Thus, sciences vary in the distance they have moved towards perfection ; in mental and physical science, the former can largely be studied by reflection in our own mental operations, the latter requires observation, experiment and comparison of facts obtained, inductive and deductive reasoning, all ending in as wide a generalisation as the obtained facts will admit. No one can be a truly scientific student unless he places truth as a prima importance, and is prepared to sacrifice all preconceived ideas and elaborate opinions, whenever he finds them to be in error. No expenditure of time, money, or even life, is considered extravagant, if the sacrifice be made for the discovery of new truths. The early stages in the evolution of science go back to remote periods of antiquity. Moral science, a department of mental science, reached some degree of maturity first in primitive man, in a desire to ascertain what his conduct should be to his fellows and God or Gods. Mental science or the investigation of the thinking and feeling mind came next, but even up to the present time has made but slow progress. Physical science had really commenced, although in its infancy, when ancient myths of observation were formed, many of which were hypothesis to account for natural phenomena, its progress being slow until the eighteenth century, since which time its progress has been rapidly increasing. Prior to this, the greatest advances were in astronomy and physics, then in chemistry, botany, etc., geology not attracting much attention until the beginning of the present century. The nineteenth century has been so prolific in scientific and mechanical inventions that doubts may be expressed as to whether the rate at which discoveries and inventions are now introduced will continue, or whether we are becoming too clever and are likely to come to a full stop. But as science knows no finality, so also will invention know no finality, as circumstances increase, and mankind's dominion over the earth, sea, and air, becomes more pronounced, new wants will arise and new means of supplying old ones will be devised. The time was when science was cultivated only by the few, who looked upon its application to the arts and manufactures as almost beneath their consideration. This they were content to leave in the hands of others who, with only commercial ends in view, did not aspire to further the objects of science for its own sake, but thought only of benefitting by its teachings. Progress could not be rapid under these conditions, because the investigator into pure science, rarely pursues his investigations beyond the physical and chemical principle, while the simple practitioner is at a loss to know how to harmonise new knowledge with the stock of information which forms his mental capital in trade. The world owes much to those ardent students of nature, who in their devotion to scientific research, do not allow their aims to travel into the region of utilitarianism and self interest: but it is not to them that we can look for present progress in practical or applied science, it is to the man of science who also gives his attention to practical questions, and to the practitioner who devotes part of his time to the prosecution of strictly scientific investigation, that we owe the rapid progress of the day, the advancement of which has rendered theory and practice, or science and art, so interdependent that an intimate union between them is a matter of absolute necessity for future progress. Theory and practice must go hand in hand. Although it may be somewhat heretical to say, in these days of division of labour, I see no reason why a Bachelor of Arts should not be able to make a door, or a B.Sc. work and attend a lathe. Science and art naturally stand to each other, as cause and effect. Professor Abbe of the U.S.

Weather Bureau, gives the following very pretty illustration, of how a simple mechanical act has its relation to physical science: "Everywhere one is confronted with the laws of force. If you strike a smart blow upon the head of a cold chisel, and make a cut into a piece of soft iron, you are doing one of the simplest mechanical operations, and yet you are awakening a long series of reactions that invade nearly every branch of physical science. First, the muscles respond to the eye and the will, the hammer moves with great acceleration, and strikes straight and hard, the energy of the blow comes from the chemical transformation going on within the workman's body, suggesting problems that belong to the profoundest depths of Biology. Secondly, the stroke of the hammer calls forth a clear and cheerful sound from the head of the chisel, a musical ring, with all its problems in acoustics. Thirdly, the hammer, the steel chisel, the soft iron and the chips, become warm and hot, under repeated blows, suggesting problems in Thermo Dynamics, radiation and conduction of heat. Fourthly, the edge of the hard chisel becomes dull, but a deep gash is cut in the soft iron, eventually the edge of the chisel breaks, all of which results are explained by the study of the science of elasticity, as applied to the flow of solids and the exhaustion of metals. Fifthly, a better chisel is picked out and the hammering goes on all day without harm to the tool, proving that its chemical and physical properties differ from the one that is easily broken. If the anvil be of stone, and both it and hammer be insulated and connected with an electrometer, every stroke would be seen to produce electricity." Thus we see in such a simple operation the manifold and intricate connection between the sciences and arts, so we see how all practice has its theory, and the better man is he who takes, as it were, both into his confidence, and runs them harmoniously together. It has been said, and it is a truth incapable of being gainsaid, that science must be joined to practice in the advancing competition of the world, in order that a nation may retain the strength and energy of manhood. It is certain that the prosperity of a country depends mainly on the extent and variety of its natural products, and the manner in which they are utilised: Such being the case, what a great future awaits this colony of Queensland, a country which contains, one might say, the whole list of elements known to science, awaiting development by enterprise and capital, where both can be employed in peace and security, while at the same time it is being so lavishly expended in foreign lands where the danger of losing both is a factor always to be reckoned with. Our pastoral, agricultural, and mining capabilities know no bounds, and yet so little has been done to give our rising generations that rightful and necessary amount of scientific education, to enable them to utilize and make the best uses of that which nature has so abundantly bestowed upon them and placed at their disposal. It is true a small beginning has been made in the Agricultural College, where the farming youth can learn the science of his own industry, and it is gratifying to learn that at last we are to have a University and School of Mines, and let us hope that, when these are an established fact, no niggardly hand will guide them in the selection of management, and that we shall be in a position to impart to the students learning at least equal to those of older colonies. While remarking on this subject, it may not be out of place to state that the thanks of the Queensland public are due to those gentlemen who formed the committee of the Brisbane School of Arts in former years, who undertook and successfully supplied a want of secondary education, by the nursing under very great difficulties to maturity the Brisbane Technical College, which is now rendering such good service in the cause of technical education. But the limited means at their disposal, and want of adequate accommodation and apparatus, is very discouraging to those who give their time and labour in carrying on the work, a work which deserves, and is entitled to, as much sympathy and support, as either the Agricultural College, University, or a School of Mines.

The rapid progress of applied Chemistry in recent years has so combined itself with every industry that no prosperous, well-regulated manufactory is now without its chemical or physical laboratory, according to the arts or occupation for which it is designed to benefit. Chemistry is concerned with the most common acts of our ordinary life, and it is literally true that there is not a moment in which we do not hold the infinite in our hands. Of chemists themselves, the men who have studied the various forms of matter, and have gradually and surely brought it to the point and perfection it has reached at the present time, belonged to various nations. In our own country we had Professor Black, the most methodical of men ; Priestly, erratic, but original and full of new discoveries; Dalton, essentially a thinker, rather than experimenter; Davy, the most brilliant and enthusiastic of English workers; Cavendish, the careful worker and founder of many branches of experimental chemistry; Graham, the atomist and forerunner of the physical chemist of to-day; and Faraday, the perfect type of scientific student of nature. France produced such men as Lavoisier, the founder of scientific chemistry, one of the greatest names in the history of science, and who, by his own countrymen, was sacrificed to the guillotine; Dumas, also a Frenchman, a most enthusiastic chemist and brilliant writer, who lived at the time when organic chemistry began. Germany, also claims a fair share, Liebig, a monument of honour to his nation; Humboldt, a worker in all science; Wöhler, one of the greatest workers in organic chemistry; and Hoffman, the greatest organic chemist; not forgetting Professor Bunsen, who has so recently passed away. Sweden also stands in the front rank of chemistry, by the labours of Schele and Berzelius. Italy can justly be proud of Avogadro and Cannizzaro, and their works. Russia can also put forward its claim to representation, and among chemists none more distinguished for accurate imagination than Mendeleeff. Of course there are very great numbers of other distinguished names, but the few will suffice to show that science knows no nationality. Research of late has chiefly been confined to investigations in organic compounds and in high and low temperatures. Six new elements have been discovered and isolated, viz.:—Argon, Helium, Crypton, Neon, Metargon, and Victorium, the former five being gases from the atmosphere and mineral sources, the latter an earthy mineral found associated with the Yttrium Groups. Thus, the list of elements is gradually increasing, notwithstanding the ideas held by most leading scientists a few years back, that as time would enable us to obtain more perfect appliances and analysis, they would most likely disclose that some of the so-called elements would be found to be compounds, and hydrogen was looked upon to play an important part in their composition; but, up to the présent the stablity of the elements has not been shaken, although hydrogen has been liquefied and solidfied, and found to be similar in appearance to frozen water; and in it we have, owing to the enormously low temperature of solid hydrogen, a new weapon for further investigation.

Synthetical Chemistry has made great strides since Berthelot's discovery of the formation of acetyline with its elements, carbon and hydrogen, in 1862, and it is to this branch of chemical science, that we are indebted at the present time for about 180 compounds of the hydro-carbon series, which are capable of being formed by direct union of their elements; also by the great variety of beautiful colours and shades, used in calico and other printing, it is estimated that a saving of between two and three million pounds annually has been effected by the artificial manufacture from tar waste products, to the calico printers and dyers. This industry which was at one time almost entirely in English manufacturing hands, has practically now become a German industry, for the simple reason that the German manufacturer is either a trained chemist or has the good sense to understand that the problems at the root of the industry are to be trusted only to those with a sound scientific knowledge. This is one of the many instances in which Germany, if not actually outstripping, are running the English manufacturers very closely, more especially in chemical industries, and the reason is not far to seek, when we learn the amount of money, care and attention that is bestowed on Technical Education in that country—indeed some large employers make it compulsory that all their apprentices shall attend Technical Classes, at least two evenings per week, to learn the science of their own particular industry. Thus are produced workmen who are ever on the alert to improve and cheapen the cost of his own products, instead of mere automatons. It is gratifying to learn that, after having discovered the primary cause of our neighbour's prosperity, we have taken the hint, and by similar means are widely establishing universities, technical schools, and national physical laboratories, where sound theoretical, practical and scientific education can be obtained by all seeking it. The deficiency of such knowledge or theory by a large majority of inventors, and the enormous waste of time, energy and money, bestowed upon useless and impossible contrivances, must be glaringly apparent to anyone who studies the patents record of various nations, which might have been saved, had the inventor understood the fundamental principle of Thermo Dynamics, Jules' Law, that the unit of heat can only do 772 foot pounds of work, and inventors proposing to violate that law must either be deficient in theory, or lending themselves to fraud. It is now about twenty years past, in 1878, when scientific interest was awakened by the experiments, then being carried out by Cailletet of Paris and Pictet of Geneva, in the liquefaction of the gaseous elements. Very little having been done since the time of Faraday. Up to that date, although a number of the more dense gases were liquefied by him, some five or six resisted all attempts and ingenuity of the time, and some of these were looked upon as being beyond the possibility of liquefaction, so were thought to be permanent gases, until Pictet demonstrated the fact by liquefying oxygen and so upsetting the theory of permanency. He reasoned that if permanent gases are not capable of liquefying, we must conclude that their atoms do not attract each other, and this does not conform to the law of cohesion. Since the time of these researches and experiments, gas compression and liquefaction has become a large industry. It has completely revolutionised the aerated water manufacturing, and a large business is done in compressed ammonia for the frozen meat trade, compressed oxygen and hydrogen, both for lighting and inflating military balloons, and nitrous oxide so familiar to those who have occasion to visit the dentist. Hydrogen, as was to be expected, being the lightest element, was the last of the gases to yield, and it is to Professors Dewar and Ramsay that we owe much for their labors in that direction. Hydrogen has not only been liquefied but frozen solid. Much speculation was indulged in as to what solid hydrogen would be like, it was expected by some to be metallic in appearance, something like mercury, but it turns out to be very much like ordinary ice, its temperature being 247° below zero Centigrade, or 26° above absolute zero, it boils at 238° below zero, or 35° above absolute zero. Air at once liquefies and freezes on the outside of a tube containing boiling hydrogen, the exact temperature not yet being definitely settled, owing to the difficulty of constructing a reliable thermometer, but these figures are very nearly true. Absolute zero being 273° Cent. below zero, the certainty of there being a real zero was deduced from the fact that a regular rise or fall in the temperature of a gas, produces a corresponding increase or decrease in the volume, and when it was noted that a gas could be doubled in volume by raising the temperature from the artificial zero, of the Centigrade scale, to 273° Cent. the converse result was apparent. Hence, it was pointed out that if a rise in temperature of 273° Cent., would increase the volume of gas by an amount equal to the original bulk, a similar decrease in the original volume would require a reduction of the temperature to 273° Cent. below zero, or equal to 459° below ice temperature, Fahrenheit, which is agreed to be the real absolute zero. This is not a creation of the imagination by any means, a gas exists in that particular state owing to the molecules causing vibrations—more heat more rapid the vibrations, less heat less vibrations, no heat no vibrations, the point to which a gas can be cooled, until it can shrink in volume no further. When Fahrenheit devised the scale of our ordinary thermometer in 1714 he appears to have concluded that a mixture of chloride of ammodia and snow, produced the most intense cooling effect possible, and so named the temperature thus obtained zero, but observations prove that in Siberia it might fall to 90° below this preconceived lowest point, while the mercury of the original Fahrenheit thermometer would freeze at 39° below zero. Alcohol was afterwards used for low temperature recording, so that recent discoveries clearly point out that the real zero must be placed very much lower down the scale. The thermometers used in recording these low temperatures are the platinum resistance, based on the curious effect of intense cold increasing the conductivity of the metal.

Liquid air, of which we have heard so much of late, and the revolution it is to play in the near future as a motive power and powerful explosive, has yet to be brought within the limits of commercial success and usefulness. A power that may be obtained at next to no cost, must be taken with the proverbial grain of salt, and looked upon in the light of the Keely motor. Still there is no doubt that there is a large and useful sphere open to it, owing to its great expansive power, being 800 times its own volume, and the material to be had for the taking, and at the present time a large amount of machinery is being erected, to supply this article for cold storage and other purposes, for which it is proposed to supply it at 9d. per gallon, with possible reductions to half that amount. Thus we have that which was only a short time back a chemical curiosity of the laboratory produced only by the drops, followed by larger quantities available for experimental purposes, and now we have the announcements among the articles of the month, of the completion of commercial plants to supply thousands of gallons per day. The story of liquid air is but a repletion of that of aluminium, and calcium carbide, once a rarity in the laboratory, then a rare material, at so many shillings per ounce, almost ranging with precious metals, and then, all at once, brought by methods of practical Electro Chemistry, into the market as a commercial product, with innumerable applications in the Arts. Aluminium, a beautiful metal, and one of the most plentiful on the earth, is steadily working its way into the arts and manufactures, just so surely and steadily as its cost of production is lessening, The metal was first isolated by Wöhler in 1827, but remained as one of the rare metals until 1855, when Deville and Bunsen reduced small quantities by Electrolysis, but the process was found to be far too costly (£20 per lb.) to be of any commercial value. From this time up to 1884, numerous furnace smelting and reduction by sodium methods, were employed, which gradually reduced the cost to 70s. per lb., still a prohibitive price; but through the introduction of modern electric machinery driven by water power, such as Niagara, the electrolitic process has again been reverted to, and that which cost, forty years ago, 400s. per lb., is being now made by a similar process by modern appliances at 1s. 4d. per lb., thus making it bulk for bulk, corresponding in price to brass, and taking its place with the common metals. The tensile strain in relation to weight, pure aluminium is as strong as steel of over 80,000 lb. per square inch. The total production of this metal in the year 1882 was only 83 lbs., but since that date to the present time has risen to something like 4,000,000 lbs. per annum. The greatest use is as alloys with other metals, particularly copper. The lightness of aluminium, its non-corrosive properties, and the fact that it is antiseptic, renders it a most suitable metal for surgical and optical instruments.

Artificial Lighting.—Of all that trends to the comfort and well-being of mankind, good artificial light stands pre-eminent. Imagine us to-day being suddenly reverted back to the use of the old tallow and wax candle? why, life would become unendurable. The ruddy lights and picturesque shadows faithfully handed on to us by Rembrandt's pictures, point very clearly to what our poets called the dim glimmer of the taper. The advancement in artificial lighting has played no small part in the advent of science and civilization. A few years before the introduction of coal gas, Argand by his improvement in burners for oil lamps, enabled our Fathers to appreciate for the first time the comforts of a white light; and thus the oil lamps replaced in a great measure the candle. But it was not until 1848, when Dr. Lyon Playfair called attention to the oozing of petroleum from the coal seams, then with the discovery of mineral oils in America and Russia, which brought forth the birth of present kerosene oil lamps, which has steadily improved until it has now about reached the climax of perfection. Prior to the introduction of electric lighting, improvements in gas and gas-burning were few and far between, and it was only by Act of Parliament that gas companies were compelled to supply consumers with an article of standard light and quality, in fact, gas companies the world over did just what they pleased; but within the past sixteen years a great change has come over the scene, electric light companies having given them a shock that has awakened them into a new life and activity, meaning better quality of gas, new and improved burners, and cheaper rates; and one of the chief factors in enabling them to hold their own is that beautiful invention now so familiar to us all, the Welsbach incandescent mantle. This has been greatly improved since its introduction about eight years ago, thorium being the metal now used in its construction. Still, for a perfect light both for health and comfort, the electric incandescent light stands alone; it takes nothing from the air and gives nothing to it, excepting a small quantity of heat—less than any other known illuminant; it costs less to install, and if properly done is the safest. If the cost could be brought down to that of gas, as burnt in the Welsbach burners, it would be universally used. This brings us now to the last and latest rival in artificial lighting, viz., Acetylene. It is now some seventy years past since Edmond Davey, a relation of the great Sir Humphrey, while experimenting in the process of the manufacture of sodium and potassium, noticed that a black residuum was at times formed in the retort, which, practically had the same power of decomposing water as potassium, only that the gas evolved by the decomposition was, instead of being hydrogen, a compound of that element with carbon. The proportion in which these two elements united differed from the composition of any hydrocarbon then known. The material so formed in the retort being a compound of carbon and potassium, which we know now as potassic carbide, while the new hydrocarbon then given to the world, was a compound of 24 parts by weight of carbon, with 2 of hydrogen, which we now call Acetylene. Twenty-years later the French chemist, Berthelot, made a series of researches on this gas and proved that as the electric arc passed between carbon electrodes in an atmosphere of hydrogen, direct combination took place between small particles of both elements and thus Acetylene was synthetically produced, and so it was Berthelot who gave it its name, and as such it remained until 1862, when the German chemist, Wöhler, discovered that on fusing an alloy of zinc and calcium at a high temperature with carbon, a compound of carbon and calcium was formed, now known as calcium carbide, and showed that this body in contact with water, gave rise to Acetylene gas, so it may be said that with this year 1862, through the labours of Berthelot and Wöhler, it was understood and placed in the list of rare chemicals, and as such it remained for thirty years until 1892. Then commenced the present era of activity in the history of Acteylene, which brings it forth from a condition of a rare chemical to that of a commercial article, destined to play no small part in the world of commerce. About this period Wilson of Canada, experimenting with the electric furnace, noticed the formation of calcic carbide under certain conditions, and he prepared a large quantity, by direct fusing of lime and carbon. The process being simple when the desired heat can be obtained, and the introduction of the electric furnace gives us a mean to that end, lime being a most refractory substance is mixed with coke in a suitable crucible, and a powerful arc set up therein, metallic calcium is formed which immediately unites with the surplus carbon, and produces carbide of calcium, it being very much like in appearance to greyish crystalline lime stone, 1lb. of which should produce five cubic feet of gas, giving a light for five hours equal to 240 candles. Calcium carbide on being brought in contact with water, a change of elements takes place, the carbon unites with the hydrogen of the water, and escapes as acetylene, the oxygen of the water uniting with the calcium, remains as oxide of calcium or slacked lime. The simplicity of decomposition has brought forth hundreds of inventions of machinery for generating the gas, of which very few are reliable in their action, chiefly owing to the want of technical knowledge of their designers. As to the ultimate position of acetylene in competing with coal gas as an illuminant, there can be no question that in large towns, coal gas can and will hold its own, but for places beyond the limit of supply, a large field is open to acetylene, but at present, owing to the prejudice against a new and untried article, high rates of carriage, heavy royalties, insufficient and intermittent supply, mitigate much against its adoption. Still, at the present time there are about fifty odd works running and in course of construction, with a production of about 30,000 tons per annum, yet the demand is far above the supply, and now as I write these notes, I learn that a method has been devised whereby the mixing of the gas with some inert matter, it can be sent out from the gas holder through mains and burnt in the ordinary gas fittings.

Electro Metallurgy.—The progress of electrolysis and electro metallurgy, has within the past few years been very rapid and great. Electrolysis and electrolitic methods, being now largely used in chemical analysis, in preference to older chemical practice, it being much quicker and very accurate, and now that we are able to transform the energy stored in coal, into electric energy with a minimum of loss, and also to transmit that power from sources of cheap production, such as water power, the electrolitic production of materials has extended enormously, in fact, it has entirely revolutionised the chemical industry. In metallurgy the most extensive application of electrolysis have been in connection with the refining of copper from the impure matte produced by the smelting furnace. There was in operation in 1897 five electrolitic refiners in Germany, four in France, five in England, two in Russia, and eleven in the United States. I have only been able to obtain the output of the American eleven works for 1896, but it will be sufficient to show, and also what the future will be of this comparatively new and rising industry, made possible only by the late developments of modern dynamo machinery. Thus from eleven works out of twenty-seven no less than 124,000 tons of copper, 14,000,000ozs. of silver, and 70,000ozs. of gold was produced. As the process is now employed, the anode consists of the impure copper, and the cathode of pure copper, the bath being an acid solution of sulphate of copper. Electrolysis is also employed for the separation of nickel from copper, and from gold, silver, and platinum. In these cases the anodes are the matte containing the various metals, and the cathodes are sheets of pure copper, the bath being dilute sulphuric acid, the copper going to the cathode, the nickel dissolving in the bath, while the gold, silver, and platinum, fall in the form of sludge, the nickel being subsequently separated electrolitically, using insoluble anodes of lead or carbon, and cathodes of nickel. A large amount of attention has been given to the electrolitic production of zinc. There are many difficulties, however, in connection with the practical commercial application of electricity to this metal. Its solutions are poor conductors, the metal is frequently deposited in a spongy state, and above all, the low market price of zinc renders an electrical process almost too expensive. The process of Seimens and Halske, and Hoepfner, have both met with some success, but the best results so far have been obtained by the Ashcroft method, in which a solution is obtained by treating oxide of zinc with ferric chloride, and electrolysed. This process has been used on a large scale at Broken Hill, but it is not yet altogether demonstrated that the commercial economy of any of the processes is satisfactory unless the recovery of the more valuable associated metals are included. At the present time the various processes of electro metallurgy may fairly be considered to have passed the experimental stage, and while there are doubtless many improvements to be made, there is every possibility that in the near future, the electrolitic tank will in very many instances replace altogether the more primitive furnace.

WIRELESS TELEGRAPHY.—Professor Oliver Lodge has said, that at the end of the eighteenth century, the wonder was that you should be able to signal with wires: now at the end of this nineteenth century, the wonder is that you should be able to signal without wires. Telegraphing without wires has been the dream and aim of electricians for the past thirty years or more, and if anyone were to ask me who discovered wireless telegraphy, I should unhesitatingly say Professor Hughes, not that I desire in the slightest degree to detract one iota of merit from Marconi, whose research and ingenuity has made it a practical success, and who deserves all the honour and merit attached thereto: but at the same time one cannot help sympathising with Professor Hughes, after having spent years of labour and research, and actually demonstrating the fact, to be deprived of the honour appertaining thereto. In 1879 Hughes found that electric sparks from an induction coil or frictional machine, acted on the surrounding medium in form of waves, the laws of which at that time he could not understand. The following is his own description of experiments in December, 1879: "I invited several persons to see the result then obtained, and amongst others who called and saw my results were W. H. Preece, Sir W. Crookes, Sir W. R. Austin, Professor G. Adams, M. W. Grove, M. Spottswoode, Professor Huxley, Sir G. G. Stokes, and Professor Dewar. They all saw the experiments in aerial transmission by means of the extra current produced from a small coil, and received upon a semi-metallic microphone; the transmitter and receiver were in different rooms, about 60 feet apart. After trying all distances allowed in my residence, my usual method was to put the transmitter in operation and walk up and down Great Portland-street with the receiver in my hands and the telephone to the ear. The sounds seemed to slightly increase for a distance of 60 yards and gradually diminish, until at 500 yards I could hear no longer with a certainty the transmitted signals. The experiments shown were most successful, and at first they seemed astonished at the results, but towards the close of three hours' experiments Professor Stokes said that all the results could be explained by known electro-magnetic induction effects, and therefore he could not accept my views of actual aerial electric waves, unknown up to that time. I was so discouraged at being unable to convince them of the truth of these aerial electric waves, that I actually refused to write a paper on the subject, until I was better prepared to demonstrate the existence of these waves, and I continued my experiments for some years, in hopes of arriving at a perfect scientific demonstration of the existence of aerial electric waves produced by a spark, from the extra current in induction coils, or from frictional electricity." But the triumphant demonstration of these waves, was reserved to Professor Hertz, who by his masterly researches upon the subject in 1887 and 1889, completely proved not only their existence, but their identity with ordinary light, in having the power of being reflected and refracted, by means of which the length of the waves could be measured. Hertz's experiments were far more conclusive than Hughes, although he used a much less effective receiver than the microphone or coherer, and now as we all know, Marconi has lately demonstrated that by the use of the Hertzian waves, and Branley's coherer he has been able to transmit and receive aerial electric waves, to greater distances than previously ever dreamed of by the numerous discoverors and inventors, who have laboured silently in this field, and his efforts at demonstrating, merit the success he has received, and the world be right in placing his name on the highest pinnacle in relation to Aërial Telegraphy, but there is no doubt that had Professor Hughes, received the encouragement due to him from eminent scientists, the discovery of Aërial Telegraphy would have dated back 20 years ago.

Aërial navigation has been the dream of speculative minds ever since Rozier made the first ascent ever attempted, some 200 years ago. Volumes could be written of the various contrivances, mishaps and misfortunes, that have attended aerial experiments, but of late, since the introduction of aluminium owing to its lightness, a fresh impetus has been given to this subject, and there seems to be some hope that at no distant date, aerial navigation will at least meet with some measure of success, notwithstanding all the disasters and failures of the past. Confidence in a successful issue still prevails in the minds of many practical men. The importance of such an innovation must be patent to all. At the present time there is being constructed in Germany such an aërial ship, which is expected to plough its way through the regions of the air, as the Atlantic liner glides over the ocean. This vessel is being built on a floating pontoon, and has the outward appearance of an iron-clad war vessel, but as delicate in structure as a gigantic bird-cage. The framing is entirely of aluminium, together with all the fittings and utensils. The propelling machine is of the lightest description, internally she is floated by balloons, her speed is to be 22 miles per hour and a total lifting capacity of 10 tons. Her cost is something over £70,000, and we may hear very soon of the first trial of this novel and expensive venture, as much is expected from this event, since such an amount of money and skill has never before been expended on such an enterprise. All calculations have been so accurately made, every contingency so carefully considered, each possibility of failure so cautiously guarded against, that we cannot but hope that success will follow.

So while we have in Germany experiments going on in Aërial Navigation, we have at the same time, both in France and America, submarine navagation receiving a large amount of attention and experiment, especially in France quite a flotilla of these vessels of various designs have been built, from the

"Gustave Zede" to the present latest, the "Narval." This boat is propelled by oil engines for surface work, and electric accumulators for submerged propelling, which are sufficient to propel her, at surface, 250 miles at 8 knots per hour; her displacement being 160 tons. The "Argonaut" and "Holland" of the Americans are both said to have done marvellous work on their trials, but at the present their scope does not appear to be beyond a usefulness for harbour defence; however they seem to bid fair to compete with the "Nautilus" of extravagant fiction. When Jules Verne wrote his description of this boat, every one was taken with the strangeness of the idea. The author had merely collected together a number of old and new theories and clothed his conception in seemingly practical garb. Swift's account of the Island of Laputa, was based upon a curiously distorted theory of magnetism, sufficiently possible to make it interesting; and Buller Lytton's "Coming Race," in so far as Vril is concerned, turns upon a little more than the successful storage of electricity of high potential.

And now in conclusion let me add just a few words of tribute to our parent, the Royal Society of London, which has for the past 250 years, been an eye witness of the birth, rise, and progress of science; one which has at all times embraced within its membership the brightest scientific intellects of all nations, and one which recognises that "honour and fame from no condition rise." A society from which all other societies, special in their character have sprung, and it may well say unto itself, in the words of Tennyson, "For men may come, and men my go, but I go on for ever."

A vote of thanks to the retiring President for his address was moved by the Hon. A. Norton, M.L.C., seconded by the Hon. Dr. Taylor, M.L.C., and carried.

The Election of Officers for the year 1900, then took place with the following result:—*President*, John Thomson, M.B.; *Vice-President*, W. J. Byram; *Hon. Treasurer*, Hon. A. Norton, M.L.C.; *Hon. Secretary*, J. F. Bailey; *Hon. Librarian*, R. Illidge; *Members of Council*, F. M. Bailey, F.L.S., A. G. Jackson, C. J. Pound, F.R.M.S., J. Shirley, B.Sc., and J. W. Sutton; *Hon. Auditor*, A. J. Turner.

A vote of thanks was accorded to the retiring officers, after which the proceedings terminated.

END OF VOLUME XV.

NOTES ON THE ENTOMOLOGY OF A TEA-TREE SWAMP.

By R. ILLIDGE.

[*Read before the Royal Society of Queensland, 18th March, 1899.*]

Sombre and forbidding as is the appearance of a tea-tree swamp, yet there is much of interest to the lover of nature contained within its limits. Many of the trees are at present in flower, and the leaves themselves have a pleasant aromatic smell. Bird life is usually abundant, parrots alone, of two or three species, living upon the honey contained within the blossoms. Reptiles also are well represented, frogs and snakes being plentiful. However, it is not my intention to say anything further upon the higher animal life of these swamps, but to give a few notes upon the insect life, which, beyond the mosquito, to most people appears almost *nil*. Not so, however, is this the case, for but little research reveals a great variety of interesting forms.

But few butterflies are found in the swamp, and these merely are attracted by the flowers, not being true denizens of it, though members of the pieridae feed on loranthus parasitic on trees around its margin, as do also several species of skippers and a satyrid, Melanitis leda, upon certain kinds of grass growing within its borders.

Tunnelling the stems of melaleuca trees are several species of xylorycts, one very beautiful hepialid, charagia eximia (not, however, confined to the melaleuca, but frequently found therein). Other interesting borers which attack these trees comprise several species of longicorn beetles, of which the most noteworthy is

Symphyletes farinosus, the life history of which we have lately worked out. Another very pretty species is Zygocera pruinosa, which was found commonly along with the first mentioned. It is not, however, peculiar to the tea-tree, for we have obtained the larvæ and reared the perfect insects from various eucalypts. Predatory upon the larvæ of the above is the grub of a large elaterid beetle, Alaus sp. Another insect observed as emerging from the decayed stems is a tenebrionid, belonging to the beautiful genus Chalcopterus. Upon coming out from the pupa, this insect was bright rosy, with an iridescent sheen, which soon, however, changed to the usual metallic blue green. Its life history we have not yet clearly worked out.

Moths of many other families, the larvæ of which feed upon these swamp plants, are plentiful enough. Bombyces are represented by Teara protrahens, the caterpillars of which are gregarious, and eat the leaves of melaleuca. The most abundantly represented family is, however, that of the pyrales, of which very many species are found in the swamps. One very singular species attached to the tea-tree is gregarious, each insect forming a bottle-shaped nest, or cocoon, in fact, it serves both purposes. They may be often found twenty or thirty together on one little bush. The larva comes out at the lower end, which is prolonged into a tube some inches in length, to feed upon the leaves, and usually retreats backwards immediately it is disturbed.

Living in small communities, and arranged in regular order around the twigs, are found strange, repulsive-looking grubs. Posteriorly these larvæ are attenuated into tail-like processes, which wriggle about on the slightest disturbance, and probably are of a protective nature, in that they cause birds and animals to avoid them under the impression that they are stings. As a further protection, they also exude upon being touched a most disagreeable liquid. Neither birds nor animals appear to attack them. During the day-time they remain quiescent in the manner above mentioned, but at night they wander in search of food, the leaves of the twigs in their immediate vicinity. When full fed they burrow through the scaly bark of the tea-tree to the young wood, sometimes into it, and spin their cocoons. Such is a slight account of the saw-fly of the tea-tree.

There are many other insects. Some conspicuous for size are orthopterous, and commonly known as walking-stick insects, one species of which, attached to the swamp mahogany, is at least 6 inches long in the ♀, but has rather small wings, for they do not expand more than $2\frac{1}{2}$ inches, hence are more ornamental than useful; the ♂, however, flies well, and is, for these insects, quite an active creature.

However, as it would take up considerable time to go further into the entomology of a tea-tree swamp, I draw these very few notes to a conclusion, and would now respectfully draw your attention to the exhibit partly in connection with same, as it unfortunately only represents two orders of insects, the lepidoptera and coleoptera.

STONE COOKING-HOLES OF THE AUSTRALIAN ABORIGINES.

By R. H. MATHEWS.

[*Read before the Royal Society of Queensland, 18th March, 1899.*]

THE BEGINNINGS OF LIFE.

By W. J. BYRAM.

[*A Lecture delivered before the Royal Society of Queensland, 22nd April, 1899.*]

Of all the inscrutable problems for the solution of which man has vainly groped since his mental powers were so far developed as to enable him to reason the most momentous has been the supreme question "What is Life?" We see the manifold manifestations of life around us day by day in animal and plant; we associate with it the phenomena of spontaneous movement, of nutrition, of growth, of reproduction; we feel it in ourselves through the medium of its highest manifestation, our consciousness; we are in contact with it everywhere, always; and we are so intimate with it and its correlative, death, that we look upon both with the unquestioning eye of familiarity, and strangely forget that here we are in the presence of the greatest of all marvels, the most profound of all mysteries. We talk as a matter of course in a hundred varied phrases of every day life, of mind, of soul, of spirit; we fill our literature with beautiful conceptions concerning them, and our poetry especially clothes them in lovely images and telling metaphors; but in the silence of our studies—in those critical phases of our thought when the glamour of poetry is withdrawn and the scientific method dominates us we pause in awe and ask ourselves the old-time questions "What?" and "Whither?" Then we well know that if science cannot approximate to any answer to those questions they must rest for ever "behind the veil." All the vast speculations, all the grandeur of thought and subtlety of diction of the greatest of the abstract philosophers have been but so much vain beating of the air in all that concerns these momentous problems. Not in the arena of speculative philosophy, not in the tenets of any theological system, but in the cautious method of science lies the possibility of some adumbration of the truth. But though we know that in all probability the problem is insoluble to our finite faculties, though we know that we must fail under all existing conditions to reach the life source, there is a wonderful fascination in even approaching it, and in scrutinizing in its beginnings the mystery which afterwards passes through such infinitely varied phases, and culminates at last in that transcendent marvel conscious intelligence. There is a little poem of Tennyson's which you will at once remember:—

> Flower in the crannied wall
> I pluck you out of the crannies;
> Hold you here, root and all, in my hand
> Little flower—but if I could understand
> What you are, root and all, and all in all
> I should know what God and man is.

We have been apt to smile at that, and treat it as so much poetical hyperbole. But it is true notwithstanding. We cannot understand what the little flower is, for it involves the mystery of life; and though modern science is unlocking "door by door of mystery," we are nevertheless convinced that each unlocking will but reveal a vista of vaster mysteries beyond.

You will remember that so profound a philosopher as Herbert Spencer has reminded us in his "First Principles" that of necessity explanation must eventually bring us down to the inexplicable, the deepest truth we can get at must be unaccountable; comprehension must be something other than comprehension before the ultimate fact can be comprehended.

Yet, even while the recognition of these limitations fills us with humility, we cannot resist the overmastering temptation of getting as near as we may to the threshold of the unknowable. We know that our quest is a struggle against the infinite, but the very attempt is an elevating effort, which leaves him who makes it with broader views and higher thoughts and nobler aims.

You sit down to your microscope some evening and place on its stage a drop of water from some favourable locality. You see disclosed to your scrutiny a new world of life and beauty before undreamed of; but you must be blind for awhile to all the seemingly more striking objects in the field of view and concentrate your attention upon a certain insignificant jelly-like patch *(Amœba)*, which is attached to the cover-glass; which displays a very slow, gradual, diffluent movement, and keeps putting forth parts of its substance in the form of protuberances or processes. There you have the whole life-problem before you, ere you have fairly realised that you are looking at anything at all. That greyish-white, glairy, albuminous-looking patch is an amœba, a term which means "formless"; and, as the name implies, the amœba is a shapeless speck quite invisible to the naked eye. An insignificant speck truly, but a speck of a most marvellous substance, protoplasm, which differs from all other substances in having as one of its attributes *life* or *vitality*. Well has protoplasm been designated by the late Professor Huxley "the physical basis of life," for whether in the protozoon, or lowliest animal, in the protophyte or simplest plant, in a mushroom, in a tree, in a worm, or in a man it is the seat of the wonderful vital phenomena, and is the source and fount alike of all the bewildering complexity of the organic world. We now see that the understanding of Tennyson's little flower involves the understanding of protoplasm; and you might substitute for the complex flowering plant our amœba and apply the poet's apostrophe to it equally well. The amœba, therefore, is of profound interest to us as the type of the biological unit—the single cell. Here, on using the term cell for the first time, we must get a clear conception of what we mean. The term was brought into prominence in the first half of the present century by two German biologists (Schleiden and Schwann), and they both defined the cell as a minute vesicle enclosing fluid contents, that is to say, a small chamber or cellula, in the true sense of the word. This conception is a good example of one of those half truths which are often the first fruits of the scientific method. The definition exactly describes the usual form of the plant cell, and certain forms of animal cell; but we now know many forms of both the plant and animal cell in which the cell wall is entirely wanting. The research of the past fifty years has resulted in the modification of the idea of an enclosed vesicle; and although we still retain the term "cell" as a convenient mode of referring to the biological unit, we associate with it the modern definition, which simply declares that the cell is a minute mass of protoplasm endowed with the attribute of life. Looking at our amœba again we see that the idea of a vesicle cannot be applied to it, for it has no investing membrane. All we can notice is that the outer portion of its protoplasm is rather denser than the inner, and is free from granules. In the interior the protoplasm is much more fluid and is filled with streaming granules. In this inner portion we observe a small round or oval body called the nucleus, which is of different chemical composition to the surrounding plasm and in which the vital activity seems to be centred, for it has been shown that if the nucleus be removed the cell may still exhibit movement and irritability, but can neither grow nor persist. In the diagram also you will observe a space marked P.V., which stands for pulsating vacuole. Kindly remember that space for I shall refer to it again presently. We see, too, that the creature slowly, almost imperceptibly, puts out finger-like processes, which are technically called pseudopodia, or false feet. They may well be styled *false* feet, for they are not feet at all; they are simply prolongations of the protoplasm, and they are drawn in in one place and put out in another indiscriminately. By means of these pseudopodia the amœba creeps in a sluggish diffluent way across the glass, and it also uses them as tentacles to enable it to capture food particles. This brings us to another interesting phase of amœba life—the way it takes its food. It is a way that I have often wished that I could imitate myself when I have had the toothache. A food particle comes in contact with the surface of the cell, a process is put forth on each side of it, the processes close round it and it is drawn into the centre of the cell, where the nutrient matter is absorbed. You know the Yankee slang phrase which represents a man as "getting outside of" his victuals. The amœba realises that to perfection, and I have seen it in its sluggish way "get outside of" an immense meal of small things. Such aldermanic feeding powers cause the creature to increase in bulk, and when such increase has proceeded far enough it sets to work to reproduce its species. This is an equally simple process. A constriction appears in its nucleus and gradually the cell divides into two cells, each of them the counterpart of the original, though of course smaller in size. It is on this account that Professor Weismann has declared that under favourable conditions the amœba is immortal, that is, that it would go on subdividing in this way indefinitely. But we now know that this is not the case. After a certain number of subdivisions the momentum seems to be lost; and it appears to be restored by a remarkable reversal of the process. Occasionally two amœba are seen to approach each other, to meet, and gradually fuse into one. There is an interchange of nuclear material, and the result of the fusion is renovated powers of reproduction by subdivision. If you ask me why this union and interchange should effect this result, I can only answer "behind the veil." But while you have been looking at your amœba in a spirit of lofty criticism, you have been forgetting one little fact. If the amœba was not a remote ancestor of your own, something very like it was. It is a striking confirmation of this fact that the ova or egg cells from which the higher organisms are developed are in their earlier stages indistinguishable from amœbae.

The diagram shows the young stages of the ova or egg-cells. They are minute nucleated masses of protoplasm, from 1/200th to 1/220th of an inch in diameter, which put out processes or pseudopodia, perform the amœboid movements, and correspond very closely with the ordinary form of the amœba. The mature ovum, of which a diagram is now projected, has secreted a thin translucent cell wall, and neither puts out processes nor exhibits amœbiform motions. If you did not remember its earlier phases you might not consider that there was any analogy whatever between it and the amœba. But the correspondence is very strikingly shown by the fact that the amœba itself at certain times assumes what is known as the encysted condition, when it draws in all its processes, develops a cell-wall, and no longer shows the streaming and diffluent movements characteristic of the ordinary form. We thus see that the usual phase of the amœba corresponds to the young stage of the egg-cell, and the encysted amœba to the mature ovum. The amœba, therefore, begins to assume an interest and importance for us that we had not thought. That in the ontogeny of each one of us there was a time, when we were what it is, is an incontestable fact, and, knowing this, we have no difficulty in realising what the law of evolution declares, that in our phylogeny or race-history the amœba represents one of our earliest ancestors. The ancient Egyptians used to have a skeleton at their feasts, with a memento, "Such as he is you soon will be"; but the memento before me lately has related to the beginning, for I never look at an amœba without thinking, "Such as it is so once were you." If you still think that you have no connection with such a diffluent jelly speck as the amœba, just run a penknife blade into the back of your wrist, put a drop of your blood on a slide, dilute it slightly, put a cover glass on it, and examine it with a high power. You will see what is now thrown on the screen. Amongst the red blood globules, or corpuscles, you will notice, if you observe patiently, something which will make you exclaim, "That is very like an amœba; are there amœbae in my blood?" Yes, the leucocytes or white corpuscles of the blood are the analogues of amœbae, they perform the amœboid movements, put out processes, multiply by subdivision, and ingest solid particles, chiefly the bacteria which gain entrance to the system. This is beautifully shown in the two very remarkable and typical preparations made by Mr. Pound, the slides of which he has been so kind as to lend me. In the first you will see that the leucocyte is winning the day; it keeps intact, and is demolishing the invading bacilli. In the next the invaders are victorious, and the leucocyte is undergoing disruption, with the result that the death of the animal would ensue.

What then is protoplasm? That question brings us to the threshold of the unknowable. Protoplasm is not a single chemical substance. It is a vast complex of a large number of chemical substances known as proteids. These proteids are themselves, even looked at singly, the most complex of all known organic substances. To take an instance, certain ambitious chemists have endeavoured to express the molecule of one of them, egg albumen, by the formula C72, H106, N18, SO22, meaning that in its composition 72 parts of carbon, 106 parts of hydrogen, 18 parts of nitrogen, 1 part of sulphur, and 22 parts of oxygen are united in chemical combination. Considering that this is an approximation to the composition of one of the proteids, and that protoplasm is a complex of proteids influencing and reacting on each other in ways we cannot at present even dream of, you will realise with what a baffling mystery we are confronted. The scientific writers of a few decades back were accustomed to speak of the homogeneity of protoplasm and of the structureless character of the cell, and the poets still glibly affirm, like Sir Lewis Morris, that science has

> Thrust life to its utmost home,
> A speck of grey, no more nor higher.

A speck of grey, truly, but that speck in itself a labyrinth of matter, a laboratory of chemical activities utterly baffling in their bewildering complexity. Bearing in mind then that remarks about the homogeneity of protoplasm and the structureless nature of the cell are defective, let us pass on to scrutinize some further examples of cells. Turning back to our microscope, we shall not unlikely observe a whitish-grey spherical body, rayed like the small diagrams of the sun given in the text books of physical geography. This is the sun-animalcule, or actinophrys sol, as it is called scientifically, an organism very little higher in the scale of being than the amœba. It consists of but a single cell, a speck of protoplasm, which contains in its interior a number of empty spaces or vacuoles. At one side is a remarkable round space, which opens and closes with a regular rythmic pulsation like a minute colourless heart; this space, known as the pulsating or contractile vacuole, which we also saw in the amœba, seems to indicate a kind of rudimentary respiration. The water in which the sun-animalcule and amœba live has oxygen gas dissolved in it, and through the contractile vacuole the oxygenated water is distributed through the various spaces of the cell. The amœba and the sun-animalcule cannot live in water which has been boiled, and from which consequently all the oxygen has been expelled, and if we keep the cover glass of the live cage upon them they become languid, and afterwards break to pieces. There is, therefore, certainly a process of respiration. The sun-animalcule feeds and reproduces by subdivision in the same simple way as the amœba. And here again the subdividing process cannot go on indefinitely, for occasionally there is a union of two individuals as a prelude to increased powers of subdivision. How wonderful that all the essential vital functions should be present in that minute jelly speck! Having no stomach, it feeds and digests; having no respiratory apparatus, it performs the equivalent of breathing; having no nerves, it feels the slightest touch of any small creature that strikes its rays, for they bend together at the contact; having no eyes, it is so sensitive to light that it will shift to the side of a glass trough which is illuminated by a sunbeam.

Leaving the sun-animalcule, we take a little fresh yeast which we have obtained from our baker and examine it under the microscope. With a high power we find that it consists of a vast number of cells of globular elliptical form moving in fluid. These bodies are the yeast plant or Saccharomyces which produces the frothy fermentation of the yeast. They are unicellular plants, minute points of protoplasm surrounded with a very thin delicate cell wall, and by employing special methods of investigation a nucleus can be detected. The mode of reproduction in the yeast plant is peculiar. A small bud-like protuberance of protoplasm forms at the surface of the cell pushing out the cell wall before it. It enlarges, and at last a partition forms between it and the mother cell. Ultimately it separates, but before doing so may itself develop a bud, so that sometimes chains or groups of cells are formed.

Placing the yeast aside we take from one of our collecting flasks a drop of water obtained from a pond after a thunder-shower and which attracted attention by its uniform green tinge. On examination under the microscope we are surprised to find that the green tinge is due to a multitude of ovoid cells filled with bright green colouring matter interspersed with occasional spots of red. Each of these ovoid bodies is a little plant which consists of but a single cell and which has received the alarming name of Protococcus pluvialis—a name, however, which ceases to be a bugbear when we perceive that protococcus is simply a compound of two Greek words meaning primary grain or granule, and that pluvialis is a Latin adjective pointing to the fact that you are likely to find the little plant in your tanks after a heavy shower. Continuing your examination you see that the ovoid cells have a thick colourless cell wall enclosing the protoplasm in which we observe the nucleus and the bright green colouring matter known as Chlorophyll, which we see in the leaves of plants. The little cells are quite motionless, but keep them under examination patiently and notice what happens. The protoplasm of the cell divides into two, and the process is soon afterwards repeated, so that there result from four to as many as sixteen daughter cells contained within the cell wall of the mother cell. The enclosed cells assume a pear-like form, the cell wall bursts and the daughter cells are set free. As soon as this happens we are surprised to see that the free cells begin to swim actively about, and by careful treatment of one of them we are able to discern that the movement is caused by two long delicate filaments or processes, which have developed at the pointed end.

These filaments are technically called flagella. They act as propellers and their motion is so rapid that it is difficult to see them. After swimming about actively for a time the cells come to rest, draw in their flagella, develop a thick cell wall, and pass into the resting stage, to recommence another life-cycle of the same kind. I have called the protococcus a plant because it is filled with the green colouring matter of plants, chlorophyll, and because it obtains its nutriment as plants do by decomposing carbonic acid gas, appropriating the carbon, which is one of the elements of which that gas is composed, and giving off oxygen, the other constituent. Animals, on the other hand, cannot feed in this way, but derive their nourishment from already formed organic matter, which they submit to a process of digestion. Notwithstanding this distinction, we are now in the borderland between animal and plant, and we find that there is no line of demarcation between them. The protoplasm of the amœba, of the sun-animalcule, of the human leucocytes is the protoplasm of the yeast plant, of the protococcus, and of Tennyson's "flower in the crannied wall." It is all very well to compare a wallaby with a gum tree, and ask incredulously whether there is not a very decided line of demarcation between animal and plant. Look into your microscope again. Amongst the protococcus cells you see a spindle-shaped body as brilliantly green as themselves. One end is blunt, or snout-like, and is furnished with a long translucent filament or flagellum, just like the flagella of the motile stage of protococcus. It swims rapidly, and performs peculiar contracting, expanding, and twisting movements as if it were elastic. This strange body is a lowly animalcule, the Euglena. It is a mere point of protoplasm—a single cell—and we notice in its protoplasm the nucleus and the same remarkable pulsating vacuole which interested us in the sun-animalcule. At the snout-like end is a bright red pigment spot, which the discoverer of the creature took for an eye, and from it chose the Greek name Euglena, or bright-eyed. It is not even a rudimentary eye, however, for though the Euglena is sensitive to light, the greatest sensitiveness is in the other end of the cell, away from the pigment spot. The Euglena has, however, really the rudiment of a mouth, though it consists of but a simple depression or groove into the soft interior protoplasm. Through this depression minute nutrient particles are carried into the interior. But the remarkable fact is, that while the Euglena feeds in this way—the strictly animal way—it also obtains nutriment like a plant. It is filled with chlorophyll, the green colouring matter of plants, and under the influence of sunlight it can decompose carbonic acid gas, taking to itself the carbon and giving off the oxygen. Like protococcus, too, it passes into the resting condition, in which it loses it flagellum, secretes a cell wall, and undergoes the same phases of subdivision within the envelope, rupture of the envelope, and escape of the daughter cells. We thus see that in the Euglena there is a blending of the essential plant and animal characteristics; it is the one or the other as we list. The same doubtful position is occupied by a remarkable group of organisms known as Myxomycetes, or slime-fungi, which are found on bark, stones, or decaying vegetable matter. They are extended expansions of protoplasm, so ramified and interlaced as to form a network. The illustration shows one of them. Strange to say, these so-called fungi are constituted by the fusion of a number of organisms indistinguishable from amœbae, as becomes evident if we keep them under observation for a time. The protoplasm of the network, or plasmodium, as it is called, breaks up after arranging itself into a number of spherical spores, each surrounded by a cell wall of cellulose—a starch-like substance of which the wall of the typical plant cells is composed. These spores burst their enclosing cysts and assume the form of small amœbae, which, after remaining free for a time, coalesce to form the expansion or plasmodium with which we started. As if the more conclusively to show that nature abhors a line of demarcation even more than a vacuum came the discovery of Professor Haeckel, in the Canary Islands, of a minute orange-red marine organism of the lowest type of animal life, which he called protomyxa. It bears a striking resemblance to the slime-fungi just referred to. Like them, it is a network of protoplasm, which interlace and exhibit a constantly flowing and changing movement. In this phase it feeds like an amœba, by the ingestion of small creatures. But after a time the tree-like extensions are all drawn in. Then the interior protoplasm divides into a number of bodies, first spherical, but afterwards pear-shaped, and furnished with processes. The sphere bursts, and these bodies being set free swim actively about by means of their flagella. Soon they become transformed into amœbæ, which coalesce to form the extended network or plasmodium. Another lowly animal of a kindred nature, known as labyrinthula, forms a ramified expansion of protoplasm upon submerged objects, and another form, known as Vampyrella, attaches itself to microscopic plants and sucks out their protoplasm. You see it in the illustration attached to a stalked diatom. These strange organisms with their alternation of generations bring home to us the conviction that we are in the debatable land between the animal and vegetable kingdoms, and show us that the distinction between them diminishes until it is finally lost. Turning back to our microscope we observe in the field of view a number of fairy mats of a beautiful light green colour, with indented edges. In these we have an instance of a very large family of microscopic plants, the desmids, a word which means ribbon or chain-like, because they grow in ponds attached to water weeds in chain-like tufts. They are single cells—minute points of protoplasm—surrounded by an investing membrane, and they are remarkable for the beauty and variety of their forms—crosses, triangles, crescents, hour-glasses, spindles, circles, stars, cylinders, purses, hearts, ribbons, bands, necklaces, fairy mats. The photomicrograph is of the latter form, known as Micrasterias, or little star. If you keep one of these little plants under patient observation you will see that the notch in the centre, or suture, as it is called, gradually widens, a hyaline protuberance is put forth on each side ; each protuberance becomes lobed, and gradually grows into a new half-cell. Two cells thus result from the one, and separate to lead an independent life. But here again we find that the process of subdivision cannot go on indefinitely, but has to be recovered by the reverse process of union. At times two of the little plants meet, and their contents blend together. The result is the formation of a body so different in colour and appearance from either of them that if you had not actually witnessed the process you would not connect it with the desmid. This body is circular, its colour is light red, and it has long pellucid arms, indented at the extremities. It is known technically as a zygospore, that is a spore resulting from the process of conjugation. These zygospores sink into the mud, and will bear being dried up in the worst drought. At the first shower of rain they burst, and the contents develop into the ordinary fairy mats. The formation of zygospores is well seen in another little plant, the spirogyra. You cannot fail to have noticed the green slime which floats in tangled masses on standing water. If you examine some of this slime under the microscope you will see that it consists of beautiful green filaments, made up of cells placed end to end. The cells reproduce by subdivision, but here again at times two filaments (as far as we can see, in all respects identical) approach each other. Canals are thrown across to opposite cells, and through these canals the cells on one side pour their contents into the cells on the other. The contents fuse together, and form a reddish brown oval spore in each of the latter cells. Then the membrane bursts and the spores are set free. These spores may be dried up and carried by the wind to vast distances. At the return of favourable conditions they acquire flagella, swim about actively for a time, and then gradually develop into the usual filamentous form.

The next illustration shows another form of flagellate animalcule, which is so large as to be just visible to the naked eye. It is remarkable as being the cause of the phosphorescent light which you often notice in the sea; and it is therefore aptly named noctiluca, or the night-light. It is a peach-shaped body, and grooved something like a peach. From the groove proceeds the whip-like filament or flagellum. In the interior of the cell is seen the protoplasm, branching in all directions so as to form a reticulated mass. The light has a beautiful greenish tinge, and appears to originate from the marginal portion of the protoplasm, and to be due to electric action. When the noctilucae are very numerous they give rise to streams or tracks of light after any object moving through the water, a phenomenon which suggested the fantastic imagery of Coleridge in the "Ancient Mariner"—

> Beyond the shadow of the ship
> I watched the water-snakes.
> They moved in tracks of shining white,
> And when they reared the elfish light
> Fell off in hoary flakes.

The diagram now shown illustrates the beautiful slipper animalcule, or paramœcium, as it is called scientifically, an animalcule common in ponds and standing water. As it darts into the field of view we notice that it is surrounded with minute quivering hair-like processes, known as cilia, which glisten like spun glass. These cilia are the same thing as flagella; they are prolongations of the protoplasm, but they are far more numerous and delicate. We observe, too, in the protoplasm a groove or primitive gullet, and two pulsating vacuoles, one at each end. These vacuoles, shown separately in the diagram, are more complicated than in the amœba or sun-animalcule, for as they pulsate we notice from six to ten delicate spindle-shaped spaces forming star-like vacuoles. The paramœcium reproduces by subdivision, and in it also, as the researches of Hertwig and others have shown, we have the same phenomenon of the union of two individuals as a momentum to renewed powers of feeding and subdividing. Hertwig says that the union brings about a complete reorganisation of the nuclear apparatus and at the same time of the infusorian. The individuals which have thus become rejuvenated have regained the capacity of multiplying enormously by means of division, until again the necessity for a new conjugation arises. During a period of six and a-half days a single individual, when provided with sufficient nourishment, divides thirteen times, that is to say, produces about 8,000 descendants.

If we have water weeds under examination, we often see pendent from them a number of beautiful little crystal bells on flexile stalks, which expand to a straight line and suddenly contract in corkscrew fashion as the bell darts downwards. These are the vorticellae, or bell flower animalcules, another example of the ciliated infusoria. We notice that each bell is crowned with a circlet of cilia in rapid vibration, and as they vibrate little whirlpools or vortices are produced in the surrounding water. Like all the other lowly forms that we have reviewed, the vorticella reproduces by subdivision, and when a colony gets too large some of the members of it detach themselves from their stalks and swim away to find fresh pastures elsewhere. This is a mere method of dispersion, but at times, if we watch the bells closely, we observe a cluster of buds at the base of certain of them, which looks something like a minute crystal bunch of grapes. These buds develop cilia, detach themselves, and after swimming about for a time approach the bells and gradually fuse into them. This is another phase of conjugation, and after it the vorticella acquires quickened powers of feeding and subdividing. As instances of other infusors we may notice the opalina and gregarina, which are curious as showing how species of infusoria can become parasitic. The opalina is found in the large intestine of the common frog, where it is nourished by the partially digested food of its host. The gregarina is found chiefly in the intestinal canal of the earth-worm. The ordinary adult form is shown in the diagram A. Instead of cilia it has at the distal end a small circlet of hooklets. Diagrams B and C show two individuals uniting. They fuse and pass into the encysted condition as at D; then the protoplasm breaks up into an immense number of spores, as at F, the investment bursts, and each spore develops into a new gregarina. Those earth-worms have my profound sympathy. But while you have been considering these infusors, and perhaps feeling some disgust at the parasitic forms, you may not have realised that here again you are in contact with creatures which have an intimate connection with yourself. The human body furnishes examples of a multitude of infusors, which are part and parcel of us, just as the blood globules and leucocytes are part and parcel of us. The whole of the respiratory tract, the lower parts of the nasal passages, the central canal of the spinal cord, and other parts of the body are lined with cells, which are furnished with cilia, and if detached will swim about by means of their cilia and maintain for a time an independent life, like true infusors. These ciliated epithelial cells are shown in the photomicrograph now on the screen.

In all the instances which we have considered we have had cells either consisting of naked protoplasm or surrounded by a cell wall of cellulose, the starch-like substance already mentioned; but in a very large family of microscopic plants, or animals, as some still insist, the diatomaceae, the protoplasm is enclosed in a minute silicious test or shell. These casings consist of double valves of pure silex or flint, and are objects of exquisite beauty, not only from the variety of their forms, but from the mathematical accuracy of their shapes and the marvellously minute markings upon them. In the living state they are filled with a yellow or yellowish green colouring matter, and they are endowed with the power of spontaneous movement, the cause of which is obscure, for they are not furnished with flagella or cilia or any other apparent means of locomotion. The variety and beauty of their forms is shown in the photomicrograph, which is a portion of a strewn slide of 150. [Dk. ground.] That is a smaller portion of the same slide which I have taken with dark ground. [Dk. ground triceratium.] That is a triceratium, or triangular diatom, also on a dark ground. [Group.] This photomicrograph is a grouped slide, from which you will see the mathematical precision of the shapes. [Arachnoidiscus.] That is the beautiful arachnoidiscus, or spider-web disc, the reason for the name being obvious. [Pleurosigma.] That photomicrograph is the beautiful pleurosigma under a high power. And I should like to direct your attention to the small portion at the side turned back so as to show the two sets of markings. It is a pretty feat of mounting that, when we consider that the whole object is a minute point invisible to the naked eye. The diatomaceae occur in every part of the world in countless myriads, and how numerous these minute organisms have been in the geological past you will realise when you learn that they occur fossil to such an extent that whole strata consist of little else, and whole mountains are composed of them. The slide now projected shows some of this diatomaceous earth.

The enclosure of the protoplasm in a test or shell occurs in a variety of other forms. In the animalcule called Gromia, the shell or carapace is of chitin, a peculiar horny nitrogenous substance, of which the wing cases of certain insects are also composed. In the shell there is only a single small orifice at one end, and through this the protoplasm streams forth abundantly, completely investing the shell externally, and branching and re-branching and interlacing so as to form a delicately complicated network. The carapace is the home-centre, and in states of quiescence the whole of the protoplasm is withdrawn into it. The creature is like an amœba that has acquired a shell.

Another example of the enclosure of the protoplasm in a test or shell is seen in the beautiful little creature, Clathrulina elegans. That name sounds formidable, but the word Clathrulina simply means little trellis or grating, and you will at once see that the name has been given to it on account of the perforations in its shell. The shell is placed upon a stalk, which, like the shell itself, is composed of silex or flint. The creature is a speck of protoplasm, and through the apertures of the shell it puts forth rays like the sun-animalcule. This comparison with the sun-animalcule is no fancied resemblance, as the method of reproduction shows. At times numerous small oval masses of protoplasm are formed within the shell. They escape, acquire flagella and swim about actively. Then they assume the form of free sun-animalculae, and ultimately gradually acquire the silicious shell and stalk. From these forms the transition is obvious to the two extensive and beautiful marine groups of the radiolaria and foraminifera. The radiolaria are so called from the raylike arrangement of their processes or pseudopodia. Like the last form, they are sun-animalcules, enclosed in silicious tests or shells. These shells are of remarkable beauty and variety, as you will see from the photomicrograph of some of them, taken with dark ground illumination. In the next two illustrations the radiolaria are represented in their living state, with the rays protruding from the numerous orifices. No less striking from the variety and graceful sculpture of their forms are the foraminifera. In their case, however, the tests or shells are not composed of flint, but of carbonate of lime. The animal itself is simply a point of protoplasm resembling the amœba, and, like it, putting out processes or pseudopodia. These are often so numerous that they interlace and form a protoplasmic network, as you will observe from the diagram of a very graceful form, the rotalia, in which the shell is many-chambered, and is covered with minute pores, through which the processes are put forth. Another elegant form is the miliolina, in which the shell is a spiral, whose convolutions are folded over each other. In another form, called by the fantastic Greek name Haliphysema, or bubble of the sea, there is an approximation to the sponges, for the protoplasm is enclosed in a cell built up of a mass of spicules or needle-like rods, which are characteristic of the skeleton of sponges, but also occur upon the integument of the echinodermata, sea eggs, sea slugs, &c. In one of the latter, the synapta, these calcareous spicules assume the form of beautifully symetrical anchors and plates. They are shown in the photomicrograph arranged in a group. So vast has been the number of the foraminifera in the geological past that whole strata are composed of their fossil tests. The chalk beds are almost entirely made up of them, and one species, the nummulites, occurred in such vast quantities that they form a band of limestone stretching from the Atlantic shores of Europe and Africa through Western Asia to Northern India and China. The photomicrograph represents a section of chalk rock, with partly decomposed tests, and the diagram illustrates the various forms of foraminifera from the chalk. The next diagram shows several forms of foraminifera, but I wish particularly to direct your attention to the section of nummulitic limestone with the organisms in situ. This limestone is of great interest to us as being the material of which the pyramids are built. And what a wonderful lesson of life energy those pyramids afford. Think of the countless myriads of exquisite living forms whose fossil tests made up the limestone; think of the untold ages it took to consolidate those shell masses into rock; think of the strange semi-civilisation of the Egyptians and of the appalling expenditure of human life and energy by which the Pharoahs raised those vast edifices—monuments not of the superior wisdom of the Egyptians, as the ignorant even yet believe, but of an iron despotism, which could only be the concomitant of semi-barbarism. Nummulities in untold myriads, limestone rock, armies upon armies of human beings under the lash of the task-masters—the pyramids!

It is most interesting, too, to know that processes similar to those which formed the limestone of the pyramids and the chalk strata are still proceeding. This is evident from the microscopic examination of the silt which collects in bays and estuaries, and from the so-called ooze which is brought up by soundings from great ocean depths. Let us hope that these minute organisms are not building up a new limestone for the erection of new pyramids by a Pharoah of the future. When I see how strong are the forces of reaction and obscurantism I often fear it.

From the lowly forms of life, which consist but of single cells, we pass by slow gradations to those higher organisms, which are aggregates of cells, and whose structure becomes more and more complex, more and more differentiated; and long before we come to man, the highest, we have amply realised the truth of Darwin's remark that each living being must be considered as a microcosm, a small universe which is formed from a collection of organisms, which reproduce themselves, which are extremely small, and which are as numerous as the stars in heaven. So great is this complexity in ourselves that language fails to express it. Consider the number of globules in the blood, the vast multitude of nerve cells in the skin, which you see in the diagram, or the intricate differentiation in the human eye. Each of us is an immense army of living beings—the body cells, in their various differentiations, the sum of whose activities makes up our consciousness, for they are governed by and co-operate with a wonderful group of cells in the brain, the thought-cells. The realisation that we ourselves are cell aggregates leads us to observe with absorbing interest the first advances which the biological unit makes along the path which leads to such bewildering complexity and to such a marvellous phenomenon as conscious intelligence. With a few illustrations in this direction I must occupy the remainder of my paper. We saw in spirogyra that the cells adhered end to end so as to form a filament; but each cell is the counterpart of every other cell, and if separated is perfectly able to lead an independent life. There is no assumption by different cells of different functions—no division of labour. A step higher we have colonies of cells. You can often obtain a beautiful example of such a cell colony in the ponds round Brisbane. If you obtain a bottle of water from any of these you will not unlikely observe, on holding it up to the light, a number of minute green globes, just visible to the naked eye, rolling slowly and majestically onward, and at the same time rotating on their axes. This is that favourite of microscopists, the volvox globator. When one of these tiny globules is examined with a low power it looks like a light green pellucid net dotted regularly with minute green spots, and generally having within it from two to eight smaller spheres. When each of the spots is examined more carefully, and with a higher power, it is found to be a cell—a speck of protoplasm, furnished with two long processes or flagella, just like the active form of protococcus, of which you saw a diagram earlier this evening. Although the appearance of the volvox is that of a net, there are no interstices or gaps in the surface of the sphere, for each cell is connected with the cells around it by means of its hyaline envelope. The green bodies in the centre of the net are young volvoces, which have been formed from enlargements of the ordinary cells, and when sufficiently developed have detached themselves internally, remaining in the parent sphere until it finally bursts and they swim forth. Before this happens you may often see them revolving by the action of their own flagella in the interior of the mother sphere, and the mother sphere at the same time rotating itself. It is a most beautiful sight, and one of which the crushed and broken forms of the photomicrograph on the screen can give you no idea. The beginnings of differentiation are further seen in the beautiful little fresh water plant called by the quaint name of Batrachospermum, or frog spawn, to which its whorls of cells were supposed to bear a resemblance. The whorls are made up of beaded filaments, and the main axis consists of elongated cells, but certain of the beaded filaments, instead of radiating from the main axis, grow downwards upon it and form an envelope, closely investing it. Here we have a step towards differentiation, or division of labour, for these investing cells are no longer independent, but constitute a membrane foreshadowing the cuticle or cortex of the higher plants. Another illustration is afforded by the higher forms of sea weeds, where we meet with a faint hint of the distinction between leaf stem and root. The photomicrograph shows the cells of the frond of the beautiful Polysiphonia. These are vegetable types, but differentiation in the animal follows a similar course. From single cells like the sun-animalcule we pass to groups like the vorticella, and thence to colonies of animals. But still each cell lives for itself alone ; there is no division of labour. Go a step forward, however. There is a little creature known as the hydra, often found in ponds amongst duckweed and utricularia, which shows in a most decided manner the early advance in differentiation. I have often met with it in the ponds in Bowen Park. It consists of a cylindrical body, ending in a small orifice, and crowned with from six to eight tentacles, with which it captures minute creatures for its food. As we watch the hydra we observe that it assumes so many different shapes that if you did not see it passing from one to the other you would not connect them with the same animal. Sometimes it is an almost spherical mass, and the tentacles are reduced to small rounded excrescences ; sometimes it is fully expanded and the tentacles are thin, delicate processes. Between these extremes every gradation occurs. The photomicrograph on the screen shows it about half expanded. The diagram presents it in its fully expanded condition. In structure the body of the hydra consists of but two layers of cells, an outer and an inner, but the inner cells have taken upon themselves the function of nutrition, and the outer cells are both irritable and contractile, forming a kind of rudimentary nervous and muscular system. In certain of the outer cells there is a strange and deadly weapon. If we tear a hydra to pieces with very fine needles and examine the pieces carefully with sufficient magnification, we see that certain of the outer cells possess peculiarities. They exhibit a clear elliptical cavity. Coiled up within this cavity, like a spring, is a delicate thread, furnished at the basal end with three projecting barbs. The cavity is filled with a poisonous fluid, though what its chemical nature may be I have never been able to determine.

Certain it is that this weapon is of great use to the hydra, as you will realise if you watch one of them feeding. A water flea or other small creature comes in contact with one of these machine guns. The spring uncoils with such force that the cavity and the thread are turned inside out. Then you see that the water flea, before so alert and lively, is completely paralysed, and if the hydra is feeling in need of a meal the captured prey is brought within reach of the tentacles and gradually transferred to the digestive cavity. The interior layer of cells comprises cells of two different varieties. Like the outer cells they are nucleated, but, unlike them, some of them are seen to possess one or more filaments or flagella, and others are constantly varying their free ends by the protrusion and drawing in of pseudopodia or processes; they are, as it were, a series of amœbae fixed in their places. The inner cells are a rank of flagellate monads and of amœbae marshalled into line and working for a common end—the nutrition of the cell aggregate.

Ordinarily the hydra reproduces by budding; a small excresence makes its appearance on the exterior. It is formed by a pushing out of the two layers of cells. It becomes lobed at the outer end, and gradually develops into a young hydra. This capacity for reproducing by budding brings about a curious result in the hydra. You remember in the Greek mythology which you studied at school reading the myth of the hydra or many-headed serpent which Hercules destroyed. It was a nasty customer to deal with, because when Hercules cut off any one of its heads two new ones grew in their place. Our hydra realises something akin to that, for you may make mincemeat of it, and each piece will develop into a perfect hydra. I have referred to the volvox and hydra only so far as to show the advance in differentiation, or division of labour. A lecture of many hours duration might be devoted to the life histories of either of them. The hydra is of the greatest interest to us, for it represents the permanent form of what is known in embryology as the gastrula stage in development—a stage through which the majority of the higher organisms pass early in their prenatal history, a stage in which they consist of a purse-like form composed of but two layers of cells, the inner performing nutritive functions, and the outer the functions of sensation and protection, just as in the hydra. From the hydra we proceed to the hydroid polypes, or zoophytes. Some representatives of them are to be found on all coasts in rock pools left by the tide or attached to sea weed, and to the unaided eye resemble small pieces of cotton thread. I have photographed a portion of one of them. They are like colonies of hydrae, for the bells, or hydranths, as they are called, are each of them a zooid or living being, though they are attached to a common stalk.

I cannot pursue this subject further, it is too extensive, and I must be content with very few concluding remarks. As I have said, we cannot answer the question, "What is life?" but if we are even to approximate to a solution of the problem we must divest our minds of the idea that it is something apart from other phenomena, something unique and supernatural. It is a mystery in the same sense that electricity is a mystery, or that gravitation is a mystery; its causes are so recondite that they elude our limited powers of comprehension. We must hold, provisionally, that it is the attribute of protoplasm, the resultant of the interaction—the intricate chemical change and interchange of the porteids of which that most instable complex consists. We have no knowledge of life apart from protoplasm; such a thing is inconceivable. Yet we must frankly admit that we do not know what life is or what its origin has been. As far as the precise experiments of the late Professors Tyndall and Huxley, and of the eminent biologist, Dr. Dallinger, extend, spontaneous generation or abiogenesis has been negatived. As far as we can see under existing conditions all life comes from previous life. But it must be remembered that precise as they were, these experiments are essentially imperfect. They only prove that at the present time, in a small confined space, and under existing conditions, all life is the derivative of existing life. When we take all the analogies into consideration, there is a strong probability that there is no line of demarcation between the living and the inorganic; but that, if not now, at anyrate under different conditions in the geological past, protoplasm, with its attribute life, originated from the non-living. This is, indeed, an irresistible corollary from the law of evolution, otherwise we must ascribe the first appearance of life to a special fiat of the Creative Power, a theory which is not only unthinkable, but which has been beaten all along the line. More and more, too, the mechanical theory of life is winning its way, despite old school treatises like Dr. Lionel Beale's book on Protoplasm. We find life constantly standing in relation to the physical forces. It does work, and in doing it uses up the protoplasmic material, which has to be renewed by the assimilation of other protoplasm, as in animals, or the metabolism of inorganic matter, as in plants. It is manifested in conjunction with other forms of energy, heat, light, and electricity, and seems to stand in the same category as they. Indeed, as the suggestive experiments of a German biologist, Professor Bütschli, have shown, the work which the protoplasm does in the movements of the amœba may be imitated mechanically. He prepared frothy mixtures of oil with certain chemical substances, chiefly olive oil and finely powdered potassic carbonate, which makes a soapy foam. Tiny drops of this emulsion introduced into water, and viewed under the microscope, are found to be filled with vacuoles, and to exhibit, for as long a period as six days after their preparation, the streaming, diffluent movements of the amœba, and, like the amœba, put out and draw in processes, or pseudopodia, and creep across the glass. But remembering the vast complexity of protoplasm, and the comparative simplicity of the oil-foam, we must suspend our judgment as to whether the movements of the amœba are purely mechanical. The striking correspondence shown by Professor Bütschli may be more apparent than real. Still, the whole tendency of scientific thought favours the mechanical theory of life, and if anyone should collate these considerations with the further one that the soul of man is but a name we have given to the sum total of his consciousness, and should feel pain or alarm in consequence, we can only remind him for his comfort that what we know is but an insignificant fraction of the vast unknown and unknowable. In that dark region there is room for boundless possibilities, boundless hope.

[The diagrams and photomicrographs with which this lecture was illustrated will be reproduced in a future Volume of the Proceedings.]

THE NATURE AND ORIGIN OF LIVING MATTER (PROTOPLASM).

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MR. BYRAM's exceedingly interesting paper on the "Beginnings of Life" touched at its close on topics which belong, as he remarked, rather to the realm of philosophy than of science, strictly so called. He described to us the simplest known living beings, illustrated in a very able way their marvellous variety of form and activity, and at the same time pointed out their apparent simplicity of structure; how that they all were but modifications of a single cell, that is, a naked mass of jelly-like protoplasm, containing a central portion of greater density known as the nucleus. We were shown how cells of the closest similarity of form and activity to these existed in the higher animals and plants, how the tissues of all animals and plants were composed of collections of such cells, modified more or less from their primitive simplicity to perform special functions, yet never departing very far from it; and how, in fact, every animal and plant, every one of us, originated from a cell of very simple form, the ovum, closely comparable to an amœba, or other unicellular organism. So far our lecturer kept to the firm ground of science. All that he told us is easily demonstrable, and very much of it can be actually seen by anyone who will devote a little pains to the investigation. But anyone so doing, if of a thoughtful disposition, can hardly fail to ask himself certain questions, which, as Mr. Byram remarked, are probably to be regarded as insoluble. What is the nature of this glairy, transparent, mobile substance we call protoplasm, which forms the body of this shifting speck of life? How does it differ from other substances know to us as lifeless and inorganic, and is this difference merely one of degree, or is there a deep and unfathomable gulf between them? Finally, how did living matter first arise and come to exist?

You will not, I hope, suspect me of thinking I have any new solution to offer of these well-discussed problems. Scientifically they are insoluble. They take us into regions where observation and experiment, the methods of science, are unavailing, and where the human mind is ever in danger of mistaking its self-evolved imaginations as equivalent to demonstrated truths, or worse still, of mistaking merely verbal solutions for real. For the latter error there is one sufficient remedy, and that is to substitute mentally the meaning of the word, or, in logical terms, the definition, for the word itself, and unless one is continually prepared to do this the discussion of any philosophical problem becomes futile.

When, for instance, we are told that all matter is living, that there is no such thing as dead inorganic matter, we are, I submit, in danger of deriving comfort from a mere verbal assertion. For if we apply the term living to all matter, what meaning do we attach to it? That there are great and real differences between living and non-living matter is a fact of science, which we cannot explain by denying it to be. If, however, the assertion be explained to mean, in more accurate language, that the protentiality of life exists in all matter, that the properties of living matter exist in an attenuated degree, or in a dormant condition, in simpler chemical combinations, we have an admissible hypothesis, which deserves discussion. But the facts must be recognised in the first place.

Let us for a moment contemplate the amœba, and consider the properties of its living substance. I cannot do better than quote one of the earliest observers, who sixty years ago described this substance, not by the term protoplasm, by which we know it, but by the term sarcode. "I propose," said Dujardin, "to name sarcode that which other observers have termed a living jelly, a substance glutinous, diaphanous, homogeneous, refracting light a little more than water, but much less than oil, extensible and ropy like mucus, elastic and contractile, susceptible of spontaneously forming within itself spherical cavities or vacuoles which become occupied by the surrounding liquid. The most simple animals, such as amœbae and monads, are entirely composed, at least to all appearances, of this living jelly. Sarcode is without visible organs, and has no appearance of cellularity; but it is nevertheless organised, for it emits various prolongations along which granules pass, and which are alternately extended and retracted; in one word, it possesses life." In this old description, to which the most recent science has but little to add, you will note the stress laid upon the movements of protoplasm as indicative of life. And, indeed, these movements are sufficiently remarkable. It is true that of recent years Bütschli has shown that if oil be rubbed up with certain alkaline salts in a moist condition, and a minute fragment of the paste be examined in water, the latter diffuses into the paste and converts it into a froth, in which streaming movements occur and changes of external form not unlike those shown by living protoplasm. These movements are due to diffusion currents set up by the chemical changes taking place between the water and the soapy oil. How far they can be regarded as explaining the movements of protoplasm is, I think, very doubtful. Similarity may be apparent as well as real, and it is very doubtful whether protoplasm really consists of a vacuolated mass as Bütschli contends, and further, even more doubtful whether these simple diffusion currents, which cease after a time, really explain in any way true amœboid movements.

But there are other and more subtle differences between living and non-living matter. A proper mental grasp of these is essential to the understanding of our problem. They consist in chemical changes which are characteristic. All living matter has this in common, that it continually absorbs oxygen and gives off carbonic acid. If you will consider this for a moment, you will see that it involves the recognition of the fact that living protoplasm is always in a state of wasting or decomposition. Its constituent molecules, which consist partly of carbon, are continually becoming oxidised and breaking up into much simpler non-living chemical compounds. As a necessary condition to its existence, it possesses the opposite power of taking up non-living matter and transforming it into protoplasm. Its chemical equilibrium can only be maintained by a continual succession of chemical changes, opposite in character, for its substance is in a continual state of flux. On the one hand is an in-stream of molecules containing carbon, nitrogen, &c.; on the other, an outflow of the same elements in other, usually much simpler, combinations. By these chemical changes a continuous formation of energy takes place, which energy is given off as heat, or sometimes also partly as mechanical motion, or in other ways. Living matter is continually in a state of unstable chemical equilibrium.

By a preponderance of assimilation over waste the living cell grows in size. A consideration of the statements just enunciated will convince you how fundamentally different such growth is from that, for example, of a crystal. The latter growth is wonderful to contemplate, but it is a growth by accretion; each increment once formed is stable. The growth of the cell usually ends in division, which, in the case of the amœba, leads to the formation of two individuals each resembling the parent cell. But in the higher animals, the process of cell division leads to more complex developments. A brief glance at these is necessary for our purpose.

The human ovum, not very different in structure from an amœba in the encysted stage, consists of a nucleated cell about fifteen of a millimetere in diameter, forming a speck just visible to the naked eye. The first stages of development consist, as in much humbler forms of life, in the division of this cell into two, four, sixteen, and more cells, forming a cluster, somewhat resembling the form of a mulberry. As the cells multiply fluid accumulates between them, and they form a minute vesicle, round which the cells are grouped at first in two, then in three layers. From these three layers of cells are developed by successive steps all the marvellous complexity of the adult human frame. The process by which this change occurs has to a great extent been observed and mapped out. It is a wonderful history, and the process by which each cell assumes its right place, and each group of cells differentiates itself into the right tissue in exactly the right situation, is entirely baffling to the imagination. Let me very briefly glance at the developmental history of one portion of the human frame. It is at first surprising to learn that the whole nervous system is developed from ancestral cells, which formed part of the external surface, or skin, of the embryo. As the development of the individual is but a recapitulation, with some modifications, of the development of the race, this fact seems to take us back into a very remote past, when the cells specially devoted to sense-perception, which would naturally be situated near the surface, were not yet differentiated into peripheral sense organs and central cells, receiving nervous impressions from these sense organs. However this may be, you will observe in a very early stage of the embryo of a hen's egg, or of any other vertebrate, the appearance of a superficial groove, bounded by two ridges of thickened cells. These ridges increase in height, meet above, and coalesce, forming a tube lined by cells which originated from those covering the surface of the embryo, but have become distinct from them. The forepart of this primitive nervous tube undergoes very complicated changes, into which I will not enter, to form the brain. The hinder portion retains to the end very much of its primitive form, and constitutes the spinal cord of the adult. The first step towards the connection of the embryonic spinal cord with the other organs and tissues is a budding out of groups of cells along its dorsal surface on each side. The cell-buds become detached as little cell-islands, which develop into the spinal ganglia. In the next place the cells of these embryonic ganglia grow out into processes at each end, the two processes of each cell travelling in opposite directions. The centrally growing processes return to the spinal cord, and so resume connection with the central nervous system. The remaining processes have a peripheral direction, and form the sensory nerve fibres. They are joined by outgrowths from the anterior cells of the spinal cord, which grow out to form the motor nerve fibres. At each vertebral segment a nerve is formed by the union of one of the motor and sensory roots. I wish you to try and picture to yourselves the peripheral growth of these nerve fibres, how they insinuate themselves among the other tissues, as the roots of a plant insinuate themselves between the particles of the earth on which it grows. But the process is not an aimless one; each nerve cord, each branch, each filament takes its determined course, and no part of the body is free from their invasion. The sensory filaments form a network all over the body, but of especial fineness on its surface. The motor filaments seek out the developing muscles, and each one attaches itself to its appropriate muscular fibre. If you try to realise this you will gain a faint conception of the method by which one strand is woven in the wonderful fabric of flesh common to all of us.

The purpose of this brief sketch has been to bring home to your minds the real and great difference between the phenomena exhibited by living matter, that is to say, protoplasm, and other varieties of matter. As to this difference there is no dispute, and the more one grasps it mentally the less inclined one is to minimise it in any way. But when we come to the explanation of this difference, we find two possible alternatives. We may regard protoplasm as ordinary matter acted upon by ordinary chemical and physical forces, but of exceedingly complex constitution. Or we may regard it as ordinary matter plus an immaterial something to which is commonly applied the terms "life," "vitality," "vital principle." On the former alternative the differences between protoplasm and ordinary matter are differences of great extent, it is true, but only of degree. On the latter hypothesis there is a gap between the two which no thought nor reasoning can bridge over.

I have lately been reading a quaint old book written some two hundreds years back by one of our old English naturalists, John Ray. It so happens that in this work two opposing views as to the nature of living matter are both stated. In treating of this very development of the animal body, Ray remarks—"It seems impossible that Matter, divided into as many minute and subtle Parts as you will, or can imagine, and those moved according to what Catholick Laws soever can be devised, should without the Presidency and Direction of some intelligent Agent, by the meer Agitation of a gentle Heat, run itself into such a curious Machine as the the Body of Man is." The difficulty, which must have occurred to everyone who has considered the problem, could not be stated with more definiteness. When Ray is treating of another subject, the contractions of the heart, he states his views again. The cardiac contractions were, he supposed, due to an influx of spirits (by which he did not mean anything immaterial, the word meaning simply gases or vapours) into the heart during systole. "What," he asks, "directs and moderates the Motions of the Spirits? They being but stupid and senseless Matter, cannot of themselves continue any regular and constant Motion without the Guidance and Regulation of some intelligent Being. You will say, What Agent is it which you would have to effect this? The sensitive Soul it cannot be, because that is indivisible, but the Heart when separated wholly from the Body in some Animals continues still to pulse for a considerable time; nay, when it hath quite ceased it may be brought to beat again by the application of warm

Spittle, or by pricking it gently with a Pin or Needle. I answer, it may be in these Instances, the scattering Spirits remaining in the Heart, may for a time, being agitated by Heat, cause these faint pulsations, tho' I should rather attribute them to a plastick Nature or Vital Principle." This "plastick Nature" was a great comfort to John Ray, by its means he releases himself from every difficulty. It answers, I apprehend, exactly to the term "vitality" or "vital force," which, till quite recent years, could always be invoked to cut the knots of physiological puzzles. But on the very next page to the quotation given is an extract from a contemporary work by Mr. Boyle (whether the same as the physicist who enunciated Boyle's law of the volume of gases I have not ascertained), in which a very different order of ideas is introduced. "I think it probable," writes Boyle, "that the great and wise Author of Things did, when he first formed the Universe and undistinguished Matter into the World, put its Parts into various Motions, whereby they were necessarily divided into numberless Portions of differing Bulks, Figures and Situations in Respect of each other; and that by his infinite Wisdom and Power he did so guide and overule the Motions of these Parts at the Beginning of Things, as that (whether in a shorter or longer Time Reason cannot determine) they were finally disposed into that beautiful and orderly Frame that we call the World; among whose Parts some were so curiously contrived as to be fit to become the Seeds or seminal Principles of Plants and Animals. And I further conceive that he settled such Laws or Rules of local Motion among the Parts of the Universal Matter, that by his ordinary and preserving Concourse the several Parts of the Universe thus once completed, should be able to maintain the great Construction or System and Economy of the Mundane Bodies and propagate the Species of living Creatures." Ray's reply to this hypothesis is so curious that I must quote it:—"This Hypothesis, I say, I cannot fully acquisce in, because an intelligent Being seems to me requisite to execute the Laws of Motion; for first Motion being a fluent Thing, and one Part of its Duration being absolutely independent upon another, it doth not follow that because anything moves this Moment it must necessarily continue to do so for the next, unless it were actually possessed of its future Motion, which is a contradiction; but it stands in as much Need of an Efficient to preserve and continue its Motion as it did at first to produce it.

Secondly, let Matter be divided into the subtilest Parts imaginable, and these be moved as swiftly as you will, it is but a senseless and stupid being still, and makes no nearer Approach to Sense, Perception, or vital Energy than it had before. . . And as for any external Laws or establish'd Rules of Motion, the stupid Matter is not capable of observing or taking any Notice of them, but it would be as sullen as the Mountain was that Mahomet commanded to come down to him; neither can those Laws execute themselves. Therefore there must, besides Matter and Law, be some Efficient, and that either a Quality or Power inherent in the Matter itself, which is hard to conceive, or some external intelligent Agent, either God himself immediately or some Plastic Nature."

It is my opinion that, judged even by the standard of his own day, Ray was a better naturalist than philosopher. My object in reading these extracts is to point out some errors that may not yet be entirely dead. Firstly, we have the highly figurative and wholly false conception of the "laws" of nature as something which poor, stupid matter has to understand and obey. Secondly, we have assertions regarding motion which are purely verbal, and embody no real conception of what actually occcurs. Here, of course, science has advanced greatly since Ray's time, and we know motion to be both universal and indestructible, and to exist in forms which were then unsuspected. Thirdly, I would ask is there not something purely subjective also in Ray's ideas of matter? Have we any right to speak of "stupid and senseless matter"? Are not these question-begging epithets?

Whatever view we may take of the nature of protoplasm, there is no doubt it is composed of the same elements as the rest of the universe. As long as life continues there is a continual procession of atoms of carbon, nitrogen, hydrogen, oxygen and other elements, variously combined, into the living substance, and an equally unbroken procession of carbon, nitrogen, hydrogen, and oxygen out of the living substance. It is not only after death that the animal body is resolved into inorganic combinations of these elements. We may compare a living organism to the little columns of dust which are sometimes seen spinning down the streets of our western townships. The sleeping dust is for one instant aroused, whirled round in complex and unaccustomed motions, and then returns to rest again, to be ever replaced with fresh particles as long as the air-vortex continues its brief career. So during life dissolution is an unceasing process, and the living organism is but a temporary resting place of migratory atoms from the non-living world. Furthermore, it is also certain that there is no creation or destruction of force in the living organism. Here, as elsewhere, the rule of the conservation of energy holds good. The greater part of the vegetable world derives its energy direct from the sun's rays, and stores it up in the form of chemical combinations. The animal world, destitute of this power, appropriates the energy stored up by plant life by devouring these complex chemical substances, albumen, fat, starch, sugar, &c. Its energy is derived from the chemical changes which result in the combination of the contained carbon, hydrogen, &c., with the oxygen of the air. This energy is given off mostly in the form of heat, a smaller fraction in the form of mechanical work, which for the most part is also soon converted into heat. So that all life derives its energy from the sun, and sooner or later gives it back in the form of heat. In the process there is change, transmutation of force, but neither loss nor gain; one form of vibration is replaced by another, but the chain is never broken. As a late distinguished physicist wrote, in lines which, though half jocular in form, contain serious thought:—

> "When earth and sun are frozen clods,
> "And, all its energy degraded,
> "Matter to Ether shall have faced,
> "We, that is all the work we've done,
> "As waves in ether shall for even run
> "In swift expanding spheres through heavens beyond the sun."

Having grasped this conception of the living organism as a temporary halting place of atoms derived from the inorganic world as a temporary focus of energy derived from without and passing without again, must we add to matter and force a hypothetical something called "vitality?" Admitting to the full the vast difference between the phenomena of living and non-living matter, and the impossibility of picturing to oneself any mechanical arrangement of atoms and molecules, which will explain the former, I ask do we make the problem any clearer by such an assumption? Indeed has the word vitality any meaning that we can figure before our minds. Is it any more than a verbal expression, a word that merely covers ignorance, the negation of knowledge? I cannot see that it is. Even if we call it vital force I cannot see that we gain anything. For force is some form of movement, of molecular or atomic vibration. It is conceivable that molecular vibrations may occur in protoplasm which have no analogies elsewhere, but if so we know nothing of them. Further, they are derived if present from forms of vibration, chemical or heat vibrations, which exist without the living cell, and are speedily resolved into these again. Once more I think we gain nothing by the assumption. I may be pardoned for using an illustration which has done good service in much abler hands than mine. In this glass you have the familiar substance water, of well known and comparatively simple chemical constitution. You might not suspect it of being the seat of molecular forces of most intricate and mysterious complexity. Yet, if guided by scientific knowledge, you follow it with the imagination, you will see that it is so endowed. Let this glass stand on the table sufficiently long and its contents will disappear; they have become converted into aqueous vapour diffused in the atmosphere. Let the air containing this vapour be transported by a favourable atmospheric disturbance to the Alps of New Zealand. The gaseous particles will become transformed into solid crystals of snow, and on microscopical examination the constituent molecules of our humble fluid will be seen to have arranged themselves in wonderful and intricate patterns of geometrical regularity, which for marvellous beauty cannot be surpassed even by the organic world. Do we render this mysterious power of water to assume intricate geometrical forms any easier to understand by attributing it to a hypothetical something called *aquosity*. You will reply doubtless that to do so is merely to invent a word, not to explain a phenomenon. And granting that the phenomena of life are much more complex than those of crystallisation, does this invalidate our applying the same reasoning to the word vitality.

To this reasoning it may be objected that our protoplasm, a mere speck of structureless jelly, exhibits none of the machinery which might be reasonably expected in a substance capable of such complex evolutions as I have endeavoured to briefly indicate in the early part of this discourse. But this objection can be hardly pressed, unless we are prepared to limit the possibilities of organisation by what we can actually see.

Protoplasm may well be, and no doubt is of infinite molecular complexity. Recent research has revealed a very complicated structure in one portion of the. cell, the nucleus, which by the extraordinary changes which it undergoes during cell-division, must be regarded as playing an important if not the chief part in this process. It would be interesting to describe these changes at length, but would not advance us in our argument. For these nuclear changes explain nothing of the process in which they occur, they merely indicate what we might have otherwise inferred that the process is a very complex one.

If we contemplate living matter from the point of view of chemistry, we have sufficient evidence that it must be exceedingly complex. At no very distant date it was believed to be a peculiarity of all chemical substances derived from the products of vital activity (always excepting the ultimate products of its oxidation, such as water, carbonic acid, &c.), that they were incapable of formation by artificial synthesis from inorganic materials. The rapid progress of organic chemistry has since then resulted in the synthesis of great numbers of these substances, and has at the same time thrown much light on their molecular constitution. Compared with that of the substances treated of in inorganic chemistry this constitution is much more complex. But chemistry falls very far short of revealing the constitution of even dead protoplasm, far less of living. It has indeed been said that chemical analysis can never give us any idea of the structure of living matter, because in the act of analysis it has become no longer living. If life be regarded as a metaphysical principle resident in protoplasm, of course it cannot be considered susceptible of analysis. But if not so regarded there is nothing in this objection, for all analysis necessarily involves destruction, the resolution of one form of matter into others which do not possess the same properties. We cannot even analyse water without resolving it into oxygen and hydrogen. A more serious if not fatal obstacle to chemical analysis lies in the impossibility of obtaining living matter in a pure condition. Leaving the nucleus out of consideration we are in the habit of speaking of protoplasm as something homogeneous. But if we consider, it cannot be so. As living substance is continually undergoing decomposition, it may be inferred that the products of this decomposition are constantly to be found in what we call protoplasm. We have reason to believe that the ultimate products formed arise not suddenly, but by gradual stages of chemical degradation from the living matter. These transitional products will naturally be present to a variable extent in conjunction with the actually living substance itself. Again, the cell-protoplasm contains nutrient material, and probably (though here we have no clear knowledge) intermediate products between this nutrient material and living matter. How much of this apparent homogeneous protoplasm actually possesses the properties of living matter we do not know, and have no present methods of ascertaining. If, however, we take masses of what is usually termed protoplasm and subject it to chemical examination we can always obtain from it three kinds of matter, fats, carbohydrates, and proteids. Of these the proteids (of which albumin is one) have a molecular constitution of peculiar complexity. A chemical formula, which can only be regarded as a rough approximation, C_{72} H_{112} SN_{18} O_{22} has been assigned to them as the result of analysis. Even if approximately correct, this formula only indicates their minimal complexity. Their real structure might be more correctly indicated by any multiple of this. But the composition of proteids has no relation to that of cell-protoplasm except this, that the latter must be more complex, and may be exceedingly more complex. Furthermore, living protoplasm differs fundamentally from dead proteid in one respect, that it must be regarded as in a peculiar state of unstable chemical equilibrium, while the latter is a comparatively stable substance. To this point I shall return presently.

Although we are unable to follow the complex physico-chemical changes which we believe to occur in living cells, we are able in one special instance to obtain indirect evidence that such changes do occur. The association of chemical and electrical changes are very obscurely understood in the inorganic world. But it is well known that such an association is real. We have no means of detecting any electric phenomena in the amœba, but in two highly specialised living tissues, muscle and nerve, of the higher animals we can detect them. If a muscle removed from the body be stimulated by an electric shock (which for present purposes may be regarded as instantaneous) the contraction which follows does not occur instantaneously. There is an appreciable interval, called the latent period, which intervenes between the stimulus and the contraction. Accurately measured, this interval occupies about 1/100th of a second. During this brief interval the electrical reaction of different parts of the muscle undergoes a change. This change arises at the point of stimulus, and travels as a wave along the whole length of muscle, which, be it remembered, is still in an apparently quiescent condition. Immediately or very soon after this electrical wave has exhausted itself, the muscular contraction begins. The conclusion can hardly be resisted that muscular contraction is preceded as well as accompanied by physico-chemical changes. The rate at which the electrical wave travels has been measured ; in the frog it is about three metres (10ft.) per second. In warm-blooded animals it is probably somewhat faster. Its wave-length in the frog is about 3 millimetres (one-eighth of an inch). Surely these results point to the existence of some very complex mechanism. But muscular contraction is a vital act, performed by a living tissue. When we find that similar electrical changes have been observed to accompany the contractions of the leaves of the plant called Venus' Fly-trap, the structure of which is as far removed as possible from muscular tissue, we are, I think, justified in generalising, to the effect that all movements of living matter, including those of the amœba, are due to physico-chemical changes, and depend on an exceedingly complex mechanism.

If we apply our electric shock, not to a muscle, but to a nerve, no obvious result ensues, unless the nerve is attached to a muscle. In that case the muscle contracts, showing that a stimulus has been propagated along the nerve fibres. But whether a muscle be attached to the nerve or not, examination by suitable apparatus will show that this propagation has been accompanied by an electrical change precisely similar to that which occurs in a muscle during the latent period, with the exception that it has a greater wave-length, 18 millimetres (three-quarters of an inch), and a considerably greater velocity. This velocity in the frog is about 28 metres (92 feet) per second, in man about 33 metres (107 feet) per second (compared to the velocity of light, or electricity, or even of sound, this is extremely slow). It can hardly be doubted that these electrical changes in nerve fibres are due to some physico-chemical mechanism, and that their velocity is fixed by this mechanism. Yet it will hardly be denied that nerve fibres are living tissue, and that the conduction of impulses is a vital act.

Some light seems to be thrown on the unstable chemical equilibrium of living matter by its great susceptibility to the action of a large number of substances, which we call poisons. Many of these are fatal to protoplasm, converting it into dead matter, even when they come into contact with it in infinitesimal dilution. On the physico-chemical theory of living matter this action presents no special difficulty to the understanding. The molecule of strychnine for example can be regarded as a complicated piece of mechanism, which when brought into contact with the still more complex mechanism of the cells of the spinal cord at first excites its molecular or other vibrations and disturbances to greater activity, but carrying its action further it deranges this mechanism altogether, in other words the cells are killed. Another poison will diminish the activity of the cells of the spinal cord from the first, and then kill them. On the physico-chemical theory the conflict is not wholly unintelligible. We can to a certain extent picture to ourselves two mechanisms which interfere with one another. But if we suppose living matter to be inhabited by a metaphysical something, "vitality," how can we imagine the struggle between it and our strychnine molecule? The vitalists may, to borrow an old witticism, conjure up their "metaphysical grenadier," but how will they make him fight?

To all this reasoning I can imagine the objection raised: "You may, perhaps, in a few instances, and to a small extent, discover physico-chemical analogies in the behaviour of living matter. All this is beside the point. No mechanism, however complicated, no possible combination of atoms and molecules can be conceived to explain all the activities of protoplasm." Here, I think, we come upon the "stupid, senseless matter" of our old author. If we arbitrarily conceive of our atoms and molecules as so many hard, round particles, like small shot, only much smaller, such an objection is natural. But this conception is a purely arbitrary one. We cannot at present form any clear idea of the structure of non-living matter which will explain all the phenomena which it presents. For instance, who of us has any clear conception of what takes place in and around a metallic wire when a current of electricity is passed through it? Or, to ask another question, how can we explain the attraction that every particle of matter throughout the universe has for every other particle, which attraction we know as gravitation? Or, again, why is it that an atom of oxygen will combine with two atoms of hydrogen? We say that the oxygen has an "affinity" for the hydrogen; but this is merely to re-state the fact in a figurative way. On what mechanism does this "affinity" depend? It would be easy to multiply unanswerable questions of this kind. We need to remember that the simplest form of matter is something mysterious, as to the nature of which we know very little.

To cease the argument here would be easy, but it would be to shirk the real difficulty of the problem of life, a difficulty which is no doubt present in your minds. Life in ourselves is indissolubly connected with consciousness. Furthermore, when we come to the bottom of things, it is the nature of our own consciousness which really interests us most. That this consciousness is intimately connected with certain living animal cells, which, with their processes and ramifications, constitute that highly complex organ known as the brain, cannot be disputed. A slight external pressure on this organ, a small clot of blood washed into one of its blood-vessels, cause instantaneous loss of consciousness. A febrile condition, or the presence of a minute proportion of various poisons in the blood profoundly affects our consciousness. A long, lowering illness will sometime reduce a powerful intellect to a condition of utter childishness, to be followed after recovery by a complete return to mental power. These facts are familiar, but what explanation can be given of this association of matter and consciousness?

Let me say at once that science has no explanation to offer. I would go further, and say that, to the best of my belief, no conceivable extension of scientific knowledge would bring us any nearer to a solution. By way of illustration, let me remind you of an instance in which science is able to offer explanations. Few things are more complicated than the infinite variety of sounds produced by the human voice. Yet these can to a large extent be analysed and resolved into their component parts, and the method of their production is also susceptible of scientific investigation. By a simple arrangement of mirrors it is possible for a singer to watch the motions of his own larynx, and to observe the movements of the vibrating vocal cords as the various notes are sounded. Let us now, by an effort of the imagination suppose that it were possible, by some extension of scientific knowledge, for a man to directly inspect the workings of his own cerebrum. There is nothing inconceivable in such a supposition. Let us imagine further that it were possible for any one of us not only to observe the intricate interweaving of the processes of his own brain cells, but to be cognisant of every molecular tremor which passed down those processes, and to be able even to follow the vibrations of molecules and intricate dance of atoms as one micro-chemical change leads to another in the mysterious laboratory of the protoplasm of the nerve cell. Extend the imagination as far as you please, and then ask yourselves whether the nature of consciousness, of the thoughts that accompany these molecular storms, becomes any clearer. If you will allow me to anticipate your reply, it will be—" Not by the least infinitesimal fraction."

Granted that direct observation and experiment can here avail us nothing, and that the nature of consciousness is inconceivable, it might still be contended that the intimate connection between matter and consciousness is not confined to the solitary instance of the human cerebrum, that it is in some sort common to all living matter. The argument would run somewhat on these lines: Consciousness is known directly only to the individual. By analogy and inference he naturally, indeed inevitably, attributes a similar consciousness to his fellow men. But the lower animals most nearly allied to ourselves also exhibit, in an inferior degree, phenomena which in our own species we should consider to be indicative of the possession of consciousness, and by irresistible analogy we are led to attribute consciousness to them also. This once granted, we have a series of animal forms of gradually decreasing complexity, in no part of which can we draw a line and say, here consciousness ends. A similar line of reasoning may be applied to the development of the individual. By insensible gradations, therefore, we are led to attribute a consciousness of some sort to the amœba. If to the amœba, then also to the white blood-corpuscle, and to every animal or vegetable cell.

It seems to me that if this line of argument be admitted we could not stop here. If we attribute consciousness to every speck of protoplasm, it would be equally easy, or equally difficult, to attribute it to a drop of water, or a grain of sand, in fact to all matter. What we should mean by the word consciousness used in such connections it is impossible to say. We seem to have come back to something like the old "vitality," but with extensions to inanimate nature, like the "plastic nature" of John Ray; execept that we do not invoke this "plastic nature" to explain physical phenomena. Furthermore, these speculations offer no explanation whatever of the nature of consciousness; they merely extend the problem. And it might with great force be urged that the chain of analogy has been strained to breaking-point. Starting with the human consciousness, the nature of which is quite inconceivable to us, we have imagined the existence of an infinite series of "consciousnesses" equally inconceivable, but certainly different to the first. We have landed ourselves into a region where assertion and denial are both little more than verbal, and therefore, to my mind, alike illegitimate.

It is no help to the understanding of consciousness, as we know it, to attribute it to the combination of the separate "consciousnesses" of some thousand nerve-cells. To speak of the human mind as built up of such particles, as a wall is composed of bricks, or as water is composed of oxygen and hydrogen, is to use materialistic propositions of something which is not matter; to misuse language, not to express mental conceptions, but to conceal their absence. The synthesis is unthinkable. We have no right to forget that all our knowledge of matter depends on sensations represented in consciousness. Our molecules, atoms, ether, vortices, are all only extensions of sensation. They are what, if our inductions are trustworthy, we should see and feel if our sense-organs had their range sufficiently extended. Of what lies behind the sensations we do and can know nothing. The real nature of the external universe is as much beyond the possibility of knowledge as the nature of consciousness itself. There is nothing in science to contradict the familiar lines of the poet:—

> "The cloud-capped towers, the gorgeous palaces,
> "The solemn temples, the great globe itself,
> "Yea, all which it inherit, shall dissolve
> "And, like this insubstantial pageant faded,
> "Leave not a rack behind. We are such stuff
> "As dreams are made of, and our little life
> "Is rounded with a sleep."

Leaving the nature of consciousness on one side, as a problem altogether outside the range of science, we may. I think, regard all the other properties of protoplasm as susceptible of physical and chemical explanations. I do not see that this is a conclusion which ought to give offence to anyone. It is the natural and inevitable result of the application of scientific method to the study of living matter. So long as in the non-living world motion was regarded as a property of matter, which needed some immaterial agent to keep it from ceasing at any moment, a science of physics was not possible. In the same way the continuance of the supposition of an arbitrary principle of vitality which made the phenomena of protoplasm something quite different in kind from other chemical and physical changes would have deprived the science of biology of any stable foundation. It is true that with our present knowledge we have scarcely approached the ultimate problems of physiology. Yet all that has been learnt, and it is no small total, has been acquired on the assumption that living matter is subject to ordinary physical and chemical laws. In this sense science is materialistic. I use the word with some misgivings, as there is, I know, a vague popular horror of a something called "Materialism," which is supposed to explain away all mystery from the universe. Why, the very air we breathe is full of mystery! Such fears are irrational, mere chimaeras raised by ignorance and want of thought, and therefore beyond the reach of argument.

To fulfil the promise of my title I ought to add a few words regarding the origin of life. This is a problem to be approached with diffidence. In speaking of the nature of living matter we were treating of something that we can actually see and examine, but its origin is far removed. We must recognise that our present state of knowledge shows a great gap between non-living and living matter, and we know nothing of any development of the former into the latter. We no longer believe, as some used to believe, that frogs arise from a mixture of dust and rain-water, that maggots are bred from decaying flesh, that bacteria arise *de novo* in turnip infusion. At the same time we have very strong reasons for thinking that at a distant epoch this globe was in a molten condition, at a temperature which would render the existence of any living beings impossible. Life must be concluded to have arisen since this epoch. Sir William Thompson has suggested that living matter in a dormant or spore condition may have been conveyed to the earth by some falling meteorite. If we admit this possibility our difficulty is but pushed further back. There is but one method, that I know of, of meeting the difficulty, and that is by invoking the principle of the "continuity of nature." By an induction, supported by numberless instances, we have come to believe that natural changes come about, not by sudden and violent means, but by the summation of long series of gradual transitions. We can, for instance, trace in thought much of the gradual alteration sustained by our cooling globe as it passed from its primitive molten condition into one suitable for sustaining life. We can trace the gradual transitions between living beings. Under their infinite diversity we can trace a fundamental similarity. The nuclear changes during cell-division, for example, to which I have already alluded, appear to be of a similar character (with some variations in detail) in all animal and vegetable cells, from the most highly organised animals and plants to the lowest. Where we meet with gaps in our classifications, we are accustomed to suppose that these imply the former existence of intermediate forms, which have now become extinct. In this way we may become inclined to believe that the present gap between non-living and living may at one time have been filled by steps of which we are at present ignorant. An attitude of scepticism on this point is reasonable, but if forced to choose between the hypotheses of continuity and discontinuity I should incline to the former.

This brings me to the end of my task, which has expanded much beyond my original intentions. My object has been not to attempt impossible solutions, but merely to state these problems, as they present themselves to my own mind, as clearly as I could. How far I have succeeded in making myself intelligible is for you to judge.

LIST OF MINERALS, WALSH AND TINAROO MINING DISTRICT, NORTH QUEENSLAND.

By { **J. STEWART BERGE**
J. HARRISON BROWNLEE
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[*Read before the Royal Society of Queensland, 13th May, 1899.*]

A FEW particulars of the great Walsh and Tinaroo Mining District of Northern Queensland will not be out of place as a preface to this first attempt at cataloguing its known minerals.

Messrs. William Jack and party discovered the first tin mine—"The Great Northern"—in 1879, and from that year up to the present new finds have continually been and are now being made, which demonstrate the extent and variety of its mineral resources.

Tin, copper, lead, silver, wolfram and bismuth are the chief mineral productions, and numerous other useful minerals, such as antimony, molybdenite, zinc, &c., are to be found, but do not pay to work under present conditions. It is only during the past year or two that wolfram and bismuth have been obtained in any quantity.

Within the boundaries of the district are included several proclaimed goldfields, the gold returns from which show many thousands of ounces.

Extending from Mount Spurgeon in the north to Christmas Hill Station in the south, and from Cooroo Peak in the east to Torwood in the west, distances of 230 miles and about 150 miles direct respectively, the Walsh and Tinaroo has a proclaimed area of 12,640,000 acres, or 19,750 square miles, being larger than Switzerland and nearly as large as Tasmania, and of this vast area an experienced geologist has written as follows :—" A more highly mineralized district it would be hard to find on the face of the globe."

NOTES *re* CLASSIFICATION.

DIVISION 1.—Includes the native metals.

DIVISION 2.—The principal ores.

DIVISION 3.—The varieties of silica and rock forming minerals.

DIVISION 4.—The precious stones.

DIVISION 5.—The organic products.

The following summary will show clearly how the classification has been made :—

DIVISION 1.—*Native elements.*

Section 1. *Metallic*—Gold, silver, platinum, etc.

Section 2. *Non-metallic*—Graphite, etc.

DIVISION 2.—*Metals in combination with various elements forming ores, etc.*

Section 1. *Metallic minerals* (principal ores, *i.e.*, compounds of the following metals: Gold, silver, mercury, bismuth, etc.)

Section 2. *Earthy minerals* (compounds of elements forming earths, clays, etc., excepting silica).

Aluminium, potassium, calcium, etc.

DIVISION 3.—*Silica and the silicates and other rock-forming minerals.*

Section 1. *Silica in its many varieties* :—Quartz, agate, opal, jasper, etc.

Section 2. *Silicates or ordinary rock-forming minerals, e.g.*, Felspars, micas, hornblende, zeolites, etc.

Section 3. *Other rock-forming minerals.* Lime, iron, etc.

DIVISION 4.—*Precious stones.* Garnet, topaz, zircon, etc.

DIVISION 5.—*Organic products.* Coal, etc.

(N.B.—The popular classification of Campbell has been followed.

NOTE.—This list has been compiled from reliable records and geological reports on the district.

We also acknowledge the valuable assistance given us by Mr. Skertchley, and many experienced miners and others connected with mining who forwarded us information in reply to our inquiries.

DIVISION 1.—NATIVE ELEMENTS.

SECTION 1.—METALLIC.

Reference No.

1. GOLD *(Alluvial)*.—Found in the Russell River terraces, the wash being capped with basalt.

Tinaroo Creek with the tin.

Hodgkinson River.

Tate Goldfield, and

Deep Lead, Herberton, in small quantities in tin drifts.

(Reefs and Lodes).

Towalla, on Russell Extended.

Balcooma, a little over 100 miles S.S.W. of Herberton.

Mt. Luxton, California Creek.

Hodgkinson Goldfield in numerous quartz reefs, enumerated in Jack's Report on that field.

On the East Hodgkinson, associated with iron pyrites, copper pyrites, and galena, and at Northcote with antimony.

Tate Goldfield, the principal mine being the "Golden Treasure," which occurs in a schistose sandstone country.

The Mareeba Goldfield—"Mareeba Jubilee" line of reef in schist country.

Gold is also found in many of the outcrops of the copper lodes of the Chillagoe, but especially at Arbouin, where it appears to occur in payable quantities.

The total output of gold from the Hodgkinson alone, to the end of 1898, exceeded 240,000 ounces.

2. SILVER.—Mount Garnet, associated with the copper ore, in threads and shapeless masses.

The "Combination Copper Mine" at Halpin's Camp, in the Mt. Albion locality, has produced some very fine specimens.

Newellton with lead ores.

"Nellie" Lease, Chillagoe, with copper ores.

"Queenslander," Chillagoe, with copper ores.

"Mountain Maid," Mt. Albion, with lead ores.

Reference No.

3. Copper.—Mount Garnet, in country rock.
"Paisley" Shaft, Muldiva.
"Lancelot" Lease, Newellton.
"Combination Copper Mine" at Holpin's Camp.
"Sorata" Lease, Moorefield.
"Nellie" and "Queenslander" Leases, Chillagoe.
Moss copper is found in some of the mines in the vicinity of Calcifer.

4. Platinum.—Occasionally found in minute flakes among the fine grains of gold on the Russell Goldfield.

5. Bismuth.—Some very good specimens have been found at Lappa Lappa, where wolfram is associated with it.
Wolfram Camp, Walsh River, with wolfram and molybdenite.
"Lancelot" Lease, Newellton, with tin ore.
The "Bradlaugh," Herberton.

6. Arsenic.—Rare; at Dargalong.

DIVISION 1.—SECTION 2.

Non-metallic.

7. Graphite (*Plumbago*).—"Star of the South," Herberton, Watsonville, and in the vicinity of Thornborough.

DIVISION 2.—SECTION 1.

Metallic Minerals (*Principal Ores*).

Ores of Silver.—

8. *Argentite—Silver Glance—Sulphuret of Silver.*
Dargalong, Chillagoe;
The "Comstock," Lappa Lappa.

9. *Pyrargyrite—Ruby Silver.*
Muldiva.

10. *Proustite—Light red silver ore.*
Muldiva.

11. *Stephanite—Brittle Silver Ore.*
Muldiva.

12. *Cerargyrite—Horn Silver—Silver Chloride.*
Principally at Mt. Albion,
Muldiva, and
Lappa Lappa,

Reference No.

Montalbion, Muldiva, and Lappa Lappa have been the three principal silver producing centres of this area.

The total yield of this mineral for the district to the end of the year 1898, was 2,200,000 ounces,

ORES OF COPPER.—

13. *Chalcopyrite—Copper pyrites—*

Found principally at Mount Garnet, Mt. Cardwell, Newellton, Coolgarra, Fossilbrook, Mt. Molloy, Mt. Albion, and in most of the Chillagoe copper mines.

14. *Chalcocite—Copper glance—Vitreous copper ore.—*

In the mines in the vicinity of Watsonville, Mungarra, Mt. Albion, and Calcifer.

15. *Bornite—Erubescite—Variegated Copper Pyrites.—*

The Mount Garnet centre.

"Ruddygore" Lease, Chillagoe.

"Pirate" Lease, Tate.

Montalbion and Watsonville.

16. *Eetrahedrite—Gray Copper—Fahlerz.—*

Found in large quantities in one locality only, viz.—Mt. Albion Hill, in a pipe vein.

17. *Atacamite—Copper Oxichloride.*

The "Ruddygore" and "Boomerang" Leases, Chillagoe.

"Paisley" Lease, Muldiva.

18. *Cuprite—Red Copper Ore.*

Magnificent specimens obtained all over the copper region, principally the "Dorothy" and Griffith Leases, Chillagoe.

"Red Oxide" and "North Australian," Watsonville.

"Paisley," Muldiva, in fine needle-like crystals.

Mount Garnet and Mt. Cardwell.

19. *Tile ore—earthy oxide of copper.*

The Prospecting Claim, Newellton.

20. *Melaconite—Black copper.*

Occurs as a black powder in most of the copper mines, *e.g.*, North Australian, Watsonville, and Anniversary, Herberton.

Reference No.

21. *Chalcanthite—Blue vitrol—Sulphate of copper.*

Occurs as a secondary deposit in nearly all copper mines, and at Montalbion forms magnificent sheets of stalactite.

22. *Olivenite—Hydrous copper arsenate.*

Muldiva up to the present is the only known locality within the district.

23. *Malachite—Green carbonate of copper.*

Found in all the copper localities named, among the principal of which are the "Griffith" and "Boomerang" at Chillagoe, and the "Paisley" at Muldiva.

24. *Azurite—Blue carbonate of copper.*

North Australian, Watsonville; Maybell, Newellton; Boomerang, Chillagoe; and in most of the copper mines throughout the area. Mr. Skertchley states that the finest specimens known to him were obtained from Muldiva.

25. *Dioptase—Copper silicate.*

Occurs at Mungana and Muldiva.

26. *Chrysocolla—Hydrous copper silicate.*

Muldiva, and generally throughout Chillagoe.

27. *Bournonite.*

Albion Mine, Montalbion.

28. *A Copper Phosphate.*

Found in the Queenslander Lease, Chillogoe, and at Arbouin.

N.B.—The total output of copper for the district, to the end of December, 1898, was 2,150 tons.

29. MERCURY.—*The Sulphide Cinnabar.*

Found at Dargalong.

Mercury is also found in small quantities in the "Lady Jane," at Mt. Albion.

LEAD ORES.

30. *Galena—Lead Sulphide.*

Occurs in great quantities in many localities throughout the area, a few of the principal being as follow:—

The "Silver Streak," Rainbow and White Star

Reference No.

mines, Newellton; "Penzance," "Queenslander," and Macrossan Leases, Chillagoe;

Muldiva, Coolgarra, Mt. Albion, and Dargalong.

31. *Anglesite—Lead Sulphate.*

Not uncommon with galena, but particularly fine specimens have been obtained from the "Mountain Maid," Mt. Albion.

32. *Minium—Oxide of Lead.*

Penzance and Macrossan Leases, Chillagoe;

Dargalong, and as a secondary deposit at Muldiva and Mt. Albion.

33. *Wulfenite—Lead Molybdate.*

Mr. Shertchley states that he has seen but one specimen in this district, which he was informed was found here, but he could not determine the locality.

34. *Linarite—Sulphide of Lead and Copper.*

"Caledonia" Mine, Newellton.

35. *Minetite—Lead Arsenate.*

Mount Garnet.

36. *Pyromorphite—Lead Phosphate.*

Newellton, Chillagoe, Coolgarra, and Mt. Albion.

Some of these specimens were exceedingly beautiful.

37. *Cerussite—Lead Carbonate—White Lead Ore.*

Newellton.

Various mines at Lappa Lappa.

"Paisley" Lease, Muldiva.

"Queenslander" and "Girofla" Leases, Chillagoe.

"Vulcan," Irvinebank; and

Dargalong.

38. *Barysilite—Lead Silicate.*

Specimens have been obtained at Calcifer, and Mr. Skertchley informs us that this is the cnly known locality, with the exception of two in Sweden.

N.B.—Total lead production of the district to the end of December, 1898, was 8,303 tons.

Reference No.

ZINC ORES.—

39. *Sphalerite—Zinc Sulphide—Black Jack.*

Newellton, silver field.

Penzance and Eclipse Mines, Chillagoe.

Paisley Mine, Muldiva; and

Woodleigh.

40. *Calamine—Hydrous silicate of zinc.*

Rainbow Mine, Newellton; and Mt. Albion.

41. *Goslarite—Zinc sulphate.*

Found as a secondary deposit at Mt. Albion.

42. *Willemite—Zinc silicate.*

Montalbion.

43. *Smithsonite—Zinc carbonate.*

Montalbion.

44. COBALT.—

In small quantities in the "Lady Jane," Montalbion.

Staaten River, near the Lynd, and Mt. Garnet.

TIN ORES.—

45. *Stannite—Tin sulphide.*

Lass o' Gowrie Claim, Eureka Creek; and at Bakerville.

46. *Cassiterite—Binoxide of tin.*

In quartz at No. 2 Shaft, Great Northern, Herberton.

In chlorite at Great Northern.

In porphyry at Watsonville.

With fluorspar in the Poor Stroller and Bradlaugh Claims, Herberton; and the Lass o' Gowrie and Gladstone Claims, at Eureka Creek.

Associated with copper ores in greywackes and sandstones, etc., North Australian Mine, Watsonville.

With metallic bismuth in Lancelot, at Newellton.

With bismuth and chlorite in Vulcan, Irvinebank.

With garnets in Dreadnought, Watsonville.

With wolfram in Stewart's T Claim, Watsonville.

With galena and pyrites, at Koorboora.

With native copper in Lancelot, at Newellton.

Reference No.

With tourmaline at Irvinebank, with zinc ore at Mt. Albion, and with azurite, aluminite, chlorite, fluorspar, goethite, haematite, limonite, misquickel, penninite, pyrites, quartz, topaz, and wolfram at Coolgarra.

Some of the varieties of this ore of tin found within the area, are ruby, amber, rosin, and wood tin.

The principal tin producing centres are as under :—

Lode Tin.—

Herberton.
Watsonville.
Irvinebank.
Coolgarra.
Newellton.
Bakerville.
Montalbion.
Thompson's Creek.
Glen Linedale.
Koorboora, etc.

Alluvial Tin.—

Herberton and Deep Lead.
California Creek.
Woolooman Creek.
Tate.
Tinaroo Creek.
Oakey Creek, etc.

Particulars of tin production of District to end December, 1898 :—Alluvial, 5,288 tons, value £226,622; Lode, 22,750 tons, value £1,050,850; Total, 28,038 tons, value £1,277,472.

ORE OF BISMUTH.—

47. *Bismuthite—Carbonate of Bismuth.*

Associated with tin lode near Fossilbrook.

N.B.—Sixteen cwt. of bismuth ore was exported during 1898, of the value of £224 (estimated).

ANTIMONY.—

48. *Stibnite—Antimony Sulphide.*

West Albion Mine at Mt. Albion.

Reference No.

Many claims in the Watsonville locality; Planted Tree Crossing; and on the Walsh River, a few miles from Watsonville, rich lodes are to be found, samples taken from the outcrops giving very good returns, but it is stated that the present demand and value do not pay for working.

N.B.—Two large leases have recently been taken up for the purpose of mining for antimony.

49. *Cervantite—Antimony Oxide.*

Obtained in a few of the localities with the sulphide, and near Thornborough.

50. NICKEL.—

Has been found at Coolgarra and Chillagoe.

IRON ORES.—

Found everywhere in the district. There are regular mountains of these ores in some localities, viz.—Woodleigh and Chillagoe.

51. *Pyrite—Iron pyrites—Sulphide of iron.*

Associated with tin, lead, and copper in various lodes throughout the district. Sometimes with arsenical pyrites, at Herberton and Watsonville.

Chillagoe, Mt. Albion, Irvinebank, Mt. Garnet, and especially the "Chance" mine, Watsonville.

52. *Marcasite—White iron pyrites.*

Common at Mt. Albion in all its forms, viz., radiated, hepatic, coxcomb, and spear.

53. *Pyrrhotite—Magnetic iron pyrites.*

Herberton, Watsonville, and Mt. Albion.

54. *Arsenopyrite—Mispeckel.*

Plentiful in the Mt. Albion centre.

55. *Haematite—Specular iron ore.*

Very abundant all over the area. At Red Hills, near Mungara, occurs as a glistening specular iron. At Mt. Albion as nodules of clay ironstone.

Hodgkinson.

Coolgarra, and

Russell River.

Reference No.

56. *Magnetite—Magnetic iron ore.*

The Boomerang, Chillagoe; Mt. Cardwell, and Newellton.

Occurs rather sparingly in the ironstone masses, but hitherto has not been recognised in massive form.

57. *Menaccanite—Ilmenite—Titanic iron.*

Found in grains in the wash at the Russell Gold-field.

Deep Lead Sands and Lake Eacham.

58. *Melanterite—Copperas—Iron vitriol.*

Occurs as a secondary deposit in many of the copper mines of the district.

59. *Limonite—Brown haematite.*

Abundant where haematite occurs (*see* haematite).

60. *Columbite—Niobite.*

In the tin leads beyond Fossilbrook.

61. *Gotheite—hydrous iron oxide.*

Coolgarra.

62. *Scorodite—Phosphate of iron.*

At Arbouin, West Chillagoe; and the Silver Star, Mt. Albion.

63. *Vivianite—Hydrous iron phosphate.*

The Anniversary, Herberton; and as specks in the decomposed ferruginous matter about Watsonville.

64. *Siderite—Spathic iron—Iron carbonate.*

The Federation at Watsonville, and not uncommon where haematite is found.

ARSENIC.—

65. *Orpiment—Yellow sulphide.*

66. *Realgar.*

Occurs in the St. Kilda and Chance Claims at Watsonville.

The Iolanthe, Irvine Bank, The Consolidated, Mt. Albion, and at Herberton.

67. *Arsenolite—White Arsenic.*

In the vicinity of Watsonville and other places.

Reference No.

68. MANGANESE.—

69. *Pyrolusite—Black Oxide of Manganese.*

Redcap, Griffith, Queenslander and Macrossan Mines, Chillagoe; and the Hodgkinson Goldfield.

70. *Psilomelane—Hydrous Oxide of Manganese.*

Specimens have been obtained in parts of district.

71. *Wad—Bog Manganese.*

Occurs in patches in the Herberton series of rocks, and is not uncommon.

72. MOLYBDENUM.—

73. *The Sulphide—Molybdenite.*

Found around Herberton; also found associated with wolfram and bismuth at the Wolfram Camp.

On the Tate River, about 25 miles from the Telegraph Station, there are quantities which would pay if there was a demand for large parcels.

74. TUNGSTEN.—

75. *Wolfram—Tungstate of Iron and Manganese.*

Principally at the Wolfram Camp and Lappa Lappa; also occurs in the vicinity of Herberton, Coolgarra, Eureka Creek, and Woodleigh.

N.B.—54½ tons of this ore were exported during 1898. Some of the Wolfram Camp wolfram yielded as much as 67 per cent tungstic acid. During the present year larger parcels have been sent away, giving good returns.

76. *Scheelite—Tungstate of lime.*

Found at Cattle Creek, Wolfram Camp, and Watsonville.

77. *Uranium.*

We can learn of one place only in the district where this mineral has been found, and that is Watsonville, at which place Mr. Pyle states specimens have been found.

78. *Torbernite—Hydrous phosphate of Uranium and copper.*

Said to be found in the vicinity of Watsonville.

Reference No.

79. *Selenium.*

Specimens have been obtained from the Albion Mine at Mt. Albion, some of which were exhibited at the Melbourne Exhibition in 1888.

Common at Chillagoe.

80. *Titanium—Rutile—Titanic oxide.*

Coolgarra and Tate Tin Mines.

Also fairly abundant in the gold gravels.

DIVISION 2.—SECTION 2.

Compounds of elements forming earths, clays, etc., excepting silica.

81. ALUMINIUM.—

82. *Aluminite—Hydrous aluminium sulphate.*

Coolgarra.

83. *Alumina.*

The oxide is a constituent of a large part of the earthy siliceous minerals, as the felspars micas, etc., and the characterising ingredient of common clays.

(See micas and felspars).

84. MAGNESIUM.—

Its compounds occur abundantly as in talc dolomite, which, *see*

85. *Epsomite—Magnesium sulphate.*—

Lady Catherine Mine on the Hodgkinson.

86. *Magnesite—Carb magnesium.*

Newellton.

87. CALCIUM.—

Widely and abundantly disseminated as in its compounds, limestone, gypsum, fluorspar, all of which are given in this list.

88. POTASSIUM.—

Occurs combined in the minerals muscovite, orthoclase, etc.

89. BORON.—

Occurs combined as in tourmaline.

90. SODIUM.—

Always occurs combined, as in albite.

Reference No.

90A. *Sodium chloride* in the mineral waters at the Innot Hot Springs.

91. LITHIUM.—

A trace of *lithia* is found in the Springs' Waters.

92. BARIUM.—

See Barytes.

93. STRONTIUM.—

Occurs combined as in arragonite.

DIVISION 3.—SECTION 1.

SILICA AND ITS MANY VARIETIES.—

93A. *Silica* and the *Silicates* and other rock forming minerals.

94. QUARTZ.—*(Oxide of silicia).*

Found throughout the whole area.

Commanly the gangue of tin ore in porphyry country; also the gangue of the auriferous reefs of the Hodgkinson and Mareeba Goldfields.

QUARTZ, VARIETIES OF.—

95. *Rock crystals.*

Plentiful in all tin country. They have a tendency to become smoky or cairngarm colored at the apex.

96. *Smoky quartz.*

At the Wolfram Camp, Walsh River; also in the tin grounds throughout the district.

97. *Amethyst.*

Rather fine crystals in the granite at Mt. Borunda, Tate; and at Coolgarra.

98. *False topaz.*

Abundant in the tin grounds of the area.

99. *Rose Quartz.*

Mt. Borunda, Tate.

100. *Milky Quartz.*

The common variety found everywhere.

101. *Prase.*

One or two specimens have been obtained from the gravel in a creek at Dargalong.

102. *Chalcedony.*

Chillagoe.

(Sub-divisions)

Reference No.

103. *Carnelian.*
In Wild River.

104. *Sard.*
In Tate River.

105. *Agate.*
Good specimens obtained near Bellevue Station, Mitchell River.

106. *Chert.*
Occurs occasionally in the Chillagoe limestones as nodules.

107. *Jasper.*
Common all over the sandstone district, Chillagoe, and in the conglomerate of Herberton series.

108. *Petrified Wood.*
Common in the Deep Lead, Herberton locality.

109. OPAL.—

110. *Common Opal.*
Found in Deep Lead.

111. *Noble Opal.*
In the vicinity of Elizabeth Creek, a tributary of the Walsh River.

112. *Wood Opal.*
Many of the fossil trees of the Deep Lead are converted into wood opal.

DIVISION 3.—SECTION 2.

Silicates, or ordinary rock forming minerals.

113. FELSPARS.—

114. *Sanidine.*
In the Elvan at Watsonville.

115. *Albite.*
In Trap Rock at the Gorge, Flaggy Creek.

116. *Oligoclase.*
In the syenitic granite at Dargalong.

117. *Apophyllite.*
In the basalt, Evelyn Run, and the Jump Up, Herberton Road.

118. *Plagioclase.*
The old Lottery Claim, Herberton.
Coolgarra and Calcifer.

Reference No.

119. *Orthoclase.*

In the porphyry, near Oakey Creek.

Pink crystals in the granite of the Great Northern Mine, and the Old Welcome Claim, Herberton.

In the porphyritic granite near Muldiva.

It is common in the granites and porphyries of district.

120. Micas.—

121. *Muscovite—White mica.*

Plates have been obtained at Brookland's Station, seven inches square.

Wandoo Creek, West Chillagoe, Tate Tin Mines.

Coolgarra.

Watsonville, and generally throughout Chillagoe.

122. *Biotite—Black mica.*

In the granite of the Great Northern, Herberton.

In pegmatite at the Tate, and between Bismarck and Granite Creeks, Chillagoe, and at Baker's Camp.

123. *Lepidolite.*

In Greisen rock at Mt. Borunda, Tate.

124. Hornblende—Amphibole.—

125. *Common.*

The Great Northern, St. Patrick and Monarch, Herberton; Oakey Creek, Bakerville, and many places throughout the district.

126. *Tremolite.*

Coolgarra.

Some beautiful specimens of the gray and white varieties have been obtained from the Paisley Mine, Muldiva.

127. *Actinolite.*

Good specimens at Calcifer; Macrossan Lease, Chillagoe; and "Eclipse" Claim, Muldiva.

128. Augite.—

129. *Common.*

"Big Ben," Herberton.

Wild River Valley.

Reference No.

130. *Bronzite.*

Between Tate and Lynd Rivers.

131. *Diallage.*

Macrossan and Boomerang Leases, Chillagoe.

Calcifer and Herberton.

132. *Hypersthene.*

Between Tate and Lynd Rivers.

133. ABESTOS.—

At Dargalong.

134. OLIVINE.—

In the basalt of the Deep Lead, near Herberton, occasionally in fine crystals, and at Lake Eacham.

135. *Chrysolite.*

Fair crystals in the basalt at the Russell Goldfield.

136. TOURMALINE.—

Found in radiated crystals in the porphyry at the "Baal Gammon," Watsonville.

Around Calcifer, forming tourmaline rock associated with eclogyte.

Bakerville and Irvinebank, with tin.

137. SPHENE—TITANITE.—

Occurs in the granite rock in the locality of the Tate.

138. STAUROLITE.—

Occurs in the mica schist throughout Chillagoe.

139. ZEOLITES.—

Several varities are found among which are :—

140. *Natrolite* which occurs in the centres of the Basalt, at the Deep Lead, Herberton ; and another variety found at Muldiva.

141. CHLORITE.—

Common among the serpentinous rocks, which are plentiful around Herberton as an altered form of diorite.

Newellton, Watsonville, Irvinebank, etc.

142. *Penninite (chlorite in part).*

Coolgarra.

143. *Viridite (undeterminable chlorite).*

Common especially in the tin lodes of district.

Reference No.

144. Kaolinite.—*Silicate of Alumina.*

Watsonville.

"St. Patrick," Herberton,

Paisley, Muldiva,

Mount Garnet, and in the granite and porphyry regions throughout area.

145. Talc.—*Silicate of Magnesia.*

Orient and Wheal Vohr Claims, Herberton, Watsonville, and Dargalong.

146. *Steatite.*

Good Friday and North Australian at Watsonville.

It occurs as a constituent of the copper and tin lodes, and is not uncommon.

147. Serpentine—*Hydrous Magnesium Silicate.*—

In the decomposed gangue, "Iolanthe," Irvinebank.

Watsonville.

Chillagoe.

Plentiful around Herberton as an altered form of diorite.

148. *Fibrous Serpentine.*

Is found in the "Great Northern," Herberton.

DIVISION 3.—SECTION 3.

Other rock forming minerals.

149. Limestone.—

Occurs in large deposits in many parts of the district, principally in the vicinity of Mount Garnet and throughout Chillagoe.

150. *Calcite—Carbonate of Lime.*

Plentiful all over the limestone region, some of the localities being Muldiva, Newellton, Mungarra, Koorboora. In the two last mentioned places the whole mass of limestone where in contact with the granite is converted into magnificent rhombs of this mineral, often showing a remarkable crypto — cleavage structure.

some types of malaria from the so called "Crescent Body," in others from large extra-corpuscular plasmodia. They are only seen after blood has been drawn and oxygenated.

CRESCENT BODIES.

These are shaped something like caraway seeds, are transparent, with melanin bodies about their central zone, and are partly clothed with the remains of the blood corpuscles in which they developed. The crescents are usually uniform in appearance, twin crescents rarely occur. Mannaberg's suggestion that the crescents are formed bythe conjugation of two ordinary plasmodia is the most likely one.

The crescent body is the parent of the flagellated body, and the gradual change from one to the other may be readily followed. The crescent becomes an oval, then a sphere, the pigment bodies form a sphere within a sphere, then they begin to dance about, finally the flagella shoot out from the periphery and the flagellated body is complete.

Ross has shown that when blood drawn from the human subject is kept from the air no flagellated bodies are formed. On the other hand exposure to the air, or the addition of water to the slide favours flagellation.

FUNCTION OF FLAGELLATED BODY.

From the fact that the flagellated body does not enter into existence until the blood has left the vessels, it is evident that the function of the flagellum must lie outside the human body—in fact, that the flagellated body constitutes the first phase of the extra-corporeal life of the plasmodium.

THE MOSQUITO.

As the plasmodium while in the circulation is always enclosed in a blood corpuscle, and is therefore incapable of leaving the body by its own efforts, it must be removed by some suctorial insect common in the haunts of malaria.

Surgeon-Major Ross has shown that the crescents ingested by mosquitoes, fed on malarial blood, become transformed into spheres, and then into flagellated bodies. It is now known that these flagella detach themselves and coalesce with other non-flagellated bodies, which then become endowed with locomotive powers, and penetrate through the wall of the stomach of the mosquito, embedding themselves among the muscular fibres lining it outwardly. They may be seen like minute pustules from the inner surface. When one of these fertilised bodies is pressed on a glass slide, myriads of so called germinal rods are seen. These are seldom found free in the stomach of the mosquito, but may be found in countless numbers in the peculiar veneno-salivary glands connected with the proboscis. These glands, two in number, consist of a number of plump, clearly-defined cells, arranged along a branching duct; in these cells the germinal rods may be found in countless numbers, and when the mosquito is feeding on human blood these rods, which are really spores, are passed into the circulation and give rise to the plasmodia.

A REPLY TO "SOME CRITICAL NOTES ON THE QUEENSLAND VOLUME OF THE INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE."

BY JOHN SHIRLEY, B.Sc.

Read before the Royal Society of Queensland, August 19th, 1899.

Each member of this Society has received a copy of the Queensland Volume of the International Science Catalogue, compiled by the Royal Society of Queensland at the request of the late Hon. T. J. Byrnes, and of his successor, the Hon. J. R. Dickson. Copies were also sent to the chief scientific societies of Australasia. On receipt of a copy by the Queensland Branch of the Royal Geographical Society of Australasia, the Hon. Secretary, Mr. J. P. Thomson, read a criticism on the Catalogue, since printed without date or signature, to which your Council has requested me to reply.

This is not Mr. Thomson's first attack on matters pertaining to our Society; in Volume XII, pp. 59 to 71 of our Proceedings may be found Mr. (now Dr.) R. L. Jack's crushing reply to Mr. Thomson's remarks on the Government Geologist's paper entitled "Artesian Water in the Western Interior of Queensland."

In his criticism of the Catalogue Mr. Thomson's statements prove:

1. That he failed to ascertain beforehand what reasons led to the compilation of the Catalogue; and

2. That he is wholly unacquainted with the printed directions issued by the International Conference, by which the arrangement and classification of the work criticised were determined.

Mr. Thomson's principal charges are printed in italics, and following each will be found my reply.

I. P. 2, lines 9-15 and 27.

"I had to collect, arrange, and classify the material without a colleague." This not altogether unambitious statement is, however, scarcely consistent with a subsequent remark, in which our bibliographer acknowledges the services of three well known authorities, who revised, arranged and classified the chemistry sections, the vertebrates, and the Lepidoptera. The preface discloses an error.

As a matter of fact the whole of the subject matter of the Catalogue was collected, arranged, and classified before any portion was submitted to the three gentlemen, whose assistance is gratefully acknowledged in the preface. Professor Liversidge read and corrected the final proof of the Chemistry section forming pp. 48-51. Mr. De Vis supplied the class names given in brackets after each new species named by Mr. Saville Kent or by himself. Mr. Tryon read the two last proofs in pages of Section 2435, Lepidoptera, and suggested several valuable improvements affecting the classification of species adopted by the authors themselves. There is therefore no error to disclose.

II. P. 2, lines 27-29.

The second entry on the first page of the Catalogue of Authors reveals a stupid omission of the title of a work.

It may be some satisfaction to Mr. Thomson to know that, notwithstanding his evident animus, this is the only error in the Catalogue which he is able to substantiate in his criticism of twelve printed pages.

III. P. 3, lines 13-14.

The preface of the work is in itself inadequate.

The catalogue was compiled for the use of the International Conference at London, for whom no explanation was necessary; from this body came the first application, through the Agent-General, to the Premier for assistance in the matter; but a short preface was written to advise members of the Royal Society and others of the causes which led to its production.

IV. P. 3, lines 33-35.

Only two (of the resolutions) have been published in full in the Queensland volume, by Mr. Shirley, and these, strange to say, have really no material bearing on the character of the catalogue.

As the material for the Queensland Catalogue was collected by request of the International Conference, and for their use, it was hardly necessary to quote to them their rules in full, but those rules were quoted which showed that there was a discretionary power to be exercised in the selection of material.

V. P. 3, lines 35-37; p. 4, lines 1-16, 25-28.

Three of the most important ones of all have not been given. They are as follows:—

"*That the Catalogue shall comprise all published original contributions to the branches of science hereafter mentioned, whether appearing in periodicals, or in publications of Societies, or as independent pamphlets, memoirs, or books.*"

"*That in judging whether a publication is to be considered as a contribution to science suitable for entry in the catalogue, regard shall be had as to its contents, irrespective of the channel through which it is published.*"

"*That a contribution to science for the purpose of the catalogue be considered to mean a contribution to the Mathematical, Physical or Natural Sciences, just as, for example, Mathematics, Astronomy, Physics, Chemistry, Mineralogy, Geology, Botany, Mathematical and Physical Geography, Zoology, Anatomy, Psychology and Anthropology, to the exclusion of what are sometimes called the applied sciences—the limits of the several sciences to be determined hereafter.*"

As a matter of fact, there is not a word about "research work" in this resolution at all, the words being simply unnecessarily used by Mr. Shirley for reasons best known to himself.

In the rule first quoted by Mr. Thomson, the words "original contribution" form a term well understood in scientific societies as meaning a distinct discovery, adding some item or items to the sum total of scientific knowledge; and the words "research work" merely paraphrase this term. Mr. Thomson has wholly misunderstood this first rule, which plainly debars all extracts, summaries, and popular lectures from a place in the catalogue.

The second rule quoted by him clearly proves that a selection as to quality must be made.

VI. P. 4, lines 37-39.

"All productions that do not contain original or research work" have not been ruled out by a long way.

(a.) "Contributions to the Bibliography of Gold."

This was written by Professor Liversidge as an appendix to the "Bibliography of Gold," published in Locke's Gold (London, 1882), a standard work; it had been accepted and printed by the Australasian Association.

(b.) Narrative of an Exploration of the Coen.

I am still of opinion that Captain Pennefather's notes as supplied by him to Major Boyd are worthy of an entry.

(c.) In the Early Days.

This is really a history of the colony as rescued from contemporary records, and the valuable information supplied was judged to deserve mention.

(d.) Life among the Afghans.

Mr. Thomson conceals the facts that on p. 22 there is printed in brackets (Communicated by), and on p. 62 it is distinctly shown to be Dr. Gray's.

(e.) Queensland Past and Present.

A statistical record of the material position and progress of the colony, with the Government impress, stands on a different level to a private production. As the work is published annually, the last volume is the only one that needs mention. On receipt of a copy of this work from Mr. Weedon, Mr. Thomson wrote as follows:—"I must thank you very cordially for your thoughtfulness in sending me a copy of your splendid work on 'Queensland, Past and Present,' a gift which I value most highly. It is a book for which you deserve the greatest praise."

(f.) Geographic History of Queensland.

There is original matter in Mr. Meston's "Geographic History," and the work deserves mention on that account, as also for its interesting historical information concerning geographical nomenclature in Queensland.

(g.) Synopsis of the Flora of Queensland.

Mr. Bailey, in his preface, and in the introductions to various classes of plants, acknowledges his indebtedness to other authors, especially to the late Baron F. v. Mueller; but there are slight additions of original matter on pp. 686, 694, 708, 714, 809, and 811; and the "Synopsis" is the foundation stone of all subsequent work of our worthy Colonial Botanist.

(h.) Supplements to the Flora of Queensland.

Following these entries in the catalogue, in each case, there will be found lists of new plants named and described by Mr. Bailey, which form his "original contribution." See pp. 133-4.

VII. P. 7, lines 5-8.

On the first four pages there occur about a dozen entries of mere meteorological maps, whilst similar cartographical contributions crop up on pages 10, 12, and 13, in the shape of geological maps.

Had Mr. Thomson referred to these maps he would have found that the notes accompanying them form a valuable addition to our scientific literature; and a study of the specimen catalogue supplied by the International Conference would have shown that charts and daily weather reports are asked for under Meteorology, and maps under Geology.

VIII. and IX. P. 7, lines 36 and 37, and pp. 8 and 9.

It would indeed be safe to say that not more than a half of the scientific literature of the colony has been included.

In proof of this statement, Mr. Thomson quotes 23 works, which would at most add two pages to a catalogue of 154 pp.

These works were weighed and found wanting. They may have been excellent as extracts, or summaries, or popular lectures, but they merely traversed well trodden ground. To show that papers by members of the Royal Society of Queensland have been no less freely excluded, the following papers, from the first five of the fourteen volumes published by the Society, will be found omitted from the Catalogue:

1. Inaugural Address, Vol. I., pp. 3-7.
2. Mesoplodon Layardi, Vol. I., pp. 58-59.
3. Sesbania—a native fibre-producer, Vol. I., p. 101.
4. Fasciation in Sicyos angulata, *Linn.*, Vol. I., p. 102.
5. Summer Heat v. Health, Vol. I., p. 173.
6. Presidental Address, Vol., II., pp. 67-76.
7. Practical Hybridization, Vol. II., p. 141.
8. The Establishment of a Geological Survey in Queensland, Vol. II., pp. 198-207.
9. Artesian Wells v. Water Supply, Vol. II., pp. 208-209.
10. On the Curative Properties of the Cunjevoi, Vol. II., pp. 211-213.
11. Notes on a Living Tree Stump, Vol. III., pp. 38-39.
12. Presidental Address, Vol. III., pp. 116-119.
13. Indelible Writing Inks, Vol. III., pp. 144-150.
14. Fasciation of Bouvardia triphylla, Vol. III., pp. 153-154.
15. On Native Zinc in Queensland, Vol. III., pp. 154-155.
16. Report of a Meeting called to Promote the Formation of an Australasian Association, Vol. III., pp. 159-165.
17. A Bee Parasite, Vol. IV., pp. 17-19.
18. President's Address, Vol. IV., pp. 94-96.
19. The First Discovery of Gold in Queensland, Vol. IV., pp. 114-118.
20. Gold Occurrence in Queensland, Vol. IV., pp. 124-128
21. An account of the chief objects of Botanical Interest in an excursion to Peechey's Scrub, Vol. IV., pp. 135-136.
22. Report of the Field Naturalists' Section &c., Vol. V., pp. 70-72.
23. Field Naturalists' Excursion to Caboolture, Vol. IV., pp. 137-142.

X. P. 10 lines 26-29.

We find, for example, some of Mr. Shirley's own contributions entered say on p. 24, Palaontology, to reappear in other sections, for instance, Botany. p 36.

In the explanatory notes accompanying the specimen schedules of the botanical section, it is expressly directed that

Reference No.

150A. In the Chillagoe Caves every possible variety can be found, except Iceland Spar, and in some places, as at Red Hills, the calcite is almost pure enough to be called Iceland Spar.

Varieties of calcite found at Chillagoe, are :—

151. *Dog tooth spar.*

152. *Satin spar.*

153. *Granular limestone.*

154. *Compact limestone.*

155. *Stalactite.*

156. *Stalagmite.*

157. FLUORITE.—*Fluorspar—Fluoride of calcium.*

Occurs at Girofla, Newellton, Herberton, Bakerville, Eureka Creek, and Dargalong. It is not as common as might be expected.

158. ARAGONITE.—

Common through the alteration of calcite rhombs, Chillagoe, Newellton, etc.

159. DOLOMITE.—

California Creek.

Some of the Chillagoe limestone seems to be sufficiently impregnated with magnesia to become dolormite.

160. GYPSUM—*Lime sulphate.*

Not uncommon in the Chillagoe district, the more frequent crystals being twin forms of selenite, due to secondary decomposition.

Varieties of gypsum found are :—

161. *Alabaster,*

162. *Selenite,*

163. *Plumose, and*

164. *Fibrous.*

SCHEELITE (*see* Tungsten).

165. ANHYDRITE—*Lydrous lime sulphate.*

Found with gypsum.

166. *Apatite—Calcium Phosphate.*

Occurs in the granite rocks of the district in microscopic quantities.

Another variety occasionally occurs as efflorescences at Wandoo Creek, Chillagoe.

Reference No.

167. BARYTES.—

168. *Barite—Heavy Spar—Barium Sulphate.*

Tate, Dargalong and near Girofla. It is very scarce.

169. SULPHUR.—

Occurs as a secondary product in many of the silver ores found around Chillagoe, &c.

N.B.—There are other rock forming minerals, such as garnet, spinel, &c., the former being a constituent of the garnet rock found around Chillagoe, but for these, *see* Division 4 following.

DIVISION 4.

170. PRECIOUS STONES.—

171. *Sapphire (Blue).*

Jordon Creek.

172. *Sapphire (Green).*

The Oriental emerald—Jordon Creek.

173. *Spinel.*

Jordon Creek, Nigger Creek, Californian Creek, and Tate River.

174. *Pleonaste (Black Variety).*

Jordon Creek and Tate River.

175. *Zircon.*

Jordon Creek and Tate River.

176. *Jargon (Colorless).*

Jordon Creek.

177. *Topaz (Yellow)* in short prisms.

California Creek.

178. *Topaz (White)* Nigger Creek and Coolgacra.

Tourmaline (*see* No. 136).

179. *Garnet (Red),*

180. *Garnet Pyrope,*

181. *Garnet Andradite.*

Present in nearly all tin gravels at Calcifer, sometimes a constituent of Garnet rock.

The pale-greenish white garnet, the essential garnet of eclogyte, which is the ore bearing rock of Chillagoe.

Amethyst (*see* No. 97).

Reference No.

Opal (*see* No. 109).

Sphene (*see* No. 137).

DIVISION 5.

182. Organic Products.—

183. *Graphite or Plumbago.*—In the vicinity of Watsonville and Thornborough.

More or less common throughout the district as slickensides on the sides of lodes.

184. *Lignite or Brown Coal.*

Good specimens have been obtained from the Russell Goldfield.

185. *Bitumen.*—Hodgkinson Goldfield.

Index to List of Minerals, Walsh and Tinaroo Mining District.

MOSQUITOES AND MALARIA.

By JOHN SHIRLEY, B.Sc.

Read before the Royal Society of Queensland, June 17, 1899.

CAUSE OF FEVER.

In the blood of malarial fever patients is always found an organism, discovered by Laveran in 1810, and consequently known as the *plasmodium malariæ*.

THREE STAGES.

This organism is found to exhibit three phases, one adapted for life with man as its host, a second adapted for life outside the human body, and probably a third or latent stage.

HUMAN CYCLE.

Every variety or species of the plasmodium inhabiting man has its special and more or less definite life span of 24 hours, of 48 hours, or of 72 hours. On examining malarial blood towards the end of one of these cycles, before one of the paroxysms of the characteristic periodic fever is induced, the parasite may be recognised as a pale ill-defined disc of protoplasm, occupying a larger or a smaller area, within a proportion of the red blood corpuscles. Scattered through this pale body are a number of particles of intensely black, or reddish black pigment—melanin.

On repeated examination at short serial intervals the observer notes a systematic series of changes in the discs of pigmented protoplasm.

1. The scattered pigment particles collect into little groups, or into radiating lines ;

2. The pigment groups concentrate further into one or two larger, more or less, central blocks ;

3. Around these central masses the protoplasm groups itself as globular masses, *i.e.* spores ;

4. The blood corpuscle breaks up and the spores enter the liquor sanguinis;

5. Such spores as escape the phagocytes attach themselves to red corpuscles and enter them;

6. In the interior of the corpuscle the plasmodium exhibits amœboid movements, and grows at the expense of the hæmoglobin;

7. By assimilation they convert the hæmoglobin into the pale substance of the plasmodium and into melanin;

8. Finally, just before sporulation all motion ceases.

STRUCTURE.

On staining, the plasmodial spore is found to consist of a minute, deeply tinted nucleolus, surrounded by an unstained vesicular nucleus, and this again by a covering of protoplasm. As the parasite grows and approaches maturity the nucleolus disperses, and the vesicular nucleus becomes less distinct, finally just before sporulation both nucleus and nucleolus cease to be distinguishable.

MELANIN.

The melanin particles occur either in dust-like specks, in coarse grains, in short rods, or aggregated into dense clumps.

LATENT PHASE.

Concurrently with the subsidence of acute clinical symptoms, the plasmodium may disappear from the general circulation and pass into a latent stage. This it does either spontaneously or as the result of the action of quinine. The exact conditions which cause latency are not known.

EXTRA CORPOREAL CYCLE—FLAGELLATED BODIES.

When fresh malarial blood is examined under the microscope, strange octopus-like creatures, the flagellated bodies appear; like the ordinary parasite they are of colourless protoplasm, with melanin granules, but they are furnished with one to six whip-like arms, termed flagella. These arms, three or four times as long as a blood corpuscle is broad, move with the greatest rapidity, and they double up and distort the blood corpuscles by their blows. Occasionally the flagella break away and swim about freely.

Careful observation shows that the flagellated bodies are developed from two forms of the extra-corpuscular parasite—in all references to fossil plants must be catalogued under both Botany and Palæontology; similarly, all references to fossil animals must be given under both Zoology and Palæontology. Mr. Thomson would have been wiser had he studied the printed directions by which the auther was guided, before he so hastily formulated his ill-based charges.

XI. P. 11 lines 2-7.

Some of the entries in the second section show all too plainly the leaning sympathy of the compiler, especially in the Palæontological and Botanical divisions, being overloaded with details, recounting numerous species, sub-species and types familiar to the author.

In this instance Mr. Thomson again proves that he has not taken the trouble to refer to the specimen catalogues supplied from London, which formed the model for the construction of the Queensland volume. Any unbiased critic who compares the two will see that the copy has been rigidly and faithfully followed.

XII. P. 11, lines 10-14.

The second part of the catalogue shows haste and inexperience in bibliographic compilation. Here the entries, supposed to be arranged according to the subjects, reappear in the order of authors up to p. 76, where the proper arrangements only begins, and is carried to the end of p. 132.

Mr. Thomson is again wrong in his contention. The rule followed in the specimen subject-catalogues for Physics, Mathematics, Anthropology, &c., is to arrange each sub-section alphabetically under authors ; but in Botany and Zoology, with their scientific names, the titles and not the authors' names are in alphabetical sequence.

XIII. P. 11, lines 28-33.

Many valuable and original literary contributions to science have been published from time to time in most of our local periodicals. According to the resolutions of the conference these should have been listed.

Mr. Thomson is wrong in supposing that a newspaper is a periodical in terms of the second rule given by him on p. 4 of his "Critical Notes." Newspaper articles such as he mentions are never acknowledged as authorities or quoted as such by scientific journals.

ON A METHOD BY WHICH A PURE WATER-SUPPLY COULD BE OBTAINED FOR BRISABNE.

By THOS. L. BANCROFT, M.B., Edin.

[*Read before the Royal Society of Queensland, 19th August, 1899.*]

If the Enoggera water be analysed, it will be found to be free from inorganic matter with the exception of a very small amount of common salt, [In March last, after a considerable spell of dry weather, there was only 1.2 grains Chlorine to the gallon.] but to contain an enormous amount of organic impurity.

In March, I made an analysis to ascertain the amount of organic matter, with the following result :—

Free Ammonia	·00	Parts per million.
Albuminoid Ammonia	·24	

A water containing ·10 parts per million is generally considered too impure for consumption until subjected to filtration and the amount of Albuminoid Ammonia reduced to ·05 parts per million.

Consumption of water containing ·20 parts per million of Albuminoid Ammonia by a community has been found to bring about various conditions of ill health. In England, such a water would be condemned as unfit for use, but here in Brisbane, we are compelled to consume water of that discription.

How can water be freed from organic impurity?

It has been found that this is possible in many instances by filtration, but it must be remembered that efficient filtration, on a large scale, entails a very serious expense and one that Brisbane could scarcely afford at the present time.

I understand that some experiments have been made by the Board of Water-works to filter the Enoggera water, but without satisfactory results, owing to the excessive amount of organic matter quickly choking the filters.

How does the Enoggera water become contaminated by organic matter? It is from the decomposition of Water-lilies (*Nymphaea gigantea*, Hook), Pond-weed (*Hydrilla*), microscopic algæ, protozoa, excrement of birds, and from leaves washed by rains into the reservoir. The Enoggera water is rich in microscopic life, it is this that gives the water a bad odour on reaching Brisbane; at the reservior it is free from bad smell; whilst in the pipes, in darkness and under pressure, the living bodies die, and by the time they reach town are in a state of decomposition.

Water-plants and fish have unfortunately been introduced into the Enoggera reservoir; the plants serve as food for various insects *e.g.*, the lavæ of dragon-flies, and also for snails, and these again serve as food for ducks and other aquatic birds, also for fish; the fish entice cormorants and water-rats, so that the reservoir terms with life. Considerable areas are very shallow and in these parts, not only do the water-weeds grow luxuriantly, but the water being comparatively still, and much warmer than in the deeper portions, microscopic algæ grow to profusion.

The excrement of birds is not to be ignored as a factor in contamination although, in the case of Enoggera, owing to the great bulk of water, it is a minor one.

Recently in this district [Deception Bay] after a drought, a fresh-water lagoon of about twenty acres in extent, two-thirds of which is covered with the large Blue Water-lily, became the resort of thousands of water-birds, the excrement of which, together with the decomposition of water-lilies, increased the impurity from Chlorine 6·0 grains per gallon.

Free Ammonia	·00	Parts per million.
Albuminoid Ammonia	·30	

to Chlorine 148·0 grains per gallon.

Free Ammonia	·08	Parts per million.
Albuminoid Ammonia	1·00	

The water in this lagoon generally is drinkable, although it possesses a very distinct weedy taste; recently it has become so foul as to be little better than sewage.

In another lagoon, near by, of great depth of water (8 to 30 feet), no water-weeds grew and no birds congregated, the impurity was:—

Chlorine 2·0 grains per gallon.

Free Ammonia ·00 } Parts per million.
Albuminoid Ammonia ·24 }

This water gets its organic impurity from the leaves of over-hanging trees.

Now I have observed over and over again, not in Queensland alone, but in various other countries, that water-weeds, rooting at the bottom, will not grow in fresh water rivers and lakes provided there be no shallow parts, no parts less than six feet deep, and I have observed that where there are no water-weeds there are no free algæ, neither will Duck-weed (*Lemna*) and Azolla grow; the waves soon cast on shore these floating plants; whether the same would apply to the Water Hyacinth is doubtful.

On Stradbrook Island there are several large fresh-water lakes with deep water (20 feet) free from water-weeds, fish and birds; the water is practically pure; by preventing the leaves from over-hanging trees entering the lakes, the water would remain as pure as rain water in an ordinary galvanised iron tank.

It is true that the large Water-lilies, particularly the yellow one (*Nuphar lutea* H.K.), can grow in water up to ten feet, but in order for them to do so, they must be well established in shallow water and gradually creep into the deep water; ten feet seems to be about the limit at which they will grow.

When growing in water ten feet deep the slightest increase in depth by rain causes them to die. If well rooted specimens be sunk into water over six feet deep they will die, at any rate, that is my experience.

It is manifest then that were a water reservoir constructed so that no parts would be less than six feet deep, water-weeds would not grow in it.

The Enoggera reservoir could be made to contain twice the quantity of water it now does and the water would be pure. Sooner or later the water-supply for Brisbane will have to be augmented; I believe the cheapest and best way to do this would be by deepening the Enoggera reservoir. I suggest that the

Board of Water-works temporarily increase the water-supply from other sources than Enoggera so as to be independent of the latter and then proceed to reconstruct.

The method suggested is to cut gradually a trench into the by-wash to drain off all the water; to make a wall of rough stone and concrete, at least six feet high, round the water's edge and back this with earth dug from the shallow parts of the lake so as to make a gradual ascending slope from the top of the wall to the hill sides; otherwise, water would lodge between the wall and the hill; plant the bank with Buffalo-grass; clean out logs, stumps, vegetation, and fish; finally, strengthen and raise the dam and build up the by-wash. The lake would then hold sufficient water for the requirements of Brisbane for some time to come: the water would be pure and every drop available if at any time pumping had to be restored to. The other reservoirs could then be abandoned until the growth of the city necessitated a further increase of water. There should be a space cleared at least fifty yards wide, all round the lake, fenced in and planted with Buffalo-grass; the grass should never be cut nor grazed by cattle; it would serve to prevent leaves from the adjacent land being washed by rain or blown in the reservoir.

Deception Bay, July 1899.

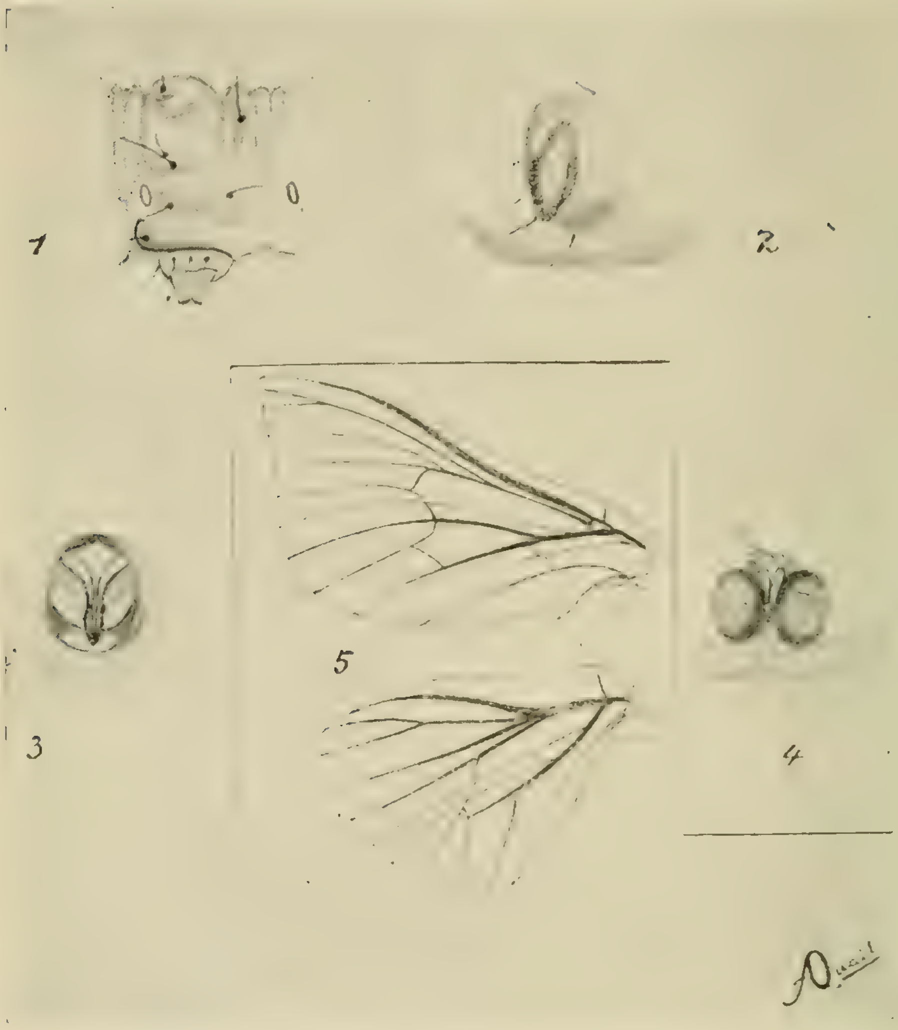
DESCRIPTION OF SOME CAVES NEAR CAMOOWEAL.

By T. P. KEYS.

[*Read before the Royal Society of Queensland, August 19, 1899.*]

About twelve miles to the eastward of the township of Camooweal the monotonous level of the country is interrupted by the presence of a number of irregular chasms, varying in depth from 50 to 120 feet, and in width from 30 to 100 feet. Leading into most of these chasms are water-courses, which in flood-time pour in an enormous quantity of water, which disappears as rapidly as it enters. Being anxious to solve the problem of the dissappearance of all this water, I set out one morning in company with a few companions, and, having reached our destination, selected a cave which seemed suitable for exploration. We had taken care to come provided with a supply of ropes and candles, also a quantity of kerosene for the purpose of making fire-balls. Fastening our rope to a large boulder, we clambered, or rather slid, to the bottom at a depth of 105 feet. At this level we found a cave opening into the rock, the entrance being about 30 feet high, but increasing to a height of nearly 50 feet as we advanced. After walking some distance our progress was barred by an enormous rent or hole in the floor. Having succeeded in getting round this, we found the cave opened out into numerous passages, the largest bearing some resemblance to a great cathedral, with pillars of limestone supporting the roof, which appears as if chiselled by the hand of man into a sort of mosaic work. Some of the side passages contained beautiful stalactites, which on being struck, gave out a clear, musical note. Retracing our steps to the opening in the floor, we fastened on our second rope, and again descended, having first thrown down a large ball of cotton soaked in kerosene, to test the atmosphere and to light us on our way. On reaching the second floor, we found several caves which we explored till our progress was again stopped by a second hole. After dropping fire-balls into this, we made fast another rope and decended, reaching a third floor, or rather platform, of considerable size. Looking over the edge of this platform, we could discern below at the distance of about 40 feet a considerable body of water. Determining to examine this, I had a rope fastened round my waist and was let down by the others—I found the water beautifully clear, cool, and pure ; but had no means of testing its depth, or its exact temperature. Further progress being impossible we retraced our steps, and having reached the surface and the light of day, we found, by measurement of our ropes, that the surface of this subterranean lake is about 300 feet below the level of the plain. We also estimated that the distance which we had penetrated horizontally into the bowels of the earth could not have been far short of a quarter of a mile. The floors of the caves were free from rubbish of any kind, and the atmosphere was tolerably pure throughout.

In connection with this subject, it is, I think, worthy of note that the Rocklands' Pastoral Company have put down several bores in the neighbourhood of Camooweal which have struck water—an inexhaustible supply of sub-artesian water—at depths varying from 250 to 300 feet, proving conclusively (in connection with the above) that below the surface of this arid region there exists a vast reservoir of pure, fresh water of many square miles in extent, and at a nearly uniform depth below the surface.



EXPLANATION OF PLATE HEPIALUS VIRESCENS.

Figure 1. Third abdominal segment showing position of tubercles, spiracle and hairs; enlarged; 4 x 4 diameters.

2.—Ventral aspect of proleg, showing terminal hooks, position of four outer hairs and one on inner sides; much enlarged.

3.—♂ Genitalia; enlarged; 4 x 4 diameters.

4.—Ventral aspect of caput showing antennal base and palpi; enlarged; 2 x 2 diameters.

5.—Neuration of fore and hind wing; natural size.

A FRAGMENTARY PAPER ON THE LARVAL STRUCTURE ETC., OF HEPIALUS? VIRESCENS (D'BLD.) OF NEW ZEALAND.

(Plate I.)

By AMBROSE QUAIL, F E.S. (London.)

(Communicated by R. Illidge.)

[Read before the Royal Society of Queensland, November 18, 1899.]

Probably it is well known to you that the Hepialidæ are a very interesting group of the Lepidoptera—from a scientific point of view—possessing as they do certain affinities with the Trichoptera ; the Hepialidæ are not without interest from the economic point of view also. I shall however, deal with the former.

A note of the distribution, so far as is known to me, may be of interest. In Europe there are eight representatives all of the genus Hepialus, five of these are British. I have no list from America, nor any means of reference, but am acquainted with several species. I do not believe them numerous, as recently, Professor Dyar stated that not sufficient material has yet been studied for the modifications of larval structure to be known (Ento Record IX-137). This would hardly be so if the group had numerous representatives in America. From Africa I have no lists, but there is a fair number of species, and in that country the same development of antennal appendages takes place—as in Australia—in the imagines. From Asia I have no lists, and have no reason to believe the group numerous. I have received one species from Ceylon, but there are more. It is in the Australian region that the group is most numerous. Mr. R. Illidge of Brisbane, and other entomologists have kindly furnished me with lists. From these I find thirty-one representatives of the group are described. In New Zealand nine representatives are described. Of the Australian species, twelve, and three doubtful are of the genus Hepialus. In New Zealand Hepialus virescens is the only one, the remaining eight being of the genus Porina. The Hepialus of Europe are root feeders, the ova are black, spherical, and laid loosely amongst the herbage. The Porinas of New Zealand are also root feeders, ova black, spherical, and laid loosely. I am not acquainted with the ova of Hepialus virescens. Hudson states they are "very small yellowish, round" (N. Z. Macro Lepidoptera.) Illidge states the ova of the Australian Hepialus (*Charagia*) "are a pale yellow colour" when extruded "turn slaty gray hue" afterwards, the larvæ are internal wood feeders. Between the European black ova, root feeding larvæ, and the Australasian yellow-gray ova, wood-feeding larvæ, there seems sufficient distinction to provisionally adopt the name Charagia (Walk) for those species associated under the name Hepialus (F.) leaving the latter name to the European representatives. This is done by Illidge in his paper ("Proceedings of the Royal Society of Queensland," volume XIV).

Dr. S. A. Chapman some years since, in a letter to the writer expressed the opinion that the true position of the Hepialidæ and Cossidæ among the Lepidoptera could be best worked out in Australia, but the subterranean and internal feeding habits of the larvæ render observation and collection of material difficult and uninviting to the general worker. Of the N. Z. Porinas I have obtained ova, etc., of four species. The larvæ of H. virescens I have often watched when they replaced the damaged cover of their burrow at night, but was unable until recently, to procure any of the wood into which they burrow. In August the insect is in pupa, but I succeeded in obtaining half-grown larvæ, proving the species occupies at least two years in its transformations. Hudson gives no hint as to the time so occupied. Illidge mentions from "one to three years" for the Australian species, and that the larvæ burrow into the tree then, downwards. A specimen of the virescens which I examined burrowed into the wood, the burrow being at a slightly upward inclination. About half an inch from the entrance was another bore, downwards, and again at the end of the entrance burrow was another bore, downwards. These two bores were $2\frac{1}{4}$ inches long, and from the entrance to extremity of the upward burrow $1\frac{1}{2}$ inches, altogether 6 inches of boring $\frac{1}{4}$ inch in diameter. The larva was situated in the second bore at the extremity of the entrance burrow, and fitted tightly into the cavity.

Turning now to the subject matter of this paper, the larval structure. Larva half-grown length $1\frac{1}{4}$ inches, shape, tolerably uniform, slightly tapering at anus, and two preceeding segments. Colour, very like a strip of raw meat; head very dark brown, roughly striated; pro-thorax dark red; meso-thorax, red; segmental swollen areas pale flesh colour; segmental incisions deeply incised, composed of several small sub-segments, pinkish red in colour; tubercles pale brown, scarcely distinguishable from the fleshy swellings upon which they are situated; spiracles, black rimmed; hairs, dark brown; legs, brown; prolegs, pinkish.

The head is flatter in front than the Porinas, more striated, and has several fine hairs, the segments much more swollen areas, especially dorsally. The positions of the spiracles, of the tubercles, and the number of hairs upon them are the important features in the larval structure for the purpose of classification. Number of segments, 14, including the head. Lateral aspect under 1 inch objective.

Pro-thorax, dorsal plate (*scutellum*) scarcely distinguishable from the fleshy segment. It has three single hairs on the anterior edge, and in the middle of the lateral area of the plate is a black concavity from within which rises a single hair. Below this concavity is a single hair. The lateral edge curves upwards at the posterior corner, and the spiracle is situate on the posterior area of the segment within the curve of the dorsal plate. A large anterior swelling above the leg has two hairs. The legs have five hairs at, or above, the joints.

Meso-thorax consists mainly of two large sub-segments (and several small situate in the incision), each bearing one hair on the dorso-anterior edge. On the posterior sub-segment is another hair below, the middle of the ventral area is swollen and has two remote hairs. Below is a large fleshy swelling, bearing 1 hair, below which is a large tubercle, slightly posterior, with one hair. Post thorax corresponds with meso-thorax, and the legs on each with pro-thorax, no spiracles. Abdominal segments: 1st situate on the large dorsal swollen areas of the principal sub-segment are the two dorsal tubercles (anterior trapezoidals) one on each side, separated by a thin median line along the back. These have one hair. The posterior trapezoidals are remote, smaller (more lateral) with one hair on the posterior edge of the next sub-segment. Spiracle large, situate about $\frac{2}{3}$ down the anterior sub-segment (from the median line) on the anterior edge if not actually on the intersegmental membrane; above the spiracle slightly posterior is a swollen area with a tubercle bearing, one long, one short, hairs (supra spiracular tubercle); immediately posterior to the spiracle is a large swelling bearing two remote hairs; below the spiracle is a large swelling bearing one hair, and below this a sub-ventral swelling bearing two hairs; 2nd abdominal segment, corresponds with 1st except that on the large sub-spiracular swelling are two scarcely distinguishable remote tubercles, each with one hair (posterior and anterior sub-spiracular tubercles); 3rd abdominal segments, corresponds with 2nd except there is no sub-ventral swelling, the pro-legs having instead four single hairs at the base, the 3rd, 4th, 5th, 6th, abdominal segments having pro-legs, and correspond in other respects. 7th corresponds with 2nd; 8th correspond with 7th; 9th has the anterior trapezoidals small and more remote than are the posterior trapezoidals, the supra-spiracular tubercle is small and has only one hair, the latter and three other tubercles (one hair each) are situate one below the other on the posterior edge of the segment. 10th has three single hairs above the anal fold and the leg has two single hairs at base. Ventral aspect under one inch objective.

Immediately at the base of each leg of the thoracic segments on the posterior ridge is a single hair; 1st and 2nd abdominal segments have four tubercles each, with one hair each, arranged transversely (from side to side of segment) 3rd, 4th, 5th, 6th, have one hair at the base of each pro-leg on inner side. 7th has two tubercles at either side with one hair each, arranged longitudinally. 8th has only the outer most tubercles, and an inner hair marking the transverse position (as on 2nd) of the tubercles. 9th has two single hairs only. 10th has several hairs on inner side of claspers.

Pro-legs have a complete encircling row of hooks turned outwards, at the extremity. Under a $\frac{1}{4}$ inch objective the larval skin is comparatively smooth, having the very slightest roughness, and the hairs are smooth.

In conclusion, I would point out the scientific importance of accurate descriptions of the Australian Hepialidæ. From the foregoing I draw special attention to the curious black concavity on the scutellum which remains until the pupa stage. Its significance is an interesting problem. The hair within is evidently articulated, or at any rate is movable at will of the larva. Probably all the hairs are so, but I specially noticed it with this particular hair. The position of the spiracles, and the arrangement of the tubercles on the abdominal segments are matters of importance.

I append a note of the more important imaginal structures. The genitalia of ♂ figured for comparison with Australian Hepialus, Antennæ are simple base figured, palpi are terminated by small lobes connected by a narrow neck with main joint. These are covered densely with light and dark hair (scales ?) Neuration of the wings, one of the most important imaginal structural characters for the purpose of classification—note the series of transverse nervures at base of wings and the jugum, a small projection near base of fore wing on inner margin, this only occurs in the Hepialidæ and Micropterygidæ among the Lepidoptera, but also in the Trichoptera.

Can I enlist the assistance of Australian entomologists in my researches into the structural characters of the Hepialidæ? I am desirous of obtaining ova and newly hatched larvæ (accurately labled in spirits) for observation and comparison, and should be most happy to publish results through the Australian societies.

PUBLIC ABATTOIRS AND THE PREVENTION OF TUBERCULOSIS.

By HON. W. F. TAYLOR, M.D., M.L.C., D.P.H.

Read before the Royal Society of Queensland, December 16, 1899.

I PROPOSE to show this evening, as briefly as possible, what effect public abattoirs should have in checking the spread of disease caused by the tubercle bacillus. Tuberculosis, in its different manifestations is all too common among us, and it becomes the duty of everyone in a position to do so, to point out, if not from his own particular experience, from that of others, by what means the disease may be arrested, and its ravages mitigated. We have had the subject of tuberculosis prominently brought before us at a recent public meeting held for the purpose of forming a society to cope with the disease in the human being, and a few days ago many of us were privileged to hear a lecture, with lantern-slide illustrations, on the tubercle bacillus, by Mr. Pond, so that the subject has of late been tolerably well ventilated. As you are doubtless aware an Act was passed last session—"The Slaughtering Act of 1898," giving the Government power to construct public abattoirs where it was found to be necessary. Section 7 provides that—"The Minister may, out of any moneys appropriated by Parliament for the purpose, establish, maintain, and manage such, and so many public abattoirs as are, in his opinion, necessary for slaughtering stock, and may permit the use of the same by all persons upon payment of the fees and observing the conditions prescribed by the regulations." It is not sought by this Section to compel all those engaged in slaughtering to give up their private slaughter-houses, but it is proposed to give proper facilities to those who are unable to meet the necessary requirements of the Act as to water supply, drainage, and other sanitary measures, to carry on their business under suitable conditions ; so that should the owner of a private slaughter-house be unable to comply with the provisions of the Act from the want of a sufficient supply of pure water, inadequate drainage, or other causes, he may slaughter his stock at the public abattoir for a moderate cost. The Act also makes provision for the efficient inspection of slaughter-houses by a duly qualified inspector who "may at all reasonable times, enter, inspect, and examine any slaughter-house or butchers' shop, and may inspect and examine all stock and all utensils, machinery, apparatus, works, and things at a slaughter-house or butchers' shop, or used in connection with stock or meat, and all places, things and vehicles kept or used for storage, sale, carriage or delivery of meat or stock." Section 9 gives the inspector power to take action when he finds a slaughter-house or butchers' shop in an unclean state, and when any stock at a slaughter-house or elsewhere are diseased, and when any person employed in or about the premises is found to be suffering from disease likely to contaminate the meat. He may also order a sufficient supply of pure and wholesome water in the case of an inadequate supply, or when the water is not pure, and he may order any vehicle or utensil used for the purpose of carrying meat to be cleansed, disinfected, and otherwise rendered wholesome.

The inspector may order the removal or isolation of any person found to be affected with disease after he has satisfied himself by "reference to the Health Office of the district in which the slaughter-house or butchers' shop is situated, or to some duly qualified medical practitioner, that the disease with which any person is affected is one or other of the diseases mentioned in the second schedule." The inspector therefore cannot, of his own authority, order the removal or isolation of any person whom he supposes to be suffering from disease, but only on the authority of a medical practitioner.

It is competent for any person who may feel aggrieved by an order or decision of an inspector, other than an order to cleanse, to appeal therefrom to any two justices sitting in Petty Sessions on giving to such inspector the prescribed notice in writing of his intention so to do.

This Act is a most useful one, and while giving power on the one hand for full inspection of meat and slaughter houses, prevents on the other hand any harsh or arbitrary action on the part of the inspector, and provides the means whereby butchers and others may carry on slaughtering in premises peculiarly adapted for the purpose. So far as I am aware, however, the provisions of this Act have not yet come into operation ; at all events no public abattoirs have been erected, so that we are, so far as the slaughtering and inspection of meat for home consumption are concerned, very much in the same position as before the passing of this Act. There is one obstacle which no doubt has influenced or prevented the Minister charged with the administration of this Act from putting its provisions into operation, and that is the difficulty in obtaining the services of a staff of qualified inspectors. When this Bill was before the Legislative Council it was insisted on by some Honourable Members that the inspectors, having such extensive powers conferred upon them, should be Veterinary Surgeons. This no doubt would be very desirable if a sufficient number of duly qualified Veterinary Surgeons could be obtained at a reasonable salary ; but here was an obvious difficulty which could not be very easily overcome—for granting that a sufficient number of duly qualified Veterinary Surgeons could be obtained—the salary required by each would render their employment prohibitive. However, the assurance was given that a number of intelligent fairly qualified inspectors were being educated locally, and that in process of time a sufficient number of individuals would be available as inspectors at a reasonable salary, and the difficulty foreshadowed at the discussion on the Bill in the Legislative Council would rapidly be removed and a staff of qualified inspectors soon be obtainable. I have thought it advisable to go into this matter of the "Slaughtering Act of 1898" to show that ample power exists in this colony to carry out the erection of public abattoirs, and to insure the efficient inspection of meat ; it now remains to show in what way, if any, the erection of public abattoirs would prevent the spread of tubercular diseases. The effects of the tubercle bacillus may become manifest in different parts of the human body, the lungs, glands, brain, serous membranes, and bones being all liable to its ravages, the part affected depending to a great extent on the mode of entrance of the bacillus. The larynx and lungs will be infected by inhalation of the bacillus, and tuberculous material being swallowed will infect the intestines, causing ulceration, and affecting subsequently the mesenteric and other abdominal glands, and possibly the entire organism. Of infection by food, such as milk, ample evidence is forthcoming, and there can be no doubt from experiments carried out on the lower animals that meat may be also a fertile source of danger. In the report of the Royal Commission on Tuberculous of 1895 the following appears:—"We have obtained ample evidence that food derived from tuberculous animals can produce tuberculosis in healthy animals. The proportion of animals contracting tuberculosis after experimental use of such food is different in one and another class of animals; both carnivora and herbivora are susceptible, and the proportion is high in pigs. In the absence of direct experiments on human subjects, we infer that man also can acquire tuberculosis by feeding upon materials derived from tuberculous animals."

78. The actual amount of tuberculous disease among certain classes of food-animals is so large as to afford to man frequent occasions for contracting tuberculous disease through his food. As to the proportion of tuberculosis acquired by man through his food, or through other means, we can form no definite opinion; but we think it probable that a considerable part of the tuberculosis that effects man is obtained through his food.

79. The circumstances and conditions with regard to the tuberculosis in the food-animal which lead to the production of tuberculosis in man are ultimately the presence of active tuberculous matter in the food taken from the animal and consumed by man in a raw or insufficiently cooked state.

80. "Tuberculous disease is observed most frequently in cattle and swine. . . . Tuberculous matter is but seldom found in the meat substance of the carcase, it is principally found in the organs, membranes, and glands. There is reason to believe that tuberculous matter, when present in meat sold to the public, is more commonly due to contamination of the surface of the meat with material derived from other diseased parts, than to disease of the meat itself. The same matter is found in the milk of cows when the udder has become invaded by tuberculous disease, and seldom or never when the udder is not diseased. Tuberculous matter in milk is exceptionally active

in its operation upon animals fed either with the milk or with dairy produce derived from it. No doubt the largest part of the tuberculosis which man obtains through his food is by means of milk containing tuberculous matter."

82. "Provided every part that is the seat of tuberculous matter be avoided and destroyed, and, provided care be taken to save from contamination by such matters the actual meat substance of a tuberculous animal, a great deal of meat from animals affected by tuberculosis may be eaten without risk by the consumer."

83. "Ordinary processes of cooking applied to meat which has got contaminated on its surface are probably sufficient to destroy the harmful quality. They would not avail to render wholesome any piece of meat that contained tuberculous matter in its deeper parts. The boiling of milk, even for a moment, would probably be sufficient to remove the very dangerous quality of tuberculous milk."

89. "There is always a difficulty in making sure of the absence of tuberculous matter from any part of the carcase that shows evidence of tubercle elsewhere."

Dr. Sims Woodhead is reported to have stated that a man might eat a sufficiently large quantity of tubercular meat containing tubercle at one meal to induce tuberculosis.

Bovine tubercular matter is much more virulent to animals generally than human tubercular matter.

Dr. Sydney Martin in a contribution to the "Journal of State Medicine" says:—The parts of the body which are affected by the disease after infection are very varied in individual cases, and this variability, which in former times led to great misconception as to the nature of the disease (which was described as arising in the body, for example), led undoubtedly to a delay to the acceptance of tuberculosis as an infective disease. There are cases, for example, which are readily explained, such as primary pulmonary tuberculosis, and primary intestinal tuberculosis, in the former of which the infective material is evidently inhaled, in the latter of which the material is swallowed, and produces ulceration of the small intestine, affecting secondarily the mesenteric glands. There are other cases of tuberculosis which are not so easily explained. These are the cases of scrofulous glands in the neck, of tubercular peritonitis without intestinal ulceration, and cases of so-called remote tuberculosis, "primary" tubercular meningitis, or tubercular disease of the joints and bones. The experimental study of the disease explains in great part the anomalies in the distribution of the lesions in the human subject. A single dose of tuberculous material given with the food of a healthy pig will, if large enough, produce intestinal ulceration, subsequent infection of the mesenteric glands and of other glands in the abdominal cavity, followed by a general infection of the body. A smaller dose will produce no ulceration or sign of infection of the mucous membrane of the intestine, but will produce enlargement of the mesenteric glands, and perhaps affect no other part of the body." This important fact, namely, that a small dose of tuberculous virus may infect the internal organs of the body without producing a lesion in the mucous membrane by which it is absorbed was well illustrated by many experiments of the Royal Commission. From a practical point of view, the reproduction of scrofulous glands in the neck was as important as any of the results. Thus with a large dose of tubercular virus given to the pig ulceration of the tonsil might result, with infection of the glands below the jaw, and then a general infection of the body. With a smaller dose there was no ulceration of the tonsil, but the glands below the jaw were infected, and subsequently the glands of the neck, and then the lungs. With a smaller dose in one case, and also in a calf, the glands below the jaw were alone affected, there being no affection of the tonsil or of the body generally. The second and third classes of experiment reproduced cases which are continually occurring in human beings, namely, scrofulous glands of the neck, occurring either by themselves or associated with tuberculosis of the lungs. After the administration of a large dose of the poison the disease progressed gradually, but with certainty. It is not unfrequently seen with smaller doses, that the disease, after infecting one or the other parts, appears to remain stationary for a long time; but even when remaining stationary for months the lesions produced are still infective, as is frequently seen in the human subject. These lesions may lead to a generalization of the disease. Too much stress cannot be laid on this point as an explanation of the cases of so-called remote tuberculosis. In some of these cases in man—such as cases of tubercular meningitis, bone and joint disease—there is found an old lesion, may be not larger than a pea, at the apex of one lung, in a mesenteric gland—the glands below the jaw, or in the bronchial glands—and there may be no lesion, old or recent, in the mucous membrane of the alimentary tract to show the point of absorption. These are cases in which the primary local lesion has retrograded, but still remained infective, the infective material being absorbed into the circulation, and conveyed to the meninges, or to the joints and bones. In the other cases careful research has not revealed any local lesion in the body, and these must be cases in which the tubercle bacillus is absorbed accidentally directly into the circulation."

Tuberculosis is very common among cattle, and swine, in this and other countries, are very liable to it. Sheep and calves, however, do not appear to be easily affected by it. The udders of tuberculous cows are liable to become infected, and the milk from these is a fertile source of infection to those who consume it. Boiling the milk is the only safeguard; but so many persons, both children and adults, object to drinking boiled milk, that the practice of boiling all milk before using it is by no means an universal one. Neglect of this practice in the case of the milk consumed by infants and young children is a common cause of intestinal tuberculosis, usually called tabes mesenterica, or abdominal phthisis. Cattle and swine being so liable to contract tuberculosis, it is very necessary that all such killed for human consumption should be properly inspected, and the only efficient way to do this is to carefully examine the thoracix and abdominal organs of the animals when killed—for although it may be, and probably is true, that the flesh of tuberculous animals is in most cases free from contamination, and may be safely eaten when properly cooked, still cases do occur where the flesh becomes contaminated by contact with diseased lungs or other organs, and would therefore be a source of danger unless properly cooked. In any case it is highly desirable that the purchaser should know that he is buying the flesh of an animal who may have had tuberculosis of the lungs or udder, so that he may take such precautions respecting efficient cooking as will minimise any risk of infection to those eating it. The carcase, therefore, of an animal that has given evidence of tubercular infection of any of the organs or glands should be duly labelled and only sold as that of a tuberculous animal. I am decidedly of opinion, however, that in no case should the flesh of a tuberculous animal be used for human food. We have seen from the Report of the Royal Commission on Tuberculosis that "There is always a difficulty in making sure of the absence of tuberculous matter from any part of the carcase that shows evidence of tuberculosis," and we know that the system may become generally infected from a tuberculous deposit, however minute, which may have existed for months in a quiescent state in any of the organs of the body. Is it right, therefore, to assume that the flesh of such an animal is safe to use for human food, no matter how well cooked? Again, the deeper parts of meat are not, as a rule, thoroughly cooked—many people like their meat underdone, and such underdone meat can hardly be said to be quite safe and free from the risk of infection. One argument in favour of the use of the flesh of tuberculous animals is that it could be sold cheaper to the poorer classes than the flesh of healthy animals. I am of opinion, however, that if the flesh of tuberculous animals is to be used at all for human food, it should only be used by those who are in a position to have it well and thoroughly cooked, and who are not living in crowded, ill-ventilated, and insanitary tenements, as the poorer classes generally are, especially in our cities. In other words, it is less risky, personally, for the better well-to-do classes to consume meat of doubtful character than it is for the poorer classes, and the danger to the community as a whole from one of the well-to-do classes becoming infected would be less than it would be from one of the poorer classes, by reason of the evironments of the one being so much better than that of the other, the risk of contagion from an infected individual being less in proportion to the degree of isolation, purity of air, and sanitary condition of his surroundings, and his intelligent understanding of the various means by which the infection may be propagated. Every individual infected with tuberculosis is a source of contagion, and many become a centre for the spread of the disease. It is necessary, therefore, if the disease is to be controlled, if not stamped out, that every probable or possible source of infection should be eliminated. As the flesh of tuberculous animals may, and sometimes admittedly does, become infected, it appears to me to be obvious, that if tuberculosis is to be combatted suceessfully no loophole of escape should be permitted it; therefore, as the use of the flesh of tuberculous animals is attended with some danger of infection it should not be admitted as an article of human food. A rigid inspection of every animal killed for human consumption should be instituted, and on the discovery of tuberculous deposit in any of the organs the carcase should be condemned. To permit the whole or portions of the carcase to be used for human food is, in my opinion, playing with the question of prevention of tuberculosis, and the statement of the Royal Commission, which I have quoted, goes far to prove this contention. If, therefore, the flesh of tuberculous animals should under no circumstances be used for human food, it follows that the inspection of the animal to be thorough must be made under suitable conditions, and every facility offered to the inspector for performing his work properly and efficiently. It will be necessary, therefore, to have the slaughtering done in as few places as possible, and at certain fixed times, so that an inspector may be always present, and have every facility for examining the internal organs for any obvious disease, and when doubt may arise, the opportunity for a microscopical examination of the tissues should be afforded. The slaughter-house should be well lighted and ventilated, there should be a plentiful supply of pure water, and the drainage should be perfect. The addition of a cooling chamber is not only very desirable, but a necessity, in order to preserve the carcases during hot weather, pending a thorough microscopical examination in suspected cases. The slaughter-house should be divided into compartments, in order that each butchers' stock may be kept separated, and there should be suitable conveyances for the removal of the carcases to the different butchers' shops. The modern abattoir fulfils all the necessary requirements recommended, and is replete with conveniences which cannot possibly exist in every small slaughter-house. The following is a description of an abattoir which may be regarded as tolerably up-to-date:—A square piece of ground, open on one side to the public road and on the other side to a railway siding, so that animals coming by road or rail could be readily admitted. The chief entrance on the street would be for persons coming on business. Cattle arriving by rail would be received into a number of pens in the first instance, and be examined by a veterinary inspector. If any were found to be diseased, they would be taken to a place set apart for diseased animals. Pigs, if possible, should have a bath, being made to walk through a cement tank containing water, so that they arrived clean at the lairs in which they were to be kept. There should be separate lairs for the sheep, swine, horned cattle, and calves, there being a little space between the lairs and the abattoirs. The animals should be kept in the lairs for a few days until wanted, and all properly marked, so that each butcher would know his own cattle. In the abattoirs every part should be kept perfectly clean, as well as everything in the vicinity. The buildings could be made as ornamental as desired, so that they would be an improvement to a locality, and there should be nothing objectionable in or about them. The cattle should be taken into the slaughter-hall with a mask over their faces (blindfolded), and a spike fixed in the mask ready to be driven with a mallet into their skulls. The slaughter-hall should be a spacious building, open from end to end, a passage running down the centre. On one side all animals could be slaughtered, and the carcases hung up on the other side. When slaughtering was in process the inspectors could walk up and down the central passage, and special hooks should be provided on which to hang the different viscera directly the animal was killed.

If the inspector was not satisfied, specimens of the meat would be taken and examined microscopically; if satisfied, however, the meat would be stamped in every part. If the butcher did not want the meat at once it could be run into the cooling chamber and kept at a temperature of two or three degrees above freezing point. There would be every convenience of dealing with the meat without handling it. The administration of the abattoir should be under a Veterinary Surgeon or medical man.

Abattoirs, leading as they would to a more efficient inspection of anmials than could possible be made in the case of a number of private slaughter-houses, would benefit the stock-owner by inducing him to try to eliminate tuberculosis and other diseases from his stock, and thus improve the value of his herd.

There would be an increased demand for meat from abattoirs on account of the guarantee afforded of its freedom from disease. This would benefit the butcher by increasing the sale of his meat.

The losses of the butcher in close, hot weather would be very much reduced, owing to his being able to keep his meat stored in the cool chamber at the abattoir until required, and the meat would be much more tender and palatable from being kept a day or two, instead of being consumed a few hours after killing, as must be done under the system of private imperfectly equipped slaughter-houses.

On hygienic reason abattoirs are to be commended, for their erection would remove nuisances from the neighbourhood of dwellings. I have not visited any of the slaughter-yards about Brisbane for some years, but on one occasion, when a member of the Central Board of Health, I was induced to inspect and report on two yards about five miles each from here. One I found tolerably clean, the owner having done all that was possible in the absence of efficient drainage and a sufficient supply of pure water to prevent his place becoming a nuisance to the dwellers in the vicinity, but the fact that a slaughter-yard being in existence was amply demonstrated nasally for a mile or more to leeward of it. The condition I found the other yard in defied any powers of description, but I have no hesitation in saying that it could not possibly have been filthier, and more loathsome than it was in all its details, and the smell was something to be remembered. It was situated on the bank of a creek, which at the time of my visit was not running, consequently all the drainage collected in a stagnant water-hole a few yards away from the killing shed, the floor of which was of round logs, defying all attempts at efficient flushing or scouring, had any ever been made. The people living in the neighbourhood tried year after year to stop the issuing of a slaughtering license to the owner of this yard, but without success. I do not know whether it is still in existence, but if so sincerely hope that it is in a decidedly better condition now than it was formerly.

Abattoirs would protect meat from exposure to the foul emanations, which are so often an accompaniment of the private slaughter-yard, would ensure the thorough examination of all meat for disease, and would materially tend to limit the traffic in diseased meat. On economic grounds abattoirs are desirable, for the meat would be less liable to spoil, being slaughtered under better conditions. Much blood and offal now lost would be saved and utilised, and there would be a saving from order, the proper division of labour, avoidance of driving animals along the roads, and the doing of business on a large scale. Abattoirs properly managed yield a profit.

On humanitarian grounds abattoirs are to be preferred, because they would entail less cruelty to animals, owing to the use of improved appliances for slaughtering, and the cattle, being brought by rail to the abattoirs, would avoid becoming weary and exhausted from being driven along hot, dusty roads.

Sir Richard Thorne, in one of his Harben lectures, says:—"How is the very proper demand of the butchers for uniformity in the condition regulating the seizure of carcases on account of tuberculosis to be met? How is such skilful handling of slightly tuberculous carcases to be attained as will secure the removal of the diseased portions in such a way that no risk will attach to the remainder? I know only one answer, namely, by the abolition, as far as practicable, of private slaughter-houses, by the provision in all large centres of population, whether technically styled urban or rural, of public slaughter-houses, under the direct control of the sanitary authorities and their officers, and by the adoption of measures which will, as soon as practicable, provide a class of skilled meat inspectors.

"The properly administered public slaughter-house is demanded as an act of justice to those trading in meat; it is demanded in the interests of public health and decency; it is demanded for the prevention of cruelty to the lower animals; and it is demanded to bring England, if not the United Kingdom, somewhat nearer to the level of other civilised nations in this matter. Public slaughter-houses, officered by skilled inspectors, and supervised by medical officers of health, are urgently required, amongst other reasons, for the prevention of tuberculosis in man."

The main difficulty in dealing with the erection of public abattoirs in this colony would no doubt be the cry of injury to vested interests; but no man has a right to injure his fellowman by the sale to him, for purposes of food, of diseased meat, or meat which has been exposed to foul emanations; and unless private slaughter-houses are managed according to prescribed sanitary methods, and every facility given for the efficient inspection of the animals killed therein, they should be abolished. The health of the community as a whole, and of every individual member of it, is of paramount importance, and no cry of this sort should be allowed to stay for one moment the enforcement of strict sanitary regulations respecting private slaughter-houses, or their prompt abolition on failure to comply with such regulations.

It is admitted that in sanitary matters generally, Great Britain is far ahead of any Continental nation, but in the matter of public abattoirs the reverse holds good. Germany appears to have led the van in this particular, and the number of public slaughter-houses is constantly on the increase, and there is a perfect army of meat inspectors, something like 35,000, I believe. But Germany is a populous country, and due regard is paid to the health of its inhabitants by the governing powers, and no doubt this large army of inspectors give good value for the money they cost, and many valuable lives are saved through their watchfulness and skill. However, where public abattoirs have been erected in Great Britain they have, to a greater or less extent, superseded the private slaughter - house. In Glasgow private slaughter-houses have been abolished, and the butchers now express a strong preference for the public slaughter-houses over the old system. And no doubt if we had public slaughter-houses here conducted on the same system as the one in Manchester where the butcher can enter and use the public slaughter-house as his own private slaughter-house, paying rent for it, our butchers would soon become alive to the advantages of an abattoir, and willingly give up their private slaughter-houses with all the trouble and annoyance connected with them. Let us hope that the Minister charged with the administration of the Slaughtering Act of 1898, will see his way to construct a public slaughter-house for this community in the near future.

In looking through the Journal of the "Sanitary Institute" for 1898, I came across a plan and description of the Munich slaughter-house which I cannot do better than read to you. The communication was made by C. Childs, M.D., (Oxon), D.P.H., and is as follows :—

The buildings of the Munich Slaughter-house and Cattle Market, &c., &c.

The plan I have had copied and enlarged.

The buildings of the Munich Slaughter-house and Cattle Market commenced in March, 1876, were formally opened in August, 1878.

The site occupied by these buildings is practically well outside the city, at its south-western angle, in direct communication with the Southern Railway, and, through that railway, with the chief central station.

The buildings, with their enclosing wall (a little over 8 feet high), cover about 25 acres; provision being made for future extension.

The Cattle Market is in direct contact with the Southern Railway Station, and is separated from the Slaughter-house by a road of about 32 yards width.

(*A*)—The Slaughter-house.

For the slaughtering of different animals, six halls (*g*, *g*, *g*, *h*, *h*, and *j*) were provided in parallel lines, separated from one another by roadways about 50 feet wide.

Three of these halls (*g*, *g*, *g*) are for the slaughter of large cattle. Each consists of two parts about 46 yards long and 16 yards broad, separated from one another by gangways about 20 feet wide.

Each hall contains 80 slaughter places, and is fitted with appliances convenient for slaughtering, dressing, cleansing, flushing, &c. Air is freely admitted by numerous openings. Direct sunlight is excluded by jalousies made of upright iron plates, fixed outside the windows in such a way that they can be adjusted for this purpose according to the position of the sun.

The two halls (*h*, *h*) for slaughter of small cattle are similar in size and construction. That for swine (*j*) differs by being about 20 feet wider, and has special appliances, on a large scale, for scalding and scraping the carcases.

Smaller buildings are provided—

(*k*) For the slaughter and examination of diseased animals, also for the slaughter of horses (in a separate hall).

(*l*) For the collection and removal of dung.

(*m*) For quarantine stalls.

(*n*) For skin and suet chambers.

(*o* & *p*) For the collection of blood.

(*q*) For the cleansing and scalding of stomachs, intestines, &c.

(*s*, *s*) For the stalling and preparation of animals which are about to be slaughtered.

(*t*, *u*, & *v*) For management and finance offices, with dwelling-rooms for some of the officials.

(*B*)—The Cattle Market.

The Cattle Market occupies about eleven and a half acres, and provides for the stalling, feeding, and watering of the animals.

It consists of—

(*a*, *a*) Two large market halls for large animals.

(a^1, a^1) Two smaller halls, containing stalls for those large animals which are ready for slaughter.

(*b*) A large market hall for living swine and sheep.

(*c*) A large market hall for living calves, and for slaughtered calves and swine.

(*d*) A central weighing house.

(*e*) A restaurant.

(*f*) Stabling and carriage houses.

The population of Munich in 1878, when the Slaughter house and Cattle Market were opened, was a little over 200,000; at present 1897 it is (like that of Leeds) about 400,000.

OBSERVATIONS ON THE LIFE HISTORY OF THE COMMON MOSQUITO.

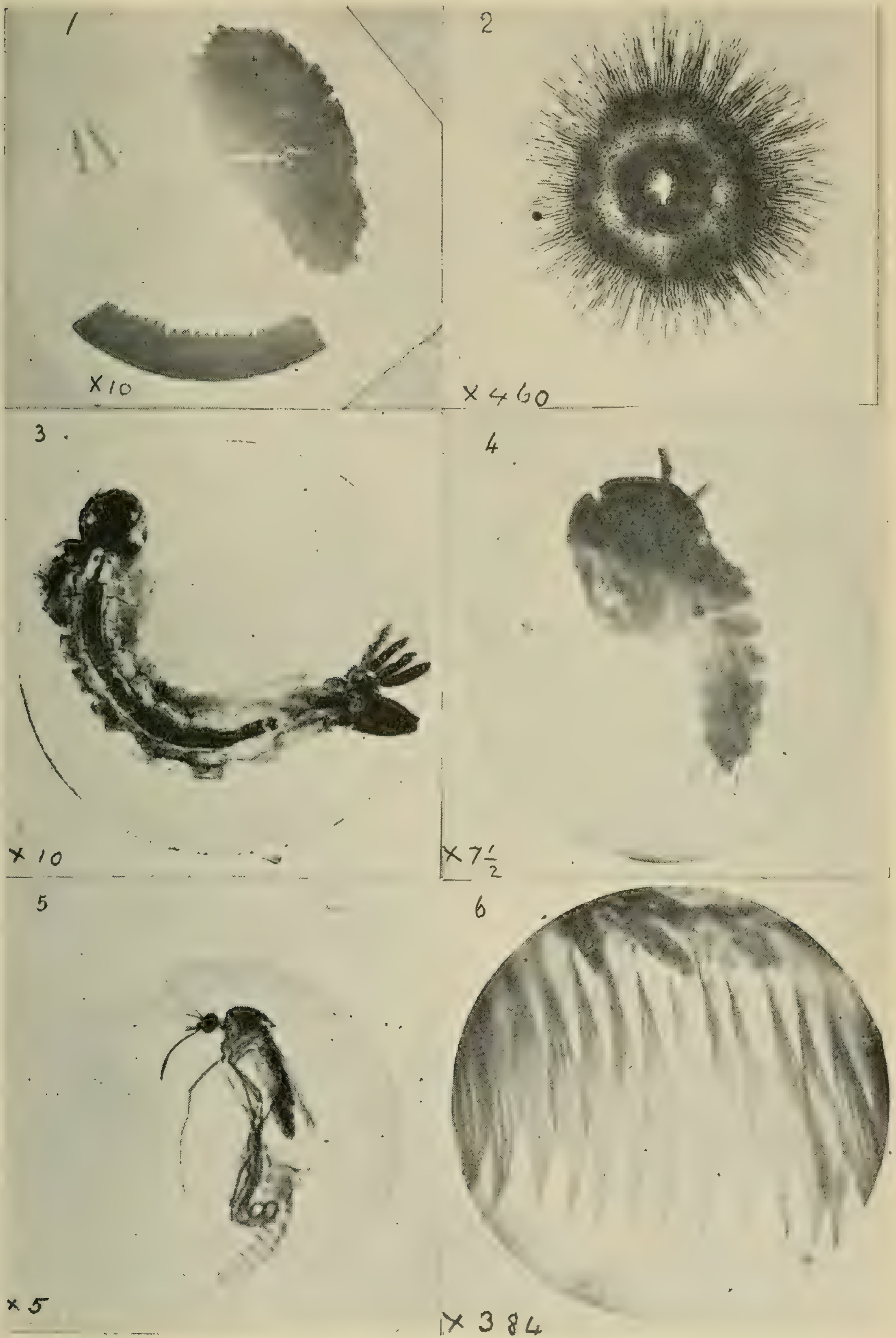
PLATES II. & III.

By W. R. COLLEDGE.

(Read before the Royal Society of Queensland, June 17th, 1899.)

I HAVE pleasure in bringing before your notice some facts regarding that much-abused insect—the Mosquito. It is difficult to find in Australian literature, or society, anyone who has anything good to say on his behalf. Our Scottish poet sings, "Man's inhumanity to man makes countless thousands mourn." But what shall we say of his treatment of this little insect from its point of view? If learned mosquitoes meet to discuss ethical questions in their own royal societies, they probably have grave doubts as to the wisdom of the Creator in forming a creature like man so viciously disposed to themselves. But, notwithstanding all the ill-treatment received from mankind, he manifests a most Christian spirit of friendliness, and loses no opportunity of forming the most intimate acquaintance with his most deadly enemy. As my paper is mainly intended to diffuse information to non-scientific hearers, I have sought to divest it of all technical terms using, where possible, only such language as the ordinary hearer can clearly understand. The word mosquito comes from the Spanish, and simply means "little fly." Its first visible starting point is the egg, for the insect does not bring forth her young alive, but she lays eggs. The egg is in shape not unlike a miniature sailor's marline-spike, one end rounded and tapering gradually down to the other, so that it assumes a conical form. In fig. 1 two separate eggs are seen on the left side. At the centre of the thick round end is a little point slightly projecting. This is really a neat little cap of beautiful structure, to which I shall refer presently.

When the female is about to increase her family she goes about the business in a very methodical way, displaying skill and forethought that would do no discredit to any Australian couples about to marry. It is essential that she should have water whereon to lay her eggs. Running water is avoided; it would carry her eggs she does not know where. So she searches out for a still and quiet pool, as dark and as much hidden from observation as possible. If dirty and filled with rotten leaves and branches, so much the better. The youngsters will then have cover from their enemies, and find food for nourishment. Having satisfied herself as to the best place, she alights on the water, the dirty scum or air film adhering to the water surface being quite sufficient to support her slender form. Resting on the front and middle pair of legs, the hinder pair (which are often seen projecting upwards into the air) are then crossed in the shape of the letter X, and in the angle thus formed she places an egg, holding it upright with the capped end down; another is then glued to it by some cement, of which she is the original manufacturer, and so she goes on laying one row of eggs against another. She still keeps the mass between her hind legs, pushing it further out as it grows bigger to make room for another row of eggs, and so she industriously pursues the work until it is finished. Occasionally she is disturbed, and I have seen many of these little rafts half completed. This work occupies a considerable time. Recently I had one in captivity, and as I went to bed at 10 o'clock I noticed her standing on the water; so suspecting that she was growing broody, I carefully examined the place; she, not liking my appearance at such a time, flew away, and there was certainly no trace of eggs then. About 12 I awoke, and, lighting my lamp, I examined the place and there, in exactly the spot from which I had disturbed her, lay the egg-raft complete. So that the work was done in less than two hours; and it is always done during the night. When complete, the raft is exactly the shape of a boat, three or four times as long as it is broad. At the bottom of fig. 1 you have a side view just as it appears when floating on the water. It forms a complete segment of a circle, and might have been plotted out by a Government surveyor with a pair of compasses. Looking closely at the upper edge, you see it has a saw-like aspect. What looks like the teeth of a saw is really the small ends of the eggs set together in regular rows, all pointing upward. A



Observations on the Life History of the Common Mosquito.

mistake is never made in putting an egg wrong end downwards. All are placed with the thick end on the water. The consequence is that, being conical, when they are all massed closely together, each egg slopes to the centre, producing that curbed boat-like shape you see in the lower part of the picture.

The upper figure represents an egg-boat turned up on end. You are looking at it inside. The eggs are placed so closely together that it looks like one dark mass. Counting the rows in the first boat they will be found to be about twenty-five. And if you take an average of ten eggs in the breadth, these numbers if multiplied will give you 250 in the boat. That is a fair average. Some contain 300, others less. It forms a thoroughly good and perfectly unsinkable life raft. Push it down into the water: it springs up again lighter than cork. The mosquito-boat is so perfectly built that it is impossible for it not to right itself when it has been submerged. If you try the experiment of pouring water from a jug down on it from a height you will find, though it may be driven down into the water and whirled about in all directions, you cannot break it up, and as soon as it is free it will rise to the surface and right itself perfectly. I have seen a dozen of these little vessels lying side by side just like a little fleet of boats.

The mother has now done her work and she leaves it, like Moses in the ark of bulrushes, to the tender mercies of the elements. The warm, moist air assumes the functions of the mother, and in from $1\frac{1}{2}$ to 3 days the young are hatched.

In the first picture I mentioned that there was a little projection in the centre of the large round end of the egg. This is a detachable cap which, apparently, has not been hitherto remarked by observers, so that our society has the honour of adding this interesting fact to the world's book of science. It is very minute, almost transparent, and in that state difficult to photograph. Some little time ago, however, I managed to fix these caps on a slide and strain them. One specimen I sent to Dr. John Thompson, and he gave me a surprise by returning in a couple of days a most admirable lantern slide enlargement of it. It is one of the most perfect micro-photographs that I have ever seen. A copy of it is seen in figure 2. It bears a resemblance to one of those pretty little table mats, with a deep fringe with which young housewives so often decorate their tables. It seems large here but it is only the three-thousandth part of an inch in diameter, and this is magnified 460 times.

It reveals very strikingly the beauty and complexity of some of the things that are ordinarily hidden from our eyes. What a task a young mother would have if she had to crochet 250 of these little caps to put on the heads of as many babies. But Mrs. Mosquito never troubles her head about it. She simply does her work gracefully, easily, and perfectly. I cannot say what is the use of these pretty caps. The baby mosquito does not emerge from the egg through them. They are much too small for that process. One thing I notice that if you remove them from the egg-boat and return the boat to the water it cannot maintain its upright position. It will fall on its side or turn bottom up in the water. It hopelessly loses its balance if the caps are removed, probably by reason of the admission of air. My impression is that there is a slight circulation of water through it to aid in developing the contents of the egg. The circular fringe is attached to a thick cushion, and in the centre of the cushion is a hole ; a corresponding aperture is found in the end of the egg, whereon the cap lies, and as circulating movements are easily discernible in the living insect in the inside of the shell, it seems probable that this little cap with the apertures is a provision necessary for the development of the creature within.

When the little babies inside of the eggs are hatched, which takes place in favourable weather in from 36 to 72 hours, they find the small world within the shell too confined for their aspirations. They get too big for their clothes. So they stir, kick and struggle inside, and in consequence the shell splits at the thickest part of the round end, so that it either falls off entirely, or else it opens like a lid to allow the baby to crawl out. Now you see the utility of the eggs being placed with the capped end down on the water. The head of the youngster is always at that end. These little caps are kept moist as well as the round part, and when it splits, the baby has nothing to do but to crawl out into the water. And he does not get drowned. Put a mature mosquito into the water and it may be drowned, but when it comes from the egg at first it is much more like a fish. It takes to the water and swims about just as naturally as a child breathes air.

You have in fig. 3 one of these young gentlemen, so that you may admire his person and the peculiarities of his structure. Not much of the mosquito about him yet, but a good deal like a caterpillar. He has a round head, two rudimentary eyes like little dots of ink, and from each cheek projects a fleshy arm jointed at the base and ending in a fan of long hairs. These two fans he holds out in front of his face as though he were too modest to show himself without some covering.

His body is built up of thirteen segments or flat rings. The engagement ring a young man gives to his intended bride is a good type of the sort with which the body of the larva is built. Nine form the abdomen, attached by a flexible skin, permitting movement in any direction. Three are fused together in the chest, and one, more modified, forms the head. Tufts of long hairs spring from the body segments, and many of these are tactile or endowed with the sense of touch. The short thick section near the head contains the circulatory organs, and their movements may be very clearly seen under the microscope. That long black tube in the centre of the body is not his backbone, for you know insects have no vertebræ, but it is really his stomach. It is of extraordinary length, for it stretches from his neck right down to his tail. And I can assure you that his appetite is quite on a par with the length of his stomach. He is always eating and never seems to be satisfied. And I am sorry to give him a bad character too, for I caught one actually eating his brother. The unfortunate brother was nearly as long as himself, but of slenderer build. His head was within the other's jaws, but, notwithstanding that he kicked and struggled with all his might, he gradually disappeared down the bigger cannibal's throat, being swallowed whole.

They generally swim tail first, a peculiar mode of progression, but one which seems to suit their larval dignity best. If you notice the tail, you will see that it is divided into two branches. The lower fork is bluntly rounded, and the other seems like the four fingers of a hand. This is his swimming apparatus. Really a splendid four-bladed propeller. He moves as a canoe is propelled, by its occupant thrusting the paddle on one side and then on the other. Even so, this four-bladed propeller is thrust on either side and pulled; and as his body is flexible at the end of the pull, he is bent like a bow; then the propeller is thrust on the opposite side, and so he advances by a series of zigzag movements. He can move head first, and in a straight line when he likes, but he prefers the jerky method of progression.

Another proof of the peculiarity of his lordship is that he breathes through his tail. Notwithstanding that he possesses a head, and a large mouth, he actually breathes through his latter end. If you examine his tail, you will find that the lower conical-shaped fork is the end of his breathing tubes. They run one on each side of his body to the head. When he requires to breath, which is every few minutes, he twitches himself up to the top of the water, and shoves the conical end of his tail above the surface. Its end is closed by five triangular flaps which seal it from the water. These neat little valves open out like a star, and the bubble of air enclosed in, or attached to them, keeps the little fellow suspended. His specific gravity is greater than the liquid, and he would sink were it not for the pull of the air bubble. So effectual is it, that occasionally I have seen them revolving with great rapidity, the air bubble acting as a pivot, and maintaining them while they spun round and round. Their usual position, however, is hanging head down from the surface while they suck in the air by the tracheal end of the tail. They remain so for several minutes at a time, twirling their head brushes in evident enjoyment. When satisfied, the little flaps fold themselves together, releasing the pull of the air bubble, and he slowly sinks to go off on another marine excursion. A tooth brush is said to be a sign of civilization. If so, then the larva is highly civilized, for he possesses several of these signs, and uses them well too. You cannot see them in the last picture for they lie there in the inside of his mouth. These tooth brushes are thrust in and out of the mouth with such rapidity that they resemble the action of those circular brushes used by hairdressers, which make your hair fly as though a ghost had appeared before you. One effect is to cause a current of water to rush into the mouth, and food borne along with it is entangled in the hairs of these brushes and swallowed. I have now to show you one of the most interesting slides of the series, that is, the larva in a living state. I have been breeding some of them lately for your special benefit, so that you can be assured of the fact that they are native-born Australians. They are enclosed in a glass cell with water, so that the light of the lantern may shine through and project them on to the screen. I daresay they will be much alarmed at the brilliant circle to which they are so suddenly introduced. All the peculiarities of which I have been speaking, their zigzag movements, breathing at the top of the water, through the tail, moving in straight lines, &c., you will see now on the screen.

This fish-like life continues for a variable period, depending mainly upon temperature, and the condition of the atmosphere. During hot, close, sultry days, they may reach the end of this stage in a week, or ten days, but in cold wintry weather it may be prolonged to two months, or more. They usually moult three times during this period, casting off the old and getting a new skin, but, like prudent folks, they always get the new clothes before they throw the old ones away. They grow from one-sixteenth to about half-an-inch in length. They become yellower and less transparent, so that you cannot trace their internal organs so clearly as you could before, and perhaps the next time you visit them a complete transformation has taken place. They have altered so that their own mother would not know them.

It does seem a wonderful thing in nature that one creature should grow up in the inside of another. The two beings co-existing for a time, but each possessing different shapes and habits of life, and then at a certain stage, the inner absorbs the life of the outer creature, whose head, skin, and tail, are discarded.

When it reaches this second stage, the skin of the larva splits at the neck, the old head falls off, and a new being with a different head and body wriggles out of the old skin, and the left-off garment goes sailing away. In the water where it breeds, you will find lots of these cast-off garments, all in one piece. He doesn't first throw off the hat, then the coat, and lastly the pants, but he wriggles out of the slit between the shoulders leaving the old suit entire.

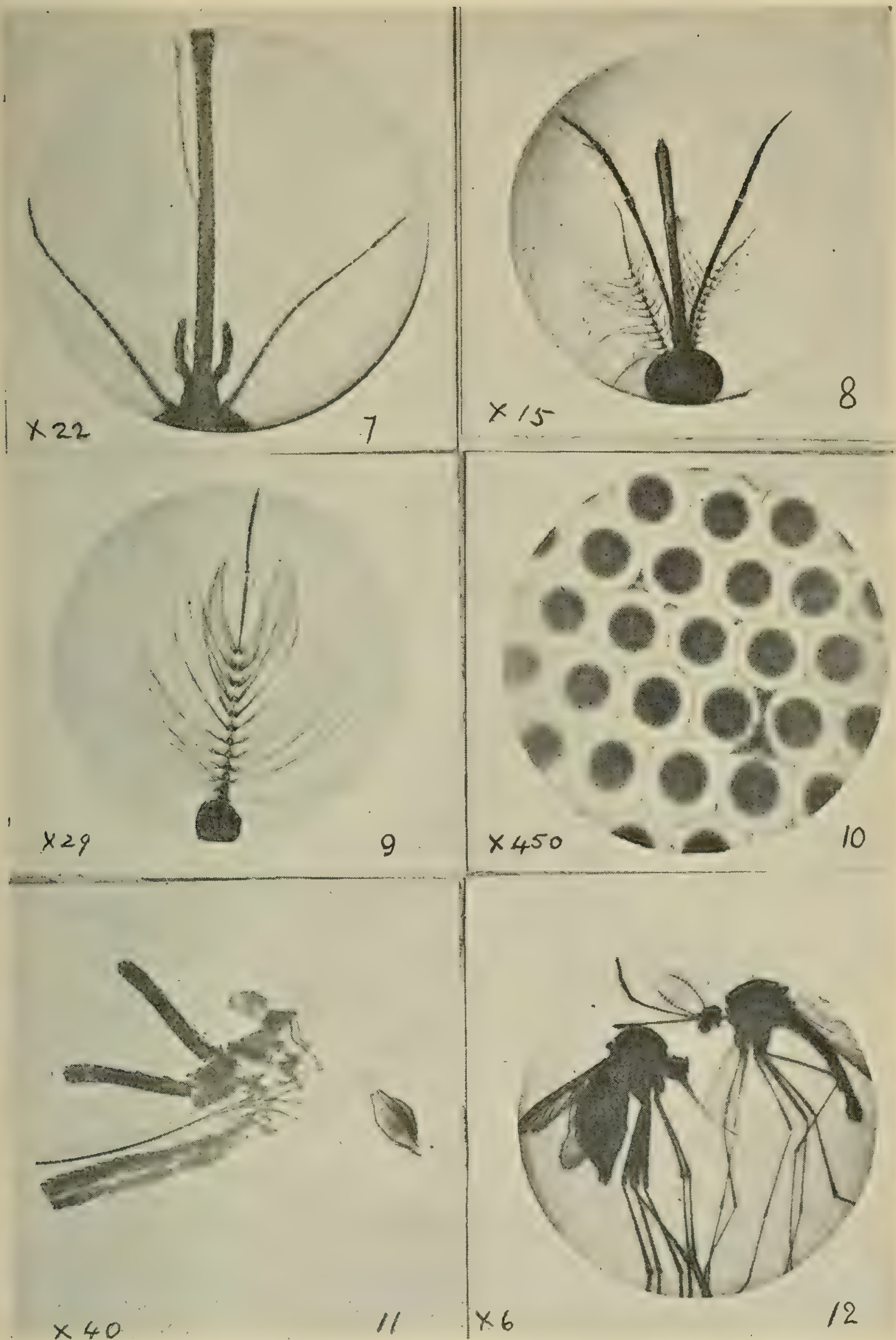
This is now the third stage of the mosquito's existence. First the egg, next the larvæ, now the pupa. He is dressed in a light-fitting cream coloured suit, like a young cricketer. Notice in his extraordinarily big head in fig. 4; that is, the large, round, upper part of the body. His shape suggests the stop used in punctuating words, called the comma. Head and shoulders are fused together in one mass, and he has no neck. In his former state the round head was moveable in any direction. Now that has disappeared, and the head is stiffly attached to the body, so that it can only be moved up and down, enabling him to give a solemn nod, like Lord Burleigh. Two lovely black eyes gleam out from the sides of his head, and above them rise two trumpet-shaped horns *thoracic spiracles.* Their use is seen when we remember that, though still living in the water, he is an air-breathing insect. Formerly he breathed through his tail; that aperture is now gone. Having no mouth, his only means of communication with the air is through these curious horns on the sides of his head. He bobs up and down in the water in a very amusing way, and every few minutes, rising to the surface he thrusts up these horns, and the air drawn through them is distributed by tubes through his body. The segments of his frame are united after the pattern of a lobster. A series of flat rings being hinged to each other by a flexible membrane, so that the tail can be bent so as to come beneath the head. During this stage he eats nothing. All that work is done before while he is in the larval state. Probably some of our boarding-house keepers would not object to their lodgers following the example of the pupa. The mosquito larva manifests a very healthy appetite. He grows fat and plump, but after stripping off his combination garment, and rising up into a pupa he eats no more food. But though he does not eat, yet he is very active. Most insects, while in the pupa stage, lie perfectly still, but he is an exception. Always swimming, dodging, and diving, and varying these occupations by resting on the surface of the water, and sucking air though these trumpet tubes on his head.

During this time, lasting 2 or 3 days, his cream-coloured garments grow into a darken hue, and inside a wonderful transformation is going on. The mosquito is being built up by unseen hands in that tiny workshop, legs, wings, antennæ, proboscis. and body, gradually appear, all packed neatly together on the case, as if by fairy hands. In that pupa frame (fig. 4) was a perpectly-formed mosquito. Through the cover can be traced different portions of the body. The notch on the top of the head is where the neck of the insect lies; it marks the division of the head and shoulders. The dark tapering line below is where the proboscis and attennæ lie, and the lighter curvature behind indicates the outline of the end of the wings, also of the legs, which pass into the lower part of the case. Before dismissing his lordship, I must point out his swimming apparatus. Instead of the four-bladed propeller, formerly possessed, he has a new one on his latter end. In fact, by taking a couple of palm-leaf fans and laying them side by side, one overlapping a little the edge of the other, then you would get an accurate representation of the double paddle of the pupa of the mosquito. In swimming, these flippers are contracted towards the head and thrust violently backwards, the force of the stroke driving the body forward a considerable distance. Sometimes, if alarmed, he gets into such a dreadful hurry, and lets out so suddenly, that he turns a series of somersaults, going over and over, head over heels, until he reaches a safe place. I have now another slide of living things to show on the screen (which, unfortunately, cannot be reproduced to the readers of this paper). Here is a family of pupa disporting themselves in the water. Their motions amply prove all that I have been speaking to you of them. From their sudden outshoots you might imagine they were intercolonial footballers, and that those chaps sucking air at the top through their breathing horns were just taking a spell after a supreme kick.

Now comes the final change. I watched, often and long, before I found one in the actual process of emerging into mosquito life. One morning I had this pleasure. On the top of some water lay a dark-coloured pupa, looking big about the shoulders. Suspecting what was going on, I lifted him out on to a glass side. Then I saw he had burst his coat between the shoulders, and in another minute he was clear out. The old pupa-skin lay empty on the slide, and he stood beside it a fully-fledged mosquito, perfect in every part. The whole process did not take more than two minutes. I daresay I helped him to get free by lifting him out and setting him on solid ground. Since then I have often watched the process, and have noticed that, when a little way out, he frees himself by bending forwards; this releases a little of the back and wings; then bending backwards a little, more of the legs are freed, and so he indulges in a slow rocking motion. When the front pair of legs get out, his progress is accelerated; for these are set down, and the leverage they give soon clears the rest of his body. Sometimes you will find him standing on the empty skin, using it as a float, until his wings are dry and unfolded and capable of flight. Often, at this critical moment, a puff of wind may come and upset him, and, in his helpless, entangled state, he drowns.

I have a view in fig. 5 that shows the process almost completed. I say almost, for this one had the misfortune for himself to get the end of his long legs entangled in the upper part of the pupa case; you see them as two rings through the clear cast-off case. It was a bad job for him, but a proof of the old saying that "it's an ill-wind that blows nobody any good." It was the means of adding him to my collection, and of demonstrating to you this interesting change in insect life.

The succeeding picture, not reproduced here, shows one of the completed forms a little larger than life, but quite as natural. This lady had the audacity to pay me—a batchelor—a midnight visit. Managing to creep through a hole in the curtains, she succeeded in her desire to have a private interview. She may have been of an ambitious nature, desiring fame. At all events, she got one thing she wanted—a good draught of my blood. You see how fat and buxom she has grown in consequence. I am sure she had to let out her waistband a good bit before her meal was finished. However, she got more than she expected. She was captured, imprisoned, and then, as is the custom with notorious criminals, she was photographed, and there is her portrait for your inspection. The wings lie folded along the back. There are only two in the mosquito, as it belongs to the Diptera or class of insects possessing two wings, but behind, and hidden by them, are two little club-like organs called *Halteres*, or balancers. They are jointed at the base, and special muscles raise and lower them. They are plentifully supplied with nerves, and believed, by some scientists, to be organs of hearing. If one is cut off, the insect is unable to fly straight. So that they are called balancers, in that they aid them to fly steadily, just as the pole helps a tight-rope dancer to maintain his balance. The insect has six legs of extraordinary length and so elastic that you often cannot feel them touching your skin. Each leg terminates in two hooks like grappling irons. By this means they can cling to anything they please; climb up a perpendicular wall, or hold on to a ceiling.



OBSERVATIONS ON THE LIFE HISTORY OF THE COMMON MOSQUITO.

The wing is a clear strong transparent organ traversed by hollow ribs, which render it very light and strong. These ribs too, serve a double purpose, they not only strengthen the wing, but carry air, so that they are really an extension of the tracheal system. They are in the ordinary species even down to their minute branches covered with beautiful scales. The edge is fringed with various-sized scales, the deepest being found on the lower parts. We have (in fig. 6) a little morsel of the edge ; of course it is very highly magnified. You see the terminal rib at the top, like a beam of wood. The stems of the scales are inserted at regular intervals, and hang down like a deep fringe. They are not unlike the short broadsword used by some eastern nations in warfare. For purposes of strength, the scales are also ribbed longitudinally from base to point. The whole of the body, legs, and proboscis are likewise covered with scales, and these are of various shapes. Some are curved like a canoe, others like battledores, some like cricket bats ; all have the pecularity of being strengthened by ribs, just as the plumber ribs sheets of iron to make them more rigid for the walls of tanks, or roofs of houses. Likewise they are arranged in regular order, just as tiles or shingles are placed on the roof of a house, the base of one overlapping the top of the next, and so on in regular succession. An exception to this order is found in the head. At the back of the head are scales, in shape like an American broom, and composed of a long slender shank, and a fan-like head. These are set upright, the fan pointing into the air. So they resemble a Red Indian dressed in his war-paint and feathers.

The mosquitoe's chest is remarkably deep and broad, being built to accomodate the powerful muscles connected with the wings and legs. So powerful are these that the wings have been calculated to move 50 times a second, or 3000 times in a minute. Any athlete or footballer might be proud if he possessed muscles built on a corresponding scale. Each single muscle would probably be as thick as a person's arm, and the combination so irresistable that he might almost kick the football into the adjoining colony.

Now I suppose you are wishful for me to say something about the apparatus used by this insect when sucking the blood of his victims. I must tell you that it is believed, in scientific circles, that the male mosquito does not stoop to do such blood-thirsty work. He is too much of a gentleman, using that word in its original sense, to do such crimson deeds. Therefore all that deadly work is done by the females. With velvet wings, neatly-boddiced figure, a soothing song in her mouth, but an armoury of swords in her nose, she penetrates everywhere in search of blood. Of course, men have not always been correct in their opinions, and in the future, when we may have female biologists and microscopists as eminent as Lubbock and Dallinger are now, their more piercing vision may find some flaw in this opinion and roll away from the female mosquito the stigma now attached to her name. However, that is the verdict at present, and I must say it is confirmed by my own experience. Every time I have killed the insect that has bitten me, on examination the culprit has always been a female.

But you may ask how I can tell the sex. Well, by simply examining their heads, nature has made a difference between male and female heads. In the human race the new woman has of late years been trying to abolish the distinction. They have succeeded to a large extent, in fashion and costume. To see only the busts of a lot of fashionably-dressed men and women it is not always an easy matter to tell their sex. This was not the case in my boyish days, but now the ladies have adopted so many articles of attire formerly used only by gentlemen, that it puzzles one sometimes to know which is which. The hair is often cut and parted in the same way. Hats, caps, fronts, collars, and jackets are often precisely the same. The sexes of the mosquito have not so distinguished themselves. They wear the same kind of garments, and trim their heads in the same way as did their grandfathers and grandmothers. I have here in fig. 7 a representation of a female head. It is incomplete, for to take in the full length of the organs I had to leave out part of the head. You only see the upper rounded part, from which the various organs spring. The straight, thick, central projection is the proboscis. This is a flexible tube enclosing the sharp lancets. At the base lie two little organs, one on each side, these are the *palpi*. Usually very short in the female, but long in the male. Two slender organs, called the antennæ, stretch out to each side. These possess 14 joints, and from each of these joints a little circlet of hair springs. These whorls of hair are almost of equal length in any joint from base to tip. Remembering these points you will be able to distinguish the difference between the head of a gentleman and that of a lady. Here you have a male head in fig. 8; the central organ, the proboscis, is all there, but quite as long as the females; but look at the palpi how they rise alongside and curve out even further than the proboscis. That alone is a marked difference. In the female they were short not more than one fifth of the length of the organ depicted, although there are exceptions to this rule in some varieties, and then the antennæ of this gent has quite a fringe of long hairs which may very fitly be called whiskers. So that there is a decided dlfference between the sexes. When once you catch these points, by merely glancing at one on the window or resting anywhere, you can say whether it is male or female. I have in fig. 9 one of these antennæ from a gentleman's head, which shows the difference more strikingly; it looks like a plume. The hairs are longest at the base, gradually shortening as they approach the tip. The root of these organs is rounded like a ball, and it rests in a cup on the side of the head close to the base of the proboscis. It forms a ball and socket joint and is freely movable.

It has been discovered that these hairs are musical chords, and the antennæ is really the male mosquito's harp. When a tuning-fork giving 512 vibratious per second is sounded, these long hairs are thrown into vigorous motion. The shorter ones respond to other tones. The range of sensitiveness to sounds extends from the middle through to the next higher octave of a pianoforte. That note of 512 vibrations per second is the dominant note of the female mosquito when she sings. The harp on the male head is built to respond to the female voice. Whatever other purposes it serves, it is at the same time a delicate musical instrument.

In the darkness, when the female sings, supposing the male is flying across her position, the sound will be most felt on the branch of the harp nearest to her, for the off-side harp will be partially shielded by his head. Therefore, two series of notes will be conveyed to his brain, stronger on one side, weaker on the other. If he wishes to meet her he has only to wheel round and adjust his position until the sound vibrates on the both harps with equal force. Then, no matter how dense the darkness, flying straight forward he will reach her side. Thus her song is not intended to annoy you when she lifts her voice around your head and bed. It is the mosquitoes love song. It may be a serenade to her lover, or a prolonged cooey to her husband, to come, after her drinking bout, and help her to fly steadily home, or it may be an invitation to her daughter's and neighbour's wives to join her in the picnic, and they are not long in coming to her side.

The eye is a wonderful organ, occupying the largest part of the head. I have never been able to secure a good photograph, but here in fig. 10 is a little bit as a sample of the whole. That is about the 50th part of his lordship's eye. Each of these round dots is a perfect eye in itself, and is furnished with a crystalline lens and a slender branch of the optic nerve. They are planted as close together as they can be, and are set all over his cheeks, forehead, and right round the back of his head. I have attempted to count them, and the nearest estimate is that the mosquito has a thousand eyes. The eye forms a very beautiful object under the microscope, especially when seen by reflected light on a dark ground.

The *antennæ* and *palpi* appear not only to be organs of touch, but of hearing too.

Now about the piercing apparatus. On the upper side of the proboscis lies a deep groove, or channel, and in the female there are packed into it, no less than six sharp-pointed lancets. They are named after similar parts on other insects' heads. A pair are called mandibles or upper jaws. Another pair maxillæ or lower jaws. One is called the labrum or upper lip. The thickest lancet is the lingua, and represents the tongue, while the thick sheath covering the whole, is the labium, or lower lip. On account of their extreme fineness and transparency, and their resistance to most stains, I have not yet been able to get a slide that will show them satisfactory, although—like the King of Dahomey—I have sacrificed hundreds of heads in the attempt. If a hundred of these lancets were tied into a bundle, it would not then be so thick as the smallest sewing-needle used by a lady. The other lancets are very much finer: in fact, it takes some practice with the microscope to be able to discern the whole six, and it is most readily effected by dark-ground illumination. In many illustrations, the mistake is made of representing all the lancets of one thickness. The photographic lens, if rightly used, give a truthful rendering of their dimensions.

The male has no mandibles, and the maxillœ are not barbed at the tips like those of the female. Their mode of using their weapons is after this fashion :—After alighting in so fairy-like a manner on the skin that one is scarcely conscious of the touch, she tries various places with the soft tip of the proboscis before finally fixing on a spot wherein to bore. We speak of a mosquito bite, but it is not really a bite; it is a thrust or stab. Having decided where to bore, she plants her proboscis firmly down. The lancets, firmly held together, in one group, are pushed steadily into the skin. The sheath, elbowing itself, is drawn back, allowing them to sink nearly in to their full length. After being satisfied, the lancets are slowly withdrawn, and the bent sheath straighten out to receive them. It is quite easy to trap the mosquite that operates on the back of your hand. Before she has quite done sucking, gently close your fingers until the hand is clenched tightly, and the skin on the back, being thus drawn tight, it will grip the lancet points, and the insect, unable to free itself, will be held tightly by the nose. The withdrawal of the blood is effected by the largest lancet, the one most visible on the picture. It is a hollow tube. While working on it under the microscope I have, by gentle pressures here and there, forced liquid that has been in it up and down, clearly proving its tubularity. It is curved, and the end slopes to a point. The old saying that there is nothing new under the sun is exemplified here, for the sloping point and barrel of the hypodermic needle used by doctors to inject medicines under the skin is a mere imitation of the mosquitoes' principal lancet. Long before the hypodermic system was invented by medical men, she practised it successfully every day, but no monument has yet been erected in her honour.

It has been a disputed question, whether the irritation arising from the puncture is caused by the simple injury of boring, or by the injection of a poisonous fluid; but that point is now decided. For, lately, the mosquito has been receiving a large amount of attention from scientific men and its anatomy has become more perfectly understood. The poison and salivary glands unknown before, have been found. They are exceedingly small and so delicate that they break up easily when disturbed. I have spent much time and labour in trying to detach them in a perfect condition from the surrounding parts. I have some specimens, but not sufficiently complete and well displayed to form a good picture. Taking the finest sewing needles for dissecting instruments, the parts upon which they are used are so minute, that I can fitly compare the work to that of a surgeon who would use a couple of crow-bars to dissect out the glands of a man's neck. Our fingers are so clumsy, that in 99 cases out of an 100, so much mischief is done to the parts, that the operation is useless. They resemble three irregularly shaped sausages connected at the upper parts. The middle gland in each set differs slightly from the others, and it is supposed to be the chemical laboratory where the poison is made. Its two neighbours are thought to be salivary glands. But the secretions from the three mingle in the tube from which they all hang. This tube ascends to the lower part of the mosquitoe's neck, where it joins the one leading from the other set of glands. The two thence unite and become a larger tube, traversing the neck and head to empty their contents into the largest lancets at the base of the probos·is. Thence the mixed poison and salivary secretions are injected into the punctured skin of the victim. I have here in fig. 11 a dissection of the pumping apparatus, so that you may see this interesting bit of the insects economy. This is a complete one, and resembles the bulb of an india-rubber enema. It is connected there to the base of the lancets, the brain and other portions of the head being cut away. The tube leading to the stomach is connected to the end that is now free. I am not quite satisfied about its mode of working. My first conjecture was that it worked like an elastic enema. The alternate compression and relaxation of its walls pumping up the blood into the stomach. But one night, when racking up the condenser to get a better illumination on the focussing glass of the camera, I accidently forced the slide against the nose of a high-power object glass. The result was just what happened when Mary Jane drops the milk jug on the cement kitchen floor—the pump was broken into fragments, and the pieces lay on the slide. My newly-formed theory that this bulb might be a muscular bag, like the heart, was shattered too by this accident, for its walls were as hard and brittle as china. I find it is separable into four longitudinal sections. There is traceable on the edges of the sections a fibrous structure, transversely striated, uniting them together; I have also found muscle attached to the walls. This gives some colour to the notion that the sections of the pump, united by elastic ligament, may be pulled apart by these side muscles, and contract by the connective elastic tissue, and so set the pump in operation. But this is only conjecture. This shows that though many of these fields have been trodden by microscopic walkers, there are still numerous by-paths where research can be pleasureably and profitably pursued.

The mosquito has actually been used in Havana by Drs. Finlay and Delgado as the means of inoculating new-chums with a mild form of yellow fever. The insects were kept in a ward in which lay a yellow fever patient, and afterwards introduced to the person they were intended to inoculate. A number of these patients took the fever in a mild form, the deaths only reaching two per cent. A very decided contrast to the number of deaths usually resulting from "yellow Jack." These experiments almost decide the question as to whether the mosquito is capable of carrying infectious diseases. Some time ago the Indian Government deputed Surgeon-Major Ross to investigate the action of mosquitoes in conveying malaria. He showed a series of slides recently, before the Royal Society in London, which exhibited successive stages in the process of infection, and he claims to have proved that the malarial parasite is absorbed from a diseased subject and itself becomes attacked. The parasites fertilise and multiply in its body, finding their way ultimately into the salivary and poison glands, and thence are injected into the next subject they sting. He believes that only one species of mosquito, "the *anopheles*," are concerned in this business, and it may be possible to stamp them out.

There is a curious disease named "*Filaria Sanguinis*" in which small worms are found in the blood during the night. Every year a few cases are treated in the Brisbane Hospital. The late Dr. Joseph Bancroft, of Brisbane, was the first to discover the parent worms in this disease, and in recognition of his valuable work, one of the names of this disease has been christened after him *Filaria Bancrofti*. Dr. Manson caused a Chinaman, suffering from this disease, to sleep in an outhouse infested by a certain kind of mosquito. Afterwards he killed some of them, which had been feeding on the man, and found numbers of filaria embryo in the stomachs of the mosquitoes, and by a series of observations showed that, though many of them were digested, others pierced the stomach and lodged in the muscles of the mosquitoes. The embryo go through the changes that fit them for an independent existence, and the mosquito dying, the filaria escapes into the water, which may be drunk by human beings and so propagate the disease. Dr. Thos. Bancroft, who has recently devoted a good deal of attention to this subject, has, apparently, shown that the disease is not propagated in this way, as the young filaria are killed by a few hours immersion in water.

One peculiarity of the mosquito is its music, if we are disposed to dignify such a sound by that name. These sounds are caused by the rapid vibration of parts of the body. The wings help to make it by their rapid motion. But the main cause is the breathing apparatus. You remember the breathing tubes of the larvæ. A similar arrangement of tubes exists in the adult mosquito. These tubes terminate in round holes on the sides of the body. Air is admitted and expelled through these openings or *stigmata*. Just below their margins are two folded leaflets which vibrate beneath two external valves by the movement of the air. They resemble two reeds in a pipe. The air passing rapidly through these openings during flight, they, being capable of contraction or expansion at the will of the insect, is the main cause of the sound.

The next time you entertain a mosquito listen to the song. As she slows her movement over your head the note will grow deeper on account of the slow movement she is executing. The male mosquito has a voice, and sings too. But his voice is just the opposite of that which exists in the human family. The female has the deep booming voice, while the gentleman's is pitched on a much higher key. It is weaker and much more shrill than that of the female, and the tones likewise differ in different species of mosquito.

Now the question arises—What is the use of the mosquito? Does it exist only for torment? Well, I do not think we understand all the uses of the insect world sufficient to give a decided answer to that question. Our knowledge must be much more extensive and complete before we conclude that they are merely nuisances.

One useful work they fulfil in their larval stage is that of scavengers. I kept a numerous family in a large glass jar. To keep them from drowning after they assumed the flying stage, I put the branch of a tree in so that they might have something to rest upon. By-and-bye, some of the leaves decayed and dropped into the water. Very soon the pulp of the leaves disappeared, and there were only left the ribs looking like a network of lace. The fact was that the young skeeters, skirmishing around, found them to be good eating. And I often saw them engaged in sucking the decaying leaves. They are not strict vegetarians either. One night, a big black beetle, who was out on a marauding expedition, had the misfortune to tumble into my mosquito-tank and was drowned. I allowed him to remain, te see if they would tackle him too, and I found they did. As he decayed, and smelt high, they gathered round him with gusto. He served large families with tit-bits for days, and they left him when only the shell and hard wing cases were to be seen. By thus disposing of a large portion of decomposing animal and vegetable matter in swamps and pools, they help to purify the water, and do the world service in that way.

Likewise they serve as food for fish. I put both *larva* and *pupa* into a tank beside a small fish. As soon as they were perceived, he went for them at once, and whenever the fancy took him he bolted a few more, so that soon there was not one left in the tank. Serving as food for fish, we in our turn catch them, and find that mosquitoes, transformed into the flesh of fish, are not bad for humankind.

It has been asserted that mosquitoes only live one day. That is not correct, for I have kept them much longer. The full-grown female that you saw was confined in a cell not much larger than sixpence. And she lived there for a week. And on one occasion, when I awoke in the morning, I saw a lady in the curtains of my bed. She was very stout, having filled herself with as much of my blood as she could stow away during the night. I put her into a good-sized vase, with a iittle water to slake her thirst. It was quite a week before she digested the good meal she had had, and resumed her natural shape. To test this point of age I kept her in prison for 21 days. How much longer she might have remained alive I cannot say, for in trying to move her from the vessel into a larger one, she managed to escape. Thus she was my guest for three weeks, and that disposes of the idea that they only live one day. I have often kept them for a month, and I understand that Dr. J. Bancroft has succeeded in keeping some species alive for 80 and even 90 days. Mv impression is that their natural term of life is about three months. A good many born in the autumn live right through the winter until the next spring. They remain in a dormant state under houses, and the rafters of houses, in dark places, and, as a proof that they are not all dead, if an unusually warm and close day comes in winter, they soon come out to give you very practical evidence of their vitality.

In conclusion, I may say a word as to the best means of getting rid of them. They cannot be propagated unless water is to be had whereon to deposit their eggs and breed their young. You ought not to allow any water to lie around your houses. Unused tubs and buckets should be turned upside down. Two inches of water is all that Mrs. Mosquito requires for family purposes. Then your tanks should be well covered and the outlet-pipes covered with caps of perforated zinc. If this is not done, and the lady can find no other place, she will pass up the outlet-pipes, and deposit her eggs in the tank, and as she lays from two to three hundred, in a short time you will be surrounded with a respectable family. In a pond where they breed a few minnows will annihilate them, or the application of a little kerosene will also work wonders.

Finding a pool containing large quantities of both *larvæ* and *pupæ*, I poured a little oil on the surface and it spread in a thin film all over. When the young gents arose to breathe, a dose of oil went down both breathing tubes and trumpets, and in an hour, when I visited it, not a living one was to be seen.

As a last injunction: avoid living on low ground, and in the neighbourhood of swamps. If possible, pitch your house on high ground, facing the prevailing winds of the colony. Mosquitoes are so light, that they cannot face a strong breeze. They must go with the current and will be born past you to find shelter in the bush, or on lower ground.

I have another picture here, in fig. 12, in order to impress upon your memories the distinction between the sex. In the couple before you, the gentleman is on the left and the lady is on the right. He is thin and slender, but she is quite a buxom lady. His proboscis gently touches her shoulder, while the long *palpi* curl above. Very modestly she droops her head while he pops the momentous question, and if we follow the interview, we should probably find that she had accepted him as her lover, and had gone off for a waltz together. I have often seen them flying in couples, especially near sunset. Their flight is slow, and they are more easily caught when locked in each others' arms.

MISCELLANEA ENTOMOLOGICA: OR ODD NOTES ON THE HISTORY AND TRANSFORMATIONS OF VARIOUS INSECTS.

By R. ILLIDGE.

[*Read before the Royal Society of Queensland, December 16.*]

A FEW years ago I wrote a short paper for the Natural History Society of Queensland (now defunct), on "Insects, whose food plant is the Native Fig;" but, as this paper was lost, I now propose to reproduce some of the matter, together with facts concerning other insects under the above title.

The figs, Ficus Australis, macrophylla, etc., appear to be subject to the attacks of quite a number of insects, chief amongst which are certain species of moths of the genus Hypsa, and some pretty pyrale moths of the genus Glyphodes; also, a noctuid Ophyx ochroptera, together with others whose depredations are not, however, confined to these trees.

Of Hypsa, there are three species found on the fig; they are H. chloropyga, H. nesophora (?), and H. plagiata. The first-named has a rather pretty caterpillar, brownish, marked with brick red and ochreous yellow; the other two have larvæ which bear considerable resemble to birds' droppings. None of these insects, however, are sufficiently common to do any appreciable damage to the trees, in fact, chloropyga is a rare moth round Brisbane, nesophora is never common, and plagiata, though usually readily obtained, does not occur in numbers.

The noctuid moth, Ophyx ochroptera, in the larval form, is brilliant green with a broad lateral band of bright yellow; it also is a rare species.

The species of pyrale moths of the genus Glyphodes, which have been noted as attached to these trees, are four in number, each having somewhat different habits. The largest of them is Glyphodes cosmarcha, and its caterpillar attacks the young terminal shoots, binding them firmly together with silken threads ; feeding under cover of the external leaves, it devours the interior developing leaves and does not even take the trouble to cast out its own droppings. When about to pupate it deserts its fouled nest, selects a couple of suitable leaves and binds them together, leaving an opening for the escape of the moth, it securely fixes itself with head towards this opening amongst a skilful network of silken suspending threads. Glyphodes luciferalis differs from the above, in that it selects two leaves for its habitat and binds them together, feeding on the parenchyma within ; this accounts for the ugly brownish patches so frequently seen on the leaves of these trees. In pupating it differs somewhat from G. cosmarcha, as it joins the leaves along the margins, but also suspends itself in the same manner. Glyphodes excelsalis is more frequently to be found on the * black fig of the creek sides, though it also occasionally attacks Ficus Australis ; it usually lives in a web spun on the surface of the leaves, but in pupating generally spins up between them for greater safety and secures itself much as do the others. Both this species and the following will largely attack the introduced edible fig. Finally, Glyphodes tolumnialis attacks the ends of young leaves, curls them over and binds them down with its silk threads and lives within the shelter so formed ; it is a common, but very beautiful species, and I have only found it on Ficus Australis and the introduced edible fig; curiously, however, when attacking the latter, it has much the same habits as G. excelsalis. As these pyrale larvæ are all of solitary habits, no particular damage is done to the trees, whereas the caterpillar of another pyrale of gregarious habits, Margarodes vertumnalis, attacks Alstonia constricta and Ochroscia moorei, and sometimes completely denudes them of leaves, to such an extent also have I seen them upon the Alstonia that the grubs could not get enough food to attain their full size, and the imagines have emerged not much more than half the normal dimensions.

In April last, my attention was drawn to certain wood-boring larvæ in the stems of Ficus Australis. The webs covering up the openings were to be seen generally at the axils of

* Ficus aspera

all the smaller branches, and for some time I was under the impression that a new xyloryct awaited investigation. It was not, however, until the month of October following, upon inspecting a chrysalis cut out of its chamber, that it was found to be that of a pyrale moth. Upon this several of the bores were opened out and the larvæ examined, which still further confirmed the previous determination. Full confirmation shortly followed upon the emergence of the moths of a not uncommon pyrale, familiar to us under the name of Aphytoceros lucalis. The grubs of this insect are of a pale yellowish white colour, when full grown about an inch long, cylindrical, naked, and 16-legged; head rather small, and quite unlike that of a xyloryct caterpillar. The food consists of the bark and young wood of the tree, which they eat under a cover composed of frass loosely massed together with silken threads. Besides their tunnel in the stem, they also form a covered way partly round it; in this tunnel they live through the winter, pupating towards the end of September, or during October. Before pupating, the opening into the bore is neatly closed by an operculum, similar to that of a trap-door spider, and as a further protection the larva spins a strong web in front of itself, leaving just room for the change to the chrysalis. Emergence takes place in about a fortnight or three weeks after pupation. The larvæ are tolerably numerous upon the fig trees, and the perfect insects are not uncommon, so that it is rather surprising that the changes of this large and fine pyrale should have hitherto escaped observation.

In addition to those above mentioned there are other lepidopterous insects which feed upon the foliage of the figs, but as they are not singular to it, a passing notice of one, the butterfly Euplœa corinna, will complete my remarks upon the lepidoptera attached to these trees. The larvae of this insect are not uncommon on Ficus Australis and the introduced F. benjamina, but it also attacks Stephanotis, the Oleander and rarely Rhynchospermum, likewise several other plants of the Apocynaceous order. The silvery chrysalides may frequently be seen suspended from the under sides of leaves.

Amongst other orders of insects which attack these trees, that of the beetles stands first, and some of our very largest prey upon its decaying timber. Notable amongst these is the giant longicorn Batocera Boisduvalii, whose metamorphoses, now familiar to me, I hope to make the subject of a special memoir, together with a large elater Alaus sp., the grub of which devours its larvæ.

TRANSFORMATIONS OF ÆGERIA CHRYSOPHANES, Meyr.

The few notes given upon Aphytoceros lucalis recall to mind some observations made upon the changes of the above rare insect.

Early in September, some few years ago, we noticed a sore looking spot upon a red ash, Alphitonia excelsa, growing in the Wickham Terrace Gardens. A branch sprouted obliquely upward from near the base of the tree (the branch itself was dead) and at its intersection considerable decay had taken place. Desirous of finding out the cause, we, with a pocket-knife, removed the decaying bark and found a nest of larvæ. Carefully transferring the bark and grubs to a box they were taken home, and in a very few days out came one of the lovely little wasp-like moths, probably from a pupa we had not noticed. However, within a month they had all changed and become imagines, so that the patch had just been struck at the right moment. The moths now adorn my own and several friends cabinets. From notes kept I find these larvæ were sixteen-legged creatures, very similar to Aphytoceros. Only once since then have I seen this insect and that was at Gympie; it was captured flying about some flowers overhanging a small creek, and its wasp-like appearance was very noticeable.

CASYAPA BEATA.

Some notes on this insect appeared in the Trans. of the Nat. Hist. Soc. of Qld., but, as I have since succeeded in following it through all its stages, it may be as well to record these.

Immediately on emergence from the ovum, which is placed against the margin, and sometimes the point of the leaf, the grub cuts out a portion of leaf, taking care however to leave a narrow connection with the main leaf, the piece so cut it then bends upward and backward over itself until it has succeeded in forming a curious shelter. As these pieces thus cut out shortly turn brown they are readily seen and thus lead to the detection of the caterpillar. Under these singular dwellings it lives until big enough to enter upon another phase in its larval existence, for when about half grown it deserts these, and forms a shelter between two leaves, the upper of which it succeeds in curving up in a somewhat inverted spoon-like shape. Herein it now completes its larval state and changes to a chrysalis.

NEW SPECIES OF QUEENSLAND LEPIDOPTERA.

By THOS. P. LUCAS, M.R.C.S., England,

L.S.A., Lond., L.R.C.P., Edin.

(Read before the Royal Society of Queensland, 16th Dec., 1899.)

GROUP PAPILIONINA—FAMILY LYCŒNIDÆ.

LYCAENA ELABORATA. NOY. SP.

♂♀ 25—28 m m. Head fuscous with white orbicular rings round eye. Antennae black and white annulated, club black with red tip. Thorax and abdomen fuscous, the former densely clothed with bright lavender-blue scales. Forewings broadly dilate, costa rounded, hindmargin gently rounded. In ♂ bright lavender-blue, with veins black, shewing conspicuously beneath the blue; in ♀ bright Adonis blue in cell and along inner margin, with a deep patch of black border along costa to $\frac{1}{2}$, then obliquely to vein 4, and at a sharp angle to form a broad hindmarginal band; the central piece of the wing which it encloses is moon-light white. Cilia in both sexes, white with fuscous dots opposite the veins. Hindwings in ♂ as forewings; in ♀ white, with central third diffused with bright Adonis blue; this is bounded on hindmargin with a diffused fuscous black band enclosing a row of six white rings with a smoky-black centre; wings in both sexes finely tailed, tails fuscous tipped with white. Cilia white irrorated with fuscous, more so in ♀. Under surface of wings, in ♂ light fuscous with bands of chocolate colour and diffusions of reddish fuscous; the basal third of both wings is chocolate with an undulating waved white line through centre transversely dividing it into two bands, and a like white line on posterior border; a patch of like colour, bordered by white, just beyond, reaching half-way across wing, and a broad band at $\frac{3}{4}$, are both bordered on both sides with white; a subterminal row of lunulated spots, diffused in white to hindmargin; hindmarginal line chocolate. In the hindwings the middle band is broken into rhomboidal columns, arranged promiscuously, to enclose a blotch of ground colour; the hindmarginal white suffusion borders an undulating continuous subterminal chocolate line and marginal line with dots on veins; two peacock eyes of blue and silver at and just before anal angle. In the ♀ the white patch is conspicuous in middle third; the basal chocolate is divided into three bands and the posterior again into two by white lines; there are two rows of lunulated spots in the white bordering; the marks on the hindwings are more spread out and regular than in the ♂. Brisbane, one pair.

FAMILY HESPERIDÆ.

ISMENE LUCESCENS. NOV. SP.

♂ ♀ 40—45 mm. Head green, interspersed with fuscous, face ochreous. Palpi black, tinged with ochreous. Antennae deep chocolate fuscous. Thorax and abdomen deep chocolate fuscous, interspersed with long green hairs; anal third of abdomen devoid of hairs, but tinged with irridescent violet. Forewings broadly triangular, costa gently rounded, hindmargin almost straight, deep chocolate, fuscous, clouded with diffusion of black, and with long greenish hairs over base. Forewings in ♀ with two prominent white dots near together in the disc. Cilia deep chocolate fuscous, finely edged with ochreous. Hindwings as forewings, but inner margin, and basal half densely covered with glaucous or glaucous-ochreous hairs. Cilia as forewings. Undersurface of forewings fuscous with effusion of black in middle towards base; white discal dots in ♀ conspicuous. Hindwings, colour as forewings, but with lilac effusion, a lilac white line, broadly diffused, extends from near apex of costa to a rich velvety black blotch, filling anal angle, resembling a silvery brook falling into a dark lake or reservoir; a lunular ochreous line from base, parallel to and cutting off a portion of ground colour of hindmargin, is more or less diffused with white; these two lines form a large W, in a view of the two wings; a hindmarginal ochreous line extends from the anal black blotch or reservoir to near apex. Cairns.

GROUP ARCTIADÆ—FAMILY LITHOSIADÆ.

CALLIGENIA LIMONIS. NOV. SP.

♂ ♀ 22-25 mm. Head and face lemon colour. Palpi fuscous. Antennæ light lemon, shaded with fuscous. Thorax lemon, with a line of four smoky grey dots anteriorly, and a row of three posteriorly. Abdomen pale lemon, diffused with smoky grey, two anterior segments with a fine black line at base. Legs lemon colour. Forewings elongate, strongly dilated, light lemon with smoky grey markings, costa rounded, apex obtuse, hind-margin obliquely rounded. The markings imitate scribbling, and are evenly distributed. The first is subtended from, but does not touch a broad dash along base of costa, it commences in a black speck, and diffuses into a running band to meet the second nearer to inner margin than to costa; the second and third span the wing as the letter X, the fourth is roughly parallel with hind-margin, it is very wavy and freely denticulate, and touches the third on inner margin at $\frac{3}{5}$; the fifth is deeply dentate and communicates with the fourth by dentations, less freely in ♂, and the costal and inner thirds are prolonged to hindermargin. Cilia lemon, tinted with fuscous. Hindwings pale ochreous grey. Cilia as forewings. A pair taken in the Lucas-Rye Expedition, near Bellender Kerr. Allied to C. melitaula, Meyr, but a smaller insect and with the markings differently distributed, and a lemon rather than a reddish colour.

CALLIGENIA MELITAULA. MEYR.

Musgrave River, Lucas Rye Expedition.

GROUP BOMBYCINA—FAMILY LIPARIDÆ.

DARALA CONSUTA. NOV. SP.

♀ 72 mm. Head, face, thorax, and abdomen densely hairy, deep ochreous fuscous. Antennae ochreous fuscous. Legs black with ochreous fuscous hairs on under surface. Forewings broadly triangular, costa gently rounded, hindmargin rounded, reddish fuscous, with veins and marginal lines ochreous fuscous, and creamy white markings; a conspicuous round discal spot at $\frac{1}{3}$ nearer to costa than to inner margin; a continuous, deeply dentate hindmarginal line. Cilia rufous fuscous. Hindwings as forewings, with no discal dot, but a widely toothed hind-marginal line. Cilia as forewings.

One specimen, Aloomba. Lucas-Rye Expedition.

ARTAXA ARROGANS. NOV. SP.

♂ ♀ 45—60 mm. Head, palpi, antennae, and thorax deep ochreous yellow. Abdomen lighter ochreous yellow. Forewings broadly dilate, costa rounded, hindmargin rounded, light ochreous yellow, veins marked and whole surface freely irrorated with deep reddish ochreous. Cilia light ochreous yellow. Hindwings as ground colour of forewings, without the darker ochreous. Cilia as forewings. Base of Bellender Kerr, Cairns, Lucas-Rye Expedition.

FAMILY PSYCHIDÆ.

OECETICUS FELINUS. NOV. SP.

♂ 28 mm. Head fuscous, face wool white. Palpi and antennæ fuscous. Thorax creamy grey, with anterior band, dorsal and lateral bands rich velvety fuscous, inclining to blaok. Abdomen ferrous red, freely covered with rich velvety black hairs, caudal segment ferrous red. Forewings elongate, gently dilate, costa gently rounded, hindmargin obliquely rounded, hialine, with veins rich velvety fuscous. Cilia blackish fuscous. Hindwings and Cilia as forewings. ♀ Apterous. Builds its domicile of Casuarina needles. A female in its domicile was visited by two males and so taken. May Orchard, Brisbane.

GROUP GEOMETRINA.—FAMILY GEOMETRIDÆ.

ACIDALIA COERCITA, NOV. SP.

♂ ♀ 16—19 mm. Head, face, and palpi ferrous red. Antennae pinky drab. Thorax and abdomen silvery drab. Forewings triangular, costa gently rounded, hindmargin oblique, sparsely wavy, silvery drab, with finely pencilled ferrous red marking. Forewings with a conspicuous ferrous red band bordering costa and hindmargin; three transverse wavy sinuate finely pencilled ferrous red lines, here and there faintly duplicated, or split into dots, the first, before $\frac{1}{2}$ costa to $\frac{1}{3}$ inner margin, the second from $\frac{2}{3}$ costa to $\frac{2}{3}$ inner margin, and the third from $\frac{5}{6}$ costa to $\frac{7}{8}$ inner margin; several faint lines, portions of lines, or dots, indefinitely scattered over wing generally. Cilia ferrous red. Hindwings as forewings, first line wanting, second from $\frac{1}{2}$ costa to $\frac{1}{2}$ inner margin, nearly parallel to hindmargin; third line from $\frac{4}{5}$ costa to $\frac{4}{5}$ inner margin, in part doubled, but in part dotted; hindmargin bordered by ferrous red band as forewings. Cilia as forewings. Brisbane, rare.

ACIDALIA VIBRATA. NOV. SP.

♂ ♀ 20—22 mm. Head, face, and palpi ferrous fuscous. Antennae ochreous fuscous. Thorax and abdomen ochreous fuscous. Forewings costa straight, hindmargin gently rounded, ochreous fuscous, with smoky fuscous fasciæ and dots, and irrorated with black and fuscous scales. Forewings with diffused pale fuscous drab fascia from centre of base, through wing, gradually nearing costa towards apex: a number of lines and bands obliquely across wing; a faint line from $\frac{1}{2}$ inner margin to apical end of longitudinal fascia; a distinct but small discal spot; faint wavy lines parallel to first transverse line; a broad fascia obliquely from $\frac{2}{3}$ inner margin to $\frac{1}{3}$ hind-margin; a row of darker fuscous sub-marginal dots parallel to hindmargin, a hindmarginal row of similar dots. Cilia ochreous fuscous. Hindwings as forewings, discal spot plain, median band continuous with that of forewings; three wavy lines or dots beyond run parallel, and a sub-marginal row of dots, a hindmarginal row of dots, in some specimens diffused into a line. Cilia as forewings. Brisbane, rare.

ACIDALIA PARTITA. NOV. SP.

♂ 21 mm. Head, ochreous drab, with a posterior frontal fuscous spot, face fuscous. Palpi fuscous. Antennae ochreous drab. Thorax and abdomen ochreous drab. Forewings costa nearly straight, hindmargin rounded, with markings smoky fuscous, and black dots, freely irrorated with minute fuscous and black scales. Forewings with black discal dot on fold; a broad, smoky, diffused fascia from beyond $\frac{1}{2}$ inner margin toward, but stopping short, at $\frac{1}{4}$ before apex; this is crossed by several indistinct lines parallel to hindmargin; these lines continue on inner half of wing to hindmargin, but the costal half lines run in a crescentic curve from costa to costal half of hindmargin; a row of black dots from opposite $\frac{7}{8}$ of costa obliquely toward inner margin at $\frac{1}{4}$, this row stops short of both margins but sends two or three small irregular placed dots near hindmargin; hindmarginal fuscous line with black dots. Cilia ochreous. Hindwings as forewings, with oblique fascia continued as a median band, containing black discal dot; a succession of wavy lines to hindmargin, black dotted line as forewings. Cilia as forewings. One specimen, Brisbane.

EUARESTUS. NOV. GEN.

Face smooth. Antennæ in male bipectinated. Palpi moderate, slender, adpressed scales, porrected, terminal joint short. Posterior tibiæ, with all spurs present. Thorax with woolly hairs beneath. Forewings with veins 3 and 4 separate, 7 and 8 stalked. Hindwings with veins 3 and 4 from a point, 6 and 7 from a point, 8 from cell at half.

EUARESTUS NOBILITANS. NOV. SP.

♂ 37 mm. Head and face bright to pea green. Palpi moderate, deep red, first joint with long whitish hairs, on under side. Antennæ bipectinate, stalk deep red, pectinations grey, shortening at either end. Legs reddish fuscous, to ochreous on under surface, spurs long. Thorax bright pea green, white woolly hairs underneath. Abdomen pea green, laterally and in last segments ochreous, with a black spot on centre of dorsum, and hind margin of posterior segments edged with purple rose. Forewings costa rounded, apex acute, hindmargin gently rounded, bright pea green. Costa white grey, finely annulated with ferrous fuscous, and suffused with cherry red ; four or five spots or blotches of ferrous red on fore part of cell and on veins ; a line of minute black dots on veins along a narrow line of indistinct darker green, from $\frac{2}{3}$ costa to $\frac{2}{3}$ inner margin ; a few minute black dots scattered irregularly and sparingly. Cilia green, gradually shading to creamy grey. Hindwings same as forewings, with very indistinct darker green line, and a very few scattered minute black spots. Cilia as forewings. Under surface of all wings greenish ochreous, suffused with red towards base, and becoming lighter ochreous toward hindmargin ; an irregular broad band of purple, shaded into violet, from middle of wings to $\frac{7}{8}$, shaded towards margins, and interrupted in hindwings in centre by groundcolour to form two diffused blotches.

One specimen taken in scrub near Brisbane in October.

EUARESTUS PATROCINATUS. NOV. SP.

♀ 45 mm. Head and face bright green. Palpi with profusion of adpressed hairs on first joint, terminal joint short, creamy pink. Antennœ serrate, light fuscous, with creamy annulations, white underneath. Legs ochreous, spurs long. Thorax bright pea green, white woolly hairs underneath. Abdomen bright pea green, becoming ochreous laterally and over under surface ; a conspicuous arched violet red blotch on centre of dorsum, bordered narrowly and freely dotted with black. Forewings costa rounded, apex acuminate, hindermargin gently rounded, bright pea green. Costa creamy grey diffused with cerise, and annulated in basal half with deep ferrous fuscous, more sparingly towards apex ; an ochreous discal spot at $\frac{2}{3}$, edged with ferrous fuscous ; a darker green indistinct wavy line, from costa $\frac{2}{3}$, enclosing discal spot, to $\frac{2}{3}$ inner margin ; a few scattered black specks on veins near costa. Cilia green, edged with ochreous. Hindwings as forewings, with wavy line indistinct. Cilia as forewings. Undersurface of all wings light fuscous ochreous, with a broad deep purple band at $\frac{3}{4}$ over costal two thirds of wing, and separated by a band of ground colour ; a shading of same anterioriy to inner margin ; a broader irregular band across hindwings. In hindwings veins 5 and 6 are concurrent at either end—the middle third enclosing a space.

One specimen base of Bellender Ker Mt., Lucas-Rye Expedition. There is a remote possibility that the above may be sexes of one species—but so many characters differ, I have placed them apart.

SKORPISTHES. NOV. GEN.

Palpi moderate, porrected, second joint densely rough haired beneath, terminal joint short. Antennæ in male pectinated for three-fourths, thence finely ciliated. Thorax densely hairy underneath. Abdomen with strong dorsal crests. Posterior tibiæ with all spurs present. Forewings with viens 3 and 4 from a point, 5 parallel with 4, 6 from point with 9. Hindwings with viens 3 and 4 from a point, 6 and 7 from a point and united with 5 by a short crossbar, 8 anastomosing with upper margin of cell at base.

SKORPISTHES UNDA-SCRIPTA NOV. SP.

♂ 25 m m. Head grey. Palpi fuscous, terminal joint grey. Antennæ fuscous, pectinations fuscous grey. Forewings broadly dilate, costa straight, rounded at base and apex, hindmargin obliquely rounded, white grey, densely dusted with iron grey, and with transvese black undulating lines. Forewings with costal edge finely irrorated with iron grey dashes ; a three wave line from $\frac{1}{4}$ costa to $\frac{1}{4}$ inner margin ; a short wavy line in disc just before $\frac{1}{2}$: a waved line with eight undulations, five straight, from $\frac{3}{4}$ costa, the three last obliquely to beyond $\frac{1}{2}$ inner margin ; a hindmarginal wave line ; diffused blotches of ferrous fuscous posterior to second line. Cilia grey. Hindwings as forewings with first line wanting; space between second and marginal line freely dusted and diffused with ferrous fuscous. Wynnum Swamps, Brisbane. One specimen taken by Mr. Benson Hall.

The forewings are thrown forward until their costal edges almost meet when at rest. As the creature sits on the tee-tie bark it is almost impossible to detect it, so perfect is the deception.

FAMILY MONOCTENIADÆ.

MONOCTOPHORA. NOV. GEN.

Face with dense hairs. Tongue developed. Antennæ in ♂ unipectinated, apical third simple. Palpi rather stout, short, sub-ascending, densely scaled, terminal joint thick. Thorax stout, densely hairy, long woolly hairs beneath. Anterior tibiæ in ♂ with apical hook, all tarsi spinulose. Forewings with vein 6 out of 9, 10 connected with 9 by bar. Hindwings with veins 6 and 7 stalked.

Allied to Monoctenia, but the stalking of veins 6 and 7 is very distinctive.

MONOCTOPHORA STILLANS. NOV. SP.

♂ 36—38 m m. Head, thorax, and palpi pale brownish ochreous. Antennæ reddish ochreous, pectinations pale ochreous. Abdomen whitish ochreous, under surface of thorax and abdomen, thickly covered with long white woolly hairs. Forewings broadly triangular, apex acute, subfalcate, hind-margin gently rounded, slightly contracted or puckered opposite vein 2; pale brownish ochreous, with two transverse lines of purplish red dots, in some specimens enlarging to blotches; first line consists of two dots equi-distant between $\frac{1}{3}$ inner margin to $\frac{2}{5}$ costa; second line consists of dots on all the veins, in some suffused into a blotched bar, from $\frac{2}{3}$ inner margin to $\frac{4}{5}$ costa; a deep red brown hindmarginal band to just before anal angle, fringed anteriorly with ochreous red, which continues to anal angle. Cilia deep brown to before anal angle, thence and along inner margin pale ochreous. Hindwings as forewings, with two transverse lines of purplish red dots parallel to hind margin, first line of some four dots, from $\frac{1}{2}$ inner margin to half across the wing; second line of dots and splashes from $\frac{2}{3}$ inner margin to just before apex of costa; dark red-brown hindmarginal band from vein 4 to anal angle, with a brownish ochreous fringe anteriorly, extending along all hind-margin. Cilia as forewings. Under surface of wings marked as upper surface. Bred from caterpillars feeding on Geebung, Persooma cornifolii, Brisbane.

MONOCTOPHORA CAPRINA. NOV. SP.

♂ ♀ 33—35 mm. Head, palpi, and thorax ashy grey. Antennæ brownish ochreous, pectinations lighter ochreous. Abdomen whitish grey, with a shading of darker grey in the centre of the dorsum, and a few scattered dark hairs. Forewings triangular, costa straight, apex acute, slightly falcate, hind margin strongly bowed ; ashy grey with small fuscous dots or specks on veins, and with whole surface dusted with minute specks, as pepper ; a series of minute dots along costa, two transverse lines of dark grey dots, first line of three dots from $\frac{1}{3}$ inner margin to $\frac{1}{3}$ costa, parallel to hind margin, one dot just before inner margin, one just before costa, and middle one equidistant ; second line, dots on all veins, from $\frac{2}{3}$ inner margin to just before apex costa ; dots in veins are incorporated in a dark brown hindmarginal line ending abruptly before anal angle. Cilia to just before anal angle dark red fuscous, thence and along inner margin ashy grey. Hindwings as forewings with first line indefinite, second line chocolate red, developed before costa into two or three lunar blotches, transfused into one general blotch ; in ♀ dark shading but not blotched. Brisbane, bred from caterpillars feeding on Geebung, Persooma cornifolii.

ARRHODIA FENESTRATA. NOV. SP.

♂ 34 mm. Head cream colour, face with dense fuscous scales. Palpi light fuscous, antennae ochreous fuscous. Thorax light grey with a semilunar band, anteriorly fuscous, darkened with black on dorsum. Abdomen fuscous, densely irrorated with black dots, posterior margin of segments white grey shading into dark fuscous. Forewings elongate triangular, costa straight, apex rounded, hindmargin rounded, ashy grey, with veins ochreous grey, densely irrorated with light fuscous and minute specks of ochreous. Costal margin ochreous, banded and blotched with rich velvety fuscous ; an irregular translucent figure bounded by median vein, and veins 3 and 4, bounded posteriorly with rich, velvety, fuscous black band, and extending to costa and inner margin in errant patches; three or four lines of same colour along hind margin; five lunar marks; black marks along hind margin, diffused into thin lines toward anal angle. Cilia fuscous with a basal ochreous line. Costal half of hindmargin wavy. Hindwings as forewings, with translucent figure elongated, crossed by veins 2, 3, and 4, bordered anteriorly on inner portion with rich fuscous, breaking into dots outwardly, bordered on posterior border with rich fuscous black band, extending to inner margin, but interrupted as dots to costa; numerous dots of black over basal half of wings, one or more blotches of fuscous before apex of costa; irregular subterminal black line on costal half of hindmargin. Cilia as forewings. One specimen, Brisbane, at light.

ASPIDOPTERA. NOV. GEN.

Head and face with adpressed hairs. Antennae bipectinate, to near apex, pectinations short. Palpi slender, with rough scales, terminal joint short. Thorax hairy beneath. Forewings 9 and 10 stalked. Hindwings with 6 and 7 from a point, 8 coincident at base. Closely allied to Aspilates.

ASPIDOPTERA NAVIGATA. NOV. SP.

♂ 40 mm. Head and face, antennæ and palpi orange ochreous streaked with fuscous. Thorax and abdomen light fuscous ochreous. Forewings elongate triangular, costa gently rounded, apex acutely prolonged, hindmargin nearly straight in costal half, obliquely bowed to anal angle, ochreous fuscous, diffused with orange fuscous, and freely dusted with black scales. Costa freely irrorated with short black lines; a series of five black and fuscous equidistant transverse sinuous lines, more or less parallel with hindmargin, the posterior ones somewhat indistinct; a broad deep waved fuscous band runs obliquely through the wing from ⅓ inner margin to apex; a light ochreous discal spot at angle of third line and oblique central band; the space between first and second transverse bands is suffused with grey, beyond the orange deepens, but the grey is again conspicuous on hind border of oblique line and towards inner margin; there are a number of irregularly scattered black spots near the hindmargin, and a pair of star rayed black dots opposite anal angle. Cilia deep ferrous fuscous. Hindwings as forewings, hindmargin straight for costal half, then doubled at right angles, anal part crenate; the oblique band of forewings is continued from ⅓ costa to $\frac{1}{3}$ inner margin; the first transverse line is only a light diffusion, the second and third are suffused with grey, which is shaded into the space they enclose; the fourth is very conspicuous is parallel with the hindmargin, the space it encloses with the third contains a black discal spot, and is freely suffused with ochreous orange: the broad band between lines four and five is freely dusted with grey. Cilia as forewings. Under surface of all wings light ochreous, freely speckled and dusted with grey fuscous. Brisbane.

ASPIDOPTERA AMBIENS. NOV. SP.

♂ ♀ 28-33 m m. Head deep cherry red, with a line of four ochreous dots across face, and an interrupted ochreous line between antennae. Palpi cherry red, with second and third joints finely tipped with ochreous. Antennae ochreous fuscous, finely irrorated on basal third with cherry red. Legs cherry red, with grey banded lines. Thorax light fuscous grey, with a faint tinge of lilac. Abdomen fuscous grey, diffused with light lilac red. Forewings gently dilate, costa rounded at apex, hindmargin strongly bowed, crenulate, fuscous grey, freely diffused with lilac red, and transversely crossed by circular, interrupted, dotted lines of ferrous fuscous; an ochreous costal line with short bars of ferrous fuscous edged with cherry red; a faint reddish discal spot; a wavy ferrous fuscous dotted line from $\frac{4}{5}$ costa to $\frac{3}{4}$ inner margin, darker as it approaches costa and inner margin; a ferrous fuscous hindmarginal line of crenulations and dots, with a suffused, narrow, reddish-brown band anteriorly. Cilia reddish-brown, with white lunations in crenulations. Hindwings as forewings, with dotted line continued to inner margin, darker and bowed outward along costa; hindmargin reddish fuscous, without ferrous dots. Cilia creamy white. Under surface of all wings grey, tinted with lilac red, with the lines of upper surface intensified and tinged with purple; in forewings a violet suffusion along costal half of hindmargin, narrowing toward costa; a like suffusion on hindmargin before costa. Brisbane, one pair, at light.

GALANAGEIA. NOV. GEN.

Head and face smooth. Antennae unipectinated, abruptly becoming ciliated in apical fourth. Tongue developed. Palpi. moderate, with closely adpressed hairs, terminal joint very short

Under surface of thorax densely hairy. Hindwings, 6 and 7 from a point, 8 closely approaches cell before middle, thence diverges.

GALANAGEIA QUARDRIGRAMMA. NOV. SP.

♂ 43 mm. Head white, with fuscous lines on crown, and a fuscous bar before collar; face ochreous fuscous. Palpi reddish ochreous, terminal joint blackish fuscous. Antennæ, stalk black and white annulated, pectinations light ochreous. Thorax and abdomen reddish ochreous. Forewings costa slightly but distinctly bowed, apex rounded, hindmargin crenulate, gently rounded to one half, thence obliquely rounded, ochreous fuscous, suffused with light lilac. Along the costa are a number of short strigulations, black intermixed with light bluish grey, and suffused with ferruginous; a light ochreous band darker on anterior border from $\frac{1}{2}$ inner-margin to $\frac{2}{3}$ costa; a large discal spot, light bluish grey, bordered with ferruginous and contains anteriorly a hyaline dot and a lunar figure, bordered with ferruginous; crenulations of hind-margin bordered with a ferrous line edged with conspicuous ochreous. Cilia at angles deep ferrous, elsewhere ochreous. Hindwings as forewings, discal figure almost square, with the median band cutting, but not bisecting; apical and anal crenulations bordered as in forewings. Cilia as forewings. Brisbane.

FAMILY SELIDOSEMIDÆ.

CHLENIAS SAGITTARIA. NOV. SP.

♂ 38 mm. Head creamy white, with a fuscous band between eyes. Palpi light grey. Antennæ fuscous, pectinations drab. Thorax grey with fuscous anteriorly on dorsum, epaulettes and crest bordered with fuscous line. Abdomen creamy grey. Forewings triangular, gradually dilate, costa gently rounded, hindmargin obliquely rounded, creamy white, freely splashed with iron grey, and with lines and marks of black. Forewings with basal third of costa finely edged with fuscous, thence the line does not touch costa, but at $\frac{2}{3}$ finely scatters into dots and specks; a broad, black line from centre of wing at base, turns obliquely toward costa to opposite $\frac{2}{5}$, thence inwards as diffused dots to a second black line, which lies parallel to a white line edged with fuscous, which runs from base of wing to apex of hindmargin; this median black line is interrupted at $\frac{3}{4}$, and indented in apical fourth ; a black line near base of inner margin obliquely to centre of wing at $\frac{1}{3}$; a suffusion of fuscous more or less beyond to hindmargin ; a zig-zag transverse line in middle third of wing at a little distance from hindmargin. Cilia grey, specked with black. Hindwings pale grey, becoming fuscous toward border, veins darker grey. Cilia as forewings. Brisbane, three specimens at light, two on trunks of scrub trees.

ANTEIA CANESCENS LUC.

Base of Bellender Kerr, Lucas-Rye Expedition.

ANTEIA DODDSIANA. NOV. SP.

♂ ♀ 28—30 mm. Head, antennae, thorax and abdomen white. Forewings broadly dilate, triangular, costa rounded, apex obtusely rounded, hindmargin straight, snow-white, with light leaden or water mark lines and dots. Forewings with numerous lines along costa to just before apex; an elongated discal spot not conspicuous, a row of 8 dots along inner margin ; seven or eight interrupted lines of dots or short lines irregularly across wings ; a narrow hindmarginal black line. Cilia white shaded with grey or fuscous towards base. Hindwings as forewings, squarely angled and acutely produced at vein four ; a definite discal dot, sometimes divided into two spots ; inner and hind margins freely lined with rows of short lines ; basal half of wings without markings ; hindmarginal line darker than in forewings, thickened and interrupted on either side of anal angle. Cilia as forewings.

Reared by Mr. Dodds from larvæ taken at Brisbane.

GROUP NOCTUÆ—FAMILY ORTHOSIDÆ.

LEUCANIA SEPULCHRALIS NOV. SP.

♂ ♀ 30-32 mm. Head, palpi, and thorax metallic leaden colour, with minute specks of grey. Antennae fuscous drab. Abdomen ashy grey, with dorsal ridge smoky grey, and caudal black. Legs smoky grey, middle and posterior tibiae segment with lighter grey. Forewings elongate, gently dilate, costal basal half straight thence sensibly arched, hindmargin straight, rounded just before anal angle, metallic lead, lined with ochreous and black lines along veins, and ochreous lines between and dusted with lines of bluish white hairs. Forewings with costal edge ashy grey fining toward apex, a median suffused black band passing obliquely from base to $\frac{4}{5}$ and then deflected at an obtuse angle to apex of hind margin ; this band contains a white small spot of minute rings just beyond centre, and is opposite to a smaller dot nearer costa; obliquely from this to apex there is a light tinting of ochreous fuscous; on inner side of oblique black band the ground becomes decidedly fuscous ochreous, becoming darker towards inner margin; a fine line of blue white specks parallel with, but not touching inner margin, hind marginal line black. Cilia ashy grey based with ochreous fuscous. Hind wings translucent white with veins grey and a suffusion of grey on hind margin. Cilia as forewings. Brisbane at light.

FAMILY CARADRINIDÆ.

BRYOPHILA EXQUISITA. NOV. SP.

♂ ♀ 30-34 ㎜.—Head and palpi light grey, diffused with green, and speckled with black scales. Antennæ fuscous, annulated with white near base. Thorax greenish grey, freely dusted with black, with wavy arching black lines forming a band across dorsum anteriorly. Abdomen grey, freely dusted with black, and with a whiter band bordering segments posteriorly. Legs white, anterior tarsi annulated with black. Forewings, costa gently rounded, hindmargin rounded, white diffused with grey, and freely irrorated with green and black, with black markings; a waved line at base encircling the thorax, a waved undulating line from $\frac{1}{4}$ costa gradually approaching and enclosing first line in costal two thirds of wing, and then deflecting to inner margin; three other lines more or less definite and mostly symmetrical with this second line, at from $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{7}{8}$ costa, the last is the most strongly marked, and is angled towards apex by a dark shading, this breaks up into a submarginal band of black grey dust: the ends of the definite and partial lines on costa and inner margin are strongly marked with black dots or short bars. Cilia grey with bands of black. Hindwings fuscous, lighter toward base, darker to hindmargin. Cilia grey with short stripes of fuscous.

At light, Brisbane.

FAMILY PLUSIADÆ.

PLUSIA CHILLAGOES. NOV. SP.

♂ 30 ㎜. Head ochreous fuscous. Palpi fuscous, with ochreous hairs on under side of second segment. Antennæ fuscous. Thorax creamy grey. Abdomen light fuscous. Forewings triangular, gently dilate, costa sparingly wavy, apex obtuse, hindmargin straight in apical half, thence obliquely rounded, ochreous fuscous, variegated with drab and with darker fuscous lines and diffusions and metallic bronze. Forewings with costa strongly metallic to just before apex ; a curved bronze line from $\frac{1}{4}$ costa to $\frac{1}{5}$ of inner margin ; a second bronze line from $\frac{2}{3}$ of inner margin to $\frac{3}{4}$ of costa, becoming less distinct towards costa ; this is bounded by a dark fuscous line posteriorly, denticulate toward costa ; a curve bronze line from costal origin of first line obliquely outward, rounds close to submedian, becoming indistinct to middle of second line ; this connecting line bounds a patch of dark fuscous which borders all the bronze lines, and gradually shades off toward inner margin ; there are lighter fuscous patches in costal half, the most conspicuous before second line ; a bronze suffusion from anal angle of inner margin to middle of wing, thence obliquely to middle of a sub-marginal bronze line extending from apex to middle of wing ; these lines are bounded by dark fuscous suffusion which becomes more pronounced toward apex ; a hindmarginal row of same colour spots more or less diffused into a continuous line. Cilia ochreous fuscous, with ferrous fuscous, darker median fuscous band. Hindwings fuscous with veins darker fuscous. Cilia as forewings. Brisbane. Allied to P. agramma, Gn.

FAMILY DELTOIDÆ.

HERMINIA IRIDESCENS NOV. SP.

♂ ♀ 35-38 ♏ ♏. Head black fuscous, with a prominent frontal tuft. Palpi, basal joint black fuscous, second and third ochreous fuscous. Antennæ, stalk dark fuscous, pectinations ochreous fuscous. Legs black fuscous, with bases of tarsi ochreous fuscous. Thorax and abdomen deep black fuscous. Forewings gently dilate, costa gently rounded, hindmargin obliquely rounded, blackish fuscous with black markings and ochreous lines, dusted with scattered whitish and purplish minute scales, and suffused chiefly in median band with purple iridescence. Forewings with a black crenulate line from $\frac{1}{8}$ of costa to $\frac{1}{4}$ of inner margin, suffused anteriorly with ochreous ; a blackish or purple or white minute dot on or just outside this line, close to median ; a second undulated multidentate line from $\frac{3}{5}$ costa to $\frac{1}{2}$ inner margin, shaded with ochreous posteriorly, and ending in an ochreous costal blotch ; between these two lines is a conspicuous discal spot, black, in some with two or three white dots, and in one variety the whole discal spot is white ; a third line $\frac{7}{8}$ costa to ⅞ inner margin, thrice arched, in some more or less dentate, subtending a deep, black effusion anteriorly, and bordered by a faint ochreous line posteriorly ; a fuscous ochreous submarginal line, subtending rich black dots on veins. Cilia blackish fuscous. Hindwings as forewings, but with first line absent, or only faintly indicated. Cilia as forewings. Base of Bellender-Kerr, Queenland. Lucas-Rye Expedition.

HERMINIA DORMIENS. NOV. SP.

♂ ♀ 36—40 ᵯᵯ. Head and palpi ochreous fuscous. Thorax and abdomen ochreous fuscous, speckled in some specimens with grey and black. Forewings costa unevenly rounded, hindmargin rounded, ochreous fuscous, shaded with shades of fuscous, and freely speckled with black, markings ochreous : an indistinct darker, transverse line at ¼ ; a prominent ochreous bar from ¾ costa to ¾ inner margin shaded on either side with blackish fuscous; a curved line of interrupted black dots from ½ costa to ¼ inner margin ; a banded group of scattered black dots ½ costa to ¾ inner margin ; an ochreous line at base of cilia, with black dots on veins. Cilia ochreous fuscous. Hindwings as forewings, a dark transverse band of blackish shading just before half : an ochreous bar at ¾ shaded on inner side with fuscous to black. An ochreous line at base of Cilia with fuscous dots on veins. Cilia as forewings. Allied to H caenealis Walk, but a larger insect. and the transverse bars are differently placed. Foot of Bellender-Kerr, Lucas-Rye Expedition.

GROUP PYRALIDÆ.—FAMILY BOTYDIDÆ.

CONOGETHES JUBATA. NOV. SP.

♂ ♀ 20 ᵯ ᵯ. Head, face and antennae golden yellow. Palpi ferrous black. Thorax yellow. Abdomen yellow, with three or four ferrous dots on base of anterior segments, caudal appendix fringed with ferrous. Forewings gently dilate, costa nearly straight, apex rounded, hindmargin obliquely rounded, golden yellow, with ferrous red dots, and suffusion of same in middle third of wing, shading off in dots to costa and inner margin. Forewings with spot near base of costa, a second just beyond subtends a curved line of three dots, an elongated dot on either side of suffusion, the posterior one subtends a rounded line of dots bordering the suffusion to inner margin ; this line of dots gives off a row obliquely to ⅞ costa, and a second row from nearer inner margin to opposite ½ hindmargin. Cilia yellow.

Hindwings golden yellow, with ferrous red dots, three along costa, each subtending a line of dots, first from $\frac{1}{3}$ costa to $\frac{1}{3}$ of inner margin consists of three dots, the last two diffused into a line ; the second from just beyond holds four or five dots in a circle to half across wing, nearly parallel with hindmargin ; and the third from before apex of costa forms a submarginal line of dots to anal angle. Cilia as forewings. In Mr. Meyrick's advice I tabled this as a variety of C punctiferalis. Dr. Turner has taken a series which show no variation. The whole build and habits of the insect are quite different from our common peach devouring moth, the C punctiferalis. Brisbane, at light.

GROUP TINEINA.—FAMILY XYLORICTIDÆ.

CRYPTOPHAGA EUGENIAE. NOV. SP.

♂ 32—34 mm, ♀ 38—42 mm. Head and palpi snow white. Antennæ basal joint snow white, in ♂ stalk fuscous, pectinations rich ochreous fuscous, in ♀ black, gradually shading to white at base. Thorax snow white with prominent lateral crests and petagia, with a ferrous band posteriorly narrow on dorsum, but broadening on each side laterally. Abdomen in ♂ black, each segment bordered and fringed with white or grey hairs, second segment with a dorsal semi-lunar patch of orange red, in ♀ the abdomen is snow white with orange red on second segment. Legs white, with base of all tarsi black. Forewings obovate oblong, costa gently rounded, hindmargin rounded, snow white, with minute black dots. Forewings with a black in disc at one third, and two others obliquely beyond at two thirds, in ♂ a fourth spot is indicated or faintly marked in a line with and near first dot ; nine or ten black dots on apical fourth of costa and along hind margin. Cilia snow white. Hindwings in ♂ black, with grey and white scales toward inner margin, costa edged with black line, with a wide costal space white. Hindwings in ♀ ; snow white, apex of costa and costal half of hind-margin with seven triangular black dots, indicated in ♂. Cilia in ♂ white with smoky black marks opposite veins, becoming grey to black in anal third. Cilia in ♀ white. Brisbane, feeding in Eugenia.—This species differs considerably from C. Pulteneæ, Lw., with which it has been confounded. Many white species run very closely and only present fine differences to detection. This insect is larger, the males are smaller uniformly than the females ; the antennæ in Pulteneæ are stated to be white, in this species they are rich ochreous fuscous; the thorax has in this species a ferrous band and special prominent white crests, and the abdomen of the ♂ is black, not white; all legs are white.

CRYPTOPHAGA MOLARIS. NOV. SP.

♂ ♀ 29—36 ㎜. Head and face whitish grey. Palpi fuscous, second and terminal joints light grey. Antennae white, pectinations ochreous fuscous. Thorax white, with a light grey fringe behind collar, and dusted laterally and posteriorly with fuscous and grey. Abdomen fuscous drab, fringed anteriorly with ochreous hairs from thorax, with a light ferrous band on second segment. Legs fuscous drab. Forewings elongate, costa nearly straight, hind margin straight, rounded at anal angle, fuscous drab, freely marked with black and grey. Forewings with interrupted fine lines of white along half to three-fourths of costa; the costal half of wing is irregularly diffused with rich black, the inner half and base of wing is freely irrorated with white, this white arches toward costa at base, and extends as a line to near costa just before apex; a subterminal band of ground colour, bordered by a terminal line of light black dots. Cilia grey white, with a brown border. Hindwings fuscous drab. Cilia fuscous grey with a light brown line through base. Allied to L. fumata, Turner, but easily distinguished by the whole costal half of forewings being blotched more or less irregularly with black, and the inner half being freely irrorated with white. May Orchard, Brisbane, at light.

CATORYCTIS EMARGINATA. NOV. SP.

♂ 14 ㎜. Head white. Palpi white. Antennæ fuscous. Thorax white, collar narrowly fuscous. Abdomen ochreous fuscous. Forewings elongate, costa gently rounded, hind-margin obliquely rounded, whitish ochreous with markings white and ochreous fuscous. Forewings with broad white band on costal border, from base, to and attenuating towards $\frac{2}{3}$ of costa; a second white band commencing just below, opposite apical end of first runs to apex; a broad fuscous band separates, and encloses these two white bands on inner border; a small triangular fuscous blotch in disc, two linear spots opposite ends of white bands; a pale suffusion along disc, and a conspicuous fuscous blotch before anal angle; a suffusion of fuscous along inner margin; and an oblique hindmarginal line of same colour bordered on either side with white lines. Cilia fuscous, with white basal line. Hindwings pale fuscous drab. Cilia pale fuscious drab.

May Orchard, Brisbane.

LICHENAULA VELITATA. NOV. SP.

♀ 22 mm. Head, palpi, and antennae chalky grey. Thorax chalky grey, faintly tinged with smoky grey. Abdomen ochreous grey, bordered anteriorly with ochreous ferrous; a dark ferrous fuscous spot on dorsum of first segment. Forewings elongate ovoid, costa rounded, hindmargin rounded, chalky white, sparsely dusted with light grey, and sparingly but generally dotted with black and diffused smoky grey dots. Forewings with fine black line along basal fourth of costa; a black dot in centre of base, with a linear one almost touching, and a third beyond in centre of wing; a line on costa at $\frac{1}{8}$ forming basement of an oblique line of fine dots; a dagger-like line, in middle of wing nearer inner than costal margin, and extended in diffused specks and dots to anal angle of hind margin; a dot at $\frac{1}{2}$ costa, with a dot, and, after an interruption, a line of dots, a comma dot, and a line of diffused spaces and dots to anal angle of hindmargin; the apical third of costa is irregularly studded with diffused lines and dots more or less faintly marked; scattered diffused dots near hindmargin. Cilia whitish grey. Hindwings light smoky grey. Cilia lighter grey. One specimen. May Orchard, Brisbane. The dots are scattered, but arranged in irregular lines, as in light skirmishing order.

LICHENAULA CIRCUMSIGNATA NOV. SP.

♂ ♀ 22-24 mm. Head and face white. Palpi and antennae grey. Thorax iron grey, dotted with black; a band of white anteriorly; epaulettes lighter grey. Abdomen light drab, with bands of darker drab; a spot of ferruginous fuscous on first segment. Forewings elongate, costa gently rounded, hindmargin obliquely rounded, white, freely dusted with iron grey, and black linear markings, and diffused slaty grey patches. Forewings with two black dots separate or indistinctly united at base of cesta and base of wing, opposite centre; a straight line from before $\frac{1}{8}$ costa, to within $\frac{1}{3}$ hindmargin, where it becomes a slaty diffusion; a third concave line in disc, extending over middle third of wing; a short bracket line $\frac{2}{3}$ spans $\frac{1}{3}$ of wing, but rather nearer costa than inner margin; four slaty grey lines from costa, the first beyond ½ reaching ⅓ across wing, the remaining three nearer costa short; a wavy slaty grey line or effusion beyond second costal line to inner margin at ¾; a subterminal diffused band of same colour, and a row of terminal spots forming a more or less interrupted line. Cilia white, bordered with grey. Hindwings fuscous drab, with veins darker. Cilia drab, with a dark line at base on a fine light grey line. May Orchard, Brisbane, 4 or 5 taken at light.

LICHENAULA DIRIGENS NOV. SP.

♂ 20 mm. Head, palpi, antennæ whitish grey. Thorax smoky grey, with a white dorsal patch posteriorly, bordered laterally with ferrous fuscous. Abdomen light fuscous drab, with a fine black line along either side of dorsum through posterior ⅚ to anal segment. Forewings elongate obovate, costa rounded, hindmargin obliquely rounded, white, freely dusted with iron grey, and thickly dotted with black and iron grey dots. Forewings with a fine iron grey line bordering basal fourth of of costa; a black spot at base of costa, subtending a second and smaller one and a grey diffusion to ⅛ costa; a black spot diffused with grey at ¼ costa, forming the edge of a semicircle of dots circling basal third of wing, parallel with hindmargin, and with a central dot nearer costa; a row of eight costal dots irregularly from base to apex; an irregular zig-zag figure ochreous grey, bordered and dentated with black or dark grey lines, from opposite ¾ costa to beyond ¾ inner margin, bordered posteriorly by a circular line of dots from sixth costal dot; a few scattered dots near inner margin; inner margin more or less diffused with grey; a conspicuous hindmarginal row of square black dots centred or barred with white. Cilia white. Hindwings whitish grey with darker toward hindmargin. Cilia whitish grey, with a central band of darker grey. May orchard, Brisbane.

LICHENAULA PROVISA, NOV. SP.

♂ 18 mm. Head, palpi, and antennae greyish white. Thorax grey white with a shading of fuscous dorsally anteriorly. Abdomen ochreous fuscous, with a band of ferrous on each of the anterior segments. Forewings elongate, bowed at base and obtusely rounded at apex of costa, hindmargin nearly straight, greyish white with fuscous specks, and markings black and fuscous. Forewings with a white blotch on base having a black spot on costa, and a black dash toward hind inner margin, bordered by a transverse row of black dots; a white diffused patch covers two-fifths of wing with an arched diffusion of dots and splashes longitudinally through centre to inner margin at $\frac{1}{2}$; a line of six spots from costa at $\frac{2}{3}$ to apex, becoming diffused into a fascia over posterior $\frac{3}{5}$ of wing, irregularly marked with fuscous black spots, and splashed with metallic copper; a white spur runs into this dark fascia half way across wing, immediately before anal angle; a subterminal grey white line. Cilia white with a central grey fuscous band. Hindwings ochreous white, with veins grey, shaded with fuscous along hindmargin. Cilia as forewings. May Orchard, Brisbane, at light.

LICHENAULA PETULANS, NOV. SP.

♂ ♀ 13—18 mm. Head, antennae, and palpi slaty grey. Thorax slaty grey, fuscous grey posteriorly. Abdomen light silvery grey. Forewings with costa rounded, hindmargin gently rounded, inner margin bowed before anal angle, slaty grey with silver specks and black dots, only discernible in special lights; subhindmarginal and hindmarginal black lines faintly defined. Cilia slaty grey barred with black. Hindwings silvery grey, darker diffused toward hindmargin. Cilia grey, with lighter line at base. May Orchard, Brisbane. Three specimens; at light.

LICHENAULA UMBROSA NOV. SP.

♂ ♀ 26—28 mm. Head black, face grey. Palpi and antennæ black, inclining in strong light, to iron grey. Thorax black or iron grey. Abdomen fuscous drab, with faint ferrous lines across base of anterior segments. Forewings elongate, costa rounded, hindmargin gently rounded, iron grey, with diffusion of whitish grey toward costa, and diffusion of black and iron grey toward inner margin, freely dusted all over with minute black scales. Forewings with costal edge bordered with fine black line from base to $\frac{1}{3}$, thence with white changing to grey towards apex. Cilia fuscous drab. Hindwings light fuscous drab. Cilia as forewings. One pair May Orchard, Brisbane. Allied to L. haplochroa, Turner, but a much darker insect, and the black head, &c., readily distinguish it. The shading from grey to whitish grey and white toward costa and to black and iron grey toward inner margin is most perfect.

LICHENAULA TORTRICIFORMIS, NOV, SP.

♂ 17 mm. Head fuscous drab. Palpi and antennae fuscous, Thorax grey, Abdomen fuscous with grey band at base of segments. Forewings costa arched, apex acute, hindmargin rounded, silvery grey, freely irrorated with fuscous and marked with red fuscous and black. Forewings with a costal row of blackish fuscous spots, or breaking into scattered dots from base to $\frac{1}{2}$ costa, but not touching costal edge ; a transverse ferrous fuscous fascia from $\frac{1}{2}$ costa diffused across wing, and shaded with scattered black dots and fuscous scales ; this fascia is diffused broadly and irregularly to apex, and more or less continuously over costal half of hindmargin ; numerous black dots and short fuscous lines on veins toward hindmargin. Cilia fuscous, pale grey at base. Hindwings light fuscous grey. Cilia as forewings. May Orchard, Brisbane.

CLENARCHA DRYINOPA. MEYR.

May Orchard, Brisbane.

XYLORICTA LYCHNOBII. SP. NOV.

♂ 21 mm. Head, palpi, and antennae white. Legs white, tarsi annulated with fuscous bands, posterior tibiae densely hairy. Thorax white, suffused with very light lilac posteriorly. Abdomen metallic grey with a *chandeliered* design of ferrous dots and spots posteriorly across the middle segments. Forewings moderately dilate, costa rounded, apex obtusely rounded, hindmargin obliquely rounded, white, suffused with a beautiful light lilac, and freely speckled with grey, the grey ceasing towards base, markings metallic drab. Forewings with a narrow costal line, creamy white, thinning out to apex, and finely bounded towards base by a black margin ; a curved circular metallic drab line of dots, interrupted in fold, from beyond $\frac{2}{3}$ costa to just before $\frac{3}{4}$ inner margin. thence anteriorly along inner margin, where it joins the angle of a triangular blotch and suffusion of the same colour, this triangle reaches to within $\frac{1}{3}$ of base, separating from the inner margin towards centre of wing, where it forms a darker apex to before middle of wing, posteriorly the base of the triangle becomes lighter tinted with ochreous. Cilia metallic drab with a whitish band through the middle. Hindwings ashy grey, tinted with ochreous, with the veins outlined with fuscous. Cilia ashy grey. The transverse circular line which runs to join the broken triangle of same colour on inner margin specially characterises this species. Brisbane, bred.

XYLORICTA AUSTERA. LUCAS.

(Tr. Roy. Soc. Dec. 11, 1898.)

♂ ♀ 24-35 mm. As I have this year obtained better specimens of this moth, I here append a fuller description. The thorax is creamy white, with three arrow triangles of ochreous fuscous ; the dorsal one is narrow, the lateral ones broader at base and bordered outwardly with fine blackish chocolate line. The segments of abdomen are creamy, shaded with ochreous along base, and a broad blotch of coppery ochreous on second segment. The forewings are cream colour, with chocolate fuscous longitudinal bifurcating bands, 1st along costa, 2nd from centre of base of wing, bifurcating at $\frac{1}{6}$, the inner branch to anal angle of hindmargin, the other toward costa ; this again bifurcates beyond middle of wing, the one branch to costa before and along apex, the other to hindmargin before middle ; 3rd, a border band from near base along inner margin, thinning out to anal angle ; a discoidal spot at $\frac{2}{3}$ and touching band to hindmargin ; a row of fine lines beyond and below this to hindmargin. May Orchard, Brisbane, at light, and bred.

TELECRATES TESSELATA, NOV. SP.

20 mm. Head black, forehead and face creamy white. Palpi ochreous fuscous. Antennæ fuscous. Thorax deep black, with a round white dot on either side and a larger one posteriorly. Abdomen ochreous yellow, faintly dusted with fuscous. Forewings elongate, costa gently rounded, hindmargin almost straight, black, with creamy white markings. Forewings with a large pear shape blotch of white from costa at base widening to inner margin ; a second cream white blotch from $\frac{1}{8}$ to $\frac{1}{4}$ costa obliquely outward to middle of wing ; a third blotch from before middle to $\frac{1}{2}$ costa as a band across wing, widening out beyond middle, and filling inner margin from $\frac{1}{2}$ to $\frac{3}{4}$, inner margin, edge rounded and finely dentate ; a fourth blotch to $\frac{3}{4}$ costa reaches half across the wing, posterior border twice dentate ; a hindmarginal narrow band drawn to a line to anal angle. Cilia cream colour, base shaded with fuscous. Hindwings ochreous yellow diffused with fuscous along hindmargin chiefly over apex. Cilia ochreous diffused with fuscous. Brisbane, one specimen at light.

PHYLOMICTIS ARCTANS NOV. SP.

♂ ♀ 14-16 mm. Head, palpi, and antennæ blackish fuscous. Abdomen grey, with fuscous bands at base of segments. Forewings ovate oblong, costa rounded, hindmargin straight, grey freely sprinkled with iron grey, and dark black lines along veins. Forewings with a black spot at base, thence a diffused black band of lines more or less welded longitudinally through centre of wing, diverting and spreading beyond cell to margin, also a large dark suffusion along costa, and a third along innermargin ; a black spot in disc, which is the centre, whence radiate black lines and dashes toward margins ; a sub-hindmarginal band of short black lines in interneural spaces. Cilia grey shaded with fuscous. Hindwings uniform light grey. Cilia as forewings. The suffused black forewings readily distinguish this species. May Orchard, Brisbane.

PHYLOMICTIS DECRETORIA. NOV. SP.

♀ 16 ㎜. Head pinky cream colour. Palpi pinky cream bordered with fuscous, terminal joint fuscous. Antennæ reddish fuscous. Forewings elongate obvate, costa rounded at base and apex, hindmargin rounded, creamy ochreous with reddish fuscous markings, and white between veins. Forewings with pink border along middle third of costa ; a median longitudinal band of deep red fuscous along wing to end of cell, where it bifurcates, and along its whole course gives off linear branches to costa and hindmargin, and is thickened toward inner margin by two longitudinal short bands which give off branches to inner margin ; the branches are given off as fine lines, and thicken proportionately as they approach either border ; between the radiated lines, the spaces are white ; the inner border is suffused with fuscous, and the whole wing more or less tinted with pink. Cilia grey fuscous. Hindwings light ochreous grey. Cilia same colour with a dark line at base. Brisbane. Allied to P. maligna, Meyr, but very distinct in median longitudinal band.

PHYLOMICTIS OBLIQUATA. NOV. SP.

♂ ♀ 18—22 ㎜. Head, palpi, and antennae grey. Thorax grey, sparingly and finely dusted with black, and with a dorsal black line and a shorter lateral black line, with a light ferrous spot posteriorly, on either side. Abdomen grey with ferrous fuscous patch on segments, but diffused in anterior segments. Forewings ovoid oblong, costa gently rounded at base and apex, hindmargin gently rounded, light grey, densely irrorated with fine black, and with longitudinal velvety black lines along veins, and outlining cell. Forewings with decided black line on both borders of cell, median branching into two, and giving off short lines, which are again united by a row of short dots and lines obliquely from opposite $\frac{1}{2}$ costa ; from centre of this short line a row of short or welded lines obliquely goes to apex, and a similar row from end of cell to apex of hindmargin ; a continuous black line along inner margin breaking up into dots along hindmargin ; along submedian vein a black line, a line parallel to and before inner margin, and a number of short lines form a line obliquely to apex. Cilia grey spotted with fuscous. Hindwings light drab with veins fuscous. Cilia light drab, with a darker and a lighter line at base. Allied to P. palœmorpha, Turn. Five specimens at light, May Orchard, Brisbane.

AGRIOPHORA CURTA, NOV. SP.

♂ 15 ♏♏. Head grey. Palpi and antennæ fuscous. Thorax fuscous black, with epaulettes white grey. Abdomen fuscous grey. Forewings elongate, costa rounded at base, hindmargin rounded, white, diffused with grey, with fuscous shading and fine black lines and dots. Forewings with costal line fuscous, a black line of dots from base of costa for a short distance along median ; a longitudinal fuscous suffusion with black lines irregularly scattered, nearer inner margin than to costa ; an outward semicircle of black dots at $\frac{1}{4}$ inner margin to median, this is continued along inner and parallel with hindmargin to $\frac{3}{4}$ costa, a curved diffused fuscous line with black dots from one third costa to middle of longitudinal median band ; hindmarginal line fuscous. Cilia grey with fuscous dots. Hindwings witish grey, with veins darker grey. Cilia as forewings. Brisbane, at light. Near A. poliopepla, Turn., but much more marbled and has several black scales.

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PREVENTIVE MEASURES AGAINST THE SPREAD OF TUBERCULOSIS.

By E. HIRSCHFELD, M.D.

[*Read before the Royal Society of Queensland 24th February, 1900.*]

THE discoveries of the last twenty years have established two important facts with reference to pulmonary consumption. The disease, which up till lately had been considered always to end fatally, has been proved to be curable in almost any stage; moreover, with patients suffering from it in the first stage recovery is the rule in the vast majority of cases, especially in places, as in Queensland, where favourable climatic and social conditions come to the assistance of the patient. The second fact, which has been brought out by the researches of Robert Koch, Cornet, Flügge, and others, is that pulmonary consumption can be prevented by the adoption of precautionary measures. Of course, it is absurd to expect that such a result can be achieved without considerable sacrifices on the part of the community and individual. But we must keep in mind that the sum total of deaths occasioned by this disease is very much greater than all the losses sustained in wars, and remember, that the individuals affected by it represent frequently the brightest and best intellects in the country. The campaign initiated against the spread of tuberculosis, ever since Koch discovered the infectious nature of the disease, will not be given up till we have succeeded in stamping out the disease in man and beast. This is not likely to happen within our generation, but we ought to put our shoulder to the wheel in order that we may achieve our full share in it. In dealing with this question, as far as it confronts us in Queensland, we must beware of following too closely in the footsteps of European hygienists, as the vastly different climatic conditions of a sub-tropical and tropical country demand that the subject be dealt with, if I may express myself so, from a local standpoint, based upon our practical experience of the effects of the climate, social conditions, alteration of the qualities of the race, &c. I therefore propose not to enter into an exhaustive discussion of the prevention of pulmonary consumption, and retail to you the stock of knowledge contained in the most recent handbooks of preventive hygiene, but limit myself to those aspects of the question which have presented themselves most strongly to my mind during a ten years' experience of the disease in Queensland.

Is Compulsory Notification Necessary?

The trend of public opinion of medical men in Great Britain, and especially in the United States, has been towards some form of compulsory notification of every case of pulmonary consumption. The opinion expressed by German authors at the last Tuberculosis Congress at Berlin, eight months ago, was less decisive in the matter. If carried out in its entirety, it would mean that the medical man who was called to see a consumptive patient would have to report the case to the authorities, as we do at present with scarlet fever. They (the authorities) would then take the proper measures believed to be required against the spread of the disease. At the first view the suggestion seems to commend itself. The duties are delegated to a central authority equipped perhaps with the most modern knowledge and the most modern means of dealing with the spread of infectious diseases. But as far as pulmonary consumption in Queensland it concerned, I see most serious obstacles in the way of carrying out such a measure of compulsary notification. In the first instance we must remember that we have to deal not with an acute disease like scarlet fever, which is over in a few weeks, but with an illness that lasts for many years. To place all the patients so affected under constant supervision for a number of years would entail an enormous expense; besides it would be absolutely contrary to the instincts of every free man. Moreover, Queensland is so large, the population so scattered, that an efficient supervision could not be carried out. Notification would interfere with the consumptive earning his living. During the greater part of his illness he is able to follow his occupation. Reporting him to the authorities would brand him as dangerous, and he would most likely lose his employment.

Apart, however, from the injustice inflicted upon the consumptive compulsary legislation would defeat its own object, and I think considerable stress must be laid upon this point. For the proper disposal of the expectoration, the chief carrier of the infective agent, the turbercle bacillus, we must rely upon the willing co-operation of the consumptive patient. No amount of supervision could look after this as effectually as the properly educated phthisical patient. If we harass him by unnecessary restrictions, is it likely that he would take much trouble to protect the community against the danger emanating from him when the community protects itself by persecuting the consumptive on account of his affliction.

The Disposal of the Sputum.

The consumptive patient himself is in nowise dangerous, the real danger lies in the sputum which he expectorates, which carries millions of tubercle bacilli. Researches published in the last year have shown that the bacillus does not thrive outside the body ; even when cultivated on special nutrient soils it loses its virulence to a certain extent. Still the dried sputum retains its infectious qualities for a considerable time. The dust of our streets is, however, hardly ever dangerous since exposure to direct sunlight kills the bacillus within very short time. The best way of fighting against the spread of tuberculosis is to render the expectoration innocuous as soon as it leaves the patient. It should be deposited in a spittoon which can be easily cleaned and contains some antiseptic solution, or into a portable bottle, or lastly into the handkerchief. I should like to suggest, that our authorities set a good example in public hygiene by providing suitably appointed spittoons in all public buildings. Even our splendid Treasury building would not be disgraced by a liberal number of these vessels. Schools, churches, theatres, waiting rooms, and all public rooms, and conveyances should be similarly fitted up. I am sure business people of their own accord would readily follow such a good example for the benefit of their employees. The habit of spitting upon the floor is not only disgusting but dangerous, and should be put a stop to whether the man is suffering from tuberculosis, or any other disease, or from none at all. I fancy many an office will find it to its advantage to supply spittoons for their employees as suggested, more particularly during an influenza epidemic.

Education.

Knowing the danger of infection and how it is carried about almost amounts to being able to avoid it. But how is the great mass of people to know? We cannot put a policeman behind everybody to see that he does not expectorate on the floor. The best means of spreading information to the masses is provided by our educational system. Why should not every boy be taught in the public school the salient features of this part of hygiene, how far it is in the power of everybody to prevent the spread of infectious diseases generally. Above all let him be taught that it is criminal to endanger the life of his fellowmen by careless expectoration. A habit thus early acquired is likely to persist in after life.

Houses.

It is not likely that hygienic principles will be exclusively followed in the building of houses. On the whole we are rather fortunate, as far as the spread of tuberculosis is concerned, that most of our private residences are wooden buildings. A brick house, the walls of which are papered, is more difficult to disinfect after having once been inhabited by a consumptive than a wooden building. It is also a consideration, that the latter has a far shorter life than the former, especially when we remember the experience reported by certain authors, who found that certain houses formerly inhabited by consumptives were regular death traps for subsequent lodgers. Having regard to the great disinfecting power of direct sunlight, it is of importance that the sun should have access to the bedrooms during some part of the day. As wood does not retain the heat so much as bricks, the temperature of the bedroom will not be unduly increased in consequence. The difficulty of disinfecting the papered walls of a room could only be done away with by varnishing the paper. A very important research has been published a few months ago by Heimes, from Löffler's laboratory. It is of great interest for us. He investigated the disinfecting power of different kinds of paints, viz., oilpaint, enamel, distemper and limewash, with the result that bacteria were most quickly killed by oilpaint, while distemper proved least efficient. He found the antiseptic power of oilpaint = 100; enamel = 40; limewash = 20; distemper = 10. Oilpaints should therefore be chosen, where ready disinfection is an object, as in hospitals, schools, public buildings, etc. The antiseptic qualities of the oilpaint are both mechanical and chemical, the latter probably due to the turpentine and the action of the atmospheric air upon it leading to the formation of ozone and peroxide of hydrogen.

Bedding.

Infected bedclothes form one of the readiest means for the spread of pulmonary consumption. Time after time I have had occasion to draw the attention of patients and their relatives to the seriousness of the matter, especially since in the last few years so many consumptives have gone up to Roma, and other places in the West. The whole matter has become a source of grave public danger. A tubercular patient will occasionly expectorate during sleep, without being quite conscious of it. It is therefore almost impossible to prevent that pillows slips should become saturated at places with tubercle bacilli. Pillow slips, of course, are changed, and the ordinary boiling they undergo in the wash is a fairly sufficient protection. The pillow covers, however, are not changed, and if a consumptive with profuse expectoration has slept several nights the cover always contains bacilli. Now anybody else, say in a hotel, sleeping on the same pillow, the moiscure of his breath will again moisten the dried sputum of the cover and the fresh pillowslip becomes resaturated from it. The man sleeping upon it will be in the most suitable position for inhaling tubercle bacilli, or for the matter of that any other infectious germs which might have been deposited. A more ready way of contracting consumption it is difficult to imagine. This also applies to a certain extent to the blankets which can only be washed with lukewarm water. Without in any way desiring to impugn the cleanliness of their proprietors, I feel convinced that any man sleeping in a hotel or boarding house at Roma runs a very appreciable risk of infection. What can be done to guard against this source of infection? Steps must be taken against such a serious public danger. A rather primitive but fairly efficient way of killing the bacillus is to expose pillows and blankets every morning to the sun. The strong insolation in our western plains can be relied upon to destroy all the tubercle bacilli which are on the surface. On the other hand the antiseptic power of the sun does not reach below the surface into the kapock. My suggestion is that the ticking used for pillow-covers be treated in such a way that it becomes non-absorbent and impermeable for liquids, and that only such materials be used in hotels, boarding-houses, sleeping-cars, and similar places for pillow covers. Especially with reference to influenza, even more so than tuberculosis, the adoption of such a method would tend to prevent the rapid spread of the disease. The covers thus impregnated could readily be disinfected either by exposing them to the sun or washing them with some antiseptic solution.

Disinfection.

An absolutely necessary condition for an effective contest against the spread of tuberculosis is the facility for disinfection. Effective disinfection of infected furniture, clothes, bedding, etc., can only be successfully carried out by trained men in public disinfecting chambers. These disinfecting chambers ought to be established in every municipality of a certain size. They are as much a necessity as a hospital, to which they might be conveniently attached. The increased cost would be made up by the lessened number of patients suffering from infectious diseases. We have in our Ambulance Brigade a good nucleus of men who could be trained in the methods by which proper disinfection of the different articles is carried out. The disinfecting chambers must be of the most modern description, so that the articles to be disinfected be not damaged, neither should they be handled by untrained men. A moderate fee charged for the disinfection would very soon recoup for the outlay. As things stand at present infected furniture, bedding, clothes or other articles are either burned, if they are of low value, by conscientious people, or they are more or less successfully disinfected, or what is most frequently the case, they are sent to the auction room spreading the infection to whosoever has not got the money to buy new things. Second-hand books are a frequent source of infection. Wetting the leaves in turning them over impregnates the book with the bacillus, which remains there for the purchaser. As we ought to look to our public bodies for a good example, may I suggest to the railway authorities that the cushions on the seats of the carriages, especially the sleeping cars, should be made removable, so that they may be readily disinfected if the necessity for doing so arises. The substitution of linoleum for the footmats formerly in use has already been a step in the right direction.

The space at my disposal does not allow me to deal exhaustively with the whole subject in one paper. I could only touch upon a few points. I do not wish to raise any unnecesary alarm, but really people ought to be made to think. It is pitiful to see almost daily fine lives that simply have been thrown away through sheer ignorance. But a brighter future is in store for us. Since the discovery of the tubercle bacillus and the modes of infection, the efforts for the prevention of consumption have led to an appreciable decrease in the mortality from the disease during the last 15 years. Man, not Nature, has created tuberculosis, and it behoves man to retrieve the errors of the past.

NOTES ON SOME MODERN EXPLOSIVES.

By T. McCALL,
Assistant Government Analyst.

[*Read before the Royal Society of Queensland, 17th March, 1900.*]

EXPLORATION IN WESTERN AUSTRALIA.

(WITH MAP.)

By FRANK HANN.

(COMMUNICATED BY MAJOR A. J. BOYD, F.R.G.S.Q.)

[*Read before the Royal Society of Queensland, 7th April, 1900.*]

I MADE two journeys to the north-western interior of Western Australia, where it was my intention to take up and stock any good country which I might meet with in the course of the trips, or rather, on my second trip, which I propose to describe more fully than the first, the latter being merely what may be described as a preliminary canter. I left Lawn Hill, on the Gulf of Carpentaria, on the 1st April, 1896, and travelling across to Western Australia without any unusual experiences, crossed the overland telegraph line in South Australia at Newcastle Waters. My party consisted of one white man, six Queensland blacks, and sixty-seven horses, nine of which belonged to my white companion, who went with me as far as Roebourne (W.A.), where we parted company, and from that time I had no white man in the party, but the Queensland black boys behaved well and rendered me many valuable services. After leaving the telegraph line, I made for the Victoria River, and on reaching it I ran it down as far as Victoria Station, which is situated on the banks of the Wickham, a branch or tributary of the Victoria.

At the Victoria Depôt I was able to get some needed rations, which are regularly brought there by the steamer from Port Darwin. The boat runs up the Victoria River to a point about ninety miles from the coast and eighty from the Station. Leaving the depôt, I struck the Baines River, a tributary of the Victoria, and followed it till I arrived at Avern Station. On the Victoria I saw a celebrated baobab tree, which was marked by Mr.

A. C. Gregory in 1856. In appearance it somewhat resembles a gigantic bottle tree, the head bulging out into a huge ball-like top, with branches straggling out of it in all directions. This tree was about 100ft. in circumference at the base. After leaving Avern Station, I ran the Baines River to the head. I should have said that Avern is a very well-watered run. A boat can come up the river to within four miles of the head station, and land goods direct from the deck into a dray at the bar crossing the river, the water being there deep enough to allow the boat to lie close to land. My course now lay over the range, and during the day I struck a creek which joined the Negri River about seven miles from its junction with the Ord River, which latter flows into Cambridge Gulf at Wyndham. I followed up the Ord by way of Flora Valley to Hall's Creek, and thence passed by Mt. Dockerell (a deserted gold camp), over sixty miles of poor desert country, where I got water, however. This is in the Kimberley district, in the midst of a gold-producing country. As I stated, I got away 60 miles to the south of Mount Dockerell, where I left most of my horses, and, taking three of my black boys and sixteen horses, I made on attempt to get through the desert to try to find a track to the head of the Oakover. The attempt nearly resulted in fatal disaster. We watered the horses at 1 p.m. on Saturday, and from that time till Tuesday morning we found no water. My one chance of keeping life in the unfortunate animals was to give each a pannikin of water from our precious supply in the water bags. We poured the pannikin of water into a plate, and allowed them to lick it up. It was a pitiful drink; but it wet the poor brutes' mouths, and was the means of saving their lives.

Finding it of no use to persist in my object, I turned back, and on reaching Christmas Creek, after giving the horses a needed spell, I ran the creek down to where it joins the Fitzroy. This is good country, and I found stations all the way down the Fitzroy. The Quamby River flows into King Sound. Mr. E. Rose's station is the first station met with on the Fitzroy. I met with great kindness from the squatters all along the line. I now followed the river down until I struck the telegraph line from Derby to Broome where the cable goes to Banjoewangie. Broome is a beautiful little place, and a great pearling station, much like Thursday Island, and population much the same as of that Island. Then followed the dreary 90 mile beach along an open plain, all sand, where water is obtained from a series of Government wells, which are, on an average, 20ft. deep. The water is fair in many of them, but for want of constant use has become stagnant in a few. However, we got along very well in spite of the eternal red sand and, having passed the 90 mile beach, arrived at Condon, eighteen miles from De Grey's station, on the De Grey River, named by the late F. T. Gregory. Then passed several stations before reaching Roebourne. All the settlers get water out of wells, all worked by blacks. At Roebourne I only remained long enough to replenish the ration bags, and then followed the Fortescue River up to the head, whence I struck north-east to the Narradine gold diggings. Now came another dry trip out into the desert country to the head of the Oakover, after crossing which I met Mr. Rudall, who was out looking for some members of Wells' expedition who were lost. Before I met Rudall, I had named a river, which I had struck about 100 miles north-east of the Oakover, the Rudall. Certainly, I was not the first to see it, but as I knew it had not been named, thought myself entitled to give it a name by which it might be known on the map, and it has since been charted on the official maps under that name.

It is a peculiar stream, rising inland towards the west and losing itself in the desert towards the east. It is remarkable that there are no fish to be found in it. This little deviation completed I returned with my party to the Narradine, crossed the Oakover and went out to Mount McPherson, which was named by the late Mr. F. T. Gregory, who nearly perished in his expedition of 1861, having lost all his horses, had to walk back to their main camp, where he had only three horses left. I then set about erecting a trigonometrical cairn on Mount McPherson.

I had already lost several horses. Some died from poison bush and from other causes, three had their thighs broken owing to being kicked by other horses, one broke its shoulder by a fall, another broke its leg, two got their feet entangled with the spare hobbles round their necks and had killed themselves in their struggles. These were the saddest cases I have ever witnessed. Unable to extricate their feet they had evidently thrown themselves violently about during the night. One of them had torn his eye out and was fearfully lacerated about the head. To make the loss still greater, after leaving Mount McPherson, I came across a small water hole at the head of the Oakover. Thinking to refresh the animals I put them in for a swim, and six were drowned. This event disgusted me with the trip, and I was about to return to Queensland, when at Derby I met Inspector

Ord of the police. He advised me to go out to Mount Broome, at the foot of the Leopold Range, and prospect for gold, where diggers were getting very fair returns.

I left Derby with six Queensland blacks, thirty-one horses, and two dogs, and arrived without any misadventure worth mentioning at Mt. Broome. I crossed the Leopold Range at the west side of the mountain, which I and my party ascended with great difficulty, owing to its steepness and roughness. During the ascent, two of my pack-horses fell and smashed the pack-saddles badly. Whilst we were repairing damages, we suddenly were surprised by hearing cooees from the wild blacks above us. Not wishing them to become acquainted with the smallness of my party, I directed a few rifle shots towards the voices, which had the effect of stopping the approach of the enemy. Arrived at the summit, I found, by my aneroid, that the height was 1,800 feet above the level of my camp at the foot of the mountain, whilst the range is but 1,000 feet above it. As may be seen by the map, the Lennard River or Creek lies at the back of Mt. Broome to the west. It is a splendidly watered creek, and there are a few patches of really good cattle country, averaging about three miles in width, bordering it. In some places, the range comes right down to the Lennard. On the north side of this creek, there is another big range, not quite so high as the Leopold, but nearly as rough. We managed, however, to negotiate it, but our greatest trouble was getting down again on the other side. It was a pretty break-neck descent, but we reached the bottom without casualties.

Here I found another splendid running creek, and the surrounding country much resembled that of the Lennard, but it occupied a greater breadth. On the north side of the creek there is a range so precipitous as to be absolutely impassable. Finding I could not cross it on the east, I skirted it for about five miles in a north-west direction, until I found I was approaching the end of it. Here I was able with difficulty to make the ascent, but I was well repaid for the arduous task of climbing its rocky sides. In the distance, about five miles away I observed a range, not very high, but what might be called a regular "terror." Its sides were entirely composed of large, flat, slippery rocks, on which no horse could have found a footing.

I forgot to say that I named the aforesaid creek the "Bell," after Mr. Bell, of Derby. I could not then ascertain what river it flowed into. It is certainly not into the Lennard. This point, however, I afterwards cleared up.

From my position on the range, I could see that the country was open to the east. I therefore travelled in that direction, and in six miles came to a fine running stream emerging from the big, rough range. There was some really first-class cattle country here. Two miles further saw us at the end of the first range, but the precipitous one before mentioned, was still on my right and stretching away east-south-east. The spring-like creek where I crossed it, flowed towards the south, and after a meandering course of three miles made a sudden bend, returning again towards the north.

Near the place where I crossed it for the second time was another running spring. The two creeks are not more than two miles apart, and there is no range whatever. I observed that the country opened out and dipped towards the south-east, so I ran the creek towards the north for about ten miles and then camped. All the conntry round these streams is excellent cattle country, consisting of small plains and open forest. The formation is basaltic, but the country is not stony. The water on which we camped was evidently not permanent.

Looking out towards the east-south-east of my camp, I noticed a high, precipitous, table-topped mountain. On breaking up camp, I travelled towards it for four miles, and then came to a divide. (There is no range whatever on the north-west fall). Riding down the gully, I came upon a fine running spring, with stony basalt hills on each side, splendidly grassed, and no spinifex. Continuing the same course for about two miles, I traversed some rather rough country, after which it opened out again into plains. Seven miles further on I discovered a magnificent running spring, flowing south-south-east, containing a large quantity of fish. The big mountain was still about two miles ahead of me. Being in a favourable position for grass and water, I decided to camp. I then went off to climb the mountain. From the summit I could descry another high, precipitous, table-topped mountain, bearing south-south-east fifteen miles on the left bank of the creek. The creek I named the "Adcock," in compliment to Messrs. Adcock Bros., of Derby, who were very kind to me and proved exceedingly reasonable in the important matter of a supply of rations.

The big isolated mountain I have named "House," after Dr. House, of Derby, to whom I was indebted for much kindness and assistance before I started on my trip. Viewed from any point, it stands out as a prominent mountain.

On the following day, I went in the opposite direction to the creek three miles below my camp. The creek, the head of which I had seen before, I now found to flow into the Adcock, near a range on the west side. This range, although not the actual main precipitous range I have mentioned, forms a spur of it. The surrounding country is very good, being well-grassed and watered. The country along the creek for about a mile, is very rough, but it soon opens out into beautiful small plains, dotted with pink lily lagoons on the western side. The main range lies about two miles to the back.

I now came upon the big mountain I had seen from Mt. House. It descended right into the Adcock on the left bank, and trended thence east by south. It much resembles Mt. House, but is not so isolated. I have named it "Clifton," after the Under Secretary for Lands at Perth. It appears to come very close to the creek on the east side for some distance, and the main range lies four or five miles back from the stream on the west. All between is splendid cattle country. About ten miles from Mt. Clifton, the creek appeared to vanish in a a gorge. Crossing the creek above Mt. Clifton, I went back, then crossed again to the west side, where I found a large creek coming in from the north-north-east. It has no running water, but there are some splendid water-holes in the reaches, whilst all the country is magnificent from a squatter's point of view. The main range is distant fifteen miles from this spot.

The creek I have named the Edkins, in remembrance of my excellent good friend Mr. Edkins, of Mount Cornish, North Queensland. Here, and on the Adcock, I met with large numbers of blacks, but they were as wild a lot as I ever saw and were quite unapproachable.

I now travelled to the N.N. West, crossing the Adcock, and after proceeding some 10 miles struck another splendid running creek going south west. It appeared to take its rise in the ranges 10 miles above us. There is magnificent land on either bank. The banks are low, yet the country has no appearance of being subject to floods. The land, grass and timber are good, and in the creek there is an abundance of fine fish. Forming a camp, I went to the top of a hill close by, and obtained a good view of the surrounding country. I saw that the range intercepted the Adcock, and the creek last discovered. I therefore went back to my previous camp, and next day crossed the creek, tracing it to my present camp. I noted that for the whole distance, the country is of excellent description for stock raising, as indeed is the whole country about here. It was long after dark when I got back to camp. I was quite alone, and must say that it is not quite the safest thing to go out by oneself in blacks' country, even although well armed. Still next day I again set out alone to run the creek down, and sent my party along the north bank whilst I traversed the southern one.

After travelling about eight miles, I found that it ran into the one at the head of which I had camped on a previous occasion. I have named this creek the McLarty, after Mr. McLarty, of Nullagine, in recognition of his many good offices towards me. The big creek I have named the "Isdell," after Mr. Isdell, of the Nullagine, for the same reason. For ten miles the Isdell runs through ideal cattle country, with a few basalt hills. Then it flows into a terrible gorge, which is naturally impassable. Finding a splendid camping ground, I determined to remain here for one day to look round me. The blacks were exceedingly numerous, but whenever one of our party came into view they fled. On the very next night, they came up and made a fire on the slope of Mt. Isdell. My boys declared they saw two blacks walk between us and the fire, but this I doubted for the blacks' camp was too far away for exact observation of their doings. Still I thought it well to be on the safe side, so I had the fire put out and extinguished my lamp, for we formed too good a target for stray spears with these both alight. Having had a good look at the country for several miles round my camp I came to the conclusion that such country was much too good to lie idle as a mere hunting ground for wild blacks, so I packed up and set off for Derby with the intention of taking it up.

I took a S.S. East course and travelled along, skirting the high, rough range on our right, which I have called the Isdell Range. After 10 miles of pretty smart travelling I struck the McLarty at a splendid spring, then ran the creek up 3 miles and came across my *outward* tracks. Seeing no other or better way of return, and not wishing to lose time in finding another pass, I retraced my old tracks, intent only on getting to Derby as fast as I could that I might not be forestalled in taking up the grand country by anyone else who might perchance have got wind of it.

I think the Isdell is the head of the Glenelg, and the Adcock either the head of the Fitzroy or a branch of it. We had found the second range so rough on our return journey that I thought I could not go wrong in trying for a better track. As it turned out the old proverb "The longest way round is the shortest way home" once more proved its truth. Here a basalt dyke cuts through the range, so I ran the gully into a fearful looking gorge. I think this is about the strangest part of Australia. On one side, only a few hundred yards back, there is a range over 1000 feet high and as rough as possible, with the creek running through the aforesaid ugly gorge. Then appear rippling streams, lagoons, and small grassy plains as good as any in Australia, and in contrast with these charming spots the rough, wretched ranges surrounding them.

I decided to camp in a pretty spot on the creek, and as soon as all was settled my boys amused themselves by rolling big stones into the gorge, down whose precipitous sides the boulders rushed, bounding into the air, crashing through the brushwood and finally crashing in a thousand pieces on the rocks below. It was great fun for them, but I had to find a way out somewhere. Fortunately there was no sign of any blacks being about, although I saw plenty of their tracks. Perhaps the roar of the rocks rolling into the gorge made them believe that "debbil debbil" was about and they had better keep close. Striking camp early next morning we passed along a stretch of country only a few hundred yards wide, having on one side a range 500 feet high and on the other one of over 1000 feet.

I named the camp we had just left "Eva Camp," after Mrs. Broadhurst, of the Pyramid, Roebourne, and the pass we were then in the "Broadhurst Pass," in recognition of the family's courtesy to me. After we had negotiated some 3 miles of the pass we reached a large running creek coming out of one of the gorges and entering another. Whilst I was examining this I heard a black cooee in the range to our left, a couple of hundred yards off. About a minute afterwards a great number showed themselves, all armed with spears and making a tremendous row, at the same time running towards us. As they looked dangerous, and outnumbered us probably by fifty to one, I let go a few shots to try and stop them, and told the boys to be quick about getting out a supply of cartridges, which were in the pack bags. I could see that the blacks were determined to take advantage of what Julius Cæsar called, "the inferior position." It was certainly a very dangerous position, for the blacks were high above us, and we were utterly ignorant of the way out of the gorge. The shots I fired had the effect of blocking them for a time, so I went alone down the creek below the second gorge, thinking we could get through there. As it looked feasible, I shouted to the boys to bring on the horses as quickly as possible. We passed under a wall of rocks, where the blacks had all got above us. Had they chosen, they could have either speared or stoned us all to death without our seeing them or being able to retaliate. However, we managed to pass the horses into a clear spot, where they were safe from missiles. All this time the blacks were yelling, and evidently drawing nearer to us. I fired a few more shots on chance, and then went to look for a place where the creek was crossable. Seeing that it entered a third gorge, I tried to cross, and at once got my mare bogged in the mud, amidst reeds which rose high over my head. Dismounting, I succeeded in getting her out. Then I tried another place, with the same result, except that this time I was compelled to leave my mare and struggle out as best I could through the reeds between the rocks. The mare extricated herself at the same time. I saw there was not a moment to lose, as the blacks were closing on us in great numbers, so I shouted to the boys to bring along the horses and put them across the boggy creek as best they could. We got them through all right, but my mare on again trying to carry me over fell, and I got a thorough ducking. At last, however, we were all over in the open country. I did not seem to care much about our danger at the time, but had the blacks got on the rocks above us whilst we were floundering in the creek, some of us or our horses would undoubtedly have been speared.

Our next proceeding was to roll some stones away to enable us to get to the Lennard from the Leopold Range. We had a deal of trouble here, as the horses would not follow, and were continually getting into trouble. However, all things come to an end, and at last we pitched camp on the river, and finally arrived safely at Derby. I then wired to Sir John Forrest, asking that Inspector Ord might accompany me to report on the country I had found. Sir John handed my telegram to the Commissioner of Police, who at once instructed Mr. Ord to accompany me.

There is a very high, bold bluff on the McPherson Range which I have named the "Bold Bluff." It lies seven miles from the west end of Mt. Broome. After passing Bold Bluff, Mt. Broome cannot be seen from any position east of north, for Bold

Bluff shuts it out, and a north-east line from Mt. Broome will pass right through the middle of the good country. My next business, on leaving Derby, was to see if I could find a dray track to a port, and to see if there was any more good country, but found I should not be successful by taking the Leopold Range *en route*, so I determined to try to find one to Secure Bay. I now returned to the west end of Mt. Clifton. For ten miles down the creek the mountain reaches to within one mile of the creek (Adcock) on the north-east side, and the main range to within three miles on the south-west side. All between is good cattle country. There is a most singular mountain commencing here (where Mr. Ord, who had accompanied me from Derby, left me). I have named it Mt. Hamilton, after Mr. Hamilton, who was with Mr. Ord. I also named a big mountain after the latter gentleman.

Looking at Mt. Hamilton one would almost take it to consist of a single mountain. At each end there is an isolated bluff about 600ft. high, precipitous on all sides, and between these lies the main mountain, also very precipitous, about four miles long, but only a quarter mile wide. At the upper end of the range, the Adcock takes sharp turns to the south-west, so that the Hamilton is between the Adcock and Mt. Clifton. I left it on my right. In four miles I came to the south-east end of Mt. Clifton. Here there are two peculiar peaks, which I have named the Estaughs, after Mr. Estaugh, of Derby. The Adcock now runs south-east. The main range, about a mile off, is here quite impassable. Some six miles from Mt. Hamilton I crossed a large creek, one might really term it a small river, flowing from the north-east. This I have named the Throssel, in honor of the Commissioner for Lands, who has written a very sensible, useful little book on "Advice to Selectors."

Going forward another four miles I reached another very fine creek, running strongly, which, in honour of Mrs. Cunningham, relict of the late Mr. E. Cunningham, of Woodhouse, Queensland, I named the "Annie." Another four miles brought me to the junction of the Adcock and the Fitzroy. Half-a-mile below the junction the river enters a gorge, which appears to be fairly open, but terribly stony, with very high ranges on either side. At the head of the gorge there is a splendid water-hole. There is a little very good country between the rivers, but it is very little. A high and impassable range runs north-east and south-west on the south-east side of the Fitzroy. The river looks at this place as large as where I struck it at its junction with Christmas Creek. The high range I have named the Sir John, in honour of Sir John Forrest, K.C.M.G.

Another high, table-topped mountain, to which I have given the name of Mt. Brennan, after Mr. Brennan, of Derby, lies between the Annie and the Roy. All the country here is very stony. I may mention that, as I went along from mountain to mountain and from river to river, I took bearings by the prismatic compass wherever it was possible to do so, so that their relative positions may be laid down fairly correctly on the map.

As we were descending the slope of Mt. Brennan we heard the blacks cooeeing in our immediate vicinity. My packs I had left at Roy Creek, close to the foot of the mountain, which we reached without being molested. But whilst we were at dinner, two blackfellows made their appearance. I knew it would never do to let them see the strength, or, rather, weakness, of my party, for I only had my six Queensland boys (one of whom shortly afterwards died, to my great regret), so I fired a few shots over their heads, and they beat a rapid retreat to the mountain. The blacks appear to be very numerous all through this country, and it behoves the traveller to be constantly on the look out for them.

Ten miles past the gorge I was able to turn the range, and here, about Roy Creek, I found some really good country.

I now directed my course east-south-east, and in six miles came again into the Sir John Gorge. It is a most romantic looking place. You can ride your horse right to the edge and drop a stone plumb, a sheer drop of 200 feet, into a magnificent lagoon, formed by the widening of the river. In shape, this gorge resembles a boomerang. To get completely round the range I had to travel four miles in a north-west direction, having splendid cattle country on my left. Once round, I shaped my course south-east, and after travelling six miles I arrived at a fine river coming from north-north-west. At a distance of about a mile south-east of where I struck it, it forms a junction with the Fitzroy, about half-a-mile above the Sir John Gorge, which at this spot appears to have been cut by the action of water through the solid rock. I now left my camp, and went up the south-east side of the Fitzroy. The Sir John Range I observed to lie at a distance of about a mile from the river all the way. As for the country, it is tolerably good, but fearfully stony, rolling basalt predominating.

I followed the river for ten miles, and found that it came out of another gorge, impassable, but nothing to compare in wildness, ruggedness, and savage grandeur with the Sir John Gorge. To the former I gave the name of Warton Gorge, after Mr. Warton, Resident Magistrate at Broome. The range here I found trending to the north west. To it, also, I have given the name of Warton. Subject to Sir John Forrest's permission, I have called the high range on the south-west of the Adcock the Lady Forrest Range.

These ranges form three sides of a gigantic square, through which I think it would be possible to pass to the left of the Warton Gorge. Far away up the gorge is a bluff range, and judging by the look of the formation of the hills in that direction, I think that good cattle country is pretty sure to be found there.

On my return I took the opposite side of the river Fitzroy, and I could see in the back country some small plains, splendidly grassed, and not so stony as that last seen. Both these rivers are large and appear to be much of the same size.

At the point where I first struck the river, I found a tree marked "R.B. 44," by Mr. Robert Buttons, the 44 standing for the 44th camp. He has been a great traveller and explorer, and it is a pity he has not published any account of his explorations in these regions, for he is an excellent man for such work.

The river from the north-north-west falling into the Fitzroy, which I had just discovered, I called the Phillips, in recognition of the assistance afforded to me by the Commissioner of Police, and for which my best thanks are due to him.

I now ran the river up, and after going seven miles I dropped on a third river flowing from the Warton Range, and promptly assigned to it the name of Traine, after Mrs. Traine, of Condon, as she was the first native born Western Australian I had ever met, and a very nice, pleasant lady I found her. I ran this river up, and found that, as per usual, it came out of one of those tantalising, impassable gorges, where I also found numbers of blacks, who proved to be exceedingly wild. I then got back, and running the Phillips up, found that at ten miles from its junction with the Fitzroy the Warton Range came down to it, whilst there was a chain of stony hills running along its left bank for about six miles, when they break off. The river at this place is a quarter mile wide, and I doubt if in all Australia there is a river better adapted for watering stock. It is always running with clear water, has low banks, no bogs, the margins solid sand, and the stream opening up every now and then into large water-holes, all of which are full of crocodiles, a harmless species, about 6 to 8 feet long, which live principally on fish. Travelling about twenty miles up this beautiful stream I saw, about half-a-mile from it, on the left bank, a splendid small lake, about three miles in circumference, nearly round, and very deep. This I have christened the Gladstone Lake, after the late Mr. W. E. Gladstone, Premier of England. On the lake, and on the river, I found geese, ducks, water hen, and many other kinds of game in abundance.

The country about the river is rather sandy, but back from the river, towards the south-west, there are splendidly grassed open plains.

The remarkable thing about Gladstone Lake is that no river runs into it, nor has it any visible outlet. In all probability it is fed from underground sources, and supply and evaporation are probably equal.

This is the most astonishing country for rivers, creeks, and lagoons. They intersect the whole country, and would be an immense boon to the more arid and rainless tracts eastward towards South Australia and Queensland, but it is difficult country to get at, at any event, over the Leopold Range. The Warton Range breaks away a little here, and I think a pass could be found through it by which Hall's Creek could be reached.

We now came to the commencement of another mighty range, running east and west. This I have named the Phillips Range. To a large creek coming out of the Warton and Phillips Ranges I have given the name of M'Namara, after Mr. M'Namara, of Wallal (Ninety Mile Beach). So far the river runs from north-west by north.

By aneroid I found Lake Gladstone to be 750 feet above Derby, the Fitzroy 700 feet, and Phillips Gorge 800 feet.

There is very fine timber on the river for station work. It consists mainly of coolibah, box, plum, gum, and magnificent bloodwood, bauhinia, currajong, and baobabs, which are really splendid. I measured a solid one, which rose perpendicularly to about 100 feet. I found it to be nearly 15 feet in diameter and 45 feet in circumference. On the plains mimosa predominates.

Forty-three miles from its junction with the Fitzroy, the M'Namara River comes out of one of the usual impenetrable gorges in the Phillips Range, which is very high, very rugged, and I think impassable. There is a splendid water-hole at this gorge, and eight miles below it I found a large creek coming in from the north-east, which I have called the Urquhart, after Mr. Urquhart, of Lagrange Bay.

I took a number of bearings from the top of a pretty little mountain situated two miles below the gorge. This I named Mt. Caroline, after my late sister. Here a most splendid creek comes in from the west at the south side of the Phillips Range, with clear, permanent, running water. The country on its south side is by far the best I have yet seen in Western Australia.

Below Mt. Caroline a creek, which, it will be remembered, I called the Edkins on my last trip, rises in the Phillips Range, and flows into the Adcock above Mt. Clifton, a most remarkable circumstance in such high country as this.

I camped on the west branch of the Edkins, eight miles west of the Phillips Gorge, about north-east by east from Mt. Broome. A fine running stream flows out of the Phillips Range, with stony basalt hills all round, which, however, are well-grassed. There must be a great number of blacks about here, for we could see their tracks and camps in every direction, and they were then camped a short way from us up the gorge. A few hundred yards below us was a blacks' graveyard, in which I then counted eight graves, each covered with stones. On two of them there must have been some tons of stones. Wood is placed on top of the stone. I have, in all my travels in unexplored Australia, never seen anything like this before. I must say I think the wild blacks of this country are a far better class than those we have in Queensland.

On the following morning I went down to the graves, and counted thirteen of them. Saddling up, we travelled west along the foot of the Phillips Range, skirting the banks of a fine running creek, bordered by stony, basalt hills, splendidly grassed. I thing I saw here struck me as very strange. In a certain locality on the side of the Phillips Range, there are some thousands of tons of basalt overlying the sandstone, looking exactly as if it had been violently thrown there. No other basalt is nearer to it than 100 yards, on the other side of the creek.

That day one of my boys picked up a black's skull in the grass, a strange object to find in such a position. On my return to camp I found they had stuck it on a tree and made a target of it. At night I camped on the Isdell, a splendid running creek which I named on my last trip, when I crossed it thirty miles lower down. It comes out of a gorge two miles above this camp. Mt. Broome from this camp bears 250deg. 50 miles. Of course, it is a blank on the map, but the bearing fixes its position. The Phillips Range now goes back about six miles south-west from the Isdell, and there joins the Isdell Range, which is a spur of the Leopold. Thus it will be seen that all this country is, so to speak, fenced in by ranges, and there is actually only one pass by which stock may be brought into it from Hall's Creek, and that is down the M'Namara. I never saw better watered country in my life, and such splendid water—better could not be found anywhere. The Isdell flows west from here, and I intended to find out where it went to. At the Divide, which is really a splendid plain, I found the elevation by my aneriod to be 1200 feet above Derby. Mt. Ord, which is one of the Leopold group, is by far the highest mountain about. Mt. House is the most remarkable, as it stands out conspicuously alone in its glory. Mt. Clifton is the largest in extent, having a length of some seventeen miles by a breadth of ten miles, yet, as far as I could see, there is not one single track by which a horse could be taken to the summit. Here I saw more blacks' tracks than I have ever seen in Western Australia before. These tracks were as broad as if made by a mob of cattle. All the country along the range at the head of the Adcock was on fire, set alight no doubt by the blacks for hunting purposes. I could easily have found their camp, but did not wish to attempt it, as I thought they, being so numerous, would show fight, and in that case I should have been compelled to drop some of them, a thing I particularly wished to avoid, so we passed peacefully on our way. It is very cold here now, the thermometer in the morning registering 36deg. Fahr. That night we camped on the Isdell again, having got over the Phillips Range. It was very rough work reaching the top, which the barometer showed to be 1600 feet above Derby. Our camp was situated 1200 feet above that town. In one of the gorges on this side of the range, we got two of our horses bogged, but we took their packs off and they quickly struggled on to dry land. This creek now came from the west, whilst forty miles below us it flowed towards the west, when the country opens out once more. I went by myself down the creek to see what became of it, and after riding for eight miles, I found it entering another gorge, where I saw a number of blacks' fires. As darkness was rapidly coming on, I decided to give them a wide berth, and it was pitch dark as I rode campwards. Riding slowly along, I saw a small fire which I took to be our camp fire, and thought it strange I could hear no horse bells, All at once I saw the fire disappear, and I became aware that what I had taken for my camp fire, was a black's firestick. I fired a shot, when the blacks shouted and cleared. They must have seen me going down the creek, and went travelling off. I confess this gave me a start, for, as I had seen their fires in the gorge, I certainly never suspected they would be so close to our camp. My boys hearing my shot fired a shot or two in reply. I was glad to get in with a whole skin, and decided that it would not do to go travelling about alone in the dark, with such numbers of apparently noctivagous blacks in the neighbourhood.

This is such a very interesting country that I could write a book on it. It was a perfect revelation to me, and certainly will be to others, especially in the eastern colonies, who believe West Australia to consist mainly of sandy deserts, tireless spinifex plains and salt swamps and lakes. I much regret that Inspector Ord was not with me to see this magnificent country and report on it. I think when it is surveyed, my descriptions and bearings will be found fairly correct, as I have a good idea of surveying and of the country I write about.

On both sides of the Phillips Range there are some very fine pine trees, as well as other useful timber.

I now travelled south-east by south, and after covering ten miles, I struck a splendid running creek or river (I am inclined to call it a river). The divide between the two rivers is quite unnoticeable and consists of open forest country, and small plains splendidly grassed; there I saw the first iron-bark trees I had seen in West Australia.

The river (which I have called the Barnett, after Mr. Barnett, of the Lennard) runs along the base of a huge mountain which I have also named Mt. Barnett, a branch of the Phillips Range. It runs north and south, and I ran it down for eight miles south-east, and then camped. Leaving the camp in charge of the boys, I went on four miles along the mountain, following the Barnett till it joined the Phillips, which forms here a fine river, running very strong. It appears to come out of a gorge between Mt. Barnett and another big mountain I have called Mt. Harris, after Mr. Harris, of Broome.

One mile below the junction, there is a large creek, coming from the south-east, with clear running water. This I have also named the Harris. A mile further down, the Phillips seeks the inevitable gorge, which appears to have been cut through the solid rock. I think this is the strangest country in Australia for gorges. I intend, if all goes well, to have the finest of them photographed. No one, without seeing them, would believe that such places exist in the country.

Between the two gorges there are 4 miles of excellent cattle country. Having travelled 10 miles up the Harris I returned to camp, which was then situated at 1150 feet above the level of Derby. Next day I went back under Mount Barnett. This is a most picturesque mountain. All over the summit is a forest of grand pine trees. The red precipitous sides also have all kinds of trees growing on them. For 14 miles I travelled along its base, and the same vegetation was everywhere apparent. The Barnett River I now found left the mountain and crossed to the big range that runs N.E. and S.W. This is a terribly rough range, and I have named it the Caroline after my late sister. Never did I see such country for grass and water as between these ranges. It would need a hand that can wield a pen better than I can to adequately describe it. Right opposite my camp was a magnificent clump of immense pine trees, and behind the pines a beautiful little plain—an ideal place for a homestead. Two miles below this beautiful camp there is a fine, large, running creek coming in from the Caroline Range. This I have dubbed the Manning, in honour of Mr. Manning, of the Lennard. As usual it comes out of another impassable gorge, where the ranges are only 4 miles apart. Getting to camp early I saddled a fresh horse and had a ride round, taking bearings. Thus I saw a good deal of the country. I always do this. I make a point of getting early into camp if possible and then ride out into the surrounding country, getting back at dark. At this camp my boys caught a large quantity of fish. We were then 1200 feet above Derby.

Leaving the Barnett River I travelled along the foot of Mount Barnett on a generally N.E. course for the first 10 miles. The country is everywhere good, and the river runs along the foot of the Caroline Range all the way, coming out of a gorge there. Mount Barnett did not seem so high, but still had the same grand appearance. I travelled on for 12 miles more and then struck a nice looking creek opening into Phillips River. It was not running, but held permanent water. Above us all the country was on fire, but in our fine open camp we were quite safe. For the last 12 miles the country is not so good, stunted tea-trees predominating; but at the divide the timber is grand, consisting of forests of pine, messmate, woolly butt, and grand ironbark. I had now followed round Mount Barnett for 40 miles and had found only one place where a horse could possibly be taken up. The mountain still continues, and not a single creek, not even a spring, comes from it, which is a most strange thing in this land of springs, creeks and rivers. When the country is taken up and stocked the blacks are sure to be troublesome, speaking from my experience of taking up new land in Queensland.

While I was at work plotting my map that day, I had my boots and socks off, with my feet against a tree. Suddenly a long kind of snake, new to me, came crawling over my bare feet. He was a wonderfully quick fellow, and the boys had a job to kill him. According to Dr. Krefft, of Sydney, it was a most deadly one. I counted its labial scales, and found only five, which showed it to be one of a venomous species. It was a kind of slate colour, and about 5 feet long. There was one peculiar circumstance about this adventure. I did not feel the reptile bite me, in fact, it could not have done so, yet on my leg were two small spots of blood, looking exactly as if they had oozed from the punctures made by the venom fangs, but no puncture could I find. At all events, I suffered no inconvenience from his snakeship's visit.

This camp lay about 80 miles north-east by north from Mt. Broome.

I followed the creek above mentioned towards the east for five miles, to where it entered the Phillips River above the Barnett and Harris Gorges. All the way was good cattle country, although somewhat sandy. The river I found to be running stronger than ever. I decided to run it up. For one mile above the gorge it is bordered by Mt. Harris on the left bank, then it takes up the running of Mt. Barnett and trends away to the east. A fine creek comes to it from the north-east, which I have called the Bella. The river flows from the north. The country is sandy, but for six miles is still good cattle country. The river now emerges from a gorge, a low one this time, and by keeping back from the water I managed to get above it, and continued to run the river up. The ranges on both sides were fearfully stony, but by crossing and re-crossing I succeeded in getting along. I pitched my camp nine miles from the gorge. The river was running still stronger, and I wondered where all the water came from. I found this a very bad camp for the horses, but they had to make the best of it.

Taking a boy with me, I got to the top of a big mountain close by. It was terribly rough scrambling, but we got up.

Arrived at the top I found I would have to climb a tree to enable me to take bearings. The most suitable tree had a straight, smooth trunk, and I had a tough job to climb it, as my climbing days were over long ago. But I sent the boy up first, then, with my saddle surcingle, I managed to get up. Well was I repaid for my trouble, as I got a splendid sight. This is by far the biggest mountain in the neighbourhood, as it rises from such high ground, the camp being 1500 feet above Derby and the mountain 600 feet above the camp. I have given it the name of Mount Elizabeth, in memory of my late mother. It will form a most important trigonometrical station when the country comes to be surveyed. I could get no bearing from south-east almost to north, as it happened to be a long, low range all the way; but I got the bearings of five other big mountains, one of which appeared to be about fifty miles away on a bearing of 322 deg. From south-east to north the country did not appear to be very rough.

Next day I shod seven horses and made a start at 8 a.m., and ran the river for 10 miles on a N.W. course. Along the bed of the stream the travelling was fair, but very rough on the land. I found myself confronted here by my old enemy—an impassable gorge, so as the river was coming from N.W. and I wanted to get West I did not attempt to get round the gorge, but turned back for three miles and camped, so as to get time to finish up my plotting. I made this camp to be about 80 miles S.E. from the mouth of Prince Regent River. I had no idea the river would come round as it did, to the West. It looked as if it were going 100 miles more in the same direction. I feel sure there is no other river so good as this in Australia to water stock at. It has high banks, no bogs, is always running, and can be crossed at every few hundred yards. Here there are most splendid cajuput trees.

Three blacks showed up to-day with spears, but a few harmless shots soon sent them to the right-about. I regretted that I had not time to follow this grand river to the head; but I had to get away to the coast for I feared to run short of horseshoe nails. I had only 10lb. weight at starting and 2cwt. of horseshoes. What with shoeing horses every day, owing to rough country, my supplies in this line had dwindled alarmingly.

I went up the range on the W.S.W. side and found the climbing rough; still, it was better than I expected. I travelled 5 miles before reaching the top, which is 1750 feet above Derby.

Then I travelled N.W., 2 miles through very level pine forest, the pines being very high, and struck a gully going in the same direction in open country, where it turned into a fine running creek. Five miles further on a creek came in from N.W. As the country was so level I ran it up for a mile and then concluded I was on the same creek as before, but they junctioned and then ran South. One mile further on it entered a gorge. I climbed a pine tree, and following it as far as I could with my eye it appeared to continue to flow South through the gorge. I believe it to be the head of the Barnett. Here I found a kind of stone charged with mineral. As I was smashing it with a piece of rock one of the stones hit me on the knee and caused me most agonising pain for a time. I had to camp very early and doctor the limb. I considered that I was then 1700 feet above Derby, and that I should soon commence a big descent.

We crossed the Caroline Range at 2,000 feet above Derby. The travelling was very rough, but still it might easily have been worse. We then camped on a creek running west, surrounded by mountains. One of my blacks shot a kind of parrot that I had never seen before. I had it skinned for the purpose of future identification. I then reckoned that I was about 60 miles from the mouth of the Prince Regent River. Although we were still in a wonderful country for water, the creeks contain no black bream, such as we caught in abundance on the other side of the range. We crossed several running creeks, and I found that the creek we had camped on the previous night was the head of the Isdell. Climbing a rocky mountain, I got a number of sights, getting even Mt. Ord and Mt. Bold Bluff. The former must be a very high mountain, as it showed up splendidly. The latter I could make out with my glass. It is on a bearing of 45 from Mt. Broome, Mt. Ord bearing 85, Mt. Ord from Mt. Bold Bluff 111½, Mt. Ord from Rocky Mountain 196, Bold Bluff 205, so if so wished the position may be fixed. The creek runs north-west, and the country it passes through is fearfully rough. The water, on the other hand, is splendid.

Owing to the interposition of gorges, I was unable to run the creek down, so I travelled north-west, and striking a gully running in that direction, I followed it for five miles. On this creek I saw the finest Leichhardt tree I have ever seen. I followed the creek till it entered a larger one coming from the east. I ran it to the west for two miles and then found that it junctioned with the creek we had camped on. I ran it down north-west over four miles of splendid cattle country. Going to the top of another rocky mountain, I succeeded in getting some bearings of a number of high mountains to the west of north. The creek then went into a gorge and for twelve miles we had fearfully rough country, nearly breaking the legs of two horses amongst the rocks. One horse had a bad fall. In the gorge the blacks' fires were visible.

It would require a man greedy of trouble who would want rougher country to travel over. We went down the range, and struck the creek again. It had now assumed the dimentions of young river, a large creek from the south-west having joined it. The plains here have plenty of mimosa but the grass is coarse, and the surrounding ridges are all basaltic, causing the horses to lose a great many shoes.

I now moved the camp four miles down the river where I found good country but the ranges came down rather close. Another large creek came in here from the east, which I have named the Charnley, after Mr. Wallace Charnley, of the Nullagine. The big creek I called the Maudie. Here my boys caught ninety black bream. There must be a great number of blacks about here, as I saw several of their fires towards the south, one of them quite close to our camp. There was still a big range to descend, as my aneroid showed this camp to be 1000 feet above Derby.

Running the river down for 4 miles I found another nice little river coming in from N.N.E. Judging from the amount of water that came down it in a flood it must run a long distance. This I named the James, after Mr. James, of the Cable Station, Petang. Another river comes in from the North, 8 miles below the James through a fearful looking gorge. On the N.E. side of the river the range continues for the whole distance, and there are basalt ridges on the opposite side. I called this river the Pearson, after the Police-Sergeant at Derby. The grass here was very plentiful, but coarse, and there are many high mountains which I believe I have placed fairly correctly. One I named after my late brother, Mount William, the other Mount Grosser. This is a most remarkable hill rising like a castle. I doubt if anyone could reach the top even on foot. Twenty miles back from the river rises a hill which I named Mount Shadforth, after Mr. Robert Shadforth, of Queensland, who helped me in the hour of need. Another I entitled Mount Kerr, in honour of Mr. Kerr, of the Nullagine. Mount Nicholson and Mount Blythe were also named by me after Mr. Nicholson, of the Derby police, who was with me for some years, and Mr. Blythe respectively. I then had to shoe twenty horses, and in the evening I put shoes on four more.

The river now came round to the S.W. for four miles, after which its course was generally West. For 8 miles the country is good, but fearfully stony. I now had to leave the river as its banks were too rough to travel over. By keeping South I hoped to get down the range. The shoes were being lost wholesale, the nails were nearly all gone, and there seemed to be a bad time looming ahead for unshod horses. The flood marks here were very high. As we rode along the country was something fearful for stones, and the river had cut clean through a big range. To look along that range it would appear incredible that any river could cut its way through it, yet it has done so. The range is covered with immense stones, slippery as glass, affording no footing for a horse. I never saw basalt hills so high before. They are covered with splendid grass, and spinifix does not appear. Needless to say that the country is splendidly watered. I at last ran out of horseshoe nails and had lost a number of shoes which I could not replace. Here the big range appears to end. I noticed thousands of a new kind of palm growing on the range, and my boys cut a number down to get at the succulent head which forms a splendid vegetable, something like cabbage. This range I have named the Edkins, in remembrance of my partner in Queensland. To the South there was a very high tableland, of which I had seen but 20 miles, and have called it the Synott Tableland, after Mr. Synott, of Queensland, who helped me on my trip out to Western Australia. A high mountain I named the Kennie, after Mr. Kennie, of the Cable Station, Broome. I noticed blacks' tracks all about us, and we were unfortunately camped in a very bad place, 450 feet above Derby.

The following day's travelling was much the same as I had lately experienced, fair but stony, with grand grass and springs everywhere. In years to come this will be grand cattle country. I left the river, hoping to get round the range. There is only one way to get on to this river from Hall's Creek, and that is down the James River.

Next day I ran the creek down in a west-south-west direction, but had to keep out, as the country was so fearfully stony. The creek I found to pass into one of the worst gorges I had seen on the trip. I camped on a fine spring, having crossed three running streams in six miles, and meeting with some patches of splendid country. Leaving camp, according to my usual custom, I went out to look for tracks, and found a splendid sandy stretch between two high ranges, where I thought I was going to get through, but a spring blocked me. However, I managed it, partly, and in spite of the long reeds. I had to lead my horses, and as I went along I burnt a track to make my return easier. Then my mare got bogged, and the grass was over my head, and I fully expected she and I were going to be burnt to death, and would have been had there been any wind, as the flames were as high as 20 feet, but by great exertion I got her out on the burnt land. I consider I was in a very dangerous position on that occasion. After all, I found I could not get through, so I returned to camp, got a fresh horse, and tried another place, which also proved quite impassable. There was nothing left but to go back and try a place I saw from a hill out towards the east. I intended to find a way to the sea if it was at all possible, for some day this will turn out a grand country. It will grow anything, I believe. We were then nearly out of flour, and had neither sugar nor beef, and could find nothing to shoot. The horses were in a fearful state, and things wore a very unpleasant appearance. Still, I had to find a way out, so I had all the horses put over the creek, which was a most troublesome job. I went ahead, with the pack following me. At sundown I camped, and whilst making the camp fire I heard the wild blacks close by, so I went over a low ridge 300 yards away, and there saw a great mob camped. I got right on to them before they saw me, when they all bolted, some catching up their spears. I got some fine spear heads in that camp. When the packs came up I moved half-a-mile back, and camped on the open, where I thought we should be safe. I should state that I left a tomahawk and some other things in the blacks' camp in place of the spear heads I had taken. There are two running creeks here, and the range I have named the Artesian Range, as it is so full of water. We had now only four days' flour rations left, and the horses were in a woeful plight owing to the want of shoes. The blacks we saw here are not nearly so modest as those we saw in the desert east of the Oakover; they could not possibly be wilder, but the gins all had a covering about 3 inches by 3 inches, made of booty's wool, and the tie round their bodies was made of gins' hair. The former had nothing whatever in their camps which had been got from the whites. Their knives and tomahawks were all of stone. But here the blacks use no covering of any kind; they had a piece of a horseshoe rasp and some iron they had made into tomahawks, and I fancy they had half a horseshoe made into the same weapon.

Next day I went to the blacks' camp and left some knives there, but the people had not returned. Then, with a boy, I followed the Artesian Range, and finding a creek coming out of it, ran it up and pitched on a spot for a camp. I sent the boy back to bring the camp on, and I went on up the creek. Getting into a spur of the Edkin Range, I saw a place where I thought I could get through on to the river. I determined that on the following day I would leave the camp where it was, take one boy and try to get over. Finding next day that I could not take horses up the Edkin Range, I walked four miles to the top before coming to the gorge. The range I found to be 1000 feet above Derby, and it was 400 feet to the bottom of the gorge. The river appeared to run through a continuous gorge and to turn afterwards towards the north. A high table-land mountain loomed up some ten miles away, which appeared to run north and south. There was evidently no possible way of getting to the sea in this direction at least, so I had to get back and try to the southward.

Nature has been a wonderful engineer here. She has made the ranges terribly rough, and forgot to leave any room for the rivers to pass, so she set to work to cut a passage for them through the ranges.

Having struck my old tracks on a south-west course, I followed them for eight miles, then changed the course to south-south-west for two miles and camped, having crossed two running creeks. This country I have already described. I now went ahead and got on to a divide, and then saw that the country beyond was terribly rough. One big mountain I saw, I named Mt. Philp, after the Hon. R. Philp, Premier of Queensland, who has proved a true friend to me at all times. It is a very remarkable and prominent object. Another big mountain which I have had in sight for several days, I called Mt. Smith in honour of the Governor of West Australia.

The horses were now in a dreadful state for want of shoes; however, I had to go on at all hazards. I ran the creek up to the southward, leaving the big table-topped range close on my left. For ten days this range has been on my left hand with no apparent break in it. This is the Synott Range I mentioned previously. To the right were very high stony basalt cliffs. I now struck the head of a creek going south and ran it down for six miles, where a large creek came out of the Synott Range. Here I camped and went on to a hill, whence I saw the creek cut through the range and running north-north-west. After dinner I tried for a way out to the south-east, and in four miles struck a nice river, which I have called the Sprigg, coming out of the same range. It does not appear to be a long one, but evidently by the flood marks, it brings down a vast quantity of water. I now made a grand discovery, for I found I had 50lbs. of flour in one of the packs that I knew nothing of, so I was well off for rations of that description for a week or more. On the whole of this trip I saw no auriferous country.

My pack horses had so far travelled 679 miles since leaving Derby, but I think I must have actually travelled over 1000 miles, taking deviations and side journeys into consideration.

Sending my horses over my previous day's track to camp on the river, I took one boy with me, and went up the range to Mt. Phillip. It was a very tough job to get up. On reaching the top, where I went over five miles of basalt country, with a creek running through it, I then went on to Mt. Philp, 1600 feet above Derby. On the way back, I ran down a creek, over rough country. Here I think a dray track could be made for a few hundred pounds. The road would pass under a high bluff about 400ft. in height, with two miles of very rough range to cross. On reaching my camp, I found that my party had killed a kangaroo and five wild ducks. They also had caught a lot of fish and one craw fish, and had gathered a quantity of lilies. Five pups had been presented to the party by our remaining dog —these, however, were not eatable.

There is here a fine patch of good country, but only about twenty four square miles in extent. The ranges close in, and the water is excellent. Since leaving Mt. Broome I had travelled over 590 miles of country, and in no place was water more than ten miles apart.

Having burnt the grass, I then found an easier track up the range, and also saw that a dray track could be made. Followed willingly by the poor horses, I succeeded in getting a good camp at the foot of Mt. Philp, which bears 146 deg. from Mt. Broome and 120 deg. from Mt. Ord.

I now tried to find a track through the other part of the range, and discovered a most wonderful pass, where the creek goes through a deep gorge. Away back from this gorge there is a pass going up one gully and down another. As I was alone, and it was getting late, I deferred trying to go through till next day, when I was entirely successful, getting through wonderfully well. A really good dray road could be made over this pass. It is about eleven miles from one side to the other, and if so inclined a person could travel only a mile a day and get permanent water at every camp. Standing on a range four miles from the gorge after getting through, it was difficult to make out the exit, as it looked like a perfect steep bluff, with no break in it.

As soon as we left the range we found the country changed rapidly for the worse. I have not seen the Barker, but I think this must be the same river, judging by the course and the strong running. Next day I ran the creek down, and camped to the right of some granite hills in a gorge. It was the worst camp I had yet had on the trip, as far as the horses were concerned. The creek here does not run, and the water is bad. Running the creek down for four miles, we at last got out of the gorges. Then came twenty miles of very sandy country. I never saw such immense granite hills; some of them were hundreds of feet high, and all solid rock. That night we had to dig holes in the sand to water our horses. What a change from the country we had just passed through! We were camped on one of the strangest formations in the world, I should think. There is a line of very hard, sharp limestone, only 100 yards wide in places, and here and there from 200 to 300 feet high. It rises out of the level, sandy country, and runs generally north-north-west and south-south-east for, I believe, about 150 miles. I should like to hear Mr. Maitland's opinion of it when he sees it some day.

At last I arrived at Mr. Blythe's place, on the Lennard, and my troubles were over.

THE BŪRBŬNG OF THE WIRADTHURI TRIBES.

By R. H. MATHEWS, L.S.
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[*Read before the Royal Society of Queensland, 7th April, 1900.*]

A paper by me under the above heading, read before the Anthropological Institute of Great Britain in 1895, was the first description of the inaugural ceremonies of the Wiradthuri tribes.* The following year I contributed a supplementary article containing further and more complete details.† In the present paper it is intended to give a short account of another meeting of the aboriginal inhabitants, which took place in June, 1898.

The general camp was erected about three miles farther down the Bulgeraga Creek than the locality I visited and described in my first article, and was on the right bank of that creek. This place is situated on what is known as the "Mole Country," on the Lower Macquarie River, Parish of Wullamgambone, County of Gregory, New South Wales. On one side of the main encampment was the *boorbung*, an oval space, whose diameters were 92 feet 8 inches, and 86 feet 5 inches respectively, bounded by a nick cut in the soil about three inches deep and four inches wide.

From the interior of the space referred to, all grass, stones, and timber had been removed, and the surface made level and smooth. In the side of the oval farthest from the camp, about four feet of the perimeter was left intact, for the purpose of affording ingress and egress when using the enclosure on ceremonial occasions, it not being permissible at such times to step over the nick or groove cut in the ground.

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* Journ. Anthrop. Inst. (London), xxv., 295–318, Plates 25–27.

† *Ibid.*, xxvi., 272–285.

The *goombo*, or *buddha-goonang*, was formed in some thickly wooded country 425 yards distant, in a northerly direction, and the four earthen heaps composing it were about thirty feet apart, and from fifteen to twenty inches in height. There were two inverted stumps of saplings, about two feet out of the ground, erected in a corresponding position to those shown in "Diagram 3," Plate xxv., accompanying my first paper on the Burbung.* Beyond the goombo was the usual screen of boughs, known as *gareel*. The stumps were about the same height and otherwise similar to those formerly described, and were stained with human blood in the same way.

On proceeding 241 paces along the pathway, *tharambal*, from the *boorbung* towards the *goombo*, it was found to pass through a rustic archway, formed by pulling together and fastening the tops of a number of saplings naturally growing at that spot, with boughs piled up thickly at each side, leaving a clear passage about three or four feet wide. From this point onward to the goombo the surface of the ground on either side of the path was ornamented with the usual *yooran* patterns, interspersed among which were human figures, representations of animals, native weapons, and other objects, which I shall briefly describe presently. Around the outside boundary of the area containing these mystic drawings, a fence of saplings and bushes had been erected to add to the exclusiveness of the place, and also to keep the white man's stock from trampling upon and defacing the artistic labours of the natives.

Three yards beyond the archway referred to there were cut into the turf the figure of a man and a woman, a little less than life-size, lying side by side, with their genital organs conspicuously displayed. Not far from this pair was the effigy of a man formed by stuffing a suit of European attire with grass and leaves. This was propped up to keep it in an erect posture, giving it the appearance of a sentry on the watch. A little further on the outline of an immense snake, called the *Wahwee*, was cut in the ground.

At the distance of 130 paces from the archway (or 371 paces from the boorbung), still going towards the goombo, a colossal horizontal representation of Baiamai, eight feet six inches long, and five feet ten inches across the chest, was formed by heaping up the loose earth into human shape. The chest, which was

* Journ. Anthrop. Inst., London, xxv., 295–318.

the highest part of the body, was about a foot and a-half above the level of the surrounding ground. He was lying with his head towards the goombo, and near him was a boomerang and other weapons cut in the soil.

Between Baiamai and the goombo, a kangaroo was outlined by a groove in the soil, with a real spear inserted in its body. This spear was supposed to have been thrown by Baiamai before he slipped and fell where he is now lying.*

Besides the foregoing there were represented on the ground an iguana, a fish, an emu, a bullock, some birds' nests, a death-adder, a pig, and other things. An eagle hawk's eyrie was represented in one of the trees, and not far from the image of Baiamai was the usual fire on top of some raised earth. At another place an oval hole, between two and three feet in length and about a foot deep, was dug in the ground, to represent the *vulva* of a woman. Along the margin of this depression grass and small bushes were stuck in the loose soil, in imitation of hair. Around this device the men danced, muttering incantations and indulging in libidinous gestures.

On both sides of the path, between the archway and the goombo, the trees were marked with different objects, including iguanas, turtles, snakes, birds, the moon, and human figures. One of the trees had a wavy line cut into the bark along its bole for about seventeen feet from the ground, to represent the mark made by lightning, such as we sometimes see on trees in a forest after heavy thunder.

About two hundred people of all ages and both sexes, including several half-castes, were gathered at the main camp. They came from Gulargambone, Coonamble, Trangie, Dandaloo, Dubbo, Brewarrina, and Conkapeak. From the time the local mob selected the site and commenced preparing the ground, until the last contingent arrived, was more than three months, owing to various delays. At this gathering nine youths were admitted to the status of membership in their respective tribes. For particulars of the course of secret instruction in the bush—the inculcation of a mystic language and other occult teachings, the reader is referred to my previous articles on this subject.†

The punching out of a front upper incisor tooth of the graduates was formerly practised by these tribes, but of late

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* Journ. Anthrop. Inst., Lond., Vol. xxv., 300.

† "The Burbung of the Wiradthuri Tribes," Journ. Anthrop. Inst. (London), xxv., 295–318, Plates 25–27. *Ibid.*, xxvi., 272–285.

years it has fallen into disuse. The custom of one or more of the tribes present contributing a victim to furnish a cannibalistic feast in connection with the secret ceremonies (*) has also ceased for a number of years, in consequence of the stringency of the white man's laws respecting murder.

The Wiradthuri tribes are spread over a wide zone of country, commencing a little way south of the Barwon River, and stretching southerly almost to the Murray. Throughout this immense territory the language spoken is substantially the same; in the northern half of the nation the name is pronounced Wiradthuri, and in the southern Wiradjuri. The people are divided into four sections, called respectively, Murri, Kubbi, Ippai, and Oombi, with laws of intermarriage and descent as particularized in the following table :—

Husband.	Wife.	Offspring.
Murri	Ippai	Oombi
Kubbi	Oombi	Ippai
Ippai	Murri	Kubbi
Oombi	Kubbi	Murri

* "The Initiation Ceremonies of Australian Tribes," Proc. Amer. Philos. Soc., Phila., xxxvii., 66.

AUSTRALIAN VEGETATION AND ITS GEOLOGICAL DEVELOPMENT.

By JOHN SHIRLEY, B.Sc.

[*Read before the Royal Society of Queensland, 26th May, 1900.*]

An observer on the banks of the Brisbane River during the floods of 1893, might have observed vast masses of vegetable matter, trunks and limbs of trees, clumps of bamboos, bushes, leaves and fruits floating down with the current towards the sea. The water had the colour of yellow mud from the mass of sediment it contained, and all this organic and inorganic matter, scoured from the surface of the river basin, was on its journey out to sea. Somewhere in the bed of the Pacific, there must be layers of vegetable material, covered by the sand and earth brought down in this mud-coloured water. At some future age, when, by a series of possibly slow but irresistible upthrusts, what is now the bed of the sea becomes a portion of the land surface of Australia, the leaves and stems then buried may be classified among fossil plants by the palæobotanist of that age.

The records of the Queensland plants of past ages are by no means as complete as those of its extinct animals. The shells of bivalves and univalves and the bones of vertibrates have been far better preserved in a fossil state than the leaves and fruits of trees; and it is far easier to reconstruct an animal from its skeleton, than to determine a plant from the remains of its fossil stem, or from its detached and scattered leaves.

Prior to the eighteenth century, when fossil plants began to be noticed, they were almost universally regarded as the remains of plants overwhelmed by the deluge described in the 6th, 7th, and 8th chapters of Genesis. As keener minds were drawn to the study of this ancient botany, three important points were recognised :—

I. *Few fossil species of plants have now living representatives, but have in part been succeeded by others more or less closely allied.*

From this it is seen that in certain groups of plants there has been regular and constant change, by adaptation to environment; and there has been a complete extinction of other species which could not readily conform themselves to the changed conditions.

II. *The deeper the stratum containing the plant remains, the lower these plants are in type, and the greater the difference between them and species now living in the same region.*

This simply shows that the greater the time given for change, the further from the original type have the plants metamorphosed themselves; and, as in animal life, it tends to show that the higher plants are produced by gradual development from those of simpler structure.

III. *The fossil species are often of a kind wholly unsuitable for the present climate of the region in which they lie.*

In a recent magazine there is an account of an imaginary visit to one of Jupiter's satellites, which was found in a condition approaching that of our moon. The few inhabitants were found grouped about the equator of their world, living under glass, like exotics in an English hot-house. Similarly our world is losing its internal heat, and it is conceivable that places now covered with ice and snow, once carried a prolific vegetation. This may account for the discovery in Greenland of remains of plants which are said to have required a climate like that of the Mediterranean coast. De Heer calculates that to grow such plants, the average daily temperature must have been 30 degs. higher than that of Greensland at the present day. Similar plant remains were found in Franz Josef Land by the Jackson-Harmsworth expedition, and are mentioned by Nansen in his "Furthest North."

For a knowledge of the fossil plants of Queensland we are indebted to Messrs. W. Carruthers, J. W. Dawson, R. Etheridge, junr., the Revs. W. B. Clarke and J. E. Tenison Woods, Professor McCoy, and the German specialists Ottokar Feistmantel and C. von Ettingshausen. Feistmantel dealt mainly with the plants of the coal measures, and Ettingshausen with cretaceous plants. Mr. R. Etheridge, junr., determined all fossil plants collected by the Queensland Geological Survey Department up to the end of 1895.

Devonian Period.

The oldest Queensland plant fossil appears in Devonian rocks at the Fanning River, Burdekin Downs, in shales and sandstones. Strange to say it is not a member of any lowly group of plants, but belongs to the family of pines and firs. Dicranophyllum, the plant in question, is an ally of the Chinese gingko, that mysterious tree, which though found in a fossil state is still cultivated around temples in Japan and Northern China. The remains consist of portions of branches, with spirally arranged leaves, and short internodes, and with their surfaces marked out into rhombic meshes, closely crowded together.

It is not to be conceived that this plant came into existence without ancestors or contemporaries. It belongs to a fairly high type of plant life, and its solitary position in the Devonian rocks of Queensland may at any moment be altered by fresh discoveries.

Permo-Carboniferous Period.

With the next geological epoch—the Permo-Carboniferous period—represented by the whole series of beds belonging to the coal measures, we come upon a great wealth of plant material, in strong contrast to strata beneath them. In the Gympie, Star, and Bowen beds are found the remains of plants—enormous in their growth, but lowly in type, and in our days represented merely by small and delicate plants, pendant from our trees, or growing sparsely in marshes or on sandy soils. These plants of the coal measures, known as Calamites, Lepidodendrons, Sigillarias, Stigmarias, &c., are nearly allied to the lowly yet beautiful lycopods, selaginellas, marestails, and nardoo. In our Permo-Carboniferous rocks there are also found many ferns, the most common forms having large ovate pinnæ; some few cycads, relations of our Zamias; and trunks of fossil conifers.

In other parts of the world Lepidodendron, Sigillaria, and their allies first appear in the Devonian formations; and, although they have not been found in Queensland rocks of that age, we know from the testimony of the rocks elsewhere that they were contemporaries and predecessors of our single Devonian fossil already referred to.

It has been advanced as a reason for the enormous development of the lowly, possibly succulent, plants of the coal-measures, that the climate then was much hotter and moister than at present, that the greater internal heat of the earth made climate far more equable than in our era, and that with this equable climate there was far less liability to winds and storms than that now prevailing. Under these conditions, plants of delicate texture could grow to a considerable height, and had not the necessity to strengthen their stems to resist wind pressure, as our modern plants have.

The fern remains of the period belong mainly to a family possessing enormous fronds, with ovate or lanceolate pinnæ. This is the typical fern of the coal-measures, the Glossopteris family. The modern ferns of Queensland which resemble them in outer aspect are the genera Marattia and Angiopteris; but it is not intended to infer that these are in any sense allied.

Some very doubtful remains referred to Cycadeæ, and believed to be allies of our Cycads and Macrozamias, were found by the Rev. J. E. Tenison Woods in the Star beds of the Drummond Range; but, until a much greater quantity of material has been collected, determination must be reserved.

Specimens of a fossil wood, found by Mr. R. L. (now Dr.) Jack at the Bowen River coal field, were examined by Mr. Carruthers, and its internal structure, as revealed by the microscope, proved it to belong to an ally of our bunyas and hoop-pines.

Trias-Jura Period.

After the Permo-Carboniferous period the luxuriance of vegetation, geologically considered, began to diminish. In the Burrum beds which form the lower half of the Trias-Jura system, no further advance in type is made, but the most complex in structure, the cycads and conifers, are now richly represented.

The Ipswich beds, the upper portion of the Trias-Jura, form a mine of botanical wealth. They have been most carefully examined, near Ipswich and Brisbane, by Mr. J. H. Simmonds, who possesses a private collection of fossil plants from this formation of the very greatest value. No true flowering plants have been found in these beds, but the advance in type is most marked. Equisetums and Calamites are few in number, but there is an enormous wealth of ferns, cycads and conifers. Among ferns Glossopteris has disappeared, the most common forms are Alethopteris and Thinnfeldia. Cycads of the Zamia family are also richly represented; and cone-bearing trees akin to the bunya, the yew, and the giant trees of California, have left numerous remains.

The flora of New Zealand with its tree-ferns and its conifers, which seem to be survivals from old-world types, is said to approach most nearly to the Trias-Jura flora.

Cretaceous Period.

The Lower Cretaceous beds, known in Queensland as the Rolling Downs formation, have as yet yielded no plant fossils. The facts connected with the Upper Cretaceous period have to be stated with some diffidence. Mr. Henry G. Stokes some time prior to 1892 collected from beds of clay, shale and sandstone, lying between Sherwood and Wolston stations on the Ipswich Railway Line; on the 17-Mile Rocks road; and in paddocks lying S.S.E of Sherwood, a number of beautifully preserved plant remains, belonging to the most highly developed forms of vegetable life. The same beds are reported by Mr. Stokes as extending from Corinda to Runcorn on the Southport line. These fossiliferous beds were regarded by Mr. Stokes as belonging to some period of the Tertiary epoch. Mr. Jack, on the other hand, says in his "Geology and Palæontology of Queensland and New Guinea," p. 597, "I have gone over the section carefully, and can see no marked lithological distinction between the strata from which Mr. Stokes obtained his fossils, and many other well known beds which unquestionably form part of the Ipswich Coal Measures." These plant fossils from Mr. Stokes' collection, were sent to Baron von Ettingshausen for determination, and are said by him to include palms, figs, banksias, cinnamons, oaks, aralias, eucalypts and cassias, &c. The whole facies of this fossil flora agrees exactly with that of Upper Cretaceous floras from Aix-la-Chapelle in Europe, and from the Cretaceous strata of New Jersey, Alabama, Nebraska, and Kansas, &c., in North America. It seems impossible to deny that the beds extending from Oxley to Wolston, and from 17-Mile Rocks to Runcorn, belong to the Upper Cretaceous epoch.

About one-twentieth of the area of this colony, from Windorah to the divide between the Gulf and the Northern Pacific waters, is covered by the Desert Sandstone formation, also a part of the Upper Cretaceaus system. These rocks yield very few fossil plants. A fern—Didymosorus—is the most common form; and, strange to say, undoubled leaves of Glossopteris, the typical fern of the coal measures, have been discovered by Mr. W. H. Rands in Cretaceous rocks of this group. This survival is most remarkable, although, in India and South Africa, Glossopteris is found in beds of Triassic age.

TERTIARY PERIOD.

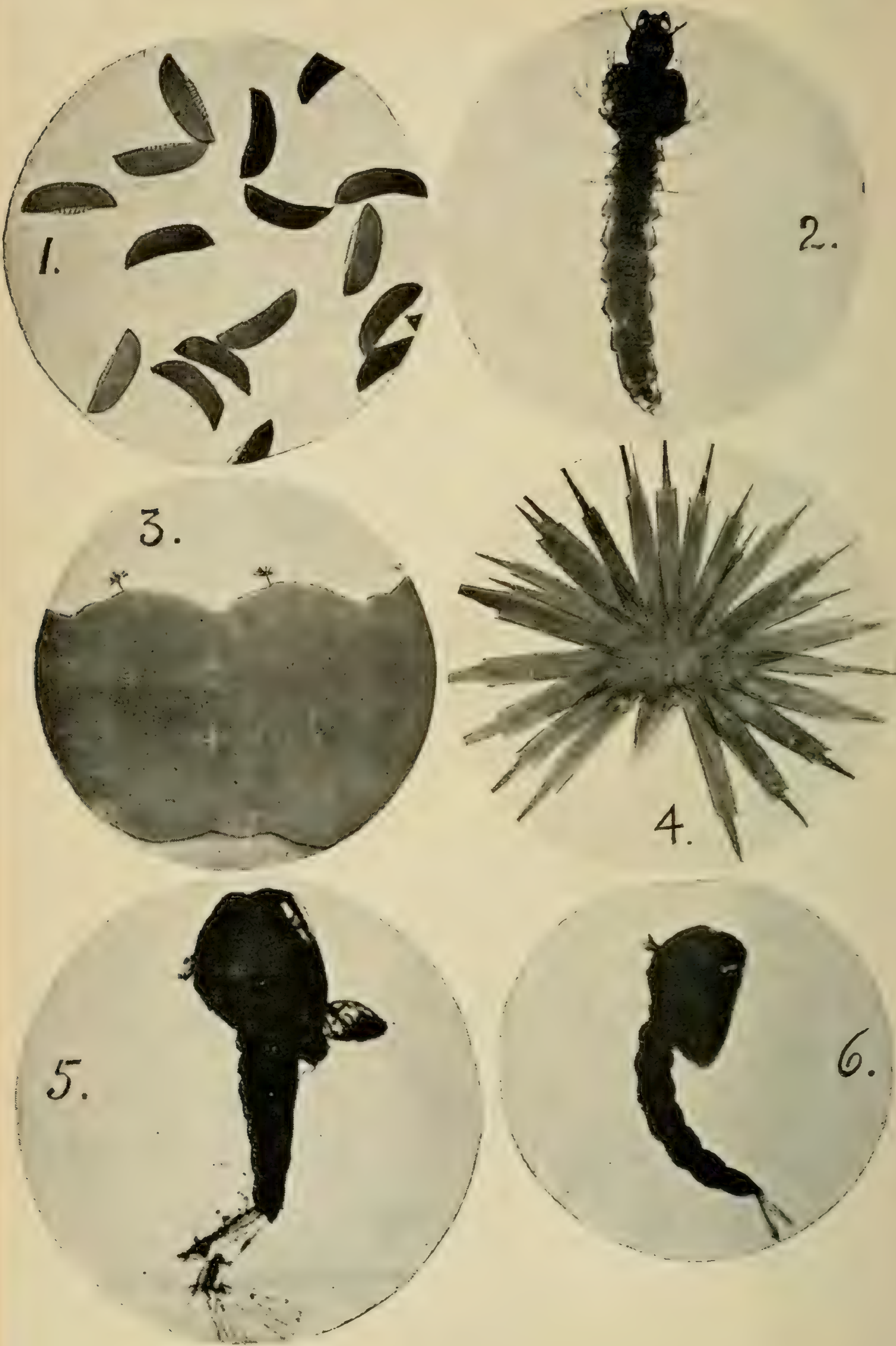
The Tertiary rocks are mainly represented in Queensland by volcanic beds, and are therefore not likely to yield many specimens of fossil plants. There is therefore an immense gap in the record, between Mr. Stokes' fossil plants, and the flora now existing in Queensland, which may yet be bridged over by future discoveries. The post-tertiary deposits are mainly river and lake drifts, raised beaches and sand dunes; and so far have given no assistance whatever in tracing the descent of living plants to their old-time ancestors. In New South Wales, however, tertiary plant fossils are common, and approach partly to modern Australian species and partly to the European and North American floras. In the gold-fields of Victoria, too, dicotyledonous fruits have been found, and determined by the late Baron F. von Mueller.

THE INSPECTION OF HOME AND EXPORT MEAT SUPPLY.

By W. C. QUINNELL, M.R.C.V.S.L.

[*Read before the Royal Society of Queensland, 16th June, 1900.*]

(WITHDRAWN AT REQUEST OF AUTHOR.)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NOTES ON A MALARIA-CARRYING MOSQUITO.

(ANOPHELES PICTUS.)

(Plates I.—IV.)

By W. R. COLLEDGE.

[*Read before the Royal Society of Queensland, 22nd September, 1900.*]

I have the pleasure of presenting to you a few notes and illustrations of the particular kind of mosquito which propagates malarial disease. It is only within the last few years that it has been suspected of fulfilling this function. But an elaborate series of experiments have been conducted in various places, and the suspicion has deepened now into a scientific fact. Pure bred mosquitoes have been allowed to bite patients suffering from malarial fever. Some of these insects have been dissected, and the malarial germs seen in the stomach, salivary glands, and proboscis. Some of the same batch of insects have bitten healthy persons and inoculated them with the fever. The chain of evidence is therefore so complete that the English experts do not require any more experiments on human beings. The evidence accumulated is considered amply sufficient to establish the fact. As probably ten millions of people die annually from this disease, and three or four times that number are disabled from pursuing active occupations for considerable periods, this discovery is fraught with deep interest to the inhabitants of the tropical world. Various experiments made in India, Africa, and Italy with the common mosquito, gave negative results, so that the ordinary kind is not thought to convey the decease. But a particular kind called the Anopheles is the one concerned. They are found around Brisbane, but in small numbers. Out of a thousand collected under ordinary circumstances, probably only one would belong to this particular variety. As you travel north I think the proportion increases. Some came to me from Cairns, and the batch contained twenty per cent. of the Anopheles. It must be understood that the Anopheles are naturally free from malarial germs. It is only where they can suck the blood of malarial patients and so receive the germs that they become propagators of the disease. The eggs are difficult to find. They are too small to be seen by the naked eye, being only the fiftieth of an inch in length and two hundredth in breadth. They are not massed together into a raft like the ordinary culex eggs, but are laid separately on the water. In Fig. 1 a number are seen. They are shapen like a beautiful little boat with curved ends. The boat used by the ancient Britons called a coracle bears a strong resemblance to them. On looking at the upper edge, or gunwale, a slender line is traceable. This consists of a thin loose membrane falling over the inside of the vessel in transverse folds. Turning a boat bottom up this silken canopy may be seen projecting on both sides. This no doubt helps the boat to preserve an even keel, and probably acts as an attachment to anchor it to a twig or stone, and when the egg is hatched its thin skin can easily be ruptured by the young larva in its effort to crawl into the water.

In the next stage the larva are easily distinguished by certain peculiarities of structure and habit. They can be found in our district at all times of the year in suitable places. The most likely are low-lying grass fields, which are often submerged and form shallow pools not sufficiently deep or permanent for the existence of fish. I have never but once found the larva separate from those of the ordinary mosquito. In Queensland the two varieties are generally together, and I have found them so at Southport and the Tweed Heads in old barrels containing water in the open air. The most distinguishing feature is that while the culex larva hang with the tip of the tail above the water, and the body hanging down in an almost perpendicular direction, the Anopheles stretches himself out on the surface like a bit of stick. It may be vanity that induces him to assume this position, for he is certainly more handsome than the common variety. The body is usually of a mottled brown colour, occasionally they are black, with a white collar and one white abdominal segment. On the back of the thorax is often seen a shield, in shape like a diamond, a heart, or the letter U.

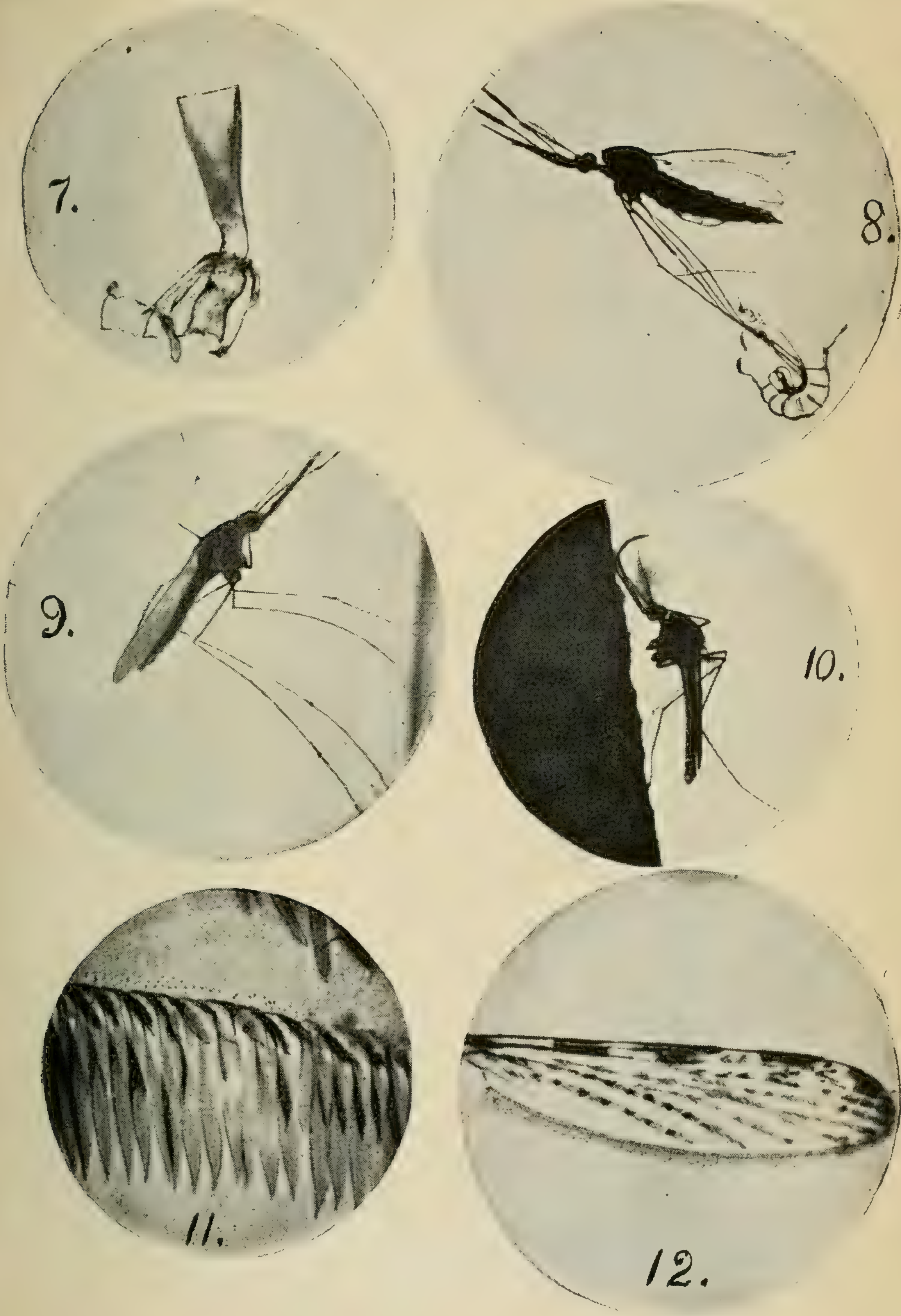
The colour is sometimes cream. or varying shades of pink up to red. Patches of the same colour are often repeated on the centre of the third, fifth and seventh dorsal segments. Some times two stripes run parallel down the back. They are therefore more handsome and interesting than the common mosquito. Its head is also smaller, the maxillary brushes curve in the opposite direction and are less complicated. The neck is very flexible. A frequent practice is to twist the head round so that the forehead lies in the same plane as the abdomen. This position does not appear to be inconvenient, for it eats and swallows food all the time. One of these gentlemen is seen in Fig. 2. You can see the small, narrow, slightly oval head, the expanded brushes, and the tail differs entirely from the ordinary kind. The long projecting tracheal tube has disappeared, and though a paddle with four triangular blades is there, yet it is small, and projecting downwards is a broad fan composed of setæ or strong bristles, enabling it to swim rapidly through the water. Three of the terminal segments are seen in the next slide, showing more clearly the propelling apparatus with two of the triangular paddle blades, the other pair are hidden by the bristles. One peculiarity of the Anopheles is what I have called a series of epaulettes on the segments of the back. Their discovery about a year ago was, to me, a source of great pleasure. I do not know whether they are actually new to science, but I have not seen any reference to them in the literature on the subject, so it is possible that they may be so. Six of the abdominal segments bear a pair of these peculiar organs on their dorsal surfaces, so that there are twelve altogether. They rise on a short channelled stalk from the skin and then spread out their star-shaped leaves like a flower. The radii would form a complete circle or star, but that on the side directed to the body a few of the points are always missing. It therefore forms three quarters of a circle. In Fig. 3 are three abdominal segments showing how they rise upward from the back. The next slide is a perpendicular view showing how they are arranged on the back; one is traceable in each corner of the segments. Fig. 4 gives a good idea of the structure, but the view being taken at an angle does not give so natural an idea as the succeeding slide. Rising upwards like a flower, anyone familiar with high power photography will know the difficulty experienced in representing the parts lying in different planes in one picture.

It is a problem of some interest to determine the function of these beautiful organs. I think they mainly fulfil a mechanical office in enabling the larva to float on the surface with the least muscular effort. The body, denser than water, will tend to sink, but the epaulettes being flush with the surface must by capillary attraction lay hold of the air film. Their slender star-like points will lay hold of it. There will thus be twelve epaulettes pulling at the air film together, counterpoising the specific gravity of the body and enabling the larva to lie and breathe without exercising any muscular effort in maintaining that position.

I have found another variety with longer epaulettes much finer in structure, the rays rising more in a perpendicular manner, not unlike a feather duster, and when it died the leaves clasped a bubble of air, like the fingers of the hand clasping a cricket ball. In confirmation of this opinion I have seen the tips of the epaulettes showing slightly above the water's surface. Likewise on moving they do not sink like the culex larvæ, but slide over the surface with a sharp zigzag motion, first in one direction then in another. But when alarmed the body is bent into a curve, so breaking the adhesion of the outer epaulettes to the air, they then sink to the bottom of the pool lying motionless for a considerable time. They may likewise be the receptive organs of some special sense of which we have no knowledge.

An excellent book on Gnats and Mosquitoes has just come to hand as these pages are being revised for printing. In it one of the epaulettes is figured and termed a natatory hair from the body of the larva. But this is a very insufficient description of the beauty, and does not form a satisfactory idea of the functions fulfilled by these beautiful organs. Their position on the dorsal surface and the break in the leaves being directed inwards towards the back seems contrary to the idea that they are swimming hairs, and a fuller investigation I think will confirm the opinion I have expressed.

As the larva grows the old skin is shed, and it acquires another more suited to its development. More practical than men and women, their habits of economy are carried so far that when they have stripped off their old clothes they generally eat them. Frequently there is a rush among the members of the family as to who is to catch them first. The next slide represents a part of one of these discarded garments. It shows the skin covering the tail segments, the long branching hairs by which it was propelled through the water. Further up eight of those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beautiful epaulettes may be counted. The ladder-like structure consists of the two tracheal or air tubes, which traverse the sides of the body, while the cross bars are the dorsal plates. These two air tubes terminate in the tail segment. In the culex they project beyond the body. Here they are cut off flush with the skin of the back, forming two circular apertures. These are closed by valves when they descend so as to shut out the water. Occasionally some obstruction gets into them and they bend like a ring, and sweep the maxillary brushes across until the obstruction is removed.

The larva feed on organic forms attached to the stems and leaves of aquatic plants. They can be seen industriously sweeping their head brushes along and swallowing the product. And I should think the hunter after diatoms might be rewarded by finding some of these beautiful forms in the stomach and intestines.

They remain in the larval state much longer than the ordinary variety, and likewise show the remarkable effect of cold in retarding their development. During mid summer, the cycle of change from the deposition of the egg to the fledging of the matured insect may occupy a month, but in cold weather double that period is required. This is about three or four times longer than the time occupied by the ordinary variety. This is a great check upon the production of the insect in Queensland. It so often chooses shallow pools for the reception of its eggs, and these pools, under the dry winds and porous soils of our colony, dry up long before the period of incubation is ended, so that a very large portion of the insects die in the immature state. The next slide represents a composite creature. I had the good fortune to secure one of the larva passing into the pupa stage (see Fig. 5). It has burst through the larval skin, and the round projection on the shoulder is the head of the old larva, whose skin partially invests the pupa. The tail, with its propelling setæ, and a number of those beautiful epaulettes, are seen at the side. The next view (Fig. 6) is one of the pupa entirely free. This is a lateral view of his lordship. Attached to the last segment of the abdomen are two broad flappers, which are used to propel him through the water. From the sides of the head arise two breathing tubes, or thoracic spiracles. They project, and are thrust through the surface of the water for the purpose of inhaling air, which is distributed by various tubes through the body, and helps to develop the future mosquito. Through the partially transparent case of the pupa may be traced parts of the insect. The head, with its organs, wings and long legs are very neatly packed up inside. To show how these spiracles are situated, I have a view of the gentleman's back, taken as he floats on the water. He was alive, and had the good manners to remain still on the stage of the microscope while he was having his portrait taken. In the succeeding view (Fig. 7), is one of the spiracles detached. It differs in shape from the organ of the ordinary Culex, so that the pupa may be distinguished by this feature alone. In the Culex it has a resemblance to the leg of a Wellington boot with the top cut off transversely. In the Anopheles it is shorter and open for the most part of its length. It is not unlike the coal scoop seen in the parlour coal boxes in the old country. Before leaving I will show you the powerful swimming apparatus attached to his latter end. Being almost transparent, it does not photograph well, so this is taken on a dark ground, and brings the outlines very distinctly before you. The next object is a live cell with a number of the pupa disporting themselves in the water. You see the way in which the tail fans strike the water backwards, the rebound projecting the insect through the water as though it were a football driven by a powerful kick.

The succeeding picture (Fig. 8) shows the final stage being completed. Here the insect has been matured in the pupa case. This may occupy three days in summer or a fortnight in winter. It has been preparing for a change of life, and has seemed conscious of some impending change, for it manifests a general uneasiness, darting through the water with quick, jerky movements. Then, if carefully watched, the skin at the back of the head is seen to split; then the mosquito's head appears. Slowly the slit enlarges, and the shoulders and chest appear. No decided motion is traceable for a while, but still there is progress. Now the insect bends forwards, releasing a little of the wings and body; then bending backwards a little more of the legs is freed. So this alternate movement continues until the forelegs are free. These are then placed on anything near, and by the leverage they give the rest of the body is soon cleared. When the wings have been outstretched a few times they are put to their intended use, and bear the insect away to new fields and pastures green. In this figure the insect has succeeded in disengaging itself with the exception of the tips of its long legs, which are entangled in the pupa case. When once free the Anopheles are easily distinguished from the common variety. Here is one of the common kind (Fig. 10). It was photographed alive, so it is in a perfectly natural position. Its body hangs nearly parallel to the surface upon which it rests. It is supported by the fore and middle pair of legs. The hind pair curl backwards and project into the air. If ever you see a mosquito with its hind legs in that position, you may be sure it does not belong to the Anopheles variety. The latter uses the whole of his six legs to support itself. They are very long, the hinder ones much more so than the front. When they are planted firmly down the body projects at an angle varying from 30 to 45 degrees. The next slide (Fig. 9) is a natural photo. of one of these gentlemen. He was good enough to allow me to operate upon him, and the position shows very distinctly the difference between them and the ordinary mosquito when at rest. They can be picked out by any ordinary observer.

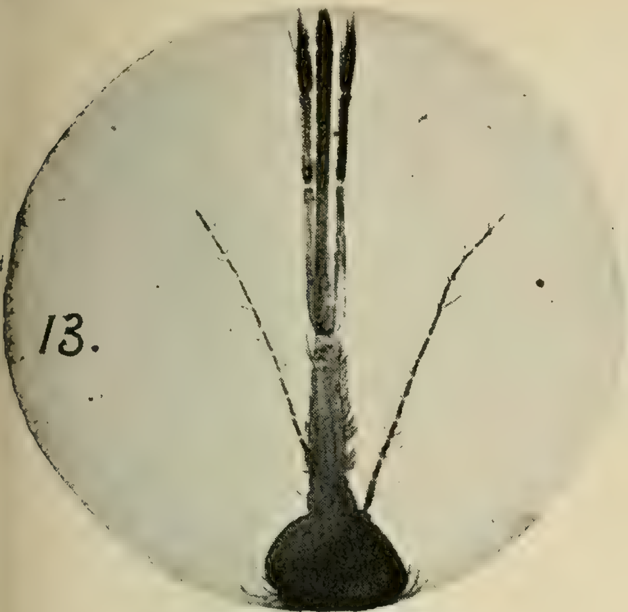
Another distinguishing feature is their spotted wings. One variety of the ordinary kind, usually called the Scots grey, have faintly spotted wings, but the marks are not nearly so distinct as in the Anopheles. In the figure (No. 12) the dark spots and light spaces are clearly manifest. In the light portions the scales appear to be absent, but a careful search shows them to be still there, but almost devoid of colour. This peculiarity of the wings is most beautifully seen when the microscope is arranged for dark ground illumination. The nervures of the wings are traversed by a double row of scales, set at an angle to each other, and a deep fringe of long sword-shapen ones hang from the lower border of the wing. The next slide (Fig. 11) shows this beautiful fringe. Here is one with scales taken from various parts of the body. They differ a good deal in shape, and are inserted like shingles on the roof of a house, the tip of one being overlapped by the base of the next. An exception to this is found on the back of the head ; here the scales are wedge-shaped and set upright like plumes.

Certain appendages of the head differ from the ordinary mosquito. One of these is the length of the palpi in the female. On the screen is the head of a female of the common kind. The palpi are short, not more than one-fifth of the length of the proboscis. In the next view (Fig. 13) is seen the head of the female Anopheles. The antennæ stretch out on each side, but the palpi are prolonged until they nearly equal the proboscis in length. That is a characteristic feature of this family.

The male organs of the head also have their peculiarities. The succeeding slide (Fig. 14) shows the proboscis in the centre. The palpi are longer, and near their tips expand into a club-like form. Below are seen the beautiful feathery antennæ so characteristic of the male sex. Many of you are aware that these are musical instruments, made and pitched to receive the notes of the female's song. She is the player, he the instrument upon which she plays, a relation not exclusively confined to the mosquito family.

The palpi are supposed to be organs of touch, but the insect does not appear to use them for that purpose. The organ of touch is the proboscis, the fleshy tube in which the lancets lie. The tip of this organ is deeply cleft, so as to form two fleshy lobes bearing hairs which are probably tactile. I have seen it pass over fruit, and up and down the ridges on the skin of my hand apparently seeking for a suitable place wherein to bore.

Very exaggerated statements are heard about the piercing capabilities of the lancets. My own experience goes as far as this: I have gone into their haunts with soft chamois leather gloves, such as housemaids use, on my hands, and they have pierced through these into my hands. The female possesses six lancets, these are so constructed that they all fit together like one weapon. The lingua or tongue is the largest and takes the form of a long hollow tube, the end sloping down to a sharp point. Around this the other lancets are grouped, these are too slender and delicate to be used separately, and fit closely around the stronger barrel of the tongue. Two of these lancets, the maxillæ, however, are barbed for a short distance from the tips on their exposed sides. Here is a highly magnified representation of one: a dozen teeth fine at the tip and then gradually enlarging are clearly visible. This constitutes a neat double surgical saw, not meant for cutting bone but flesh. These two barbed lancets are longer than the rest and project backwards into the head where they terminate in a sort of hammer head. In this photo, Fig. 16, you see how they project backwards beyond the rest. To the ends of this cross hammer, strong muscles are attached, and by them these two special lancets can be pulled up and down, sliding over the tongue which acts as a guide. So they are used to enlarge the original puncture and cause a freer flow of blood for the tubular tongue to suck. It is a peculiar and interesting provision for the insect's welfare. If the hypodermic needle of the principal lancet were simply thrust into the skin, unless it pierced a blood-vessel, little blood would flow, for the flesh would close round the sloping aperture and choke it up. But by the action of these little perpendicular saws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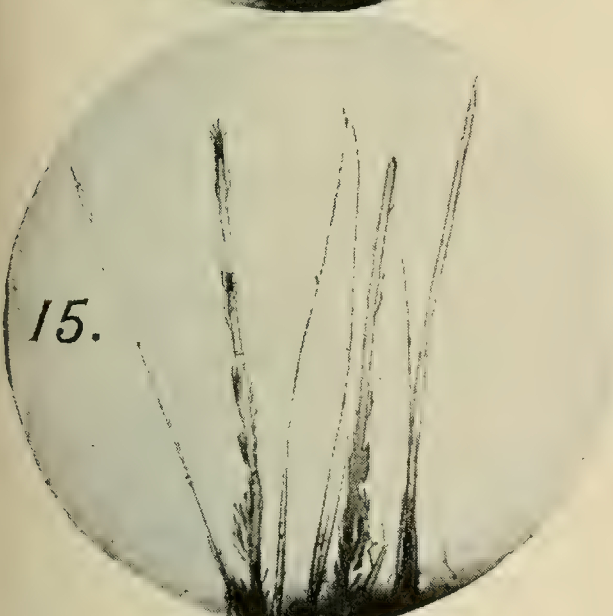
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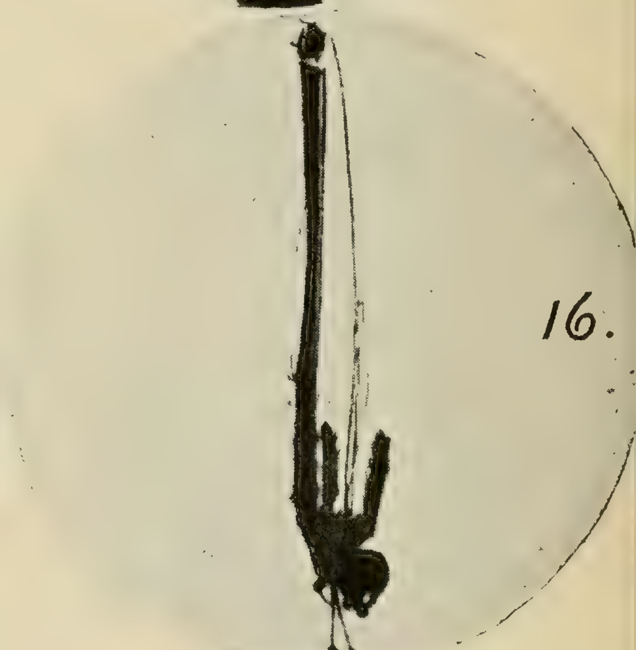
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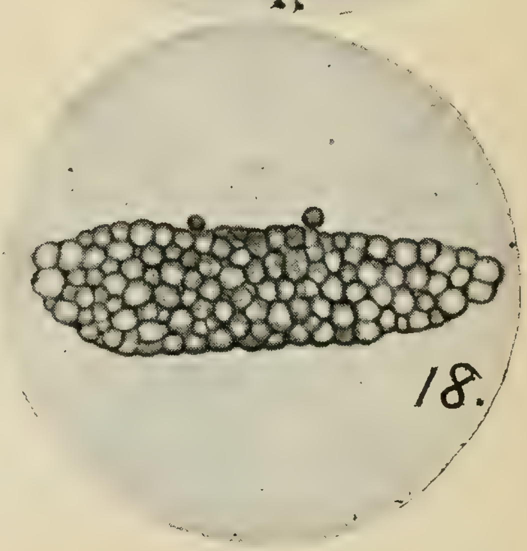

18.

the muscular structure of the victim is sawn around the point, the aperture is kept clear and a freer flow of blood insured. I made a little glass cell, big enough to hold a mosquito, and capable of being strapped to the finger, or on any other object, and of being placed on the stage of the microscope at the same time, and I found that they could not pierce the fruit of the fresh pineapple. They could freely suck up the juice, but when they tried to pierce the fruit they failed. I could see the combined lancets bending like a fishing rod under the force with which they were thrust against the fruit, but it was too tough for them to penetrate. The poison and salivary glands of this species are small and delicate and difficult to separate in an uninjured state. They lie in the prothorax contiguous to the neck, and appear like three long sacs, the central being the largest, and somewhat larger at the base. They have a granular appearance, and are each traversed centrally by a fine ductule, which collects the secretions. The three ductules then unite, forming one tube which joins at the neck, the tube proceeding from the opposite set of glands. It passes along the under part of the head until the base of the large sucking lancet is reached, where it terminates in a circular cup. This is now on the screen, see Fig. 20, the lancet is magnified so that it appears like the mast of a ship, and out of the centre of the cup there hangs the poison duct, looking like a ship's cable. This enables you clearly to understand how the poison and salivary fluids are conveyed from the glands to this tiny reservoir. When the lancet is thrust into the skin, that exertion probably injects the poison fluid into the wound, then the suction apparatus is brought into play. The base of the lancet curves back in the shape of a tube, and then expands into a hollow bulb or pump, Fig. 19. It really acts as a reservoir, and I think the work of sucking is performed by the ringed muscles of the æsophagus and proventriculus which are attached to spiny processes at the further end of the bulb.

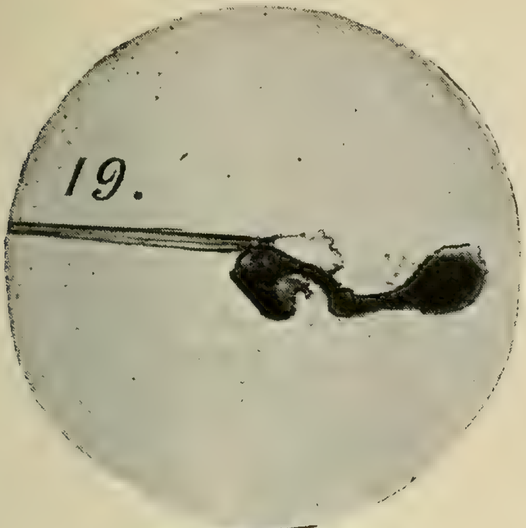
With regard to the function of respiration very elaborate organs are used to ensure it The oxygen of the air is as necessary for its existence as it is for us. We inhale air into the lungs, the corpuscles of the blood extract the oxygen and carry it to all parts of the body where blood vessels go. But if we could empty out all the blood, and after filling all the arteries and veins down to the minutest capillary vessels with air, and send it circulating through the system, that would be an illustration of the way in which insects breathe. The whole insects body is like a lung. Air is received by openings on the body called spiracles. Here, Fig. 17, is a photo. of one on the pro-thorax, immediately behind the first pair of legs. It is oval and fringed with a row of hairs like eyelashes, for filtering out dust. From the orifice large tubes proceed. These are built with a spiral fibre running round the interior wall. The india-rubber tube of a gas stove, with its spiral wire furnishes us with an illustration of it. So these tracheal tubes are kept distended for the passage of the air. They branch like a tree, gradually growing smaller the further they extend. By this means air is carried to all parts of the body. On each of the lower part of the abdominal segments are a pair of these spiracles, but so minute as easily to escape observation. This tracheal system is the source of an immense amount of trouble, and annoyance to the anatomist. Their tiny branches clasp every organ of the body, and being so tough and elastic are very difficult to separate without injuring them.

In the interior of the body occupying the space between the chest muscles and the stomach is a long transparent air sac, filled with separate bubbles of air or gas, Fig. 18. The bubbles vary in size from the three to two-hundredth part of an inch in diameter. A transparent silk bag filled with india-rubber toy baloons would resemble on a large scale the air bag of the mosquito. The walls of the air vesicles consist of some oily fluid, on rupturing the sac they float on water some time before they disappear. On the back of the thorax, where it joins the abdomen, are two club like organs projecting outwards. They look like an aborted pair of hind wings. Here is a view of them on the screen. The connection between them is simply a piece of skin torn from across the back. Scientists are not agreed as to their function. They are called halteres or balancers, because if one is cut off the insect cannot fly straight. They are therefore thought to be helpful in preserving a balance, just as the pole of a tight-rope dancer enables him to adjust. By some they are thought to be organs of hearing or of some special sense. They are freely supplied with nerves, and are jointed at the base so that they can be moved through the portion of the arc of a circle. I have seen them sink down to the sides, and then rise in a step by step motion until they have attained their altitude, then sink and rise in the same way every six or eight seconds.

We have in Fig. 21 a view of the stomach and other organs of the abdomen. The air sac is attached to the upper part of the gullet or æsophagus. The latter tube possesses strong muscular rings, and gradually expands as it enters the stomach. This is a very expansible muscular bag, swelling out to a considerable size after a good meal of blood. It may be dissected into five coats. The outer consists of a network of trackeal or air tubes, below this are two coats of muscular fibres crossing each other at right angles. Then comes a thin structureless membrane, and lastly the lining membrane of the organ. From the lower portion of the stomach five blind tubes arise, they look as if they had been grafted on the organ ; they rise parallel to the sides, then bending backwards, curl about the lower part of the abdomen, the outer end of each tube lying free in the cavity of the body. They are called the malpighian tubes, and are supposed to exercise functions similar to the liver. They appear to be divided into angular partitions, and large circular cells of a glandular nature dot their walls at regular intervals. A little lower on the screen lies the intestine. It is attached to the last segment of the body, showing the two terminal hooks. The whole of the organs of the abdomen are subject to a perisaltic motion ; they are drawn upwards towards the chest, and then thrust downwards with a regular rhythmic movement every few seconds. In the downward act, the muscular walls of the large intestine roll in concentric waves and force the contents onwards, and in the upward act the contents return to the end of the section in which they lie. There is thus a continual movement of the contents of the intestines, exposing them thoroughly to the digestive fluids.

This is the interior of a female, and these two large projections on each side are the egg sacs. In the unimpregnated state they are made up of clear globular cells, each with a nucleus not unlike two masses of colourless grapes. A big air-tube passes over the upper portion, giving off branches, which ramify not only over, but right through the egg mass. From one end of each sac, a tube leads to the lower orifice of the body, and when the eggs are ripe they pass down singly and are conveyed to the outside, being placed into position by the terminal hooks on the body. At the lowest point of the slide is seen what appears to be one of the renal capsules. It is an oval brown vesicle.

The parasites of Malarial fever have received a large amount of attention. Successive observers in various countries have been gathering up facts, and their life history is being steadily unravelled. Drs. Manson and Ross state that blood drawn from a malarial patient has a peculiar character. A large number of the red corpuscles are filled with pale protoplasm. In it are a number of black specks or rods. These concentrate in the centre, the protoplasm arranging itself around forming a little rosette. The walls of the blood vessels collapsing, the rosette floats into the liquor sanguinis. Afterwards the rosette splits, the black clump remaining and spores are set free. Some of these penetrate red blood corpuscles, as pale specks. These soon begin to throw out feelers in various directions, at the same time wandering round the limits of the cell wall. They increase in size by assimilating the hæmoglobin. By-and-bye appear the characteristic specks of black pigment again. These little detached feelers which wander about the blood fluid, and penetrate corpuscles, appear to be of the nature of spermatozoa, and propagate the disease. And the problem that struck Manson was, how do they first find their way into the malarial patient. In studying the matter, he concluded that the mosquito was the most likely source. Not having the opportunity of working out the subject thorougly, he enunciated his views and consulted with Dr. Ronald Ross, then about to proceed to India. By a series of most patient and careful experiments, he demonstrated some of the leading links in the process. Other experimentors look up the subject and none more enthusiastically than the Italian doctors, who have completed the subject. On Manson's recent visit to Rome, Professor Grassi showed him the pigmented vermicule in the inside of the mosquito's stomach. It had got there by being fed on the blood of a fever patient. Another specimen showed it penetrating the stomach wall between two epithelial cells. In another it rested in the interspace formed by the crossing of the muscular fibres. Then it was shown as a wart on the outer stomach wall. In the inside of this were seen the little black rods having gone through their cycle of development in the mosquito's body. When the walls of the capsule gave way these rods passed into the mosquito's body. Endowed with moving and penetrating powers, they travel along and easily penetrate the delicate skin of the poison and salivary glands. Sections of these glands were also shown him, actually containing large numbers of the little germinal rods, this clearly tracking step by step the whole process from the blood of the patient up to the gland connected with the proboscis of the mosquito. Numerous experiments have been made on healthy Italian peasants, and recently Dr. Manson's son offered himself as a subject. Pure Anopheles bred from larva were sent to Rome and allowed to bite fever patients.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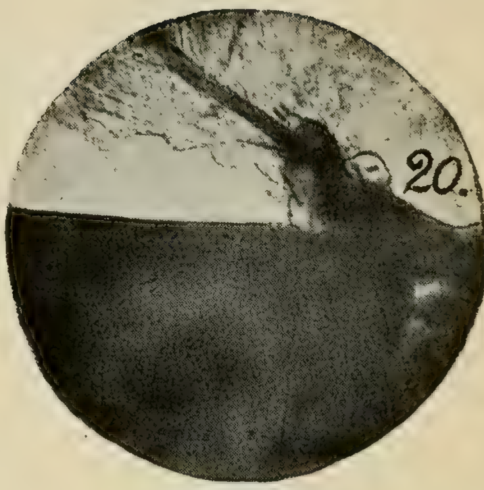
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Carefully protected from other contaminating influences, they were sent to London, and there permitted to bite young Manson. There in the English climate malarial fever was developed, and in his blood was seen the black pigmented and crescentic forms so characteristic of the disease. Italian doctors who have studied the subject, and whose opinion must carry weight, give their deliberate conviction that the mosquito is the only source of human infection. They believe that it does not originate from residence in a malarial district. It cannot be received from drinking impure water, neither is it spread from personal contact with a malarial patient, but solely by the bite of this peculiar species of mosquito. Being a blood disease, it requires a blood channel for its propagation, and this is found in this little insect. Break down the bridge of the mosquito and malaria will be stamped out. "A consummation devoutly to be wished." The scientists may be too sweeping in the assertion that the disease only originates in this way from a fever patient. I do not think it has been proved that malaria does not exist in any other living creature ; if it does, that might be the original source. The question of it is only derived from a diseased patient, Where did the first mosquito receive it ? This opens up a wide speculative field, but as the first mosquitoes are found in the Tertiary rocks of the Lower White River, Colorado, long before the beginning of human history, it is evident that the answer would be difficult to find. The practical fact that this is the main source of contagion now is too clear to admit of doubt.

Another fact of great value to the world has recently come to light in these researches. Medical men in tropical countries have a great many patients who are seriously ill, but yet there are either few peculiar symptoms, or they are of such a general character that the doctor cannot put them down to any special disease. A large number of these cases are of malarial origin, which can be determined by a simple examination of the blood. A few minutes with a good microscope now settles the question, which formerly worried for months earnest medical practitioners.

I have another slide, Fig. 22, which I am sure will interest Mr. Pound. He knows a good deal about cattle ticks, and our pastoralists have been sore sufferers from their ravages. I do not know whether they will derive any consolation from the fact that they are not the only sufferers, but that mosquitoes likewise suffer from ticks. And the cattle tick to them is but a pigmy. Comparatively speaking, these ticks would be about the size of a man's head to the human body. I caught a male Anopheles lately which looked sickly. He had good reason. Three ticks were boring into his neck, another on his chest, a fifth just below the insertion of the wing, and a sixth was affixed to the last segment of the abdomen. Here is a photo. of the last one. In colour they are of a warm orange approaching to red; possess six jointed legs, the body being oval, measuring one hundredth of an inch in diameter and a little more in length.

Two more slides will complete our subject. The Anopheles male and female. The gentleman comes first, Fig. 23, because he is an innocent and good-hearted fellow. He never soils his lancets with blood. By nature and practice he is a strict vegetarian. The juices of fruit and the nectar of flowers are his banquet. Now then for his missus, Fig. 24. Could he only persuade his wife to follow his example we would not grumble. But the missus has a strong will of her own, and prefers the ruby wine of blood.

Professor Celli states that the Anopheles do not make the humming sound so characteristic of the ordinary Culex, and persons may be bitten unconscious that they are near. Perhaps, like the little black bush mosquito, they go straight to business without hovering around. Those that I have kept in captivity make as much noise as the ordinary variety. The sound is more shrill, and reminds me of nothing so much as the skirl of the Scottish bagpipes at a distance.

During the day they are quiet, sometimes they will stand in one place for hours together. At the approach of sunset they become active, singing and flying continuously, as if that was their particular time for work and they were determined to make the most of it.

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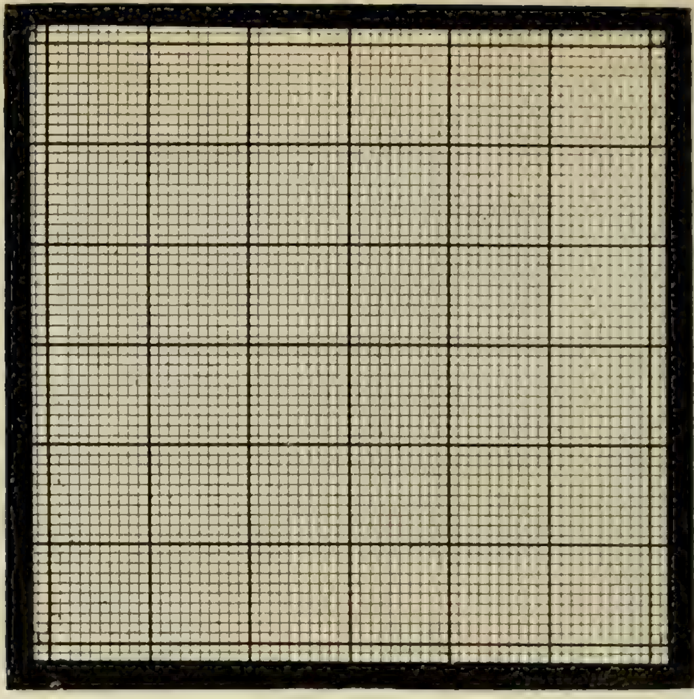
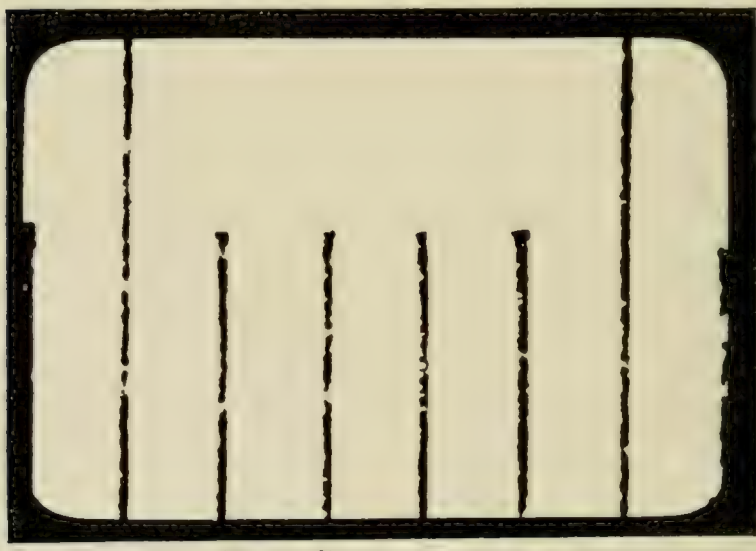
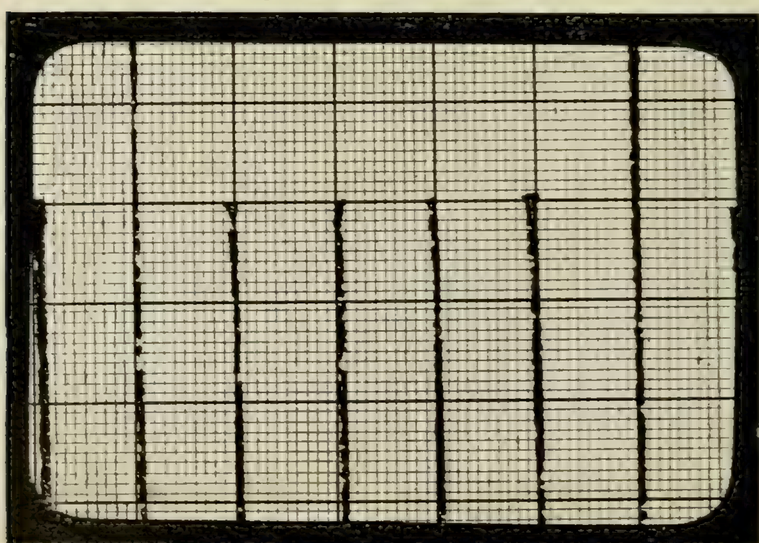


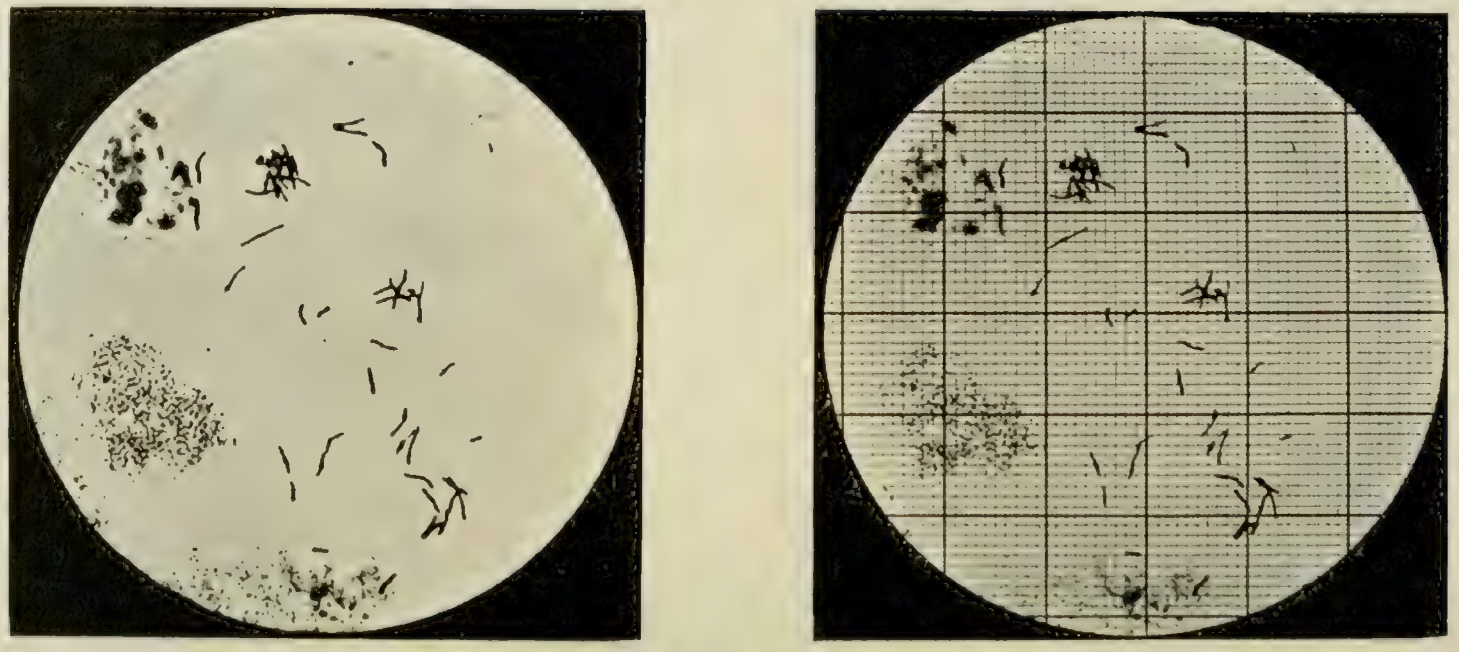
THE SCALE.
Each small division represents a millimetre, and is equivalent to a *micron* magnified 1000 diameters.



ACTUAL PHOTO-MICROGRAPH.
Part of a Zeiss Stage Micrometer divided into 100ths of a MM, magnified 1000 diameters.



APPLICATION OF THE SCALE TO THE PHOTO-MICROGRAPH.



THE BACILLUS OF TUBERCLE. X 1000.

PHOTO-MICROGRAPHY AND PHOTO-MICROMETRY.

(PLATES V.—VIII.)

By JOHN THOMSON, M.B. (President).

(Read before the Royal Society of Queensland, 20th October, 1900.)

THE ordinary working microscopist seldom refers to the amplification he is obtaining, but speaks of the objective and ocular he employs. He does not bother much with a stage or eye-piece micrometer—nor need he in his every day task—but should he desire to record his observations, either by drawing or by photography, it is important he should know the magnifications given by certain combinations and arrangements of his apparatus, and better still if these magnifications be of recognised standards.

Looking at many, perhaps most, of the reproductions found in microscopical literature, one cannot but recognise their uselessness for comparison purposes. Some, chiefly the drawings, represent scales difficult to calculate, such as 140 or 330 diameters, perhaps with the units added as 143 or 337 ; others, mainly photographs, although originally perhaps of the value attached to them, as 500, 750, or 1000 diameters, have suffered at the hands of the photo-mechanical printer, and losing their true dimensions have ceased to be standards.

As so much educational work is now done with the optical lantern, its $3\frac{1}{4} \times 3\frac{1}{4}$ slide seems to be accepted as the recognised size of photo-micrographs, whether on glass or paper ; and the usual masks having circular openings of $2\frac{7}{8}$, $2\frac{7}{16}$, and 2 inches respectively appear admirably suited for the micrographs referred to.

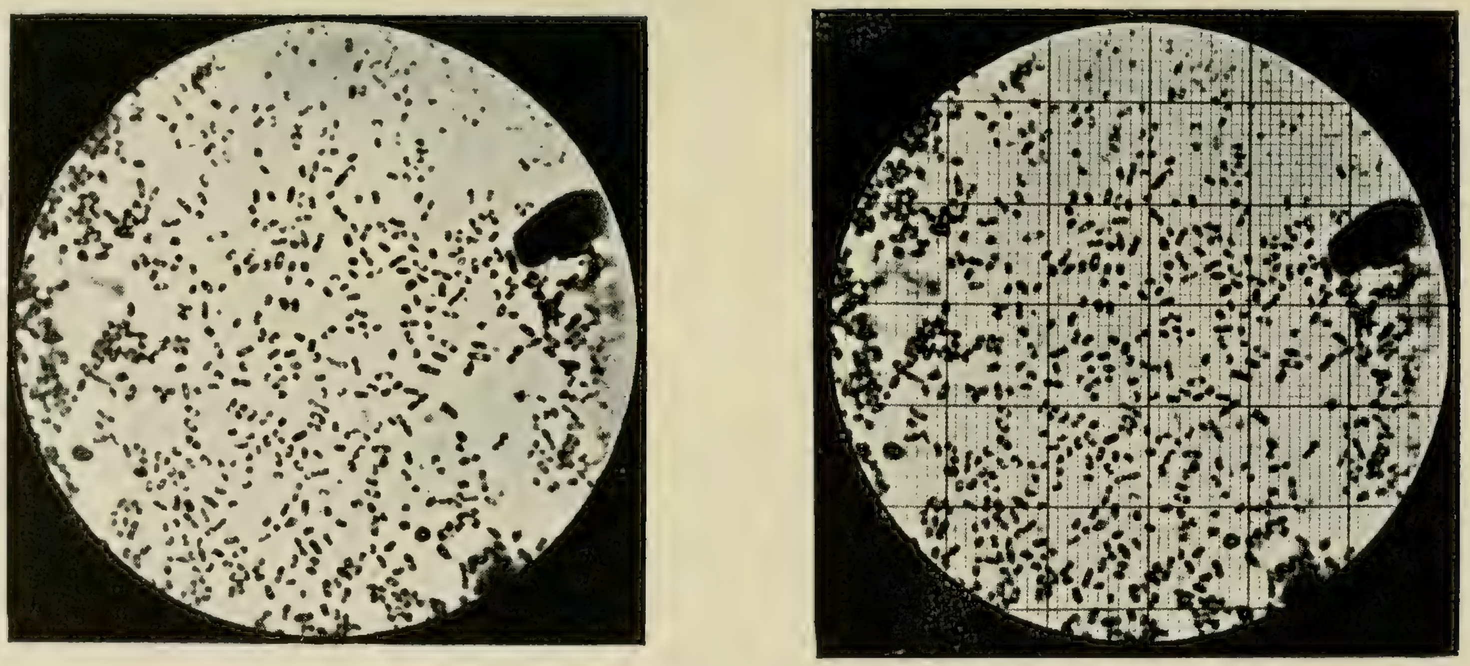
With the lower powers it may be impossible to insist on the use of standard amplifications, for something has to be sacrificed to pictorial effect, or a general or bird's eye view has to be given, and the whole object crowded into the opening of the largest mask ; but, surely, with the higher magnifications, where the pictorial has given place to the diagrammatic, it would be perfectly practical to adhere to recognised numbers, as, say, 125, 250, 500, 750, and 1000 diameters—perhaps the 750 might be omitted.

These numbers can easily be obtained, verified and recorded by photography, for future reference.

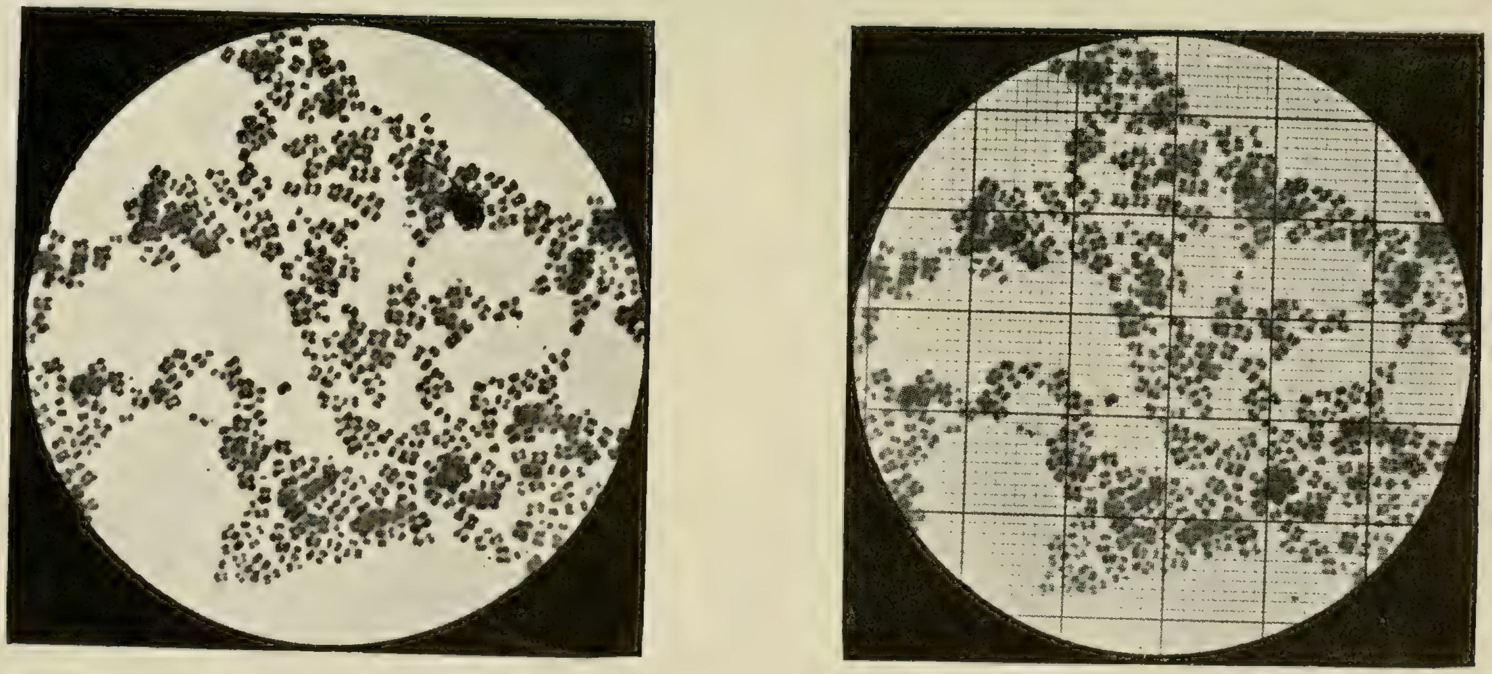
A stage micrometer is essential, preferably one cut to the 10ths and 100ths of a millimetre rather than to the 100ths and 1000ths of an inch, as the subsequent calculations by the former are much easier. I have six of these micrometers in my possession, one by Zeiss, and the other five by London makers, and I can strongly recommend the German slide as being infinitely cleaner and truer cut than any of the others.

This slide is then placed on the stage and examined in the usual manner, care being taken that the microscope is at its best. The following items should then be carefully noted and recorded—whether the nose-piece is attached, and how this affects the tube length—the condition of the draw-tube, and if extended, the readings of its scale—the eye-piece, if any, employed, and, if a projection one, the position of its spiral focussing arrangement. The camera is now attached to the microscope, and the joint made contact-tight, not merely light-tight. With a Hooke's key the picture is readily focussed on the screen, and by using a metric rule and moving the camera bellows to and fro, the required scale is speedily found. Say 1000 diameters are wanted. The 100th of a millimetre as cut on the stage micrometer must be magnified on the ground glass equal to 10 millimetres—that is, 1 centimetre. It is well to have a scale on the camera to show the bellows extension. Most cameras are so provided, but if not, it is a very simple matter to attach to the base-board a yard tape, or a piece of one. Now clamp the bellows and photograph the enlargement, and keep an accurate record of the optical and mechanical arrangements, including the total distance from the slide on the stage to the ground glass screen, and it will be very easy on some other occasion to adjust the apparatus for similar amplification.

With my own appliances I obtain 1000 diameters by using a 2 MM ($\frac{1}{12}$) apochromatic homogeneous immersion lens—short or Continental tube, with nose-piece attached—draw tube opened



The Bacillus of Plague. X 1000.



SARCINA LUTEA. X 1000.

to 140 of its scale—projection eye-piece No. 4 set to 2 on its collar—and a bellows extension giving $29\frac{3}{8}$ inches between the stage and the focussing screen.

All photo-micrographs obtained under these conditions will represent a magnification of 1000 diameters; but it may be necessary to prove this, to demonstrate it to others, or to find a means of measuring and comparing other prints of similar amplification, and by means of another scale this can be effected.

The basis of this scale is the *micron*, known by the symbol μ—the unit of microscopic measurement—the 1,000,000th of a metre, or the 1000th of a millimetre, or, practically, the $\frac{1}{25400}$th of an inch; and yet there are many objects constantly under observation which are but fractional parts of a *micron*.

To prepare this scale, draw on a smooth surfaced piece of Bristol board an area of 10 inches square, and divide it vertically and horizontally by 100 lines, each 10th line both ways, being intense. Reduce this scale by the ordinary methods of photography until each 100th division is exactly millimetric, and each 10th, or broad line, centimetric. The millimetres on the negatives are equivalent to *micra* magnified 1000 diametres. A glass positive or transparency from this, when varnished or collodionised for protection, can be used as a scale, and if the varnished surface is imposed on the object to be measured there is an absence of parallax. This scale can also be printed on the same glass or paper positive as, and with, the object, and the dimensions of the latter are at once, and graphically, apparent. This double process is very simple. Submit the glass or paper to the scale negative, by contact, in a printing frame, with a short exposure; then change the glass or paper to the object negative, and give a full exposure; develop, and the results should be satisfactory. Of course negatives are required of sufficient density to give contrast.

I need hardly add that the scale I have described is for a magnification of 1000 diameters, and that any other amplification must have its special scale.


I
II
III
IV
VI
V
VII

AUSTRALASIAN WOODBORING HEPIALIDAE.

Charagia daphnandræ "*Lucas,*" *C. eximia* "*Scott,*" *C. ramsayi* "*Scott,*" *C. Virescens* "*Dbld.*"

(PLATE IX.)

By R. ILLIDGE

AND

AMBROSE QUAIL, F.E.S. (London.)

[*Read before the Royal Society of Queensland, December 8th, 1900.*]

IT has been a very great pleasure to the writer to examine the living larvæ, pupæ, &c., of three species of this interesting group of lepidoptera, viz., C. daphnandrae, C. eximia, C. ramsayi, from Queensland, as we have also been making enquiry into the life history of C. virescens, a New Zealand species of similar habits and closely allied to the above. Mr. Illidge attached descriptive labels to the sticks of wood which contained the larvæ, and furnished notes from time to time on the habits of the several species under observation.

While unpacking one of these parcels, a Maori saw the larvæ and exclaimed "they are very sweet food," and when informed that they were from Australia, he said they were very like the New Zealand grubs which are in "white pine" and the "houhere" — (thousand jacket), the former — a Longicorne Coleopteron, he said they eat raw, but the latter — Charagia virescens, cannot be eaten raw, but is very nice food when roasted. "Houhere" is the Hoheria populnea—"Cunn," in which we have found C. virescens larvæ.

Ova.

We obtained imagines of C. virescens plentifully during the month of September this year, by searching treetrunks in the bush where they were known to be. They emerge half an hour or so before dark, and the males take flight within half an hour after dark. In consequence of the wings being limp when first taken they were placed in a rather large breeding cage, having gauze sides, so that though for some time a dozen of each sex were in this cage together, none were observed to copulate. This was rather a surprise as we thought the close proximity of the sexes would induce copulation. The females commenced to deposit ova immediately after dark, and in a short time there were countless numbers of ova at the bottom of the cage.

One pair were kept together until they died, ♂ on the third day ♀ on the fourth, they were never seen in copulation, but the female deposited ova every evening. The abdomen of the female was opened after it died, and the space within was at the thoracic end, the pressure of the remaining ova being towards the anal extremity of the abdomen.

The ova within the abdomen are connected by a continuous thread-like tissue, and are yellowish in colour, they are extruded automatically at random, and must in a state of nature fall to the ground about the roots of the trees upon which the females probably rest while depositing. The ova of C. virescens are spherical and smooth, when first extruded they are yellowish, but in a few hours become black in colour. A female C. eximia which emerged during the journey from Queensland, commenced to deposit ova freely the first evening after its release from durance vile. The ova of C. eximia are very much smaller than those of C. virescens, they are spherical, smooth, yellowish at first, and afterwards become black in colour.

Hitherto we believe there is no record of the colour change in ova of C. virescens: Hudson says* "The female lays an enormous number of small, round, yellowish eggs." With regard to the Australian Charagia, the eggs "are of a pale yellow colour, but soon turn to a slaty gray hue" (Illidge), there is a grayish hue on the ova of C. eximia, which we have also observed on the ova of C. virescens, and of some Porina, but cannot detect it under the microscope. It is important to note this colour change which we suspect is characteristic of the whole group, and the real colour of the eggshell is black

* New Zealand Macro Lepidoptera.

and remains so after exclusion of the larva in Hepialus, Charagia, and Porina.

The ova obtained were all infertile.

Larvæ.

These insects live throughout the larval and pupal existence within the branches and trunks of trees. C. daphnandræ in Eugenia, Daphnandra, Tristania, Eucalyptus, &c. (Illidge), C. eximia in Melaleuca, &c. (Illidge), C. virescens we have taken commonly in Hoheria, which is stated to be restricted to New Zealand, but Hudson gives also Olea, Aristotelia, Leptospermum, and Melicope, which include Australia in their range of geographical distribution. It has been noted elsewhere* (Illidge) that the food of these larvæ consists largely of the sap of the tree. We have often observed that if wood containing larvæ of C. virescens is turned upside down, the fluid contents, undoubtedly sap, will run out of the inverted burrows.

The burrows of Charagia are horizontal in the first part, and then perpendicularly downwards; the entrance is wider than the continuation, and has an external cover from the first constructed of silk with particles of bark worked in, making it inconspicuous.

(I.) C. daphnandræ constructs a very loose external cover much exceeding the size of the burrow entrance; just prior to the pupal stage an inner operculum is constructed horizontally covering the perpendicular shaft. The length of burrow varied from four to nine inches (Illidge).

(II.) C. eximia forms an extremely stout external cover, and the prepupal operculum is inner to the external cover not horizontal as in the other species. Length of burrow, one to three feet or more (Illidge).

(III.) C. ramsayi also forms a stout external cover, but instead of an operculum as in the preceding species, spins a web of pure glistening silk around and over the opening, as do also C. splendens, C. lewinii, and C. lignivora It is worthy of note that these four species which spin the silken web inner to the external protecting cover before pupating should be all strongly adorned with silvery markings, whereas those which form the operculum are either devoid of such or have only traces of them. They thus seem to fall naturally into two groups.

(IV.) C. virescens constructs a compact close-fitting external cover, and the prepupal operculum is horizontal to the

* Proc. Roy. Soc. Q'land, Vol. xiv.

perpendicular shaft as in C. daphnandræ. Length of burrow, about one foot.

The larvæ of each species can hang by a thread of silk, and we have noticed that the perpendicular shaft of C. virescens is thinly lined with silk threads. Unfortunately, we have no description of the newly-hatched larvæ of either species. Apart from the interesting habits of these insects, we hope a description of their structure will have a scientific value. It is hardly necessary to mention that these larvæ are bilaterally symmetrical, and the segments are as follows :—Head, Pro-Meso, Postthorax, each with a pair of legs, and ten abdominal segments, some of which have feet.*

(I.) C. daphnandræ larvæ live nearly two years (Illidge); at six months the length is about ¾ inch. Colour : Head, dark reddish brown ; Prothorax, pale brown scutellum ; remaining segments, cream colour. Spiracles are brown with outer rims. Thoracic legs, brown. Abdominal feet and claspers, cream colour with dark brown terminal hooks. Setæ are brown with minute blunt thorns. The skin is comparatively smooth. The head is larger than succeeding segments, larva tapers to anus.

Head : striated, setæ numerous ; ocelli, six in number on each lobe, arranged in two rows of three each, they are yellow with a black area on inner side ; antennæ are immediately anterior to the two lowest ocelli ; spinneret is long and slender.

Prothorax: anterior edge of scutellum darker with a marginal series of setæ equidistant ; a midlateral concavity or scutellum is apparently lined with soft down-like hairs, within the concavity are three setæ, and below it one seta. The spiracle is immediately posterior, below the scutellum, and about twice the size of the abdominal spiracles ; anterior to the legs a tubercle bears two setæ, on base of legs are two anterior and one posterior hairs, and at the lower end of each joint there are several hairs.

Mesothorax : a small anterior subsegment bears the dorsal (trapezoidal ?) tubercles with one seta, and a small lateral tubercle with one seta. The larger subsegment bears on either side a marginal series of three equidistant setæ, and one posterior lateral seta all on one well defined area.

* Abdominal feet proposed by Dr. Sharp to be used instead of the older term prolegs, pro being usually the term for anterior, whereas in larvæ the thoracic legs—identical with imaginal legs, are the anterior legs. The term abdominal feet seems more appropriate.

(equivalent to the prothoracic scutellum), below are a central and a lower anterior tubercle each with one seta.

Postthorax corresponds with Mesothorax but has a less distinct scutellum like area.

Abdominal segments 1 to 8 have spiracles, 4 to 6 have abdominal feet, and 10 has claspers. Segmental incisions are composed of two minor subsegments without tubercles or setæ, the large middle subsegments bear all tubercles. Anterior (dorsal) trapezoidal bears one seta, posterior (subdorsal) tubercle one seta, supraspiracular (lateral) tubercle bears one long one short setæ, it is below the anterior trapezoidal; the spiracle is slightly anterior below the supraspiracular tubercle; a little lower are the two subspiracular tubercles posteror to the spiracle, almost in line, each bearing a remote seta; a lower anterior tubercle bears one seta, and a subventral tubercle bears two setæ. The abdominal feet bear four anterior setæ on base (these correspond to the subventral tubercle with two setæ and two ventral setæ). Segment 9 has anterior and post dorsal tubercles each with one seta; anterior and post subdorsal tubercles each with one seta; two tubercles each with a single seta, one below other on posterior edge of segment; a subventral tubercle with two setæ. Segment 10 has two dorsal tubercles, two lateral tubercles, each with one seta; immediately posterior to the anal flap there is a tubercle with one seta on either side. There are four setæ on the base of claspers.

Ventrally anterior to each prothoracic leg there is one seta; posterior to each thoracic leg one seta, these can be observed also on the inner side at the base of the abdominal feet. On abdomen 1, 2, there are two tubercles with one seta each (already mentioned), outer to the leg seta on 7, 8, there is only one tubercle outer to the leg tubercle, and on 9 there is only the leg tubercle with one seta. Terminal hooks of the abdominal feet are one central row of strong hooks and one outer row of smaller hooks, the circle is incomplete on the outer side; the claspers have two rows of similar hooks but only on the inner side of claspers.

C. daphnandræ at twelve months length is about $1\frac{3}{16}$ inch. Head not noticeably larger than other segments, which are uniform to about 7 abdominal; 8, 9, 10 taper somewhat smaller. The principal subsegments are swollen in appearance and the incisions very pronounced. Colour similar to early stage but with a reddish tinge and a thin mid dorsal line. Head is very dark brown. In every detail of structure it corresponds with younger larva.

C. daphnandræ full fed at nearly two years; length about 2 inches. Head smaller than Prothorax, abdominal segments 4 to 7 are slightly larger than anterior or posterior segments. Head very dark brown; prothoracic scutellum pale brown; thoracic and abdominal segments dirty yellowish white; anal segment reddish colour. A slight mid dorsal line of brownish colour, and segmental incisions are reddish. The structure as preceeding, black concavity of scutellum has three setæ; terminal hooks of abdominal feet are incomplete on outer side, claspers likewise as before described. Setæ retain minute blunt thorns.

(II.) C. eximia larvæ live (?) two years, at nearly twelve months length is 1¼ inch. Colour: Head mahogany red; Prothorax light brown; thoracic and abdominal segments cream colour, with greenish mid dorsal line and incisions. Tapers from head to anus. As regards structure, the position of tubercles and number of setæ exactly corresponds with C. daphnandræ. Black concavity of scutellum contains three setæ and one below. The spiracles of abdominal segments are well forward on anterior edge of principle subsegment. Circle of terminal hooks is complete on abdominal feet, but the claspers have only the inner rows of hooks. Setæ are almost smooth but have a few minute thorns near base. Head of larva very much smoother than C. daphnandræ and it is shining.

C. eximia full fed at nearly two years, length about 2 inches. Colour: Head red brown; Prothorax pale brown; thoracic and abdominal segments are cream with pinkish tinge. All segments about same size, except 9, 10 abdominal, which are smaller. Can only distinguish one seta within the black concavity of scutellum. Terminal hooks, two very distinct rows encircling extremity of abdominal feet, of claspers as before described.

(III.) C. ramsayi (?) two years, length 2 inches. Colour: Head dark brown, striated; Prothorax scutellum, pale brown with rosy tinge; thoracic and abdominal segments yellowish, thin darker mid dorsal line. Segments apparently uniform in size to 9, 10. Terminal hooks of abdominal feet complete, of anal claspers like a figure 3 without hooks, posteriorily as in C. virescens. Tubercle setæ smooth. Skin smooth.

C. ramsayi full fed length 3 inches. Colour: Head reddish brown; Prothorax, very pale brown; thoracic and abdominal segments, yellowish. Head smaller than Prothorax, abdominal segments 3 to 7 are larger than the anterior and posterior segments. Prothorax scutellum has within the black concavity three setæ. Terminal hooks of abdominal feet complete, anal claspers as before described. Tubercle setæ smooth. Skin smooth.

(IV.) C. virescens live (?) three years, there is a great difference between the larvæ which may be regarded as full fed, some about 3 inches, some about 4 inches, it is not improbable that the larvæ which produce female imagines, live a year longer than those which produce males. The larvæ of C. virescens are described elsewhere,* but it may be worth noting that the black concavity of scutellum contains three setæ in young larvæ, but one only in adult larvæ, likewise in young larvæ the terminal hooks of abdominal feet are incomplete, but in full fed larvæ they completely encircle the extremity of the abdominal feet. It might also be worth mention that these larvæ, and probably the other species also, vary in colour much in accord with the colour of the sap wood in which they feed.

PUPÆ.

The pupal stage is of short duration, "from six weeks to occasionally as long as three months (Illidge).

(1.) C. daphnandræ pupa. Colour: Head and prothorax very dark brown, remaining segments are yellowish brown with reddish shading on posterior edge of segments, spines and spiracles are dark brown.

Head dorsally and ventrally, dorsum of Prothorax, and anterior dorsal area of Mesothorax are deeply pitted and striated in a manner resembling that of the larval caput. The wing cases extend to the anterior edge of abdominal 3; antennæ extend only to base of wing cases of which the second pair of legs forms the costal margins, the first pair of legs are inner to the second. Margin of hind wing cases show a little at the outer margin of the fore wing cases. Abdominal segment 1 is dorsal, small and without spiracles; 2 has spiracles subdorsal and apparently partly covered by edge of wing cases; 3 to 6 have normal spiracles in lateral position, these segments also have setæ — small but definite, which correspond in number and position to the larval tubercle setæ; 7, 8, have scars of spiracles, the four terminal segments are fused together.

* Proc. Roy. Soc. Q'land, Vol. xv, and Trans. Entom. Soc. London, 1900.

Dorsal spines commence on the posterior edge of Meso and Postthoracic segments, abdominal 1, 2, have an anterior ridge of spines; 3 to 7 have anterior and posterior series, the spines of anterior series being strongest, and of 7 more so than the others.

Ventral spines, a few posterior on segment 3, a strong undulating series posterior on 4, 5, 6, an anterior disconnected series and a posterior series on 7, the latter not so strong as those of other segments; 8 to 10 are smooth.

(II.) C. eximia pupa appears to correspond in all details of structure with C. daphnandræ.

(IV.) C. virescens pupa compared with C. daphnandræ has a smaller dorsal segment 1, the spines of the abdominal segments are also stronger in the former, this may be associated with the greater length of the burrows.

When the time for emergence of the imago arrives, the pupa "by alternately extending and contracting the segments" (Illidge) aided by the spines, forces its way up the perpendicular shaft, through the prepupal operculum and external cover (when the latter has not been removed prior to pupation). The species with short horizontol burrows extend the anterior pupal segments beyond; C. virescens which usually has long horizontal burrows, remains wholly within the entrance.

On dehiscence the pupa ruptures longitudinally from the dorsal posterior edge of Mesothorax to the ventral extremity of wing cases, and the sutures of the Pro-meso, and meso-post thoracic segments become partially split, the ventral head piece with antennal case becomes wholly detached, but the leg cases appear to remain intact, though I am not sure that in some instances the cases of first pair of legs become partially severed from the second pair.

The remarkable identity of structure in all stages is a clear indication of very close relationship between Charagia daphnandræ, C. eximia, C. ramsayi, and C. virescens.

Explanation of Plate.

I.	C. daphnandræ	prothorax 1st year (x 4).
II.	,,	3rd abdominal segment (x 4).
III.	,,	10th ,, ,,
IV.	,,	anterior pupal segments (x 4).
V.	,,	posterior ,, ,, (x 4).
VI.	,,	Terminal hooks of abdominal feet
VII.	C. eximia	Dehisced pupal headpiece (nat. size)

QUEENSLAND LEPIDOPTERA.

By THOMAS P. LUCAS, M.R.C.S., Eng.
L.S.A., Lond., L.R.C.P., Edin.

[Read before the Royal Society of Queensland, 16th February, 1901.]

ARCTIADÆ.

CHOOREECHILLUM, NOV. GEN.

Head smooth. Tongue well developed. Palpi short, loose scaled. Antennæ in ♂ ciliated. Thorax smooth beneath. Abdomen moderate. Tibiœ smooth scaled, posterior tibiœ with spurs moderately developed. Forewings, 2 from $\frac{2}{3}$, 3 and 4 connate, 7 and 8 out of 9, 10 connected with 9. Hindwings, 2 from beyond $\frac{1}{2}$, 3 from angle, 6 and 7 stalked, 8 anastomosing with cell to middle.

CHOOREECHILLUM DISTITANS, NOV. SP.

♂ 60 ♏♏. Head black; face orange. Palpi ferrous, tipped with black. Antennæ black. Thorax, black on dorsum, orange at sides, with small dots of black surrounded by orange. Abdomen orange, with black dorsal segmental bands and lines of black dots laterally. Legs black. Forewings broadly dilate, costa gently rounded, hindmargin rounded, black with a broad white median fascia, narrowing toward middle and diverging again on inner margin; a small white dot in posterior band of black at $\frac{3}{4}$ costa, two small elongate white streaks near apex opposite hindmargin, and a fourth opposite anal angle. Cilia black. Hindwings, as forewings, with white median band filling half wing; one very minute white dot opposite middle hindmargin. Cilia black. One specimen from the late Mr. Handley, taken near Cairns. Another in Brisbane Museum.

SYNTOMIDIDÆ.

SYNTONIS LUCTA, NOV. SP.

♂♀ 22-28 ♏♏. Head, palpi, and antennae black. Thorax black, collar orange. Abdomen orange, with narrow black segment rings, anal segment black. Forewings narrow, costa gently rounded, hindmargin very obliquely rounded, black, with ochreous spots, more or less suffused with orange red. Forewings with first two spots across middle of wing, subcostal one small, broader posteriorly, inner one elongated toward but not as far as anal angle; the second row of three dots are small, the subcostal one linear, and alone, the inner two contiguous divided only by vein four. Cilia black. Hind wings orange red, with a fine black line dividing off one fourth costal portion, and bordered by deep black, narrow on inner margin and inner half of hind margin, and thence covering anal half of wing. Cilia as forewings. Bellenden Ker Lucas-Rye Expedition.

BOMBYCIDÆ.

BOMBYX FRUGALIS, NOV. SP.

♂ 35 m.m. Head, palpi, thorax, and abdomen sepia fuscous, or smoky brown. Antennae, stalk ochreous white, pectinations ochreous yellow, 1—4, narrowing rapidly before apex. Forewings costa straight, apex rounded, hindmargin gently rounded; sepia fuscous or smoky brown. Forewings costa darker fuscous, veins reddish fuscous, a small diffused discal spot black, a few scattered irrorated white scales on borders, and a darker suffusion on inner margin. Cilia darker than ground colour of wing. Hindwings as forewings. Cilia whitish grey with fuscous line at base, and sending transverse bars across. Brisbane at light.

BOMBYX FIGURATA, NOV. SP.

♂ 32 m.m. ♀ 45 m.m. Head rich chocolate fuscous, face reddish ochreous. Palpi reddish ochreous, fringed with chocolate fuscous. Antennæ, stalk chocolate fuscous, pectinations reddish ochreous. Thorax fuscous drab, with a white and fuscous irrorated band or collar, a whitish line continuous with costa of forewings, and posteriorly a conspicuous broad white patch on either side. Abdomen grey white, with anal segment fringed with fuscous hairs. Forewings, costa gently arched, hindmargin rounded, woolly white, with fuscous and chocolate bands and lines; fine costal chocolate line thinning at apex, a broad transverse wavy chocolate band near base from costa to opposite $\frac{1}{8}$ inner margin; a second curved band from $\frac{1}{3}$ inner margin, with three waves to median vein, thence bent at right-angles along median to $\frac{2}{3}$; the transverse half is lighter fuscous between boundary lines, and the median vein half contains three conspicuous white dots; a third band curves round from $\frac{2}{3}$ costa, and parallel with hind margin, to $\frac{2}{3}$ inner margin, anterior border toothed, centre of band light grey, the costal space divided by portion of second band on median line, and bounded by first band and by a third band, is suffused with light fuscous; a rich chocolate line extends from before apex of costa in short waves to before anal angle; a submarginal lighter line is connected with a finer marginal line by short bars. Cilia light fuscous. Hindwings woolly white, with a few light fuscous hairs on costal margin, and a pale fuscous suffused spot near anal angle. The ♀ is larger, is similarly marked, but has a smudged appearance, as the ground colour is ashy grey, and the marks, both the darker boundary lines and the enclosed spaces are of a much less definite tint, and appear as if smudged with ashy grey. One pair taken by Mr. Illidge, Brisbane.

BOMBYX EFFUSA, NOV. SP.

♂ 34-38 mm. Head, palpi and antennae ferrous fuscous. Thorax black, almost hidden by long hairs of deep ferrous fuscous, inclining to purple. Thorax fuscous with more or less scattered black hairs. Forewings, costa gently rounded toward apex, hind margin rounded, fuscous, with diffusions of deep black, markings of ferrous or chocolate, and ochreous white lines. Forewings, costa edged with deep fuscous inclining in some specimens to black; base of wing ferrous black extending as a black line one-fourth along inner border; a rich bar of black from $\frac{1}{6}$ inner margin to median vein, nearing base of wing; this is bordered posteriorly by two circular star-rayed ferrous figures, resembling sea anemones, the encircling rays annulated with white, a third like figure extends to subcostal area, and a fourth runs along subcostal area, but darker and without the ferrous; the four form a chain concave posteriorly, bordered by a rich chocolate discal spot, edged on both borders with white; a wavy dentate band from $\frac{3}{4}$ of costa to $\frac{3}{4}$ of inner border, variously coloured black and white lines, and more or less tinted with ferrous red; from this band whitish ochreous lines run along the veins to a sub hindmarginal line of black, forming cells more or less tinted with red ferrous; all borders white; a rich black line in middle of inner margin forms the base of a ground colour area, and continues as a black line, bordering the star figures anteriorly, and united with the second fascia posteriorly; a hind marginal band of white spots bordered with ferrous, or black. Cilia grey based with fuscous. Hindwings, fuscous grey to smoky grey. Cilia as forewings. Lucas-Rye Expedition, Bellenden Ker. The variety of colour is very remarkable, being scarcely the same in two specimens.

PINARA PERVICAX, NOV. SP.

♂ ♀ 30-36 m m. Head, thorax, and abdomen chocolate fuscous. Abdomen in ♀ lighter fuscous. Palpi chocolate fuscous, terminal joint in ♂ tipped with fuscous black. Antennae, stalk chocolate fuscous, pectinations lighter in ♀ 1-1, in ♂ 1-4, rapidly narrowing to base and apex. Forewings rich chocolate fuscous, veins darker brown, costa gently rounded toward apex, apex angled, hindmargin gently rounded, discal dot before half very small, black or fuscous, brokenly bordered with white. a line of not very distinct fuscous dots from ¼ inner margin to apex of costa. Cilia brownish fuscous. Hindwings chocolate fuscous, lighter and redder toward base, veins darker. Cilia as forewings. Brisbane, a pair at light.

LIPARIDÆ.

ARTAXA USTA, NOV. SP.

♂ 18 m m. Head ochreous orange. Palpi reddish fuscous Antennae, stalk reddish fuscous, pectinatious ochreous. Thorax ochreous fuscous. Abdomen reddish fuscous. Forewings costa arched, hind margin oblique, almost straight, ochreous, with ferrous and red dots and markings. Forewings, costa with scattered minute ferrous red dots ; a faint reddish ochreous line from ⅔ inner margin to costa at apex ; a discal ferrous dot with suffusion, and enclosing yellow dots in middle of wing, near end of cell, gives a scorched or burned appearance, a line of small dots from this discal spot to inner margin ; two small black blotches and a small dot on hind margin nearest to inner margin with burnt appearance suffusion ; veins prominent ; a hindmarginal reddish or ferrous suffusion. Cilia reddish ochreous with darker basal line. Hindwings ochreous. Cilia as forewings. Lucas-Rye Bellenden Ker Expedition. One specimen.

LIMACODIDÆ.

DORATIPHORA COLLIGANS, NOV. SP.

♂ 28 m m. Head and thorax light ochreous. Palpi fuscous, terminal joint tipped with ochreous. Antennae, stalk light ochreous, pectinations ochreous fuscous. Forewings costa straight, apex rounded, hindmargin strongly rounded, ochreous white or wool colour. Forewings with costa and hindmargin finely edged with a light fuscous line ; light fuscous tufts at base, and lines of same indistinctly parallel to costa in costal half to middle of wings; a light fuscous band from costa parallel to hind border to before $\frac{1}{2}$ inner margin, costal half paler; a second ill defined, paler line beyond; a patch of minute black specks on costal third of wing from $\frac{1}{4}$ to $\frac{1}{2}$ costa; a rich band of chocolate colour bars from $\frac{4}{5}$ costa to inner margin before anal angle. Cilia whitish grey. Hindwings light reddish ochreous. Cilia as forewings. One specimen, Brisbane.

DORATIPHORA QUADRIDENS, NOV. SP.

♂ ♀ 30-34 m.m. Head ochreous white. Palpi reddish fuscous. Antennae, stalk ochreous white, pectinations fuscous. Thorax reddish fuscous. Abdomen reddish fuscous, rather lighter than thorax. Forewings costa gently wavy, apex rounded, hindmargin bowed, reddish fuscous diffused with tints of ochreous and shades of red. Forewings costa finely edged with fuscous, broken up into fine dots and freely irrorated in costal area with fuscous and white scales; at $\frac{2}{3}$ a band of four conspicuous white spots in disc, the third often divided into two, bordered and banded by rich fuscous shading suffusion toward costa and extending as a line to centre of wing, with a small fuscous dot half way to inner margin; a suffused shading of fuscous along hindmargin. Cilia fuscous tinted with pink, and banded with a line of darker fuscous. Hindwings, colour of forewings, but shading ochreous white to basal half. Cilia as forewings, inner margin ochreous white. Found feeding on the Pteris, or common bracken fern. It is a finely coloured caterpillar, with stinging spines, which discharge an irritant poison into the hand which carelessly seizes it. Mr. Tyron first reared this species. Brisbane, rare.

GEOMETRINA.

GEOMETRIDÆ.

HYPOCHROMA PURPURISSATA, NOV. SP.

♀ 44 m.m. Head ochreous fulvous. Palpi black. Antennae purplish fuscous. Thorax fuscous, freely irrorated with grey and black. Abdomen ochreous fuscous, with bands of irrorated black scales across the segments, and laterally diffused with golden yellow. Forewings costa, nearly straight, hindmargin gently crenulate, apical half straight, anal half sharply bowed, fuscous grey, freely diffused with purple, and dotted with silver specks, and red and grey scales, with fuscous and black markings. Forewings costa finely edged with black; basal fascia bowed outward, darkest along the veins; a second broad fascia from $\frac{1}{4}$ costa to $\frac{1}{3}$ inner margin, costal third narrowed to a line, and more or less communicating with basal fascia by diffused interrupted black lines, the whole space between the lines freely tinted with reddish yellow; an elongated discal spot obliquely from near costa at $\frac{1}{2}$, not touching costal area; a deep broad fascia beyond, anterior border from $\frac{2}{3}$ costa, straight and denticulate, a deep black line for one-third across wing, then deeply bowed outwardly, and bent at a right angle over vein 2, straight to $\frac{2}{3}$ inner margin, posterior border rich black line from [illegible] costa to anal angle inner margin, costal half finely denticulate, thence deeply dentate and again finely denticulate to inner margin; this line is bordered anteriorly with a conspicuous white line, the enclosed fascia is suffused posteriorly with purplish ground colour, but anteriorly and middle is freely covered with fuscous and black dentate bars and lines; beyond this fascia the wing is suffused with fuscous in middle and before hind thirds, and some of the dentations of the posterior line are prolonged to hind margin; a hindmarginal fuscous very fine crenulate line, the wave crests dotted with rich black. Costa grey, dusted with darker grey and white. Hindwings as forewings, with first transverse fascia circularly expanded and spread to $\frac{1}{2}$ inner margin; the anterior border line of second fascia is black wavy denticulate, and doubled, the posterior border line is spread out as a sub-hindmarginal band, and is more or less suffused with red and ground colour; the inner half of wing is clouded with black and fuscous, interspersed towards borders with red and ground colour; hindmarginal line as forewings. Cilia as forewings. Under surface of forewings rich black, shading to grey toward base, and with conspicuous triangle of white in disc, and a large rich black discal spot, a row of small white dots parallel with hindmargin at $\frac{7}{8}$; costal area, and base of wings orange, with red area along middle third. Hindwings, inner half rich orange with a small black discal spot subtending a white line extending to black border; outer half deep black. Costa of all wings whitish grey, sparingly irrorated with fuscous. One specimen from Herberton, Queensland.

HYPOCHROMA MUNITA, N. SP.

♂ 38 m m. Head green, face greenish buff, with a rich chocolate band between the eyes. Palpi fuscous. Antennae greenish ochreous, stalk ochreous. Thorax green, patagia lighter green. Abdomen greenish ochreous, with bluish white grey bands fringing each segment, and with chocolate lined figure on dorsum of each, the three posterior ones suffused with fuscous, no mark on two last segments. Forewings, costa nearly straight, hindmargin gently rounded, green, with ochreous scales, and marked with purple, fuscous and suffused fuscous and with the veins ochreous; costa freely irrorated with short purplish fuscous lines; a waved black line four times broadly dentate, from a blotch $\frac{1}{3}$ costa to $\frac{1}{3}$ inner margin; a second circular line with seven narrow tooth-like projections, from $\frac{2}{3}$ costa to $\frac{2}{3}$ inner margin; two small dots in disc between, nearer costa; a broad suffused fascia extends half way from second line toward hindmargin, but is not well defined near costa, and it diverges sharply just before inner margin to anal angle; this fascia is freely dusted with purple dots and fuscous shades, and contains an ochreous band before anal angle, which is divided by a black line into two conspicuous spots, the posterior border of the fascia is more of an indigo, and is bordered by a dull green line; hindmarginal row of minute black lunar dots, and a dark fuscous suffusion over middle third to hindmargin. Cilia grey green, barred with darker lines. Hindwings as forewings, first line wanting, second line with outer fascia absent in middle and forming two conspicuous blotches near apical and anal angles. Cilia as forewings. Under surface of wings silky white, with broad hindmarginal black band and an elongated lunar black line in disc. Cairns, Queensland.

HYPOCHROMA ASSIDENS, NOV. SP.

♂ 42 mm. Head ochreous fuscous, with a decided fulvous tint. Palpi, second joint fulvous fuscous, upper surface fuscous ochreous shading fuscous towards base, third joint fulvous ochreous. Antennae fulvous ochreous, pectinations fuscous. Thorax fulvous ochreous, freely irrorated with black. Abdomen fulvous ochreous, with lines irrorated black at base of segments, and transversely on dorsum of segments. Forewings costa, nearly straight, hindmargin bowed, ochreous tinted with fulvous, and with irrorated markings of black and white scales. Forewings, costal area profusely banded with smoky grey and fulvous hieroglyph lines; five transverse black lines, first encircling base, with black spots on either side of a deep dentation outwards; second circular, wavy, from $\frac{1}{4}$ costa to $\frac{1}{3}$ inner margin, immediately preceded by an irrorated black fascia, diffusing to white grey anteriorly and to inner margin; third line from opposite $\frac{1}{2}$ costa, one-sixth from costa to before $\frac{2}{3}$ inner margin, twice deeply dentate in the middle; the space between the second and third lines is irrorated with black and fuscous scales, and the black and white irrorations along the veins are here most conspicuous, and hence are continuous along the veins; the fourth line from costa is nearly straight and serrate, to half across the wing, when it continues in a diffused irrorated black and white fascia, to before anal angle of hind margin: between lines three and four an irrorated black and white fascia extends across inner third to inner margin; a broad irrorated fascia beyond fourth line extends from the costa and meets the fourth line in the broadening fascia beyond middle; a fifth line from costa just before apex extends outwards in gentle waves to median vein, it is bordered by a well marked ochreous line anteriorly and a black and white irrorated diffusion posteriorly; there is a like patch of irrorated fascia opposite hind margin, between veins two and three; a black hindmarginal line. Cilia ochreous fuscous, with lighter ochreous outer band, and crossed opposite veins with black. Hindwings as forewings, all lines present and more or less irregularly continuous with those of forewings; several short irrorated lines between lines one and two; a line of raised scales between lines two and three and extending along inner margin; line three diverges to meet line four at $\frac{2}{3}$ inner margin; lines four and five are fulvous fuscous, parallel with hindmargin, are wavy crenulate, and subtend ochreous lunules; the fifth line is much paler, and not so distinct as line four; irrorated black and white diffused lines along veins; hindmarginal line black. Cilia as forewings. Under surface of all wings grey, with costal margin of forewings, and nearly half inner portion of hindwings yellow; a deep black band on outer third diffused with grey on hindmargin, and not reaching inner margin of forewings; a large black discal spot in forewings, a linear pale spot on margin of yellow in hindwings. Appears to be allied to H. Emiliaria Gn., but the number of lines, configuration and distribution of colour do not at all agree with Guenee'e description. Brisbane.

SELIDOSEMIDÆ ?

ANTEIA CADAVÈROSA, NOV. SP.

♀ 33 m m. Head white; face whitish ochreous. Palpi short, fuscous. Antennæ whitish ochreous. Thorax white. Abdomen whitish ochreous. Forewings broadly dilate, costa rounded, hindmargin nearly straight, white covered all over with numerous transverse longer and shorter very faint ochreous fuscous strigulæ. Forewings with scattered faint ochreous, fuscous or creamy dots on costa. Cilia whitish ochreous. Hindwings as forewings in colour, and marked with strigulæ as forewings in posterior fourth along hindmargin, produced to right angle round vein 3, with a prominent dot of black in angle, and a small line of black on hindmargin across vein 4. Cilia as forewings. 1 Specimen, Lucas-Rye Bellenden Ker Expedition.

NOCTUINA.

CARADRINIDÆ.

TRINGILBURRA, NOV, GEN.

Head clothed with short hairs. Tongue well developed. Palpi moderate, clothed with short hairs, second joint longer than third, terminal joint porrected. Antennae filiform, ciliated. Thorax without distinct crest, densely hairy beneath. Abdomen moderate. Femora densely hairy. Spurs of middle and posterior tibiæ well developed. Forewings vein 2 from angle of cell, 4 and 5 from a point, 7 and 8 out of 9, 10 united to 9. Hindwings, with 3 and 4 short-stalked, 5 obsolete, 6 and 7 closely approximate, 8 anastonasing with cell half way to base, a strip of hyaline texture in hindwings from base in place of vein 5. Allied to Stilbia. Tringilburra is native name for a small stream at foot of Bellenden Ker.

TRINGILBURRA LUGENS, NOV. SP.

♂ 40 m m. Head, thorax and abdomen rich fuscous, Palpi dark fuscous, terminal joint lighter fuscous. Antennae fuscous. Forewings elongate dilate, costa wavy, apical portion rounded, apex acute, hindmargin obliquely rounded, rich fuscous, with ochreous tesselations, and blackish fuscous markings and suffusions. Forewings with a pencilled circular dark fuscous transverse line near base, an irregular ziczac fascial line with dots at angles from $\frac{1}{8}$ costa to $\frac{1}{8}$ inner margin; a second like line more definitely marked, with longer ziczacs from $\frac{2}{3}$ costa, outwardly bowed and inwardly to $\frac{1}{2}$ inner margin, between these two lines the ground colour is definite, with a small subcostal black dot near first line, and a small black discal spot splashed across centre with purple iridescence, and two small difused blotches of black on inner border; an oblique double line, ochreous and dark fuscous from $\frac{2}{3}$ inner margin to beyond $\frac{3}{4}$ costa running along and submerged into costa towards apex; the ground colour posterior to the line is suffused with darker fuscous, intermingled with blotches of ochreous fuscous; a submarginal fuscous line of crescentic lunules, with black dot on each bow. Cilia fuscous with lighter basal line. Hindwings coloured as forewings with base lighter fuscous and oblique line well marked from apex to anal angle; a hyaline band in middle third from base to one-third of wing. Under-surface of forewings with black dot close to median, and discal spot well defined ; two chain lines dark fuscous clearly defined, circular and more or less parallel to hind-margin ; a number of like lines faint and indistinct between darker lines. Under-surface of hindwings with five transverse circular chain lines as forewings, first basal suffused into several broken lines and a small dot, only on costal half of wing, others very definite, fourth containing orchreous fuscous dots in lunular waves, ground colour, darker over hindmargin. Lucas-Rye Bellenden Ker Expedition.

BRYOPHILA VEGETATA, NOV. SP.

♂ 22 m m. Head grey, forehead with a black dot. Palpi short, smoky grey. Antennae smoky fuscous. Thorax grey with scales of black and black spots on dorsum. Abdomen ochreous fuscous. Forewings costa straight, apex rounded, hindmargin rounded, creamy grey, dotted with black, and strongly marked with black and grey markings. Forewings with costal band freely speckled with grey to beyond $\frac{1}{2}$: a wavy transverse chain line near to base ; a second and darker fascia shouldered from basal line along costa and transversely to $\frac{1}{4}$ inner margin, contracted in middle ; a wavy ziczac fascia from $\frac{1}{4}$ costa to $\frac{1}{4}$ inner margin, angled outwardly before inner margin, suffused outwardly chiefly along inner margin to a wavy line from $\frac{2}{3}$ costa to $\frac{1}{2}$ inner margin, concave below middle and with discal ring nearer costa towards apex ; beyond this are four transverse chain wavy, denticulate lines, the angles of lines joining and suffused before apex, the third is an accumulation of suffused dots, and the fourth or hind marginal is a row of strong spots. Cilia creamy grey. Hindwings golden ochreous with dark fuscous border, gradually shading off inwardly. Cilia golden ochreous with a dividing fuscous bar. Brisbane.

PLUSIADÆ.

YERONGPONGA, NOV. GEN.

Head thickly clothed with short hairs. Tongue well developed. Antennae in ♂ filiform, very short, single cilia. Palpi long, subascending, second joint long, covered with dense brush of hair, third joint nearly as long as second, clothed with very short hairs, cylindrical, semi-club shaped. Femora densely hairy. Posterior tibiae spurs very long and developed. Forewings 2 from before $\frac{2}{3}$, 3, 4 and 5 approximate, 6 from near 9, 7 and 8 from 9. Hindwings 3, 4 and 5 approximate at base, 6 and 7 approximate, 8 approaches cell close to base.

YERONGPONGA EXEQUIALIS, NOV. SP.

♂ 70 mm. Head rich rich fuscous black, sparingly irrorated with light blue scales. Palpi rich fuscous black with light blue scales, terminal joint tipped with orange ochreous. Antennae dark fuscous. Thorax and and abdomen rich fuscous black, irrorated with light blue scales, central abdominal segments ferrous on dorsum. Forewings broadly dilate, costa nearly straight, apex rounded, hindmargin gently rounded, rich fuscous black, shot with a shiny purple iridescence and freely irrorated with light blue scales and dots, and marked with ferrous patches and ferrous ochreous spots. Forewings with four transverse lines of dots, basal three indistinct and broken, fourth only plain and definite, first line marked by two dots, $\frac{1}{4}$ from base and at equal distance from costa and hindmargin; second line circular marked by four dots, the one beyond $\frac{1}{2}$ inner margin, the three at equal distance between this and $\frac{1}{3}$ costa; the third line from a large subcostal spot beyond $\frac{1}{2}$ costa to a circle of dots on anterior border of a large ferrous blotch opposite $\frac{3}{4}$ inner margin, and one-third breadth of wing from inner margin; the fourth line curves from a chain line at $\frac{2}{3}$ costa posteriorly in a chain of dots, and turns round to posterior border of the large ferrous blotch; a submarginal row of dots on veins. Cilia indigo fuscous. Hindwings ferrous fuscous, brown towards base, shading to purple and iridescent towards hindmargin, where are scattered blue white scales; a line of ferrous ochreous dots parallel to hindmargin from anal angle of innermargin across two-thirds breadth of wing; faint indications of other dots nearer hindmargin, hindmarginal dots faint. Cilia as forewings. One specimen. Bellenden Ker, Lucas Rye Expedition.

IMLEANGA, NOV. GEN.

Head with two brush fans resting back from crown. Tongue well developed. Palpi long, recurved, second joint thickly clothed with short hairs, third joint cylindrical, about as long as second. Antennae biciliate, cilia in fascicles 1-2. Thorax densely hairy beneath. Abdomen moderate. Posterior tibial spurs well developed. Forewings vein 2 from $\frac{1}{2}$, 3 and 4 from a point, 5 approximate, 7 and 8 out of 9, 10 approximate to 9. Hindwings 2 from $\frac{2}{3}$, 3 and 4 stalked, 6 and 7 stalked, 8 amalgamated with cell near base, 5 irregular nearer to 6 than 4.

IMLEANGA FLUVIATILIS, NOV. SP.

♂ 40 mm. Head chocolate fuscous, with two fans spread back from crown, fringed with light ochreous. Palpi ochreous fuscous. Antennae fuscous. Thorax and abdomen ochreous fuscous. Forewings costa gently rounded, hindmargin rounded, ochreous fuscous with transverse wavy lines of darker fuscous, scales of fuscous, and markings black. Forewings with scattered black dots near base; a large D-shaped discal spot black with a projection from middle posteriorly; a wavy dark line before this from $\frac{1}{2}$ costa obliquely to $\frac{2}{3}$ inner margin; a like line not so well defined near base, but interrupted and not so well seen in all specimens, a broad blackish diffused square on costa before apex, subtending numbers of river-like winding channels parellel with hindmargin to inner margin; a dark dot close to median before middle, and diffused dots along median fold; short strigulæ in hindmarginal portion of wing; a hindmarginal dark fuscous line. Cilia ochreous fuscous. Hindwings as forewings, without blotches, and with lines suffufed as darker shade towards borders. Cilia as forewings. Two specimens, Brisbane, at light. Mr. Illidge has also taken it near Brisbane.

XYLORICTIDÆ.

PILOSTIBES SERPTA, NOV. SP.

♂ 27 m m. Head palpi, and thorax snow white. Antennæ white, shading to fusccus beyond base. Abdomen ochreous grey, with a band of orange red near edge of each segment. Forewing gently dilate, costa rounded, hind margin obliquely rounded, light ochreous fuscous, with central and marginal diffusions of darker fuscous, markings black or white and dark fuscous. Forewings with a subcostal black line from near base to beyond $\frac{1}{2}$ costa, interrupted near base and dotted with white dots throughout; a band of ground colour suffused with bluish white separates this costal line from a median fuscous diffusion; in this darker area are two circuitous white lined rounded figures answering to discal and orbital, outline gently undulating in and out and containing darker fuscous toward costa; and with white dots scattered between figures, and a winding white line anterior to second figure, which turning sharply, circles obliquely to just before anal angle of inner margin; central fascia attenuated to a spear-like prominence beyond the second figure. Cilia light fuscous with an inner darker band. Hindwings light fuscous, lighter toward inner margin. Cilia dark fuscous. One specimen bred from a scrub tree, May Orchard, Brisbane.

CRYPTOPHAGA PHYCIDOIDES, NOV. SP.

♂ 30 m m. Head white. Palpi ochreous fuscous. Antennae fuscous, pectinatious in ♂ 1-3. Thorax white. Abdomen white with light smoky segmental bands. Forewings costa gently rounded, hind margin nearly straight, oblique to broad anal angle, silvery white, freely covered with grey scales, diffusion of fuscous along veins, and markings darker fuscous. Forewings, costa very finely edged with silver; patch over costal half of base snow white, bordered by fine black costal line, and one or more short black lines posteriorly; diffusion from veins spread to costa, darker toward apex; an indistinct diffusion of fuscous in disc, subtended from a dark spot in costa at $\frac{3}{5}$; beyond this a circular zone of fuscous at equal distance from all the borders, marked with darker spots on the veins, three or four dark fuscous spots beyond $\frac{1}{5}$ of inner margin; hindmarginal fuscous line, with darker spots between veins. Cilia white with a fuscous band dividing. Hindwings silvery white, with smoky scales towards costa and hindmargin. Cilia as forewings. May Orchard, Brisbane.

CRYPTOPHAGA CANNEA, NOV. SP.

♂ ♀ 18-24 m m. Head, palpi, and thorax rich ochreous red. Antennae ochreous at base, shading to fuscous. Abdomen ochreous, with broad ochreous fuscous bands on segments. Forewings gently rounded, apical half straight, hind margin obliquely rounded, ochreous red. Cilia lighter ochreous. Hind wings smoky grey, with veins distinctly outlined. Cilia light ochreous. One pair at Sunny Bank, Brisbane, feeding in a species of Banksia.

CLERARCHA PROCELLOSA, NOV. SP.

♀ ♂ 20-28 m m. Head, ferruginous ochreous, in ♀ whitish ochreous. Palpi, ferruginous, terminal joint long, ochreous fuscous. Antennae, fuscous, finely annulated with ochreous. Thorax, deep ferrous, in some specimens almost white, and with every variation between ferrous and white, as either colour spreads. Abdomen, ochreous fuscous, with fuscous fringe to segments. Forewings, costa rounded, hindmargin gently rounded, light ochreous freely dusted and marked with ferrous diffusions, and ferruginous scales deeper ferrous at their apex, and becoming almost black on hindmargin. Forewings, costa, with fine ferruginous line; a subcostal band of ground colour divides this from a band of ferruginous which runs parallel from base to $\frac{2}{3}$ of wing, and then turns inward to form a suffused cloud, with a like modian band, originating from itself near the base and enclosing an area of ground colour; at $\frac{4}{5}$ of costa a cloudy fascia of ferruginous extends more or less diffusedly round the margin of wing to anal angle ; a more diffused cloud of same colour runs along whole length of inner margin, but shows more of ground colour, and with median band encloses a strip of ground colour ; a dark ferruginous spot in disc, and second smaller just beyond ; a costal, apical and hindmarginal interrupted line of dark spots and lines bound a patch of ground colour continuous with subcostal, and enclosing a short transverse ferruginous fascia which commingles with median fascia. Cilia ochreous, barred irregularly with fuscous. Hindwings, smoky fuscous, shaded to ochreous toward base. Cilia as forewings. This is a most variable species, according to the depth or sparsity of ground colour. In some specimens the thorax is deep ferrous, in others pure white. In some the ground colour of the wings is white over large patches, and the ferrous colouring in such specimens is more limited. It is only by comparing my full series of eight specimens that the species can be described with anything like accuracy. Unfortunately, Meyrick described C. dryionopa from a single female, and my specimens, named by himself, do not tally at all well with his description. The species here described is narrower in the forewings than dryionopa and all the markings aro more definite and distinct in pattern. At first I believed there must be two or three species or varieties, but as in any others of this family the variation is extreme with intermediate forms, because of droughts, winds and other causes which interfere with the perfect development of the colouration. May Orchard, Brisbane.

XYLORICTA CORTICANA NOV. SP.

♂ ♀ 24-28 mm. Head, light grey. Palpi, fuscous. Antennae light fuscous. Thorax and abdomen, light grey. Forewings elongate, costa rounded, hindmargin very obliquely rounded, silvery white, ground colour almost lost in covering of grey scales ; veins shaded fuscous grey ; a white discal spot at $\frac{2}{3}$, followed posteriorly by a small fuscous ring ; a diffusion of scattered light fuscous scales through centre of wing and along fold, most freely toward apex. Cilia grey, with bars of fuscuous opposite veins. Hindwings as forewings. Cilia as forewings, with a dividing fuscous line near base—one pair. Bellenden-Ker, Lucas-Rye Expedition.

LICHENAULA STERNOIDES, NOV. SP.

♂ 20 mm. Head white. Palpi white, fuscous at the tip. Antennae very fine fuscous and white annulated. Thorax white with cuprous fuscous narrowly on either side. Abdomen white. Forewings gently dilate, costa rounded, hindmargin obliquely rounded, snow white, with cuprous fuscous markings; a clubbed fascia from base to $\frac{1}{4}$ inner margin, includes a thin strip of ground-colour along inner margin, and terminates in a clubed head on inner margin; a broad fascia from base, on costal side of first fascia; costa, runs along centre of wing, becoming dilate but not touching, and abruptly truncate posteriorly, a suffusion unites this with a broad oblique fascia from posterior third of its cortal border extending to between $\frac{3}{6}$ and $\frac{4}{6}$ costa, thence diffused outwardly to middle of hindmargin; there is a small black discal spot in this diffusion; this spot subtends a small blotch which suffuses towards inner margin with surrounding fascia; a broad apical blotch, also diffused. Cilia white, tinged opposite marks with coppery fuscous. Hindwings light smoky fuscous. Cilia smoky fuscous. One specimen at light, May Orchard, Brisbane. A very strongly-marked species.

LICHENAULA APPROPINQUANS NOV. SP.

♂ ♀ 17-23 m m. Head white, with black spot on crown. Palpi white, black at junction of segments. Antennœ white, with black annulations. Thorax grey, freely sprinkled with black hairs, epaulettes white. Abdomen grey, with narrow light fuscous bands on segments. Forewings costa gently rounded, hind margin gently rounded, white suffused with grey, and densely irrorated with blackish fuscous scales, with blackish fuscous markings. Forewings costa narrowly edged with white; a circular dentate black band crosses wing close to base, and is diffused into a broader band along inner margin, ending in a prominent circular spot at $\frac{1}{4}$ inner margin; a broken band of four diffused spots from $\frac{1}{2}$ costa to $\frac{1}{2}$ inner margin; spot on costa most prominent; a diffused spot between inner marginal spot at $\frac{1}{4}$ and the costa; spot at $\frac{1}{2}$; beyond row of four spots, are two different dots, one over median vein, and the other close to inner margin at $\frac{3}{5}$; a costal row of diffused spots subtends a suffusion of grey and fuscous over centre of wing, extending to a large pronounced blotch which runs toward inner margin near anal angle; a submarginal band does not touch margins; a hind marginal band of minute diffused dots. Cilia grey, irrorated with black lines. Hindwings smokey grey, lighter towards base. Cilia grey, banded with smoky fuscous. Near to L. Lichenaea, Mey, but many well established characters seem to divide it from that variable species. May Orchard, Brisbane.

PLECTOPHILA SARCULATA NOV. SP.

♂ ♀ 14-18 m m. Head, palpi and thorax white. Antennae fuscous, faintly annulated with white. Abdomen, ochreous fuscous. Forewings narrow, costa gently rounded, hindmargin obliquely rounded, white with fuscous markings which are diffused with ochreous, and irrorated with black scales; a broad fascia from fold opposite $\frac{2}{5}$ inner margin, anterior border in two waves to $\frac{1}{3}$ costa, and continued as a fine line toward base, but not as far as base, posterior border irregularly curved and toothed, nearly parallel to anterior border, thence curves along costa, and gradually narrows to a thinned out line at $\frac{4}{5}$ costa; this subtends a second fascia, sometimes is commingled with it from a point opposite $\frac{2}{3}$ costa and which gradually widens to inner margin, the anterior border twice waved and finely denticulate to beyond $\frac{1}{2}$ inner margin, the posterior border with a sinuate outward curve to anal angle of inner margin; from its centre a bar connects with a broad diffused apical fascia. Cilia white, ochreous at base, and ochreous tinged with fuscous at anal angle. Hindwings, light fuscous. Cilia, whitish ochreous, in some specimens indistinctly banded with a fuscous line. May Orchard, Brisbane.

PLECTOPHILA ASCRIPTA NOV. SP.

♂ 15 m m. Head and palpi, white. Antennae, white and fuscous finely annulated. Thorax, white, posteriorly shaded with fuscous. Abdomen, light fuscous. Forewings, costa gently rounded, hindmargin obliquely rounded, white with ferruginous markings. Forewings, with a narrow fuscous line on costa at base, which gradually becomes obscured along costa; an oblique line from $\frac{2}{3}$ costa to below apical angle on hindmargin, the hindmarginal half is darkened deep black, and the whole line is suffused with ferruginous on costal side and with two or three small dashes on costa; a black margin line surrounds this round apex; from a point at $\frac{3}{5}$ of costa a bread ferruginous fascia commences, having its base separated from half of apical fascia by a line of ground colour, thence runs to inner margin to just before anal angle; both borders are jagged and threw out tooth-like longer or shorter lines; a conspicuous spot opposite anal angle; a diffusion of light ferruginous along inner margin sends a quadrate spot of ferruginous to middle of wing before the half; a smaller spot on inner margin, nearer base. Cilia, white, with an apical ferrous bar, and becoming ochreous at anal angle and along inner margin. Hindwings, light fuscous. Cilia, ochreous fuscous. May Orchard, Brisbane.

OECOPHORIDÆ.

PHILOBOTA DIFFUSA NOV. SP.

♂ 17 m m. Head, white. Palpi, white. Antennae, white and fuscous annulated. Thorax fuscous, with collar and dorsal triangle white. Abdomen, light fuscous. Forewings, costa gently rounded, hindmargin nearly straight, creamy white with ferrous and chocolate markings. Forewings with a subcostal line of ferrous from base thinning out at $\frac{1}{2}$ costa; a broad band of ferrous ochreous from middle third of inner margin, anterior border not touching subcostal line, posterior border becoming commingled with a large diffused blotch on costa, and turning sharply on itself angles a narrow bar of ground colour, and diffuses to a broad bar on anal angle along inner margin, which is again suffused in a hindmarginal line to deep blotch at apex of wing; these blotches, or diffusions, are bordered with chocolate, more or less suffused, and which also colours the veins within their area; a hindmarginal row of interrupted chocolate dots. Cilia, creamy white, tipped with fuscous. Hindwings, light fuscous. Cilia, ochreous fuscous. Brisbane.

MACROBATHRA LUNACRESCENS NOV. SP.

♂ ♀ 18-20 m m. Head black. Palpi, black, upper surface shading into ochreous, and terminal joint ochreous red. Antennae ochreous fuscous, becoming white before tip. Thorax black. Abdomen ochreous, shading fuscous posteriorly, and deepening to black on dorsum before anal segments. Forewings narrow, costa almost straight, apex rounded, hindmargin obliquely rounded, blackish fuscous, with ochreous markings tinted with light red, or orange. Forewings, with three conspicuous well defined transverse fascial from costa to inner margin, the middle one only scarcely reaching inner border, first fascia broad, like the moon at three quarters, just beyond base; the middle one at half, and the third just beyond three-fourths; the middle one broadens circuitously towards inner margin, and the third, the narrowest of the three, has a straight anterior border and a concave posterior margin; in one specimen the apex of the costa is tipped with white. Cilia, smoky fuscous. Hindwings, fuscous grey, with fuscous scales, Cilia, as forewings. Brisbane, rare.

MACROBATHRA DEFINITIVA NOV. SP.

♂ 18 m m. Head, palpi, antennae, thorax and abdomen, whitish ochreous, the thorax and abdomen tinted with light fuscous. Forewings, costa straight, rounded at base and apex, hindmargin rounded, rich velvety black with bright white markings. Forewings with three transverse fasciae, broad and conspicuous; first fascia obliquely from costa just beyond base, does not reach inner margin by one-fourth breadth of wing, and is broadened in middle by a cross bar broken off, as it were, and showing denticulate edges as if it had been torn off; the second fascia from a point at middle of costa, broadens into a six-sided rhomb, and only just stops short of, or is diffused to inner margin; the third fascia at three-fourths is broad at the costa, and bows anteriorly, anterior border, thence a straight line to $\frac{3}{4}$ inner margin, posterior border deeply dentate and contracted in middle, then forms a tooth projection on posterior border, and takes a straight course to inner margin. Cilia, fuscous, prominently white along hindmargin. Hindwings light fuscous. Cilia, light fuscous. One specimen, Brisbane.

MACROBATHRA VEXILLARIATA, NOV. SP.

♀ 16 mm. Head black, face white. Palpi white, terminal joint shaded with light fuscous. Antennae fuscous. Thorax fuscous, the dorsum anteriorly and the patagia white. Abdomen fuscous. Forewings costa gently rounded, hindmargin obliquely rounded, fuscous black with scattered grey scales, markings white or cream coloured. Forewings with a dot on $\frac{1}{2}$ costa, a triangular blotch, with base on $\frac{3}{4}$ costa, to just before apex; the apex of the triangle nearly reaches to inner border, a conspicuous small square spot on $\frac{1}{4}$ costa, thence diffuses to a smoky tinted white which extends more or less diffused along the whole inner border, sending up a small projecting tooth-like spot, intermediate to second and third costal dots; a few scattered black specks on this inner border white surface; a band or line of rich black borders base and inner margin of wing for a short distance, this is finely bordered with a line of white; the white diffusion plays more or less to base through centre of ground colour. Cilia black, light grey towards inner margin. Hindwings fuscous grey, diffused in middle with lighter grey. Cilia, a smoky grey, lighter grey toward base of inner border. One specimen, Brisbane.

MACROBATHRA OBLIQUATA, NOV. SP.

♀ 13 mm. Head black, face white. Palpi creamy white, tipped with diffused fuscous. Antennae fuscous. Thorax black. Abdomen smoky fuscous. Forewings, costa gently rounded, hind margin rounded; rich velvety black, with conspicuous creamy white marks; a broad fascia at one-third obliquely to inner margin; a minute indistinct dot at $\frac{1}{2}$ costa; a small round dot at $\frac{2}{3}$ inner margin; an oblique line at $\frac{4}{5}$ costa, extends toward the spot on inner margin to half across wing. Cilia black. Hindwings smoky fuscous. Cilia lighter fuscous. One specimen, Brisbane.

EULECHRIA MITESCENS NOV. SP.

♀ ♂ 16-18 m m. Head, ochreous white. Palpi, ochreous white, terminal segment black on upper surface and tip. Antennae, black and ochreous annulated. Thorax, black, with tufts of white ochreous on either side. Abdomen, light golden yellow. Forewings, costa, gently rounded, hindmargin obliquely rounded, whitish grey, with irrorated smoky diffusions and blackish fuscous markings; a basal band of spots from base of costa runs along wing to opposite $\frac{1}{5}$ inner margin, and connected with second dot to costa; a broad band of dots, lines and scales from $\frac{1}{5}$ to before $\frac{1}{2}$ costa and extending to from $\frac{1}{2}$ to beyond $\frac{3}{4}$ inner margin, the anterior border bounding a lunule of ground colour, extending to $\frac{1}{2}$ inner margin, the posterior border containing spots and a broad suffusion in some specimens obscuring dots to inner margin; a line or diffusion of ground colour divides costal half of band; an oblique fascia of three or four lines or dots from $\frac{2}{3}$ costa to half way across wing to opposite $\frac{3}{4}$ inner margin; a row of four dots along apex of costa and continuous with four along hindmargin; these subtend a diffused fascia of dashes or lines opposite costa and a broad blotch to anal angle of hindmargin; spots and lines bordered by definite ground colour. Cilia, whitish ochreous. Hindwings, fuscous, shading to light golden yellow at the base, and along the whole inner margin. Brisbane.

JOONGGOORA NOV. GEN.

Head rough scaled, sidetufts well developed as spreading fans, tongue moderately developed. Palpi recurved, long, 2nd joint covered by loose rough scales, terminal joint nearly as long as the 2nd, smooth cylindrical. Antennae long, filiform, finely serrulate, ciliate, basal joint elongate truncate. Thorax moderately hairy. Abdomen moderate. Posteroir tibiæ hairy, with spurs moderately developed. Forewings elongate ovate, narrow, veins 2 and 3 stalked, 7 and 8 stalked, 8 to costa before apex. Hindwings 1 a furcate at base, 3 and 4 stalked, 8 separate from 7, not touching cell.

Joonggoora is the native Australian name for a leguminous tree, in the foliage of which these moths find shelter.

JOONGOORA TRICOLLATA, NOV. SP.

♂ 16 mm. Head white, crown black in centre. Palpi white, terminal joint fuscous. Antennae white. Thorax white, with dorsum black continuous from crown, and black bands laterally. Abdomen light fuscous with broad bands of darker fuscous. Forewings costa rounded, apex acute, hind margin obliquely rounded, grey white with three collateral bands of rich chocolate fuscous. Forewings with a very narrow light fuscous line bordering costa ; a subcostal band from base to $\frac{1}{2}$ costa, thence dividing into dark lines along veins to costal apex and diffused between lines as one fascia, this fascia is attenuated at base and gradually broadens toward apex ; a rich chocolate band from base not touching inner margin, runs in a bowed line to inner margin at $\frac{1}{3}$; a triangular band has its base on anal half of hindmargin and its apical point opposite $\frac{2}{3}$ costa : the ground colour bands on either side of the two inner bands are nearly equal in width to the chocolate bands, and thus form a series of six bands from inner margin to costal, with the narrow ground colour band at base of costa. Cilia whitish tinted with fuscous. Hindwings light smoky fuscous. Cilia light smoky fuscous. May Orchard, Brisbane. One specimen at light.

JOONGOORA CUNCTILINEATA, NOV. SP.

♂ 17 mm. Head whitish grey, crown and face fuscous. Palpi grey, terminal joint irrorated with fuscous, basal joint black. Antennae fuscous, darker at base. Thorax whitish grey, shading posteriorly and laterally to fuscous. Abdomen light fuscous. Forewings narrow, elongate, costa gently rounded, hind margin bowed, whitish ochreous with lines and bands along veins dark fuscous. Costal area of forewings ground colour : a subcostal dark fuscous band from base, attenuating to $\frac{2}{3}$ costa ; a broad fuscous band through middle of the cell, and there breaking up into forked lines, main continuation to near middle of hind margin and 4 or 5 to hind margin along veins : a dark fuscous band from base near inner margin to $\frac{1}{3}$ inner margin, and continuous in divided lines to hind margin ; a fainter fuscous line between median and inner marginal bands, and another from base of median band divides into two lines, which run to costa before apex ; inner and hind margins interrupted, lined with fuscous dots. Cilia light fuscous, finely lined with darker fuscous. Hindwings silvery fuscous. Cilia light fuscous. May Orchard, Brisbane.

TEERAHNA, NOV. GEN.

Head smooth, scaled. Tongue well developed. Palpi recurved, second joint surrounded by a brush or plume fan hiding stalk, terminal joint longer than second, cylindrical. Thorax very hairy underneath. Abdomen moderate. Posterior tibiae densely clothed with long hairs, spurs well developed. Forewings narrow, elongate, 3 and 4 connate, 5 absorbed, 6 and 7 stalked, 8 to costa. Hindwings very narrow, 8 anastoming with cell, wing elided before middle contracted $\frac{1}{3}$ and gradually narrowing to apex, 5 wanting. Cilia very long. Antennae filiform long finely serrulate, basal joint elongate truncate. Teerahna is the native name for a corrobboree or tribal social meeting.

TEERAHNA REGIFICA NOV. SP.

♀ 24 m m. Head iron grey, marked with metallic. Palpi whitish ochreous, first segment barred with black; second segment with fringe or brush of scales, black and white annulated; third segment as long as second, barred with black on under surface and faintly on upper side. Thorax rich chocolate fuscous, bordered posteriorly on either side with long fuscous hairs. Abdomen fuscous, with a dorsal chocolate line, and laterally a line of interrupted chocolate dots. Forewings narrow, elongate, costa gently wavy, apical fourth rounded, apex acute, hindmargin obliquely rounded, inner margin with very long cilia, rich chocolate fuscous, with veins deep black. Forewings, with a well defined fuscous line on edge of costa to $\frac{3}{4}$ costa; a subcostal band of deep black from base to $\frac{1}{2}$ costa and with costal line encloses a bluish white band freely irrorated with fine black specks; streaks of this bluish white similar to costal band between veins which end in costa and hindmargin; a rich chocolate band from base for half breadth of wing extends along inner margin to $\frac{1}{3}$, it is bordered and blotched with deep black, and divides to median and inner marginal diffusions, which surround the black veins as they branch from cell; this black basal patch is bordered toward costa by an indistinct band of bluish white, irrorated with black, but a like band is very distinct on middle third of inner margin. Cilia deep fuscous, darker in middle. Hindwings attenuate, elongate, deep fuscous, with a bronzy tinge. Cilia as forewings. One specimen at light, May Orchard, Brisbane.

WOORDA, NOV. GEN.

Head smooth. Tongue well developed. Palpi ascending, second joint with short adpressed hairs, third joint as long as second, cylindrical. Antennae filiform, ciliate. Thorax with tufts of hair laterally and posteriorly. Abdomen moderate. Forewings elongate lanceolate, veins 2 and 3 stalked, 5 wanting, 8 to apex. Hindwings 3 and 4 stalked, 5 wanting, 6 closely parallel with 4 near margin, 8 approaching 7 beyond middle. Woorda is the native name for a kangaroo, from Kangaroo land.

WOORDA AQUOSA, NOV. SP-

♂ 16 mm. Head ochreous. Palpi and antennae fuscous. Thorax fuscous irrorated with smoky black, and shading to ochreous posteriorly. Abdomen ochreous fuscous, grey laterally underneath. Forewings narrow, costa nearly straight, hind margin obliquely rounded, blackish fuscous, splashed with grey and creamy brown dashes and markings. Forewings with a narrow median ochreous white or creamy band, from base to just before the half of wing, nearer to costa, thence diffused and mixed with grey, gives off spurs to costa, irrorated with bluish specks; a submedian line of grey and blue specks from base, and suffused with bluish to $\frac{1}{2}$ inner margin: a small white discal dot in middle subtended from median band, a suffused area of light fuscous brown from three-fourths, passing in streaks to anal angle, and again more or less sparingly to hind margin, and a wider belt to $\frac{3}{4}$ costa; costal area more or less irrorated with lines or spots of fuscous; a discal dot near middle in black band. Cilia fuscous with black diffusions. Hindwings smoky grey, becoming lighter toward base and inner margin, darker on veins; a hind marginal dark fuscous fine line. Cilia light fuscous. May Orchard, Brisbane.

WULLABURRA, NOV. GEN.

Head loosely scaled. Tongue not well developed. Palpi short subascending, cylindrical. Antennae filiform, long, basal joint elongate, tufted. Thorax smoth scaled, hairy beneath. Abdomen moderate. Posterior tibiae clothed with very long hairs, spurs moderately developed. Forewings narrow elongate, 5 wanting, 7 from 8, 8 to costa. Hindwings narrow, 8 connateor anastoming with celle obliquely elongate before half wing, thence narrowing to apex, 5 wanting. Cilia long. Wullaburra is a native name for the Woomera.

WULLABURRA NIGROMEDIA, NOV. SP.

♂ 20 mm. Head ochreous grey, face ochreous. Palpi ochreous on under side, fuscous above. Antennae fuscous, with rosette of fuscous grey hairs at base. Thorax grey, dorsum anteriorly and laterally, with a deep border of chocolate black. Abdomen fuscous grey, legs fuscous, posterior tibiae with brush of long hairs. Forewings narrow elongate, costa rounded, hind margin very obliquely rounded, ashy white freely irrorated with grey, and with black markings. Forewings with a very fine black costal line ; a rich conspicuous black median band from base, parallel to the costa in anterior half of wing, then bent at an obtuse angle to anal angle ; black band between posterior half of median band and costa, becoming attenuated towards costa, and diffused in smoky grey to costa, a fuscous diffusion on anal half of inner margin. Cilia grey with black suffusions, very long from posterior half of inner margin. Hindwings smoky fuscous, darker in folds. Cilia smoky fuscous, ochreous at base and a narrow line along inner margin. The central band of black, with the white areas irrorated with grey scales along either side of median band, with apical black and grey suffusion readily distinguish this species. May Orchard, Brisbane.

PROCEEDINGS

OF THE

Annual Meeting of Members,

HELD ON SATURDAY, 16th FEBRUARY, 1901.

The Annual Meeting of the Society was held on Saturday, 16th February, 1901.

The President, Dr. John Thomson, occupied the chair, and there was a large attendance.

The President, in referring to the death of Her Majesty Queen Victoria, stated that the following resolution had been forwarded to his Excellency the Governor for transmission through the proper channel :—

"That the Royal Society of Queensland joins in the deep mourning, which is universally felt for the death of our beloved Queen Victoria ; that it desires to convey its sympathy to the Royal Family for the irreparable loss which they and the Empire have sustained in the sad bereavement ; and that it further expresses its devotion and loyalty to His Majesty King Edward VII."

The Minutes of previous Annual Meeting were read and confirmed.

The Hon. Secretary (Mr. J. F. Bailey) read the following report of the Council for the 1900 Session :—

To the Members of the Royal Society of Queensland.

According to usual custom your Council has much pleasure in submitting the annual report for the year 1900 :—

In May last, Vol. XV of the Proceedings, (186 pages and 3 plates) containing the papers read during the 1899 session, was published and distributed, as was also an index for Vols. XI to XIV, inclusive.

The Ordinary Meetings of Members, nine in number, have been well attended. A list of the papers read, is furnished in Appendix A.

Fifteen Council Meetings have been held. The attendance of officers will be found in Appendix B.

Thirteen new members were elected during the year. A list of these is given in Appendix C.

It is with deep regret the Council has to record the loss by death of two members, viz., Dr. J. N. Waugh and Mr. A. J. Norton. The former did some excellent work while connected with the Philosophical Society, which was incorporated with this Society in 1884. Mr. Norton was for many years one of our most zealous members, and acted as Hon. Librarian during the years 1895, 1896, and part of 1897, when he resigned office on account of his removal to Childers.

The Council desires to express its thanks to the Government, through the Hon. the Chief Secretary, for again placing at the disposal of the Society a similar endowment to that granted the previous year.

During the current year the Library has been enriched by numerous and valuable donations. The Societies and Institutions on our exchange list now number 170. It will be noticed that the wish expressed in former reports, that a sum should be placed aside each year for binding books, has this year been realised. About 350 volumes have been bound, and it is intended that this good work shall be continued. It has also been arranged to have glass doors fixed to the book-shelves as a protection against dust.

The Council, having found that the want of a good lantern was a drawback to the success of the meetings, purchased an instrument from Messrs. Ross & Co., Ltd., one of the leading makers of Great Britain, which has given highly satisfactory results. To further increase the usefulness of the lantern a projective microscopic attachment has been ordered. Thanks are due to Mr. A. G. Jackson for having so ably performed the duties of Honorary Lanternist.

By reference to Appendix D it will be seen that the finances of the Society are in a healthy state. The Council regrets that certain subscriptions for 1900 have not been paid, and hopes that the current year will prove an exception in this particular, as neglect of these debts of honour means a loss of Government subsidy, which is paid at the rate of £1 for every £1 received in subscriptions.

The scheme for the publication of an International Catalogue of Scientific Literature, which originated with the Royal Society of London, has recently made great progress, and it has been arranged that the issue of the Catalogue will begin this year. The Government has on several occasions sought the advice of the Council on matters connected with the Catalogue, so far as Queensland is concerned, and the Council has agreed to subscribe for a set, comprising 17 volumes, at a cost of £17. Numerous applications have been received for the Queensland Volume of the Catalogue compiled by Mr. Shirley, on behalf of the Society, and at the request of the Government; but the demands could not be met as all the copies have been distributed.

It will be remembered that Mr. O'Connor, in 1896, on behalf of the Society, and with the aid of pecuniary assistance from the Government, transferred a number of specimens of the interesting fish Ceratodus from the Burnett and Mary rivers to the Coomera, Condamine, and Brisbane waters, and to the Enoggera Reservoir, in the hope that they would adapt themselves to those new localities. The following extract from a recent report by Mr. O'Connor seems to show that the experiment has been successful.

. . . "Since I wrote you respecting the capture of a Ceratodus in the Condamine I heard of another being taken there, this specimen was only one foot and a half long, consequently one of a new generation, none of the fish taken to the Condamine measured less than two feet six inches in length. I have also been informed by a correspondent at the Coomera river that: 'The Ceratodi have increased in great numbers, I have heard of several being caught and many have been seen about fifteen inches long.'" . . .

In accordance with the rules, all the officers retire, but with the exception of the President, and Vice-President (neither of whom, according to Rule 16, can hold the same office for two years in succession), are eligible for re-election,

JOHN THOMSON, M.B.,
President.

J. F. BAILEY,
Hon. Secretary.

BRISBANE, 4TH JANUARY, 1901.

APPENDIX D.

THE ROYAL SOCIETY OF QUEENSLAND.

FINANCIAL STATEMENT for the Year 1900.

Dr. Receipts.	£	s.	d.	Cr. Disbursements.	£	s.	d.
Balance from last report	6	19	3	Rent	12	0	0
Subscriptions	98	14	6	Advertising	2	11	0
Sale of Proceedings	5	0	0	Printing	80	19	9
Government Endowment	150	0	0	Insurance	0	13	6
				Bank Fees and Cheque Book	0	12	6
				Postage and Petty Cash	13	10	0
				Binding Books	38	8	0
				Lantern Hire	1	0	0
				Lantern and Fixings	43	4	4
				Balance at Bank	67	14	8
	£260	13	9		£260	13	9

Liabilities. Bookbinding, £10 10s.; Lantern Fixings, £1 10s.; Total, £12.

Examined and found correct. A. Norton, *Hon. Treasurer.*

Brisbane, 15th January, 1901. Alex. J. Turner, *Auditor.*

APPENDIX B.

Attendance of Officers at the Fifteen Council Meetings During the 1900 Session.

Office.	Name.	Number attended.
President ..	John Thomson, M.B.	13
Vice-President ..	W. J. Byram	7
Hon. Treasurer ..	Hon. A. Norton, M.L.C.	7
Hon. Secretary ..	J. F. Bailey	15
Hon. Librarian ..	R. Illidge	14
Members of Council	F. M. Bailey, F.L.S.	9
	A. G. Jackson	8
	C. J. Pound, F.R.M.S.	11
	J. Shirley, B.Sc.	8
	J. W. Sutton	10

APPENDIX C.

Members Elected during the Year 1900.

Date.		Name.	Address.	Proposed by.
Feb. .	24	Colledge, W. R. ..	Taringa ..	W. J. Byram.
March	17	Allan, James ..	Queen St., Bris.	J. Shirley, B.Sc.
,,		Potts, John ..	Queen St., Bris.	J. W. Sutton.
April	7	Gooley, William ..	Brisbane ..	R. H. Relton.
,,		Harris, M. A. ..	Normanby Hill	J. Shirley, B.Sc.
May .	26	*Cameron, John ..	Eagle Junction	Hon. A. Norton M.L.C.
June	16	Martin, S. G. ..	Queen St., Bris.	Hon. Secretary.
,,		Inglis, Thomas ..	Normanby Hill	R. H. Relton.
July .	14	Hardcastle, W. B...	Sherwood ..	J. Shirley, B.Sc.
Sept.	22	Hopkins, G.H. (F.R.C.S.)	N'th Quay, Bris.	C. J. Pound, F.R.M.S.
,,		Cory, A. H. (M.R.C.V.S)	Town Hall, ,,	Hon. Secretary.
,,		Maclaren, J. M. ..	Geo. Survey Dep.	J. Shirley, B.Sc.
,,		Taylor, William ..	Ithaca Creek ..	A. Kaye.

* Life Member.

APPENDIX A.

List of Papers read during 1900 Session.

Date.	Title.	Author.
February 24	Preventive measures against the spread of Tuberculosis	E. Hirschfeld, M.D.
March . 17	Notes on Some Modern Explosives	T. McCall.
April . 7	The Barbung of the Wiradthuri Tribe	R. H. Mathews.
" "	Exploration in Western Australia	F. Hann.
May . 26	Australian Vegetation and its Geological Development	J. Shirley, B.Sc.
June . 16	The Inspection of Home and Export Meat Supply ..	W. C. Quinnell, M.R.C.V.S.L.
July . 14	The Morphological Character of the Plague Bacillus ..	C. J. Pound, F.R.M.S.
Septemb'r 22	The Anopheles or Malaria-carrying Mosquito	W. R. Colledge.
October 20	A few Suggestions on Photo-Micrometry	John Thomson, M.B. (President).
December 8	Australasian Wood-boring Hepialidæ	R. Illidge and Ambrose Quail, F.E.S.

The adoption of the Report was moved by the Hon. A. Norton, seconded by Mr. F. Whitteron, and carried.

The President then delivered the following address :—

PRESIDENTIAL ADDRESS.

LIFE, CHIEFLY BACTERIAL.

LIFE!—WHAT IS IT? AND WHENCE CAME IT? These questions have puzzled the philosophers of the mental and natural schools, and the answers are not yet.

We see life; we may think we know it; but we fail to define it.

Life has been described as a condition of matter—"If one substance exhibits the property of combustibility, it burns; if another, on being stretched, returns to its original size, it is elastic; and if a third presents differentiated growth, involving assimilation and excretion, or exhibits contractility and sensibility, it lives."

Spencer's definition is well known, but is cumbersome, unsatisfactory, and not likely to be popular:—"the definite combination of heterogeneous changes, both simultaneous and successive, in correspondence with external co-existences and sequences."

Béclard's "Organisation in Action" is short and crisp and as explicit as present knowledge warrants.

What of the seed that has for centuries, or tens of them, lain hid in the mummy sarcophagus and has then fallen "into good ground and brought forth fruit?" Was it alive all the years or had it only the power of living?

And the replies to the second question are as vague. If our earth was formed, as astronomers declare, from the molecular *Protyle*, whirled off as a ringed and molten mass from the System's centre; and if, from the testimony of the rocks, geologists agree with the theory of a molten birth; and that, with due regard to the effects of a glacial period, the cooling now is only of the crust and the internal fires are still raging, the Earth must have passed through eons of time and cooled down to something like its present temperature, before it was fitted to support life, or at least such life as we now know, for this yields readily to heat; the boiling point upheld for a few minutes is destructive of most organisms, while the most resistant endospores cannot withstand a temperature of 300° F.

The Earth then was sterile, and sterile it must have remained, until by its physical conditions it could sustain life, and then life came, but how?

Of the theories presented to us, four may be referred to.

1st. "Life originated under conditions beyond the sphere of scientific inquiry—A spiritual influx."

2nd. "Organisms or germs of organisms were brought to the earth by meteorites from elsewhere." And, as "it has been estimated that as much as a hundred tons weight of them (meteorites) are encountered by the earth every day and fall upon its surface," Lord Kelvin, who supported this theory, certainly had something to go upon.

3rd. "Life, like matter and energy, had no origin but is eternal, else it and they must have arisen out of nothing." If this be true, the life referred to must have been utterly different from any we now know or can possibly imagine.

4th. "Living matter evolved itself from matter which was not living as the outcome of unexplained processes of up-building or synthesis." This somewhat harmonises with the theory of evolution.

But of a surety, knowledge lingers. An unknown but very matter of fact writer declares, "Definitions of Life are useless from our utter ignorance of the nature and the conditions we attempt to define."

Assuming that the Earth was inoculated with life, was that primeval, primordial, pat of protoplasm responsible for all life as we know it? Through the countless ages, and by processes of selection, survival, and evolution, have the animal and vegetable kingdoms and the dry land, the sea and the air, found their denizens? Or do fresh inoculations occur? Do new forms of life spring into existence? Is there such a thing as spontaneous generation?

"For if the sun breed maggots in a dead dog," so said Hamlet, and this expressed the theory of his day. Bacon believed that mites in cheese and maggots in flesh were the results of putrefaction; in fact, that the lower forms of animal life were due to putridity—a mors janua vitæ—a life for a death—a phœnix arising from the ashes of its past.

In 1660 Francesco Redi published his "Experiences," and demonstrated that maggots were the larvæ of the common blow-fly. He practically taught what is now called Biogenesis, and came under the bann of the Church for so doing, for it was held that the story of Samson, the young lion and the swarm of bees and honey found in the lion's carcase, were divine proofs of spontaneous generation. You remember Samson's riddle, "Out of the eater came forth meat, and out of the strong came forth sweetness."

For long, aye, until quite recently, scientists were divided. There were the Biogenetics, or those who asserted that all life was due to pre-existing life,

"Omne vivum e vivo";

and the Abiogenetics, who believed that under certain conditions life could arise *de novo*—in other words, spontaneously.

This controversy waged from the days of Leeuwenhoeck, and although the Bs held the power, for they had the heavier battalions, yet the As managed to successfully carry on a guerilla war until about 1875, when various workers, chief amongst whom was Tyndall, settled the matter definitely to the complete overthrow of the theory of spontaneous generation. A full account of his experiments—having reference to putrefaction and infection—with some twenty-six different kinds of animal and vegetable infusions, and the appliances (1) he made use of, will be found in his "Floating Matter in the Air," a book I can confidently recommend to your notice, for it is clearly, cleverly, and popularly written.

We may fairly assume then, that life, as it is at present known—from the hugest of beasts to the tiniest of cocci—runs far back into prehistoric ages.

But these cocci and other micro-organisms were first viewed by man some 225 years ago, when, in 1675, Anton Leeuwenhoeck, a Dutch philosopher, not only made his own microscope—a simple one—grinding and polishing its lenses, but used it to such good purpose that he discovered and described certain minute living entities, which are now known as bacteria, bacilli, spirilla, and micro-cocci. He classified these as animalculæ, but he formulated no theory as to the part they played in the vast orchestra of Nature. Other observers followed, but it was not until 1837, the year of our late beloved Queen's accession, that Schwann, the author of the cell theory, asserted that fermentative processes were dependent upon the proliferation of certain yeast plants, and that putrefaction was due "to something suspended in the air which heat was able to destroy." In 1863, Davaine demonstrated that anthrax, malignant pustule or woolsorter's disease, was due to the presence in the blood of the sufferer of a specific infective organism, the now well-known *bacillus anthracis*, [2] and that may be taken as the year when Bacteriology, as a special study, had its birth. Its infancy was both puny and capricious, and it was not until 1880, that the foundations of an absolutely sound constitution were laid; "the work done earlier than that was more likely to be erroneous than correct." But the first and the greatest of the bacteriologists was the Frenchman, Louis Pasteur; to him undoubtedly belongs the honour of having been the most successful experimenter, the most careful worker, and the most original thinker in the new field of science. He led, others followed!

Many attempts have been made to classify Bacteria—a term certainly erroneous, but now universally employed when referring to the Schizomycetes, or Fission Fungi—a group of minute unicellular vegetable organisms which reproduce themselves by self-division or cleavage.

The simplest classification, [3] based on morphological characteristics, that is, shape and form, is:—

I. Cocci.—[4] Are small oval or spheroidal cells, always retaining their shape, no matter in what natural or artificial media they may grow.

1. Diplococci: [5-6] When the cells are in pairs, as in the pneumococci and others.
2. Streptococci: [7-8] When the cells are in chains, short or long, usually encapsuled.
3. Tetracocci: [9] When the cells are grouped in fours, often encapsuled.
4. Sarcinæ: [10] When the cells appear in packets of eight or more.
5. Staphylococci: When the cells are in irregular clumps of no particular shape or symmetry.
6. Zooglœa: When clusters of staphyloccoi are held together by a tough mucous membrane

II. Bacilli.—Are rod-like structures, in which one diameter is greater than the other. They may be long and thin, or plump and almost round; they may have square, [11-12] pointed, rounded, [13] or clubbed [14] ends, and they may arrange themselves in pairs, clumps, chains, or filaments. When fusiform or spindle haped they are sometimes called Clostridia.

The numbers in the text refer to the lantern slides exhibited during the address. A list of these slides is given in an appendix.

III. SPIRILLA.—[15-16-17] Include all the curved and spiral forms—Vibrios, &c.

Bacteria have also been grouped, [18] it can scarcely be called classified, according to the changes they effect in the media in which they grow.

1. Zymogenetic, or ferment producing.
2. Pathogenetic, or disease ,,
3. Saprogenetic, or putrefaction ,,
4. Chromogenetic, or colour ,,
5. Photogenetic, or phosphorescence ,,

ZYMOGENETIC.—To understand the conduct of some of the ferment producing growths it is well to refer to the behaviour of the yeast plant (of which, by the way, there are many), in the well-known domestic processes of baking and brewing. These processes have perhaps been known during all human time—leaven is referred to in the Oldest of Books, and fermented drinks of one kind or another have been quaffed by the most savage races—and yet the scientific causes, the chemical and vital influences at work have only recently been established.

The Yeasts [19-20-21-22] are half-brothers of the Moulds, the thread-like hairy patches which grow on paste, bread, potatoes, &c., and first cousins of the Bacteria. They, under certain restricted conditions, sporulate, but generally they multiply by budding, hence the name "sprouting fungi,' the daughter cell springing from the protoplasm of the parent and then separating and enjoying an independent life. The cells are oval, about $\frac{1}{3000}$ of an inch in length, and they proliferate so readily, it has been calculated that one solitary cell in 48 hours will be responsible for something over 35,000—(35,378 Engel). And an important change—fermentation—is taking place in the medium in which this enormous growth occurs. Let it be a saccharine one; the complex substance—sugar—is broken up; alcohol is produced; carbonic acid gas given off and heat generated. One molecule of grape sugar may be resolved, theoretically, during the act of fermentation into two molecules of alcohol and two molecules of carbon dioxide. [23]

$$\underbrace{C_6H_{12}O_6}_{\text{Grape Sugar (180)}} = \underbrace{2\ (C_2H_6O)}_{\text{Alcohol (2 x 46)}} \times \underbrace{2\ (CO_2)}_{\text{Carbon Dioxide (2 x 44)}}$$

or roughly, two parts by weight of sugar yield one of alcohol.

In Baking, something analogous to this—panary fermentation—takes place. Given flour or meal; leaven or yeast; water containing salt; with a sufficient temperature and a sufficient time and a form of fermentation is set up. The yeast, proliferating, attacks the gluten, starch and sugar of the flour; the later passes into alcohol and the dough swells up—"rises"—and is distended with innumerable air spaces from the evolution of carbonic acid. The subsequent baking still further inflates the air cavities, but the carbonic acid is destroyed, the alcohol is driven off, and the ferment killed.

In Brewing, a similar thing—vinous fermentation—occurs. The sugar to be subsequently acted upon is derived from barley; first, during the stage of malting, or germinating, when the starchy particles undergo alteration; and second, during the process of mashing, when a nitrogenous and unorganised ferment—diastase—changes the modified starch of the malt into malt-sugar (maltose) and dextrine. After boiling with hops and and other processes, yeast is added and fermentation begins. The surface of the liquid is covered with a brownish cream which rapidly increases in volume by the speedy proliferation of the yeast cells; the cream becomes enormously frothy and "rocky" by the abundantly escaping carbonic gas which accumulates densely on the surface of the fermenting liquid; the temperature of the liquid rises; and its specific gravity falls owing to the presence of alcohol.

Think, just for a moment, what a terrific influence in the wide world this tiny yeast cell wields What an enormous, what a vast-spread industry depends upon its little growth. What a mint of money; millions, countless millions, sums far beyond our reckoning or our ken are backing its behaviour. No wonder it has to be kept healthy; no wonder its cultivations have to be pure; no wonder a Pasteur and a Hansen devoted their talents and spent many of the best years of their lives to the study of the yeast plant and the rôle it plays in fermentation.

Having referred so frequently and so recently to alcohol, it may astonish you to learn that it is only at the extremes of Creation that any love or liking for this fluid—beverage—poison—call it what you will—is discoverable. Man, at the one extreme may be described as an alcohol drinking animal; certainly it is for him, and him only, that that industry and that wealth just referred to, has been established and has been invested. No other living thing that is in the heaven above or that is in the earth beneath or that is in the water under the earth is alcoholicly inclined—save one. At the other extreme, at the lowest rung of life's ladder, we find the *Mycoderma Aceti*, an organism which simply revels in wine, lives and multiplies in it, and consumes it. This inebriate likes its liquor weak and won't have anything to do with drinks containing more than about 10 per cent. of alcohol, but it effectually alters these and under its depraved influence reduces them to the sourest vinegar. Acetous fermentation—an oxidation of alcohol—has been brought about by the growth of bacteria. [24]

$$\overbrace{C_2H_6O}^{\text{Alcohol.}} \times \overbrace{O_2}^{\text{Oxygen.}} = \overbrace{C_2H_4O_2}^{\text{Acetic Acid.}} \times \overbrace{H_2O}^{\text{Water.}}$$

Besides these fermentations mentioned, are the Lactic (*Bacillus acidi lactici*) and the Butyric (*Bacillus butyricus*).

Pathogenetic Bacteria or the Micro-organisms of the Infections of Animal and Plant Life.—It has been thoroughly established that some of the diseases to which flesh is heir are induced by specific germs of bacterial origin.

A list is given of 17 diseases of more or less established bacteriology, 19 are catalogued as uncertain, 5 appear as communicable from animals to man, and 2 are due to protozoa ; a total of 43 ailments. [25 to 43]

Now that the action of the Zymogens is uuderstood—the breaking down complex organic substances into simpler products—it may naturally lead one to suspect that the morbiferous micro-organisms, during their proliferation in the human fluids and tissues, effect changes not unallied to fermentation ; and long before the days of bacteriology something of the kind was believed, and many diseases were grouped as *Zymotic*, a term now practically extinct.

In the normal blood and tissues, so far as is known, no micro-organisms exist ; but they are found on the skin and on the mucous surfaces. In the mouth they are plentiful, and quite ten years ago Miller described and cultivated some fifty different kinds found there, and from the number on the mucous surface of the *prima via*, it has been argued that the process of digestion is not wholly independent of bacterial aid..

This is neither the time nor the place to dwell on the influences of bacterial activity, on infection or contagion, on susceptibility or predisposition, and on immunity—factors which have to be taken into account when war between parasite and host is declared or waged. Suffice that an invasion by the former may be successfully resisted by the *Phacocytes*— [44-45-46] the policemen of the blood current—who, alarmed by the intrusion of an enemy, pounce upon him and destroy him by summarily eating him. Again, the enemy may overcome the outposts and skirmishers, and an invasion, limited in its area and effects, may be accomplished, the results being inflammation or suppuration, or even local death of the part, but without septicæmia or blood poisoning; or the enemy may overspread and devastate, occasionally, but not necessarily, working special local mischief. The invading pathogenetic bacteria, as in the case of anthrax, cholera, diphtheria, or other of the highly malignant and fatal diseases, may rapidly proliferate, and in so doing alter the human fluids and tissues in which they grow—

1st —By the assimilation of nutritive material;

2nd—By the products of secretion, elaborated and given out by the bacterial cell;

3rd —By subsequent secondary changes, induced by these products.

Bacteriological chemistry is still in its very earliest infancy, and the "bacterial products" referred to are not worked out in chemical equation, as in the cases of vinous and acetous fermentation.s Here, complex nitrogenous or proteid compounds are being attacked, and vital forces are arranged on both sides, and the result is a *poison*, "and, knowing as little as we do, it is safest to apply to these bacterial poisons the general term—*toxin*." And yet *toxins* vary; in some diseases they seem to be specific poisons, in others only the poison-producers. But however it be, bacteriology has taught the physician the *causa causans* of many ailments, and he, in his turn, is devising *antitoxins* for their effectual cure.

Saprogenetic or Putrefaction Producing.—I am sure you will pardon me if I quote the oft-quoted but graphic description, by Duclaux, of putrefaction processes and effects:—

"Whenever and wherever there is decomposition of organic matter, whether it be the case of a herb or an oak, of a worm or a whale, the work is exclusively done by infinitely small organisms. They are the important, almost the only agents of universal hygiene; they clear away more quickly than the dogs of Constantinople or the wild beasts of the desert, the remains of all that has had life; they protect the living against the dead; they do more: if there are still living beings, if, since the hundreds of centuries the world has been inhabited, life continues, it is to them we owe it. Without them the surface of the earth would be covered with dead organic matter, the remains of plants and animal bodies, which retaining the elements necessary for the building up of new plant life and animal bodies, would soon cut off the food supply of new plants and animals; life would be impossible, because the work of death would be incomplete; or, as Pasteur puts it, because the return to the atmosphere and to the mineral kingdom, of all that which has ceased to live, would be totally suspended."

While the poisonous products of bacterial action on living material are, as already stated, termed *toxins*: similar products, due to micro-organic decomposition of dead material, are known as *ptomaines* or cadaveric alkaloids, and many of these have been separated and experimented with, and putrid infection, or better, *ptomaines* poisoning, is by no means uncommon, and is, in general, due to the consumption of tainted meats, tinned foods, &c.

CHROMOGENETIC, OR COLOUR-FORMING BACTERIA, are organisms, which during their growth, elaborate or secrete colour stuff. Expose a boiled potato, or some bread, or other farinaceous article, to the air of any ordinary room for a few days, and colonies—as they are termed—of various moulds, yeasts, and bacteria will develop, and the colours of these may be very various. A bright blood red patch may be seen, this is a growth of the *Bacillus prodigiosus*, a micro-organism having remarkable characteristics: sometimes its appearance is prevalent; in Paris, in 1843, it attacked the bread in the military bakehouses. It has not infrequently been found on the sacred wafer, and by its sanguine colour has given rise to the appearance known as the "bleeding host," a phenomenon taken advantage of by the miracle monger to appall the ignorant and superstitious crowd. As Fraenkel says, "All the cases of miraculous blood-covered bread, weeping hosts, &c., which are reported, may be safely referred to this bacterium, as may also those in which the reddening of bread was supposed to result from diseased corn, and the reddening of milk from a special disease of the cows."

Colours, other than red, may be produced:—Yellow, by various kinds of *Sarcinæ*.(47) Yellowish green to blue by the *Bacillus Pyocyaneus*, which discolours the pus and bandages of a wound, making them blue; and the *Bacillus* of blue milk, the *B. Cyanogenus*. Purple to violet by the *Bacillus Violaceus*, or *Ianthinus*.(48) Red by the *Bacillus Indicus*.(49) This is historic.—It derives its name from its having been found by Koch in the intestines of an Indian monkey when he was in India, seeking the cause of cholera. It has the faculty of resisting for a long time various deleterious influences. For instance, a small quantity of potato culture grown in India, was laid between blotting paper, and in this state sent to Germany in a letter. This letter on its way was subjected to all the measures employed by the sanitary police of the different countries through which it passed for disinfecting the mails coming from cholera districts. It was perforated and fumigated with chlorine and sulphur according to the postal regulations, but the first experiments made at the Imperial Health Office in Berlin, at once showed that the vitality of the bacteria had suffered no harm whatever from all these operations.—FRAENKEL.

A somewhat remarkable organism is the *Bacillus Figurans*, [50] so named from the extraordinary twists and convolutions, which, on plate cultivations, give rise to fantastic figures and patterns; these shapes [51] are all built up of definitely arranged parallel rods with all the regularity of bonded brickwork, in which, however, all the bricks are *stretchers*.

Pigment formation seems to depend—

1. On the nature and consistence of the medium—preferably a solid one.
2. On the presence of air and oxygen—preferably both.
3. On the temperature—warmth dispels colour.
4. On the activity of light. Sunlight may prevent or bleach.

PHOTOGENETIC, OR THE ORGANISMS WHICH GIVE RISE TO PHOSPHORESCENCE.—On a dark night it is possible to read one's watch by the light of the waters as the boat and her impelling oars stir them up to glint and glow with phosphorescent pallor. This luminosity is produced by some half-dozen light producing bacteria. *The Photo-Bacterium Phosphorescens — Fluggeri — Fischeri — Balticum — Indicum — and Luminosum.* But not alone water, meat and fish, while decomposing, may also phosphoresce, and the effect is said to be due to active oxidation.

BENIGN, USEFUL OR FRIENDLY BACTERIA.—It is rather unfortunate that the public should associate bacteria with disease—in fact, view them as synonymous terms. There may be some reason, for undoubtedly the practitioner with his everlasting quest for the germ-proof of his patient's indisposition is largely responsible for this limited and partially erroneous belief.

That we have foes—foes treacherous and implacable—amongst these tiny organisms is certain; but we have also friends, trusty and reliable, humble, perhaps, and unobstrusive, but perseveringly working together for our general welfare. To the agriculturalist the friendly bacteria are as essential as the soil or the seasons. It has been asserted, I do not know how truly, that given the choicest soil for some special crop, not a blade would grow if all the factors—the earth, seed, water and air—had been absolutely deprived of bacterial life.

Certainly it has been proved that the complex process of nitrification, the process by which nitrogen from *organic* substances:—decomposing animal and vegetable bodies, manures, &c.—is transformed, or *mineralised*, into ammonia, nitrous and nitric acids, depends upon micro-organic action, and that the conversion is a double one. One set of bacteria changes the ammonia into nitrous acid, and a totally different set transforms the latter into nitric, which unites with soil ingredients to form nitrates. The process is an oxidising one, but it is one of the fundamentals of agricultural chemistry.

And the dairyman has to put up occasionally with the enmity of unfriendly bacteria: the souring of his milk; its sometime bitter, tainted, or soapy taste; its blue, red, or yellow colour; its slimy consistence, are due to the growth in the milk of unusual bacteria. On the other hand, the ripening of his cream, and much more importantly, the ripening of his cheese, giving it the special flavour which finds acceptance in the market, are but the effects of his allies, the friendly bacteria. The flavour of cheese is a bacterial growth of a fermentative character giving rise to decomposition, which, in the case of Limburger and some others, is not very difficult to discover.

It is true, then, that our lunch of bread, butter, cheese, and beer is composed of articles whose very existence is undoubtedly dependent upon or absolutely due to micro-organic life, and it is at least probable that their final digestion in our economy may be assisted by similar agencies.

And to finish well our luncheon, we light the soothing weed, and as drowsily we watch the lazy curling smoke, do we for a moment dream that the fragrance and the aroma are due to bacterial causes? Yet so it is; ere the tobacco leaves are fit for use, they have to go through many processes, some of which, at least, are fermentative. "The special quality of tobacco is in part dependent upon the peculiar type of fermentation that gives rise to the flavour and the aroma of the tobacco, and as the number of species of bacteria which are found upon the tobacco leaves in the various stages of its preparation is quite large, it is inevitable that the different kinds of bacteria will produce different results as to flavour and grade in the fermenting processes."

The effects of other friendly bacteria are seen in the "retting" of the linen and the jute trades; the preparation of indigo and the curing of opium.

But another, a more recent, and, if successful, perhaps the most important of all the friendly aids which man receives from lowly life, is the bacterial treatment of sewage.[52] The disposal of the sewage of cities has been one of the conundrums the sanitary engineer or expert has had to wrestle with since cities first began. It is unnecessary to enumerate the various schemes, more or less successful which have been adopted for all the various conditions of differently situated towns. In most or all of these there has been some one weak or defective spot (even if only an economic one) apparent to and claiming the attention of the authorities, and they, calling in the aid of the scientist have been informed of "the utilisation of bacteria in the treatment of sewage," as proposed by Scott Moncrieff in 1892. The scheme, in fair detail, but somewhat too lengthy to quote in full to-night, appears in an able paper on "Sewerage and Health," read by Dr. Mailler Kendall, Medical Adviser to the Sydney Board of Waterworks, at the Brisbane Session of the Intercolonial Medical Congress of Australasia, in September, 1899.

And this bacterial treatment of sewage or as it is referred to as "simply allowing Nature to fulfil her function by means of bacteria," is also described in "Bacteria," one of the volumes of The Progressive Science Series, 1899, and the works at Exeter are explained and plans shown.

If the promise of the present be supported by the experience of the future, Science, for the problem has been carefully worked out on Chemico-Vital lines, will have scored one of its very biggest successes.

I have said nothing of the numbers in all the classes of bacterial varieties—it is impossible—they are "As the sand which is by the sea shore, innumerable;" and it is almost equally impossible to refer to their rapidity of multiplication, but as I quoted Engel on yeast, I may be excused for mentioning Cohn on bacteria.

He calculated that a single germ could produce by simple fission two of its kind in one hour, in the second hour these would be multiplied to four; and in three days they would, if their surroundings were ideally favourable, form a mass which can scarcely be reckoned in numbers ; or if reckoned, could scarcely be imagined—4,772 billions,—and these would weigh no less than 7,500 tons. Fortunately for us, long before the offspring reach even into the millions, their rate of multiplication is checked either by lack of food or by the accumulation of their own secreted products which are injurious to them.

Nor have I referred to the life history of these organisms nor the artificial methods of cultivating them and keeping their strain pure. That can be seen daily—and it is well worth seeing—in the Bacteriological Laboratory, an Institution of which we in Queensland may very well be proud.

I know I undertook a very large order when I christened my address ; and now, too late, I am aware I have not been able to complete my contract, but at least I have submitted some scattered specimens of what ought to be, and if from these you can realise the dynamics of a microscopic world and appreciate the obligations we are under to lowly life in its most elementary form, the past hour has not been spent in vain.

I cannot help thinking that bacterial reductions and decompositions are the real mills of God, referred to by Longfellow :—

Though the mills of God grind slowly,
Yet they grind exceeding small ;
Though with patience He stands waiting,
With exactness grinds He all.

REFERENCES.

1, Angell: *Wine ;* 2, Bennett: *Physiology;* 3, Chamber's Encyclopœdia: *articles, Life, and Spontaneous Generation ;* 4, Conn : *The Story of Germ Life ;* 5, Crookshank : *Bacteriology;* 6, Drinkwater : *Bread ;* 7, Durie : *Beer and Brewing ;* 8, Fraenkel : *Bacteriology ;* 9, Frankland : *Our Secret Friends and Foes ;* 10, Green : *Birth and Growth of Worlds ;* 11, Griffiths : *Micro-Organisms ;* 12, v. Jaksch : *Clinical Diagnosis ;* 13, Kendall : *Sewerage and Health ;* 14, Kanthack : *The General Pathology of Infection, Allbutt's System of Medicine, Vol. 1 ;* 15, Muir and Ritchie: *Bacteriology ;* 16, Newman: *Bacteria, Progressive Science Series ;* 17, Sims Woodhead : *Bacteria and their Products;* 18, Tyndall: *Floating Matter in the Air.*

APPENDIX.

List of Slides thrown on the Screen during the Address.

*15.—Kindly lent by Mr. Pound, Director of the Bacteriological Institute.

†7.—Reproductions of Prints or Printed Matter by the President, Dr. J. Thomson.

36.—Original Photo-micrographs by the President, Dr. J. Thomson.

†1.—Tyndall's Sterile Case.
2.—Bacillus of Anthrax.
†3.—Classification of Bacteria.
†4.—Subdivisions of Cocci.
5.—Diplococci, Neisser's Coccus.
6.—Diplococci, Pneumococci.
*7.—Diplococci, shewing capsule.
*8.—Streptococci, coloured.
9.—Tetracocci, in fours, Sarcina Lutea.
*10.—Sarcinæ, in packets of eight or more.
11.—Bacilli, square ends.
12.—Bacilli, square ends.
13.—Bacilli, round ends.
14.—Bacilli, clubbed ends.
*15.—Spirilla, S. Rubra.
*16.—Spirilla, S. Rubra and Bacteria Termo.
*17.—Spirilla, Spirocheta.
†18.—Bacterial Groups, classification.
*19.—Yeast, Saccharo-myces Rosaceus, budding.
*20.—Yeast, Saccharo-myces, white.
*21.—Yeast, Torula, pink.
*22.—Yeast, Torula, pink, a colony.
†23.—Vinous Fermentation, chemical equation.
†24.—Acetous Fermentation, chemical equation.
†25.—Infectious Diseases, list and classification from Allbutt.
26.—Micro-organisms of Septicæmia x 1000.
27.—Bacillus of Diphtheria, pure cultivation x 1000.
28.—Bacillus of Diphtheria, direct from patient x 1200.
*29.—Bacillus of Tetanus.
30.—Bacillus of Typhoid x 1000.
31.—Bacillus of Plague, inoculation, guinea pig x 1000.
32.—Bacillus of Plague, man, bipolar staining x 1000.
33.—Bacillus of Plague, man, bipolar staining x 2000.
34.—Bacillus of Tubercle, cultivation x 500.
35.—Bacillus of Tubercle, from sputum x 1000.
36.—Bacillus of Tubercle, from sputum x 1000 (shewing scheme for measuring).
37.—Bacillus of Leprosy, smear from leproma x 500.
38.—Bacillus of Leprosy, smear from leproma x 1000.
39.—Actinomycosis Bovis, shewing clubs x 240.
40.—Actinomycosis Bovis, shewing clubs x 500.
41.—Bacillus of Anthrax x 250.
42.—Bacillus of Anthrax, blood of mouse x 500.

43.—Pyrisoma Bigeminum, organism of Tick Fever x 500.
*44.—Phacocytosis, frog's blood, giant cells and Tubercle Bacilli.
*45.—Phacocytosis, frog's blood, giant cells and Tubercle Bacilli.
*46.—Phacocytosis, Leucocytes and Typhoid Bacilli.
47.—Chromogenetic organisms, yellow, Sarcinæ.
48.—Chromogenetic organisms, violet, B. Ianthinus.
49.—Chromogenetic organisms, red, B. Indicus.
50.—Bacillus Figurans, the Figure x 35.
51.—Bacillus Figurans, details of the Figure x 1000.
*52.—Sewage Bacteria, Proteus Vulgaris.

When the first slide was on the screen, Tyndall's description of his box, its manner of use and details of the experiments conducted by its aid, were read from his book, "Floating Matter in the Air."

A vote of thanks to the President for his address was moved by Mr. W. J. Byram, seconded by Mr. J. Cameron, and carried.

The Election of Officers for the year 1901 then took place with the following result :—*President*, W. J. Byram ; *Hon. Treasurer*, Hon. A. Norton, M.L.C. ; *Hon Secretary*, J. F. Bailey ; *Hon. Librarian*, R. Illidge ; *Members of Council*, A. G. Jackson, C. J. Pound, F.R.M.S. ; J. Shirley, B.Sc. ; J. W. Sutton, J. Thomson, M.B. ; *Hon. Auditor*, A. J. Turner ; *Trustee* (in place of W. A. Tully, resigned) John Cameron.

Dr. W. E. Roth, Protector of Aborigines, exhibited a number of drawings of native basket work, and real several letters written by aboriginal girls at the Cape Bedford Mission Station, in their own language, after which the proceedings terminated.

END OF VOLUME XVI.

PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

QUEENSLAND.

VOLUME XVII. PART I.

WITH 4 PLATES.

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1902.

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[*The Authors alone are responsible for the opinions expressed in their papers.*]

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1903.

INDEX.—VOL. XVII.

PROCEEDINGS

OF THE

Annual Meeting of Members,

HELD ON SATURDAY, 15th FEBRUARY, 1902.

The Annual Meeting of the Society was held on Saturday, 15th February, 1902. The President, Mr. W. J. Byram, occupied the chair, and there was a large attendance.

The Report of the Council for the Session 1901 was read by the Hon. Secretary (Mr. J. F. Bailey) as follows :—

To the Members of the Royal Society of Queensland.

According to custom your Council submit the annual report for the year 1901 :—

The ordinary meetings have been fairly well attended, but it must be admitted that the attendances cannot be compared with those in the earlier stages of the Society's existence. It is also a source of regret that several of the Society's members, who are engaged in original research, have forwarded their papers to southern societies for publication. The primary aim of the Society is the encouragement of original research, although it has as a subsidiary object the promotion of scientific knowledge and the fostering of scientific pursuits. Your Council hope, therefore, that the members who are engaged in research of an original character will not pass over their own Society and thus weaken its salient object.

With a view to assisting as well the original worker as the demonstrator or lecturer your Council procured from Ross and Co., Limited, of London, a microscopical attachment for the science lantern previously supplied by them, and it is to be hoped that members will make use of this instrument, whenever practicable, in illustrating the results of their work.

A list of the papers read at ordinary meetings of the Society during the year is given in Appendix A. Instead of the ordinary meeting in October a lantern and microscopial evening was held in the Centennial Hall, and was very largely attended.

Fourteen Council meetings have been held during the year, and the attendance of members of the Council at the meetings will be found in Appendix B.

Four new members were elected during the year, viz:—Messrs. S. W. G. Rich; B. O. Meek, M.R.C.V.S.L.; Robert Hall and Dr. Walter Fisher.

A copy of the annual financial statement of the Society will be found in Appendix C, and from this it will be seen that its finances are in a satisfactory condition.

A large number of donations have been received for the library during the year, and the binding of the volumes is being steadily proceeded with. Glass doors have been fitted to the bookshelves, and it is intended to procure additional shelves and cupboards, as the existing accommodation is insufficient.

At the invitation of the Central Bureau of the International Catalogue of Scientific Literature, London, a Regional Bureau for Queensland has been formed, to constitute which the following members have been appointed:—The President (ex-officio), Hon. A. Norton, Dr. J. Thomson, Mr. W. J. Byram, with Mr. J. Shirley, B. Sc. as Hon. Secretary.

WILLIAM J. BYRAM,
President.

J. F. BAILEY,
Hon. Secretary.

APPENDIX A.

List of Papers read during 1901 Session.

Date.	Title.	Author.
April . 13	The principal causes of mortality in Queensland	S. G. Martin.
July . 20	The internal structure of plants	J. Shirley, B.Sc.
August 24	The preservation of Bacterial Cultures by formalin ..	C. J. Pound, F.R.M.S.
November 16	Notes on the Sand Fly.. ..	W. R. Colledge.
December 14	Impressions of Peru	Rev. W. Farnsworth, M.A.

Members Elected during the Year 1901.

Date.	Name.	Proposer.
August 24	J. W. G. Rich.	J. Shirley, B.Sc.
August 24	B. O. Meek, M.R.C.V.S.L. ..	W. E. Quinnell, M.R.C.V.S.L.
December 14	Robert Hall	C. W. DeVis, M.A.
December 14	Dr. W. Fisher	James Keys, F.L.S.

APPENDIX B

Attendance of Officers at the Council Meetings during the 1901 Session.

Office.	Name.	Number attended
President	W. J. Byram	10
Vice-President ..	F. Whitteron	7
Hon. Treasurer ..	Hon. A. Norton, M.L.C.	11
Hon. Secretary ..	J. F. Bailey	11
Hon. Librarian ..	R. Illidge	11
Memb's of Council	A. G. Jackson..	6
	C. J. Pound	5
	J. Shirley, B.Sc.	6
	J. W. Sutton	3
	Dr. J. Thomson	9

APPENDIX C.

THE ROYAL SOCIETY OF QUEENSLAND.

FINANCIAL STATEMENT, 1901.

Dr.	£	s.	d.	Cr.	£	s.	d.
Balance from last report	67	14	8	Bookbinding	23	12	3
Sale of Proceedings		2	0	Lantern (additional apparatus)	22	15	0
Lantern Hire	1	10	0	Advertising	3	1	0
Government Endowment	146	1	6	Printing and Stationery	57	13	4
Subscriptions	83	9	6	Postage and Petty Cash	12	15	0
				Insurance	1	4	6
				Carpentery	10	7	3
				Rent	14	2	0
				Bank Charge		10	0
				Electric Light (charge for)		17	6
				Balance per Bank pass-book	151	19	10
	£298	17	8		£298	17	8

Liabilities.—Nil.

Examined and found correct.

Brisbane, 24th January, 1902.

ALEX. J. TURNER, *Auditor.*

A. NORTON, *Hon Treasurer.*

The adoption of the Report was moved by the Hon. A. Norton, M.L.C., seconded by Mr. A. J. Turner, and carried.

The Election of Officers for the year 1902 then took place, with the following result:—*President*, Dr. John Thomson; *Vice-President*, Dr. W. W. R. Love; *Hon. Treasurer*, Hon. A. Norton, M.L.C.; *Hon. Secretary*, J. F. Bailey; *Hon. Librarian*, R. Illidge; *Members of Council*, A. G. Jackson, C. J. Pound, J. Shirley, B.Sc.; J. W. Sutton, and F. Whitteron; *Hon. Auditor*, A. J. Turner.

The retiring President (Mr. W. J. Byram) then delivered an address, entitled "Recent Aspect of the Cell Theory."

PRESIDENTIAL ADDRESS.

Recent Aspect of the Cell Theory.

The history of science presents numerous instances of theories which have, for the time being, appeared to receive confirmation from observed facts, and to afford a satisfactory explanation of the phenomena involved, and which yet, on further research and fuller scrutiny, are found to be but half-truths, or generalisations based upon data too restricted in their scope. This resting for the time being upon defective inductions in order to obtain a working hypothesis, and by recourse to repeated experiment and observation, to draw ever nearer the truth, is indeed the essence of the scientific method. A disciplined imagination has been as large a factor in the progress of science as the most laborious research, or the most persistent and patient observation, but the mind which has become imbued with the scientific method is scientific even in its imaginings, and holds all its inferences tentatively, and ready on every opportunity to subject them to the most rigorous criticism and to the test of actual experience. This is the method which is the gateway to truth, and some of its most beautiful applications are found in the phases through which the cell theory has passed since it was first vaguely foreshadowed at the close of the seventeenth century, and was definitely promulgated in 1838, by the German biologist Schleiden. The conception of this theory, and of evolution, has created the science of biology in its modern sense, and has changed the whole attitude of thought. It cannot, therefore, be otherwise than of the deepest moment to realise what this conception was, how it has been modified by the results of subsequent research, and to what conclusion the most recent views are tending. The cell theory is simply the generalisation that all animals and plants consist of a cell or cells—the lowest being constituted by a single cell, and the more complex being built up of a number of cells, either all alike and without differentiation, or in the higher organisms modified and adapted to subserve a variety of functions. What the cell is, what are its contents, what is their relative importance, and why it is the seat of life, are questions which have passed through such changing phases that now the very word "cell" is seen to be a misnomer based upon a half-truth, and although the word is retained it is only because it has taken its place in scientific nomenclature, and is now used as a term whereby to designate the biological unit. In the latter part of the seventeenth century the study of plant structure led to the observation of minute spaces or compartments, provided with firm walls in some cases, empty in others, filled or partly filled with fluid contents. These little compartments, which are so minute that they can only be seen under the microscope, received the name of cells, and the term cell had every appearance of appropriateness, for in plants these units appear to be minute vesicles, each surrounded by its own wall. This was the view promulgated by Schleiden in 1838, and he declared that plants are made up of cells, and that their vessels are modifications of cells. Why Schleiden reached such a conclusion will be obvious if we examine some examples of cells. If we take, for instance, a small portion of a seaweed and examine it microscopically under a magnification of about 100 diameters, it will be observed that it is built up of minute compartments, each surrounded with a comparatively thick wall. A similar structure is characteristic of plants generally. The thickened cell walls are well seen if we examine a piece of the substance known as rice paper, which is obtained by sections of the herbaceous stem of the Chinese plant Aralia. The cuticle of a leaf also affords a typical illustration. Stripped off and examined under a power of about 150 diameters, not only the cells of the epiderm are seen, but the peculiar modified cells known as guard cells, which flank the pores or stomata of the plant. These cells, though altered in shape by their adaptation as supports, nevertheless present the same appearance of minute vesicles. If we make a transverse section of the leaf, from surface to surface, and magnify it to about the same extent, we see the same cellular structure varying from the more compact cells of the epiderm to the more expanded cells of the interior, and a transverse section of a stem or twig presents the same cellular formation. In the pith of a rush the cell walls are again curiously altered in shape and have taken a stellate formation, and the cells extending the whole length of the slender stem impart to it the qualities of strength combined with flexibility and lightness; but if a single cell is selected and examined, it will be seen that it still to all appearances answers to the description of an enclosed sac or vesicle. The examination of the vessels of plants led Schleiden to the conclusion that they are the derivatives of a series of cell walls. If we cut a thin longitudinal section from the stem of a fern we see a ladder-like structure, consisting of what are known as scalariform vessels. In these the old cell walls lie in a series close together, and give rise to a vessel whose surface presents the appearance of a series of steps. Another form of cell derivative is found in the spiral vessels where the former cell walls have coalesced to form a lengthened spiral. Leaving the tissues and vessels of the plant, and turning to its reproductive elements, we pick out a few of the pollen grains and examine them under a sufficient magnifying power. We may take as an example the pollen-grains of the cotton magnified about 50 diameters. Here we have the biological units no longer united to constitute a tissue or aggregate, but detached and in the form of separate cells adapted to the special function of fertilising the germinal vesicle in the ovary. If we now descend in the scale of plant life and examine the humbler forms, such as the salt and fresh water algae, we find them still presenting the same appearance, for they consist of cell expansions, that is, an aggregate of units, each one the counterpart of the other united together in the form of a frond, as in many of the sea weeds, or filament, as in many of the fresh water forms. If we descend still further we come to minute plants like the desmids, each of which consists of one cell only. Here again we have reached detached units, as in the case of the pollen cells of the flowering plants, but in the latter these units have become differentiated and specialised for the function of reproduction of the plant, while in unicellular plants like the desmids, each cell is a distinct organism, or in other words, is the plant itself. All such observations as these went to show that plants, from the lowest to the highest, are either themselves cells, or are built up of cells, and the modifications or derivatives of cells; and that the cell is a minute chamber surrounded by a membrane or wall and enclosing fluids. So far the theory was confined to plants, but another German biologist, Schwann, published the results of a series of experiments, which extended the theory to the minute structure of animals, and enunciated the comprehensive generalisation that animals resemble plants in being composed of cells. If we examine under a high power a little human blood, we find examples of two forms of cells floating in a colourless liquid—the red corpuscles, which impart to the blood its red colour, and the white ones. The examination of a section of spinal chord, or of cartilage or bone, shows that animals, not less than plants, are aggregates of cells and the products or derivatives of cells. In animals, however, the amount of formed material, as it is called, derived from the cells bears a much larger proportion to the whole, and the cellular structure is consequently frequently obscured. Again, as we descend in the scale of animal life, we meet with organisms which are little more than a double layer of cells, as in the hydra, a little creature frequently met with in fresh water ponds, the outer layer acting as a sensory system and the inner as a digestive apparatus. And in such lowly forms as the sunanimalcule, a minute-rayed animalcule often found in standing water, we reach at length the unit or single cell existing as a separate individual. The correspondence therefore between animals and plants, in either consisting of one of these elementary units, or being built up of a number of them, and their derived material and secretions, is evident. Schleiden and Schwann, however, believed that the cell was in all cases, as the name implies, a cellula or enclosed vesicle; and although they did not overlook the cell contents, they thought that the cell wall was the essentially vital portion of the cell, and that the interior parts were merely subsidiary. Schwann seems to have been led to this belief by observing that the cell wall was the most persistent part, and that there were many cells in which the contents had dwindled away, while the cell wall remained. But further research has demonstrated that these conceptions are erroneous. In the first place, it was discovered that many of these elementary units, both in the constitution of complex organisms and in those lowly forms which each consist of but one unit, have no cell wall whatever. In the sunanimalcule, for example, which is but a single cell, no cell wall exists: the most that can be detected is a slightly greater density at the surface and a slightly increased fluidity within. The same is the case with the amœba—a microscopic jelly-like speck, found frequently in stagnant water. The outer portion of the cell is, perhaps, slightly denser than the inner; but the difference can scarcely be detected, and the animalcule is so plastic that it undergoes many Protean changes as it slowly creeps across the glass, beneath which it is placed for examination. It is a remarkable fact, however, that the amæba sometimes passes into what is known as the encysted state: that is, it draws in all its processes, assumes an oval shape, and secretes a cell wall. In this condition it greatly resembles a plant cell. From such observations as these it became evident that an error had been made in the generalisation that the cell is an enclosed vesicle, for here we meet with the unit existing in its ordinary state without any limiting membrane, and the study of animal histology has disclosed the fact that, just as vegetable cells usually possess well marked cell walls, the reverse is the rule with animal cells, which commonly lack the cell wall altogether. When the theory was revised in the light of these revelations it was, of course, at once apparent, that not only was the term "cell" a misnomer, as applied to the biological unit generally; but, as a large number of cells are entirely destitute of the cell wall, that part of the cell could not only no longer be looked upon as the most important, but where it exists, must be regarded as quite subsidiary. These discoveries and consequent change of aspect in the theory gave rise to developments which have been of the utmost significance in the progress of biology. Biologists fixed their attention on the cell contents, and the result was that the cell theory entered upon a new phase, which so changed its whole aspect, that it might almost be enunciated afresh and termed the protoplasmic theory. In his researches Schleiden, while assigning the primary importance to the cell wall, had not overlooked the fact that many of the cells which he examined contained a semi-fluid substance interspersed with granules. To this he gave the name of plant slime. Later on this substance was designated protoplasm, or primary formative substance; and it was found to possess characteristic movements, and to be most abundant in very young cells and more scanty in older ones. A similar glairy, contractile substance had been observed in animal cells, and called sarcode or elementary flesh. This substance was readily studied in the microscopic marine animals known as radiolara and foraminifera; for these forms consist of single units enclosed in minute tests or shells of carbonate of lime, and when in a state of activity they put out their substance in the form of lengthened processes from the numerous little pores which exist in their shells. Indeed they seem almost to imitate the magic of Ariel, and to be able to divide themselves and act dispersedly, for in some of them almost the whole cell substance may be withdrawn from the shell and spread abroad in the form of minute rays, which, nevertheless, unite in different places or inosculate, as it is termed, and form irregular patches or reticulations. After extensive research, two German biologists—Max Schultze and de Bary—in 1859 demonstrated that the so called sarcode or elementary flesh was identical with protoplasm, and although the term cell was retained, all reference to an enclosed vesicle was discarded, and it was simply defined as a minute portion of this substance, protoplasm, endowed with the attributes of life. Here again, however, biologists suffered themselves to be dominated by a particular idea, and it led to conceptions which are now seen to be erroneous. Protoplasm was said to be akin to the group of complex compounds known as proteids, of which albumen, or white of egg, is an example, and was thought by many to be one of these compounds, and by others to be a mixture of two or more or them. Although, therefore, observers had noticed the minute oval or elongated body in the cell, known as the nucleus, and had not overlooked the appearance of minute granules interspersed through the protoplasm of the cell, these phenomena were not supposed to possess any special significance. The protoplasm itself was conceived to be the life substance, or, as Professor Huxley defined it, "the physical basis of life." It was said that pure protoplasm would not show either nucleus or granular structure, but would be perfectly homogeneous and undifferentiated, and would have as its salient property—life or vitality. This conception was borne out by the great strides which were being made in chemistry. The synthetic powers of the chemist were no longer confined to the production of the simple inorganic compounds, but extended to the far more complex substances which are the result of animal and vegetable life. It was found that just as the chemist could combine artificially two volumes of hydrogen gas with one of oxygen, and produce by their combination the liquid—water with all its essential characteristics just as it exists in nature, so he could combine, for instance, hydrogen, carbon, and oxygen in just such proportions as to produce that acrid, pungent, liquid found naturally in the bodies of ants, and known as formic acid. Considering protoplasm to be a very complex chemical compound, or even a mixture of chemical compounds, it was a very natural inference for the chemist that only its great complexity prevented him from making it artificially, just as he had made formic acid; and that, just as when he succeeded in making formic acid, it had that distinctive pungency and acidity which characterise it in the bodies of ants, so if he succeeded in making protoplasm it would *ipso facto* possess its salient property—life. These views led to a persistent research on the part of biologists for that perfectly homogeneous protoplasm in which they believed, and in repeated attempts to discover the composition of the molecule of protoplasm as an initial step towards its artificial production, and the consequent solution of the sublime problem of life. Such attempts resulted in some strange misconceptions and too hasty conclusions, of which, perhaps, the most remarkable was Professor Huxley's belief that he had discovered the perfectly homogeneous protoplasm, for which all were seeking, in a collection obtained by deep sea soundings during the cruise of the exploring ship Challenger. As the result of these observations, Huxley stated that the bottom of the ocean was covered with a diffused mass of protoplasm, so homogeneous that it did not display any cell structure, and showed no trace of a nucleus or granulation. Huxley called this supposed diffused protoplasm Bathybias, or "deep-sea life substance." Coming from so acute an observer and so high an authority, this announcement was received with the keenest interest, and it was believed that the chemical protoplasmic theory had won the day. But the subsequent analysis of this deep-sea deposit showed it to have no connection with life or protoplasm, but to be simply a mineral precipitate, and Huxley, true to his principles of sincerity and candour, was the first to proclaim his error. The history of science is full of similar misconceptions, and, far from being a theme for regret, we must recognise that they are but the result of the imagination, which is a salient element in the scientific method, outstripping that unwearied observation and research which alone can act as its corrective, and restrain it within serviceable limits. But the demonstration of the error of Bathybias led biologists to revise the theory and to examine the cell or elementary unit with increased care and caution. There is in the cell a minute oval or elongated body, which has received the name of the nucleus. While the early observers looked upon this body as a mere insignificant adjunct—a little piece of protoplasm somewhat denser than the rest—biologists now began to pay increased attention to it, and the result was that nucleii were discovered in cells which had previously been deemed to be devoid of them. The nucleus was then discovered to be directly concerned in the vital activity of the cell. Proofs of this were abundantly forthcoming. For instance, on many ponds you will observe tangled masses of green slimy substance, known as spirogyra. When some of this is removed and examined microscopically, it is found to consist of long filaments, consisting of cells united end to end, and through each cell runs a beautiful spiral green band. If the contents of the cell are examined through the opening of this spiral, the nucleus will be observed, and passing to it from the walls of the cell are strands of protoplasm. The nucleus gradually shifts its position and traverses the cell, carrying with it the protoplasmic strands. Moreover, if the filaments are kept under observation for some time, it will be found that at times two of them approach each other and lie side by side. Then canals are put out by the cells on one side and unite with those on the other, and the contents of the cells on one side are poured through these into the cells on the other. Then comes the significant fact; the two nucleii approach each other and finally coalesce. A spore is formed by the union of the contents of the two cells, and by the coalescence of the two nucleii is formed the germinal nucleus of the spore. Again, if we study for an hour or two such an animalcule as the vorticella—a minute infusor, just visible in the colonies of the larger species to the naked eye, and frequently occurring in ponds we find that each unit consists of a single cell, placed on a corkscrew-like stalk, which expands and contracts. Its structure can be readily studied under the microscope, and the nucleus will be at once detected. If one of the cells is kept under examination for a sufficient time, the phenomenon of division can be watched. After a period of active feeding and rapid movement of its circlet of hair-like processes, or cilia, the latter are drawn in, a cleft or groove appears at the top, the nucleus elongates, and the cell gradually divides through the nucleus into two complete cells, one-half of the nucleus remaining in each. It is common, therefore, to find two cells on the same stalk, the process not having progressed to the extent of a separate stalk for each. But the essential point here is the partition of the nucleus between the cells, which are formed as the result of subdivision, and the inference which arises that the nucleus is the centre of vital activity. That this inference is correct has been demonstrated in a remarkable manner. A lowly animalcule is cut in pieces under a dissecting microscope. Some of the pieces are severed so as to include no part of the nucleus, and others so as to contain portions of that singular body. The result is very striking. The pieces which include no portion of the nucleus continue to exhibit vital activities for a time, but these soon come to an end, and death is the result. On the other hand, the pieces which have retained portions of the nucleus actually continue to carry on the vital activities and to assimilate food and grow, as if no such partition had been made. Here then, at once, we have a new restatement of the cell theory. It is not the cell wall which is the essential element, as Schleiden and Schwann thought, the protoplasmic contents are not the all-in-all, as the observers which followed them stated; but, as far, at any rate, as the powers of food assimilation, growth, and reproduction are concerned, the nucleus is an all-important factor. But this discovery was attended by another. The improvement in microscopes and microscopical methods enabled observers to see that protoplasm is not by any means homogeneous or structureless, and the former idea, that it is a chemical compound or mixture of such, having life as its attribute, is abandoned, for protoplasm is found to consist of an infinitely delicate network of slender fibres, forming a reticulated material, which is interspersed with very minute granules known as microsomes, and this network is filled with a transparent fluid. It is therefore apparent that, as in the term "cell," the essential idea to which the name "protoplasm" was given, has actually vanished, and the name is only retained to designate this conjunction of a filamentous network, and clear liquid, which constitute part of the constituents of the biological unit. Another complete change of conception has resulted from recent research, for the nucleus itself instead of being, as was formerly thought, a minute speck of protoplasm rather more dense than that which surrounds it, is found to be a distinct element, itself an intricate complex different in composition and with activities peculiar to it, but co-operating with the reticulated mass and fluid constituents. Within late years the structure of the nucleus has been studied with great care. It is found to consist of a membrane, which separates it from the surrounding cell substance, but this membrane is a variable characteristic, for it is sometimes absent, and usually disappears as a preliminary to subdivision. The nucleus, too, has been shown to contain distinct substances. There is a network, or framework, of the most delicate nature in the nuclear cavity, to which the name "linin" has been given; there is a nuclear sap, and a distinct proteid substance which is the preponderating material both in quantity and importance. This constituent is known as "nuclein," or "chromatin," the latter name being given to it on account of its taking a very deep stain when subjected to staining reagents. The nuucleus not only plays a most important part in the life of the cell, but it is that portion of the cell which passes from one generation to another, and in this process the chromatin is an active agent. In cell subdivision one-half of it becomes apportioned to each of the resulting cells, and it is the medium of the momentous phenomenon of heredity. Besides, the nucleus microscopists have within late years detected in the cell, and lying near the nucleus, another small body so minute that it was overlooked until the efficiency of modern instruments disclosed it. This body, which has been called the "centrosone," appears to exercise a controlling influence upon the vital phenomena, for around it the protoplasmic granules are found to be arranged in rays, as if the lines of force radiated from it. This centrosome generally soon divides into two, and is found reduplicated, thus presenting the appearance of two minute stars. The precise function of this body and the nature of its action are at present not understood, but in cell division it appears to be the mechanism which controls the process and regulates the apportionment of the chromatin between the resulting new cells. It will now be at once realised how completely the cell theory has been modified since the days when it was usual to talk about protoplasm as a homogeneous chemical compound, having for its attribute that property of being alive. To look at the delicate framework of fibres, studded with granules and filled with clear liquid, the complicated nucleus, with its network, and chromatin threads, and nucleolus, and the strange rayed body known as the centrosome lying near it, is to prepare the mind for the recent enunciation of the cell theory, which is so unlike the old doctrine that nothing but the words remain, and they remain only because without creating any particular confusion they have acquired a new signification. The cell theory may now be concisely stated thus: Just as the steam engine is a machine for the production of motion, or the dynamo is a machine for the production of electricity, so the cell is an infinitely subtle and delicate machine, the resultant of whose working is life. This is a novel and startling deduction, but so consonant with all the observed phenomena and with the structure of the cell that it becomes a far more efficient hypothesis than any which have preceded it. So completely have the old views undergone modification, that it has even been questioned lately that the higher organisms are aggregates of independent units, for in many cases protoplasmic strands have been detected passing from cell to cell. It has, therefore, been suggested that the so-called multicellular animals and plants are complexes of a multitude of nucleated centres all in vital inter-connection—the one with the other. These inferences are not established, and, if they were, they do not affect the hypothesis that the cell units are delicate life machines. It is apparent that in unicellular animals and plants the unit exists *per se*, and in many instances cells detached from multicellular animals and plants can continue their life either indefinitely or for a time. The ciliated epithelial cells, which may be obtained by scraping a frog's throat, have all the appearance of infusorial animalculæ. They are nucleated cells, and, when detached, they can swim about for a time by means of their processes, and lead an independent life. Again, in the zoophytes,—those minute organisms which are found in rock pools left by the receding tide—each unit, or "zooid," as it is called, although in organic connection with the stalk, which is the common base of all, and thus united with the others in a colony, is a distinct animalcule, and may be detached and live a separate life. The volvox globator affords another example of the inter-connection of the cell units. It is a minute colony of plant cells, united so as to form a bright green globule, just visible to the naked eye, moving through the water in which it lives by means of the combined ciliary action of the cells. If, while under examination, the cells are carefully focussed with the fine adjustment of the microscope, they are found to be united, giving rise to a delicate hexagonal appearance over the surface of the sphere. But it will be found that certain of the cells enlarge and subdivide, and finally detach from the mother sphere internally, and by repeated subdivisions develop into new spheres. Thus, while there is an inter-connection of cells in the multicellular plants and animals, and it is probably a misconception to regard such organisms as mere cell aggregates or complex groups of independent units, it would be no less a misconception to consider that the significance of the unit had disappeared. We might as well declare that because we have a centre of social activity in Sydney and another in Brisbane, the connection of the two by a line of railway obliterates the position of both as independent communities. In accordance, therefore, with the hypothesis which now prevails, the cell is a very delicate piece of mechanism of vast complexity. It is supplied with fuel in the shape of nutrient material, and by the action of the oxygen of the air this fuel is oxidised or burnt up; the mechanism consequently does work; complex chemical changes take place; and the ultimate resultant is life, manifested by the essentially vital phenomena of movement, irritability, metabolism, or the power of converting the altered nutrient material into its own likeness and reproduction. The phenomena of movemement and irritability can be exhibited by that part of the mechanism which we still called protoplasm, even if it is deprived of the nucleus, but metabolism and reproduction are essentially functions of the nucleus—that wonderful machine within a machine—which not only insures the continuance of life in the unit itself by enabling it to assimilate and grow, but which, by the agency of its marvellous constituent, chromatin, is the source of the bewildering problems of heredity. Besides its momentous and, at present, inscrutable resultant—life or vitality—the working of the cell creates a laboratory of the most intricate chemical changes, and gives rise to by-products of such vast importance that without them the whole range of plant life, and consequently of animal life, would be at an end. For instance, in the filaments of spirogyra we saw a spiral band, which is made up of beautiful light green granules, and each cell in the volvox displays the same green substance. This product of cell activity, known as chlorophyll, is the source of green colouring of plants, and is the agent by which, under the influence of sunlight, they are enabled to assimilate carbon direct from the air by decomposing the carbonic acid gas present in it. Without chlorophyll plant life could not exist, and without plant life animal life would cease. There is another product of cell action which is scarcely less important. If we cut a thin section of potato and examine it under the microscope, we find the cells of which it is composed filled with minute grains, which, if carefully focussed, exhibit a fine, scarcely perceptible lamination. If we have a polarizing apparatus on our instrument, and observe these granules under polarised light, each becomes marked with a dark cross. This phenomenon tells us that we are looking at the starch granules which give the potato its flowery quality and nutrient properties. The cell, then, according to the most recent theory, is an intricate piece of mechanism—a life-engine—whose parts are admirably adapted to the production of vitality. If it is asked whether this theory brings us any nearer to answering the question, "What is life?" the answer must not only be in the negative, but it must be at once admitted that we are further than ever from the solution of the problem. While it was thought that life was the property of a complex substance—protoplasm—it did not seem a very wild inference that human daring and ingenuity would overcome all difficulty, determine its molecule, and then, by a masterpiece of synthesis, make the substance artificially. Even if it were a mixture of proteid substances, still the attempt did not seem utterly beyond the powers of the chemist. But now the whole aspect is changed. That, even if he understood it, the biologist could succeed in making the delicate mechanism of protoplasm, and that stil' more subtle and baffling complex—the nucleus—is about as probable as that the astronomer of the future will succeed in making a voyage to the planet Mars. We must be content, therefore, to plead ignorance. To say candidly, "I do not know," is quite scientific, for, coupled with the admission of ignorance, there is always the determination to strive to conquer it, however vast may be the difficulties ahead, and however faint may be the hope of overcoming them. Above all, we must not be tempted to bridge over lacunæ in our knowledge by dogmatic assertions, or to forget the lessons of caution which the history of the cell theory teaches us. Although presenting the aspect of high probability, the mechanical theory of life is still hypothesis, and we have no right to assert it otherwise. All we can say is, that the observed phenomena all appear to be in unison with it, and that being so, it forms the best working theory, and must be accepted provisionally, unless and until it is displaced by a nearer approximation to the truth.

A vote of thanks to the retiring President for his address was moved by Mr. John Cameron, M.L.A., seconded by Mr. S. G. Martin, and carried by acclamation.

The proceedings then terminated.

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1902.

PROCEEDINGS

OF THE

Annual Meeting of Members,

HELD ON SATURDAY, 15th JANUARY, 1903.

The Annual Meeting of the Society was held on Saturday, 17th January, 1903.

The President (Dr. John Thomson) occupied the chair.

The minutes of the last Annual Meeting were read and confirmed.

The Hon. Secretary read the following Report of the Council for the 1902 Session :—

To THE MEMBERS OF THE ROYAL SOCIETY OF QUEENSLAND.

According to custom, your Council submit their Report for the year 1902.

Ordinary Meetings of Members were held regularly during the year, and a list of the papers read at these meetings will be found in Appendix A.

Twelve meetings of the Council were held, and the attendance of officers is given in Appendix B.

It will be seen by reference to the Treasurer's Statement, that a further sum of £20 has been expended on the lantern. This amount was for additions that the Council considered would add to the usefulness of the instrument in illustrating papers where microscopical objects were dealt with. Mr. J. W. Sutton, who is now on a visit to England, has kindly consented to arrange for the purchase of these additions.

In May last, at the invitation of the President (Dr. John Thomson), Professor Crookshank delivered a lecture, under the auspices of the Society, on "Science and the State, with special reference to Tuberculosis and the Public Health." The Council have decided to print the lecture, and it will appear in the volume of Proceedings now in the press.

Part 1 of Volume XVII. of the Proceedings was published in May last, when it was distributed to Members and also to Institutions and Societies on the exchange list.

The Council have pleasure in recording that Mr. F. M. Bailey, one of the founders of the Society and an Ex-President, was, in December last, voted the highest honour in the gift of the Royal Society of New South Wales, *viz.*, the Clarke Memorial Medal, which is awarded from time to time for meritorious contributions to the geology, mineralogy, or natural history of Australia. This is the third time the medal has come to Queensland, and the two previous recipients—Dr. R. L. Jack and the Hon. A. C. Gregory, C.M.G., M.L.C.—are also Members of the Society of long standing.

Many donations to the Library have been received during the year, and the work of binding has been continued, 338 volumes having been bound at a cost of £52 0s. 6d.

It will be seen by reference to the Treasurer's Statement (Appendix C), that the funds of the Society are in a satisfactory condition. The Council regret, however, that a number of subscriptions for the past year have not been paid, and would urge those in default to pay as soon as possible.

In January last the Hon. Secretary attended, as the representative of the Society, the Meeting of the Australasian Association for the Advancement of Science, which was held at Hobart.

JOHN THOMSON, M.B., Edin.,
President.

J. F. BAILEY,
Hon. Secretary.

Brisbane, 5th January, 1903.

APPENDIX A.

List of Papers Read during 1902 Session.

Date.	Title.	Author.
March - 8	Notes on Savage Life in the Early Days of West Australian Settlement.	W. E. Roth, M.R.C.S., B.A., Oxon.
April - 12	New England (N.S.W.); Reminiscences during the Fifties. (Part 1.)	Hon. A. Norton, M.L.C.
May - 22	Science and the State; with Special Reference to Tuberculosis and the Public Health.	Professor E. M. Crookshank, M.B., Lond.
June - 21	New England, &c. (Part 2.)	Hon. A. Norton, M.L.C.
June - 21	A Few Scientific Notes Taken During the Present Drought.	T. P. Lucas, M.R.C.S.
August - 2	On the Possibility of Preventing Damage by Frost.	P. Olsson-Seffer, Ph. D.
August - 16	Immunity; Natural and Acquired.	W. W. R. Love, M.B.
Septemb'r 13	Domestic Water Supply of Brisbane; with Special Reference to the Presence of Zinc in Tank Waters.	J. Brownlie Henderson, F.I.C., F.C.S.
October 25	Settling in Queensland and the reasons for doing so.	Hon. A. Norton, M.L.C.
November 15	The Development of Some Queensland Fish.	J. R. Tosh.

APPENDIX B.

Attendance of Officers at the Twelve Council Meetings held during 1902.

Office.	Name.	Number Attended.
President	John Thomson, M.B.	9
Vice-President	W. W. R. Love, M.B.	2
Hon. Treasurer	Hon. A. Norton, M.L.C.	11
Hon. Secretary	J. F. Bailey	12
Hon. Librarian	R. Illidge	9
	A. G. Jackson	5
	C. J. Pound	6
Members of Council	J. Shirley, B. Sc.	7
	J. W. Sutton	2
	F. Whitteron	8

APPENDIX C.

THE ROYAL SOCIETY OF QUEENSLAND.

FINANCIAL STATEMENT for the Year 1902.

Dr. **Cr.**

Receipts.	£	s.	d.
Balance from last statement	151	19	10
Subscriptions	43	11	6
Government Grant	50	0	0
Sale of Proceedings	1	10	0
	£247	1	4

Disbursements.				£	s.	d.
Printing and Stationery				25	12	6
Advertising				5	9	3
Postage and Petty Cash				12	8	11
Cupboards for Library				9	0	0
Insurance				1	2	6
Rent				1	10	0
Donation to Technical College				10	10	0
Hire of Hall and Chairs (Prof. Crookshank's lecture)				1	18	6
Bookbinding				35	12	3
Additions to Lantern				20	0	0
Bank Charge and Cheque Book				0	12	6
Balance per Bank Pass Book	£123	3	10			
Petty Cash in hand ..	0	1	1			
				123	4	11
				£247	1	4

Liabilities.—Bookbinding, £16 8s. 3d.

Examined and found correct,

Alex. J. Turner, *F.I.A.V., Brisbane, 5th January, 1903.*

A. Norton, *Hon. Treasurer.*

The adoption of the Report was moved by Mr. R. Gailey, seconded by Mr. R. C. Mackie, and carried.

The election of Officers for the year 1903 resulted as follows:—*President*, W. W. R. Love, M.B.; *Vice-President*, John Cameron, M.L.A.; *Hon. Treasurer*, Hon. A. Norton, M.L.C.; *Hon. Secretary*, J. F. Bailey; *Hon. Librarian*, R. Illidge; *Members of Council*, W. J. Byram, A. G. Jackson, C. J. Pound, J. Shirley, B.Sc., and John Thomson, M.B.; *Hon. Auditor*, A. J. Turner, F.I.A.V.

The retiring President (Dr. John Thomson) announced that he would deliver his Presidential Address at a subsequent meeting.

Mr. R. Illidge then read a paper, which he, in conjunction with Mr. Ambrose Quail, had prepared on Australian Wood-boring Cossidae.

PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

QUEENSLAND.

VOLUME XVII. PART I.
WITH 4 PLATES.

[*The Authors alone are responsible for the opinions expressed in their papers.*]

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BY
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1902.

THE

Royal Society of Queensland.

Patron:

HIS EXCELLENCY MAJOR-GENERAL SIR HERBERT C. CHERMSIDE, G.C.M.G., C.B.

OFFICERS, 1902.

President:

DR. JOHN THOMSON.

Vice-President:

DR. W. W. R. LOVE.

Hon. Treasurer:

HON. A. NORTON, M.L.C.

Hon. Secretary:

J. F. BAILEY.

Hon. Librarian:

ROWLAND ILLIDGE.

Members of Council:

A. G. JACKSON. J. SHIRLEY, B.Sc.
C. J. POUND, F.R.M.S. J. W. SUTTON.
F. WHITTERON.

Trustees:

JOHN CAMERON, M.L.A. HON. A. C. GREGORY, C.M.G., M.L.C.
HON. A. NORTON, M.L.C.

Hon. Auditor:

A. J. TURNER.

CONTENTS.

THE PRINCIPAL CAUSES OF MORTALITY IN QUEENSLAND.

By SIDNEY G. MARTIN, A.I.A. (Lond.).

(Read before the Royal Society of Queensland, 13th April, 1901).

When making this investigation into the various causes of mortality in Queensland, I at first intended to take the whole 40 years since separation. I found, however, that the figures in the earlier years were too small, and the causes of death in some cases too vague to lend themselves to useful and reliable results, consequently I have restricted the investigation to the twenty-five years 1875/99, dividing this term into five periods of five years each.

The value of comparative mortality statistics is often much impaired by reason of the diverse conditions that effect various populations. Death rates, arrived at simply on the basis of total deaths to total population, can be safely compared only when the number alive at the various ages are in the same ratio, when the sexes are in the same proportion, and when there is no considerable alien population subject to a different rate of mortality to disturb the result. When these conditions exist and are not allowed for, results which are more or less misleading are brought out.

In Queensland more than in most countries has allowance to be made for peculiar conditions. The increase of the male population in this State owes more to immigration in comparison with the natural increase than any other Australian State, except Western Australia. The result of this is that the number of males in the prime of life is greater than it otherwise would be and far exceeds the number of females; thus at the last census in 1891 while the male population *under* 20 differed very little from the female in that group, the males *over* 20 numbered 131,000, as compared with 80,000 females.

As an example of the errors and exaggerations that creep in through these disturbing elements not being allowed for we may consider the year 1884. In this year there was a heavy mortality amongst the Pacific Island population, and the returns over the whole population showed the death rate per 1000 living as 22·3, while, the Polynesians being left out from both living and dying, we get 17·2 as the death rate for the year. And in regard to the particular disease phthisis to which the islanders are specially prone, the ratios work out for that year as 19 per 10,000 living, with the Polynesians included, and only 10 per 10,000 with them excluded, a difference of nearly 100 per cent. Further, as showing the possible error when age and sex are not allowed for, the Queensland total male ratios in deaths from cancer are for 1899 greater than for females, viz. :—5·3 as against 4·1 per 10,000 living ; while, due regard being had for the greater proportion of males in the cancer ages the correct result of a higher death rate for females is arrived at, as will appear later on. The comparative mortality of a country is becoming of more practical importance as the best energies of our governments are being given to the prevention of disease. Not so very many years ago preventive medicine was scarcely heard of, now it appears to be a special branch of medical practice. So many diseases are now recognised under the heading of bacterial, and bacterial necessarily implies more or less preventible, that there is no lack of work for this branch of medicine. By observing the progress of the various diseases over a term of years we can see what success has been met with, and learn by the results of the past what, if any, modifications are necessary as regards future operations.

My authorities for the figures given in this paper are, as regards the general mortality, the very complete reports issued by the Registrars-General for England and Queensland. As regards the causes of death of Polynesians, they are given separately by our Registrar-General for phthisis and other tubercular diseases, the other causes of death I obtained from the records of the Immigration Office.

For the purpose of working out the ratios, I took the living to be the mean of those alive at the beginning and end of each quinquennium, which, though not absolutely exact, it is usual to take in comparisons of this nature, and the numbers alive at each age are proportional to the figures shown at the nearest census. I have had to modify this arrangement in comparisons involving the ages of infancy in the figures for the last quinquennium, on account of the falling off in the birth rate, which will have the effect of bringing the number under five in that quinquennium no higher than in the one previous, though the total population shows considerable increase. For older ages the comparisons are not sensibly affected, and I have not altered the figures. The death rate put against each quinquennium is the annual rate, and is simply one fifth of that experienced through the whole five years.

In arriving at the ratios, deaths to persons living, I have taken the numbers living at those ages at which the disease in the great majority of cases begins to be fatal, such as 15 for phthisis, 35 for cancer, &c., but the deaths from those diseases are the *total* deaths at all ages, including those few which occur before those ages. I have preferred not to alter the figures more than necessary, as to know the *numbers* of deaths as well as the *ratios* is useful ; and as in no case does the number of deaths outside the included ages amount to one-tenth of those inside, the ratios are not materially affected, and for purposes of comparison one year with another the results are not affected at all.

Infant Mortality.

The infant mortality is said to be generally accepted as the most sensitive test of the health of a given population, and judged by this standard, Queensland stands well. The infant mortality is found by comparing the total deaths under age 1 with the births of the year, and on this basis the average per thousand for the past 25 years is as follows :—

1875/79, 145 ; 1880/84, 127 ; 1885/89, 129 ; 1890/94, 104 ; 1895/99, 102.

The rate for all England in 1898 was 160, higher than ours has ever been. There are only four counties in England that show a better rate than our present one ; three with 99, and one with 101 per 1,000. Our rate for 1899—109, though higher than the average for the previous five years, was the lowest in Australia, South Australia being next with 111.

If we take the mortality for the first five years of life we get results as follows :—

	Total deaths under five.	Ratio to 10,000 living.
1875/79 ..	8,217 ..	58·6
1880/84 ..	8,806 ..	48·0
1885/89 ..	11,851 ..	46·8
1890/94 ..	10,926 ..	34·4
1895/99 ..	10,169 ..	32·2

Thus the deaths during the last quinquennium were not only far fewer in proportion, but actually fewer numerically than were recorded 10 years ago though the population under 5 increased one fourth in that period. Now that Queensland, in common with all other European nationalities is suffering from a reduced birth rate, it is some consolation that the children who are born have a better chance of growing to maturity. The improvement during the 25 years has been very considerable, and the rate during the last 10 years is better than can be shown in any part of England. The English rate 55·8 is about equal to ours of 25 years ago, and no part of England can now show so low a death rate over the first five years of life as does Queensland. The lowest county rate is a little under 34 per 1,000 as compared with our 32·2.

It is not possible to gather anything but the most general idea as to those causes of death in childhood that have contributed most to the general reduction, as the classification has been so completely altered during the 25 years. At the beginning of this term one-fourth of the deaths were said to have been due to debility or atrophy (wasting away), now only 2 per cent. are so classified, deaths from diseases of the digestive system were then only 3 per cent., now they contribute 20 per cent. Deaths from diarrhoeal and respiratory diseases show a most pronounced improvement, the former especially, the rate having been reduced by more than one-half within the last 10 years, viz. :—From 8·5 per 1000 in 85/89 to 4 per 1000 in 95/99.

PHTHISIS.

Of all fatal diseases to which the European race is subject that of phthisis has for a long time, and possibly for centuries, taken the place at the head of the list. That it has remained so to the present may be regarded as due, to a very large extent, to the fact that, through ignorance as to the nature of the disease, no check has been placed upon its spreading until quite recent times. Not regarded as a communicable disease, no attention was given to the danger of infection from persons suffering from consumption. Since the discovery of the tubercle bacillus, and the consequent more enlightened treatment of consumptives as persons bearing infection, we may expect to find an improvement in phthisis statistics, and we do not look in vain.

The figures given below showing annual death rate from phthisis must not be compared with other statistics of this nature, for these, so far as I have seen them, have given the ratios of deaths to the whole population, while I have worked out my ratios on the basis of the population at consumptive ages, viz. :—15 years to the end of life. As the deaths amongst Polynesians from this disease have been given separately by the Registrar-General only since 1877, I have worked out results for four quinquennia only, so that I might leave that race completely out of both deaths and population. The numbers and ratios refer therefore exclusively to Europeans and the Asiatic races which, unlike the Polynesians, show a mortality little differing from that of the Europeans. The figures are as follows for males and females respectively :—

	MALES.		FEMALES.	
	Total deaths from phthisis excluding Polynesians.	Annual Ratio to 10,000 living above age 15.	Total deaths from phthisis excluding Polynesians.	Annual Ratio to 10,000 living above age 15.
1880/84	754	15·8	398	14·8
1885/89	1019	16·0	545	13·2
1890/94	1120	15·2	562	10·8
1895/99	1103	12·8	584	9·6

It will be noticed that there is a marked difference in the movements as between the males and the females; while the latter show a continued reduction, and are now one-third less than they were in the first quinquennium under notice, the male rate was almost constant for the first three periods, and during the last period showed a reduction of less than a fifth as compared with 1880/84. This difference seems to me to be not without some significance, especially when taken in conjunction with a similar condition found in the English comparison, for whereas the mortality from this disease was practically the same for both sexes in the decennium 1861/70, viz. :—24·7 and 24·8 per 10,000 living at all ages for males and females respectively, the rate was reduced 20 years after to 18·5 for males and 16·1 for females, the reductions being 25 per cent. for the former as against 35 per cent. for the latter. The more recent figures for the year 1898 make the reductions 39 per cent. and 54 per cent. respectively. An investigation that was made some years ago into the records of the Brompton Hospital for chest complaints showed that while male consumption was more common than female as regards the London district, the cases where there was a family predisposition to the disease showed a greater ratio amongst females. This was accounted for by the more sedentary and less invigorating life of the females, and to this I should add that in view of the fact that the attendance on those of the family who are suffering from the disease falls to the females, they would be less likely to escape the infection than the males who spend a much greater part of their time away from home. As the Queensland rates have been probably effected to a certain extent by the presence of a number of persons who came here with the hope of deriving benefit from the climate, it would not be safe to draw deductions from these alone, but as they are supported by the English figures I think that they may be depended on. From these considerations I should gather that while the efforts made to reduce the spread of consumption amongst the population generally have been largely successful, they have been materially assisted by wise attention to the danger of direct infection amongst members of the family circle. I think these figures may also bear the inference that a good deal of consumption set down as due to heredity, may rather be ascribed to infection. The English annual rate per 10,000 living in the year 1898, taking the population over age 15, was 24 for males and 17 for females, a much higher rate than Queensland has ever known.

Cancer.

While the outlook as regards phthisis is decidedly hopeful, the reverse is the case in regard to cancer. The former disease is still responsible for more deaths than cancer or any other disease, but as cancer is rapidly increasing, while phthisis is diminishing, the present relative positions may not long continue. In 15 years the proportion of deaths from cancer to phthisis has increased in Queensland from 30 per cent. to 60 per cent.; indeed, at the present time in this State cancer causes more death after it once comes into evidence at about age 35 than does phthisis after that age. In England, owing to the large number of deaths from phthisis, that disease still causes more deaths than cancer even after 35, though the difference is gradually becoming smaller.

The ratios for Queensland are as follows :—

	MALES.		FEMALES.	
	Total Deaths.	Annual Ratio per 10,000 living over age 35.	Total Deaths.	Annual Ratio per 10,000 living over age 35.
1875/79	114	6·6	95	12·6
1880/84	175	8·0	158	14·8
1885/89	263	9·6	181	12·4
1890/94	378	11·8	281	15·6
1895/99	612	16·6	419	20·1

The considerable difference in the rates of increase in males and females is very marked, and is a common feature in all cancer statistics. The English rates are higher in both sexes than ours, on account of the larger proportions of persons living at the higher ages. Taking the proportions of persons living at the different ages as they exist in Queensland, the deaths in England from cancer would, in 1898, have been 15·5 for males, and 24·7 for females, per 10,000 living over age 35. Twenty years ago female cancer was in England double the rate for male, as in the Queensland experience; during that term the increase in female cancer has just kept pace with our own, but the rate of increase in male cancer has been less than ours.

There has been considerable controvesy as to whether the increase in cancer is real or only apparent. The advocates of the latter view include Mr. George King, one of the foremost of British actuaries, who, with Dr. A. Newsholm, reported in a paper read before the Royal Society of London, 1893, as the result of an investigation into this matter that the increase in deaths from cancer was due to improvement in diagnosis, and a more careful certification of the cause of death, and gave statistics to show that the whole of the increase has taken place in inaccessible cases of cancer, in which, from their position, exact diagnosis is difficult, while accessible cancer easily diagnosed has remained practically stationary. For those who contend that the increase is real, and not merely apparent, I quote from a paper read before this Society by Dr. Hirschfeld in 1893, he said: "We are therefore forced to the conclusion that the rapidly and greatly increasing prevalence of cancer in the Australian colonies cannot be accounted for by an increase out of proportion of that part of the population which is most liable to malignant tumours (aged persons), nor by greater accuracy of diagnosis, even by a certain small natural increase in consequence of hereditary transmission, that on the contrary the improved diagnosis of the earlier stages, together with the advancement of surgical treatment, should warrant a diminution instead of an augmentation of the cases of death caused by cancer."

For the other side I quote from the concluding remarks of the paper by Mr. King and Dr. Newsholme:

"1. Males and females suffer equally from cancer in these parts of the body common to men and women, the greater prevalence of cancer among females being due entirely to cancer of the sexual organs. This is shown by the Frankfort statistics, and may not unreasonably be accepted as a general law, seeing that in other respects, where comparison is possible, the Frankfort statistics are confirmed by those of the United Kingdom.

"2. The apparent increase in cancer is confined to what we have called 'inaccessible cancer.' This is shown (*a*) by the Frankfort statistics (*b*) by the fact that the difference between the rates for males and females respectively is approximately constant, and does not progressively increase in cancer in each of the sexes; (*c*) because the apparent increase in cancer among the well-to-do assured lives, who are presumably attended by medical men of more than average skill, is not so great as among the general population. (This remark is based on the different experiences of the Scottish Widows' Life Assurance Society and the general population of the United Kingdom.)

"3. The increase in cancer is only apparent and not real, and is due to improvement in diagnosis, and more careful certification of the causes of death. This is shown by the fact that the whole of the increase has taken place in inaccessible cancer difficult of diagnosis, while accessible cancer easily diagnosed has remained practically stationary."

In 1892 our own Registrar-General commenced to tabulate deaths from cancer under their various heads, and I compare below the figures for the years 1892/93 with those for the years 1898/99, dividing them as Mr. King and Dr. Newsholme did into accessible and inaccessible cancer. (Of cases that could not be classified there were 19 in the earlier period and 26 in the later.)

ACCESSIBLE CANCER.

	1892/93.			1898/99.	
	Males.	Females.		Males.	Females.
Uterus ..		28	..		57
Breast ..		13	..		26
Neck & face	12	3	..	22	1
Mouth & Throat	44	5	..	66	2
	56	49		22	84
Total -	105		Total -	174	
				Increase 66 %	

INACCESSIBLE CANCER.

	1892/93.			1898/99.	
	Males.	Females.		Males.	Females.
Stomach ..	57	17	..	112	34
Intestines ..	14	7	..	23	12
Bladder & Kidneys	3	1	..	9	8
Lungs ..	2	1	..	5	6
Liver ..	14	11	..	39	24
	90	37		188	84
Total -	127		Total -	272	
				Increase 114%	

The increase in the population was only 22 per cent., so that in both cases the increase in cancer largely exceeded it, though certainly by a great deal more in inaccessible cancer.

These figures lead us to conclusions widely differing from Mr. King's and Dr. Newsholme's for, in the first place, males and females in Queensland suffer very unequally from cancer in those parts of the body common to man and woman. Allowing for the difference in the number of the sexes, the proportion in Queensland is as 45 for males to 26 for females in the years 1898/99. Also the Frankfort statistics, which alone furnished information as to the various parts of the body affected, show an even rate for cancer in males over 30 years, while in that time our rate has more than doubled. There seems no other conclusion possible, at least, so far as Queensland is concerned, but that cancer is increasing to a serious extent. I may add that the deaths from cancer in the stomach are exceedingly heavy in Queensland, especially amongst males, the percentage of deaths from cancer in the stomach to total deaths from cancer is 32 in Queensland and only 16 in England.

Diseases of Urinary System.

Another disease causing an increasing number of deaths is that of the kidneys, classified under two heads, Bright's disease and nephritis. Kidney disease accounts for the great majority of deaths included under the heading, diseases of the urinary system, and I have extracted the figures for the whole class.

	MALES.		FEMALES.	
	Total deaths.	Annual ratio per 10,000 living over age 15.	Total deaths.	Annual ratio per 10,000 living over age 15.
1875/79 ..	131	3·5	29	1·4
1880/84 ..	204	4·0	54	2·0
1885/89 ..	354	5·2	122	2·9
1890/94 ..	449	5·7	166	3·2
1895/99 ..	619	6·8	308	5.2

The English rates for the year 1898 are for males and females respectively 5·2 and 3·9 on the basis of a population aged as in Queensland, which are lower than were our rates during that year. Almost the same rate of increase was shown in the English statistics over a period of 20 years from 1870 to 1890 as in Queensland, with a similar accelerated increase in the female section.

Typhoid Fever.

There has been a very great diminution during the past ten years in the deaths from this cause, which was at one time responsible for more deaths per annum than any other. The ratios are as follows :—

		Total deaths male and female.	Annual ratio per 10,000 living over age 5.
1875/79	..	6[illegible]1	7·8
1880/84	..	1048	9·6
1885/89	..	1083	7·4
1890/94	..	544	3·0
1895/99	..	683	3·4

We are still considerably in excess of the English rate, which for 12 years past has kept steadily at about 2·2 per 10,000.

Malarial Fever.

Considering that one-third of our population lives within the tropics, it might have been expected that malarial diseases would be an important factor in our death rate, this indeed was the case 20 years ago, and malarial fever was responsible for as many deaths as consumption, though the proportion of population within the tropics was much less than it is now. The number of deaths as well as the ratios have gradually decreased, however, during the 20 years until the deaths from this are almost the fewest among the principal causes of death.

Males.

		Total deaths.	Annual ratio per 10,000 living over age 20.
1875/79	..	547	16·2
1880/84	..	340	7·4
1885/89	..	166	2·8
1890/94	..	196	2·8
1895/99	..	138	1·8

Liver Disease.

For the same climatic reason it would have been expected that liver complaint would be responsible for a large proportion of deaths. The deaths from this cause are, however, amongst the fewest, and have been fairly regular throughout the term, with a suggestive increase during the years when money was plentiful.

Males.

		Total deaths.	Annual ratio per 10,000 living over age 20.
1875/79	..	96	2·8
1880/84	..	137	3·0
1885/89	..	311	5·2
1890/94	..	260	4·0
1895/99	..	245	3·1

Alcoholism.

The deaths from this cause are a good deal higher than in England, and showed the same increase that liver complaint did before the years of depression brought about an enforced economy in method of living. The death rate during the past quinquennium is the smallest and is only one-half that experienced in the period 1885/90.

MALES.

		Total deaths.	Annual ratio per 10,000 living over age 20.
1875/79	..	98	2·9
1880/84	..	164	3·6
1885/89	..	282	4·7
1890/94	..	189	2·8
1895/99	..	189	2·4

ACCIDENTS.

Accidental deaths always have appeared and still do appear amongst the largest contributors to our total death rate. The figures run as follows :—

	MALES. Total deaths.	Annual ratio to 10,000 living at all ages.	FEMALES. Total deaths.	Annual ratio to 10,000 living at all ages.
1875/79	1375	25·0	287	7·6
1880/84	1658	21.8	332	7·6
1885/89	2194	22.0	611	8·4
1890/94	2419	20.6	608	6·4
1895/99	2249	16.0	582	5.6

I have excluded from the last quinquennium the 250 victims (chiefly Asiatics) of the disaster to the pearl fishers in 1899.

A comparison of the various classes of accidental deaths shows that the improvement has been in regard to those accidents which are of the more preventible class, such as burns, scalds, and drowning, which are only one half the rate of 20 years ago, while those accidents which can less be guarded against, such as horse, railway and mining accidents, falls, and falling trees, show almost exactly the same rates. The rate of death from accident among children is only one-third the rate of 20 years back. Amongst adults the cause responsible for the greatest number is that of drowning, which has accounted for an average of 109 per annum during the past three years, but 20 years ago on the same basis of population the number would have been 200. Horse accidents account for an average per annum of 89, practically the same rate as that of 1877/79. The deaths resulting from accidents in mining average 16 per annum.

SUICIDE.

The deaths from suicide are third on the list of deaths from violence, with an average of 80 per annum during the past three years. The rate has been practically stationary during the past 25 years, as the figures show :—

MALES.

		Total deaths.	Annual ratio to 10,000 living above age 15.
1875/79	..	127	3·8
1880/84	..	147	3·2
1885/89	..	223	3·6
1890/94	..	284	4·1
1895/99	..	326	4·1

This rate is higher than the English rate, which is only 2·6 per annum per 10,000 living over age 20. Twenty years ago the English rate was 2·2, thus showing a slight increase.

RESPIRATORY AND DIARRHOEAL DISEASES.

It is not possible to trace the history of these two classes of disease on account of the records being swelled by the deaths of large numbers of Polynesians, which, except in the more recent years, cannot be eliminated. Comparing the Queensland ratios (exclusive of Polynesians) with the English, we have the following figures for the years 1897/98:—

		Annual ratio per 10,000 males living over age 15. Queensland.	England.
Respiratory diseases	..	15·0	26·5
Diarrhoeal diseases	..	3·7	1·2

GENERAL.

A table of comparison showing at a glance the ratios of deaths occurring from all the most important causes in Queensland and in England is interesting. The latest reports available from England are for the years 1897 and 1898, and I have taken out results for the same years from the Queensland experience. In order that the result may yield a fair comparison, I have divided the deaths into three groups—from ages 15 to age 45, from 45 to 65, and from 65 upwards; this grouping yielding in England as nearly as possible equal numbers of deaths. The deaths in each group in the Queensland experience I have proportioned to the ratios shown in the English statistics, so that the Queensland ratios are not those of actual experience, but as they would be if the age distribution of the population were of a more normal character. To these I have appended results derived from the Mortality experience of the Mutual Life Insurance Company of New York, for the years 1894 98, dealing with their figures in the same way. In this case though, from the way in which the figures are presented, I have had to take the dividing age between the second and third groups at 60 instead of 65, but the general result will not be appreciably affected. This Company's business is now world-wide; but, as far as the deaths are concerned, over 90 per cent. are recorded as having occurred in the United

States of America, so that this experience may be considered as fairly representing that of the better class in that country, such as would be found on the books of an ordinary life assurance company. I have eliminated the deaths of Polynesians from the Queensland experience, so that this comprises only the European population, and the Asiatic, which, as before stated, has much the same rate of mortality.

Percentage which the several causes of death bear to the total deaths for the years 1897/98. Over age 15—males :—

MALES.	Queensland.	England.	United States.
Influenza ..	3·7	2·2	1·1
Typhoid fever ..	3·1	1·4	4·0
Malarial fever ..	1·0		1·4
Diarrhoea diseases ..	2·6	·8	2·0
Alcholism ..	1·7	·9	·3
Cancer ..	6·3	6·1	4·9
Phthisis ..	8·5	13·8	10·2
Tubercular diseases other than phthisis ..	·8	1·2	·4
Diabetes ..	·4	·9	1·3
Diseases of Nervous system ..	9·4	12·0	16·7
Diseases of Circulatory system ..	13·4	14·8	14·2
Bronchitis ..	3·6	7·8	1·2
Pneumonia ..	5·5	6·2	8·1
Other diseases of respiratory system ..	2·6	2·2	1·4
Diseases of liver ..	1·5	2·1	1·8
Other diseases of digestive system ..	4·4	3·4	6·0
Brights Disease ..	3·1	2·7	7·4
Nephritis ..	·5	·6	
Other diseases of urinary system ..	2·2	1·9	2·7
Accident ..	10·7	5·3	5·6
Suicide ..	2·6	1·4	2·7
Old Age ..	3·5	7·6	2·0
Other causes ..	8·9	4·7	4·6
	100·0	100·0	100·0

One noticeable feature of the comparison is the high rates in England due to chest complaints, viz. :—30 per cent. of the whole, as against 20·2 in Queensland and 20·9 in the United States. Nervous diseases find the United States a good deal in advance with 16·7, England next with 12 per cent., and Queensland last with 9·4. Of digestive diseases the United States are again highest with 7·8 ; England and Queensland having 5·5 and 5·9 respectively. In the violence classes

Queensland is much the highest with 13·3, as against only 6·7 and 8·3 for England and the United States respectively. The United States are highest with urinary diseases, 10·1; Queensland and England being 5·8 and 5·2. In cancer the United States are lowest with 4·9, the other two being nearly equal with a little over 6 per cent. The larger number set down to old age in England may be accounted for by the fact that there will be a larger proportion of extremely old people in that experience as compared with the other two. The comparison in regard to certain diseases shows the effect that mode of life, apart from climate, may have in some respects. From what we know, or imagine, of our "go-ahead" American cousins, we should rather expect that their causes of death would not run on parallel lines with our own, and we find that in diseases relating to the brain and the digestion they are far ahead. Adding together diseases of the digestive, nervous (including suicide), and urinary systems, we get 24·1 for Queensland, 25·0 for England, and 38·6 for the United States.

Kanakas.

As there has been a certain amount of discussion recently concerning the mortality of the Polynesians in Queensland, I have taken out the experience during the past 25 years.

		Total deaths.	Ratio per 1000 living.
1875/79	..	1708	74
1880/84	..	4064	102
1885/89	..	3207	75
1890/94	..	2126	51
1895/99	..	1461	36

The ratios of the second and third periods were swelled by the inclusion of the figures for 1884 and 1885, when, owing to a serious epidemic of dysentery, followed by an outbreak of pneumonia, the death rates ran up to 164 and 110 per 1000 respectively. Excluding these years, and taking the experience for four years only in each of these two periods, the ratios will run 74, 60, 49, 51, and 36. The lowest rate of 36 per 1000 is still excessive, seeing that the rate for the European population of the ages of the Kanakas, 15 to 45, is not more than 8 per 1000. One-half the deaths amongst the islanders are due to tubercular diseases, and of the other half pneumonia and dysentery are responsible for the greater part.

Conclusion.

Although the only perfect comparison of mortality is that based on exact ages of living and dying, still, what has been submitted in this paper furnishes evidence that the mortality of Queensland is favourable as compared with England; and we have seen that the general movement in regard to the more important disease, is one of reduction. How the European race will fare, as regards the attainment of extreme old age, will take many years to show; this State is still so young, and the settlement, in the North especially, of such comparatively recent date, that we have not the facts yet for ascertaining what effect the heat of North Queensland will have on the longevity of Europeans. All that we can conclude at present is, that the indications are favourable as to the general healthiness of the country, and as it becomes more settled, while sanitation and other matters pertaining to the health of the people receive more attention, it does not seem an extravagant expectation that Queensland may become the sanatorium of Australia. We have within our 18 degrees of latitude great diversities of climate, ranging from the humid heat of the North to the dry summer weather with cool nights experienced in the Downs country, and we have the choice of the mild winter on the northern coast or of the bracing weather of the elevated lands towards the west, for so great is the elevation that even well within the tropics are hard frosts experienced throughout the winters on the higher table lands there.

I would conclude my paper by expressing the hope that as medical knowledge advances and municipal practice improves, and as the residents learn to adapt their mode of life more to the exigencies of the climate, some future writer may be able to record the fact that the principal cause of mortality in Queensland is old age.

NOTES ON A SPECIES OF SANDFLY.

By W. R. COLLEDGE.

[*Read before the Royal Society of Queensland, November 16, 1901.*]

The sandfly is a popular term, which includes members of different species of Diptera.

The subject of the present paper is found in Brisbane, and seems to be related to a species named "Ceratopogon Albopunctus." These insects are exceedingly troublesome both to man and animals. Being so minute, the ordinary mosquito netting is no barrier to its progress. A hole of a fiftieth of an inch in diameter is only a narrow way leading to her heaven if she is hungry and you are inside. Unlike her compeer, the mosquito, she gives no warning of her approach, but does her spiriting gently, and knows intuitively where the most tender parts of your anatomy lie.

Like all insects, it is naturally divided into three parts, viz., the head, chest, and abdomen. The head resembles a partially compressed globe, the compound eyes occupying nearly the whole of the sides and frontal space, leaving a central aperture, through which the mouth organs project. The cells of the eye do not assume the honeycomb shape of the common house fly, but each is separated from its neighbour by a firm chitinous frame, so that, though there are hundreds of these cells massed together, yet each preserves its circular form.

A pair of beautiful antennæ spring from the sides of the frontal space. These consist of fourteen joints, varying in shape according to their position. The basal one is much enlarged, globular and slightly elongated ; to this are articulated a number of joints resembling pitchers, the base of each being rounded, with a contracted neck, bearing on the lower part a circlet of long curved hairs, projecting outwards. Each hair is inserted into a socket, which, when the hair falls, appears as a white cup-like depression. The first eight of these urn-shaped joints resemble each other, but the last five differ, gradually elongating and growing narrower. The terminal one is like a minie rifle bullet. From the point projects a delicate cone, evidently a sense organ, probably a taste bud.

Between the antennæ, but a little lower are the palpi, a pair of organs consisting of four differently shaped joints, the second peculiarly so, resembling a shoulder of mutton in miniature, and on the fleshy part is a circular pit. In this are a number of truncated cones, bearing little nucleated globes on their ends. I have not seen anything like them delineated anywhere ; and it appears to me to be a delicate sensory apparatus, for communicating sound waves, inaudible to the human ear.

Between the palpi there springs the proboscis. It lies in the median line. Externally it consists of a fleshy sheath, terminating in two thick lips or flabella. They are slit on the underside, and by certain muscles can be drawn back so as to expose the lancets contained within.

Like its sanquinary friend, the mosquito, it possesses an armoury of six distinct lancets, but they are much thicker and stronger comparatively. In use, the whole are combined together, forming a stout weapon of offence, not unlike a broadsword. These lancets are paired, so that there are three groups, of like nature. The two outermost are the maxillary lancets ; these are attached to the facial plate which carries the palpi. In dissection, the two generally come away together. These are distinguished by their concave scythe-like blades, shaped so as to fit over and clasp the inner lancets. From the point to a space half-way down the organ is a row of large teeth, set like a ripping saw, to enlarge the cut when they are withdrawn. Next are the mandibles, much resembling a couple of carving knives. One edge is thin, the other stouter. The end being broadly lanceolate, one angle being tipped with small regular teeth, like a tenon or surgeon's saw. These are easily recognised by having a longitudinal slit, such as is made in the blade of a pocket knife, for ease of opening.

Still going inwards, the two central lancets of the group are found. These are like a tube with a rounded end, split longitudinally, and placed so as to form a hollow chamber. The tips are indented deeply, making straight marginal teeth. A fine tube appears to run down the centre to the point. This is probably the channel by which the poison is injected into the wound. These central lancets are prolonged into the mouth, widening into a trumpet-like chamber, which receives the end of the tube connected with the stomach. They are likewise attached laterally by two horny projections to muscles in the head, which seem capable of thrusting these lancets deeper, or withdrawing them from the wound. From the oral surface, the lancets measure one hundredth of an inch in length.

There is a probability that only the female sandfly attacks man. I have never found a male insect upon me. At the Tweed River one afternoon I caught about fifty on my hands, but there was not one male among them. Every specimen was of the feminine gender. So that what is broadly true of the mosquito —that only females attack man—seems to hold good with this little insect too.

The thorax is dark brown, almost bare on the dorsal aspect, with scattered golden hairs on the sides. The parts are welded together so that it forms a concave shield extending from the neck to the abdomen, with a well defined border along the sides. In shape it is not unlike the shell of a tortoise. On the part near the head are two angular apertures for the admission of air—the prothoracic spiracles.

Below the lateral border arise the wings, they are oval, the posterior border being abruptly rounded below the axilla, and densely covered with black hairs. No marginal cross vein is visible, and the only transverse one is in the axilla, where passing above the curve formed by the junction of the roots of the third and fifth longitudinals, it unites the first to the sixth.

The first longitudinal arises from the root of and on a level with the costal. Curving downwards, it runs parallel, and then unites with the costal at a point a little on its side of centre of the wing, Both these veins are very much thickened. A second longitudinal proceeds parallel from the middle of the axillary joint to a point two-thirds of the length of the first, where it turns np abruptly to coalese with it, forming a thickened rib which terminates in a club-like form on the costal border. Immediately beyond this is a marginal pale U-shaped spot where the hairs are thinly scattered. This is most distinctly visible when examing the insect in a natural state.

The third longitudinal starts a little beyond the point where the second unites with the first, and pursues a straight course to the border of the apex of the wing.

Below this and originating about the centre is the fourth faintly marked longitudinal, pursuing a parallel course but dipping slightly, it reaching the edge as far below the apex as the termination of the third is above it. None of these are forked.

The fifth, arising in the axilla, is very distinct; it runs obliquely until below the thickened insertion of the first veins on the costal edge; on reaching that point it forks, the upper arcuating slightly, the lower tending downwards to unite on the lower border at its central point. The petiole is a little more than the length of the fork. A sixth longitudinal faintly marked runs a little below and parallel with the petiole, near the bifurcation of which it terminates.

The legs are very muscular, and are often used in leaping from one point to another, after the manner of the lively flea. A jump of fifty times their length is no unusual thing. The pro-legs are the shortest, the middle and hind ones not differing much in length. The first long joint is the thigh or femur; the second, rather thinner, is the tibia, or shank; and the tarsus, or foot, is formed from the last five joints.

The first joint of the hind foot is noticeable for a row of spines of equal length placed in one line, like the teeth of a comb. The insect actually puts them to this use. Occasionally it can be seen combing out its hairs on the abdomen, and other parts of the body. And I have seen the gentlemen bending down his head, and with the bristles on his fore legs combing out his whiskers, or the long hairs of his antennae, very likely before he went out to visit his young lady.

The joints of the legs seem to be connected rather loosely together, but this gives them a wide range of movement. Each leg terminates in a pair of claws widely separated like the hooks of a grappling iron. They are black and sharply pointed. Between these hooks a little feathery organ hangs. I have not been able to reproduce it in a photograph, so have made a rough sketch of it. It is like a root with lateral branches. The shaft and branches are dotted with little cells. No doubt it is the representative of the pulvilli of the housefly. The minute dots are cells secreting glutinous material, which enable it to adhere to smooth surfaces, where the claws cannot obtain a foothold. On the tibia of the female are a few small cones, or club-like hairs, seemingly connected with some special sense. Most likely they are olfactory cones, or organs of smell. Insects often have sense organs in what are to us unlikely places. For instance, the locust has an ear on the leg. And it is not improbable that they have senses differing from any that we possess.

The abdomen is composed of the usual chitinous segments found in insects. The dorsal aspect is of a dark brown colour, with a narrow grey bar separating the segments, which also extends like a stripe along the sides. This lighter portion is capable of considerable expansion, when the eggs are enlarged in the ovaries. Long curved hairs, black in colour, are scattered over the parts, being longer in the male body. In his case the last segment terminates in a pair of hooks called claspers, while in the female a pair of fleshy lobes are found, which are used in placing the eggs in position outside of the body.

Passing now into the interior of the body the most interesting to us are the salivary and poison glands. These are the organs which render the insect so noticeable and mischevious. The mere prick of its tiny lancets would never be noticed but for the injection of the fluid from these glands into the wound. Two of these are found lying in the prothorax. You see one in one of the photographs attached to the head by the poison tube, and appearing like a tiny balloon. It only measures the four-hundredth part of an inch in length, and takes the form of a roundish pear. Interiorly, it is filled with granular matter which stains readily, more especially on the circumference. The long tube by which they are attached to the neck is ringed internally and expands in width as it approaches the gland. In the mosquito the veneno salivary gland divides into three distinct lobes, each having its own separate tubule ; but here each gland consists of but one lobe. At its base, two tiny buds are seen, which may possibly be the analogues of the others found in the mosquito.

At the base of the central lancet lies the aesophagus, or gullet, a stout muscular tube, in which, coupled with capillary attraction, the blood-sucking power rests. Towards the lower part it widens to unite with the stomach. This organ, when empty, is usually found thrown into longitudinal folds, and the large epitheiral cells with which it is lined are easily traceable through its walls. At its lower end it slightly thickens encircling the base by a rim, and from this spring two very long Malpighian tubes. They lie upon the outside of the stomach, folded three or four times up and down on account of their length. On these, at regular intervals, large glandular cells are placed. It is thought that these tubes fulfil functions similar to the liver in animals.

The nervous system consist of the brain and six ganglia united by a double cord of nerves. From each side of these nerve reservoirs branches proceed, which ramify to different parts of the body. The last ganglionic mass in the abdomen is double the size of those preceeding it, as it has to supply the organs of reproduction, as well as the neighbouring structures, with nervous force.

With regard to the function of respiration a peculiar provision for the reception of air is found in the possession of three air sacs. Two lie in the thorax, and the third extends like a bag to the lower part of the abdomen. They are attached to the aesophagus near the neck. The two smaller sacs are probably compensatory additions, which come into play when the abdomen of the female is distended with eggs. Then the pressure of its contents prevent the expansion of the main air sac, so that it is comparatively useless for the time, (as a matter of fact I have generally found it almost empty); then the two thoracic sacs come into play and retain air for the purposes of lightening the specific gravity, and the respiration of the insect. As in the case of the mosquito the air in the sacs is in the form of minute bubbles, separated from each other by an oily film. The sac walls are very transparent, resist most stains, and contain longitudinal and transverse fibres, so that they seem capable of contraction and expansion. The whole of the abdominal organs are subject to a perisaltic movement. They are slowly drawn forward and then thrust backward every few seconds. Thus the process of digestion is aided by the food being moved about in the intestines, and the function of respiration is likewise accelerated by the air being forced through the tracheal tubes.

In the last segment of the female are found two brown oval organs like beans; these are the spermathæca, which secrete the gum by which the eggs are united together. The mosquito possesses three, but only two are found in the sandfly. A slender tube passes from each into the lower bowel, so that their contents can be brought into contact with the eggs as they pass from the ovarian duct to be placed on the outside of the body. The egg sacs occupy in the female a large space in the abdomen. One is placed to the left and the other on the right. A large tracheal tube passes into each, giving off smaller branches, which further subdivide and ramify throughout the whole of the egg mass.

The number of eggs varies, ranging from one to two hundred. The largest number I have found has been two hundred and ten. They measure the one hundred and fiftieth of an inch in length, by half that in breadth. They are oval, yellow, and transparent, looking very like minute gelatine capsules. In the photo given they are laid attached side by side in a long ribbon; but I do not regard this as the normal shape of the egg mass. In captivity insects often do things which they would not in a state of nature, and a judgment formed under these circumstances may prove to be inaccurate, and I have others wherein the shape is much more like the egg-boat of the common mosquito.

The male and female forms are easily recognized by the antennæ. In the former these are of a beautiful plumose shape, the hairs from the basal joints extending nearly to the tips of the organs, but in the female they form a circlet around the base of each joint. Her body also is much stouter, and not so long as the male. He measures nine while she is about seven-hundredths of an inch in length, excluding the antennæ.

Measurements of	Male Sandfly	Female
Antennæ	·04 inch	·02 inch
Head	·0096	·008
Thorax	·024	·024
Abdomen	·56	·04
Prolegs	·059	·033
Midlegs	·07	·035
Hindlegs	·074	·036
Wings	·064 x ·018	·052 x ·022

PLATES OF SANDFLY.

Fig. 1.—Head of female sandfly, with appendages, x 50.
" 2.—Part of eye, x 946.
" 3.—Joints of antennæ, x 250.
" 4.—Terminal joint of antennæ, x 143.
" 5.—Terminal joint of antennæ, showing taste bud, x 500
" 6.—Palpi and proboscis, x 250.
" 7.—Palpi with first and second lancets, x 250.
" 8.—Second and central lancets, x 500.
" 9.—Wing, x 50.
" 10.—Pro legs, x 38.
" 11.—Hind foot, x 80.
" 12.—Last foot joint, with hooks, x 272.
" 13.—Sketch of pulvilli between hooks.
" 14.—Head, with poison gland in centre, x 62.
" 15.—Nerve ganglions, with nerve connections, x 60.
" 16.—Æsophagus, stomach and abdominal canal, malpighian tubes arising from base of stomach, x 60.
" 17.—Air sacs attached to head, with egg sacs below, x 21.
" 18.—Egg sacs, with one spermothæca in centre, x 55.
" 19.—Eggs, with body of mother.
" 20.—Male sandfly, x 20.
" 21.—Female sandfly, x 20.

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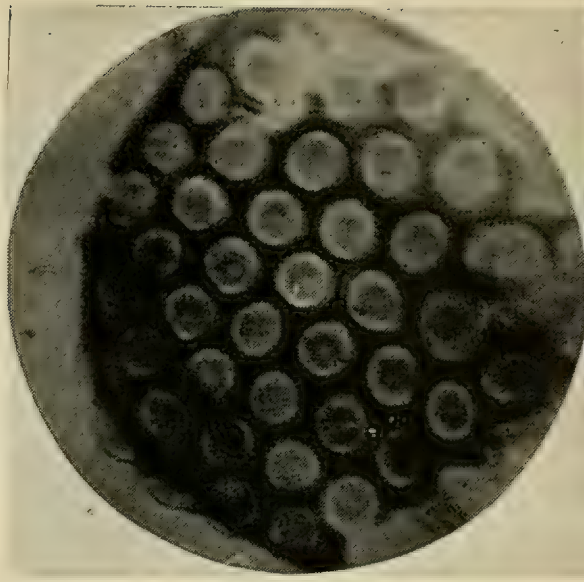

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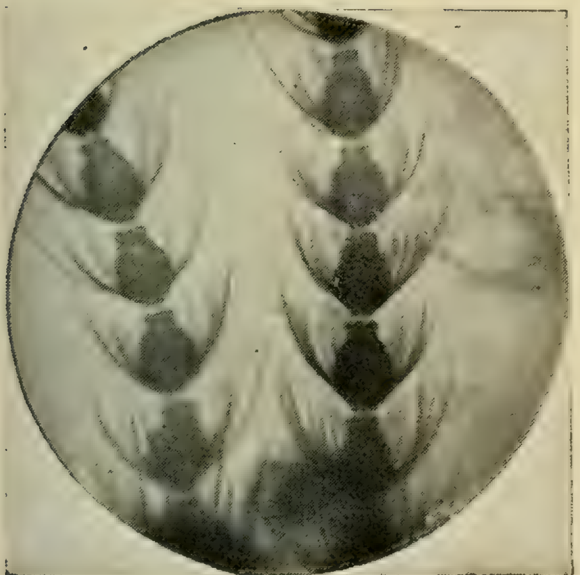

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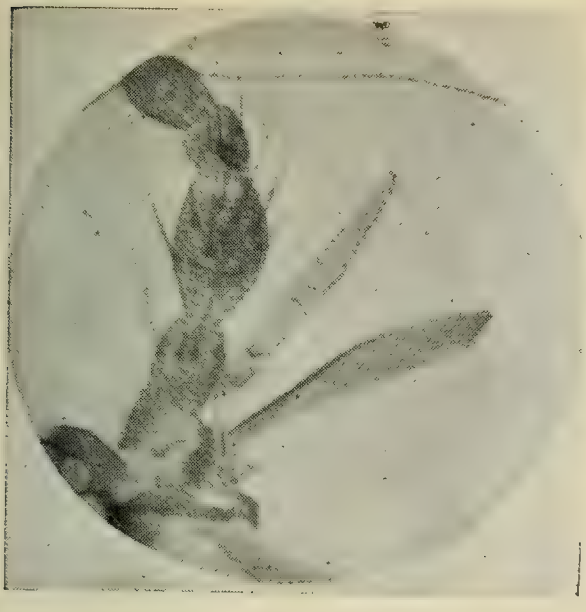

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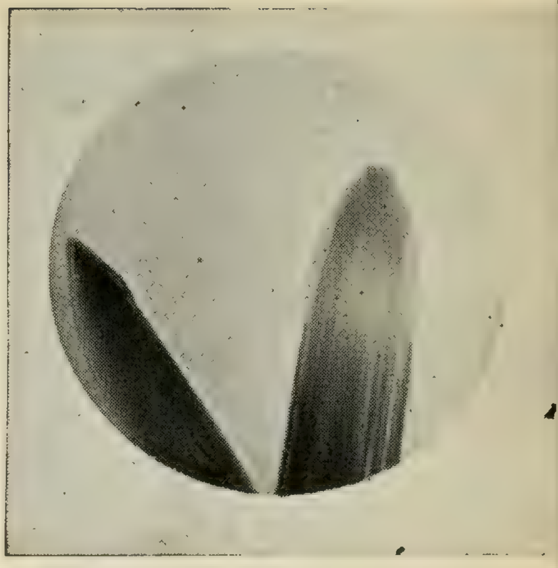

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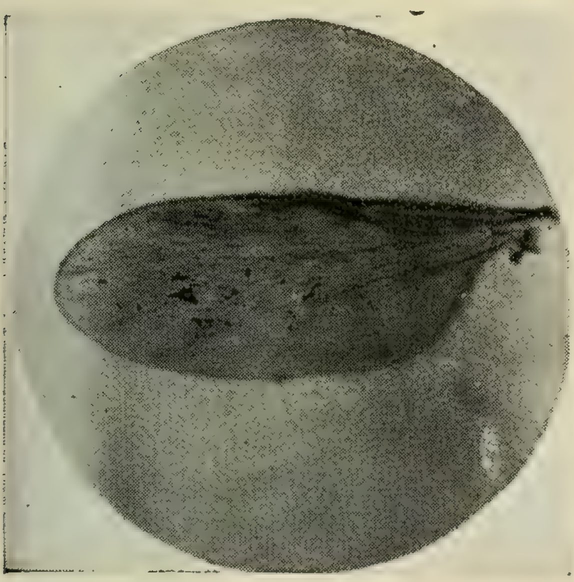

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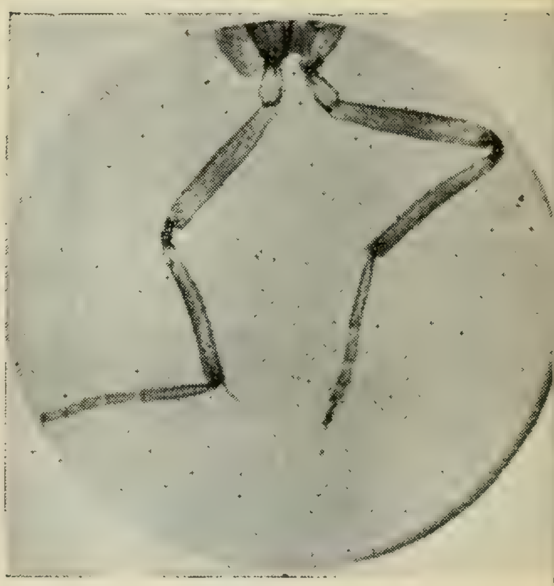

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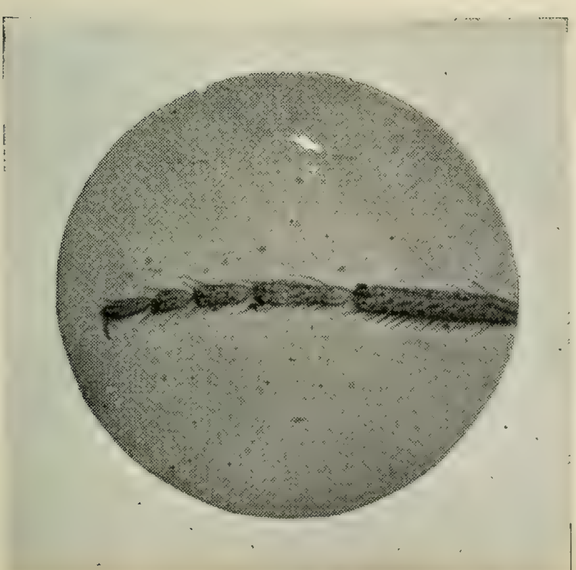

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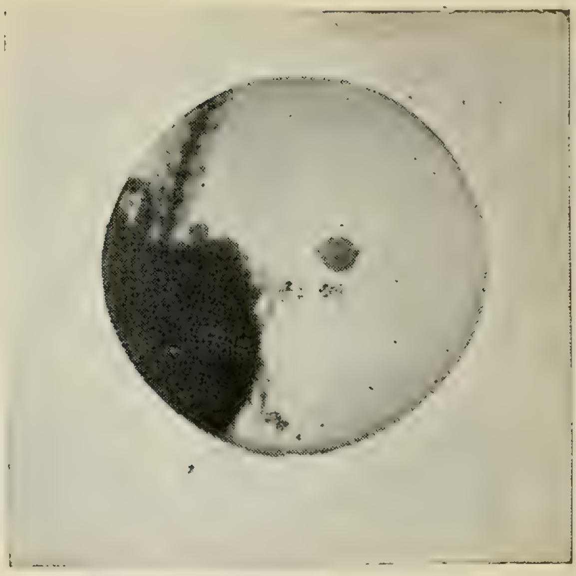

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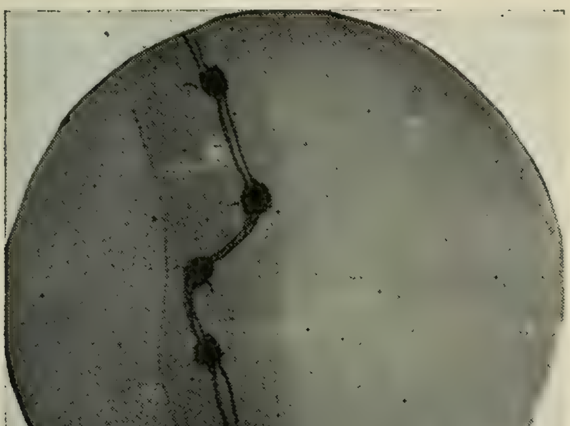

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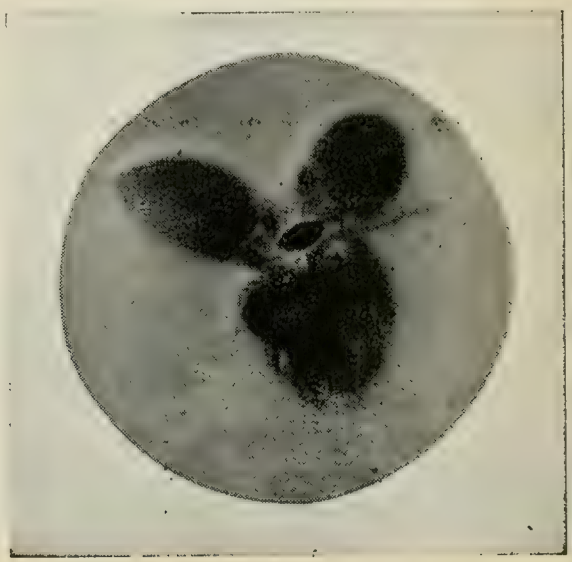

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PROCEEDINGS

OF THE

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OF

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CORRECTIONS.

Page 45, line 4, for *F. Robert Austin* read *Robert Austin.*
Page 45, line 6, for *Kimberley* read *Murchison.*
Page 152, line 4, for *Swanhill* read *Swan Hill.*
Page 152, line 40, for *Glengalen* read *Glengallan.*
Page 156, line 27, for *Fuller's Creek* read *Futter's Creek.*

AN ADDRESS ON SCIENCE AND THE STATE. WITH SPECIAL REFERENCE TO TUBERCULOSIS AND THE PUBLIC HEALTH

By PROFESSOR E. M. CROOKSHANK,

M.B., Lond.

(Delivered before the Royal Society of Queensland, 22nd May, 1902).

Mr. President, Your Excellency, Ladies and Gentlemen,—I consider it a great honour to have been invited to deliver an address before the Royal Society of Queensland, and it is also a great pleasure to comply with the request of the President and other scientific friends who have shown me much hospitality and kindness during my visit to Australia. My time and thoughts have been more than occupied with the mission which has brought me to this country, and more especially with the disastrous condition of the pastoral industry, caused by the drought which is so seriously affecting the prosperity of Queensland and New South Wales. If, however, by complying with the request of the President, I succeed in the smallest way in giving encouragement to the scientific work which is being carried on in Queensland, I shall feel amply rewarded for the sacrifice of the little time which I have had at my disposal. It is especially gratifying to me to be associated in any way with the work of the Royal Society of Queensland, which, under the able presidency of Dr. John Thomson and his distinguished predecessors, has done so much to spread scientific knowledge.

PRACTICAL VALUE OF SCIENCE.

In spite of the marvellous advances made by science during the past century, there are still those who question the practical value of many of its branches, and even if they do not oppose financial assistance on the part of the Government, they regard with little concern the retrenchments which have unfortunately to be made in various departments devoted to scientific research. I had occasion on my voyage out to Queensland to spend a few weeks in Java. In this tropical island, agriculture has been carried on for centuries, and it might reasonably be supposed that such long experience had taught the inhabitants all that was worth knowing with reference to the cultivation of their land. A rich volcanic soil, abundance of mountain streams and rivers, a wonderful system of irrigation, and the labour of industrious peasants, have made Java the garden of the East, and have enabled it to support a population which has increased from three millions at the beginning of last century to about twenty-five millions at the present day. Yet, with all these natural advantages, I found it universally admitted by those engaged in the cultivation of coffee, tea, Peruvian bark, rubber, rice, sugar-cane, and other crops, that the splendid results were largely due to the assistance given by the scientific researches conducted at the Botanical Gardens at Buitenzorg and other experimental stations under the able direction of Dr. Treub. The Government gives a very large subsidy for the maintenance of these gardens, which are admitted to be the finest in the world. Immense services have been rendered by the scientific staff in experimentally ascertaining the most suitable varieties of plants for cultivation in Java, in chemically analysing their products and in investigating insects and other pests, and suggesting the necessary remedies. To those who may call into question the value of scientific knowledge, especially as applied to agriculture, I do not think it would be possible to give a more convincing answer than by referring to the practical results of the researches daily carried on in the science laboratories and experimental gardens in Java.

SCIENCE IN QUEENSLAND.

In Queensland the policy of combining science with practice in agriculture has by no means been lost sight of. The annual reports of the Department of Agriculture bear eloquent testimony to the excellent work carried on at the State farms and by the whole of the scientific staff. If I may be pardoned for referring more particularly to those subjects which especially interest me, I would call attention to the invaluable work of the Government Entomologist, Mr. Tryon, whose reports are models of careful scientific research, and are of the greatest practical importance. I cannot refrain from mentioning the work of two of my former pupils. I refer to Mr. Quinnell, who both as an instructor and an inspector has proved his exceptional ability and fitness for the post he occupies, and to Mr. Pound, whose studies of cattle tick and other diseases of stock have been of great value to the State. I can only regret that in some of the scientific departments the work should be hampered by very necessary retrenchment on the part of the Government. Reverting for one moment to the work of the Government Entomologist, I observe with great satisfaction that attention is being given to the insectivorous birds of Queensland. A few years ago I visited Jamaica and found it suffering greatly from the destruction of birds. I was informed that the sugar-cane plantations had been over-run with rats, and the mongoose was imported to destroy them. The mongoose spread over the island like the rabbit in New South Wales. The rats being exterminated, the poultry yards were attacked and finally the wild birds. Small black ticks now literally cover the vegetation in most parts of the island, and residents and visitors suffer from their attacks. It is now almost impossible to walk where there is pasture or vegetation of any kind without being infested with ticks. An attempt is being made to restore the balance of nature, by first destroying the mongoose and then reintroducing birds to destroy the ticks. To avoid similar troubles, and in the interest of agriculturists and horticulturists, it is very desirable to put a stop to the continuous destruction of birds in Queeensland. In addition to existing legislation something, perhaps, might be done to prevent indiscriminate slaughter of wild birds by imposing a gun tax. A license to carry a gun and a license to kill game would meet with the approval of all true sportsmen and produce a substantial revenue, a part of which might be allocated to supporting and extending the scientific departments of the Board of Agriculture. The too sweeping destruction of trees in clearing the scrub for cultivation of the soil, is also a matter which I think deserves attention.

THE TRAINING OF MEAT INSPECTORS.

I shall have occasion later on to refer to the subject of meat inspection ; but with regard to the work of this department of the Board, I trust that in more prosperous times the Government will be induced to place the system of meat inspection on a more scientific footing. On studying the statistics given by meat inspectors in the annual reports, I regret to say, I have found them of very little scientific value. Thus in one report of the carcasses of cattle inspected the returns were as follows :—

"Out of 8,517 bullocks there were condemned for tuberculosis 62, actinomycosis, 26, *cancer* 4. Out of 2,573 cows the rejections for tuberculosis were 39, actinomycosis 11, *cancer* 2. Out of 11,030 tongues, the returns were tuberculosis 220, unfit 127, actinomycosis 33, pleurisy 19, *cancer* 6."

In another case the following statistics are given for tongues. Of 11,703 bullocks there were condemned for tuberculosis 63, actinomycosis 185, *cancered jaw* 83. Out of 5,717 cows the figures were tuberculosis 36, actinomycosis 27, *cancered jaw* 6. In another series of tongues and pharyngeal glands condemned by the inspector the results were given as follows :—30 per cent. tuberculosis, 60 per cent. actinomycosis, 10 per cent. ordinary abscess. You will observe that there is no record of cancer at all in the last series, and Inspector Quinnell states in his report that since taking charge there had not been a single instance in his experience of an animal being affected with cancer. I shall return to this matter again, but is quite obvious from these reports that there is great need for uniformity and scientific knowledge.

Complete and thoroughly scientific reports of meat inspection are of the highest importance to the State of Queensland which has to compete with the Argentine Republic and other countries. In England and on the Continent of Europe great importance is now attached to meat inspection, and the country which can supply meat and meat products obtained from carcases which have been rigidly inspected in a thoroughly scientific manner will capture the markets. A reconstruction of the Board of Agriculture has been suggested in the Press, and, if this is carried out, I trust that a distinct Veterinary Department of the Board will be created. This department should be controlled by a scientific and practical veterinarian, who would be responsible to the Minister of Agriculture for all matters relating to the diseases of stock, meat inspection, the control of public abattoirs, and the registration and inspection of dairies. Meat inspectors should be appointed, who have undergone a special course of training. They should hold a certificate as a guarantee to the public that they are fully qualified for the work they undertake. To obtain this certificate they ought to pass through a course of instruction in anatomy, pathology, and veterinary State medicine. Anatomy is of great value in training the mind and the eye.

It is an exact science, and the mind is not disturbed by new theories and a variety of opinions. It encourages close observation, requires an accurate memory, and trains the hands in delicate manipulations. In pathology special attention must be g ven to practical training in the use of the microscope for the detection of micro-parasitic diseases. The inspector must also have a thorough practical knowledge of sanitation applied to abattoirs, stock management, and the preparation of meat foods ; and a sound knowledge of the legislation affecting meat and dairy inspection, which will enable him to use the powers he posssesses under various Acts of Parliament. Legislation must not, however, be regarded as the only means of protection in all matters relating to the public health. The public must be educated and encouraged to voluntarily carry out sanitary measures. I have the greatest confidence in the substratum of common-sense characteristic of the British race. I do not believe in encouraging too much dependence upon State regulations and State control. If I might venture to say so, I think in Queensland too much is expected from the Government. State control can be carried a great deal too far. Legislation may often prove harassing and vexatious, and the very object we have in view may be strangled in a tangled web of red tape. Too much dependence upon State and municipal regulations is not healthy ; it tends to destroy individual enterprise and initiative, and may, in times of emergency, produce a panic, by exposing the public to conflicting interests and divided control, and involve a great waste of public money.

THE SOCIETY FOR PREVENTION OF CONSUMPTION.

Attempts are, however, being made to deal with sanitary reforms by voluntary effort. I refer to the formation of the Queensland Society for the Prevention of Tuberculosis. Its main object is to educate the general public concerning the origin and spread of tuberculosis, and to obtain co-operation with the medical and veterinary professions. I trust that the very influental committee will meet with the support it deserves, and that this society, which my friend, Mr. Thynne, has so much at heart, will prove a success. Though there may be points of detail in the programme with which all may not agree, yet all should combine to help on a work, which has for its object the cure and prevention of such a terrible disease as consumption. I should like to see the work carried on entirely by the aid of subscriptions from the public. The Government have made a grant of £50, but is it not a mistake to apply to the Government for help? I would rather base the appeal to the public for subscriptions upon the fact that it is entirely dependent upon them, and I am sure the appeal will not be in vain. There are only a hundred members at present, and this is not at all an indication of the interest taken in fighting a disease which not only involves so much suffering and distress, but perhaps more than any other appeals to human sympathy.

BRISBANE UNIVERSITY.

There is another movement on foot in which the public should assist in order to promote and extend scientific knowledge in Queensland. We have to acknowledge the necessity for Government retrenchment, and it results in hampering and even stopping scientific work. If further retrenchment is necessary, and science continues to be entirely dependent upon the Treasury, it may be starved to death. Is there no means of averting such a calamity? I understand that there has been for some time an idea of creating a University in Brisbane, and that the scheme hangs fire, owing to the financial position of the Government. Is this not again an instance of too much dependence upon the State? Let the Government by all means be asked to give a large grant of freehold land in trust for the University, and in more prosperous times, to give a subsidy towards its support; but will not private munificence endow professorships and scientific laboratories, the expenses of which cannot possibly be defrayed by the students' fees? In England, in America, and in Canada how much has been done by private effort. Surely a commencement might be made by an influential committee to organise the University and to raise a sum which will enable the building to be commenced. A University for Birmingham, largely owing to the influence of Mr. Chamberlain, has been commenced in this way. It is a matter in which everyone in Queensland will take an interest, for no country or State can hold its own, and much less advance, unless education takes a foremost place. In England we feel severely the competition of America and Germany, and we are fully conscious of the fact that the progress made by our competitors has been the outcome of their complete system of education. We are now endeavouring to meet that competition by extending scientific and technical education and by founding new universities in London and the provinces. We hope to establish a system similar to that existing in Canada, which makes it possible for a really clever lad, whatever his position may be, to pass from an elementary school step by step to a university career, and thus attain the highest possible training in any branch of learning, for which he may have shown a special aptitude. I feel convinced that Queensland will not be behind other States of the Commonwealth and other colonies of the Empire, and that if the university building is commenced, those who have made fortunes in mining and commerce, will follow the example of patriotic Canadians and Americans. With the aid of private munificence and the support of the State the Brisbane University would become a seat of learning worthy not only of Queensland but of the whole Commonwealth.

RESEARCH MUST BE CONTINUOUS.

With such a University we need no longer fear the fluctuations in the finances of the State. Scientific researches would continue to be prosecuted within the walls of the University, and continuity in research is essential. Science is always extending her frontiers, and scientific work which is stopped in any one direction, is like a mine which is temporarily closed down, except that a vein which was being followed by the prospector in science, may be altogether missed by others and his work be lost to the world. As an instance of the necessity for continuous work and the intricacy of scientific problems, and the need for modifying accepted opinions in the light of new discoveries, I propose to draw your attention to the subject of tuberculosis in relation to the public health.

HUMAN AND BOVINE TUBERCULOSIS.

I was asked to address you to-night more particularly upon some subject attracting attention in England. When I left there was no topic of conversation which was more fully discussed in scientific circles that the relation between human and bovine tuberculosis, and the origin of human consumption. This subject was brought to the front last summer, at the International Congress of Tuberculosis, by the well-known discoverer of the tubercle bacillus, Dr. Robert Koch; and it is of so much importance that the Government has appointed another Royal Commission to re-investigate it. Up to the time of Dr. Koch's discovery of the tubercle bacillus, in 1882, it was a difficult matter to give an exact and comprehensive definition of tuberculosis. Dr. Koch's discovery simplified the teaching of pathology. He pointed out that whatever might be the clinical manifestations, or the appearance of a particular morbid growth, if the tubercle bacillus was present, the disease was tuberculosis. The further discovery of bacilli with similar morphological, tinctorial, and cultural characters in tuberculosis of the lower animals, and the fact that human and bovine tuberculosis could both be readily inoculated in certain animals led to the acceptance of the doctrine that tuberculosis was a disease common to man and the lower animals and readily inter-communicable. Koch, in the first publication of his discovery, announced that tuberculosis of the domesticated animals, and especially bovine tuberculosis, was undoubtedly a source of human infection. This fact, he added, indicated the position, which in the future, hygiene must take in connection with the danger of the milk of tubercular animals. Bovine tuberculosis was identical with human tuberculosis, and was a disease transmissible to men. It was therefore to be treated like other infectious diseases transmissable from animals to human beings.

Though proofs of the absolute identity of the two diseases were undiscoverable, nevertheless Koch's statements were accepted and acted upon. The danger of consuming the flesh and milk of tubercular animals was insisted upon in England, prosecutions and heavy penalties followed for allowing meat to be sold when there was even only a trifling indication of the disease, and the flesh, to all appearance, perfectly healthy. Magistrates were very severe in carrying out what they believed to be measures for the protection of the public from a terrible disease, and honest and well-intentioned tradesmen who had erred from ignorance rather than intention were practically ruined. There was not only a crusade against the sale of flesh and milk from tubercular animals, but it was openly demanded that all animals suffering from tuberculosis should be compulsorily slaughtered, without even any attempt being made to face the question of compensation. There is no doubt that the result of this crusade was to inflict great hardships upon farmers and the meat trade, and in a great many cases grave injustice was committed. The discovery of tuberculin made the position still more impossible, for, by its aid, facts were brought to light, which proved that tuberculosis existed in cattle to an extent which exceeded the wildest statements of the most ardent believer in the danger of infection of mankind from cattle. Lord Spencer's celebrated Jersey cattle were to all appearance in perfectly healthy condition, with the exception of two, in which there were suspicious symptoms. All reacted to the test of tuberculin, and were killed for examination. In every animal there were indications of tuberculosis; a still greater excitement was caused by the testing of Queen Victoria's cows at Windsor. Thirty-two gave a reaction, three were doubtful, and five were apparently healthy. When the animals were killed and examined, thirty-six were found to be tubercular. Equally startling statistics were collected from other quarters. Of cattle tested in various parts of England and Scotland, as many as 31 per cent. reacted. In London, 25 per cent. of cattle slaughtered under the Pleuro-pneumonia compulsory slaughter order, were found to be tubercular, and in some herds as many as 30 per cent. to 40 per cent. It was estimated that about 20 per cent. of milch cows in towns in England were tubercular. In Germany, the returns from the abattoirs were in many cases even higher. You are now in a position to realise the sensation caused by Dr. Koch, when he announced at the last Congress of Tuberculosis in London, that human and bovine tuberculosis were, after all, not inter-communicable. This statement upset the policy of the medical department of the Local Government Board. It paralysed the law, for it was quite impossible in the face of such a statement, to obtain a conviction before magistrates; and it destroyed many arguments upon which the crusade was being instituted for the eradication of human tuberculosis. Many, however, hailed the announcement with unqualified satisfaction; for if Dr. Koch's views were correct, then one of the channels of infection which was supposed to exist was eliminated, and an imaginary danger removed from our midst. In order to follow the controversy which ensued, I must refer to Dr. Koch's researches in some detail, so that I may be able to make clear the points at issue, and compare his work and conclusions with the experiments and opinions of others who have investigated the subject. Dr. Koch's experiments were carried on for about two years with the co-operation of a very distinguished veterinarian, Professor Schutz, of Berlin. In various ways they inoculated 19 cattle with tubercular virus from a human source, and none of the cattle developed any symptoms of disease. On the other hand, cattle inoculated with virus from a bovine source, suffered without a single exception from the severest tubercular disorders of the internal organs. Dr Koch was forced to the conclusion that human tuberculosis differed essentially from bovine, and he expressed the opinion that it could not be transmitted to cattle; and further, that if man is susceptible to bovine tuberculosis, infection from this source must be extremely rare. He believed that the extent of infection by milk and meat of tubercular cattle (if it existed at all) was so trifling that he did not deem it advisable to take any measures against it. I entirely agree with Dr. Koch, that if infection of mankind occurs from cattle, it is extremely rare, but the statement that human tuberculosis cannot under any circumstances be transmitted to cattle, is erroneous; and I feel very strongly that his statement with regard to the inadvisability of taking any preventive measures is calculated to do a great deal of harm. It creates the impression that dairymen and milk sellers are justified in selling tubercular milk.

CALVES ARE SUSCEPTIBLE TO HUMAN TUBERCULOSIS.

I feel justified in so far disagreeing with Dr. Koch, because in an inquiry undertaken for the Board of Agriculture, I had the occasion to make the following experiment:—A perfectly healthy calf was inoculated intra-peritoneally with virulent human tubercular sputum. So far from the result being negative, there was extensive deposit at the seat of inoculation with numerous tubercles extending from it. The inoculation produced concurrently blood poisoning, and death occurred forty-two days afterwards. On microscopical examination minute tubercles were found throughout the lungs and liver, containing long and beaded bacilli of the human type. I did not extend the experiment in this direction, as I was deputed at once to make an exhaustive inquiry into another disease, which is sometimes mistaken for tuberculosis. However, other investigators in England and America have since confirmed my results. Dr. Sydney Martin, on behalf of the Royal Commission on tuberculosis, also experimented on calves with tubercular sputum. Four calves were given sputum with food. One calf, killed in four weeks, had developed 53 nodules; the second, killed in eight weeks, showed 63; the third, killed in twelve weeks, showed 13; and in the fourth, there were no nodules at all. The results, however, were somewhat puzzling. In calf three, the nodules in the intestine contained tubercle bacilli, but they were totally absent in the microscopical specimens of the nodules produced in calves one and two. In another experiment, two calves received tubercular sputum with their food. In one killed in eight weeks, there were 13 nodules in the small intestine and mesenteric glands. In the second calf killed in 19 weeks, the result was absolutely negative.

Dr. Ravenel, in the course of a very elaborate inquiry, made some experiments of an equally positive character. Four calves, were, as in my original experiment, inoculated intra-peritoneally with tubercular sputum. In one case the result was negative. The other three were all infected, the lesions in two being extensive. On the other hand the results were uniformly negative when Dr. Ravenel mixed human tubercular sputum with the food. To sum up, the evidence is conclusive as to the possibility of grafting human tubercle in bovine tissues, but the experiments are not invariably successful. The results are, I think, to be explained in this way. Human and bovine tuberculosis are distinct varieties of the same disease. They are variations resulting from cultivation on different soils. Bearing this in mind, we would hardly expect that the attempts to transmit human tubercle to cattle would be always successful. Too much stress cannot be laid upon the necessity of realising the differences which exist in the nature of the soil upon which a virus is inoculated. This is very well illustrated in the inoculation of human small-pox upon cattle. Smallpox is essentially a disease peculiar to man. It has never been known to attack cattle, but the virus of smallpox can, in exceptional cases, be cultivated on bovine tissues. The experiments are so difficult to carry out, that many have failed, and have positively refused to believe in the successful results of others. Variolation of the cow is nevertheless a fact, and so marked is the effect of cultivating the smallpox virus upon a soil which is foreign to it, that the highly infectious disease in man becomes transformed in cattle into a mild disease which is not infectious. The effect of a foreign soil is also illustrated in the result of inoculating sheep-pox in man. This highly infectious disease of sheep when grafted on human tissue is also transformed into a mild non-infectious disorder.

We can take it for granted that in exceptional cases human tubercular virus can be experimentally grafted on cattle, and we have good reason to believe that in exceptional cases, bovine bacilli may invade the human tissues. I refer to those rare cases in which there has been accidental inoculation. Veterinary surgeons, butchers, and others whose occupation brings them into contact with the diseased cattle, do suffer from tubercular nodules in the skin, which contain tubercle bacilli, undergo caseation, and disappear. I am convinced that human infection with the bovine variety of tubercle can only be quite exceptional: if it were not so, the inhabitants of every country in the world in which bovine tuberculosis is prevalent, would be decimated by tubercular disease. Tubercle bacilli occur with frequency in milk, cream, butter, cheese, and I have already given you some idea of the quantity of meat derived from animals with more or less tuberculosis.

TUBERCULOSIS IN CHILDREN.

I would next draw your attention to the theory that tuberculosis in children is necessarily due to infection from the milk of tubercular cows. Those who advocate this view appear to have entirely lost sight of the opportunities for inoculation from a human source. Tuberculosis of the digestive tract may result from swallowing sputum when there is concurrent disease of the lungs, and in many other ways. There are obviously many paths by which a child may be infected by the mouth with bacilli from a human source. A tubercular mother may take little or no precaution in nursing her children, and the habit of tasting food before giving it to an an infant suggests a channel of infection. Various objects contaminated by consumptive sputum may find their way to the mouth of a child. London physicians who have had enormous experience with patients suffering from consumption, of all ages, are by no means ready to accept the milk theory. Sir Richard Douglas Powell, one of the most cautious and scientific of living phyicians, in his evidence before the Royal Commission, stated that he had not met with any cases in his experience which would connect consumption in man with the use of milk and meat from tubercular animals. Dr. Goodhart, consulting physician to the Evelina Hospital for Children, was of the same opinion. I certainly am not prepared to attribute tuberculosis in children to a bovine origin, especially as the experiments of Nocard and others have shown that when the milk of the tubercular cow is mixed with the milk of healthy cows it is no longer virulent to experimental animals. In order to accept the theory that tuberculosis in children is due to cow's milk, we should have to believe that in every instance the milk supplied had been obtained direct from the udder of a tubercular animal, without being mixed with the milk of other cows.

I consider, nevertheless, that milk from cows suffering from any diseased condition of the udder or teats is unwholesome, and I maintain that when we pay for pure milk, we are entitled to have it. We want the doctrine of absolute cleanliness to reach our dairies, both public and private On no account should any "waster" or "piner," or cow suffering from any disease affecting the milk, be admitted into the herd. Registration and inspection of dairies are of great importance, but with or without Government Inspectors, I think the public might to a great extent protect themselves. It would be a distinct advantage to adopt the Danish system of co-operation. In towns like Brisbane, small dairymen should combine to form large model dairies. They should invite inspection of their premises and farms. They would find it to their own advantage to employ a veterinary inspector. The public would be willing to pay a higher price if they had a guarantee that the cows were healthy, and that every precaution had been taken in the collection, in the transit, and in the delivery of the milk. A great deal has been said upon the necessity of boiling milk. Except in time of epidemics, it is not a practice likely to be generally adopted. Pure fresh milk is an ideal food, and the boiling of milk alters its composition. It is then very unpalatable to many people; and is not only unsuitable, but in many cases dangerous for infants. Neither Dr. Powell or Dr. Goodhart were prepared to recommend the boiling of all milk. From their evidence, we may gather that they had other causes of consumption in their minds. They insisted upon the fact that tuberculosis of the bowels is almost unknown in very young children, and it is not very common even in children from five to ten years old. Dr. Goodhart laid great stress upon the fact that tuberculosis in children was very common when there was a distinct family history of tubercle, and it was quite common also to find children becoming tubercular after measles, bronchial-pneumonia, whooping cough, and intestinal catarrh.

I would draw attention to the fact that negro children in the West Indies suffer from tubercle, and they have very little milk, and this, owing to the tropical climate, is almost always boiled. Tuberculosis in children in England is largely a disease of the poor. Though it attacks all classes, it is extremely common among the London poor, and in all our over-crowded towns. The disease among the poor is attributable more to the want of milk, than to the possible occurrence of a few stray bacilli. Plenty of milk, good nourishing food, better hygienic surroundings, will, with certainty, diminish the number of tubercular children in England. As the slums are removed from our over-crowded cities, and when the problem of the better housing of the poor has been solved, we may confidently expect to see a steady diminution of consumption. In Brisbane, and other growing towns in Queensland, it should be the care of the Government, of Municipal Authorities, and the public that the insanitary conditions which we have inherited in the old country, should never be allowed to arise.

FLESH OF TUBERCULAR ANIMALS.

As regards any danger from consuming the flesh of animals with tuberculosis, I believe it is practically *nil.* There has not been a single case recorded of tuberculosis contracted by eating tuberculous meat. Jews have a very thorough system of meat inspection, and yet they are by no means free from tuberculosis. In the course of my travels in the West Indies I found that the negroes were very liable to consumption, and Dr. Williams, of Demerara, pointed out to the Royal Commission that the Hindoo Coolies also suffered very severely. Yet Hindoos eat very little meat of any kind, and the negroes eat meat in very small quantities, and then it is beef or salt pork imported from America, and well cooked before it is eaten. They, however, take very little care to protect themselves from chills, and they live for the most part in small and badly ventilated buildings. We are justified in concluding that if the carcase is well-nourished, the meat is perfectly wholesome, in spite of the existence of local deposits of turbercle in the viscera and glands, which should, of course, be condemned. The views of extremists cannot be carried into effect. It is sometimes argued that though an animal may be in prime condition, if there is a single tuberculous nodule, the carcase ought to be destroyed. In my opinion, there would be no justification for the wholesale destruction of such valuable food. Compulsory destruction of every animal with the slightest indication of tuberculosis would ruin the farming industry. No Government would face the question of compensation for every case of tuberculosis, however slight the lesion. Such a course would involve the destruction of an enormous proportion of the cattle of the United Kingdom, and create a meat and milk famine. To secure perfectly healthy cows, thus saving much loss, and ensuring the supply of pure and wholesome milk, will be a splendid work for veterinary surgeons and breeders of stock to undertake, and one to which they should direct all their energy. It can be confidently asserted that there can be no better recommendation of Queensland meat than a very high standard of health in Queensland cattle, and the percentage of tuberculosis in cattle in Queensland would appear to be extremely low. I find in the reports of the Board of Agriculture, out of 21,768 cattle slaughtered, the proportion of tubercle was 1.1 per cent.

In another report of 27,905 slaughtered, the percentage of tubercle was .9 per cent. But as I have already pointed out, it is difficult to arrive at a correct estimate from the published returns.

SO-CALLED "CANCER" IN CATTLE.

It is absolutely necessary to differentiate in every instance the disease known as Actinomycosis. I have already referred to the use of the word "*cancer*" in the reports of the meat inspectors. I regret to find that this popular term is still made use of. Probably those who use it little realise how damaging it is to the meat industry of the State. Last year, there was a correspondence in the *Times*, in which it was suggested that the increase of cancer in England was due to eating the flesh of cancerous animals imported from the colonies. I took an early opportunity of pointing out the absurdity of suggesting any connection between so-called cancer in cattle, and cancer in the human subject. Many years ago I published an exhaustive report upon Actinomycosis which is prevalent in England. I pointed out that various manifestations of this disease were known to farmers and breeders as "cancer of the tongue," "cancer of the jaw," "cancerous polypus," "osteo-sarcoma," and various other misleading names. Every one of the cases which came under my observation was shown to be a manifestation of Actinomycosis, a local inflammatory affection, associated with the presence of a characteristic fungus known as the *streptothrix actinomyces*. The disease has no relation whatever to cancer in the human subject. It is this disease which is met with in Queensland, and it is most unfortunate that the public should be alarmed by any reference to cancer. I trust that in all future reports of the meat inspectors, that the popular term "*cancer*" will be left out altogether, and that the scientific name for every disease will be given. Actinomycosis, though common in cattle, occurs also, though rarely, in man, and as in the case of tuberculosis, it has been suggested that the disease is derived from cattle. It is, in my opinion, a distinct variety. I do not accept the theory that man and animals infect each other with actinomycosis, but I believe that they contract the disease quite independently, and that the micro-organism is derived from some source in common. And, further, the flesh in these cases is perfectly wholesome, and only the tongue or other part affected need be destroyed.

PSEUDO-TUBERCLE BACILLI.

We have not only to distinguish Actinomycosis from tuberculosis, but we must in future pay close attention to distinguish the tubercle bacillus from some recently discovered and closely allied bacilli. There is no doubt that the reports of the discovery of tubercle bacilli to an alarming extent in milk and milk products, and in the dust of rooms inhabited by consumptive patients, will have to be modified. After the first discovery of the tubercle bacillus, all rod-like organisms, with the same tinctorial characters, were pronounced to be tubercle bacilli, with the exception of the leprosy bacillus, and a bacillus found in certain secretions. Further investigations of some of these bacilli have given very striking results. The first discoveries in this direction were by Petri and Rabinowitch, who succeeded in showing that there was a bacillus in butter, with all the general characteristics of the tubercle bacillus; and further, the inoculation of this bacillus in guinea pigs produced lesions, which to the naked eye, and under the microscope, were very easily mistaken for tuberculosis. Korn and others have described other forms in butter and milk, not materially differing from one another, and Moeller regards them as varieties of the so-called grass bacillus, obtained from grasses and dust. The latter was first obtained from Timothy grass, and is known as the Timothy bacillus. It cannot possibly be distinguished microscopically from the tubercle bacillus. It is granular, and exhibits branching and club-like swellings; it stains exactly like the tubercle bacillus; and the cultures, though differing at first, after passage through animals, strongly resemble those of tubercle. In guinea-pigs the lesions are similar to those set up by the butter bacillus, and in rabbits they are very difficult to distinguish from true tubercle, owing to the formation of giant cells and epitheloid cells and caseation. Another grass bacillus is similar in staining reactions to the tubercle bacillus, but it is rather thicker, and has a special tendency to form threads. It produces in guinea-pigs lesions similar to those caused by the butter bacillus. Another pseudo-turbecle bacillus has been isolated from manure and from the excrement of cows and other herbivora. Other bacilli of this class have been found by Fraenkel and Pappenheim in pulminary gangrene and other morbid conditions of the lungs, and by Moeller in nasal and pharyngeal mucus.

PREVENTION OF CONSUMPTION.

With regard to the prevention of consumption, this must be left principally to the sanitary inspector and the medical officer of health. We must not concentrate all our energies upon the destruction of tubercular sputum, but give much more attention to those insanitary conditions which are responsible for the causation of tuberculosis. This is a matter which, in Brisbane, can be safely left in the hands of the energetic Commissioner of Health. Dr. Ham has before him a career of great usefulness in this city, but if he were to do nothing more than what he has already achieved, he would deserve to be remembered with gratitude by the public of Brisbane. I refer more particularly to the institution of a Queensland branch of the London Sanitary Institution, the recognised authority for granting certificates qualifying persons as Sanitary Inspectors. This will have a far-reaching effect in obtaining and maintaining a high state of sanitation in this town. I regard the trained Sanitary Inspector as the most formidable opponent of diseases such as diphtheria, typhoid, cholera, plague, and yellow fever, which flourish wherever insanitary conditions prevail. If only Sanitary Inspectors could, without let or hindrance, carry out their duties under the direction of one central authority, we should soon hear of a reduced death rate and far greater immunity from epidemic diseases. The work of Sanitary Inspectors is one which ought to be more fully appreciated by the public, and instead of hindrances, facilities should be put in their way when carrying out duties which involve the general health of the community and the saving of many human lives.

As regards the relation between tuberculosis and insanitary conditions, we have some evidence forthcoming from the study of the disease in animals. Tuberculosis, for instance, is peculiarly liable to occur among birds and animals kept in captivity; poultry and guinea-fowls, and ostriches, and emus, and other birds in zoological gardens, develop tuberculosis; monkeys in captivity, pheasants in preserves, and rabbits in overcrowded warrens, sometimes die in great numbers. These examples point to the conclusion that confinement, over-crowding, defective ventilation, heredity and breeding in and in, are powerful factors in rendering the tissues prone to tubercle, and a fitting soil for the invasion of the bacilli. We must also remember the danger of damp houses, and the effect of a cold and a foggy climate. In addition to general insanitary conditions, I desire to draw particular attention to the influence of alcoholism. This was brought most forcibly before the London Congress in an exhaustive paper by Dr. Brouardel. The influence of previous diseases has been urged by Dr. Goodhart; and special trade occupations which involve inhalation of dust of various kinds, must not be overlooked. I trust that much weight will be given to these matters by the Queensland Society for the Prevention of Consumption.

HEREDITY.

I should like to say a few words on the subject of heredity. Heredity is of two kinds. There is hereditary pre-disposition, and hereditary transmission. Inherited susceptibility renders many liable to the development of tubercular disease. Family history plays a very important part in tuberculosis. Sir Richard Powell stated to the Commission that in his experience, 48 per cent. of the cases in the hospitals suffering from tuberculosis had a previous history of hereditary tuberculosis. Dr. Klein and Mr. Victor Horsley are convinced that there is direct transmission of the virus of tubercle in some cases, and that it may exist for many years in a latent form. In connection with the question of heredity, some interesting observations have been recorded upon tuberculosis in birds. According to Dr. Baumgarten, a male bird on a poultry farm developed tuberculosis. All the chickens reared from this parent were tubercular. There was no evidence of infection with either human or bovine tubercle. An identical case occurred on another farm, and these instances have been quoted in support of the theory of direct transmission of the virus from the parent. Tuberculosis is not a common disease in calves, and it seems probable that these cases which do occur are mostly, if not entirely, the result of hereditary transmission.

CONSUMPTION NOT INFECTIOUS, BUT INOCULABLE.

In conclusion, I would like to draw attention to the theory upon which so much stress has of late been laid, viz., that consumption is *infectious*. I feel very strongly that this is most misleading, and I think we ought to do all we can to allay the public anxiety which has arisen from the belief that consumption can be caught like scarlet fever. To compare it also to typhoid fever is a great mistake. In typhoid epidemics at home, in India, and recently in South Africa, we know that those in health and out of health fell victims to the disease when they took the poison in food or water. Tuberculosis is not infectious, but it is an *inoculable* disease. In the Brompton Hospital in London, it has been found that among nurses, porters, physicians, surgeons, in fact among all those who have been in connection with it, the mortality from consumption is within the average of ordinary mortality. If tuberculosis were an infectious disease, and readily conveyed from person to person, the marriage of individuals who become, or are consumptive, would be a fruitful source of direct infection. We should hear constantly of instances in which married people had infected each other with tuberculosis. There is a great difference between natural infection and experimental inoculation, and to this we should attach the greatest importance.

It cannot be too widely known how virulent is the sputum of consumptive patients when inoculated in susceptible animals, and the habit of spitting in public places and railway carriages. and other conveyances should be prohibited. It is a disgusting habit, but there is no need to create a panic or raise an outcry for legislation, making spitting in public places a matter to be dealt with in the Police Court. The sputum of consumptive persons should be disinfected. A good deal of attention has been drawn to the danger of sputum when dried and raised in dust. The virulence is greater when the sputum is moist, and when it has not been exposed to sunlight. That the virus of tubercle is scattered far and wide, and is a danger to all is not a theory which is supported by experiment or experience. For example, sputum dried and disinfected by the powerful action of the Australian sun will be rendered inert. Dr. Ransom maintains that in a well ventilated room sputum is harmless. Tubercular sputum kept in the ventilating shaft of a hospital proved virulent to rodents, but similar sputum in a well ventilated and well lighted room became absolutely harmless. It is, no doubt, owing to this exaggerated idea of infection that there have been such extreme proposals as the New Zealand Act excluding tubercular immigrants. It is probably due to the same cause that there is some prejudice in Queensland against the building of sanatoria for consumptives. There is not a shadow of foundation for the theory that there is danger to the inhabitants of a township if a sanatorium is erected in the neighbourhood. I trust there will be no opposition to erecting sanatoria for the poor and for paying patients. Bright sunshine, invigorating air, and cheerful surroundings, are conditions which compensate in some measure for separation from family and friends, alleviate the sufferings, and give hope in many cases of permanent recovery.

CONCLUSION.

In the remarks I have made to-night, I have touched upon many controversial points, and I have endeavoured to indicate the lines upon which further research is required. I trust that those engaged in scientific inquiries in Queensland will help to throw light on these points. The report of the new Royal Commission now sitting in London will be awaited with interest, but in the meantime there is no uncertainty as to the course to be adopted by those responsible for the public health. Whatever the result of that inquiry may be as regards the relation of bovine to human tuberculosis, we know that there are many factors in the production of the disease.

The removal of insanitary conditions by the co-operation of the public with sanitary officials, will secure for Brisbane the enviable position of being conspicuous among all the great cities of the Commonwealth, on account of its low death rate and practical immunity from all epidemic diseases.

NOTES OF SAVAGE LIFE IN THE EARLY DAYS OF WEST AUSTRALIAN SETTLEMENT.

(PLATES V. AND VI.)

(Based on reminiscences collected from F. Robert Austin, Civil Engineer, late Assistant Surveyor, W.A., late Sergeant-at-Arms Parliament of Queensland, discoverer of the Kimberley Goldfields, W.A.)

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[*Read before the Royal Society of Queensland 8th March, 1902.*]

THE following notes deal with an account of a tribe occupying the country around Port Leschenhault, Koombana Bay—where Bunbury now stands—lat. about 30 deg. 30 min. south, long. 116 deg. east—in the district of Wellington, Western Australia. The back country here in the years 1841-3, to which times these reminiscences refer, was known to the natives as i-lap. On the coast the nature of the soil was sandy, although further inland it was rich, fertile, and well watered; all around were large areas of Zamia,* a plant which there attained a very great size. The surrounding country, at this time, had only been settled about eleven years previously.

The habitual posture of sleep was lying on the back, but, as a rule, the head was not raised. A very common position of standing was, in the case of the men, with the sole of one foot resting upon the area just below the opposite knee, the hand, corresponding to the raised leg, being supported on a spear. In walking the foot was very straight; in those cases where it was turned outwards it was noticeable and characteristic, espe-

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* Macrozamia Fraseri, *Miq.*

cially when "tracking" was concerned. The arms were never swung while walking; they always hung straight down, and gave the observer an impression of a very erect carriage. Neither men nor women appeared conscious of any indecency in appearing perfectly nude in public whenever it was expedient to remove their cloaks. The women, however, when sitting on the ground, doubled up one leg, and placed the foot against the fork; when standing, and wishing to talk, the gentler sex would rarely face one, but generally turn more or less sideways. Climbing trees was always effected by cutting alternate nicks, and in swimming the movement was hand over hand, just like a dog.

The year was marked by the mu-jain (Nuytsia floribunda) coming into blossom; this is of a rich orange colour, and can be seen for miles around. The plant has a very soft kind of covering, reminding one of the bottle-tree. The gum exuding from it—and this is translucent, like jelly, of about the same consistency as wax, and never gets hard—is used as an article of diet, notwithstanding the fact of its producing great flatulence. They know when to expect the different seasons, and were unerring judges of the weather. Smaller epochs of time were reckoned by the moon (miki), ("big fellow" denoting "full" moon), and the sun (ang-a), according to the elevation of which the day was divided. They had a name for night, as distinguished from day, and also terms denoting the points of the compass: thus, ja-ral-li, bu-yal-li, i-re, and wu-dal-li denoted respectively the cardinal points north, south, east, and west. Travelling at night in the bush was effected by local knowledge.

Enumeration took place with the aid of the fingers and toes, separately distinct words being used up to ten; beyond that, everythig was bu-la, the idea of multiplicity and plenty. Neither stones, pebbles, twigs, nor marks of any kind ever assisted them in performing the processes of notation.

There was no term expressive of the idea of disease in particular, but the word men-dik included every pathological condition: thus, "ka-ta men-dik" implied headache; "kob-bal men-dik," stomach-ache, etc. They had a superstition that their medicine-men or doctors (bukol-ya, a name also applied to any evil spirit) could make any individual sick by various incantations and charms, and effect cures, under different manipulations, by removing sticks and stones out of the patient's body. They were invariably very good and tender to their sick, and were great believers in rubbing or massage. Wherever pain was, there the part was rubbed, women rubbing men, and men massaging one another. When suffering from headache, or otherwise sick, the hair would often be cut. Red gum was very commonly taken in cases of dysentery. The bleeding of wounds was usually stanched with blue-gum leaves, the cut surface being subsequently besmeared with mud and earth. In the case of such-like injuries they could always tell whether the damage would prove fatal, or the reverse; indeed, practising their primitive method of treatment, they could almost invariably prognosticate the length of time, even to a month, before full recovery would take place. Their vitality was remarkable. Even in the case of spear-wounds through the body—cases which have been observed—their restoration after a certain lapse of time to perfect health was of no unusual occurrence. The total absence of shock to the system, or any dread of death, may of course have materially aided the convalescence. Taking all in all, there was but little sickness among these people, ordinary colds and chills perhaps excepted.

Their methods of hunting were all primitive. Until the advent of the whites, the catching of fish with nets was never dreamt of; no hooks and lines were used, but the fish speared principally in shallow waters in the estuaries and lakes. Weirs were resorted to in swampy channels, these being formed of brushwood intertwined on stakes, with here and there a pocket, at the bottom of which a kind of basket-work would be constructed. Any poisoning of the water with noxious plants, or mud dying with the feet, was unknown. Kangaroos were not only stalked and speared, but trapped on favourable ground by digging along their customary tracks deep pitfalls, covered with twigs and earth. These pits were about 8 or 9 feet long, 7 or 8 feet deep, and about 10 inches wide, just leaving margin enough for the hind feet to fall into. Wallabies were caught in "drives," fences being built in favourable situations along the ravines, with sometimes wattle-work at the end of the drive, woven into a short square basket-work-like mesh with sticks. A common method of catching emus was, for the hunter to plant himself up amongst the thick foliage of a tree close to the spring, etc., whither the bird was accustomed to come for water. Hidden there, he attracted his prey by means of a tuft of cockatoo feathers stuck on to the top of his spear ; this special weapon being of a comparatively heavy type, quite 12 feet long, and a portion of it quite as thick as an ordinary broomstick. In open country the native would stealthily sneak up to the unsuspecting bird under cover of some bushes held in front of him. Emus were never trapped in pitfalls or nets. Cockatoos, parrots, and other winged creatures, especially those flying in flocks, were often brought down with sticks or boomerangs; the younger men especially would employ the latter weapons, as they never set much store upon the time and labour expended in manufacturing new ones when the old ones were broken. Crayfish were caught with the hands. Grubs were obtained from out of grass-trees and black wattles; the natives could apparently tell from the general aspect of the tree, from the various progressive signs of decay, whether the timber was much infested with them or not. Many kinds of roots and yams were eaten; among the latter, the wor-rain, showing thick yellow blossoms, was very common, growing down to a depth of quite 3 feet, and running from the thickness of the finger to that of the wrist. An island (? Leschenhault Island) in Shark's Bay, used literally to be covered with it. All meats, and the majority of the vegetables, were eaten roasted, some of the latter being prepared with great care, the bulrush roots in particular, a very nourishing dietary, being most methodically slowly cooked in the ashes. So far as meals were concerned, the chief one was principally in the evening, what was left over being partaken of in the morning. The natives might pick up during the day anything they could get as they passed along. A man would always share with his neighbour. In the family circle the men, women, and children dined together, but the younger single males at a certain age (puberty and onwards) always had a fire to themselves. When a stranger came to camp, he sat down outside at a distance of some seventy or eighty yards away, and did not come up to the fires until invited, when he had food given him; he remained comparatively silent except when specially addressed.

Though cannibalism was not actually witnessed, it had been heard of in the neighbourhood. Furthermore, when the human entrails, on being thrown into the fire, began to curl up, if the ends pointed in the direction of any particular individual around, this circumstance boded him ill-luck in the future.

Narcotics were unknown. Upon this sandy tract of country, extending back as it did to some considerable distance from the coast, two species of Banksia grew abundantly, one conspicuous by its broad leaf, the other by its narrow leaf. Each species bore cones with pitcher-shaped flowers, which, containing a quantity of honey, were especially visited by the black cockatoos. The natives appreciated the honey also, and, pulling down the cones by means of a long sapling (close to the extremity of which was tied a cross-piece about 9 inches or 10 inches long, somewhat after the shape of a sheep crook), would bite into them and suck the saccharine matter out. At other times they utilised the honey by making a fermented drink of it, somewhat on the following lines:—Large quantities of the flower-bearing cones were taken to the side of some swamp, in the close proximity of which several holes were dug into the ground, each in the form of a trough about a yard long and 18 inches deep. Particularly sound sheets of tea-tree bark were next stripped from the trees, each piece of bark being tied up at the ends with fibre into a sort of boat-shaped vat, the sides of which were kept apart by sticks stretched across; the shape of the vat lent itself to that of the trough, and there was one vat for each trough. The vat was next filled with these cones and water, in which they were left to soak. The cones were subsequently removed and replaced by others until such time as the iquid was strongly impregnated with the honey, when it was allowed to ferment for several days. The effect of drinking this "mead" in quantity was exhilarating, producing excessive volubility. The aboriginals called the cones and the fermented liquour produced therefrom both by the same name—the mangaitch.

Though not of a common occurrence, a man was considered mad when he committed suicide. Homicide, usually a form of reprisal, was not justifiable, the culprit having to answer for it and to fight his victim's friend at the next gathering; should he not put in an appearance the tribe as a whole would take care that a corresponding life were forfeited. "An eye for an eye, a tooth for a tooth" was the golden rule here as well as elsewhere; an individual speared in the thigh could not wound his adversary in the stomach. Abduction, the taking away of a man's wife without his permission, was most unpardonable. The greatest offence of all, however, and one the vindication of which was taken up by the whole tribe, was that of incest, the crime of sexual connexion with one of the prohibited classes. For adultery, the husband could spear his wife in the leg, etc., but not kill her, or otherwise her friends and relations would interfere. At other times, should a man prove particularly brutal to his better half, the other women would "egg" their male relatives on to him.

Each family of the tribe had a more or less defined area of country belonging to it—a kind of heritage: its rights over such track were respected, and any infringements regarded in the light of trespass. Even if an individual of the same tribe, yet of a different family, had occasion to traverse it, he would only, if obliged at all, take just enough to appease his hunger—*e.g.*, one bird, or one egg, from a nest, leaving the remainder for its rightful owners. And it was wonderful to note how these owners knew exactly what was on their piece of land; they were never selfish about its products, but during the superabundance of any food plants, game, fish, etc., at any particular season, would send round for neighbouring families to come and make common property of what Nature had so plentifully supplied them with. Thus also, when the swans were nesting, or when a whale was cast ashore, other tribes would come along by invitation.

At puberty, when, as a part of the first initiation ceremony, the young men's noses were bored, certain precepts of wrong and right were inculcated; they subsequently became responsible for their actions, and other people would no longer fight on their behalf. Win-dang expressed the idea of badness, as wanting in common sense, no good, a saucy fellow, one who was regarded rather in the light of a fool for not conforming to the general usages of the tribe. As a sobriquet, or as a matter of chaff, in drawing attention to any pet weakness, an individual was sometimes spoken of as being stone-, or wooden- headed. Kwob-ba was the opposite extreme, signifying goodness and kindness. It was considered wrong to interfere with a non-tribesman unless a fued were on, the stranger being always welcome so long as he were well-behaved and courteous. Indeed, hospitality was always very marked, but the recipient never claimed it; he would neither come up to the camp, nor even light a fire in the close neighbourhood to cook his own raw game at, unless invited so to do. A good deal of lying went on, but then it must be remembered that they were not expected to tell the truth, especially when against their own interests.

Bon-du signified the truth, ku-thum a lie, and ku-lin a liar. On the other hand, there was hardly any cheating; these blacks would give to one another practically anything that might be envied. Gluttony was regarded as very unpardonable, and in this way they were very self-sacrificing; it was well that such was the case indeed, because an individual might be lucky in hunting on the one day, and yet be unsuccessful on the morrow. Only occasionally, and in secret, would the native be gluttonous; thus, an aboriginal contaminated by whites would ask you not to give him so-and-so before another, as he would probably have to part with it—but such conduct was always considered most reprehensible and mean. On the whole, they were a chivalrous people, and cowardice brought the delinquent into supreme contempt. They were very good to their aged and weak, would tend their sick, and carry them about from place to place; if circumstances prevented this, some one would be left behind to give them every attention.

A father could do what he pleased with his own children, but neither parent would ever strike a boy; if beaten, the latter was supposed to lose courage. The mother taught her girls, looked after their chastity, and, when considered necessary, beat them. The grown-up lads slept together, separate from the others.

Among the party of men who landed with R. Austin on that coast was a young architect, one Greensell, who was supposed to resemble one of their tribe lately deceased: the blacks immediately gave him the name of wor-kap, that of the deceased individual in question. As a rule, they never mentioned the names of their deceased, but in this case they believed that this young gentleman in question was their own mate returned to them in the guise of a white man. Austin subsequently found it to be a general impression among them that deceased blacks were wont to return to their own habitats in the form and shape of whites, and that this was how they accounted for the Europeans coming to visit their country. As already mentioned, this district had been settled only a few years previously. In several places, a similar form of nomenclature in vogue, was met with, and Austin invariably did his best to destroy this belief of theirs. They also had an idea that the spirit of the departed hovered round about the grave, and, though their feelings could not be thoroughly analysed, they certainly had a fear of approaching it for some time subsequently to burial. At burial, some offerings were left generally in the shape of damaged weapons, etc (but no food) on the grave itself, while upon the bark of neighbouring trees was smeared some red paint, (wil-gi), either in complete rings, or horizontally zigzag lines. For some few days onwards they would sweep with bushes the surrounding ground, so as to track anything in the shape of a visitor, human or animal, and very gratified would they be if no tracks were discovered. This brushed part of the grave, when once finally completed, was never by any chance subsequently traversed.

Any doctrine of the transmigration of souls was only hinted at in the fact recorded of blacks returning to their homes after death in the shape of whites.

They believed that diseases, of which they could recognise no physically pathological origin, were caused by the charms of their enemies, or persons whom they had in some way or another offended. Such complaints the doctors or medicine men professed to cure by various manipulations, massage, etc. Thus, if called in attendance, the doctor would leave the camp at night with a lighted fire-stick, go away to some considerable distance, and extinguish it, and then return sufficiently near to be heard. By stretching his cloak over his thighs and fixing over his buttocks the ends upon which he sat, he clapped upon it with his hands, by this means making no inconsiderable noise, which was supposed to either drive away or to appease the alleged enemy. Upon returning to his patient he would remove a stone or stick by massage, etc., from the part most affected. No special huts were constructed by, or for the use of the medicine men, whom the tribes, believing them to be equally capable of killing or curing, were careful never to offend. Ventriloquism was never brought into requisition.

The natives here were certainly under the firm conviction that at night time the earth was permeated with evil spirits, whom they feared. Such spirits could be checked or repelled by means of fire, and this was one of the chief reasons why, in the dark, they would never leave their camps without taking a lighted fire-stick with them. In addition, the light precluded the possibility of treading upon snakes, etc., unawares.

Another very common idea amongst these people was that there was always something supernatural lying in ambush in everp deep water, or in any fairly-sized permanent water-hole—some unwritten record of an extraordinarily big crocodile, snake, or iguana inhabiting it. They would naturally be averse to bathing in such localities, or if they did, would never venture far from shore. From cross-examination on different occasions, Austin was led to the conclusion that individuals having been now and again drowned at these places accounted for the superstition—a phenomenon that he could not otherwise explain.

Tribes were not named after any animal, but children at the time of birth would be named after a particular animal, some circumstance in connection with which may have impressed the mind of the mother, either during pregnancy or about confinement. This was the name by which the child as he grew up was referred to in ordinary general conversation. Anyone so named would not, at certain seasons of the year, partake of his patron-animal, and this quite independently of, and additional to, the special dietaries otherwise prescribed for him by tribal usage.

There was no worship of gods of any description, and the idea of a Creator of all things was conspicuously absent; similarly there was no sign of any diety connected with the sun, moon, stars, or with war.

Whenever the results of previous experience taught them that game and food were sufficiently plentiful, they sent round word to their neighbours to come help partake of it. Such an occurrence would be the occasion of what might be called a festival, when songs would be sung, friendships made and cemented, and corrobborees performed. So also when the nose-boring of the males took place—the actual operation being performed secretly in the daytime—the opportunity was made a festive occasion of so many people being present. Otherwise, even at the birth of a child, or at marriage, no festivities helped to mark the event. There was never any festival of a religious character, and nothing in the shape of prayer or sacrifice.

On the death of a friend, the women (especially the wife and family of the deceased) would, with their finger nails, cut deep gashes in their foreheads and cheeks, pipe-claying in addition the former portion of the face. The men used to whiten the forehead simply.

Women were considered impure and unclean during the menstrual period, when they sat apart at a separate fire.

The position of the corpse, when doubled up before covering over with earth, was invariably towards the east.

Nothing in the way of special superstitions, other than those recorded in these notes, was noticed. That they were extremely fond of their dogs goes without saying; so much so that women were often observed suckling young puppies. They rightly believed that it was the one and the same moon which regularly put in an appearance each month.

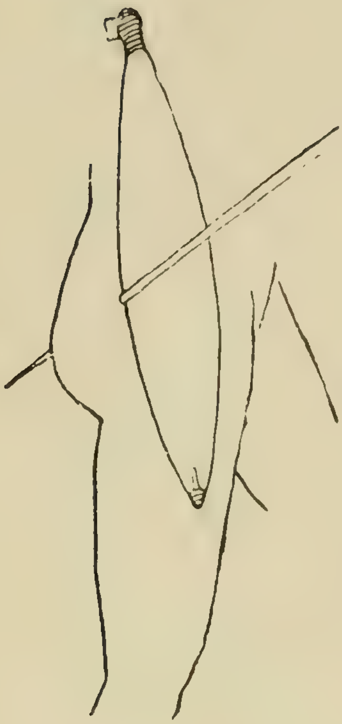
Disease and death charms in the hands of doctors and alleged enemies have already been drawn attention to. The medicine men mixed up with other individuals like ordinary mortals, but were dreaded; as a correlative, they were aware of it, and consequently traded upon the credulity of their less-witted mates. There were no such things as love charms, while the cries of birds and animals (each separately noticeable) were taken not so much as omens but as indications of the approach of strangers, were they friends or enemies.

The aboriginals here had no mythic legends or fairy tales, but could tell many a witty story relative to incidents that had occurred, and principally about individuals. Nothing escaped their observation. When crossing a flat one day along the bank of a river, where a European was building a hut, Austin's black boy pointed to an ants' nest, and spoke to the following effect: "My word! that fellow ant knows more than that white fellow man." On being asked what he meant, the boy explained the dictum on the lines of the settler building his humpy below flood-water mark, while the ant constructed its nest far above it.

Children invariably respected their parents as well as their wishes. At the ceremony of the nose-boring, the individual pledged himself to conform to the general rules of propriety in force, certain rules benefiting the whole community—*e.g.*, the respect for each other's property, and the prior right to certain portions of the land which the tribe in general acknowledged to be theirs. There was a uniform attention to decency, peace, and quietness. They were all brought up to supply their own wants, manufacture their own weapons, were almost all equally proficient in their general ideas, in the pursuit of game, in fighting, etc. They recognised a head man, on whom a special term was conferred, but the office was apparently not necessarily hereditary, and if a "strong" man, he might nominate his successor; he was not always the oldest man in the tribe, but general fitness and ability were his characteristics; he never put on any "side," and he exercised the prerogative upon the death of a tribesman, to either take his widow unto himself, or to confer her where he chose. No share in the government was taken by the the women, though they often used to stir up strife amongst the opposite sex; thus, upon the killing of a man, when doubt happened to be expressed as to what concerted action should be taken by the tribe collectively, it was the women who, in a body, would inflame and incite the men to take measures for revenge, and arouse them to precipitate action. It may be truly said that the weaker sex were invariably far more quarrelsome among themselves than the men. Among themselves the men were very good-tempered as a rule. If the younger ones attempted to start any row, the elders would remonstrate with, and their friends restrain, them. The angered individuals would be held back with their elbows to the sides, their mates putting their arms round them from behind; though the would-be assailants might kick and bite, they were firmly held. It was the difference of sex, the gratification of the grand passion, and personal applause which constituted the main causes of all strife and dispute.

Each family in the tribe had its own territorial division, its own ka-la or "fire-place," to which it had a prior right, the land being divided ultimately among the sons upon the death of the owner. Though the game was in no sense preserved, each person knew what there actually was on his own possessions, what birds' nests, etc.—very much in the same manner as a European knows the contents of his garden. When anything showed itself in abundance, the neighbours, etc., would be asked to come over and partake.

All being equal, and all being armed, one man was as good as another, hence, as a rule, they behaved themselves one to the other, and, having no fear of death, when they did fight they meant business, and never threatened without a fulfilment. In the case of serious offences, or when inter-tribal interests were concerned, the camp council decided upon the form of procedure and the mode of punishment. Mutilation or flogging was never inflicted, and justice, as a rule, was administered with clemency. In the case of wilful murder, incest, etc., the culprit would pay the death penalty somewhat on the following lines:—Standing out with one leg forward, a spear was "jobbed" into the inner side of the back of the advanced thigh; the femoral artery was thus damaged, and in four or five minutes the culprit had bled to death. He accepted his death with a dignified calm, and, if an ex-tribesman, he could elect to be killed by his own people. A wife's murder by her husband might be sometimes condoned, though he could legally be put to death by her relatives; the condonation was not infrequently granted in those cases where the woman had belonged to some other tribe from whom she had originally been stolen. In all cases it was the lex talionis which was enforced, and the following example which came under Austin's notice, may not prove without interest. Two blackboys were attached to his camp, and to the elder, about 15 years of age, he gave a gun. They went away shooting one day, when the elder accidentally shot the younger, who was walking behind, and killed him The news spread like wildfire, and the other blacks immediately wanted to kill the survivor, although the fact of its being a pure accident was well known; yet it was the law of a life for a life. Austin naturally demurred, said it was not fair, that he had determined to protect the boy, and warned them that if they dared to use force or violence in getting him away, they would have to take the consequences. They hung round the camp for several days in considerable numbers, crying and mourning for the deceased in the meantime. At last a few of them came to Austin and expressed themselves as satisfied if he would allow the boy to be speared "just a little bit," so as not actually to kill him, and explained that it would be far better for him to give them this permission than to run the risk of letting the boy escape then, only to be speared to death on some subsequent occasion. Austin thereupon talked the matter over with his dusky protegé, who willingly signified his approval, considering, on the whole, that it was a very easy "let off." Having informed the other blacks of his consent to the boy being speared in the buttock, as they had themselves suggested, Austin nevertheless gave them distinctly to understand that he should be present at the infliction of the punishment with his men and guns, and that if they even attempted to do anything else than what they had promised, he would let fire. When the time arrived, the blacks formed a circle around him with the boy. Three of the former, fully armed with their spears and accoutrements, stepped forwards into the ring, placed the alleged delinquent in proper position, with one leg much in advance of the other, and, resting a spear upon a wommera held vertically against the hip, "jobbed" it through



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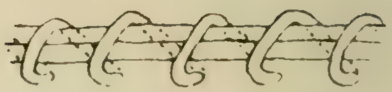

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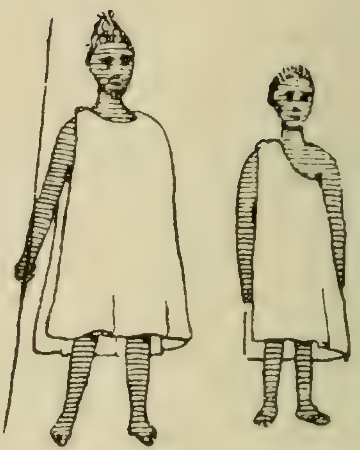

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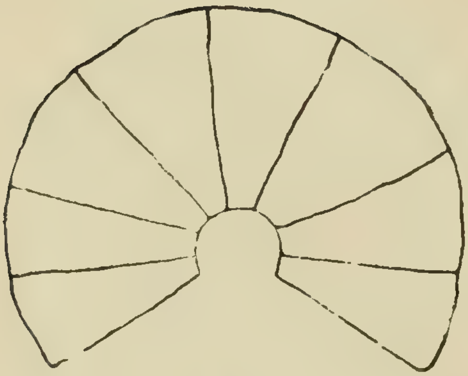

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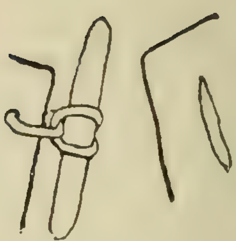


E.

the buttock (*Plate V., fig. a*). The poor wretch clenched his teeth in agony, but stood it firmly, and did not break down until all the men around began to sob and cry, when they all in a body rushed up to kiss and slobber over him.

With regard to the general custom of salutation, men used to kiss one another on the cheek, and hug one another. There was no osculation among the women. After long absences, they would rejoice over the return of the wanderer, who recounted to them the numerous adventures he had had, whom he had seen, how successful he had been in hunting, and anything curious that had come under his observation. In addition, he would illustrate *in propria persona* all that he thought might prove of interest—in one case, under Austin's observation, going so far as to imitate the waltzing of the whites. As a rule, these blacks used to get up comparatively late of a morning, unless compelled by want of food, or for any special purpose; *e.g.* to collect the mangaitch before the ants got at the honey. The young were always reproved and kept in order, but the boys were never beaten. Their sense of decency was parallel with our own; they never spoke with strangers concerning their sexual relationships, and it was only the younger males who talked filth. Their moral deportment was creditable to them in every way, with the exception that if a bachelor friend asked his married friend for the temporary loan of his wife as a great favour (especially as the lady was usually agreeable), the husband's consent was generally given.

The old men taught the young ones at initiation which diets to avoid; they reserved to themselves as elders, and as heads of families, such diet scales which were only rarely met with, or were considered special delicacies. In addition, for each individual, food was always refrained from when it happened to be anything in connection with that according to which his birth name had been given. There was no particular food tabu to any of the four special divisions of the tribe. The names of people deceased were avoided, and as a rule any reference (except by the younger males) to sexual matters discouraged. Certain water-holes and graves were also tabu.

In trading with other tribes, all that they could barter in exchange were their spears, made from the local "spear-wood," which grew plentifully in the close neighbourhood of the coastal swamps. What they received in return included the following:—

(*a*) A sort of red ochre, wil-gi, which was used with fat for smearing over the body.

(*b*) Fragments of crystalline quartz, bwor-ral, for sticking into their spears, which, with the advent of the whites, was subsequently replaced by glass. This quartz came from the Darling Ranges.

(*c*) Stone-tomahawks (kod-ja); also from the ranges.

(*d*) Wommeras (mi-ra); manufactured of the "raspberry jam" Acacia,* from beyond the ranges, in the Avon district.

(*e*) Throwing-sticks (dau-ak); made of similar wood, and from the same district.

(*f*) Cork-wood shields (hi-la-man); also from the Avon.

There were no special individuals or actual traders for carrying on the exchanges, but they would proceed to their particular market whenever they considered the amount of food available there would be sufficient for the wants of all who might be present. There was never among particular tribesmen any principle of association, special sharing, or distinctive trademarks. Letter sticks were in vogue, but the messenger himself took the message verbally. These sticks, about two inches long, were pointed at each end, and squared in their length, very much after the style of an English boy's tip-cat. They were carried in the hair just over the ear. Made of some light coloured wood, which did not ordinarily change colour, they bore incised upon them certain marks which might have been aids to memory, but they were absolutely nothing more. When the messenger happened to be charged with messages from different peoplee, the marks would be cut by the various individuals interested.

Distance traversed during the day was measured by the elevation of the sun. Measures and weights were only hinted at by speaking of anything as being large or small, long or short, light or heavy, no fixed standards being recognised.

When on the track of an adversary, a black would not challenge his enemy, unless observed; he rather preferred to steal upon him asleep or awake, though they would both prove very bold and determined if it so chanced that they met in the open. In the case of inter-tribal warfare, each party came

* A. acuminata, *Benth.*

to the attack in open rank, the tribesmen standing side by side; prisoners were not taken captive, but all killed.

Hunting parties, when game was plentiful, were often formed, and all the spoil invariably divided impartially and fairly.

Their migrations were certainly dependent upon the scarcity or plenty of the animals they hunted, their nomadic habits being thus easily accounted for.

As a general rule, a wife was very happy and obedient; indeed, she had to be civil to her husband, as otherwise she might expect a crack on the head or a spear thrust through her calf.

There was no special marriage ceremony, beyond the betrothal of a girl by her parents, and in this matter the mother would appear to have always had an important say. Of course there were certain group divisions of the tribe into which marriage could or could not take place. At any rate the betrothal often gave rise to many troubles. Faith might be broken by the parents, the girl herself might like somebody better, and ask him to steal her, or the man might not care to tarry awhile, and consequently set about stealing someone else—and thus a row would commence. This stealing of a wife constituted a very primitive measure. The bridegroom, *in posse*, would just knock her on the head, or spear her in the leg, if she refused to join him, though, in addition, he might have to fight for her with some individual who considered he had a prior claim. Punishment for this course of conduct, if the lady were a tribeswoman, was spearing in the thigh. Should it, however, prove to be a case of incest (*i.e.*, either too close consanguinity, or an infringement of the tribal regulations *re* marriageable groups), the gay Lothario would be put to death. A man could have up to as many as four wives, with usually a hut for each; but in such cases it must be borne in mind that some of these women might very probably have been his brothers' widows, to whom he had a legal right. A wife entered the tribe of her husband, if of foreign origin. Divorce was not recognised as an institution, but if a woman could not hit it off amicably, she would tempt some other fellow to steal her from her husband. Men were invariably kind to their mothers-in-law.

A widow was taken to wife by the elder brother of her deceased husband; if this arrangement were inconvenient, or she happened to be too old a body, her own blood-sons would look after her, or failing them, her daughters; the sons, however, were always first in their attentions.

Infanticide was not practised, nor was anything specially done with twins when they put in an appearance.

The conditions of marriage might be shortly expressed as suitable group relationship, stealth, or betrothal, and the attaining of the nose-boring initiation ceremony, which took place sometime subsequent to puberty. They had a very general idea that a man was always more courageous before matrimony than after; and, as owing to the comparative paucity of eligible women, the getting of a wife very often proved a constant source of feud, the older men were always discouraging the younger ones from entering the married state. On an average, there were about six men required to provide by hunting, for the wants of every two women (with children). Of the latter, the majority would appear to have died before reaching middle age; the proportion of two or three young women to every old one, being pretty constant. Three or four children would not uncommonly be noticed as belonging to one mother, who might be seen suckling more than one of her infants at a time.

Children were taught how to climb trees as well as the use and exercise of arms; they learnt to throw spears by practising on small reeds, etc., to commence with. They were certainly not instructed in the manufacture of the different weapons, but apparently did this by imitation, though they might occasionally get instruction and assistance from their fathers. The mother would look after the education of her girls, teaching them how, when, and where to dig for roots, yams, etc., and also how to prepare the different foods. Tracking was never actually taught; the aboriginals apparently picked it up as time went on.

A very common game played by both little girls and boys, up to 8 or 10 years of age, consisted in throwing along the ground, with a peculiar turn of the wrist, a more or less ovate-shaped piece of bark, and throwing a 6ft. reed at it as it spun.

Among the elders and at the camp-fires a man would often stand forward with his wommera and recite some adventure of his, telling all about what he had done, and often what he hadn't done, what prowess he showed under the circumstances, and what a brave man he was. This form of self-adulation was very common, and after his hearers had applauded another man would take his place, and give a similar recitation culled from his autobiographical memoirs. Even when starting out from camp of a morning, surrounded only by his own immediate family, a black, after shaking his spears, would very generally tell his wife and children what he intended doing during the day; how many kangaroos, etc., he proposed bringing home; how he would fight any one who dared oppose him, and vaunted himself upon his pluck, courage and endurance. Indeed, judging from what these aboriginals said of themselves, their lives must have been quite Homeric. In the ordinary corrobborees, which always took place in the neighbourhood of the camp about a couple of hours after sundown, the men only took part, while the dancing was of a stamping movement; the reverberation of the sandy ground was once indicated by the mercury in Austin's artificial horizon when at a distance of fully over a hundred yards. As decoration, feather down was stuck over their faces and bodies upon the stripes of red ochre grease, and pipe-clay. The plays usually performed represented emu and kangaroo-hunting, etc., though various other personal adventures, with embellishments, were depicted. The audience at these entertainments consisted in the main of women, children and old men. Some of the women in the squatting position beat time with the flats of their hands, or with sticks, upon the cloaks stretched tightly across their knees. Others again would stand up and beat their yam-sticks, etc., held crosswise over their heads.

They never employed roads or bridges, though, for instance, a log lying (not placed designedly) across a creek might be utilised for the purpose. They were expert swimmers, hand-over-hand fashion, like a dog. When on land their ordinary property did not consist of anything more than what they could carry. On the walk-about, halts were made generally at some very dry stage, the nature of the timber giving them some good idea of the substratum. When "at home," the increasing remnants of old refuse, the superfluity of ants, or scarcity of food in general, were causes operating to compel them to shift the sites of their camps. The general arrangement of the camp itself was crescentic, with the "horns" towards the fires; each hut, from a few to a score of yards apart had its own fire burning at about a yard to a yard and a-half in front of the entrance. Permission had to be asked and obtained before travellers were allowed within the precincts. In travelling, the men went in front, generally in single file, the women bringing up the rear some sixty or seventy yards behind. The former carried the weapons, and any game that might have been caught during the day, while the latter burdened themselves with all the remaining property. Some of the particularly old men—this was certainly never observed among the younger ones—used to carry a small dilly-bag over the left shoulder, hanging in the armpit; this contained red ochre, pieces of crystalline quartz (for the spears, etc.), gum, and hair. Their powers of rendering the voice distinct and intelligible over comparatively great distances were remarkable. They could both speak and reply. In one case that came particularly under Austin's observation, over an estuary quite one and a-half miles wide, where they would ascend a tree to a height of about 20 feet, the better so to do, the voice of conversation in that particular instance was carefully modulated rather than high-pitched, though the initial sound to attract attention was a sharp shout.

The red ochre, wil-gi, was rubbed up in the hand dry, or pounded with a stone to a fine powder. It was also subsequently mixed with snake's entrail or iguana fat held at the end of a stick over a fire. Supposing now that our individual in question was about to take his departure on a visit elsewhere, etc., he would arrange his toilet somewhat after the following fashion :—After seeing that his weapons and accoutrements were all in good condition, and removing his head and belly strings, he would put the wil-gi powder into his left hand, and then with the right thumb dab it in rings round his chest, arms, thighs and legs. Admiring himself, he would take up a spear and wommera, shake them in defiance at an imaginary foe, and probably sing a song concerning his own prowess, his wife, of course, telling him all the time what a fine, noble fellow he looked, and how that he was by far the better of the two. In this mood of supreme self-satisfaction he would squat down, and with some fat smear the whole of his body and limbs until the skin showed a uniform appearance of a greasy vermillion colour. Singing all the time, he would finally red-ochre grease the head and belly strings before putting them on again.

The former was first of all wound round the head once or twice, and the hair turned up, then another circle or two, and more hair turned up, until at last the whole of the hair was fixed in the form of an upstanding tuft. He would now consider himself suitably dressed to make a start from camp.

The wife used to paint herself on similar lines, especially if they were a happy couple, and they shared each other's joys and sorrows.

The grease-paint, in addition to serving a decorative purpose, was useful in keeping away the ants, sandflies, and other insects. The renewal of the painting process depended greatly upon the supply of the ochre itself, and whether for the purpose of paying a visit to another camp, they were desirious of appearing at their best. It was not done every day, but if they were young men and fancied themselves, they would renew it as often as the inclination took them.

Raised scars, "keloids," or "flash" marks were always to be seen in the males on the breast and arms, sometimes on the back and shoulders, but never on the thighs. On the chest they were each about 2 ins. long, lying in horizontal rows one below the other as far down as the pit of the stomach. Austin observed the scars to be originally made as small scratches, and into each saw them rub "dirt," the particular nature of which he omitted to enquire about. The women were not so strongly marked in front. The keloids here lay rather in between the two breasts, and reached below as far as the navel.

They wore a cloak, bo-ka, made of kangaroo hide (sometimes with a collar some 5 ins. or 6 ins. deep, which fell over) hanging to just below the knee, and shorter in front than behind. It was worn with the hairy side in, and was coloured on the outside with the wil-gi. It was made of some seven or eight gores (*Plate V., fig. b*), wider below than above, each prepared from a skin by pegging it out, preparing with ashes, scraping with quartz, and then thoroughly greasing until perfectly soft. The separate gores were sewn together, either with kangaroo tail sinew, or else with rushes, the separate holes for their insertion being made with a piece of pointed bone (*Plate V., fig. c*). The ends of the cloak, which was worn differently in the two sexes (*Plate V., fig. d*), were fixed together at the top of the right shoulder by means of a toggle and grummet

(*Plate V., fig e*). These cloaks were always worn in the winter time, the wet season, *i.e.*, June, July, and especially August. If the parents chose to take the trouble they would clothe their children with similar garments; otherwise, the little ones would have to make shift as best they could, each with a single skin.

In the cold weather it was a common thing for the adults to carry a lighted fire-stick under their mantles, to keep the lower portion of the abdomen warm; this stick was held in the left hand, in between two pieces of bark, just like a coal in a pair of tongs, and as it got burnt up, another would be picked up and lighted as they went along.

In connection with personal ornaments, it may be mentioned at the outset that married women wore nothing except the cloak; it was only the young, unmarried women and the little children who occasionally sported necklaces in the form of two or three rings of threaded grass-reed beads. Even the various accoutrements to be immediately described as pertaining to the men did not constitute any sort of corrobboree dress, but were the "fashion" when travelling, or paying a visit to one's neighbours. When necessary, the hair was cut with a sharp quartz stone, but never cropped as short as the women's; the men cut their whiskers from between the ear and angle of the jaw, so as to leave a beard and moustache, while some of the older ones especially shaved the moustache only. There was never avulsion of any teeth; the nose was bored, but the wearing of the nose-pin exceptional.

(*a*) The ka-ta-band (*cf.* kata—the head) was a piece of red-coloured opposum string, as thick as ordinary twine, wound across the upper portion of the forehead, the thirty or forty coils round the head forming a thick band about one and a-half inches wide.

(*b*) A dingo tail was often tied round over the kataband, while

(*c*) A bunch of feathers was often stuck into it. This bunch was formed of the pinnules pulled from the stems of white cockatoo or emu feathers, all tied tightly into a bundle, through which a wooden skewer was plunged.

(*d*) There was an armlet, always on the left arm, formed of red opossum string, wound round and round at least a score of times. Underneath it a bunch of feathers, without any skewer, was usually tucked; otherwise this bunch was fastened under the waist-belt at the loins.

(*e*) The belly-string or waist-band, nul-ban, or nul-band, was formed similarly of a great length of red opossum twine, coiled around so as to form a solid mass, quite 2½ to 3 inches wide, and ½ inch thick; in this they carried their tomahawk (kod-ja) behind, and their boomerang (kai-li) on the left side.

Besides the nasal and cicatricial mutilations already referred to there was nothing worthy of note, no circumcision was practised, though the latter rite was prevalent at the time up at Champion Bay, some 300 miles to the northward. On the other hand, the prepuce was always well forward with marked crinkles at the extremity. Children up to five or six years of age were often noticed to have what was apparently umbilical hernia, but this deformity was never observed among the adults.

The striking of the skins or cloaks stretched across their knees, either with sticks or with the hands, as well as the tintinabulation of the yam-sticks hit crosswise over their heads, was the only primitive form of music noticeable.

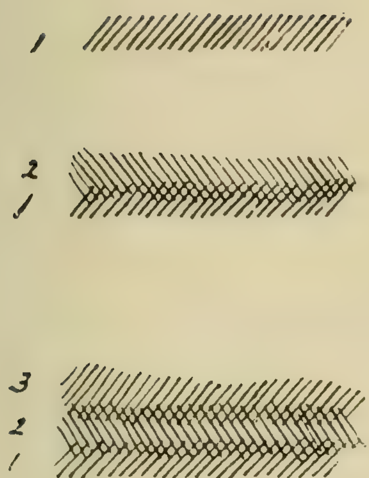
There were no canoes, or any signs of them.

As a rule, these people lived in the open in this temperate, beautiful climate, though in wet, wintry weather they used huts, and occasionally protected themselves from the violence of blowing winds by means of "break winds." The huts were of two varieties, according as they were built of grass-tree leaves, or with bark, the choice of "timber" depending upon its temporary abundance or scarcity. When made of grass-tree—and these were from five to six feet high, about four or five feet in diameter, with a floor-level unaltered from the surrounding ground-surface—some fourteen or fifteen peduncles were stuck into the sand, at pretty well equal distances apart (except where the entrance was subsequently to be), and fixed together at their apices, so as to form a kind of cone-shaped scaffolding. The grass-tree leaves—about eighteen inches long, and one sixteenth of an inch thick—having been collected from the trees, and carried in the bend of the left elbow, were then dropped in handfuls with the right hand into the sand, points downwards; each handful, it must be borne in mind, was not thrown vertically, but at an angle. The whole row round having been completed, a second layer was commenced, but this time the bundles were fixed at an angle with those of the first, the leaves interlacing with one another as in a cheval-de-frise; the third layer would have its constituent leaves of course placed in the same direction as the first (*Plate VI., fig. f*), and so on alternately, until getting higher and higher, they became wedged in between the gradually narrowing interspaces left by the peduncles. As the structure proceeded, the builder himself would occasionally from the inner side look out for any weak spots which were located by the light coming through; he would then start again from the bottom so as to act as a foundation for what was necessary to put in to fill up the gap.

When the grass-tree leaves were at all scarce, these aboriginals built themselves bark huts, their primary scaffolding of which consisted of two forked sticks, and a backstay: if the latter were forked, so much the better. The secondary scaffolding was formed of two thick pieces attached each from about the middle of the back-stay to the lower end of the main-stay, while cross-wise were placed (not tied) several additional sticks, which together supported the final covering of bark-sheets. The bark was put on from below up, the pieces above overlapping the ones underneath; on top of all, along the line of the back-stay, was fixed a projecting bark ridgecap (*Plate VI., fig. g*).

The break-wind was a semi-circular ring of bushes intertwined with a few additional ones hanging overhead at the centre.

Fire was produced by twirling a stick, held vertically, on to another stick fixed horizontally, the wood so employed being the grass-tree peduncle. The flat surface on the horizontal piece was bitten out with the teeth, upon it the vertical piece was twirled, and as soon as the "pit" was produced a nick was cut, so as to connect it with the surface edge. Within this same nick was next placed some of the powdered "fluff" (from the dried-up flowers on the peduncle-top), which acted as a sort of train to the fine dry shreds of fibre (scraped from the inside of a dead log) lying close below. As soon as the smoke appeared, this "sawdust" or "tinder" was fanned into flame by a gentle breath. If the necessary timber for manufacturing these firesticks ever proved at all unsuitable through wet, or scarce, the lighted sticks would be carried along under the men's or women's cloaks.



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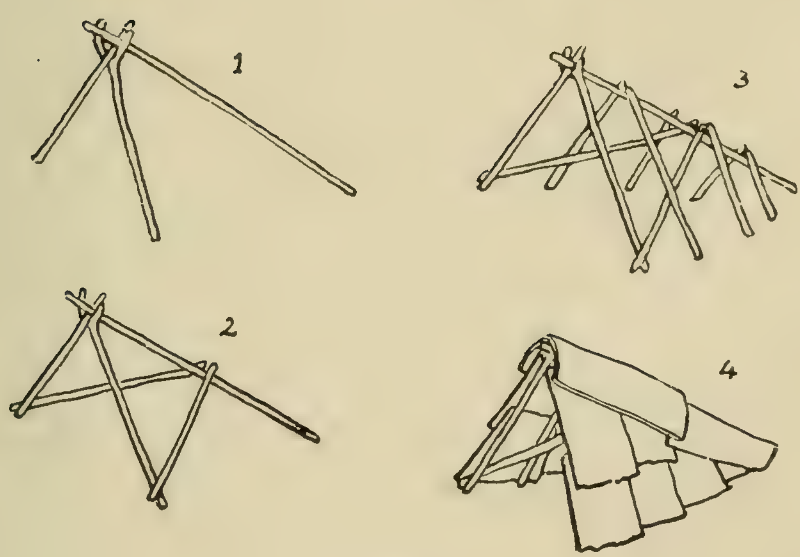

G.

Opossum string was manufactured as follows, and by the males only: From a heap of opossum hair well rubbed together, at his left side, the operator would pick up a piece, roll it up and down his left outer thigh, in squatting position, with corresponding hand, and, fixing it length to length, roll the string so formed on to a distaff with his right hand. This distaff was formed of two round pieces of stick, each about 3 inches long, tied crosswise, the shape of a cross. The string itself was of single strand, and not in any sense too strong. They further used for sewing purposes, when sinews, etc., were not available, a piece of jointless rush, a very tough kind of wire-grass without any blades on it. Austin never saw any human hair *per se* used as string, but often observed them employing longish strands of it, mixed with grass-tree gum, for fixing the sharpened shell into their wommeras, the barbs on to their spears, etc., The fixing process in these cases consisted in tying first of all with hair, then covering with a coating of gum, and heating ; again more hair, more gum, heat, and so on.

Up to the time of the advent of the Europeans they never manufactured nets. The nearest approach to anything of this sort was the basket-work arrangement at the end of a wallaby drive, formed of thin sticks stuck into the ground, and then wattled horizontally in and out with rushes.

The dilly-bag (go-ta) was used by the women only, slung up by a piece of string, and carried round the neck, so as to hang down over the back. It was formed of a long piece of dressed kangaroo skin, folded over, and sewn at the sides, leaving just a slight cover.

Omitting for the present the specially-constructed weapon for catching emu, these people had three varieties of spear—ked-ji, all made from a very hard and straight wattle, the timber of which gave the name to the instrument ; the process of manufacture was simple, the sapling being just stripped of its bark, which left it a bit "ribby," then scraped where necessary, and subsequently straightened by holding it over some heated ashes, and bending it with the teeth and hands into the required shape. They were all about 10 feet long, and from $\frac{1}{2}$ inch to $\frac{5}{8}$ inch in diameter, with a rounded point about 6 inches long, and invariably thrown with the wommera. Such a one constituted a fish-spear. The quartz-spear bore along a vertical length of the tip numerous pieces of quartz crystal, subsequently replaced by glass, fixed in position with gum. The barbed spear had tacked on to it, about an inch or two from the point, by means of hair and gum, a spatulate concave piece of wood, about 2 inches long, wider at its free than at its fixed extremity. The blacks each ordinarily carried about with them during the day one quartz-, one fish-, and two barbed spears; if on the war-path, the fish-spear would be discarded for an additional quartz one.

The wommera (mi-ra) (*Plate VI., fig. h*) was formed of a perfectly flat piece of any hard wood, cut into a leaf-shape pattern; it was about 2 feet long, 4 inches or 5 inches wide, and $\frac{1}{4}$ inch to $\frac{3}{8}$ inch thick. Both extremities were covered with hair and gum; a kangaroo tooth fixed at the distal extremity acted as the hook, while a piece of concave-edged shell, firmly planted into the haft laterally, played the part of spear scraper and sharpener.

The tomahawk (kod-ja) (*Plate VI., fig. i*) consisted of a handle 8 inches or 9 inches long, each with two stones fixed on opposite sides with gum and hair, at first sight giving the impression of there being but one; the exposed edge of one of these stones was comparatively rough and blunt, while that of the other was ground fairly fine. The width across, at their extreme edges, was quite 5 inches, and its gross thickness about $1\frac{1}{2}$ inch, This implement was particularly used in the climbing of trees. The rough stone-edge was used for smashing or bruising the bark to get a firmer foothold, while the sharper was employed for actual cutting; the lower end of the handle, previously hardened with fire and sharply pointed, was jobbed into the tree more or less horizontally, and, held close to its insertion, afforded the climber not only a means of steadying himself, but also of advancing. When not in actual use the implement was carried on the loins, under the waist band, the handle hanging along the upper portion of the fold of the buttocks.

Boomerangs (kai-li) were made of the "jam-wood" Acacia, a tree which grew favourably for the required shape. They bore no regular pattern in the way of marks beyond some zig-zags and strongly incised straight lines, and sometimes these were absent altogether. Older men used them for fighting purposes, younger men for throwing at birds, etc. Austin never observed an individual carrying more than one of these weapons at a time.

The ordinary yam-stick (won-na) was a rounded piece of wood, not quite as thick as a broom-handle, about 6 feet long, scraped, and hardened with fire at one extremity. Though primarily devised for digging up roots and yams, the women also used it for fighting purposes, in the procedure of which they adopted three lines of defence: held with both hands vertically, to the right, to the left, and horizontally over the head.

Nothing was observed on the immediate coastline here with regard to rock carvings, mural paintings, etc., though Austin discovered some beautiful examples subsequently on the Murchison.

They were not an emotional people, and were able to express themselves by signs, independently of speech. The showing of the teeth, with the beard firmly clutched in between, was a common gesture indicative of anger, and the likelihood of a row.

Austin does not believe that there were ever more than from twelve to twenty heads of families constituting the groups, each with its particular territorial divisions, who together made up the tribe, extending between the Murray River and Koombana Bay. They evidently avoided too close intermarriage.

On the whole these primitive people were amenable to the standard of honour imposed by their tribe; they were equally expert in the use of weapons, and, while restrained by those unwritten laws which tended to maintain order and insure the general comfort of the community, they were prepared to fight to the death, and go coolly and deliberately to mortal combat in the face of all men.

NEW ENGLAND (N.S.W.).

REMINISCENCES DURING THE FIFTIES.

PART I.

By the Hon. A. NORTON, M.L.C.

(Read before the Royal Society of Queensland, 12th April, 1902).

Early in the fifties I made my first acquaintance with the New England district of New South Wales. Travelling now is very different to travelling half a century ago. Australia had no railways at the time to which I refer. There were coaches on some of the principal roads, but as a rule, those persons who wished to move from one district to another used their own conveyances when they needed vehicles. Most of them rode from place to place, and on the whole, this was the best means of locomotion, because what by courtesy were called roads, were merely rough bush tracks. The friend with whom I made this my first trip from Sydney to the south-eastern part of New England, had a couple of horses of his own, one of which carried a pack-saddle and our extra clothing, etc. I had secured a useful horse for myself, and one evening, at about 10 o'clock, we left the A.S.N. Company's old wharf in Darling Harbour for the Hunter River. I refrain from referring too particularly to that sea trip. Many persons in those days were well acquainted with the s.s. Rose, Thistle and Shamrock, and my own experiences were like those of others. We passed in under Nobby's in the early morning, steamed steadily up the Hunter River, and were glad to be put ashore at about 11 a.m., at Raymond Terrace, where we spent the rest of the day. Fairly early next morning we got away from the hotel, and started for Stroud, 34 miles distant. This was not much of a day's journey, and the country was comparatively uninteresting; the road was unmade and dusty, and very few settlers had attempted to make homes within sight of it. So we plodded along until about noon we arrived at a house of refreshment! We were served with bread, salt beef, and tea; our horses found some indifferent hay in the stables. After an hour or so had been spent here, we jogged along again, and before sunset arrived at the prettily situated township called Stroud, which is part of the freehold estate of the Australian Agricultural Company. This Company is a rich one. It had a capital of £1,000,000 to start with in 1825, and the Government granted it, in fee-simple, an acre of land for each £1 of its capital. A number of the Company's principal officials lived at Stroud, and there were a few other residents there. But it was not a populous place by any means, and our evening was quiet and uneventful. A glance at the map of New South Wales will show that Stroud is not a very great distance from Port Stephens.

My companion was Mr. Frederic Morton, the managing partner in Waterloo Station, recently purchased from Captain Thornton. He was a capital fellow, and the spring mornings were lovely. We brought up our horses from the dewy paddock, saddled up, and after a modest breakfast, got away for Gloucester, about 30 miles distant. The signs of settlement were fewer this day than the previous one, but the country was more interesting, and not quite so flat. The birds, too, were more numerous and cheerful. Bell-birds and coach-whips whistled to us from the brushy-banked creeks, and a number of others greeted us pleasantly as our presence became known to them. We rested this day for lunch at a point where the Stroud-Gloucester and the Dungog-Gloucester roads unite, and were supplied with a very good meal of very homely fare, all of which, to a youngster just from school like myself, was delightful. That Dungog road I travelled several times in after years, and rough enough it was; and the Williams River, on which Dungog is situated, I have found more than disagreeable when it has been in flood; but this is a digression. After the pangs of hunger had been appeased, we started again on our journey, arriving at Gloucester before sunset. In the Art Gallery at Sydney, there is a fine picture in water-colours, by Conrad Martens, of what I think he calls "The Crags." These picturesque rock-crowned mountains are a mile or so from Lavers' accommodation house, the Gloucester River, and an open alluvial flat almost filling up the intervening space. At all times the view of the hills, but especially at sunset, by moonlight, and in the early morning, is very beautiful from the front veranda. At the period I write of, the population of Gloucester was extremely limited, for it, too, belonged to the A. A. Company, and the directors did not part with their land for a trifle.

The next day's journey was more interesting in many respects. Shortly after starting we crossed the Gloucester River, a small stream except in time of flood. About 12 miles further on we crossed the Barrington, which runs swiftly, and in flood is a source of great danger. After crossing it we followed the road through the paddocks, in which were then pastured the pure-bred Durham cows, for the increase from which the Company obtained very substantial prices. These were in charge of Mr. Clarke, and his house was the only dwelling-place between Gloucester and Giro, our next halting place. Soon after leaving the pure-breds' paddocks we crossed the Manning River. From this point onwards high ranges closed in upon the road, and these added largely to the beauty of the otherwise picturesque scenery. In the 32 miles traversed that day we had twenty-eight river crossings, and were not sorry when, about sunset, we sighted the Giro accommodation house—a lonely dwelling beside the Barnard River. The road we had travelled was, comparatively speaking, a new one. A few years later I had occasion to travel by the same route from the Tableland to the coast. This was in 1857, the year that was for a long time known as the "big flood" year in the Hunter River; the year in which the Dunbar was wrecked on the rocks under the Gap, near the South Head of Port Jackson. In the shady spots in the high land of New England, patches of snow were still unmelted a fortnight after the storm, this at an altitude of about 3,500 feet. Branches of trees littered the roads everywhere; branches broken off by the weight of snow which had hung upon them. On that occasion I found two friends at Giro who had been detained by the floods. We waited another day there, and then took the Company's old mule track along the sides and over the spurs of the mountain ranges, thus avoiding the worst of the river crossings. This track was exceedingly rough and stony, but we were assured that it was smooth compared with the track which was first in use. Along the streams there were great numbers of river oaks. Hundreds of these had been laid flat by the flood waters, and in places the crossings were so blocked by them that we had to cut our way through them with an axe which we carried with us for that purpose. We reached Gloucester that evening, long after dark, but without mishap.

Little had been done to improve the grazing capabilities of the country in those days. In 1876 I travelled from New England and back by the same route. It was known as the Port Stephens' road, and up to that year, on Giro alone, 94,000 acres, I was told, had been ringbarked !

Early in the morning, on my first trip, we went out after our horses, which, as there was no paddock, we had hobbled. We got away in good time, however, and in a couple of hours were at the foot of Hungry Hill, the rough place of the journey. I had been told that Hungry Hill was very steep and very rough, but was not prepared for the reality. We rode up the lower part of the hill ; then we dismounted, and led our horses, which, like ourselves, were not reluctant to have a few minutes' breathing time at frequent intervals. The road was a mere bush track, covered with loose stones, and the ascent occupied nearly two hours. Some money was spent upon it by the Government a few years later, and the first to drive down in a dogcart and back again was "Tom" Rusden, who, for many years was in charge of Frederick Huth's station, Europambela. Some others afterwards risked martyrdom by driving over this villainous road, which was not much better when I last travelled over it in 1876 than when I became acquainted with it in 1852.

My friend and I were not sorry to rest awhile after our long scramble. We were now more that 3,000 feet above the sea, and the air was clear and bracing. The spot we rested at was remarkable because of two tall gum trees into the butts of which hollows had been worn by fire and decay. These formed basin-like aquariums, each containing two or three quarts of cool water. This was quite clear, and moss-grown round the sides, and in all directions the footpads of marsupials and other animals radiated from the water-trees. After a time we moved on through large gum trees and stringy-barks, with more or less underbush. Where the outlook was sufficiently clear, we looked across immense mountain spurs thickly clothed with ordinary forest timber, and down into the valley of the Manning. Soon we came to "Hell-gate," the fancy name of a deeply-channelled creek, in the bed of which there is a stream of water as cool as its title is hot. It was past noon when we arrived at Nowendoc (18 miles), another of the A. A. Company's stations, the stockman in charge of which slightly augmented his ordinary allowance by keeping a house of accommodation; and here we made a modest lunch of salt beef and bread, with the addition of some very good vegetables grown on the place. As we rode onwards in the afternoon, it was not hard to realise that we were on the Tableland of New England. Beside Nowendoc's boggy creek was a narrow flat, while a little to the left was a spur of the range covered with immense stringy-barks; and between us and them were hundreds of well-grown tree-ferns, standing so closely together that the ends of their fronds, in many cases, met. For some miles we rode through the stringy-barks, under tall trees which deserve to be called "giants of the forest," through a tangle of undergrowth and fallen logs which skirted the road on either side. Here it was sheltered and warm, but no sooner had we made our way to the open country, than the chillness made itself perceptible.

That night we put up at Murphy's accommodation house, and enjoyed a good fire and an abundance of plain food. Murphy, however, was not a careless, go-as-you-please man. He was very well known throughout the district, for nobody could produce better potatoes than old Murphy, who claimed that he had raised them from seed, and thus obtained a special potato. Be that as it may, the fame of those potatoes spread, and the sale of seed potatoes became to him a source of considerable income. I shall never forget the pride with which he pointed to the slabs which formed the walls and floor of his dwelling, the whole of them from a couple of trees, he assured us. At any rate, they indicated the size of those trees on the stringy-bark ranges, for many of them were over twenty inches in breadth. Rough in his ways was Murphy, but he always gave good value for the money paid him by travellers, and however cold the night, there was always a warm corner by the fireside, and a snug bed for his visitors.

Our journey next day was an easy one, some twenty miles, or thereabouts, to Tia station, the hospitable abode of William Denne, one of the early settlers in that part of the district. Two brothers, William and Richard Denne, were men of Kent. They came to Australia when young fellows, bringing with them what money they had, and hoping to secure more. At first they tried farming at Campbelltown, about 30 miles from Sydney; but there was not much money to be made at that business, and the accounts that reached them of New England attracted and settled them there. They owned, besides the Tia station, Trinchy, on Liverpool Plains, and Coopracurrapa, below the range on a tributary of the Manning River. Eminently practical both of them, and especially kind and helpful to young fellows like myself. About fourteen miles eastward from Tia, on the road to Port Macquarie, was the Yarrowich station; this was then owned by Todd and Fenwick, who, however, divided it about that time, each taking one side of the Yarrowich Creek, which ran through the run. I believe Arthur Hodgson first owned it. Beyond this point came the rapid fall by an extremely rough road to the aforenamed port. Our road, however, turned in the opposite direction, and after spending a very pleasant night with William Denne, and making the acquaintance of Dr. Adams, an old identity who occupied a cottage close by, we moved onwards. A visit to William Denne's garden was really refreshing. No fruit were ripe at the time, September. Indeed, a very heavy fall of snow had melted only a short time before, but there was promise of a rich harvest in another two or three months. Apples, pears, peaches, plums, cherries, gooseberries, raspberries, currants, were all well represented, and there was a thriving young walnut tree, nuts from which I gathered more than thirty years afterwards.

Three miles from Tia station we came to Tiara, a wretchedly tumble-down and neglected place owned by Patrick and Sandy McNab. Within a year it was in the market, and my partners and I secured it. We then owned Waterloo, the next adjoining station, having purchased it from Captain Thornton. And at Waterloo, twelve miles distant, we arrived in time for lunch. Here I had my home for five years, and during that time I made the acquaintance of the squatters and others in the neighbourhood. The Waterloo station-house, a small shingled building, containing four rooms, with a narrow passage through the centre, and having an aspiring porch in front, was placed on a rather steep hillside, overlooking the Apsley River. The floor at the back entrance was only a few inches from the ground, while at the front it was raised about four feet. A number of logs had been rolled into the space beneath, and these formed a snug retreat for snakes and native cats, and not infrequently a death took place in the happy family. We always knew when a misfortune of this kind had befallen us. The first owner, who designed and built the house, regarded it as an architectural triumph!

Five miles west of Waterloo was the Europeambela station, owned by Frederick Huth, and managed by "Tom" Rusden. Three miles on, in the same direction, Abraham Nivison lived, at Ohio; and two miles further on was the small township of Walcha. Caldwell kept the only inn there; Daniels, I think, the only store. There was also a blacksmith's shop, and a few cottages were scattered round. Walcha was at that time what is commonly described as a one-horse place. A little later on Livingstone moved his store from the Europambela road into the little town, and other stores and hotels were opened; also, a flour mill beside a large, dark, bunyip-inhabited waterhole in the Apsley. A mile from the township Mr. and Mrs. Jamieson lived, at "Walcha Villa," and with them Mrs. Smith, a widowed sister of Mr. Jamieson. This gentleman's name calls to mind an incident which created a large amount of interest throughout the pastoral districts. The sheep he owned suffered more or less from scab—generally more—and his neighbours, Rusden in particular, complained greatly of the disease being communicated to their flocks, through intermixing on the run boundaries. At the time to which I refer, I think early in 1853, Europambela was "clean," all scabby sheep having been boiled down not many months earlier. One morning at Waterloo, my friend Morton and I had gone, after breakfast, to the folding-ground at the back of the house. Sheep then were kept in hurdle-yards at night. The flock had been taken out about an hour earlier, but just then the shepherd came back in a breathless condition, exclaiming in gasps, "Here's scab—in all its purity!" Then we had a consultation. One of Jamieson's shepherds had been lost two days before; but he stuck to his scabby flock, and followed them without knowing where he was going. Our shepherd met him near our boundary with Europambela, but the scabby sheep had not crossed it. When he heard the lost man's tale, our shepherd turned both flocks back, our own homewards, Jamieson's along the road to Walcha. I, fortunately, was out of what followed. "I want you to go to a sheep-station up the river, and then on to Walcha with letters; but say nothing about these sheep to anyone." So said Morton to me. He hastily put up some food, and we saddled up. Morton took the food to the shepherd whose want of bush knowledge had led to so much mischief, and he cautioned the man that he must not take his flock any further. He must wait where he was until some of them returned to him. Then he galloped on to Europambela, and, Rusden being away from home, he used his persuasive powers upon the overseer, Saunders. "You see," he argued, "Jamieson's sheep are on your run, and if you allow them to come on, they will convey the disease to your principal flocks. They must be killed where they are, and I will help you, because, although they were not on the Waterloo run, my shepherd turned them back. So hurry up, and let us to the slaughter." That afternoon, as I returned from my visit to the township, a wonderful sight met my view. "Blackfellow's Gully" was an open flat and very boggy. There about eight reckless men had rounded up Jamieson's scabby flock, and by the time I returned, their bludgeons had done their work. About 1,200 sheep lay dead on what afterwards came to be known as the "field of Waterloo!"

Having completed their task, Moreton sent a letter to Jamieson, telling him what had happened, and suggesting to him, quite in a friendly way, that he might bring some men over and skin the sheep if he cared to save their pelts! This Jamieson did on the following day. Being young at the time, I almost regretted that I had not had my share in the slaughter; but the sight of so many sheep lying dead in heaps was a ghastly one, and I soon became reconciled to having been absent. A few days later I became satisfied that it was wise to abstain from joining in jobs of this character. I was busy over something in my room after breakfast, when my friend Morton came in with a scared expression in his face. I had heard voices outside, and now came the explanation. "Here's a pretty go," said my friend; "a policeman has come with a warrant, and he is going to take me and those Europambela fellows to Armidale and put us in the lock-up. But he has promised that he will not put the handcuffs on me if I go with him quietly!" So he put a few things in his valise, and rode off with the policeman, and he and the other killers of sheep were safely escorted to the lock-up. The magistrates were kind to them, and took their case into consideration at once, and they were allowed out on bail, after having been committed to stand their trial in Maitland for illegally killing Jamieson's sheep: All the gloss of the affair had worn off by this time. The payment of £600 compensation did not put an end to the proceedings in the Criminal Court; but Judge and jury were considerate, and as Jamieson had been paid full value for his flock, and no malicious motives could be attributed to the breakers of the law, they were acquitted. It was this incident which soon afterwards led to the passing of laws which specially dealt with the disease in sheep commonly called "scab." But Morton and his companions always declared they would, in future, leave experiments of that sort to any other fellows who liked to break the monotony of bush life by administering the law according to their own ideas of right and wrong.

A number of pastoralists were settled within a few miles of each other in this part of the New England district. Southwards from Walcha, Herbert Salwey occupied St. Leonards. He was the first to lay down clover in paddocks in that district. Near him was John Fletcher, at Branga. Then Morrison, the McIvors, Wilson, and Girard. A little more westerly and northerly, old John Scott and his hospitable helpmate, at Surveyor's Creek, not far from Bendemeer, on the Macdonald River. Bendemeer station was occupied by Perry. Buchanan was settled a few miles up stream. At Carlile's Gully there was a roadside hotel, on the main road to Armidale. The Bells lived at Bergen-op-Zoom, close to Walcha. Not far from them, the Eliotts, at Emu Creek; the Crawfords, at Moona Plain; Mrs. Richards (afterward Wenner), at Winterbourne; Star, at Mihi Creek, near Armidale. Then there were, not far from Armidale, Gostwych, owned by the Dangars (Arthur Hunter Palmer, manager); Salisbury Court, owned by Matthew Henry Marsh; Terrible Vale, by Taylor. The road from Armidale to Salisbury struck the Great Northern Road from Maitland at Uralla township. So gradual was the decline from the summit of the Dividing Range just here, that by a drain a few feet deep, the water of a swamp on the eastern side was led through into the Rocky River, on the western side. This was cut through by the goldminers at a later date than 1853.

I do not propose to describe the stations and their occupants with whom I came less in contact. Of those I have named, my friend Morton came to Queensland, and settled the Prairie run, west of Gladstone. In 1853, William Miles, who had been overseer at Bergen-op-Zoom, for Boulton and Bell, moved north, and settled at Dulacca. He afterwards became a member of Parliament, and served as a Minister more than once. Gilbert Eliott, who owned Emu Creek, took up or bought Yenda, near Gayndah. He was the first speaker of the Queensland Legislative Assembly. A grandson of his is a highly respected officer in the Harbours Department at the present time. Palmer became the owner of stations north of Rockhampton. He entered Parliament, and, by force of character, made a prominent place for himself. He was for some years Premier, was a member of more than one Ministry, and ended his days as Sir A. H. Palmer, President of the Legislative Council. Many of my contemporaries on New England pushed north, preferring the heat of Queensland to the frost and snow of what has often been described as the "Garden of New South Wales." One to whom I have made no reference was the once owner of a station not many miles distant from Armidale, and afterwards came to Queensland. Captain O'Connell for a time, resided at Gayndah. Thence he moved to Gladstone, where he held the appointment of Government Resident, until the northern districts of New South Wales were excised, and the new Colony of Queensland was established. He was then summoned to the Legislative Council, and succeeded Sir Charles Nicholson as President, which office he held, under his new title of Sir Charles Maurice O'Connell, until his death. His honoured widow still lives amongst us. As for myself, when I was seized by the roving spirit, as so many of my friends had been, I wandered through many parts of the parent colony, gravitating finally towards what is now the State of Queensland. And even now the association with my first bush home is maintained by the many names with which I was familiar there as I now am here.

Space does not permit of further reference to the New England district and its many points of interest. I will only now briefly allude to the extraordinary formation on its eastern side. Along this, by some extraordinary convulsion which I am unable to explain, there are immense fissures, several hundred feet in depth. One of these terminated abruptly about three miles from Waterloo, where I lived for five years. The Apsley River is one of the heads of the Macleay, which finds its way to the sea at Trial Bay. Until, and for a few miles after it passes Waterloo, it runs through pleasant undulating country, and a stranger following its course would never suspect the surprise which was in store for him. Suddeny it drops into a great fissure the depth of which I cannot now remember, and forms a magnificent waterfall. It then drains down the gorge, and in the sharp bend below the first fall there is another deep perpendicular drop. From this point the gorge gradually widens and the hillsides slope into it very sharply. Every creek from each side empties by a series of cascades and sudden drops into the gorge. Some of these are most picturesque, notably that where the ever-running Tia River rushes down like a silver thread to a depth of probably more than 2,000 feet. And now I must end this part with a recommendation to those of my friends who would become acquainted with the beauty of Australian scenery, to take the earliest opportunity of visiting the Gostwych Falls, near Armidale, and the Apsley Falls, near Walcha.

PART II.

(Read before the Royal Society of Queensland, 21st June, 1902).

In a paper which I had the honour of reading before the members of the Royal Society some weeks ago, I briefly described my first trip to the New England district in 1852 and the settlers with whom I became acquainted in their bush homes. Of these I write now, as I have always thought of them, in terms of commendation and appreciation. Those who were the first to occupy the country had many and serious difficulties to contend against. They were by no means free from dangers of attacks by the blacks, but this is a subject I have no desire to enlarge upon ; I never took part in any place in the scrimmages, to use a mild term, of which I have heard very much, and it gives me only pain to recall the scenes which others have described to me. Such incidents I trust will never be repeated in any part of Australia. When I first went to New England the dark chapter had been closed in that district, and the blacks who remained went to and from station to station without let or hindrance. At that time, however, two great difficultes were ever present—that of obtaining the labour which was required to carry on the station work, and the supplying of rations and other necessaries of life to the persons who lived on stations. The goldfields had attracted most of the men who had been employed as shepherds, &c., and there were few of us who had not to tend the flocks ourselves and to do all other kinds of work when the occasion demanded it. Still we must have food and clothing; wool bales and all implements which were wanted for station work had to be obtained from the coast, and the roads were in no case good, in many very bad indeed. Before turning my attention northwards, I will briefly refer to some of these. I have written enough already about the Port Stephens road, which at that time was quite unfit for ordinary wheel traffic, and the road to Port Macquarie which was extremely rough and consequently was little used.

Our best traffic road to the coast was the Great Northern, which connected Morpeth and Maitland on the Hunter River with Armidale, and thence led to the more northerly towns. All the carriage of rations and stores was conducted by means of bullock-drays, and these were sometimes occupied for three months or even more on the trip to and from the Hunter. From the station on which I resided we had to send our drays by Walcha and Terrible Vale station to get onto the Great Northern Road a few miles south of Uralla township. They then travelled by Carlisle's Gully, Bendemeer on the Macdonald River, and over the Moonby Range by an exceedingly rough track onto the lower country near Tamworth. Thence they followed a course at no great distance from the present Great Northern Railway Line to Maitland. Not much of the track had even been formed, and in wet weather the drays often went down to their axles in the soft sticky clay. Most of the country from Uralla to Moonby is granity, and this becomes specially boggy in wet weather; but by sticking to the track which was generally used, and the surface of which was trampled into a fairly hard crust, there was some chance of getting along. The sticky red soil of the ridgy country was perhaps the most difficult to get through. On one occasion, when I was taking sheep from New England to Lake George, we lost our draft bullocks from our camp at the Clay Waterholes, about ten miles south of Tamworth. Fortunately for us, the pastoralists had plenty of room for stock on their runs, and they left us in peace with our 8,000 sheep while for a fortnight the bullock-driver and I scoured the country in search of the vagrants. We rode separately over a wide area of country, and took it in turn to camp out, so that there was never more than one absent from the sheep at night. I found the rascals one evening when the driver was camping out, and yoking them up disposed of them comfortably for the night by chaining them to one tree in front of the leaders, and to another behind the polers. I was bullock-driver next day and then learnt something of the sticky nature of the red soil. The clay fairly blocked up the spaces between the spokes when I came to the ridgy country, until the eight bullocks could not drag the dray. Seven or eight times in a mile I had to clear the spokes with a spade, and when I got to camp that afternoon I felt I had done my duty. This was the class of country over which our wool drays had to travel to port and return with rations; no wonder some persons tried to introduce an easier method.

At Clerkness, on the Bundarra River, there lived an enterprising gentleman named Clerk. He could not rest content with the bullock dray system and busied his mind in the effort to provide something better, and he made a name for himself which will long be remembered by his friends and neighbours. He went to England, and there, no doubt, took counsel with engineers of repute whose assistance he needed. The result was a steam engine, which could not only be used for grinding grain, cutting timber, &c., but it was also designed to do the work of a traction engine, and its great recommendation was that as it moved along a road, by a skilful mechanical contrivance it laid down a succession of iron shoes in front of the wheels. These revolved with the wheels, which thus passed over an endless iron way and were saved from sinking into the all too yielding bush roads. At least that was the intention of the inventor. The "Megaethon" was the name given to this new and promising contrivance. If I remember rightly, it was tested at Sydney with some success. But most of us know the difference between the well formed blue-metalled roads of a city and the soft clay tracks of the bush. In due time the Megaethon commenced its journey. The mechanical contrivances by which its movements were directed and controlled were good enough, but under the weight of the engine the iron shoes sunk into the clay, and after many efforts to get it along the owner had reluctantly to admit that his great invention was not equal to the work for which it was designed. It was intended that this should displace the dray and working bullocks; but, ah! the irony of fate! After months of detention on the road, it was at last drawn to its destination by a double team consisting of eight and twenty strong working bullocks. In 1859 I had occasion to visit Clerkness, and there I discovered the Megaethon peacefully cutting timber like any ordinary sawmill. After all, then, the bullock dray maintained its position, and several years went by before draught horses began to replace the bullocks. Indeed, anyone who knew much of the roads which were then in use quite understood the reason of this.

In 1853 our managing partner decided to send a flock of about a thousand fat sheep to Sydney. Boy as I was at the time, and inexperienced withal—I had left school only a few months before —I was to take charge of them and to have two men to assist me. One of these was called the shepherd, the other cook and watchman. None of us knew these men ; but labour was scarce in those days, and men were worth money. We could not raise a dog amongst us. None of us, I fancy, knew anything of the road we were to travel. Some time in March we got away from the station. The manager accompanied us that day, and camped with us at night. On the following day he went with us until we had passed Walcha. I do not know that he had ever travelled with sheep, but during this day and a-half he had been instructing me in the art ; then he left us and returned home. Mr. Wilson's Aberbaldie station was the first we passed, McIvor's Inglebar the next. Thence we proceeded by this short-cut of which we knew nothing ; but we were making for the Hanging Rock diggings, and we were then to go on by a track over Crawney Mountain, to descend onto the Isis River, and follow it down until we reached the town of Aberdeen, on the Hunter. We did not follow the highroad down the Hunter, but diverged to the right passing through Patrick's Plains, then made across to Cobcroft's and Parnell's stations, took the stock route across the Bulgar Mountain, crossed the Colo River, and over more barren mountains until we reached the Hawkesbury, at a point nearly opposite Windsor.

Soon after we passed Inglebar, the road, such as it was, led us into a dense stringy-bark forest. I had never seen such a quantity of magnificent timber trees. In the rich volcanic soil, constantly moistened by abundant showers in the summer and by sleet and snow in the winter, they thrived amazingly, and being closely packed together they grew to an immense height. Between the butts of the trees there was a tangled mass of undergrowth, and numbers of the fallen giants of the forest, lying here there and everywhere, formed an almost impassable barrier. The track we followed was about eight feet in width ; from this the trees had been removed, but in many cases the stumps had been left *in situ* ; a few wheel tracks however showed that it was sometimes used for vehicular traffic. Slowly enough we progressed for several miles, never by any chance catching sight of a human being. By and by the country opened out somewhat, and we found a camping place for the night. It was an odd sort of road for taking fat stock. After this we followed on through some rough, stony ranges, and at last sighted the Hanging Rock diggings. And what a wild place this was. A few hastily constructed timber stores and shanties and very many dirty looking tents. I had little time for looking about me here though. Neither of my men had any money but the faintest smell of liquor affected them very quickly. We had to cross a deep gully, then climb a steep hillside through the township. I never understood how I got those men along on that occasion ; they never lost another opportunity of getting *very* drunk. We surmounted the hill at last and looked down a much steeper and more stony decline. As we descended I had to pick my way too cautiously to watch the men. I slipped and fell two or three times and carried some bruises with me for several days. This road I concluded was used only for carriage purposes by pack animals or skids. I think it was on the following day that we got to Crawney Mountain. The road here had become a sort of goat track leading along the steep mountain side. Somebody—I cannot remember his name—had a station hereabouts. I always think of him with gratitude, however, for he gave us a supply of good fresh beef for which I paid him. In the evening we formed our camp beside the river Isis whose bright and sparkling water drains down the buttress spurs of the New England ranges. The track we had followed was extremely picturesque, but I never attempted it after that trip. On a later occasion I tried a shortcut to a station on the Peel River below Tamworth. That time I took the road from Walcha by Surveyor's Creek, the home of good old John and Mrs. Scott, their daughter Agnes and their son John, to Bendemeer. After a good homely lunch with these hospitable friends young John started me on the right track, but he warned me it was almost impossible for anyone to follow who had not been over it before. His warning was justified by the event, for by taking the likeliest-looking of two tracks, some time in the afternoon, I was led four or five miles out of my way and into an exceptionally rough and stony piece of country on the Macdonald River, above Bendemeer. However, I got away from the stones without laming my horse, and reached the hotel about sunset. Next morning I took the road towards Tamworth, but before reaching the top of the Moonby range turned into a bridle track to the right as directed. Such a weird country it was too. The track was easy to follow; its course was along the crown of a very steep spur, on either side of which the hillside sloped so precipitously that no other track could be formed. Big trees and monster granite rocks are abundant all over the Moonby, not a few enormous boulders sitting securely on small stones not larger than a good-sized chair. There is something fascinating about these lonely wilderness ranges, but to make a practicable road through them would cost many thousands of pounds.

Turning northwards we find equally broken and steep ranges dividing the western and more level country from the coast; indeed the mountain range which forms the eastern boundary of the New England district is a part of the main range of the country. In different places rough bridle tracks had been formed by settlers whose business took them coastwise on their sure-footed mountain horses. These, however, are notes of travel, not descriptions of places with which I have no personal acquaintance, and I will pass over the tracks which I never followed as well as those which have been made at more or less cost in later years. A few months after I arrived on New England I made my first visit to Armidale, and the trip was to me perhaps more full of interest because the manner of it was free from any any shadow of conventionality. I went with our dray in the capacity of bullock-driver's offsider. At that time we grew wheat at each station and had it ground at the nearest mill. This arrangement arose out of the difficulty of carriage and the frequent depreciation of flour through its becoming damp during the long trips of drays from the coast. When John Robertson's Land Act, with its free selection provisions, came into operation, enough settlers took up land in the district to supply our wants in this respect. However, having loaded up with wheat, we started off one morning on our thirty-mile trip, I riding a quiet old horse who quite understood that his business was to stand anywhere he was left until he was wanted, and at night he must never take the horse-bell he then wore beyond our hearing from the camp. My business was to keep within hail of the dray, in case I should be wanted. And so during the three days we spent between the station and Armidale I wandered about after the fashion of boys amongst the magpies and gillbirds, rosella and lory parrots, poked up ringtail possums in their snug bark nests, and kangaroo rats in their warm grass-made snuggeries. We boiled our quart-pots at a rippling stream at midday, and drank our green hysonskin tea, sweetened with the brownest of brown sugar, and thoroughly enjoyed it, as we also enjoyed our cold boiled beef and damper made in the old fashion—flour mixed with water and a flavouring of salt, and baked in the ashes where the fire had been hottest. We passed Emu Creek station, where lived the sons of Queensland's first Speaker, six miles from our starting point, and Mihi Creek, owned by Starr, about a dozen miles further on, but we made our camp at night far from these the only inhabited spots on the journey. At break of day I caught the old nag and went off for the bullocks whose bells generally indicated their whereabouts, and brought them in to the camp; then, a splash in the creek, a hearty breakfast, and once more we started on our journey. We brought up in front of the mill on the third day in time to unload the dray; then drawing away forty or fifty yards, we formed our camp between Kirkman's mill and John Trim's store. Armidale was a funny little place at that time. John Trim was an institution, the first storekeeper there, I think. Allingham ran another flourmill; Gilchrist, Danger and Co. another store. I can call to mind a couple of hotels and a limited number of other small business places and dwellings. Dr. Markham was the resident doctor. It was the Armidale of to-day in its childhood. On the afternoon of the second day we loaded up the flour and bran in time to get clear of the township before camping. We were anxiously looked for at the station, and the bullock-driver intended that there should be no unnecessary delay. He was a fine fellow, standing 6ft. 2in. in his boots, and straight as an arrow; an old gipsy, it was said, who had done some poaching and came to New South Wales in consequence. Be that as it may, he was a splendid servant and honest in every respect.

I did not become further acquainted with the Northern part of New England until 1858. Early in that year I had gone from Sydney to Grafton in the s.s. Grafton, having arranged to travel from the Clarence River with cattle to Victoria. I may here perhaps digress briefly from the subject of this paper, as so many changes in the condition of that river and its most important town must have taken place since the time I write of. Very little settlement had been effected along the banks of the river, and by far the greater part of its fine alluvial flats were covered with the original vine scrubs, and the cattle which took shelter in them were wild and troublesome. At the Devil's Elbow was a new township, St. Lawrence, about midway between the bar and Grafton. The "Devil," I fancy, has since been put out of sight, and the place is spoken of simply as "The Elbow." I have no doubt that he retains his place in the memory, if not in the affection, of the original settlers. At the time I speak of he presided over a small wharf and store, a public house, and a very limited number of other buildings. We arrived at Grafton at about 4 p.m. I find the place thus described in my notes—"A small township and very much scattered. The principal side is the North, where the post office and court house are situated." My recollection of the place does not bring before me many of the buildings. I put up at an inn near the wharf where the steamer lay; I cannot recall any other. There was a store kept by Lardner, another by Shoveller. I recollect a Church of England at which the Rev. Mr. Selwyn officiated. Mr. Greaves, the Government surveyor, lived in a cottage of his own in a clearing in the scrub. I suspect the spot now is well in the town. There were a few tradesmen's shops and a number of cottages, some of which had very pretty gardens. Captain Marsh, late owner of Camira Station, occupied one of these. On the lower side of the town there was a great deal of scrub, and in it the finest specimen of Moreton Bay fig I have ever seen; its roots above the surface of the soil were said to cover more than two acres. Thousands of cape gooseberry plants grew on the river flats, where these were moderately free from scrub. On a creek a mile or two from the town stood Kirchner and Co. soap and candle works, and there was a boiling down establishment not far from these. I forget the name of the gentleman—I think he was a Frenchman—who had started a sugar farm; he intended making the sugar from sorghum, but I never heard that he succeeded. So much can I remember of the north side, the site of the more important part of the township. I made Mr. Joseph Sharpe's station, four miles up the river, my head quarters while I was in the district at that time, and again a year later; Mr. Gale was the manager.

Before the cattle were ready for us to start I crossed one day to South Grafton having to ride up the road thence towards Armidale for a couple of horses which, if we could get them, we were to take with the cattle. I crossed the lovely Clarence River in a boat and landed amongst the few buildings in the South Grafton township. A Mr. Bawden kindly supplied me with a saddle-horse to go as far as Mr. Aitken's station. There I borrowed another and got that evening to Nimboyda station, having crossed the Oorara River a few miles back. Mr. Therold, the manager, like all others in the district, was most hospitable. My journey from South Grafton that day covered only 23 miles. On the following morning the river was in flood, and as it was an uninviting, swift-running stream, I waited until the afternoon, and at 4 p.m. started on with the post-boy. Of course there was a Big Hill to surmount; every road from the coast to New England has its big hill, so big that most men walk and lead their horses to the top. We did this, and rain drenched us as we did so. The road for some distance followed the saddle of a mountain spur, appropriately called the Razorback. Some distance down one of the steep slopes of the hill, a large boiler lay against two or three trees; this was being taken with the machinery for a mill which was to be erected somewhere up the road, but the driver had a difficulty with his bullocks and the dray on which was the boiler overturned. The boiler remained as a warning to the bullock-drivers of the future, for it was impossible to bring it to the top of the spur again. We travelled only 13 miles from Nimboyda to Peter Shea's inn, but we did not reach the latter place until late at night. On the following day I rode another 13 miles to Parrott's, having crossed Blake's River on the way. This stream is—or was—the boundary dividing the Clarence district from that of New England. Here then I was again in the latter district, and the country was similar to much more on the eastern slopes; splendid red volcanic soil, and giant stringy-barks of great height and girth, and enough of them to build a city; around their butts a confusion of fallen logs, burnt-out stump holes, and luxuriant undergrowth, and an abundance of green wattle in the less thickly timbered spaces. Here I was supposed to pick up one of the horses of which I had come in search, but the animal had got away with a wild mob, in running which in such country it would be easy to cripple two or three others. We tried that day and two others to run her in, the only result being the knocking-up of Parrott's own horse on the third day. Then I again turned northwards, had dinner with Peter Shea at his inn on Cloud's Creek, secured the other horse, and arrived at Nimboyda the same afternoon. After all my trouble the old horse I had secured at Shea's knocked up on the following day, and I did not get him to Aikin's until evening. I had to leave him there, and got back to Retreat the following day in good time.

The time had now arrived for starting with the cattle. They had been collected at one of Mr. Sharpe's stations, named Southgate, and this we left on 8th April, passing the Travellers' Rest Hotel (a bush pub), Camira station, which the McDougalls had just bought from Captain Marsh, and Hamilton's station Wyan, part of which is in the Clarence River district, part in the Richmond. The second day from Wyan we crossed the big hill of the neighbourhood. This was the Richmond River Range. A few miles on we came to Sandilands, the property of Robertson Brothers, who sold out to their sister, Mrs. Robertson, a year or two later on, and established themselves on Baffle Creek, a little north of Bundaberg. The next station, Tabulam, was occupied by Mrs. Chauvel and her son, who afterwards moved northwards to Canning Downs South From here we crossed over Grasstree Hill to Fairfield, where was another roadside inn. Now we were drawing near to New England once more and rough roads marked the approach. Girard's Downfall suggests the rugged bush track. After this we followed the old road across another big hill. A road party under Mr. Yates, who afterwards came to Queensland and made roads for our Government, were working on the new road over the Great Sandy Range, and we were not allowed to drive cattle over it as the cuttings and embankments, all through rough granite, had not settled down. We got over the range, however, and camped on Black Snake Creek, on New England. We were now near Barney Downs, then owned and occupied by John Ross. It afterwards passed through several hands, and the freehold was eventually bought by C. B. Dutton, the Georgian apostle, who in our own State in 1883-4 advocated the nationalisation of land.

Tenterfield is but 5 miles from Barney Downs. It was a village rather than a township at that time. Cowper and Riley were interested in the Tenterfield station, and Stuart Donaldson, the old Sydney politician, was also a partner. We had with us droving the cattle the son of an English parson who could recite Moore, Byron, and other poets by the hour, and often helped to entertain the camp on a dull evening; but in the more practical walks of life he had not achieved greatness when I last heard of him. Still his name, I am told, was never forgotten at Tenterfield station, where, when he first came to Australia, he was sent to take charge of the station store. After he had been there for a time, so the story runs, the stockman and other hands being exceptionally busy, they ran short of beef. What was to be done? "Oh, bother it, we can manage well enough. Let Podmore get in an old cow from the milker's mob; he will get on all right." The new chum was thus placed in a position of greater responsibility than usual. It was late when the other hands came home, and the first question was: "Well, Podmore, how did you manage? Did you get a good beast to kill?" "Oh yes," he answered proudly, "a splendid fat cow," and he described the animal. It was Donaldson's imported Shorthorn cow, the only imported animal on the station.

From Tenterfield to Bolivia there was not then a dwelling place in sight of the road. For nearly all the distance the track is ridgy and sandy. The only notable places on the way were the Bluff Mountain and the Mole River, now more often spoken of as the Bluff River; the large holes in it are said to give shelter to fine Murray River codfish. I never saw any there, but like other New England streams it is the resort of the duck-billed platypus. Of the Bluff Mountain there is a tale of black hunting and slaughter by the white settlers. Some people say they believe it. In my own opinion, if there is any foundation of truth in it, a grossly exaggerated story has been built up from very little. Near Bolivia we found ourselves confronted with another of the big hills. The cattle scrambled over the rough and shifting granite rocks, a number of them getting lamed; the dray was dragged up somehow. Mr. Irby lived at and owned Bolivia station, and continued to do so for many years afterwards. The next station on the road was Deepwater, owned by the Windeyers. Vegetable Creek had no history at that time. After leaving Deepwater we next came to a very little township called Dundee; there was a flour mill there, but only half-a-dozen houses. What is called the Newton Boyd Road branches eastward from Dundee and descends the range to Grafton. I never travelled by it, but in 1858 it was notoriously rough. Since that time the Government of

New South Wales have converted it into a coach road at a cost of many thousand pounds. After Dundee we passed the Yarrowford Station. It is there no longer, nor are its then owners, the Radford Brothers They came to Queensland and for a time settled at Princhester, near Rockhampton ; later on the younger brother obtained a parliamentary appointment and for some years he has filled the dignified office of Clerk of the Parliaments in this State. Next came the small township of Glen Innes, the Demerique's Station, Farakabad, in close proximity. No selectors' cottages marked the distances along the route, no large sheep paddocks, no ringbarked country, but white-stemmed gumtrees, rough barked bastard box, and silver-leafed peppermints with an occasional intervening patch of green wattle, an uninviting shepherd's hut and sheep yards, and here and there a shepherd with his dogs dragging himself along lazily after his flock.

After leaving Glen Innes we skirted the Beardie Plain as the railway does now, passed through the granite rocks of Stonehenge, and when we reached the foot of Ben Lomond, the biggest of big hills of New England, ascended a very steep spur on the eastern side of the railway line. The Ben Lomond station was at that time owned by Codrington. It was a very bleak spot in winter time, but I think I never felt more biting air on New England than at Falconer station, a few miles further on. There was a township there, consisting of some half-dozen buildings. I forget who owned the station. This was the old coach route which was in use until the time when the railway was constructed, and it was an uncommonly rough one. The next station was Gyra. It belonged to Millais, who also kept a roadside pub of the same name. Millais died in 1879 at the good old age of 104 years. Henry Dutton afterwards bought the station. Yet another bad hill beyond this ; the Devil's Pinch it was called. Happily we had to descend this, and, after the fashion thereabouts, the driver took a stout tree down dragging at the tail of his dray. From this point we passed by Maister's Tilbuster station, kept a couple of miles to the right of Armidale, then by Saumarez, Kentucky, Carlisle's Gully, to Bendemeer on the Macdonald River, and so on to the Moonby Range, and down it to Oaky Creek, which falls into the Peel River just above Tamworth. The rest of that trip occupied several months, during which we experienced biting frosts, pouring rains, Cumberland disease, large areas of desolating drought and almost undrinkable water; it ended up with scorching heat, mirage, and, early in October, the great comet of 1858-9.

While in Melbourne, in January, 1859, I arranged with Mr. Sharpe, from whose station near Grafton I had travelled with the last lot of cattle, to buy another lot of bullocks for the Victorian market. I had to take delivery in February, therefore left at once for Sydney by the s.s. Wonga Wonga. In Sydney I engaged some of my old drovers and bought a number of horses. We then took ship in the s.s. Collaroy for Raymond Terrace, and travelled thence by the Port Stephens Road to New England, where I secured more horses. We soon started northwards for the Clarence River, but instead of going to Armidale kept a more easterly track from Dangar's Creek. From this point we travelled to a station belonging to Hargraves, and on the following day camped at Major Parke's station on the Guyfawkes River; then we passed along some rugged country and arrived at Peter Shea's inn on Cloud's Creek. At Nimboyda we were delayed by the river which was running very swiftly. At a spot where the channel was narrow a rope had been stretched between two trees on either bank, and sitting in a loup we were dragged across one by one; each of us, where the rope sagged most over the middle of the stream, was slightly soused on the part of his body which hung lowest. On the second afternoon we had to swim the horses across. Then we arranged with Mr. Therold, the manager, to take a black boy as guide across country to the Clarence Falls, some distance above Grafton, as here we must cross the horses to the north side of the Clarence. The black boy was the best to be had at the time, but as it turned out he knew nothing of the country. None of us knew the country which in places was rather rough; but one of my men was a native of the district and a good bushman. His general knowledge of the lay of the country proved most valuable. We kept a pretty straight course, and struck a station, owned by the McDougalls, in the afternoon. We discarded our black guide here, and next morning George Davis again took the lead across country. The Oorara River where we crossed it was running very strong and only the biggest horses could touch bottom; but we got all over safely and arrived at the crossing of the Clarence at the place we had been making for. It was an ugly place to tackle, for the river was running strong, the channel was very wide, and there was only one narrow landing-place. To drive the horses in and swim them over in a body was impossible. Only one other course was open, and this, after a day's rest, I adopted. The Government kept a boat at the Crossing, and next morning, having obtained this and the services of the boatman, we haltered each horse and dragged them across one by one behind the boat. Not one of them swam the whole distance; as a rule they struck out manfully at first, but by the time we got to the middle of the stream they turned on their sides and were towed for the rest of the distance. By midday we had the lot (twenty-eight) safely landed; 14 miles further on we arrived at Retreat station.

We made our start with the cattle on 1st March, and travelled by Gordon Brook, Bundock owner, but he was away from home. We next passed Yulgilbar, Edward Ogilvie owner; he was in England at the time, and a friend of mine, "Tom" Smith, was in charge during his absence. The new palatial residence, containing scores of rooms, was then in course of construction. Smith soon afterwards joined Barnes as partner, and from them I bought the first lot of cattle I put on Rodd's Bay when I settled in Queensland. The second lot I bought from Ogilvie. After leaving Yulgilbar we next passed Hamilton's station, and then joined our last year's route at Tabulam. This we followed over the Great Sandy Hill to Tenterfield, and then travelled south by the same road as before until we reached Deepwater, whence, in the expectation of finding a better supply of grass, we took a more westerly track, and in 9 miles arrived at Oswald Bloxsom's Ranger's Valley station on the Severn River. We crossed the Beardie River, 3 miles further on, and next came to Mackattie's station, near Wellingrove. The wild ducks here were never interfered with within the house-paddock fences, and a large number of them fed round the house with the common fowls. Wild fowl were plentiful along this road, and with my fowling-piece I obtained an abundance of bustards, ducks, and pigeons, a welcome addition to our simple bush fare. The township of Wellingrove was very much in embryo in 1859. We passed it by and camped for the night at Waterloo station, which differed very much in appearance from the Waterloo near Walcha. On the following day we had to travel 15 miles to the Swanbrook River. Water is not so plentiful on the western slopes of New England, and it was this scarcity that necessitated so long a day's drive for the cattle.

Most of the streams along here were spoken of respectfully as rivers; they were very small streams, too. Six miles further on we came to Elmore station on the Mackintyre River, and to Copas Creek 10 miles beyond it. The country on this more westerly track was generally less hilly than that over which the main route passes, but ahead of us, at no great distance, was a gap—whose gap I do not remember. The road approaching it led up a narrow gully which quickly contracted as we followed it. To the cattle its unevenness was of small consequence, but with the cart matters were quite the other way. In places two of us had to put all our strength onto the ropes which we had fixed to the side of the cart farthest from the gully, but even that was insufficient and in a turnover one of the shafts was broken. We were all rather jaded when the day ended, but, happily, we had done forever with that particular gap. At Clerkness, five miles on, I found a carpenter, who repaired the damages satisfactorily. We were now on the Bundarra River, and about 40 or 45 miles further on, having passed the Woolshed and Capel's station, we descended by very rough roads to Barraba township, a miserable looking place situated on the Manilla River. We had now done with the New England district. From this point we followed the Manilla River downwards to the Manilla township, which consisted of a store and pub under one roof, and two bark huts. It is situated at the junction of the Manilla and Namoi rivers, near Baldwin's station. We passed Cobcroft's station on the Peel River; then another small township named Carrol on the Namoi. A few miles further on we struck the Mooki River and followed it up to Breeza township where we came onto the great stock-road to the South.

By following this track along the western slopes we found a generally smooth road, though in places it was extremely rough; we had better grass for the cattle, and were treated with every consideration by the pastoralists across whose runs few stock were driven, and we obtained an abundance of wild fowl. But the circumstance to which I would specially direct attention is the change that has come over the country along all these routes during the forty to fifty years which have elapsed since I travelled over them. Even in 1859 the only dwellings to be met with were those occupied by the pastoralists and their employees, and an occasional roadside inn. Scarcely a fence was to be seen, except those which enclosed the homes of the squatters, and the several townships with very few exceptions were mere hamlets. In fact the country was practically open from the northern border of New South Wales to that of Victoria. Now settlers living in their comfortable homes are met with in every district; the country from end to end is divided by thousands of fences into large and small paddocks, and what were primitive villages containing only a handful of inhabitants are now populous and generally speaking, prosperous towns. Then the railways and telegraph lines—the former carry passengers and goods in as many hours as weeks were needed in the days of bullock teams, and while the quick special messengers of the past with their relays of horses would have been getting ready for a start, the message is sent and delivered by wire! What then may we not expect within another fifty years!

A FEW SCIENTIFIC NOTES TAKEN DURING THE PRESENT DROUGHT.

By THOMAS P. LUCAS, M.R.C.S., Eng.; L.S.A., Lond.; L.R.C.P., Ed.

(Read before the Royal Society of Queensland, 21st June, 1902).

Communities may learn wisdom even from adversity. The study of nature is a search for knowledge. Knowledge of the cosmos must be of special service in framing the constitutions and helming the interests of a nation. The disasters of flood and drought, in the natural necessities of our existence, call for brain work and scientific research, and in practical experiences herald us to discoveries of the laws and activities of nature. To know the laws of nature is to be able to use nature as the servitor of power for men's physical and social needs.

In the present continued drought, water-holes and other supplies of water are being dried up. To weep and wail is folly. To set ourselves to compass the situation and mitigate the uncomfortable conditions resultant therefrom is justifiable and healthy, intellectually and morally. I have a twenty-acre piece of orchard, about eight miles south from Brisbane, gradually sloping to a chain of water-holes, and by these separated from another twenty acres of timberland, gradually sloped upwards on the opposite side. In flood time the intervening valley channel was that of a narrow stream of rushing water; in ordinary seasons and weather, simply a chain of water-holes twenty to fifty yards apart. I have held possession of the land for ten years, and until this year never knew the water to fail. But about four months ago all the water-holes were dry, excepting one. This evidently communicated with a spring of slightly brackish water, as it was always full, and in spite of cattle drinking and evaporation, etc., it always looked clear and fresh in the centre. The depth was from four to six feet. In erratic heavy showers during the last six months, three of the higher holes were again filled with surface water and still hold their supply, but the holes below the brackish water-hole have continued dry.

Being desirous of finding water for irrigation, we sunk through three feet of marly clay at the botton of the first dried-up water-hole. We then came upon a deposit of leaves and general vegetable matter some six feet thick, gradually thinning to the contour much beyond present dimensions. There is a slight mixture of sand, but not sufficient to prevent the mass being a black carbonized substance of vegetable nidus. I need not say that the deposit works up well for vegetable manure, which we are appyling to the fruit trees. It is not a true peat, lacking of course the sphagnum mosses, and not being formed in bogs but in a water-hole, evidently the accumulation of years, until a sudden high flow washed down a quantity of sand and clay to form a thick bed over it.

After clearing this carbonized deposit away we came upon a basis of marly sandy rocks, soft and friable and alternating with inferior and coloured pipeclays, also mixed with sand. Sinking eight feet through these beds we got an abundance of fresh water. The water is soft and tastes slightly of soda, and is evidently from an entirely different drainage to that of the water in the water-hole higher up, and which as I said was slightly but decidedly brackish.

On the side of the hole now dug out twelve feet deep (not reckoning the eight feet bore for water), was a large dead tree-stump its roots spreading into the soil, being thus exposed. In seeking to undermine this stump with a pick a nest of eels was disturbed. They were coiled in interlacing companionship into a solid ball evidently to mutual moisture and sustained vitality. There were four specimens about eighteen inches each in length, and they had instinctively thus located themselves under a lacing of roots, at once expedient for protection against the hardening humus, and probably supplying a degree of air and moisture as well as a rude domicile.

I must now ask you to visit Hemmant. The Doughboy Creek, an estuarine salt creek, runs by the side of Mr. Carlisle's vineyard; but there, as elsewhere, fresh water is lacking. In his difficulty the owner commenced to dig a hole, or rather to enlarge a formerly dug-out water-hole, but now dry. After passing through some feet of surface humus and washed (flood) matter he came upon a soft, plastic, black, marly, clayey deposit. In the twelve or fourteen feet of this deposit that were passed through, four bands of shell conglomerates were found. The three higher beds are eighteen to twenty inches apart, but the lowest one is quite four feet from the one above it. The shells are mostly an estuarine recent species of bivalve with an occasional piece of worn coral, now and then a stray oyster-shell and very rarely a solitary shell of another species. I am informed that in driving the piles for the railway bridge over the creek near by similar shelly beds were met with and, if I am correct, at a depth of twenty-eight feet fresh water.

Do not geologists tell us that in former times the Brisbane River was a very much larger and probably differently distributed water channel? It appears to me that both instances which I have recorded go to support this view. To-day the estuarine portion of the river appears to be much further out than formerly. In the floods of the nineties, oyster beds a distance beyond the present mouth of the river were destroyed by the sudden freshes of the Brisbane River. It takes four years for oyster spawn to form new beds, and the supply of such spawn is under other conditions. The shell beds at Hemmant do not certainly suggest local oyster habitats, but they do prove the occurrence of such at the time, at no great distance. But these beds appear most conclusively to prove that that the shell colonies were established near to the mouth of the river and in the flux of the salt water tides; for when in floods the fresh water poured in hyperabundantly the estuarine salt water shell-fish were killed, and did not appear again until deposits to 16 or 18 inches had been laid down. And in the section laid open this evidences as having occurred four times. Doubtless by deeper sinking more such and on a larger scale would be proved.

Another point is worthy of notice. If these shells had been buried as they died and immediately covered over with the flood water muds, they ought largely to be found bedded in pairs (bivalves). Instead of this they are mostly found singly or forced into irregular conglomerates in all ways and fashions, as they would be if long exposed after death to the tides and on a mud bottom.

If then my deductions are correct, the present Doughboy Creek must in pre-historic human age (post-pleistocene) have been a wide estuarine mouth of the Brisbane River, instead of as at present a moderately wide sub-tidal creek. And considering the number of sub-tidal creeks—Norman Creek, Breakfast Creek, etc.—may it not be that in earlier times these formed portions of many channels and interbranching water courses at the mouth of a large estuarine river. If so I can understand how the chain of water holes in my orchard, and which show superficial deposits of twelve feet deep, were at that time the bed of a fairly sized stream tributary.

Another consideration is worthy of notice—the question of time. In my orchard the superficial deposits, that is of the human period (the underlying rocks being mesozoic) are only twelve or so feet thick. And at Hemmant, judging by the inflow of fresh water, the depth of such superficial deposits is only twenty-eight feet. Twelve feet and twenty-eight feet deposits may represent the work of a score of years, or they may represent that of centuries of the human period. It would be necessary to know the history of possible previous denudations, and in the geology of the whole country the higher and lower levels of the land drained. It is not for me to go into these questions in this paper excepting to add the above evidences to the valuable information already tabulated by our Geological Survey. And I would, in the prestige of the Royal Society, suggest the consideration by the Agricultural and Geological Departments of the State Service of a general supervision of drought-stricken farms and districts, to the exploration for water, surface or sub-surface drainage or natural springs. In a scientific and practical guidance the cost should be but a fraction of the benefits gained.

ON THE POSSIBILITY OF PREVENTING DAMAGES BY FROST.

By P. OLSSON-SEFFER, Ph. D.

(Read before the Royal Society of Queensland, 2nd August, 1902.)

In his first report on the sugar industry of Queensland, Dr. W. Maxwell says :—"The occurrence of killing frosts in any district appears to be so rare as to cause special remark when it occurs, which indicates conditions very far removed from those obtaining in such a sugar-growing country as Louisiana, where frost is an annual occurrence, and where precautions are regularly taken to protect some part of the crop against its action."

Only a few days previous to my reading this passage I had been an eye-witness to the damages done by frost to sugar-cane and to some other crops in the Maroochy district. Shortly afterwards I experienced three nights of severe frost in the Wide Bay district, close to the coast, and I was assured by cane-growers and farmers there that frost with damaging results was by no means so infrequent in South Queensland.

Nothing is more discouraging for the farmer, who perhaps has toiled for a whole year, than to see his promising crop killed by one night's frost. A killing frost is not a yearly occurrence. If it were so the farmer would most likely be prepared for it, but as several years slip by without an attack from the enemy, he is lulled into security, and only when the damage is done does he wake to the fact that he might have averted the misfortune.

Can this be done? Is there any prevention against the result of frost? Certainly there are means of preventing damages by frost, but it is necessary to have a certain amount of experience when taking these protective measures, so as not to cause a still greater damage by the preventives than by the frost itself.

Fertilizers, applied to the soil without judgment, medicines given to a patient with no discrimination, may cause serious injuries. The using of frost preventives must also be based on knowledge and experience.

As, however, not only the climate generally in a country, but also local conditions influence the phenomena connected with the frost, it is impossible to lay down a general rule as to the methods for avoiding frost. My own experience of frost in Queensland is far too limited to allow me to speak of it with regard to this country; but my experience gathered in other countries will enable me to offer some suggestions as to the frost phenomena in general and the causes of its appearance. I will also give a short summary of the results of the frost investigations made in Sweden and Finland, the two coldest countries in the world where agriculture is carried on, the countries where Jack Frost is the worst foe of the agriculturist.

My short notes are chiefly founded on the excellent works of Professor Selim Lemström, of Helsingfors, Finland, whose researches on the Polar light and night frosts, have made his name familiar to the scientific world. Through the courtesy of the present chairman of the Finnish Society of Science, Dr. Th. Homén, Professor of Applied Physics at the University of Helsingfors, I recently received some of his latest works on the frost question, and they will enable me to discuss some of the latest results of experiments made.

THE CAUSES OF NIGHT-FROSTS.

Since the investigations of Wells in Surrey, England, in the beginning of last century, it has been known that the principal cause of night-frosts is the radiation of heat from the surface of the earth and from the substances that are upon it. Every body, the temperature of which is higher than that of its surroundings, suffers a constant loss of heat until temperature is the same everywhere.

On a summer day the surface of the earth is heated by the sun, *i.e.*, the earth obtains a surplusage of heat, which in various kinds of surfaces is different, and which penetrates more or less deeply into the ground, depending on its heat conducting power. When the sun's effect has ceased, the earth and the objects on it begin to give out heat through radiation into space. The temperature of the earth sinks at first very rapidly, being higher in comparison with that of space, but later more slowly, depending on its surroundings. The radiated heat has to go through the atmosphere, which contains besides the principal ingredients of air, aqueous vapour, carbonic acid, small quantities of ozone, nitric oxides, ammonia and water in solid and liquid form, and particles of dust of various kinds.

The gaseous matter round the earth hinders the radiation of heat, as it returns theheat to the earth more or less, and thus compensates for the loss.

The degree of the fall of temperature caused by radiation depends on the following circumstances :—

I.—The Aqueous Vapour of the Air.

The heat which radiates into space ccmes in most cases from plants on the surface of the earth. The plants receive heat from below by radiation from the bare earth, and by conduction through the plants themselves, and the heat escapes first to the atmosphere, on the state of which depends the degree of the fall of temperature, and secondly into space.

From the latest researches on the powers of emission and absorption of gases we learn that while the pure and clear air is nearly diathermous for heat, even the small quantities of carbonic acid which are present in the atmosphere exercise a perceptible absorption, which yet is not determined with sufficient exactitude.

It is probable that other gaseous matters in the air have very little influence, which also seems to be the case with the nitric oxides and the ammonia though they are the most absorbent gases.

Aqueous Vapour and Water.

Thinly scattered as the molecules of aqueous vapour are in the atmosphere, we might be inclined to disregard them as carriers to the waves of heat, and imagine that these undulations must be intercepted by the gases which form the great bulk of the atmosphere, and not by the aqueous vapour which is sparingly diffused among them.

According to Tyndall, the action of a single atom of aqueous vapour is 10,000 times than that of a single atom of oxygen or nitrogen. According to others, the absorbing power of vapour of water on the dark rays of heat is hardly greater than that of air. Concerning the power of liquid water, that is to say in this case condensed vapour, all agree that it is great and attains nearly 90 per cent. of the radiated heat.

Although dust or the solid particles of different kinds in the air exists only to a small extent, its influence is still very great. Acknowledging the fact that clear air and transparent vapour do not radiate or absorb in a marked degree, the principal radiation from the atmosphere itself falls in the very beginning on these solid particles, and their action becomes that of leading into *condensation of vapour*, being first cooled down under the temperature of their surroundings and then attaining the dew point. When condensation has once begun radiation hastens towards the earth as well as into space, because the radiant power of the atmosphere is increased by the condensed vapour, and it is soon formed into a cloudy veil.

This veil partly hinders the continued radiation from the earth, and lessens the loss of heat and thereby the fall of temperature, which stops at a point or continues to fall, though very slowly.

The degree of humidity thus determines the fall of temperature; the clearer and drier the air, the more intense the radiation and cooling. It is on account of the absence of this qualifying agent that the thermometric range is so enormous in Australia. A clear day and a dry day, however, are very different things. The atmosphere may possess great visual clearness while it is charged with aqueous vapour, or even water in condensed form, and on such occasions great chilling cannot occur by terrestrial radiation.

During the first half-hour after sunset the fall of temperature is rapid, but afterwards it becomes slower, for by degrees a cloudy veil, more or less transparent, arises through condensation, and gives back the greater part of the heat. This veil is such a serious hindrance to the radiation that, when appearing distinctly, the temperature on the surface of the earth will not sink under zero even in places sensitive to the frost. The warmer the summer day the more intense is the evaporation, the greater the amount of vapour in the air, and the thicker the veil of clouds. Considering that vapour in its turning from a gaseous into a liquid state gives out a great quantity of heat, the cause of this great effect will be easily understood. By preventing nocturnal radiation into space the clouds of vapour preserve many a tender plant from being nipped by the frosts.

II.—The dust particles and the condensed vapour radiate heat, but the air itself only does so very slightly, and thus the *cooling of the air results principally from its touching the ground and the plants on it.* Hence the remarkable fact, that the air is coolest near the surface of the earth, and that its temperature increases with the height. From this circumstance follows a particular series of movements in the air. The cooled air, by reason of its increased density, flows from the plants towards the ground, and slides down it towards the lower parts of the field, and from the mountains to the valley, where it accumulates, and if there is no issue it stays there. As this movement lasts the whole night the chilled stratum of air on the lowest places increases in depth, and the cooling is there much greater than on the places situated a little higher. This movement, which is a result of nocturnal radiation, ought not to be mistaken for such movements as are caused by a breeze however gentle. The direction of the particles of air in a wind always forms a little angle with the surface of the ground, and hence results a warming effect caused by the mixing of the cold and warm layers of air, and then by the heat which the air conveys to the ground, because, owing to the oblique direction new particles always touch its surface. A horizontal movement will certainly be without effect, unless it sweeps away a thick layer of air. A breeze so gentle that it will scarcely move the leaves of a tree will produce a considerable increase of temperature.

III.—The Radiating of Heat from the Ground to the Plants growing on it.

In order to answer the question as to the effect of radiating heat from the earth itself during the night, we have only to consider a piece of ground with plants. Let us look at the phenomena arising here and exercising a perceptible influence on the temperature.

From the fact that plants radiate more heat into space than they receive from the ground, the latter becomes warmer than the plants, and thus constitutes a source of heat the influence of which ought to be explained.

The heat which the ground has received from the sun penetrates into it, and is conducted during the night towards the surface, radiating thence to the plants. Different kinds of soil are in this respect very dissimilar, depending on the circumstance that the evaporation from the surface layer of the earth is relatively great.

It is only in later times that attention has been directed to this phenomenon by the researches of R. Russell, E. Wallny, and S. Lemström. The latter has shown by actinometric experiments that heat which radiates from the surface of the earth after sunset is scarcely perceptible on a frosty night.

The influence of this radiated heat is diminished by the circumstance that it meets the short grass which generally covers the ground in places where preventives against the damage of frost might be used. This source of heat is without any influence and may therefore be neglected.

IV.—Evaporation.

Every hour of the day water evaporates from the ground and the vegetation with more or less intensity, and thereby heat is consumed in considerable quantities. The degree of evaporation determines the degree of humidity in the atmosphere.

The aqueous vapour thus formed is mixed mechanically with the surrounding atmosphere, exercising a pressure which may be measured by the weight of a column of mercury of a certain height in the same way as the pressure of the atmosphere is measured. The evaporation only continues until the surrounding air is saturated with vapour.

Experiments show that the pressure of the aqueous vapour in case of saturation depends solely on temperature.

The degree of evaporation again, and hence the quantity of vapour formed, depends on the followiug circumstances :—

(*a*) It is proportional to the evaporating surface.

(*b*) It is proportional to the difference between the highest pressure and the pressure ruling at the moment.

(*c*) It is also inversely proportional to the pressure of air.

(*d*) The quantity of moisture depends finally on the pureness and temperature of the evaporating fluid, as well as upon the temperature of the surrounding atmosphere and its pureness.

The vapour can sometimes remain in this form even if the temperature has fallen beneath the dew point, just as a fluid is heated above the boiling point without turning into steam. These phenomena have their origin in the play of the forces of molecules, which play remains without influence if the air contains particles of dust, as is usually the case.

If we follow the changes in the moisture of the atmosphere during a clear day we find the amount of vapour rising and falling with the temperature. The changes vary greatly in different regions of the earth. We must make a distinction between a place on the sea coast and a place in a country without lakes.

The smallest quantity of moisture is found in the atmosphere about sunrise, increasing until 9 a.m., then falling till about 2 p.m.; rising again till 8 p.m. and falling by slow degrees until morning.

The degree of humidity determines the dew-point. When the temperature has fallen so low that the air is saturated, it cannot remain in form of vapour if the temperature is still falling, but turns into water.

The evaporation ceases as soon as the dew-point is reached, as it probably does long before the temperature attains 32 deg., F., and instead of an absorption of heat by producing vapour, heat is now created by condensation.

When summing up all the acting and counteracting causes of lowering of temperature on a clear night, we get among the former in the first place, *radiation of heat*; in the second place, *movements in the air*, caused by the cooling of air through its touching the plants and its running down into the lowest places.

As counteracting causes we have in the first place *condensation of aqueous vapour in the atmosphere* in general, by which the radiation is lessened; in the second place *condensation of aqueous vapour near the surface of the earth* by which first dew and then hoar-frost is produced; and in the third place *movements in the air in the form of slight breezes or faint draughts* which mix the different strata of the air.

All the other causes of the fall of temperature during a clear night may be regarded as of so small influence that they scarcely need to be taken into consideration.

All these causes prevent the loss of heat from vegetation by radiation, making the fall of temperature produced by it slower and slower. At last it reaches a limit which cannot be exceeded, *i.e.*, the heat emitted by the plants is then restored to very nearly the same amount.

The causes of night-frosts have been the subject of special study not only by Lemström and Homén in Finland, but also by Hamberg and Juhlin in Sweden.

We have now to consider the question—*To what temperature can plants be exposed without damage?* In this matter the experience is still very limited, especially as the general climatic conditions of a country influence the vegetation, and consequently the question has to be made a separate study for each country. Some important conclusions might still be derived from what is known at the present time.

Numerous but by no means final researches have shown that temperatures between the freezing point of water on the one hand and about 112° F. on the other indicate those intensities of heat motion at which plant-life generally is still possible. It happens, however, occasionally, that certain phenomena of vegetation may still occur even below the freezing point of water, because from various causes the water contained in the cells only begins to crystallize at a few degrees below zero. However these are isolated cases; in the great majority the vital movements in general only begin at a few degrees above the freezing point.

When the temperature of any portion of a plant sinks below the minimum necessary for the production and continuance of the chemical processes of metabolism—that is to say, for the calling into action of the vital forces—a period of rest ensues which continues until the necessary thermal conditions are again restored in the tissues. Should the temperature sink considerably below 32° F., the plant is frosted. In other words, a portion of the water of imbibition in the cell-walls, and a portion of the water of the cell-sap separate in the form of ice-crystals, while a more concentrated solution with a lower freezing point remains behind in the liquid form.

When the tissues of the leaves and in fact when any parenchymatous tissues are frosted, pure water is withdrawn into the adjoining intercellular spaces, but the cells themselves do not generally freeze. The result is that the cells lose their turgidity and at the same time begin to droop. This explains the familiar phenomenon of lilies, hyacinths, &c., which have been caught by frost, being prostrated on the ground until the ice melts and the cells reabsorb the water into their interior and again become turgid, when the plants resume an erect position.

As a rule when living plant tissues that contain much water are frosted—and this applies especially to young leaves and shoots that are affected by frost—large masses of ice are formed in certain regions, and notably underneath the epidermis of leaves and shoots and in the medulla. The tissues, however, remain entirely free of ice, merely shrinking in proportion to the quantity of water that is lost. These masses of ice consist of parallel prismatic crystals, which are arranged at right angles to the tissues from which the water has been abstracted.

The cortical parenchyma of the shoot usually contains numerous intercellular spaces, especially along the line that marks the limits of the collenchymatous tissues of the outer cortex. Owing to the formation of a sheet of ice in this region, a separation of the cortical tissues may take place which, however, may occasion but little damage to the plant.

It is of importance to notice the resulting circumstances at the forming of ice. They are principally *the releasing of the melting heat* (according to Lemström 80 Cal. for every kilogram water) and *the increase of volume.* The heat released by the freezing is partly utilized by the plant, and the ice formed by the dew is a good coverlet which hinders further loss of heat. Thereby the freezing of the cellwater is for a short time prevented. If the loss of heat still continues the cellwater freezes and causes the death of the plant.

When a thaw occurs in the frosted parts of a plant the tissues usually regain the conditions which characterized them before the frost appeared. As the water is set free by the melting of the ice it is slowly absorbed by the cell walls and the cell contents, so that when the cells have attained the temperature at which chemical processes are possible the normal conditions of imbibition have also been again restored, and the metabolic processes which were temporarily suspended are resumed under the influence of the higher temperature. The case is different, however, when the frosted parts of plants are rapidly thawed, as occurs for instance when they are suddenly warmed by the sun. The rapid accession of heat induces the ice in the intercellular spaces to thaw rapidly, and the ice water being but slowly absorbed by the cellwalls and protoplasm flows into the intercellular spaces and drives out the air, with the result that leaves which are suddenly thawed become translucent. The normal conditions of imbibition have not been restored when the chemical processes start afresh under the influence of the rise in temperature. Instead of these processes assuming the normal features of metabolism, they lead to chemical decomposition in the comparatively dry and withered tissues. In other words the plant is dying. It is therefore emphatically to be recommended that plants affected by night-frost should be protected against a too rapid thaw.

Views have been divided as to the manner in which death of the plants is caused by frost. It was at one time admitted that destruction took place by the bursting of the walls of the vessels caused by the augmentation of volume which took place at the freezing. Hoffman attributes a part of the mechanical injury from freezing to the separation from the cell-sap of the air previously contained therein. Later researches have shown that the destruction is caused by the diminution of water which the protoplasm undergoes at freezing, as mentioned above.

There has also been a controversy with regard to the time when frost proves fatal. While Göppert concludes that death occurs during the continuance of the frost, Sachs is of the opinion that the tissues die only after they have thawed, and that a fatal issue depends very much on the manner and rate of thawing. The two views may to a certain extent be reconciled, for it is possible that during winter death occurs during the continuance of the frost, whereas in the case of a summer night-frost it appears at the moment of thawing.

All plants are not equally effected by a low temperature. Among our common European vegetables the potato is one of the most sensitive. Far less susceptible are the cereals, as oats, barley, rye, wheat; more sensitive pea, &c., at least during the first stages of growth.

Certain plants are seriously injured by low temperatures which are considerably above the freezing point of water, but these are exceptional cases. In some of our familiar spring plants of Europe the leaves may be frozen and thawed without apparent mischief, but in general the thawing must take place slowly; if it proceeds rapidly the plant may be irreparably injured. There are however also well known cases in which plants may be thawed quickly without serious injury. Sachs has shown that the leaves of the cabbage, turnip, and certain beans, frozen at a temperature of from —5° C. to —7° C. and placed in water at 0° C. are immediately covered with a crust of ice, upon the slow disappearance of which they resume their former turgidity. If such frozen leaves are placed in water of + 75° C. they at once become flaccid.

The behaviour of certain plants during exposure to low temperatures affords some of the best illustrations of the adaptability of vegetation to its surroundings; and the question as to increasing the tolerance of a given species or variety to the adverse influence of cold by careful selection of seeds for a series of years has been successfully answered by cultivators in some northern countries of Europe.

Apart from specific peculiarities we also find individual differences, and it is this fact which makes it possible for us to acclimatize plants. As the ability to resist frost varies amongst individuals of the same species just like any other physiological or morphological peculiarity, it becomes possible to acclimatize a tender plant by propagating hardy varieties.

We have already mentioned the lowest temperature at which perceptible growth takes place, but this minimum does not necessarily suffice for the developement of chlorophyll, or for assimilation, or for the irritability of motile organs and so forth ; and when this is determined for one species of plant, the lower zero points of these functions in another species are by no means necessarily the same. The diversity of the lower zero-points of the various functions may however bring it about that at certain lower temperatures the various functions no longer work harmoniously together, so that pathological conditions are induced. It is observed in northern countries that the young leaves of cereal plants grow in the early spring, but in spite of bright illumination they remain yellow, because the lower limit of temperature for growth is not so high as that for the development of chlorophyll.

Not only the low temperature but also the length of its duration will be decisive for the destiny of the plant. We have no exact observations as to the length of time during which the vitality of a frozen plant persists. It is stated that after the recession of a glacier in Chamouni several plants which had been covered by ice for at least four years resumed their growth.

If the rays of the sun immediately after its rising reach the frozen plant, the ice will not only melt but also evaporate, consuming a great quantity of heat. The greatest part of this heat naturally comes from the sun, but one part is still derived from the little store of the plant, and it is probable that the last determining cause of the damage done by a night frost often depends on this circumstance. It would be wrong to believe that whenever rime round the plants is produced, the sunrise being clear, damage by frost will instantly occur. Lemström has shown that plants possess a certain power of resistance against frost, and that they are not in general destroyed if they are covered with ice at a temperature of —2° C. near the ground by clear sunrise, the time of the duration of the low temperature not exceeding 1½ hours. Kihlman and others have come to the same conclusion.

On the basis of what we have pointed out above with regard to the causes of night frosts and their effect on the vegetable world, we get a

Theory of Frost Prevention

that ravages by night-frosts can be avoided if we can restore to the field the amount of heat lost by radiation, or if we can reduce this radiation, or prevent a too rapid thawing of the frozen plants.

We can effect a communication of heat to the plants in the following way:—

(*a*) By a reduction of the radiation by means of artificial clouds;

(*b*) By movements in the air which mix the different strata;

(*c*) By condensed moisture that affords heat.

Nature herself offers certain opportunities which are of the greatest importance:—

(*a*) The condensation of vapour continually going on during the night;

(*b*) The universal calm which is reigning during a frosty night.

Now we will consider how this theory can be put into practical use, and give a resumé of

The Methods of Frost Prevention.

From time immemorial it has been known that frost will not occur when the sky is cloudy, and in many lands trials have been made to produce artificial clouds by burning different kinds of more or less cheap combustibles. The ancient Romans used this method as we learn from their literature, and in Peru the old inhabitants used smoke as a preventive against frost long before the country was taken possession of by Europeans.

No completely successful method has however yet been devised, and smoke as a preventive has therefore got into disrepute. In France, for instance, the people say it succeeds but always for the advantage of our neighbours, thus indicating that smoke and vapour pass to their neighbours' fields. I have heard the same remarks in Queensland. But neither the French nor the Queenslanders have formed any association, as is the case in many parts of Germany, where attempts have been made to protect vineyards and orchards against both spring and autumn frosts by the burning of coal tar.

Avoiding frost by means of smoke is since olden times well known to the peasantry in Sweden and Finland, and during the winter on many a frosty night well-applied smoke-producing fires have saved valuable crops.

The formation of artificial clouds consisting of smoke and vapour must however be effected by fuel possessing the following qualities :—

It must be handy and cheap ;
It must be easily transportable ;
It must be easily kindled ;
It must burn slowly ;
It must produce much smoke, vapour and heat ;
It must not be so inflammable that danger of spreading the fire arises.

It is of course very difficult to combine all these qualities in one combustible. Professor Lemström has constructed a kind of *frost-torch* for which he claims the said properties.

These frost-torches consist of tubes of well-dried mud, and of kindling cylinders which can be inserted into the tubes. The torches may be placed in the field which is to be protected and remain there all the time frost may be expected or until they are used, for the rain affects only their surface and they dry very soon. Frost-torches of this kind can be manufactured at a price of less than ½d. apiece.

For a description of these frost-torches and their use we can refer to a leaflet by the inventor "On the method of providing against summer night frosts by the use of torches."

The writer has had experience of these frost-torches and found them to answer the purpose of producing a thick smoke. They do not however burn long, and it is necessary to determine the exact time when they are to be kindled, so as to be sure that they are still producing smoke at sunrise, when the danger is greatest.

The inventor claims also for his frost-torches the property of producing heat to such an extent as to affect a movement in the air strata, thus bringing warmer air down for the benefit of the vegetation. This effect is however still an open question, and Homén among others is of a different opinion.

Whatever kind of smoke producing fuel is used, it is however necessary to be careful when placing the fires so as to get the use of all the natural conditions that will benefit, and to counteract those which are of an injurious character. Care must thus be taken that strong currents of cooled air are kept out from the lower parts of the field, etc. Local circumstances have to guide all the measures taken, and a careful study and thorough knowledge of the phenomenon is necessary for the successful use of this remedy.

We have already hinted at the fact that a misapplied remedy often may be more injurious than the frost itself. We have witnessed several instances when big fires kindled after the freezing of the plants had taken place caused a too rapid thawing and subsequently death. The same fires kindled half-an-hour earlier would have saved the crop.

We have full faith in the effectiveness of smoke as a frost-preventive, but the methods have to be developed, and for that purpose a co-operation of science and practice is wanted.

On the principle of movements in the air as preventing injurious effects of frost, several methods have been tried. The Finns used to pass to and fro dragging a rope over the field, thereby causing a wave-like movement of the straw which results in a success, but this method is of course only possible on a small patch.

We have not been able to ascertain from the records whether the Stiger Vortex gun has been used in connection with frost experiments, but it seems to me that shooting over a field during a night-frost would be successful through causing the air strata to be mixed, and thereby effecting a restoration to the field of heat lost by nocturnal radiation.

ON FORECASTING OF NIGHT-FROSTS.

For the practical agriculturist who wishes to avert from his crop the evil effects of frost, it is of the greatest importance to be able to interpret correctly the warning signs given by Nature herself before a frosty night, so that the protective measures be not needlessly precipitated. A night-frost never comes unawares, and its forewarnings are fortunately sure and easily interpreted.

Every meteorological handbook contains information on this head, so we need not go into that question. As we said before the occurrence of frost and the phenomena connected therewith are however dependent on not only the climatic conditions in general, but also on local circumstances. A careful investigation of the frost question is necessary in every country where frost occurs, and the scientists, both the meteorologist and the biologist, as well as the agriculturists have to work hand in hand with their colleagues in other parts of the world.

We need scarcely say that, by reason of its geographical position, Australia is especially a good place for meteorological researches. The well established system of meteorological stations distributed all over the country and the high-level mountain observatories already in work—an undertaking showing great foresight on the part of its initiator—make it possible to forecast the weather conditions with an accuracy which cannot be surpassed in any other country. The rapid development of communication, railways, telegraphs, telephones, etc., will make it possible to spread intelligence of a threatening frost into nearly every cottage, so that the farmer need not even in this instance rely upon his own judgment, but can throw his responsibility on more experienced shoulders.

THE FROST INVESTIGATIONS IN SWEDEN AND FINLAND.

The first scientific inquiry *re* the frost phenomenon in those countries was made by a Professor Hällström, in Finland, 1804. He published a prize essay, for a long time considered and used as a standard-work on this question. In Sweden Hamberg took up the question in the seventies, and Lemström started at the same time his investigations in Finland. The interesting results obtained by these scientific inquiries caused a general interest in the question. Homën made some valuable experiments during 1880 and has since devoted himself to the study of the frost phenomenon.

In 1892 the Geographical Society of Finland commenced investigations about night frosts and their distribution in the country. Circulars containing questions relative to the night frost and its effects on the vegetation were distributed to all parts of the country, and detailed reports were voluntarily sent to the Society. The information thus collected has been compiled and published from year to year in the Society's bulletins by a prominent biologist, Professor Kihlman, and many a doubtful question has thus been settled.

Meanwhile the Government has interested itself in the matter. Besides giving the above mentioned Society all assistance in form of free postage, etc., a frost commission consisting of scientists and practical farmers was appointed for establishing an official scientific inquiry.

Recognizing the importance of drainage as diminishing the danger of frost, the Government has set apart funds from which cheap loans are given for the special purpose of giving the farmers an opportunity of getting their fields properly drained.

In Sweden the Government has taken similar steps. Last year for instance a sum of £23,000 was voted by the Riksdag for the current year for loans to be used for draining purposes, and for diminishing the frost danger, and every year a sum of £56,000 is placed to a fund from which small farmers get loans at 3 per cent. interest, and to the amount of 70 per cent. of the value of the proposed improvements.

For nearly a century the Finnish Society of Science has through interested persons in every part of the country been making phenological observations which are of great importance in connection with the frost question, as showing the season of growth and the effects of the climate not only on the indigenous vegetation but also on the cultivated plants. In Sweden too similar phenological data have for a long time been available.

A co-operative company was established a few years ago in Stockholm insuring against damages by frost, and this has proved to be a thorough success.

SUGGESTIONS.

As far as is known to the writer very little has been done in Australia in connection with the study of frost phenomena or with regard to practical attempts to prevent damages by night-frosts. Last year the late manager of the Biggenden State Farm, Mr. H. A. Tardent, strongly advocated in the papers the use of smoke as a frost preventive, and experiments were subsequently made on the sugar fields of the Isis district. However lack of confidence in the method and insufficient co-operation between the neighbours seemed to have caused, if not a failure, at least not a satisfactory result.

Co-operation is the great word in all matters connected with modern agriculture. If all the farmers in a neighbourhood combine, and after getting sufficient information from a meteorologist make up their minds to fight their common enemy, the frost, there is no doubt they could with a very small outlay save a considerable sum. But without co-operation, no success.

In the future we shall have legislation to the effect that nobody must neglect his duty if he thereby injures his neighbour, and this will apply to all branches of social life; but we are not advanced so far yet. We cannot therefore advocate legislative proceedings with regard to frost prevention, but we must try to persuade the farmer not to leave all to an uncertain hope, but to watch his own interest and that of his neighbour also.

With all the advantages of the already named system of meteorological stations, and the Weather Bureau in Brisbane which makes forecasting of frost so available, and by reason of the geographical position of Queensland on the very edge of the tropics, there is hardly any country in the world where the frost phenomenon could be studied with such a success as here. Also the presence in Queensland of such a distinguished meteorologist as Mr. C. L. Wragge is a reason for going into the study of this question.

I do not know which Society in Queensland is the proper one for taking up the practical part of this question of preventing damages by frost; but I think in addressing this body of scientific workers that I have placed the question in the hands of the men who are the most suitable for giving the matter a scientific attention, the result of which would be beneficial not only to this country but to the whole humanity.

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IMMUNITY, NATURAL AND ACQUIRED.

By **WILTON W. R. LOVE, M.B.**

(Read before the Royal Society of Queensland, 16th August, 1902).

Immunity is the converse of predisposition. It may be classified under two great subdivisions, viz., Congenital (natural) and Acquired.

Congenital (*natural*) immunity may be an individual peculiarity or it may be common to the species (*racial*), and in like manner acquired immunity may be *temporary* or *permanent*; in the latter case even it may be transmissible from parent to offspring, hence the term *natural* is more correct than *congenital*. Let us take first :—

Acquired Immunity.—This means that an animal susceptible to an infectious disease may become protected against subsequent infection. This may happen in several ways.

(A) By Recovery from an attack.

(B) By inoculation (*a*) with attenuated virus, *i.e.*, living organisms of low virulence, as in vaccination against small-pox; (*b*) with small and repeated doses of living and fully virulent organisms, as in the preparation of horses for anti-diphtheritic serum; (*c*) with toxins or bacterial products, as in anti-plague prophylactic, *i.e.*, chemical vaccination; (*d*) with serum derived from protected animals, *e.g.*, anti-diphtheritic, anti-tetanic, anti-rabic; (*e*) by feeding animals with the living organisms or their products—this is merely a sub-phase of the preceding inoculation methods of conferring immunity.

Let us consider each of these methods of establishing an acquired immunity in more detail.

(A) The natural predisposition to an infective disease may be removed by recovery from an attack. To use Kanthack's words, "this is Nature's way." Certain infective diseases confer a protective effect against subsequent attacks of the same disease, either completely or partially, as regards that individual, *e.g.*, an attack of small-pox which has been recovered from, guarantees immunity from another attack throughout a life-time; *e.g.*, also measles, scarlet fever, syphilis, yellow fever, whooping cough—while attacks of typhoid fever, pneumonia, and diphtheria only confer a temporary insusceptibility. This partial immunisation is also shewn in races as well as individuals, *e.g.*, measles has been endemic among European races probably for centuries, and as a consequence an ordinary attack of measles in a child is looked upon as a trivial and inevitable ailment, thanks to the partial immunity handed down from long series of ancestors who have passed through the illness, but let this comparatively trivial disease be imported into a community where the disease has been unknown, and the result is a virulent epidemic with an appalling mortality, *e.g.*, the introduction of measles among the Fijians some 35 years ago resulted in a mortality of nearly 40,000 of the native race. Similarly chicken-pox, a trivial disease of children, becomes almost as deadly as small-pox among coloured races when first introduced. Our experience in Australia shews that typhoid fever has only a partial protecting power, as most medical men can point to cases where two or three or even more attacks have been sustained by the same individual. In India, similarly, plague has been shewn to affect an individual on two or more occasions.

(B) It is in an attempt to imitate this method of Nature that man has devised various ways of giving a slight dose of the disease to protect from severer attacks. This was recognised long ago in the introduction into England of inoculation with the scabs of small-pox, which set up a mild attack of small-pox. A safer method, because more under control, is the—

(*a*) Inoculation with attenuated virus, *i.e.*, with living organisms of a low degree of virulence. It must be known to all of you that bacteriologists have long since demonstrated the possibility of raising or lowering the virulence of various organisms by selection of cultures, or by what is the same thing, selection of animals through which to pass the micro-organism. Practically every organism when cultivated for some time outside the body loses its virulence, and in the case of some this is very marked indeed, *e.g.*, pneumococcus. Pasteur found in the case of chicken cholera that when cultures were kept for a long time under ordinary conditions, they gradually lost their virulence, and that when subcultures were made the diminished virulence persisted. Such cultures can be used for protective inoculation, and are generally known as vaccines, from their analogy to the action on the human organism of the material derived from cow-pox. Again, an organism may be "attenuated," that is, reduced in virulence by passing through another animal, *e.g.* Burdon Sanderson and Greenfield shewed that anthrax bacilli when inoculated into guinea pigs became attenuated, and could then be used for protective inoculation of sheep and cattle ; *c.p.*, also Pasteur's experiments with swine-plague, where rabbits were used to attenuate the bacilli. Similarly some organisms become diminished in virulence if grown at an abnormally high temperature, or in the presence of weak antiseptics. Exaltation of the virulence on the other hand, may be brought about chiefly by the method of cultivating the organism from animal to animal—the method of "passage" discovered by Pasteur—the animals used are mostly rabbits or guinea-pigs. This method can be applied to the organisms of typhoid, cholera, pneumonia, to streptococci, and staphylococci. Similarly the above methods may be combined, *e.g.*, by injections of cultures at first attenuated and afterwards more virulent, and by increasing the doses a high degree of immunity may be gained. Haffkine's anti-choleraic injection depends upon this combination—the virus (*i.e.*, the cholera organisms) is first attenuated by passing a current of sterile air over the organisms, which are then passed through guinea pigs by injection into the peritoneum. The virulence is thus increased 20-fold, *i.e.*, $\frac{1}{20}$th of the ordinary lethal dose of the culture is sufficient to kill. Animals are first treated with the attenuated virus, and then gradually with the "exalted" virus. This process has been tried by Haffkine on the human subject with marked success. Three injections of attenuated virus are first given, and then *virus exalté* is used.

(b) Inoculation with small and repeated doses of fully virulent organisms. The animal tissues can deal with a small dose of virulent organisms ; this produces a small amount of immunity in the animal, which is taken advantage of to introduce a larger dose, and so on, but up to a certain point only—for any animal, however highly immunised, can be killed by a sufficiently large dose ; in other words, any individual, provided the species is susceptible to a given disease, may succumb to an attack of that disease if the dose be sufficiently large and virulent.

(*c*) By inoculation with toxins or bacterial products. This is a most important advance, and has done much to disprove Metschnikoff's doctrine of phagocytosis as being the means by which natural protection was acquired by the animal. Virulent organisms are grown in a culture medium for a certain time and then filtered off through a Pasteur-Chamberland filter; the filtrate then contains the toxins elaborated by the bacilli. This can be standardised and used with the same exactitude in dose as an alkaloid. The toxin is administered to the animal at first in small doses, and gradually increased—for example, Calmette and Fraser's experiments with snake poison to produce anti-venene. In most cases the toxins are in solution, but a similar result may be obtained by sterilising the cultures, and not filtering, but injecting the dead bacilli with the culture medium, as in Haffkine's plague prophylactic.—(The method of preparation of Haffkine's plague prophylactic was here explained.)—Albumoses in the beef-tea perhaps cause fever; an improved method by two Italian scientists has led to the production of a crystalline substance which causes no fever. By this method a high degree of immunity can be produced, but as before, only up to a certain point. This is practically a chemical process, and is comparable to the toleration of laudanum in the devotees of the opium habit or of arsenic in the Styrian peasants. Similar results, but on a more restricted scale, have been obtained by feeding animals on toxins or dead bacterial cultures. The important axiom to be drawn from this method is, to quote Kanthack, "immunity therefore implies resistance both to bacteria and their products."

(*d*) Immunity may be procured by inoculating an animal with serum derived from animals protected by a previous attack or immunised by the above methods. Practically, this is the method which has found most general use in the prevention and treatment of certain infectious diseases. Take, as example, protective inoculation against diphtheria by the injection of serum from horses highly immunised by injections of cultures of diphtheria bacilli. This must not be confused with the curative or antitoxic effect of anti-diphtheria serum, as that belongs to a different category, though it may be well now to refer to this part of the subject. The chief of these methods are treatment of diphtheria by antitoxic serum, of tetanus by anti-tetanic serum, immunisation of cattle against tick fever by the injection of serum obtained from cattle which have survived an attack. The drawback to this method of protection lies in the fact that the protection is usually short-lived, conferring immunity only for a few weeks. This can be overcome by repeated injections, which however interferes with its usefulness on account of the inconvenience and expense of repeated injections. At the Plague Hospital here some of the resident medical officers were in the habit of keeping themselves immunised by taking fortnightly injections of the plague curative serum. Some of the sera may have both an immunising effect and a curative effect, although not having bactericidal properties. The introduction of serum from immunised animals as a method of treatment marks one of the most important strides in preventive medicine, and we have good reason to hope that as yet the method is only in its infancy. The most efficacious of these antitoxins has been the anti-diphtheritic serum derived from horses highly immunised with cultures of living diphtheria bacilli, with which the name of Behring must ever be conspicuously connected. The death-rate in the Children's Hospital in Brisbane for example has been brought down from 45 per cent. to 9 per cent., and it is belived that every case may be saved if the treatment can be given sufficiently early. After the disease has existed for several days or more, in addition to the poisonous effect of the diphtheria toxin, there is often the result of a mixed infection super-added, *e.g.*, broncho-pneumonia, septic sloughing of the throat, etc., due to the presence of organisms other than the diphtheria bacilli which may cause a fatal issue in spite of the diphtheritic toxin having been neutralised by the serum.

Another but less effectual anti-toxin is the anti-tetanic serum—from the use of which undoubted recoveries have taken place, both in human beings and horses—but as cases are not usually recognised until the toxin has already attacked the central nervous system, and as the ratio of anti-toxin necessary to counteract the effect of the toxin increases enormously with every few hours, the curative effect is far below that of diphtheritic anti-toxin. Greater success would be expected from immunising doses of tetanic anti-toxin in lacerated wounds where the development of tetanus might be expected.

Anti-streptococcic serum has been used with success against erysipelas, post-mortem wounds, puerperal fever, and in general septic infection due to streptococci—but is powerless against septic conditions due solely to staphylococci or to mixed infections of streptococci and staphylococci.

Anti-typhoid, anti-cholera, anti-pneumonic, anti-plague, and other sera are all prepared in an analogous manner, and have given in some instances valuable results. The only one of which we have any experience is the anti-plague serum, and we have had ample opportunities of witnessing its effects, sometimes magical, in cases of bubonic plague.

Another example is the anti-rabic serum introduced by Tizzoni and Pasteur, where conspicuous success has followed the use of this serum in persons bitten by rabid animals in whom hydrophobia would otherwise have developed.

To quote Kanthack: "There is a striking difference, however, between immunity produced by inoculation of the bacteria themselves and their toxins, whether attenuated or not, and immunity produced by serum injections. In the former case the animal gains its immunity after an active struggle with the disease or lesions following the injection or intoxication; in the latter case there is no struggle with disease and no reaction; the animal remains passive while the immunity-conferring substance is applied to its tissues. On account of this essential difference, Ehrlich distinguishes active from passive immunity. Passive immunity is effected quickly, is less persistent, and varies with the amount of the serum used and with the degree of the immunity of the animal which supplies the serum. Active immunity, on the other hand, does not appear for days, not until the animal has passed through the reactive stage; then it becomes permanent, and is proportional to the intensity of the reaction rather than to the amount of vaccine used."

Lastly we come to the subject of Natural Immunity, which I will treat very briefly. I would call your attention to two facts—(1) that there are a large number of bacteria—the so-called non-pathogenic bacteria, which, when introduced into an animal, cause no symptoms, unless perhaps in very large doses, showing that the tissues and fluids of the animal body possess a bactericidal action against germs of low virulence; (2) that there are other bacteria, which are very virulent to some species of animals and harmless against others—anthrax, for example, fowls immune to tetanus, goats to tubercle, *c.p.*, natural resistance to morphia in birds. This immunity must be due to a special power on the part of that animal of destroying the germ or neutralising its toxins, or an insusceptibility to the action of the toxine.

Different animals have different degrees of resistance or non-susceptibility to toxic bodies—a fact so far incapable of explanation. We must take this natural resistance for granted, and there is no evidence that for each case there is an anti-toxic body present which protects; the serum of a fowl, for instance, does not protect another animal from tetanus, though the serum of a less susceptible animal in which a resistance equal to that of the fowl has been artifically developed does possess anti-toxic powers. The resistance evidently lies in the tissues.

With regard to the natural bactericidal powers, the powers seem to reside in phagocytosis and in the action of the serum, the latter deriving its virtue from substances derived from various glands, spleen, lymphatic glands, the gums, etc., and termed alexines.

Having now discussed the various methods of conferring acquired immunity, there remain to be considered the hypotheses which have been built up to explain the processes in the animal body by which the immunity is gradually developed. None of them, however, are capable of satisfying every aspect of the case.

(1.) Pasteur's theory of exhaustion—in other words, it is assumed that there are certain substances in the body of a living animal necessary for the existence of a particular germ, and that this is used up by the germs which then die out. This is of course easily disproved by the discovery of passive immunity conferred by the injection of the serum of an immunised animal, *i.e.*, a small quantity of serum in which the pabulum has been exhausted cannot lead to its exhaustion in the serum of another animal into which it is introduced.

(2.) Theory of retention which supposes that the toxins elaborated by the bacilli gradually kill them—as happens in cultures in test tubes: this does not explain how it is that acquired immunity may last for years, as it is unreasonable to suppose that these toxins are retained in the system during that time.

(3.) Phagocytosis—Metchnikoff's wonderful theory, which credits the lencocytes with bactericidal powers. This theory has demonstrated one of the chief methods possessed by the body in dealing with invading organisms, but does not explain the conferring of immunity by means of serum injections or chemical vaccines.

(4.) Humoral theory—developed by Behring—so far as active immunity is concerned it may be held as proved that the production of immunity is accompanied by changes in the blood serum, *i.e.*, by the development of anti-microbic or anti-toxic substances. No doubt, however, such substances are produced, not simply by chemical changes in the body fluids, but are products of cellular action brought about by the presence of the bacteria or their toxins. What cells are these? Metchnikoff says leucocytes, but when a horse is immunised against diphtheria its serum possesses a certain degree of anti-toxic power, so does the serum derived from subsequent bleedings, although fresh leucocytes have been generated after each bleeding. Hence, fresh anti-toxin must have been produced after each bleeding withou the introduction of fresh toxin. Anti-toxin, or the immunity conferring substance, must therefore be a direct product of the tissue cells by virtue of acquired secretory changes, and its action must also be directly cellular.

I must apologize for this sketchy survey of an intricate subject —a subject which is constantly presenting new phases with increased research, but one which has a peculiar fascination for the thoughtful student as well as for the practical man.

DOMESTIC WATER SUPPLY OF BRISBANE, WITH SPECIAL REFERENCE TO THE PRESENCE OF ZINC IN TANK WATERS

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In considering the question of our domestic water supply, I intend after giving merely a short general view of the subject to deal as fully as I can with one particular item—the presence of zinc in tank waters.

As by far the most important use of water in the household is for drinking, I intend to confine my remarks mostly to that phase of the subject.

The domestic water supply of Brisbane is drawn practically from three sources: (*a*) the Brisbane River water from Mt. Crosby, (*b*) the waters from Gold Creek and Enoggera Reservoirs, which are for all practical purposes identical, and (*c*) rain water collected from galvanised iron roofs and stored in galvanised iron tanks.

I have already commented on the Mt. Crosby and Enoggera waters in a report to the Brisbane Board of Waterworks, and a full copy of the report appeared at the time in the Brisbane *Courier.* Perhaps you might care to have your memories refreshed shortly as to the general properties of these two waters.

The Brisbane River water is hard, varying from 9deg. to 18deg., and is therefore not suitable for washing. For drinking purposes, the hardness of the water, caused by the presence of carbonates of lime and magnesia, has rarely been regarded as deleterious, in fact it is generally regarded as rather beneficial than otherwise, particularly by writers of text books. The lack of lime in a water supply has repeatedly been held responsible for rickets or weak legs in children, though if a child had to depend in any way on the lime it could extract from Mt. Crosby water at say 12deg. hardness it would fall far short of the necessary daily supply. The water at 12deg. would contain about 4 grains of carbonate of lime. If a child drank, say half-a-gallon a day, it would only imbibe 2 grains of lime, about as much as it would get in a pint of milk or 4oz. of bread, while in the latter cases it would get it in the form of bone-making phosphate and not as carbonate. Besides the hardness of Mount Crosby, there is always a danger, as in all river waters, of contamination with pathogenic germs. In the present sparsely populated state of the country this danger is small, though as the water is not filtered, if once contaminated it would be delivered in that state. There is always some vegetable matter present in the Mt. Crosby water, but it is only occasionally present in sufficient quantity to be objectionable. If filtered through a Pasteur, or similar filter, Mt. Crosby water could be considered a good and safe drinking water.

Enoggera and Gold Creek waters are totally different in composition. There is not much mineral matter present, but there is a most objectionably large amount of vegetable matter in the water. The catchment area is granite, and is entirely reserved, so that the water runs into the reservoir in a very pure state. Unfortunately our semi-tropical climate soon causes the water to teem with all sorts of minute animal and vegetable organisms. A drop of Enoggera surface water from a settling jar is a perfect aquarium under the microscope, and offers a splendid field of investigation for any enthusiastic biologist. It is almost certain that there are many species there which are not yet named or classified ; and as it is certain that some one or two forms give the Enoggera water its objectionable taste, useful scientific work is waiting for some one to take it in hand. The algæ and many of the other organisms die on removal from light, so when the water is passed into the mains the products of decay make themselves manifest in that most objectionable brown sediment with which most of us are only too familiar. The porous earthenware filters are practically useless when applied to this water, as they choke up almost at once and after a short time become permanently choked. The Enoggera water then, although not liable to be contaminated with typhoid, cholera, or other pathogenic germs, may be classed as unsuitable for drinking. If the water is allowed to run until clear, the sample then collected, boiled, filtered, and allowed to stand for twenty-four hours, it is generally palatable, though even after this treatment it may have an objectionable odour.

With Enoggera and Gold Creek waters nearly always, and Mt. Crosby sometimes unsuitable for drinking, the rain water collected from galvanised iron roofs in galvanised iron tanks is the principal source of drinking water in Brisbane, even where the other supplies are available.

Organically tank water is nearly always very pure; in fact, I have never yet found a tank water as bad organically as the ordinary Enoggera or Mt. Crosby. The only objectionable ingredient I have found in tank water is zinc. This metal is always present, generally in the form of carbonate, and varies in amount from about 0·3 to 2 grains per gallon in ordinary waters, though water collected from new tanks or from new roofs, often contains much more, and deposits a thick white sediment of hydrated zinc carbonate in the bottom of the tank. My main object in reading this paper to-night is to call the attention of our medical members to the presence of this zinc. I have at various times spoken to several medical gentlemen on the subject, but no one seems to have given it any attention. Now I do not in any way want to raise a scare, as that generally does more harm than good, but from my investigations on the matter I think it is well worthy of serious study, particularly in the case of medical men dealing with children.

When I first realised that all the tank waters contained so much zinc I naturally felt alarmed, but concluded that as no one had ever noted poisonous effects from the use of such waters in Brisbane, there were no poisonous effects. When the Lead Poisoning Commission was appointed some years ago, as a member of the Commission I gave the matter a good deal of attention, and since then I have gradually been forced to the conclusion that the zinc may not be so harmless as is generally believed.

Here is a list of the amounts of zinc found in various samples of water collected in galvanised iron tanks from galvanised iron roofs :—

Date.		Grains zinc per gallon.
13th February, 1899	..	2·0
25th January, 1899	..	1·0
16th February, 1899	..	1·0
21st September, 1899	..	1·0 (Maryborough).
24th September, 1899	..	1·0 (Wynnum).
7th July, 1898 ..	..	0·8
7th July, 1898 ..	..	0·8
20th July, 1898 ..	..	1·27
6th February, 1898	..	0·3 (Toowoomba).
7th November, 1898	..	0·75
19th November, 1898	..	1·0
16th January, 1899	..	1·0

All these tank waters were examined in connection with obscure cases of lead poisoning among children, and in no case was lead found—in fact lead cannot remain in solution in presence of metallic zinc, so that one would not expect to find lead in solution in water stored in a galvanised iron tank. Many other waters were examined qualitatively in connection with the lead poisoning cases and all were found to contain zinc in solution. On 27th February, 1902, samples were tested as follows :—

Two samples Upper Paddington :—	
(*a*) Tank cleaned 9 months before ..	·70 grains zinc per gallon.
Sept. 12, 1902—from same tank ..	2·35 ,, ,, ,,
(*b*) Tank not cleaned for at least 5 years	·90 ,, ,, ,,
Sample from Milton :—	
Tank not cleaned for years	1·32 ,, ,, ,,
Sample from Kangaroo Point :—	
Tank not cleaned for years	1·32 ,, ,, ,,
Sample from Eagle Junction :—	
Tank cleaned 9 months before ..	1·00 ,, ,, ,,

From these and other results it seems that tank waters contain on an average about one grain of zinc per gallon. Just after rain this amount would probably be greater, but is not likely to rise above two grains for any length of time. The metallic taste of the zinc in the tank water is very noticeable to anyone not accustomed to drinking it. But for the presence of this zinc ordinary tank water would be a very good drinking water. As it is, thorough boiling of the water throws all the zinc out of solution, and if then filtered and allowed to stand for a day to re-absorb air, tank water gives the safest and most palatable water that it is possible to have.

Now with regard to the possibility of harmful results arising out of the continued use of tank water containing zinc in solution I of course cannot speak with authority, but I will give the chief references that I have been able to find after a rather extended search, though unfortunately owing to the absence of any good library in Brisbane I have not been able to make the search as complete as I would have liked it to be. As it would be exceedingly inconvenient for any one in Brisbane to get the following books or journals for reference, I give the contents of each reference as fully as possible.

Text Books.

Most text books vaguely condemn the presence of zinc in drinking water. The following two may be taken as fair examples :—

Mason's "Examination of Water," 1899 edition, p. 80.—"Zinc is not a cumulative poison, but its presence in water is nevertheless distinctly objectionable."

Davis's "Potable Water," 1891 ed., p. 21.—"Galvanised iron pipes are also liable to render dangerous the water that passes through them; such waters contain zinc, but the amount is generally very small."

The following references are much more informative :—

Professor Dixon Mann's "Forensic Medicine and Toxicology," 1893 ed., p. 469, states :—

"Chronic poisoning by zinc has been observed, chiefly in smelters of the metal. The symptoms to some extent resemble those produced by lead; derangement of the digestive organs, colic with constipation or more frequently diarrhœa; indications of peripheral neuritis have been observed. Gastric symptoms have resulted from drinking water or milk stored in zinc lined vessels."

Dr. Thresh's "Water Supply," 1896 ed., p.p. 10, 209, 210, 211, and 418 :—

"Waters which act on lead appear also to have the power of acting upon zinc, and of forming poisonous compounds which dissolve freely in the water. As the physical characters of the water are not altered, the presence of the metal may remain unsuspected, unless some obscure form of illness leads the medical attendant to have it examined. When water which contains an appreciable amount of zinc is heated in an open vessel, before it commences to boil an iridescent film is observed upon the surface, sometimes giving rise to the impression that the water is 'greasy.' Such water should not be stored in zinc or galvanised iron vessels, or passed through galvanised iron pipes."

"The River Pollution Commissioners mention that some polluted shallow well waters not only act upon lead violently, but continuously, and that several instances of poisoning from the use of leaden pump pipes had come to their knowledge. The one analysis given of such a water shows that it was far purer than the average of shallow-well waters, but that the temporary hardness was under 1°. When a galvanised iron pipe was substituted for the leaden one, the water, as might have been expected from its composition, became charged with zinc, and zinc poisoning followed the lead poisoning. The so-called tin-lined lead pipes also yield lead to the water, inasmuch as the tin in the process of lining becomes alloyed with the lead.

"As previously stated, water which acts upon lead will also attack the zinc coating of galvanised iron. A case of poisoning from this cause recently came under my notice. The water supply to a newly-erected country house was derived from a spring arising at the edge of a patch of Bagshot sand. The water was piped from this spring to the house, a distance of half a mile, through galvanised iron pipes. The only child, who, prior to the removal into the new house, had been perfectly healthy, became a sufferer from obstinate constipation. At length suspicion rested upon the water supply, probably because an iridescent film always formed on its surface when exposed in open vessels, or when heated in an open pan. (This film is very characteristic of the presence of zinc, and is often put down to a trace of oil or grease.) Upon analysis I found that the water contained about 3 grains of carbonate of zinc per gallon. When the water supply was changed, the constipation ceased. Many months after I again examined the water, which had been allowed to flow freely through the pipe, in the hope that it would speedily dissolve off the whole of the zinc; but it still contained too large a quantity to be considered safe for domestic use. Dr. Heaton, in the *Chemical News* (22nd Feb., 1884), gives an analysis of a water from near Llanelly, which is carried for half a mile through galvanised iron pipe. It was found to contain over 6 grains of carbonate of zinc to the gallon. Unfortunately the degree of temporary hardness is not stated, nor the reason why the Medical Officer sent it for analysis. Dr. Venables, in the *Journal of the American Chemical Society*, gives the analysis of a spring water, which, after passing through 200 yards of galvanised iron pipe, and after being in use a year, contained over 4 grains of zinc carbonate per gallon. The temporary hardness in this case was under 1°. He concludes that, 'when the dangerous nature of zinc as a poison is taken into consideration, the use of zinc-coated vessels in connection with water or any food liquid, should be avoided.'"

"Zinc poisoning from the use of water which has been stored in galvanised iron receptacles is of comparatively rare occurrence. Obstinate constipation is, so far as experience extends, the one noticeable effect produced, and possibly zinc-contaminated water may be a more frequent cause of this condition than has hitherto been suspected; but Myelius states that the water of the parish well at Tutendorf, contains half a grain of zinc per gallon, and has been used for about a century without any perceptible effect."

Hammarsten's "Physiological Chemistry," 1900 ed., p. 211:—

"Zinc . . . is easily taken up by the liver and retained for a long time," and ibid., p. 404, "Zinc . . . . passes into the milk."

JOURNALS.

The *Analyst*, since the first number in 1875, contains no reference to deleterious effects of zinc in drinking water. *Vol. XXII., p. 187*, records the use of $ZnSO_4$ as cheese spice to prevent heaving and cracking in cheese-making (A. H. Allen), while A. Bodmer found 3·7 and 2·5 grains $ZnSO_4$ per lb. of cheese in two different samples. In *Vol. 24, p. 8*, dried apples are recorded as containing ·031 per cent., ·021 per cent., ·023 per cent., and ·027 per cent, and dried pears ·020 per cent. and ·026 per cent. of zinc. These are interesting as other possible sources of zinc poisoning.

The *Journal of the Society of Chemical Industry* since the first number in 1882, gives the following information:—

Vol. II., p. 413, records acetic acid as containing zinc, derived from grey rubber tubing.

Vol. IV., p. 408, records experiments to show that zinc is inimical to plant life. In some "water culture" experiments 1 part per million killed radish, 5 per million killed oats, barley, clover, vetch, and buck-wheat. In soils, those rich in humus render the zinc insoluble so that it has little harmful effect, but in ordinary sandy soils, watering with water containing 20 parts of zinc per million after six weeks gradually killed off cabbages, peas, and even grasses. The action seems to arise through destruction of the chlorophyll, as zinc has no deleterious effect on the development of vegetation in the dark or on plants containing no chlorophyll.

Vol. IV., p. 461, gives a record by three other investigators, who confirm the above results.

Vol. V., p. 498, records the presence of zinc in dried apples. No proportions given.

Vol. VI., p. 557.—Bunte says the use of galvanised iron pipes for household water did not give enough zinc to be in any way harmful, but gives no figures.

Vol. VII., p. 689.—Max Muller found water from a copper roof to corrode zinc quickly, while water from a slate roof did not.

Vol. XI., p. 363.—A. H. Allen found "a large proportion of zinc in peas, which he found free from copper."

Vol. XVIII., p. 102.—H. E. Davies, after a long investigation established the following facts :—

(1) All kinds of water attack zinc in presence of air,

(2) Rain water appears to have the least action.

(3) A moderate degree of hardness favours the action, and extreme hardness does not prevent it.

(4) Coating the zinc with deposit does not altogether stop the action.

(5) When water containing zinc is drunk, zinc is found in all the viscera.

The article also proves that the action of water on zinc is much accelerated by the presence of nitrates.

The *Chemical News* contains very little information up to Vol. 49. On page 85 of this volume the following article appears by Dr. Heaton. This article is quoted in most of the text books when referring to zinc in tank water :—

"The water supplied to Cwmfelin, near Llanelly, is drawn from a spring at Penderry, and carried for about half a mile through a galvanised iron pipe. Mr. J. Raglan Thomas, the Medical Officer of Health for the district, detected zinc in the water of this pipe, and sent me samples from the spring and from the pipe for further examination. I obtained the following results :—

	Grains per Gallon.	
	Spring.	Pipe.
Total solids	10.8	18·9
Chlorine	1·47	1·45
Ammonia	none	0·008
Nitrogen as nitrate	0·056	none
Zinc carbonate in solution in carbonic acid ..	none	6·41

"The solvent action upon zinc of water containing dissolved oxygen and free carbonic acid is, as the above figures show, considerable. As far as I know it has not been observed before.

"I confirmed the analysis by a simple experiment. Distilled water containing some fragments of pure zinc was exposed for about half an hour to a stream of oxygen and carbonic anhydride. The filtered liquid was found to contain much zinc in solution, this zinc being readily precipitated as carbonate on boiling.

"It will be seen that the Penderry water is very pure The reduction of the nitrate to ammonia by the action of the zinc is a noteworthy feature in the case."

On page 107 of same volume is a reprint of Dr. Stevenson's well-known article which seems to give a resumé of what was known of the subject up to that date and which is here reproduced :—

"The experiments of Boutigny, Schaueffele, and Langonné have long since shown us that zinc dissolves in potable waters at ordinary temperatures; that distilled water and rain water dissolve zinc more readily than hard waters, especially those that are rich in chalk. They have shown, however, that hard potable waters do not take up zinc to an appreciable extent, for the zinc speedily becomes coated with an insoluble layer of zinc hydrate (hydrated oxide), or, more commonly, of hydrocarbonate (hydrated oxide and carbonate); but still a portion of the metal remains suspended, whilst a smaller portion, perhaps, passes into a state of true solution. Thus, all kinds of vessels in domestic use, whether made of zinc or 'galvanised,' impart to waters kept in, or allowed to pass through them, a certain quantity of zinc. The quantity of zinc thus taken up may even be sufficient to render the water opalescent, and unfit for drinking purposes.

"Fonssagrives, taking up the question of the nocuity or innocuity of waters kept in zinc vessels, or in those which are galvanised (*i.e.*, coated with zinc), investigated it by the data furnished by records of the public health, by the experience of naval hygiene, and by experiments on man and upon animals. He does not, however, adduce any experiments of his own. A French Government Commission had previously, on what appeared to Fonssagrives insufficient grounds, decided that water kept in vessels of zinc is injurious to health. Boutigny had likewise attributed very grave effects to the use of waters thus stored, and even imagined that epilepsy might be produced by the ingestion of zinc oxide. Fonssagrives concluded, as the result of his investigations, that the insoluble preparations of zinc produce no digestive disturbances except when taken in large doses, and that they do not accumulate in the economy. He admits that water in contact with metallic zinc becomes coated with zinc compounds, but that these—zinc hydrate, hydrocarbonate, and ulmate—are almost insoluble. Rain water passing over the metal may, nevertheless, remove some zinc in solution, as zincate of ammonia. These compounds, he states, exist in waters in such small quantities that no injurious effects can, in his opinion, result from their use. He adds that the facts drawn from toxicology, naval hygiene, public hygiene, and therapeutics, all attest the innocuity of water that has rested upon zinc. In consequence, the use of zinc and galvanised iron cisterns, of zinc pipes, and of galvanised iron pipes, for the conveyance of water, cannot be considered dangerous to health.

"Others, nevertheless, hold a different opinion. Pappenheim states that, though the amount of zinc present in such waters as have been spoken of, is not always sufficient to produce poisonous effects, since it is indubitable that they have frequently been employed for considerable lengths of time with impunity, yet the amount of metal taken up by large quantities of water may be sufficient to produce deleterious results. He states, moreover, that in France, spite of Fonssagrives's assertions, the water tanks of ships have had to be re-galvanised and tinned, and that zinc vessels have to be especially avoided. Dr. Parkes likewise states that Dr. Osborne, of Bitterne, has frequently observed injurious effects from the use of waters impregnated with zinc.

"Of the fact that water does, under certain conditions, act energetically upon zinc and upon galvanised iron, I have had abundant evidence. Some months ago I was consulted by a gentleman relative to the water supply to his house. The existing supply, from a well on the premises, furnished an excessively hard, chalky, and seleniferous water. It being desirable, for many reasons, to have a soft water, I advised that the rain water from the extensive slate-covered premises should be filtered and stored for use, as the house was remote from possible sources of contamination of the rain water. As a matter of precaution, I recommended the use of iron pipes for conveying the water, and that, after filtration through charcoal, sand, and gravel, the water should be stored in a tank lined with asphalt. Against my knowledge, galvanised iron pipes were used instead of those of iron only. The consequence of this has been that the water passing from the reservoir through the galvanised iron pipes has for many weeks been turbid and milky in appearance. It contains a notable quantity of zinc in suspension, and some in solution. I may remark that zinc in solution in potable waters is best detected by the addition of potassic ferrocyanide to the clear water after acidulation with hydrochloric acid, when a whitish cloud will immediately form if zinc be present. Of course this reaction must be confirmed by other and well-known tests. I know of no test for zinc which is so delicate as this.

"What might be the effect of drinking such water as I have described I cannot say, for no one would touch it if other water were to be obtained. Probably, its continued use might be productive of injurious effects.

"Engineers should bear in mind this effect of *rain water* upon zinc and upon the so-called galvanised iron."

On page 115 of same volume Dr. P. F. Frankland terminates a note on the subject by declaring that the storage of rain water in galvanised iron tanks is probably attended with some risk.

In Vol. 51 of the *Chemical News*, page 18, the full text of Dr. Venable's article, quoted above by Thresh, appears.

I examined the *Lancet*, *The Practitioner*, and the *British Medical Journal* so far as I could get them back to 1890, but with the following exception found nothing of importance. In the *British Medical Journal* of 7th September, 1901, page 615, is an article by Dr. Gimlette on an epidemic of zinc poisoning in the tropics. The following is an extract from the article :—

"The poisonous effects of various salts of zinc have been demonstrated from time to time. In England they have been reported from brass foundries as due to the oxide, and have been traced to the sulphate in the adulteration of cheese, apparently to the oxide in injurious ice creams, to the chloride in cheap wearing apparel, as well as to the carbonate in drinking water supplied by means of galvanised iron pipes. Instances of the latter kind of poisoning in the tropics are perhaps not so widely known as at home. In 1900 part of an Indian regiment, the Malay States Guides, stationed at Pahang, suffered from zinc poisoning to a very marked degree.

"The 56 men who formed the detachment were transferred from the neighbouring State of Perâk in March, 1900. I took over medical charge of this half-company in September, 1900, and found that the health of the men had been very bad during the previous six months. Gastro-intestinal complaints were so frequent and serious as to almost verge on an epidemic. Route marching had been curtailed, early bathing prohibited, and it had been supposed in July that a form of dysentery was endemic in the barracks. Inquiry showed that the half company was composed partly of Sikh soldiers and partly of Pathans, living in parallel and identical barracks on an isolated hill, a short distance from the town of Kuala Lipis and about 43 feet above it. The two buildings were erected in 1898 on an artificially-levelled flat, the surface of which was of stiff clay streaked with laterite. Each barrack was 90 feet in length by 40 feet wide, roofed in 1898 with sheets of 22 B.W.G. corrugated iron.

"In 1900, for the convenience of water supply, a galvanised iron tank (capacity 400 gallons) had been supplied to each building, one being for the use of the 31 Sikhs, the other for the 25 Pathans who made up the strength of the half-company. Rain water was collected for the first time in January, 1900, from the roofs by means of zinc gutters and down spouts leading into the tanks. No rain water separators or other appliances were in use with a view of discharging the first water collected. The water supply had previously been carried from a large river at the foot of the hill.

"The galvanised iron roofs had not been covered with a thatch, and were not painted. The tanks only had been painted green outside and washed with cement inside. There is but little vegetation in immediate proximity to the barrack square, but the jungle soil in the vicinity of the barracks is shaded and thickly covered with vegetable and organic matter in an active state of growth and decay owing to the peculiarly hot and moist character of the climate.

"In October I suspected that the cause acting so injuriously on the health of the Guides was due to the irritant action of some metallic poison, and surmised that it was some salt of zinc in combination with an organic acid or acids. By a rough application of the usual chemical tests I found in December that the water from each tank, as well as that caught directly from the roof, contained the metal zinc in poisonous quantities, and my deductions were subsequently confirmed by special analysis.

"Mr. P. J. Burgess, M.A., Government Analyst, Straits Settlements, whose report on this water is attached, reports that the water taken directly from the roof is organically a dirty water and unfit for domestic purposes, while water taken from the tanks is as far as organic impurities go, unfit for drinking. And that the tank water held zinc in solution as the acid carbonate, 4·82 parts per million (·34 grains per gallon) in quantity as compared to that taken directly from the roof which held 11·15 parts per million in solution.

"It is thus proved that zinc existed in the water in sufficient amount to cause poisoning, and the medical history of the health of the detachment will prove that to this alone was their illness due. Similar detachments from the Malay States Guides who occupied these barracks used water from other sources. They were under my care in 1898 and 1899. The numbers under treatment for gastro-intestinal complaints were not very large during these two years for this class of native.

"The present detachment used the zinc-contaminated water from their first arrival in March, 1900, until the end of the year, when its use was forbidden and prevented. After its use was stopped, the number of patients steadily decreased. There have been no new cases of this kind, and the general health has much improved.

"In 1900, colic, diarrhœa, and a spurious form of dysentery were persistently complained of. The health had never been affected in this way before, as the following records of attendance for this class of case, taken before, during, and after using this water supply will prove:

"From March to October, 1898, 30 men were under treatment for this class of case; in 1899, for the same months, 58 patients. In 1900, during the same period, 219 men, and, at at the close of the year, it was found that 43 different individuals out of the 56 had been on the sick list on account of gastro-intestinal disorders. Nine men and 1 woman had been transferred on medical certificate. One patient was recommended for four months' sick leave to India; 5 others, who had constantly been on the sick list, took all the leave which was due to them. Seven voluntarily left the service on the termination of their agreements on account of ill-health, and one of them subsequently died in Selangor. Another died at Kuala Lipis. The spirit of the remaining 31 men of the original Perâk detachment was broken, and the general loss of tone was very noticeable.

Special points of interest in the clinical histories are:

"1. The fact that gastric symptoms predominated over nervous symptoms. It is difficult to offer any satisfactory reason as to why this should have occurred, except that it is a common experience in the East that Sikhs suffer greatly from irritative dyspepsia even under ordinary circumstances, and are not often attacked with neuritis. As far as my experience in Pahang goes, they have been notably exempt from the prevalent form of peripheral neuritis which is very commonly met with in beri-beri.

"2. The fact that all the Sikh patients had had their diets prepared at the barracks, and had their drinking water supplied from the contaminated tank all the time they had been in the wards. This was on account of their religious custom, which forbids them to use food prepared by others than their own nationality, or to drink water unless it has been carried by a Sikh. The Pathans, on the other hand, being Mussulmans, were supplied with the ward diets and water by the hospital cook, who is a Mohammedan. They were also accustomed to eat and drink with their Mahommedan friends in the town, but the Sikh soldiers had few opportunities of feeding outside barracks. The hospital returns show that the Sikh soldiers suffer in a proportion of almost 2 to 1 as compared to the Pathans.

"3. The slow and deadly action of zinc poisoning by administration in small but continuous doses was well exemplified. In some cases it seems to suggest the possibility of zinc being an accumulative poison. Emaciation was, generally speaking, an evident symptom, and was so marked in the case of

V. S. as to suggest malignant disease of the stomach at the time of his death.

"With regard to the chemical analysis of the water, it is necessary to say that the samples A and B, mentioned in the analyst's report, were taken from the Pathan's tank. It was not possible at the time, owing to a short drought, to send Mr. Burgess samples from the Sikhs' tank. An excess of zinc was found in this water by me as compared to the other. For the same reason it took some days to collect the sample C, which was taken directly from the roof. The surfaces of the corrugated iron were not flushed with rain as is usually the case. This, no doubt, accounts for the large amount of organic matter which was found in this particular sample, and may explain the excess of zinc in it through non-dilution of the water. The roofs at Kuala Lipis are covered with patches of oxide of zinc.

"The amount of carbonate in solution in the tank water which caused so much sickness at Kuala Lipis, is comparatively small in quantity. It is less than one-fifteenth of that found in the contaminated water supplied to Cwmfelin, near Llanelly, a few years ago.

"It is interesting to note in connection with the latter instance, which is reported in the *Lancet* of July 29th, 1893, that the Pahang water was also essentially a soft water. The occurrence of this rather rare instance of poisoning suggests the advisability of a special inquiry with regard to a possible contamination of water in the towns of Australia and South Africa where galvanised iron roofs and tanks are used for the purpose of collecting and storing rain water; and although soil and circumstances undoubtedly play a chief part in the causation of typhoid fever in these countries, it is not unreasonable to suppose that zinc poisoning might be a factor in the causation of some of the gastro-intestinal symptoms. It appears that only after prolonged boiling and subsequent filtration water containing the acid carbonate of zinc might be harmless. It must be borne in mind, however, that the climates are essentially different, and perhaps in this may be found the determining cause of the Pahang epidemic. The mean annual temperature at Kuala Lipis in 1900 was 82·7° F., the minimum temperature 71° F., the rainfall 96·69 inches, with an average number of thirteen rainy days per month."

These then are the facts, so far as I have been able to ascertain them, with regard to what is known of the presence of zinc in drinking water. The most striking of all these extracts is the poisoning case in the Straits Settlements. The poisoning there was without doubt caused by the presence of only one-third of a grain of zinc per gallon in the drinking water. In Brisbane we have on the average fully three times this amount. If elsewhere zinc, present in less quantity than we have here, causes severe and even fatal poisoning, may it not be causing serious harm in Brisbane? I realise that this is in many ways a serious question to raise, but it would certainly be a most extraordinary circumstance if the presence of zinc in drinking water, which has proved so harmful elsewhere, should be perfectly harmless in Queensland.

SETTLING IN QUEENSLAND AND THE REASONS FOR DOING SO—WITH SPECIAL REFERENCE TO DROUGHTS.

By the Hon. A. NORTON, M.L.C.

(Read before the Royal Society of Queensland, 25th Oct., 1902.)

When in September, 1857, I left New England and the many friends I had made there, my thoughts often turned to the sunny North, where so many New Englanders, young and old, had already located themselves. The descriptions of life in what soon afterwards became Queensland were upon the whole favourable, and some of my former companions urged me to follow their example and escape from the snows and frosts of the South to the warm tropical districts of the North, where beautiful flowering plants grew in abundance in forest and scrub; where bananas, pineapples, and many other luscious fruits from oversea were as plentiful as peaches about Sydney; and where splendid pasturage for sheep and cattle insured the early success of those who took up country and settled down to steady work. Upon the whole the picture was beguiling; but already I had learnt a little of the optimism which paints things in such lovely colours; and I knew something from the illustrations with which I was acquainted of the failure of hopes that had once looked so promising. I had other thoughts running in my mind, too, and would decide nothing hurriedly. I went to Sydney, therefore, riding the first day of my journey through patches of unmelted snow, and picking my way through the numerous fallen branches which a recent storm had brought to the ground; retracing my steps along the Port Stevens track by which I had first made my way to New England; scrambling down the steeps and roughnesses of Hungry Hill; following the river valleys and crossing many pebbly river-beds; putting up at the unpretensious houses of accommodation and living on the simple fare they provided, and at night sleeping as only the young can sleep.

For some time I remained in Sydney, making inquiries and thinking thoughts which seemed to lead to nothing definite until, sauntering along George Street one morning, I met an old schoolmate who told me he was going to the Clarence River for some cattle which he had undertaken to drive across to Victoria. Would I join my lot with his? I must settle the matter at once, as he had to give an answer within half-an-hour to another young fellow who wanted to go with him. Half-a-minute was enough for me. I heard the terms, and there and then agreed to go. So I was to see the Clarence River country, of which I had heard a great deal, and something of all the districts lying between it and the golden city of Melbourne. I had heard of the droughts which had prevailed in the earlier days. I had read of the devastation caused by want of rain, even in the neighbourhood of Sydney, and I was not quite uninformed as to the terribly dry state which some explorers had gained experience of in their travels into the interior. Perhaps I should gain some personal experience in this direction, but in any case what knowledge I might pick up of the southern districts would help me to decide later on about those which lay near or in the tropics.

In due course I made my way by steamer to Grafton, on the Clarence River. During the weeks I remained there I made the acquaintance of a number of good fellows who were trying to hit upon the fortune which they had been promising themselves when they went there; and I renewed my friendship with some who I had known before; amongst the latter I specially mention the name of Thomas Hawkins Smith, who died last July from pneumonia; a good man and true was "Tom" Smith, and ever ready to do a kindly act. We got away with the cattle in what is sometimes spoken of as "the fall" of the year. At Tabulam station, then owned by Mrs. Chauvel, we came in for a "fall" of rain which lasted for several days—indeed until we all became bluemouldy. Going through the big New England district we had biting frosts and plenty of them, but happily no snow. Through Liverpool Plains we experienced dry weather and a general shortness of water. Before we reached Coolah we became acquainted with anthrax, commonly called "Cumberland" disease, after the county of Cumberland, where it was wont to kill many cattle and sheep as they were being taken to the Sydney market. When I took sheep through the Coolah country in 1854 it killed some of them also. By the time we reached Dubbo, on the Macquarie, we were well into a drought, and until we drew near the Lachlan River at Cummin's Crossing we had more and more drought. Cattle and horses had been dying by thousands, and the water we were compelled to drink told its own never-to-be-forgotten tale of thirst and starvation. Before we reached the Lachlan River the rain came. It filled the water channels and holes; as for the remains of the dead—let us hope they were drifted to some spot where there was no water to pollute! We had several days of rain, and it made things as damp and uncomfortable as usual. But it brought up the grass and herbage, and the wide plains of the Lachlan became emerald; trefoil sprang up abundantly, and the cattle ate it greedily, with hoven as the result; and on the lower flats beside the river there grew an interminable field of wild oats which were full of seed before we reached Walgiers. I would have liked to forget in this land of abundant pastures the drought we had gone through, but the remembrance of the cattle dying of starvation, the flash of the tomahawk with which I ended the agony of scores of starving animals that could not rise and were being picked cruelly to pieces by hawks and crows—these things would not allow one to forget. Besides, the grass was all green; not a single dry blade could be found. It had all grown after the rain, before which there was nothing but dry, bare, dusty soil. How could one forget?

As we slowly shaped our course along the lazy Lachlan—there were no fences in those days, and what cattle there were on the runs did not need much of the almost too abundant green pasture—I often turned my thoughts northwards, where it was all green and beautiful all the year round, just as we saw it here now—at least so I had been told. There was a suggestiveness about this country, too, which it was not easy to overlook. The river oaks had all been cut down for the horses of travellers, and the bleaching bones told a silent tale of starvation, ending at last in—oh! such a cruel death! These things the green grass could not hide, nor could the murky water of the river cover all the carcasses which lined its banks. Then I asked some of the residents about the road across to the Darling River, and they told me how one might travel through *now*, but soon the rain water which had filled up the small hollows would have disappeared; *then* one must keep in touch with the larger water channels. Lake Walgiers was a small inland sea now, so were others of the depressions hereabouts. It was not necessary to ask what happened to them in time of drought; it was enough to know that at one time Lake George, near Goulburn, had been a grazing ground for the squatters' flocks. Besides, who that had read anything of Captain Sturt's travels and those of many other explorers need ask if the country, over which we travelled in abundance, had ever before been drought-stricken? At the Walgiers Crossing the river was a banker, and we had to force cattle and horses to swim to the other side. We crossed during the night the wide plain which intervenes between Walgiers on the Lachlan and the Murrumbidgee, which we struck at Hay. Captain Sturt had gone down the river in his boat in 1830; the country on either side, right away down to Lake Alexandrina, was until then unknown. It was beautiful now with its luxuriant pastures, its small and its giant salt bushes; and in spite of dry seasons men prospered, for they had no paddocks and not too many stock. Across the sixty-mile plain, past the Black Swamp—haunted, so 'twas said, by a headless human skeleton riding a skeleton horse with hobbles on his feet—through more dry plains and deceptive mirage, until we reached the backwater from the flooded Edward River; then past Deniliquin and along the road, where the first telegraph line, a private venture, was being constructed between it and Moama. Here there was a pontoon bridge across the Murray, but the cattle and horses we had to force, as we had done at the Murrumbidgee and Edward, to swim the swift stream fed by the melting snow from the Snowy Mountains. Then we travelled along the Campaspie not knowing whither, for we were trying to hang on until we had letters to say whether or not the cattle were sold and what we must do with them. At last the news was received and we had to turn back to the Murray, cross it once more and hand over our charge to the purchaser at a station not far from Swan Hill. All along this part of the country, from the Billabong in fact, and for the rest of our journey, the pastoralists and their men hunted "the overlanders" and their stock and made their lives a burden to them. So far as I could form an opinion, the chances open for a young fellow who wanted to engage in pastoral pursuits were not tempting in these districts to one whose capital was limited. A friend and I drove to Melbourne in the light spring cart we had used on the overland route. During the following year I made another trip with cattle to Deniliquin, varying the route in places and becoming more extensively acquainted with the nature of the country ; but the only effect of these journeys was to turn my thoughts more definitely towards the undeveloped north. While I was in Melbourne, after my second overland trip, I was afforded a convenient opportunity to visit the westernmost country of New South Wales then under occupation, and without any unnecessary delay I made a start from Sydney taking a well-tried man with me. I had selected three good horses, one of which carried our pack, and we travelled by the usual road through Bathurst, Orange, Molong, Wellington, and Dubbo. From Bathurst our course was generally down the valley of the Macquarie. As a matter of fact we followed approximately the track of Captain Sturt when in 1829 he travelled down the Macquarie during a terrible drought which had commenced on the coast in 1826, hoping to solve the mystery connected with the marshes which in 1817 and 1818 had blocked Oxley's further progress. After passing Mount Harris and Mount Foster we crossed onto Duck Creek, and afterwards onto Mara Creek, and this we followed down to the Barwon River, as it is there called. There is some very fine cattle country on the Lower Macquairie, but this was already occupied. Until we reached the Barwon we had travelled through dry country, water being confined for the most part to the Macquairie River and the larger creeks. The Barwon was lined on either bank by large blue-gums ; the channel was wide and deep, and numbers of waterfowl floated lazily on the splendid reaches of water. It was only close beside the river, however, that grass was plentiful, and even it was very dry in most places. Sturt, after vainly trying to follow the Macquairie through the marshes which were then almost dry, turned to the left and crossed the dry bed of the Bogan without recognising it as a river of importance. He passed under Oxley's Tableland, Durban's Group being distant only a few miles, and named the river he discovered the Darling. His disappointment can be understood when he found the water was too salt for men or his animals to drink. The saltness they discovered arose from brine springs in the river itself. When in 1859-60 I visited the country the water was fresh and good, but its dry character was well-known, and the frontages to the river had not in all cases been stocked. For several years, however, Tyson and other pastoral magnates, who knew their way about much better than some other people, had made it a practice in good seasons to travel stock which they had bought further north down the river, and many of these they sold as fats when they arrived at Swanhill. At Breewarrina, sometimes called "The Fisheries," not far above the Bogan junction, a station which belonged to Capp and Loder, I was informed that there were 600 head of cattle when a drought desolated the country. These all disappeared, and no trace of them could be found until some years afterwards a few of them with their unbranded progeny were reported to have been found on some swampy country far away to the westward. I followed the river downwards on both sides for many miles below the junction of the Warrego. The season was not what one might call a drought, but the weather was dry, grass except along the frontages was scarce, and the showers that occasionally fell dried up at once. I should not have had the temerity to settle in a district which had so droughty a reputation, but when to this disadvantage were added the fearful heat, the dust-storms, the millions of little tormenting flies which were always in evidence, the blight, and quite a number of other hateful circumstances, I could see no inducement to remain there longer than was absolutely necessary. So I returned to Sydney and commenced my preparations for a northward flitting. This did not occupy much time, and once more I took the Port Stevens road for New England, for I still had an interest in Waterloo and Tiara, and my intention was to secure sheep country, if possible, and stock it up from those stations.

On New England I purchased a number of horses, and with one assistant started for the new Northern colony about August, 1860. My latest recollection of the high country on that occasion was a smart fall of rain and sleet the night before we crossed the Queensland border at Ballandean. Up to this time my horses had been behaving admirably, but after passing Warwick we found a scarcity of feed, for the spring had not fairly set in, and my first impression of the Darling Downs was less favourable than I had anticipated. The horses, too, experienced some disappointment, and the green spots which we passed in our travels remained fresh even in their dreams and induced them to return at night by the road we had travelled by day. After a day's rest in a snug bend in Glengalen Creek we pushed onwards past Eton Vale and Drayton to Toowoomba, which was then commonly spoken of as the Green Swamp.

Lying on a sofa in the inn at Drayton was a Mr. Perston, who I had known a few months before as the managing partner at Tooralle on the Darling River. *Then* the poor fellow was suffering from lung disease; *now* he was resting for a brief space at Drayton, sent there by his medical adviser in the hope that the fresh dry air would effect an improvement. A few weeks later he rested from his labours for ever!

At this time I thought seriously of trying for country on the Maranoa, and from Toowoomba I turned westwards, passing Gowrie, then owned by Mr. Isaac; Jondaryan, which was under the management of Mr. J. C. White; and Dalby, then a very primitive township. Information obtained "by the wayside" dispelled the idea that I should find the class of country I wanted on the Maranoa, and at Condamine township I again turned northward, passing a station owned by Mr. John Ferrett and managed by Mr. Lethbridge. Before I reached Juandah, where resided Mr. Golden, the manager for the Brothers Royds, patches of green feed here and there gave hope of a general improvement in the state of the country, and the night after we passed Juandah rain set in heavily and continued for some days. The Juandah Station, by the way, was originally held by Herbert Salway, of St. Leonards on New England, and Percy Stephen, a nephew of the late Sir Alfred Stephen. Until the rain had ceased I did not shift camp, and during that little holiday heard many details of the Hornet Bank massacre and the retributive massacres which followed. Mr. Royd's name ought to be recorded amongst the chief of those who did their utmost to protect blacks who had not participated in this slaughter. By the time the rain ceased the country had become terribly boggy; but Mr. Golden enlightened me somewhat when I referred to this by explaining the difference between it and the country on the Dawson. "*Here*," he said, "a horse will sink to his hocks; *there* he will sink below his hocks!" I followed the road towards Taroom as far as Hawkwood, a station owned by Mr. Hook, who also had property near Dungog in New South Wales. I am told the brigalow has spread very largely on Juandah and Hawkwood since then. At that time it was comparatively open and much of the scenery was very beautiful, numbers of bottle trees of great size standing out on the open patches or growing along the edge of the brigalow. From Hawkwood I turned in again towards the coast, passed Mr. Long's Bungaban station, and then crossed the range on to

Burnett waters. The next station we passed was Mr. Pigott's Auburn, but I need not here name the stations and occupants between this point and Gayndah. What impressed me more, I think, than anything else was the fact that, for the present at any rate, I was right away from the terribly dry country of which I had seen so much during the last two years. We had heavy rain somewhere before we reached Gayndah, and the granity country became about as boggy as rain could make it. The roadway had been hardened by continual traffic, but whenever a horse took a step away from the beaten track down he went to his knees in the yielding soil, and gladly enough he made the solid road again. I remember that one night, after a soaking day's rain, I sat in the tent before the fire trying to dry my blankets and clothing. It was an all-night business, but I made it a practice never to lie down for the night in wet clothes, for this I had always been taught would certainly develop rheumatism, or lumbago, or sciatica. My man slept in his wet clothes as comfortably as though he occupied a feather bed, and I honestly believe that fellow has never had a rheumatic twinge; I, notwithstanding all my efforts to stave off these things, have had all of them! The Boyne River—*The* Boyne it was called by explorers who, when they came upon it, thought it was the river near Gladstone, so named years before by Oxley, and it is still The Boyne, the river properly so called being allowed a secondary position as *Oxley's Boyne.* The Boyne River, which is merely a tributary of the Burnett and flows into it from the south, was running pretty high when we came to it, but we crossed without difficulty. The Burnett was more self-assertive, and not caring to run risks that were unnecessary, from Gayndah, where I had intended to cross, I followed the Maryborough road, crossed Baramba Creek, with its almost upright basaltic columns, passed Wetherton, then owned by the Moretons, and found old friends in Mr. and Mrs. Walsh at Degilbo. While here I determined to further reduce the number of my horses, of which I had sold a few along the road; so I took them to Maryborough and got rid of them there by auction sale. When I started Northward again, Mr. Arthur Brown, of Gin Gin, was my companion, and as the Burnett was still high, we made for Walla where was a boat in which we crossed. Our horses we had to swim one by one behind the boat, for the stream was swift and the landing place narrow. Old John Barker and his wife were hospitable, as good bush people always were. Two things I took particular note of here. Mr. Barker had the best collection of books I had yet seen at any Queensland station. He had also a splendid lot of orange trees, which thrived greatly in the drift soil on the river bank. A great deal of the lower Burnett country is of volcanic origin, basaltic columnar formation showing freely in Baramba Creek and in the river bed in front of Walla house. Indeed, the country around Bundaberg, as we now know, is largely of volcanic formation; and at Ban Ban, near Gayndah, Mr. Nugent Wade Broun, a few years ago discovered two old craters, which are now partly filled with fresh water, on the summit of a high mountain.

Twelve miles north of Walla was the Gin Gin station, then owned by the brothers Brown, and with them I stayed a couple of days. Frank Jardine was there waiting for his father, then Land Commissioner at Rockhampton, and with him young Salmon, who afterwards formed a home in South America. Old Mr. Jardine was prevented by illness from leaving home, so we three young fellows rode on together and stopped the next night at Kolongo. My old friend Holt was absent, but in charge of the station was a young fellow whose self-importance was enough to suggest that he owned Kolongo and several other stations as well. He passed out of view many years ago. He accompanied us on the following day, and at luncheon time I made the acquaintance of my friends, Mr. and Mrs. F. A. Blackman, who now live at "Boreela," near the Hamilton. I sat at their table and eat salt with them, and we have been friends ever since. That evening we found a welcome at Miriam Vale, where lived Edwin Blomfield, the managing partner, as good a neighbour as anyone could wish to have. At this time I was making for Barmundoo, a station then owned by the Browns of Gin Gin. The elder Brown, who was commonly known as "the British Lion" or the "Britisher," was staying there at the time, and I wanted first to visit him and then to go on to the Callide, where my old friend and partner, Morton, reigned supreme. From Miriam Vale we took a bush track through to Iveragh and Riverstone, stations owned by Captain O'Connell — he then was, afterwards Sir Maurice O'Connell. To the right of the road after we passed Carlo's lagoon were beautiful masses of golden flowers beside some patches of vine scrub. Such profusion and such colour I could not pass without closer examination. My companions knew nothing about it, but Carlo O'Connell, at Iveragh, was the botanist of the district, and knew the names of all the flowers in the bush. He could tell me all about it, they felt sure; but Carlo was no more of a botanist than some I could name who profess to be, and he was not one of those who make false pretences. He had never known the tree to flower before, he said, and could not tell me anything about it. I afterwards found it was *Barklya syringifolia*, and it seldom missed flowering in succeeding years. That night we slept at Riverstone, where Pocklington was in charge. At one time he was employed by the Australian Agricultural Company, and on two or three occasions, when I lived on New England, he paid us a passing visit at Waterloo. Here I parted with my companions, and next day I had lunch with "The Britisher" at Barmundoo.

By this time I had come to the conclusion that if I was going to bring sheep to Queensland I must look for country further back from the coast, and by going further west it seemed probable that I should strike country which was subject to such droughts as they had in the western part of New South Wales. Since I had left Juandah and Hawkwood I had seen no country on which I would have cared to put sheep. There was plenty of grass everywhere after the rain, but it was unlike any grass on which I had known sheep to thrive. Most of the runs had been stocked with sheep, but at this time the owners were realising the necessity for substituting cattle. Even where I was then, it seemed certain that the seasons were sometimes very dry indeed, and a place in Fuller's Creek was pointed out to me where there was a splendid waterhole and plenty of water in the creek above it to its very head. From this point upwards, at the time when I was droving cattle to Victoria in 1858 and leaving numbers of dead ones by the roadside, this hole was dry, and there was not a drop of water in any part of that creek above the crossing at Barmundoo. The fact was unpleasently suggestive, but there were reasonable grounds for believing that when the country had been stocked for two or three years it might improve by reason of the surface soil hardening. After a time I went on to the Callide where, and at the Prairie adjoining it, there was a patch of very pretty country, and I offered to inspect the Kroombit, which I had heard was for sale. John Landsborough, to whom it belonged, changed his mind about selling when he met a possible purchaser. After this I quite determined to give up the search for sheep country, and entered into negotiations for the purchase of various properties without result. At last I bought the Rodd's Bay run, unstocked and unimproved, from Mr. Walsh, of Degilbo, and sold my interest in the New England stations.

During the years I lived in the Port Curtis district I made myself acquainted with a great deal of the surrounding country, and, notwithstanding many drawbacks, I never regretted my determination to settle near the coast. The work connected with the formation of a new station is more or less expensive and troublesome, but it helps to enlarge the interest in life and breaks a monotony that sometimes becomes too dull. I soon learnt, however, that close proximity to the sea—the beach formed one boundary of my run—affords no protection against drought. On many occasions in more than ordinarily dry summers I have watched the heavy clouds rolling across the sky without letting any of their moisture fall until they hung over the ever restless sea. There the rain would come down in torrents, and on the land the dust would rise with every breeze. Still, we managed to pull along without any excessive loss; the surface of the soil had so far hardened that the water, when it rained, more readily flowed into the water-courses and filled up the creeks, upon which we relied for a constant supply. About 1867 an experience which was as bad as a drought overtook us. All the pastoralists were, of course, aware that pleuro-pneumonia was drawing ever nearer. I had sent for the newest publication on diseases in cattle, and when it arrived I turned anxiously to the treatment of this fell disease. Unfortunately, Professor Simonds had made his report upon the treatment of pleuro-pneumonia by inoculation, and here I found his words quoted in condemnation of the practice. Such an authority could not be treated with disrespect and I left it to Providence to see us through our trouble. We had been experiencing an exceptionally dry spell and were drawing water for domestic purposes from a hole about a mile from the station, when one day Page Kennedy made his appearance with a large mob of store cattle which he had brought from the Lower Burnett. He camped that night by the station and next morning his cattle trampled up the mud in our only clean waterhole; it mattered little though for rain set in and washed every water-course from end to end. It also flooded the Boyne River, and Kennedy and his cattle were blocked for several days. Very soon afterwards the cattle on the runs began to sicken; the fat bullocks which were expected to give a return that would keep bank accounts in an easy condition were the readiest to drop off; breeding cows, heifers, calves, steers, and bulls, all were affected, and, without having made any sales in two years time, my herd was reduced in number by one-third; some of my neighbours lost half. It was a hard time, but most of us recovered our position in a few years through the increase of prices that took place after the depletion of the herds.

In the last month of 1875, having taken a partner in the station, I left him in charge and moved off to Sydney. He was an excellent young man, but after a time his health became impaired; how much so I did not know until the beginning of 1883. Unfortunately for myself, I bought him out, but I had no suspicion of a big drought having begun. The recollection of that time is by no means agreeable. All of us had very heavy losses—in some cases quite 50 per cent.—and there were very few, I think, who would have believed that a greater evil in the form of drought could overtake them. The drought which has been devastating the country for so long, is probably worse than that of 1883-4-5. Undoubtedly it has been more universal; but in a new country the severity of droughts cannot be satisfactorily compared. In 1858, when the losses were so heavy in a large part of what is now called Riverina, they occurred for the most part amongst travelling cattle. The runs were unfenced and the local cattle found abundant pasture in the back county, coming to the frontages to water about every second day. Many an evening I watched them coming in from across the plains to drink from the Lachlan. In long strings they would approach, as it were, from behind the horizon—a game of follow my leader. As they drew near the stream they would run and caper about like so many calves. Then, when their thirst was assuaged, and they had had a good corroboree, they would march back in line as they had come; they needed no grass, and they were strong and in good condition, proving the sufficiency of the feed in the waterless back country. Fencing has changed all that; the rents have been raised, the number of stock largely increased, and the losses are very much more heavy. It is impossible to compare the severity of droughts where the conditions have been so materially altered. So in Queensland in the districts with which I am best acquainted it is impossible to compare the 1858 drought with that which commenced in 1883, and the latter with that which continues to devastate so large a part of this State. During the later period the finding of artesian water in so many wells is a new and disturbing factor, so far as comparisons with the past are concerned. Without, however, going into figures relating to rainfall, which are in themselves imperfect and unsatisfactory, it will, I think, be generally admitted that the existing drought is the worst which pastoralists have so far experienced, as well along the coast as in the Western districts. My own observation, after an experience extending over many years, has led me to the conclusion that the Western districts of New South Wales and the South-western part of Queensland suffer more severely from drought than the Central-Western districts of this State, while portions of our coast country may properly be described as dry belts, a term that can scarcely apply to any part of the coast of New South Wales.

How to remedy the evil effects of drought—for this we must suffer from in the future as we have done in the past—is a difficult problem to solve. The finding of artesian water has not so far helped in this direction; nor is it likely to do so as long as by continually raising rents pastoralists are tempted to crowd too many stock on their holdings. This has up to the present accentuated the distress and augmented the common loss. Something may be done by storing fodder in good seasons to help the stock through those that are dry; but when consideration is given to the enormous supplies that must be kept on hand for this purpose and the risk of losing much of it by fire, it is evident that this cannot be relied upon to cure the evil. By irrigating as large an area as practicable on each of the Western stations, relief may be to some extent secured; but even so, how far can the artesian supply, if it should permanently answer for irrigating purposes, be relied upon? Our late Government Geologist, Mr. Jack, has warned us that the supply is by no means inexhaustible. May it not be possible, by cultivating indigenous as well as imported grasses, to provide a more reliable supply both of green and dry fodder for use in droughty seasons? The cultivation of *Paspalum dilatatum* has shown what may be done in the coastal districts. Are we to regard it as an impossibility that suitable grasses and shrubs may be successfully grown in the arid parts of the country? Here undoubtedly is an experiment worth trying; but it must be conducted by an expert, and, unfortunately, the authorities have not yet discovered that we have such an one in our much-respected Colonial Botanist, Mr. Frederick Manson Bailey. The services of the only man in the State who I believe has a thorough knowledge of the subject, are to be dispensed with because it has not yet been realized that the store of knowledge which his age has enabled him to accumulate, may be used for one of the most practical purposes which the pastoral interest stands so much in need of. I do not contend that new grasses and new herbage may be easily found which will resist drought in the West; but why should we assume that they cannot be found? Should efforts in this direction prove unsuccessful, we surely may hope that drought-resisting shrubs can be found. The long-despised prickly pear, *Opuntia vulgaris* of the botanists, has saved many hundreds, if not thousands of stock. We have also amongst our indigenous plants the mulga, appletree, oak, bottletree, and others which have kept animals alive, if not healthy, for many months in succession, a fact which ought to encourage pastoralists to persevere. At least they might cultivate patches of these. And why should not the Government assist in a work which aims at so much good to the State by adding to the value of Crown lands? We have agricultural experts, tobacco experts, fruit experts, dairy experts, and others whose special business it is to assist agriculture in its various forms. Would it be too much to ask that experiments in the direction I have indicated be initiated for the benefit of the pastoral industry, under the direction of our exceptionally well-informed Government Botanist, Mr. Bailey? Surely this would be wiser than sleeping on until another drought overtakes us; and the cost need not be large. The trees which have been keeping thousands of stock alive for so long are being exterminated. Have those persons, who have derived so great benefit from them, even begun to consider what substitute may be provided in place of them if they should not be quickly replaced?

AUSTRALIAN WOODBORING COSSIDAE.

"*Endoxyla macleayi*," SCOTT; "*E. boisduvalii*," ROTHS; "*Culama expressa*," LUCAS; WITH INCIDENTAL REFERENCE TO OTHER SPECIES.

(PLATE VII.)

By R. ILLIDGE and AMBROSE QUAIL, F.E.S.

[*Read before the Royal Society of Queensland, 17th January, 1903.*]

WE are not in a position to offer a systematic classification of the Cossidae,* but believe this paper will be of value as a contribution thereto; indeed this will be something, for authorities do not agree as to their treatment. Pro tempore, we adopt Rebel's (Iris xi.) subdivision of this group into Cossinae and Zeuzerinae, of which there appear to be some forty-five species in Australia —eleven Cossinae, thirty-four Zeuzerinae, to which may be added three species of Phragmataecinae. The group is entirely without representatives in New Zealand.

We regret exceedingly having been unable to procure ova for examination, but it may be of interest to note that the ovum of Cossus cossus (Europe) is ornamented with "crystalline" sculpture on the eggshell; nor have we examined newly-hatched larvae, doubtless the first instar will furnish details of value, but these groups do not differ widely in any stage as to larval structure, according to Dyer† only in the absence in the first instar of the tubercle above the base of the abdominal feet. The material with which we are familiar consists of larvae older than the first instar, and some pupae.

* We understand Rothschild is engaged on a revision of the group.

† Dr. Dyer, New York Academy Science, 1894.

It is generally conceded that the earlier lepidopterous larvae were phytophagous, and it is well known that many Hepiali are subterranean feeders. Our previous paper‡ dealt with "Australasian Woodboring Hepialidae," we cannot, however, separate Hepialidae into two distinct phylogenetic groups—phytophagous and lignivorous—it seems rather that some Hepialidae independently from time to time acquired lignivorous habits, in an evolutionary sense these may be regarded as higher than those of phytophagous habit.

We may note, however, there is little difference in actual habits between phytophagous and lignivorous Hepialidae. Subterranean species burrow more or less vertically into the earth, and pupate without any cocoon in the vertical larva burrow. Woodborers likewise burrow vertically downwards, the only approach to a pupal cocoon being that a prepupal operculum is constructed, which seals up the vertical bore or the horizontal galleries; there is also throughout the larval existence an outer (external) cover.

There was probably little differentiation amongst early Lepidoptera as regards larval habits, differentiation accompanied specialisation, and we may trace the habit of existing Lepidoptera, exposed feeders, case bearers, leaf miners, to progenitors whose habits were similar, living in primeval marshlands, where Neuroptera passed their developmental stages in shallow pools, micropterygid-lepidoptera fed among damp mosses, and Hepialidae derived subsistence from the roots of grasses and ferns. Having acquired the habit of feeding in the interior of reeds, as do existing Phragmataecinae, some Cossid progenitors became lignivorous, and their larvae are now almost exclusively so.

Cossidae larvae burrow indifferently up or down in saplings, branches, or trunks of trees of large growth. At an early age* the lava commences to bore, and covers the burrow with an external cover (Zeuzera) or with a loose web (Endoxyla) sometimes a prepupal cover is constructed (Endoxyla), some pupate without a cocoon, others construct a pupal cocoon. Zeuzerinae do not leave the larval burrow—like Hepialidae—

‡ Trans. Royal Soc., Queensland, Vol. XVI.

* The very earliest stage of the larva is not passed in the wood, and calls for special investigation, as to what is the exact habit when first hatched.

until the pupa forces its anterior segments out of the burrow for the imago to emerge. Young Cossus larvae feed at first beneath the bark of the tree, then burrow into the wood, there to spend, as do Hepialidae and Zeuzerinae a lengthy existence often of three or four years. The habits of Cossinae are not so exclusive as those of Hepialidae and Zeuzerinae, the external cover is often absent (Culama), indeed we have frequently observed the larva of Cossus cossus when full fed, expose its whole length to warm sunshine, moreover it will commonly leave its larval burrow to pupate elsewhere, even in the earth away from its ligneous habitat. May it be that a too numerous colony (Cossus and Culama are gregarious) in the same tree, by breaking in upon each others burrows, always strictly avoided by Hepialidae, become a source of irritation, or even danger at the critical time of changes to the pupal condition, and the larva is compelled to pupate elsewhere. The normal habit appears to be that the larva tunnels to the bark which it eats away, leaving however a very thin surface, and it may be noted these larvae frequently fill their burrows with a kind of solidified sawdust (Hepialidae scrupulously eject all frass). †A cocoon of silk and chips is constructed within which it pupates, in the immediate vicinity of the exit ; finally the pupa forces its anterior segments through the thin outer cover of the burrow and the imago emerges.

Always remembering the limited material at our command, so far as it goes our observations show that Zeuzerinae and Cossinae may be associated by some identical larval structures. The number of scutellar setae of prothorax, the tubercle arrangement (and spiracle scars) of meso and post thoracic segments, the lateral thoracic intersegmental tubercle ; the duplicate remote supraspiracular seta, the position of the basal setae, and the hooks of the abdominal feet. These structures are not peculiar to Cossidae, being also observed in other groups (composing Dyer's superfamily Cossina), but they sharply and distinctly separate Cossidae from Hepialidae, which cannot be associated.

Some larval features appear to afford good characters upon which we may separate Zeuzerinae from Cossinae. The Zeuzerin prothoracic scutellum, viewed laterally, slopes upward and backward in dorsal outline, so that the length from front to back

† Proc. Roy. Soc. Queensland Vol. XIV. (Illidge).

is considerably more than the length of the ventral surface of the prothorax; the produced posterior area of the scutellum is provided with numerous spicules (Zeuzera, Endoxyla). The prothoracic scutellum of Cossinae is smooth, not produced posteriorly, being confined to normal and proper limits, the posterior margin parallel to the anterior margin (Cossus, Culama).

An important feature in Zeuzerinae is the presence on the dorsum of the abdominal segments of minute tubercles (one each side) with seta, in front of the typical anterior trapezoidal tubercles (Zeuzera, Endoxyla), but which are not observable in Cossinae. These tubercles are probably homologous with the thoracic intersegmental tubercles, observed also in Cossinae, and in other groups of Lepidoptera. Mr. A. Bacot, in a letter some years ago, drew our attention to these (abdominal) tubercles on the larva of Zeu era pyrini (Europe), he having also observed those of the thorax in several isolated groups of Lepidoptera e.g. Lycænidae, Psychidae. We have noted such thoracic intersegmental tubercles with setae in newly-hatched and adult Hepialidae*, in Lysiphragma (Tineina) without seta†; they are also present in Tortricina (Cacaecia) and others. Bacot believes this to be a once common character, now generally lost in Lepidoptera, and had not then detected the setae which are present on the thoracic and abdominal tubercles in question of Endoxyla. We have been unable to find whether Dr. Dyer is aware of these extra abdominal tubercles.

We are not inclined to insist upon minor differences; that Zeuzerin larvae are circular or nearly so in transverse section; Cossinae, being flatter, are barely more than semi-circular; that Zeuzerinae have middorsal spiculate abdominal humps, and some other features, as young larvae in either group may be more alike.

A consideration of the pupal structure affords additional support to the conclusions arrived at from larval characters as to the separation of Hepialidae from Cossidae,‡ and the subdivision of Cossidae. The pupae bear a superficial resemblance to each

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* Trans. Ento. Soc., Lon., 1900 (Quail).

† Trans. New Zealand Institute, 1900 (Quail).

‡ We wish to emphasize that these groups cannot be associated, which, of course, is generally admitted, but are sometimes treated of or referred to as if they were. Their primitive ancestors were probably neither Hepialid nor Cossid, but had some of the characters now found in each group.

other, but, when examined closely, we find sufficient points of distinction between the groups.

The Hepialid pupa is remarkably cylindrical, Cossidae are not so. Hepialidae have dorsal and ventral segmental spines, Cossidae have the dorsal spines only. The Hepialid antenna is diminutive, reaching only to the "knee" of 2nd leg, in fact that portion of the antenna which extends beyond the pro-meso-thoracic suture is half its entire length. The Cossid antenna reaches to fully half the wing margin being some four times the length of the basal portion. The ancestors of these groups had comparatively short pupal antennae, and if Cossidae are derived from progenitors with antennae like those of typical existing Hepialidae, then the latter are lower in the evolutionary scale than Cossidae, which will have specialized in having developed antennae of greater length.

The Lepidopterous pupa has its appendages—legs, wing-cases, etc., extending beyond the thoracic segments downwards, adherent to certain abdominal segments which become incorporated with more or less fixity, so as to lose their individual movement; the terminal (anal) segments likewise become one coherent mass, in varying number, and movement of the pupa is thus confined to the intermediate segments, of which the incisions remain free and functional. Dr. Chapman has pointed out the importance of this structural character, in classification.†

The wing cases of Hepialidae adhere to the abdominal segments 1 and 2, that they have become integral parts of the anterior mass is shown in that the spiracle of 2 is subdorsal, and on dehiscence they (the wing cases) still adhere to those abdominal segments. In Hepialidae the free segments are ♂ 3, 4, 5, 6, 7; ♀ 3, 4, 5, 6.

The Cossid spiracles are normal in position, and on dehiscence the appendages lose their apparent fixity to the abdominal segments, remaining attached only by the inner membrane of 3rd legs and hindwings, the disseverance exposing to view the abdominal spiracles (1 and 2) in normal position, until then covered by the wing cases. In Zeuzerinae the free segments are ♂ 3, 4, 5, 6, 7; ♀ 3, 4, 5, 6. In Cossidae the free segments are ♂ 4, 5, 6, 7, ♀ 4, 5, 6. In respect of incorporation of the numbers of abdominal segments into the anterior mass Hepialidae are the lowest, there being a tendency in Zeuzerinae to

† Trans. Ento. Soc. Lond., 1892.

incorporate segment 3 also, and in Cossinae 3 is so incorporated, but Cossidae—both Zeuzerinae and Cossinae—retain a character relatively more ancient than that of Hepialidae, that is, the freeing by disseverance of the appendages from the abdominal segments on dehiscence.

ZEUZERINAE—ENDOXYLA.*

Description of larvae.—The dorsal horns of anal segment may prove a good *generic* character. The arrangement of scutellar spicules is probably a good *specific* character.

E. boisduvalii—"Roths." (Plate VII., Fig. 6.)

† The larva at an early age feeds beneath a light-coloured silken web, which falls off subsequently when the larva has burrowed into the wood of the tree; our description is made from a larva 35mm. in length, it has at this stage a very pleasing plumage, being ringed alternately red and yellow, it is in appearance quite an elegant aristocratic larva, but with approaching maturity loses its remarkable coloration.

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* Derived from endo and xulon.

† The first intimation of the presence of the larva is readily noted by this freshly-formed web of loose silk and gnawed pieces of the bark of the tree, upon raising which the caterpillar may be seen, either partly buried in the bark and young wood or quite entered within the small tunnel it has bored. Later on the bark begins to grow over the opening made into the tree, the web falls off or is blown away by the wind, and a small circular scar is the only indication then left of the insect inside the tree. The larva continues tunnelling towards the centre of the tree, increasing in size, and the bore becoming larger. Having gone as far as the heart of the tree, or nearly so, it cu ves upwards at right angles to its former course for from 6 to 8 inches, and completes the remainder of its existence by feeding upon the constantly forming young wood and sappy matter, sometimes making two or three short pseudo-bores at the foot of the perpendicular tunnel, which together form a large chamber within the stem of the tree. Having attained full growth within it prepares for its change and exit as an imago or winged insect by gnawing outwardly with its powerful cutting mandibles, and forms a clean cut round hole often nearly an inch and a-half in diameter upon the outside of the tree. This opening is frequently blocked up by triturated fragments of wood loosely spun together with silk. The next process is the retreat of the insect to the perpendicular tunnel, where it first forms a most singular network of a very viscous substance from 1½ inch to 2 inches in depth, which when first formed is a pure glistening white, but becomes yellow with age. On this it forms its operculum of finely triturated wood closely felted together with silk and saliva. Having completed all its arrangements the larva, now head downwards, and quite filling up the chamber-room left, turns to a pupa (chrysalis), and in the course of a month or six weeks, occasionally longer, the imago emerges in the manner usual to insects of this group.

Head is yellowish brown ; scutellum has the anterior half blackish, except at margin which is yellowish, as is the posterior area ; segmental area of prothorax is yellow ; mesothorax thinly bright red dorsally and subdorsally, yellow below ; postthorax and 1 to 9 abdominal segments are divided transversely, anterior red, posterior yellow, sections, above the spiracles the band is dull red, at and below the spiracles and ventrally it is bright red ; the posterior dorsal humps are brighter red than are the anterior humps ; the anal segment is wholly yellowish brown.

Shape : Viewed dorsally, is uniform, robust ; viewed laterally, the meso and post-thoracic segments are " weaker " than others. Head : Finely striate. Prothorax : Scutellum finely striate anterior, and finely spiculate on posterior area, four larger spicules are arranged in a trapezoidal position, *i.e.*, two in front approximate (with some minute spicules between them) and two posterior remote. On either side of the median line of scutellum are one anterior, two posterior dorsal setae on the unspiculate area of scutellum ; two anterior and one central setae are on a lateral subdivision of the scutellum ; a prespiracular tubercle bears two long setae with a small inner seta near the spiracle. Spiracle is very large, above the legs a tubercle bears two setae. Meso and post thorax : the dorsal and subdorsal setae are duplicate pairs ; lower a more central lateral tubercle bears a single seta, and an anterior tubercle bears also a single seta, between these tubercles a rudimentary spiracle or scar may be detected ; a lower anterior tubercle bears a single seta, and tubercle above legs bears one seta.

Abdominal segments : the dorsal humps are divided transversely, not longitudinally, and are covered with minute spicules, the anterior hump is largest. The trapezoidal tubercles are normal with a single seta each, placed on the segmental area, not on the humps. The supraspiracular tubercle has a single long seta above the large oval spiracle, and there is a remote anterior supra spiracular tubercle with a minute seta. The subspiracular tubercles each have a single seta, the anterior highest in position ; above the legs a tubercle bears one central seta ; the basal setae are three in number, one being above the others, not in line with them. Segment 9 has the anterior trapezoidals remote, posterior trapezoidals inner ; 10 has two small blunt protuberances of red colour representing what in other species are a pair of anal horns, the setae are one anterior, one level with horn, one posterior, one more lateral, three lateral setae are below the anal flap, and basal setae are on the anal claspers. The abdominal feet have a single row of hooks, the interspace being pear-shape. In addition to the typical tubercles described, the intersegmental area of pro-meso-post-thorax carries two minute setae one below the other, a little below the subdorsal pair of thoracic setae in position. On the abdominal segments a minute seta is placed on the anterior margin longitudinally in line with the posterior trapezoidal tubercle; it appears to be frequently turned under out of sight by contraction of the segments.

E. macleayi—"Scott." (Plate VII, figures 1, 2, 3, 4, 5.)

Larvae varying in length from 47 mm. to 67 mm. have been examined, and are identical as regards structure, and we especially noted the scutellar spicules were so. Head brown, scutellum anterior area brown, with middorsal and lateral areas black, general colour of body dirty pale brown, with pinkish lateral flanges, blackish spiracles, brown legs, and abdominal feet.

Shape: Viewed dorsally is robust, uniform except that the subdorsal tubercles of mesothorax protrude conspicuously; viewed laterally meso and post thorax are smaller than abdominal segments, which latter are produced to prominent humps on the middorsal outline (as the preceding species); 8 and 9 are without humps; 10 has a pair of postero dorsal horns—distinct chitinous (not fleshy) processes curved backwards.

Structure: Head freely striate, clypeus with straight sutures having two setae one before other at lower corners; ocelli four, in fairly close crescent, one lower, another near and below antenna; jaws dentate; maxillae short and stout with one palpus developed.

Prothorax: scutellum slopes (as in preceding species) upward and backward from the small caput, the anterior half striate transversely, posterior area covered with chitinous spicules of which *three* of the largest are in line, considerably in front of the others; these spicules are hollow protuberances (shown by dissection of the thorax) as much so as cow's horn, they are somewhat irregular in size, more numerous and more minute towards the outer and posterior edges of scutellum. The larger spicules are invariably blunt at the top, the smaller ones intermixed are sharp pointed. The function of the scutellar spicules is evidently to act as a saw or rasp upon the wood of the tree, thereby assisting the work of the jaws, such action causing the larger spicules to become blunter, the spicules are directed backwards (*i.e.*, upward).

The tubercles and setae of thoracic and abdominal segments are as described of the preceding species. The prothoracic spiracle is extremely large, earshaped with convex curve posterior. Owing to innumerable number of brown spicules which cover the thoracie and abdominal segments on dorsum, laterally, and ventrally, intersegmental tubercles cannot be detected, nor can the extra abdominal setae, except the small remote supra-spiracular.

These larvae grow to a very large size, we have a specimen which is, we believe, this species in its ultimate instar, in length 16·4 cm.; in width, 19 mm.; being so large it offers a good subject to examine for different structures. The colour is dirty whitish yellow, jaws brown, head dark brown shading to yellow at suture of clypeus, scutellum yellow anterior margin with dark brown shading to reddish either side of a V shape median mark yellow in colour which spreads over the whole posterior area of scutellum on which the spicules show distinctly as little brown dots; the abdominal humps are slightly brownish from the numerous brown spicules; the tubercles are little brown areas on the skin, but the spiracles are very dark brown, almost black, raised oval rims, the dorsum of the anal segment is brown with posterior horns of darker brown colour.

In most respects it agrees with the above description as regards structure, but the frontal spicules are *four* in number, the largest of the hinder flanking spicules marking the trapezoid similar to Boisduvali. The skin of the thoracic segments has numerous brown spicules, but the abdominal segments are practically free from spicules except on the humps. The pro-meso-thoracic intersegment carries a dorsal seta (almost hidden by posterior edge of scutellum) just below the dorsal pair of setae in position, and two lateral setae below the subdorsal pair of setae. The meso-post thoracic intersegmental area carries two lateral setae, but cannot detect dorsal setae. The extra dorsal anterior setae of abdominal segments are just below the posterior trapezoidal tubercles in longitudinal position; it seems probable that the minute anterior supraspiracular tubercle is homologous with the lower thoracic intersegmental seta, which it resembles in size, and approximates in position. The extra tubercle of 9th abdominal segment are a little more dorsal in position than the second (inner) tubercle. Abdominal feet have a single row of hooks.

Pupa of *E. macleayi*, ♂ length 10·4 c.m. (Plate VII., Figs. 13, 14, 15, 16).

Almost unicolorous dark brown in colour, with darker polished areas on pro-meso-thorax, wing and leg cases. The wing cases extend partly over the third abdominal segment, but are not adherent at any rate on dehiscence, they are then detached and connected only by the inner membrane of legs and hind wings to the second abdominal segment, the spiracles of 1st and 2nd abdominal segments may be seen, normal in structure and in position uncovered by the semi-detached wing-cases.

The head on dehiscence carries antennae, eyecovers, etc., as one piece, terminating with an anterior apparatus with a chisel-like organ ; between the eyes another, and still lower a pair of similar chisel-like organs.

The abdominal segments have the anterior row of dorsal spines best developed, the posterior row being merely a thin line of spicules, the anterior spines are curious as regards shape, each having at its tip a cuplike hollow ; there are no ventral spines, the scars of abdominal feet are very distinct, but are not spinous. Segment 8 has no dorsal spines, but transverse lateral series more strongly developed than are the dorsal spines of other segments—this is so with pupae of *E. affinis*. Segments 9 and 10 are smooth, except for a few spicules which may be related to hooks of anal claspers, the scar of the cloacal aperture is distinctly marked. The sexua' organ extends from 9-10 suture forward to about middle of 8th, being a slightly raised polished surface, where it meets a V and again continues as a thin straight line. The free segments are 3, 4, 5, 6, 7 ; in ♀ the free segments are 3, 4, 5, 6.

Cossinae—Culama.

C. expressa—" Lucas."* (Plate VII. Figs. 7, 7a, 7b, 7c, 7d, 8, 9, 10.)

Of all the internal wood-feeding larvae we have known this is the most gregarious, one piece of branch less than a foot in length containing ten larvae. The burrows may be distinct and run parallel with each other, or may coalesce and in one and the same burrow quite young and older larvae are found. As may

* Trans. Linn. Soc. N.S.W., 1902.

be imagined the damage to the tree is proportionately great, the wood (*Aegiceras majus*), however is tough, and despite the removal of the interior by Culama larvae, still looks solid, showing no external evidence of the ravages committed, and Termitidae could not do their work more effectually than do these larvae.

The larvae under observation were of various sizes 6 to 35 mm. Colour: it recalls the larva of Cossus cossus, being bright red and pale pink ventrally, head dark red, jaws brown, scutellum brownish, spiracles, thoracic legs and hooks of abdominal feet brown.

Shape: Very uniform, flat viewed laterally, broad dorsally; the head is small retractile; of the thoracic segments prothorax is longest, mesothorax widest; 1 and 2 abdominal segments are smaller than thoracic segments, the succeeding six (four of which carry abdominal feet) are more robust; 9 and 10, of course, are terminal and smaller.

Structure: Head smooth, ocelli pale, in crescent of five with one forward below antenna; two setae are enclosed by ocelli; jaws curved dentate; maxillae, one palpus developed others minute; labial palpi anterior to spineret, which is short and stout. No perceptible difference between the organs of caput in this species, and of Endoxyla.

Prothorax: Scutellum smooth, anterior transmarginal; setae three each side, two transposterior setae, one mid lateral near edge of scutellum, anterior to the spiracular position. On each side of the scutellum is a depression less definite, but not unlike in position to the scutellar concavity of Charagia (Hepialidae, Xyloryctina also have similar scutellar depressions); also there are three (apparently) rudimentary circular tubercle bases without seta, in arrangement not unlike the scutellar transmedian setae of other Hepialidae. We are not sure that these are on the outer surface or inner (showing through) of the scutellar integument, they would most likely be overlooked, unless one had a knowledge of the Hepialidae, and being observed on all the *expressa* larvae examined they are at least worth mentioning. Spiracle is oval, large, not extremely posterior. Prespiracular setae, three in number, smallest near spiracle; above the legs a longitudinal tubercle bears two setae; the scutellum of Culama differs from that of Endoxyla.

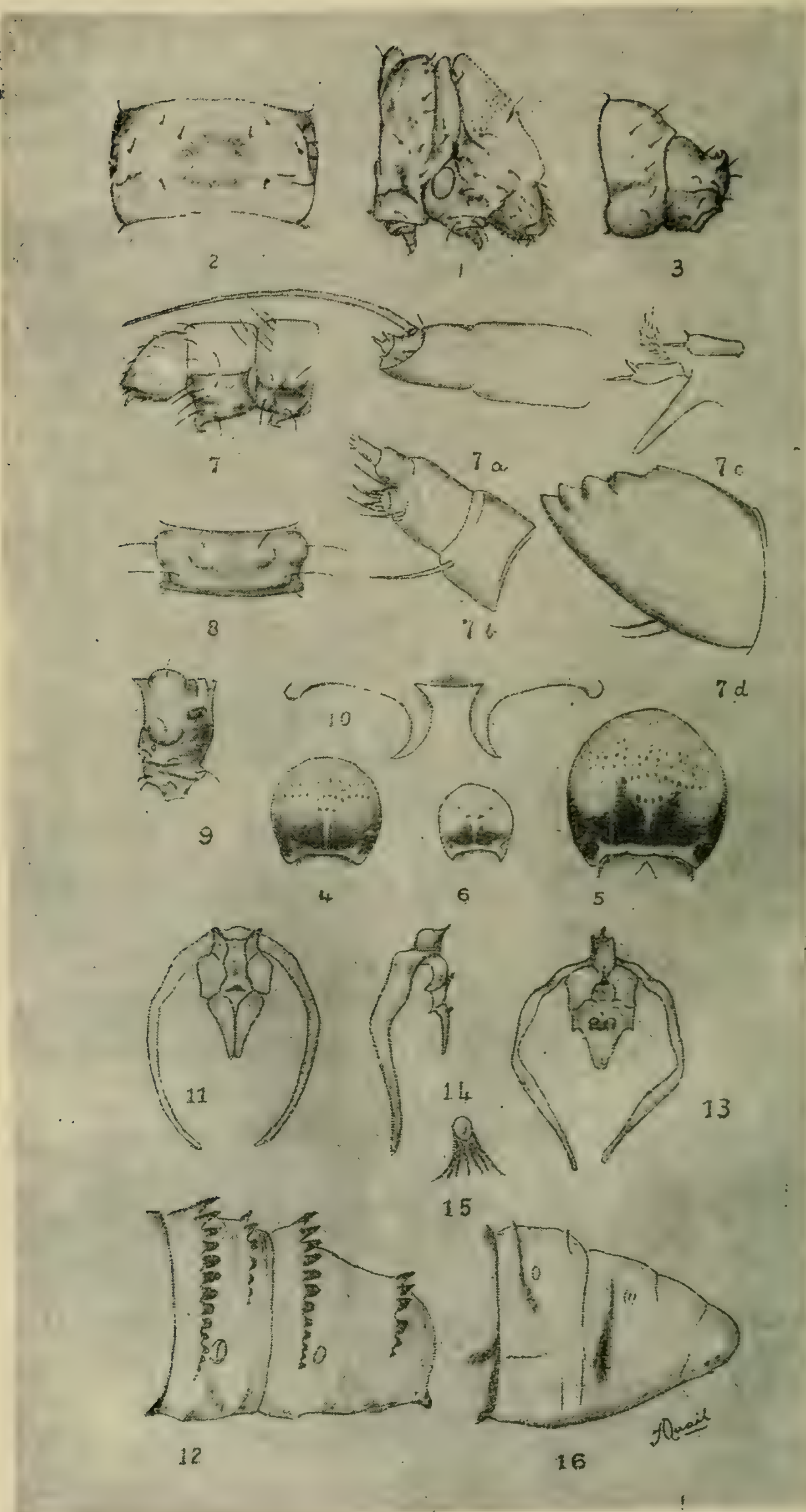
Meso and post thoracic segments: the dorsal and subdorsal tubercles are duplicate pairs, a little lower a more central tubercle and an anterior tubercle ; each bear a single seta, with spiracle scar between, but not so distinct as in Endoxyla ; a lower anterior tubercle bears a single seta. In addition to the typical tubercles, an intersegmental midlateral tubercle bears two setae in position a little lower than the subdorsal pair of setae.

Abdominal segments : have two subsegments, the larger anterior subsegment carries all the tubercles, except the posterior trapezoidals which are on the posterior smaller subsegment. Dorsal elevations form the areas from which rise the trapezoidal setae in normal position ; the other tubercles are as in Endoxyla. The minute anterior supraspiracular tubercle with seta is present, but the anterior minute dorsal seta cannot be detected. Terminal hooks of abdominal feet are as in Endoxyla, consisting of a single row, each hook having a long embedded shaft with a strong free hook. The anal claspers have hooks only on the inner edge. All setae are smooth. The skin of thoracic segments is spinulose only on dorsal area.

Pupa of *Culama expressa.* (Plate VII., figures 11, 12.)

♀ length 21 mm. ; greatest width, 8.5 mm.

Almost unicolorous brown, dorsum rather darker, spines still darker brown ; probably when alive the wing cases are more or less transparent, as in the case with other wood feeders (Charagia) ; preservation in spirits while hardening the tissues renders them opaque. The dorsum curves definitely from 1 to anal segment, ventrally from 7—10. Meso thorax has distinct lateral "shoulders," prothorax and head abruptly tapering. The anterior (head) apparatus, which in Endoxyla is very prominent, is in Culama expressa represented by three parallel ridges passing back to suture of prothorax and ventrally to between eyes, where a raised area carries a depression and terminates with a broad chisel-like apparatus. The antennae pass behind the eyes with a very wide curve, and terminate ventrally about the locality of 1-2 abdominal incision, if same could be seen ventrally. The superior wing cases extend from mesothorax to suture 3-4 abdominal segments, rather slightly beyond, but in no way adherent to 4th abdominal. The short maxillae ? and mandible ?, 1st and 2nd pairs of legs, are between the antennae on ventral surface, tips of 3rd pair of legs show between the apices of the wing cases. The dorsal incisions between 1—7 abdominal segments are distinct, the ventral incisions only between 3—7 are so, segments 7—10 are fused into one coherent


2
1
3
7
7a
7c
8
7b
7d
9
10
4
6
5
11
14
13
15
12
16
A. Quail

mass, thus 4, 5, 6, are free segments. Abdominal segments 1 to 6 each have posterior and anterior parallel rows of strong spines across the dorsum; 7, 8, 9, have a single row each; 10 has three lateral spines on each side. The scar of the cloacal aperture appears as a postero ventral median line, the sexual organs appear as a median linear depression on the ventral surface of 8—9 segments. The pro-meso-thoracic sutural spiracle opening is rather large, and abdominal spiracles 2 to 7 are in normal position, 8 appears as a rudimentary scar. On dehiscence the head, antennae, and mouth parts (ventral appendages) separate as one piece—corresponding to that of Hepialidae—the legs and wing cases remain attached loosely (divided centrally) to the general body of the pupa. The suture with 1st abdominal opens dorsally to near the tips of wing cases ventrally the wing cases becoming semi-detached throughout.

The ♂ pupa differs from the ♀ in being less robust and in having segments 4, 5, 6, 7, free.

The chisel-like apparatus of the head presents a marked difference from Endoxyla.

Explanation of Plate VII.

Figure 1.	*Endoxyla macleayi*		larva:—	Head, prothorax, mesothorax, nat. size.
2.	,,	,,	,,	Dorsal view abdominal segment, nat. size
3.	,,	,,	,,	Lateral view anal segment showing posterior horns, nat. size
4.	,,	,,	,,	Scutellum showing spicules, nat. size
5.	,,	,,	,,	,, ,, ,, ultimate instar, nat size
6.	,,	*boisduvalii*	,,	Scutellum showing spicules, nat. size
7.	*Culama*	*expressa*	,,	Head, prothorax, mesothorax, magnified
7*a*.	,,	,,	,,	Antenna largely magnified (x250)
7*b*.	,,	,,	,,	Maxilla ,, ,, ,,
7*c*.	,,	,,	,,	Spineret and palpi ,, ,,
7*d*.	,,	,,	,,	Mandible largely ,, ,,
8.	,,	,,	,,	Dorsal view abdominal segment magnified
9.	,,	,,	,,	Lateral view abdominal segment magnified
10.	,,	,,	,,	Hooks of abdominal feet (x250)
11.	,,	,,	pupa	Head-piece magnified
12.	,,	,,	,,	♂ Segments 7, 8, 9, 10, magnified
13.	*Endoxyla*	*macleayi*	pupa	Head-piece nat. size
14.	,,	,,	,,	,, profile nat. size
15.	,,	,,	,,	Segmental spine largely magnified (x250)
16.	,,	,,	,,	♀ Segments 7, 8, 9, 10, nat. size

PRESENT DISTRIBUTION OF COSSIDAE.

—	Species	Australian Region.	Oriental Region.	Palaearctic Region. Asia.	Palaearctic Region. Europe.	Ethiopian Region.	Nearctic Region.	Neotropical Region.
Phragmataecinae—								
Phragmataecina, "Newn"	6	Australia ..	Ceylon, India, Burma	Amur, Japan ..	All Europe ..	..	Mexico	..
Genus incog	1	..	..	..	..	..	..	..
Pachyphloebius, "Feld"	1	Australia ..	..	..	..	..	..	..
Gnira	2	..	..	..	..	..	..	..
Zeuzerinae—								
Zeuzera, "Latr"	6	..	Ceylon, India ..	China, Japan ..	All Europe ..	N. Africa ..	U.S.A., N. Am'ca	Texas .. ..
Xystus, "Grote"	3	..	..	..	..	..	..	..
Paracossus, "Hampson"	2	..	Ceylon, India ..	..	..	..	..	..
Azygophleps, "Hampson"	13	New Guinea ..	India	..	..	S., E., C. Africa, Natal, Nigeria	Mexico	..
Duanitus (Butl) Xyleutes	43	Tas., Q'land, W. Australia ..	Ceylon, India, Sickhim, Assam Java, Penang, New Britain, Singapore ..	..	..	Natal, Madagascar	..	Venezuela, Brazil Guatemala, Bolivia, W. Indies, Honduras ..
S.G. Endoxyla ..	11	Australia ..	..	..	..	..	..	..
Cossinae—								
Culama, "Walk"	3	Australia ..	..	..	..	Algeria	..	..
Eremocossus, "Hampson"	3	..	India	..	..	Central Africa ..	..	..
Genus incog	4	..	India	..	..	..	..	..
Stygia, "Latr"	2	..	..	..	Europe	..	..	..
Endagria, "Boisd"	9	..	..	Altai	Europe	..	..	..
Hypopta, "Hubn"	3	..	..	..	Russia, Hungary	..	..	..
Holococerus, "Stgr" ..	6	..	..	Palestine ..	Russia	..	..	..
Cossodes, "White" ..	1	Australia ..	..	..	..	..	..	..
Rethona, "Walk"	2	..	..	..	..	S. Africa ..	..	..
Cossus, "Fabr"	39	Australia ..	N. India, Thibet, Burma, Sarawak, Borneo .. Singapore ..	Japan, China	All Europe ..	Natal, S. Africa, Madagascar ..	Colorado, U.S.A., Canada ..	Chili .. ..
Genus Incog	1	..	..	..	..	..	Mexico, U.S.A.	Coquimbo ..
Genus Incog	3	..	..	..	..	..	..	Rio Janerio, Chili
Genus Incog	4	..	..	..	..	..	..	Bahia, W Indies
Genus Incog	1	..	..	..	..	Natal	..	..
Genus Incog	1	..	..	..	..	Natal	..	..
Genus Incog	1	..	..	..	..	E. Africa ..	..	..
Eutheca, "Grote,"	2	..	..	..	..	..	N. America ..	Argentina ..
Dudgeona, "Hampson" ..	1	..	..	..	..	W. A?rica ..	..	..
Acritocera, "Butl" ..	1	..	..	..	..	..	..	..
Daulia," "Walk"	1	..	..	..	..	..	..	Haiti .. ..

Based on list compiled from collection British Museum by A. Bacot, F.E.S., with additions by authors.

ON THE COMMON WHITING OF MORETON BAY

(*Sillago Bassensis*).

(PLATES VIII.—XIV.)

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Sillago Bassensis, Cuv. & Val. Poiss. III., p. 412.

Synonyms.—*S. Terrae-Reginae.* Cast., Proc. Lin. Soc., N.S.W., vol. II., p. 232.

S. ciliata. Gunth. Cat. Fishes II., p. 245.

S. de Bass. Quoy and Gaymard, voy. Astrolabe, Poiss., pl. I., fig. 2.

S. Bassensis. Cast. Proc. Lin. Soc., N.S,W., vol. III., p. 380.

Local names—whiting, trumpeter whiting. There has been some confusion as to this species. Cuvier and Valenciennes give the fin formula as D. 11—1/18, A. 1/12, and immediately thereafter, "Il y a deux epines à son anale."

Count Castelnau—*loc. cit.*—describes as *S. Terrae-Reginae*, a whiting caught in great numbers in Moreton Bay with this formula, D. 10—1/18, A. 2/15, L. lat. 64, but in the next volume of the same publication he goes back to *S. Bassensis*.

Dr. Gunther under the name *S. ciliata* gives a description that fits the common Moreton Bay whiting, but Cuvier and Valenciennes, who established the species, say distinctly it has no silvery streak along the side. This streak Gunther adds, and as it stands his description of *S. ciliata*, fits *S. Bassensis* better than any I have seen of the latter species.

The *S. de Bass*, figured by Quoy and Gaymard, differs from the Moreton Bay fish in several particulars. The teeth are too large. The first ray of the ventral fin is not prolonged into two feeler-like filaments. The denticulations of the operculum are too prominent and do not extend forward from the angle. The first dorsal fin has 12 spines instead of 11. The markings on the dorsal fins are spots. In Queensland specimens they are on the first dorsal irregular blotches, and on the second blotchings fairly regular in shape and arranged in rows. The anal fin shows 2/19.

The formula is D. 11—1/17; A. 2/16; V. 1/5; P. 15; L. lat. 63; L. trans. 5/12. The back is coloured to resemble the sandy ground over which the fish moves. When freshly taken it varies from a yellowy green in fair sized fish to a greeny grey in old specimens—parts of the scales showing silvery in some lights, with here and there a fleck of gold. After being out of the water some time the back is silvery blue or golden green, according to how the light falls. The head is of the same colour as the back but becoming dark in old fish. There is much variation in the colour of the under side of the head—usually white but often with much dark colouring. The colour of the back shades down into a silvery grey on the lower parts of the sides and an enamel white on the belly. The broad median band is of a silvery yellow becoming indistinct with age. The band often disappears in preserved specimens.

The first dorsal fin has brown blotches on the membrane between the rays. In the second dorsal the blotches are small and in rows—from 3 to 5 blotches between every two rays. The anal is yellow. The ventrals are orange yellow. The pectoral is transparent with a blue black spot at the base. The under lobe of the tail is usually much worn.

The opercle is finely denticulated on the angle and vertical margin. Small teeth are in both jaws on the vomer and palatines. The anterior nostril has a small pointed flap on its back edge. The pupil of the eye is not round but drawn to a corner in front and on the under side—the corner in front is the more conspicuous. The scales are ctenoid.

The whiting is one the most valuable of the food fishes in Queensland. A good-sized fish attains a length of 17 inches and weighs a pound and a-half. The name whiting was given because the flavour of the flesh was considered to resemble that of the whiting of British waters. The latter species is one of the haddock family. The species under discussion at present belongs to the *Trachinidae.*

Spawning Season.

The spawning time of the whiting may be stated to last from September to February. The first ripe fish taken were large males in June. Ripe females occured in fair quantity in September. In a female specimen just over 16 inches long and weighing 1lb. 8¾ ozs. the weight of the ovaries was 3½ ozs., or about 14 per cent. of the total body weight. The fish were observed to have been feeding at intervals during the process of spawning.

Development.

The egg of the whiting is small, measuring from ·68 to ·69 mm in diameter, and contains one oil globule, measuring about ·18 mm in diameter (Pl. VIII. fig. 1.) It is a transparent sphere, and is pelagic. On the perivitelline membrane are a number of faint lines, wrinklings or thickenings of the membrane. The pores in the outer capsule are visible for only a very short time after extrusion. The oil globule is not altogether transparent, but shows a black edging.

After about 15 minutes in the water, the segmental disc (d. fig 2), shows on the under side of the egg. Fig. 3 is a side view of the disc just before segmentation begins. After fertilisation, cell division begins—the 2-cell stage being reached when the egg has been half-an-hour in the water. Thereafter the disc divides rapidly into 4, 8, 16, 32 cells--the last-mentioned stage being reached at 1hr. 35mins. No horizontal divisions could be seen at the 16-cell stage. Figs. 8 and 9 are the large- and small-cell morula stages—the latter occuring at 2hrs. 40mins. Thereafter the cells become smaller rapidly, and proliferating at the edge of the disc begin to envelop the yolk mass. Fig. 10 at 8¾hrs. shows the blastoderm almost covering the yolk. (The oil globule has been omitted in figs. 3 to 10).

When the enveloping process is all but completed, the embryonic streak (em. fig. 11), is visible. At the same time, 9¾hrs., pigment cells appear on the blastoderm especially over the oil globule. They are of a light grey colour, and irregularly stellate in shape. By 10 hrs. 40mins., the embryo is clearly outlined—the tail being twice as broad as the head. Pigment cells of a thin grey show on the body, the oil globule and on the membrane near the tail. Yellow cells show along the sides of the body. The wrinklings are now much diminished. At 12½hrs. (fig. 12), the embryo shows the optic lobes, notochord and Kuppfer's vesicle. At 14½hrs., Kuppfer's vesicle begins to be narrowed, and distinctly pointed towards the capsule as the tail elongates. Then it gets smaller, and appears to retreat from its position at the tip of the tail, and ultimately disappears after having existed for about 3 hours. Fig. 13 shows the optic lobes cut off, and the appearance of the muscle flakes on the body. At this stage, the rounded ends of the myomeres give a crenated appearance to the sides of the body. At 17½ hours, the heart shows as an aggregation of cells on the breast, and an hour later is beating faintly. In fig. 14 at 19 hours, the optic vesicles have been invaginated, and the tail is slewed to one side of the oil drop. Fig. 15 is a side view of the stage shown in fig. 14. The heart (ht.) in a capsule under the chin, is a tube extending from the median line to the left and forward. The choroidal fissure of the eye is seen. Fig. 16, 22 hours, shows the otocyst and a membrane enveloping the oil globule. Just before hatching, a part of the continuous fin shows on the tail. The eggs from which the series of drawings so far were taken hatched at 23½ hours from time of extrusion. The temperature of the water ranged from 25·6° to 27° C.

The larvae figured on Plates X. and XI., were hatched in colder weather—temperature 22° to 23° C. The stage shown in fig. 17, occurred at 38 hours after extrusion. The continuous fin (c.f.) is well developed, and the vent and the urinary vesicle behind it are seen. The yellow pigment has taken its characteristic early larval arrangement. In figs. 18 and 19 the gut is shown forming and stretching forward to the yolk, while a few finely branching pigment cells show on the membrane enclosing the yolk. At 70 hours the pectoral fins make their appearance (fig. 20). The membrane enclosing the yolk, which has up to this stage maintained its position, as the yolk and oil globule diminished in size, now suddenly collapses, and the yolk moves forward. While the membrane remain d turgid it interfered with the locomotion of the larva, which was forced to swim in circles, but from this onward the young fish swims actively. Soon after hatching when the larva is floating passively, the position is horizontal and supine. From the stage shown at fig. 19, the position is vertical with the tail upmost.

Fig. 22, Plate XI., shows the beginning of the mouth cleft (m). Fig 23 is a top view of 22, and shows along the middle of the body a number of small clear bodies—usually 8 in number. The small circle on the continuous fin, close to the back, in fig. 20, should not be there, but it represents one of these bosses on the left side of the body seen obliquely through the fin. They do not show at all on a side view. Fig. 23a is a horizontal long section through one of these bodies. It is an epidermal structure with an almost glandular appearance enclosed in a split in the epidermis, and having no evident connection with the underlying layers of tissue. In the live animal these bodies are slightly stained by a very weak solution of Methylen Blue. At this stage the larvae are very active.

Fig. 24—at 4 dys. 16½ hrs.—shows the mouth formed and the yolk with the oil globule reduced almost to the vanishing point. The branching pigment cells disappear from the continuous fin, and later are replaced by a few branching spots. Pigment is developed in the retina. The stomach and liver are formed. In figs. 25 and 26 the body is beginning to become opaque—the notochord showing as a lighter streak in the median line. The gut is now completed, and some of the divisions of the brain can be seen. Scales are formed at about one month.

The times and sizes of the stages figured are given below.

Habitat and Habits.

Soon after the beginning of the spawning season young whiting of 10 mms. and over can be observed swimming actively in small droves of from 10 to 20 on sand flats and beaches. They move up and down with the tide, swimming in very shallow water. As they grow older they keep further from the shore. The whiting may be said to live almost exclusively on sandy ground. The adults appear to be gregarious only at spawning time.

The most characteristic habit of the whiting is that of burrowing in the sand to escape from enemies. In so doing the fish literally dives into the sand. The dive can be executed with great rapidity and is a most serviceable accomplishment. When fishing for whiting with a seine net one can observe as the bunt of the net nears the shore here and there a small cloud of sand thrown up; the fisherman marks the place, and when his net is in, wades out and feels about in the sand with his feet; when a fish moves under his foot he stamps his foot down to hold it there, and then picks it up with his hand. Often as many as a dozen fish are so taken which had otherwise escaped the foot-rope of the net. Very small whiting, an inch and a-half long, have the trick. When burying the whiting throws up its tail, and actually takes a header into the sand using its tail fin vigorously. Once the head is under, it appears to throw up like a diver, and when buried has got into a horizontal position. The whiting can remain down for 2 or 3 minutes. On an ordinary sand flat, a whiting can bury itself to a depth of from 3 to 4 inches, but on a hard sand beach, it can hardly cover itself. The eyes, in such a case, show plainly against the sand, but immediately the net has passed over, the fish is up and away.

When taken the whiting often makes a short, croaking, frog-like sound—whence the name trumpeter.

Food.

A common article of diet is a small perch, *Ambassis marianus*,* which abounds in Moreton Bay. It is usually about $1\frac{1}{2}$in. long, though the giants of the race attain a length of 4in., and may be seen in shoals near every jetty in the Bay.

Two species of crustacea are favourite food of the whiting, one the common soldier crab, *Mycteris longicarpus*, and the other locally known as the sand lobster, *Callianassa sp.* or an allied form (pl. XII., fig. 4). The soldier crab can burrow corkscrew fashion into the sand to escape attack, and the sand lobster lives for the most part in a network of tubes it has excavated in the sand, though in warm weather it is said to come to the surface.

Another item in the food list is evidently considered by the whiting to be a tit-bit. It is the proboscis of a spoon-worm (pl. XII., fig. 3.) . This worm lives in sand with which there is a good deal of mud. The body is from 9in. to a foot down, but the spoon or proboscis is sent up to feel round for food. The tube, in which the worm lives, opens usually about the middle of a slight hollow on the sand surface. In this depression, about 6in. of the proboscis is moved slowly about lying flat out from the mouth of the tube. The proboscis is very extensile, and very sensitive and can be withdrawn with great rapidity on the approach of danger. It is very interesting to watch a

*Kindly identified for me by Mr. J. Douglas Ogilby.

whiting stalk one of these worms. The fish swimming low down carefully approaches one of these hollows, and after manoeuvering for position, suddenly makes a dart for the opening of the hole. All that falls to the share of the whiting is about half-an-inch of the lip of the rapidly retreating snout. The snout can be used effectively as bait. Both the sand-lobster and the spoon worm can be taken in quantity between tidemarks. Young whiting feed on small sand crustacea, and worms.

I think it possible to connect the whiting's habit of burying in the sand with the fact that it hunts its food largely among animals that take refuge there.

The Ventral Fins.

The ventral fin of the whiting is peculiar in having the first ray forked only once, and the divisions of the ray prolonged a quarter-of-an-inch or more beyond the tip of the fin. In swimming along the bottom the tips of the ventral fins are trailed over the surface, and the prolongations of the first ray look somewhat like feelers. These prolongations are much larger proportionally to the size of the fin in young fish than in adults. Moreover in fish up to a year old, the ventral fins are whitish and more noticeable than the orange yellow fins of the old fish. No special innervation could be detected for these elongations though they are probably to a certain extent tactile. Their development in the young fish is figured on Plate XIII. The smallest whiting that could be taken with ventral fins was 13 mms. long. The fins were 1 mm. (fig. 1). They consist of a long process that would become the first ray, and the spine is represented by a pretty broad flap. Fig. 2 shows the spine and the first 2 rays in a fish 17·5 mms. long. The first ray has forked and the division next the spine has grown out into a filament. Figs. 3, 4 and 5 show the other division growing out after the first. In fig. 7 the filaments are of about equal length in which condition they remain. Later the other rays fork four times. Fig 6 is a sketch of a sport in which the first ray tried to divide into four. Three of these divisions became elongated, but the fourth appeared to be undergoing atrophy. The other ventral fin in this specimen was normal.

Markings.

The young of *S. Bassensis* are marked somewhat similarly to *S. maculata*. The markings practically disappear at about two years. In a whiting about 6 months' old, the markings are dark blotches—with no evident arrangement—on the upper side of the body. At one year (Pl. XII., fig. 1) they begin to assume the oblique arrangement described for *S. maculata*; at two years they have run into one another to form about eight oblique irregular bands running downwards and forward. By that time they are very indistinct, and can be shown or not according to environment. In no case do the markings show below the lateral silvery band or on the tail (cf. *S. maculata*, Bleeker, At. Ich. Ind., T. 8, Tab. 389, Fig. 5). Well-grown fish when just taken from the water show sometimes from 6 to 8 dark areas, extending about $\frac{3}{4}$in. out from the median dorsal line. They disappear when some time out of the water. The dark colour is not even in the blotchings which have rather a mottled appearance.

The markings on the young whiting, when seen from above in its natural surroundings, counterfeit very accurately the shadows of the ripples on the sand surface below.

Rate of Growth.

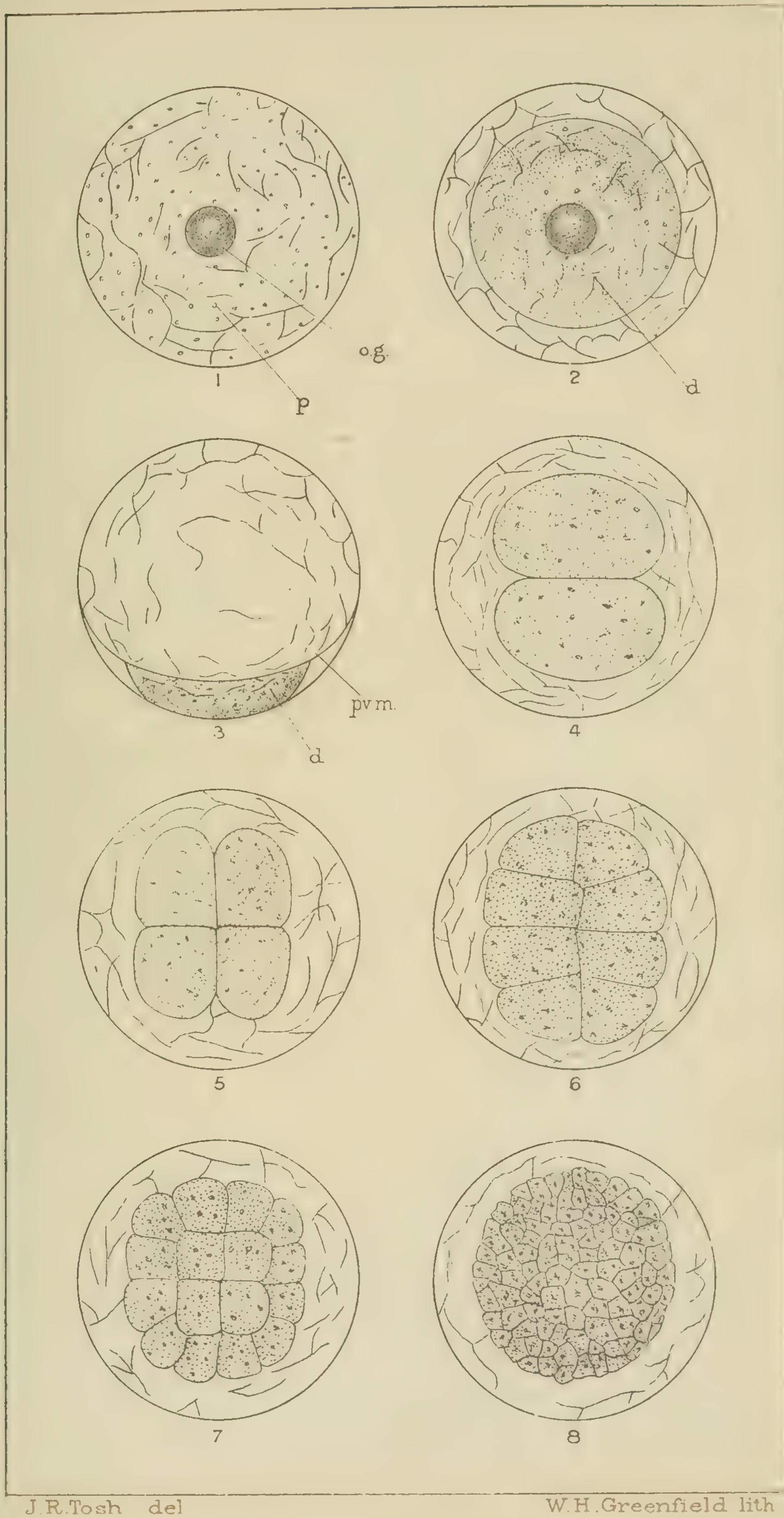
Observations on the whiting were in progress from June to January. Early in June young whiting of last season's spawning can be taken at lengths varying from 31 to 79 mms. Averages of sizes divided arbitrarily into two groups—those over 50 mms. and those under—give approximately the lengths attained at that time by those spawned early and those late in the season. At 10th June averaging 40 of each group, the early spawned fish were 68 mms. and the later ones 40 mms. On 24th June the average of all sizes was 70, and on 19th August 72 mms. On 7th October, at the beginning of the spawning season, the average was 76 mms., or about three inches. At the same time the average size of a number of two-year old whiting was found to be 201 mms., or about eight inches. That was of course early in the spawning season, and the sizes of one and two-year old fish probably exceed slightly those given. These two-year olds had reproductive organs of small size, but well advanced. They spawn in the early months of the year. It is very probable that fish spawned late in the season do not breed till the third year.

LIST OF FIGURES IN THE PLATES.

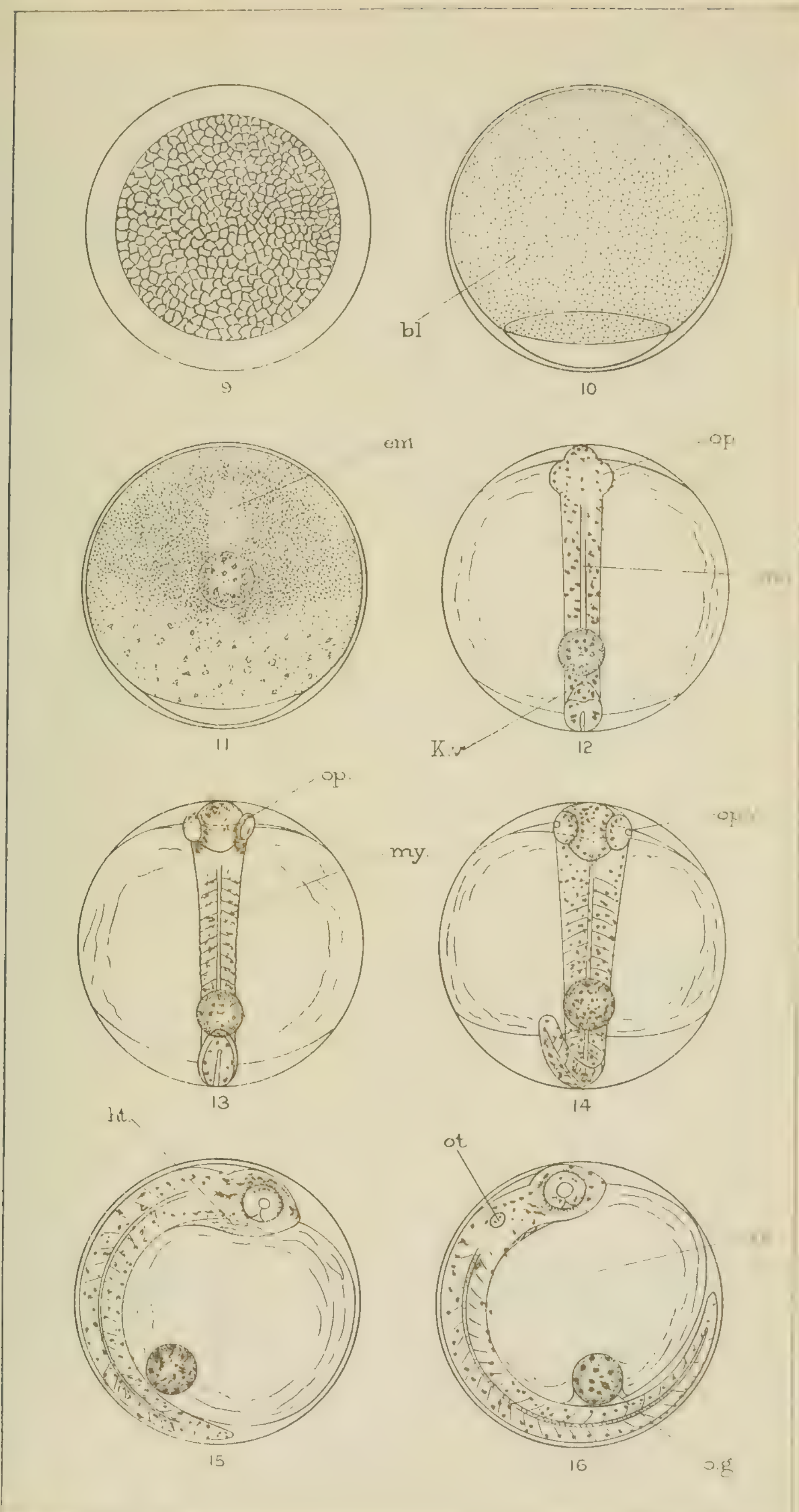
			Mins. after extrusion.	
Pl. VIII, Fig.	1.	Egg on extrusion		
	2.	Germinal disc	15 mins.	
	3.	Side view of 2	20 ,,	
	4.	2-cell stage	30 ,,	
	5.	4-cell ,,	45 ,,	
	6.	8-cell ,,	58 ,,	
	7.	16-cell ,,	1hr. 20mins.	
	8.	Large cell morula	1hr. 55mins.	
Pl. IX.	9.	Small ,, ,,	2hs. 40mins.	
	10.	Blastoderm enveloping yolk	8$\frac{3}{4}$hrs.	
	11.	Embryonic streak	9$\frac{3}{4}$hrs.	
	12.	Embryo	12$\frac{1}{2}$hrs.	
	13.	,,	15$\frac{1}{4}$hrs.	
	14.	,,	19hrs.	
	15.	,, side view of 14	,,	
	16.	,, shortly before hatching	22hrs.	
Pl. X.	17.	Larva	38hrs.	1·4 mms. long.
	18.	,,	48hrs.	1·6 ,,
	19.	,,	63hrs.	2·1 ,,
	20.	,,	70hrs.	2·1 ,,
	21.	,,	3dys. 14hrs.	2·2 ,,
Pl. XI.	22.	,,	4dys.	
	23.	,,	,,	
	23a.			
	24.	Larva	4dys. 16$\frac{1}{2}$hrs.	2·5 mms.
	25.	,,	5dys. 16hrs.	2·3 ,,
	26.	,,	6dys. 16hrs.	2·4 ,,
Pl. XII.	1.	Whiting one year old. Nat. size. Well grown. Showing markings.		
	2.	Whiting about 6 weeks.		
	3.	Food of whiting—sand worm—*Thalassema sp.*		
	4.	,, ,, sand lobster.		
Pl. XIII.	1.	Ventral fins of whiting	13 mms. long.	Nat. size 1 mm.
	2.	Spine & 2 rays of ,,	17·5 ,, ,,	,, 2·4 ,,
	3.	,, ,, ,,	19 ,, ,,	,, 3·0 ,,
	4.	Spine & first ray of ,,	21 ,, ,,	,, 3·2 ,,
	5.	,, ,, ,,	23 ,, ,,	,, 3·6 ,,
	6.	,, & 3 rays of ,,	40 ,, ,,	,, 6·6 ,,
	7.	Ventral fin of ,,	29 ,, ,,	,, 5·1 ,,
Pl. XIV.		Adult whiting. *Sillago Bassensis.* Length of specimen, 11$\frac{1}{4}$in.		

ABBREVIATIONS USED IN THE PLATES.

a. anus
bl. blastopore
c.f. continuous fin
ch.f choroidal fissure
d. disc
em. embryo
f.b. fore brain
ht. heart
i. intestine
K.v. Kuppfer's vesicle
m. mouth
m.b. mid brain
my. myomere
no. notochord
o.g. oil globule
ol. olfactory
op. optic lobe
op.v. optic vesicle
p. pore
p.f. pectoral fin
pv.m. perivitelline membrane
s.b. sensory body
u.v. urinary vesicle
yk. yolk



J.R.Tosh del W.H.Greenfield lith



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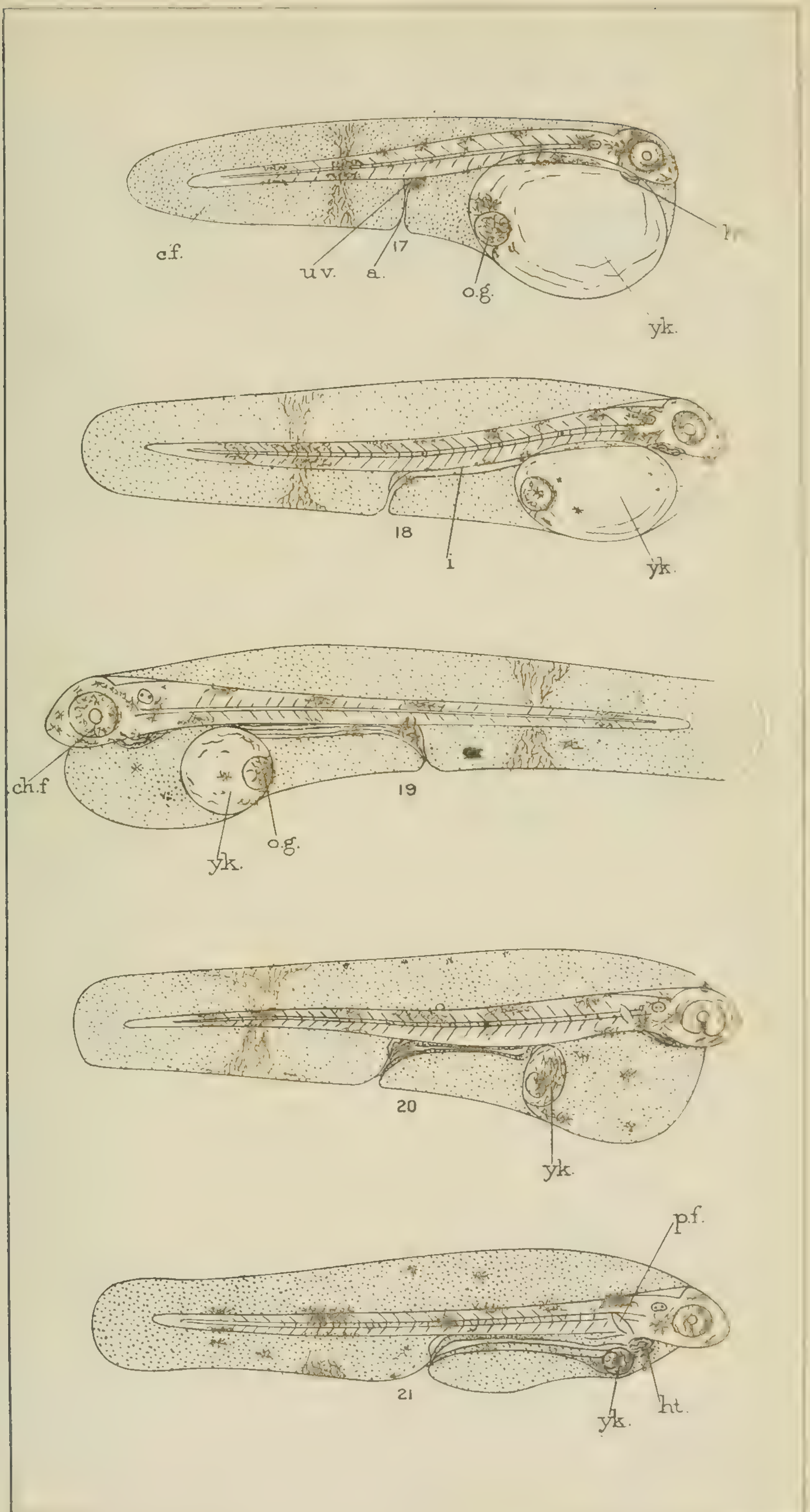

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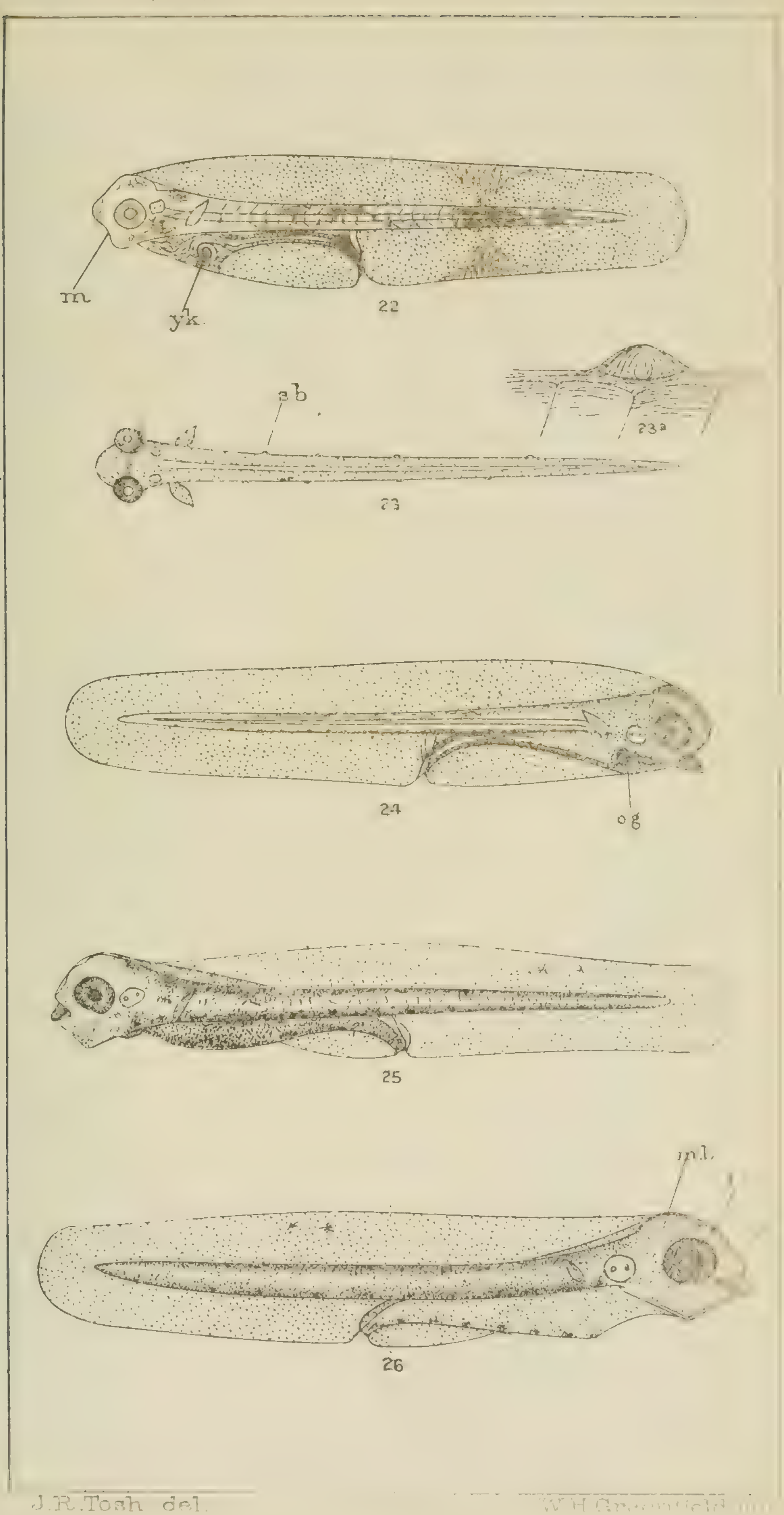

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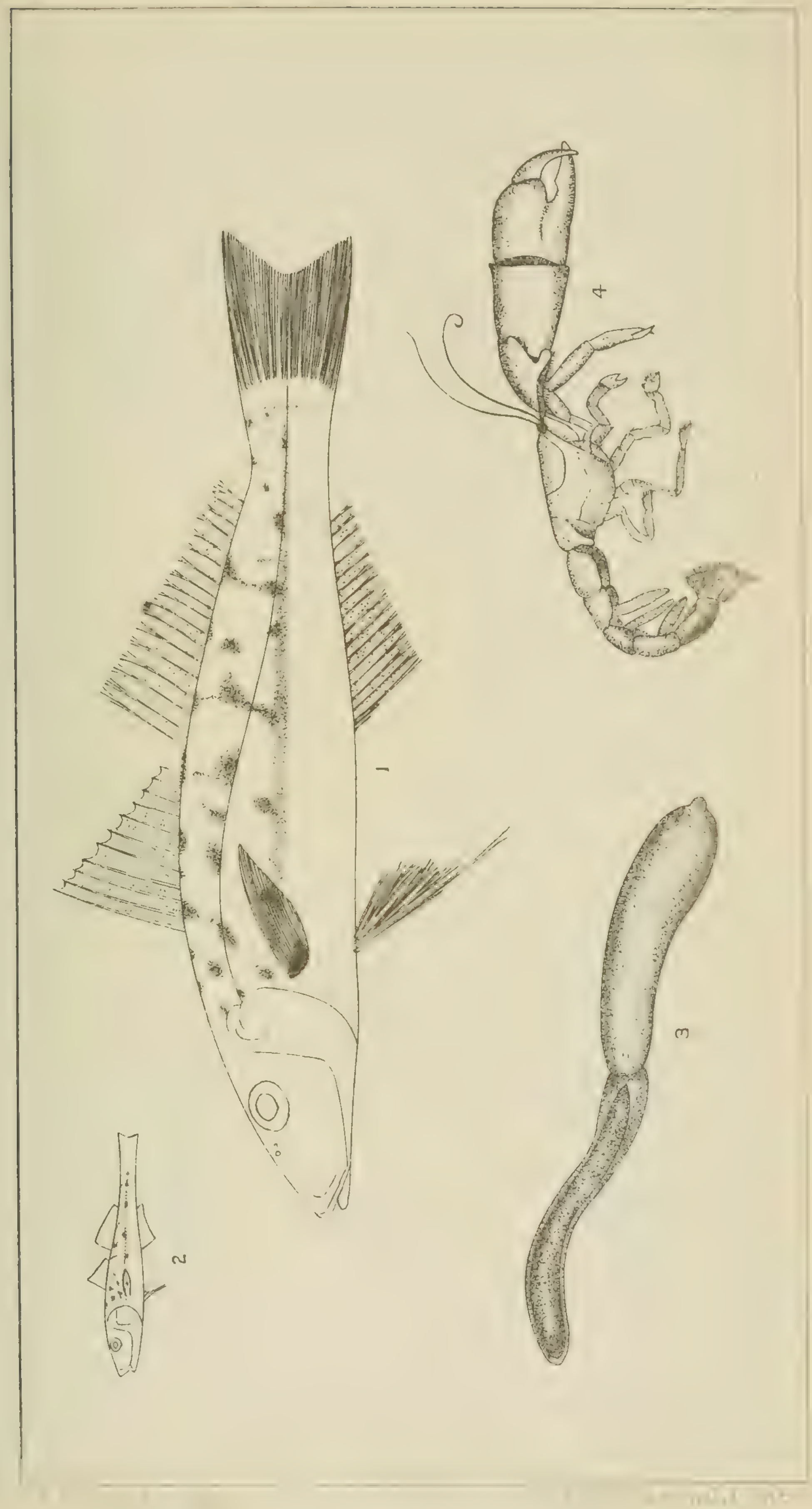

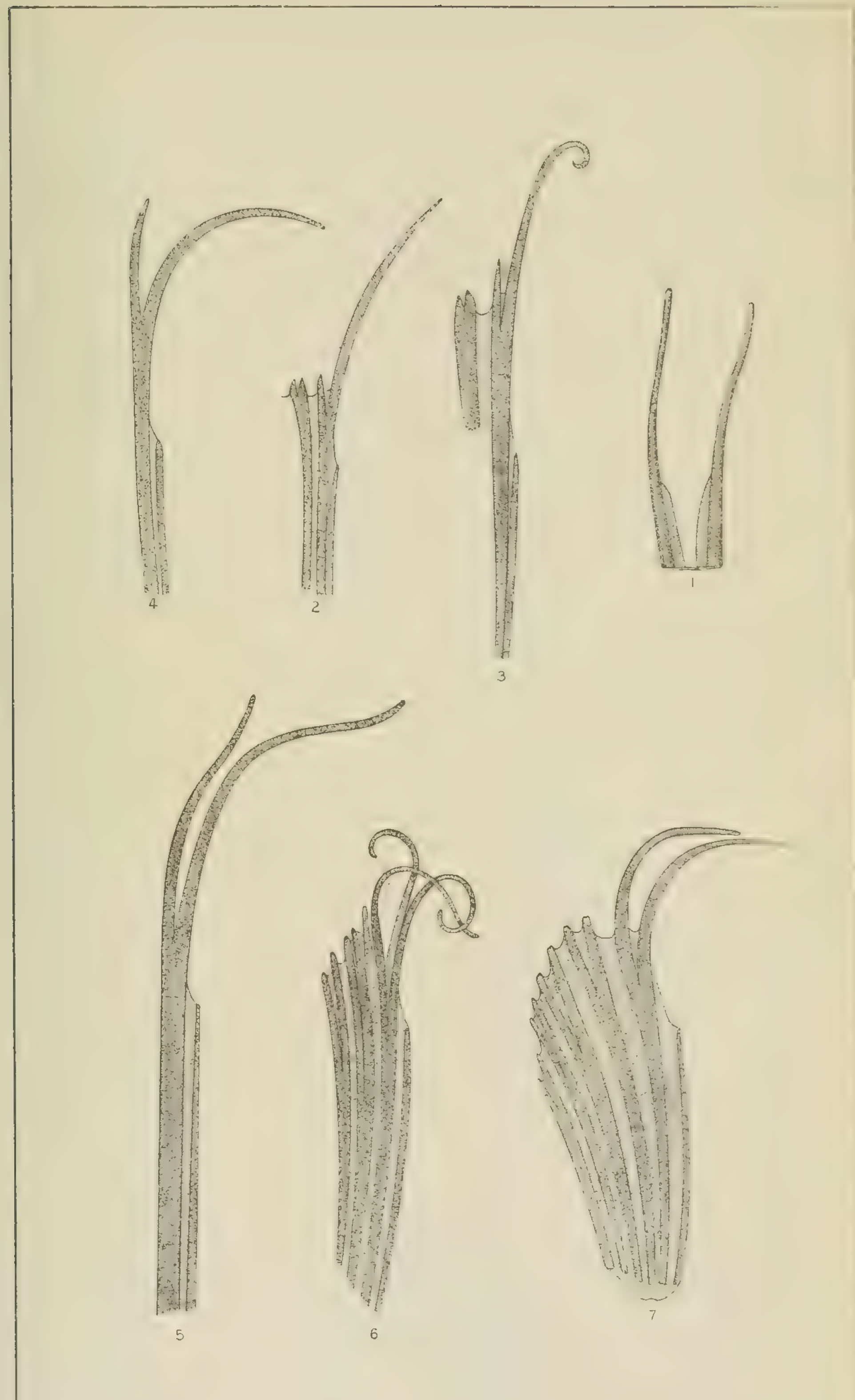

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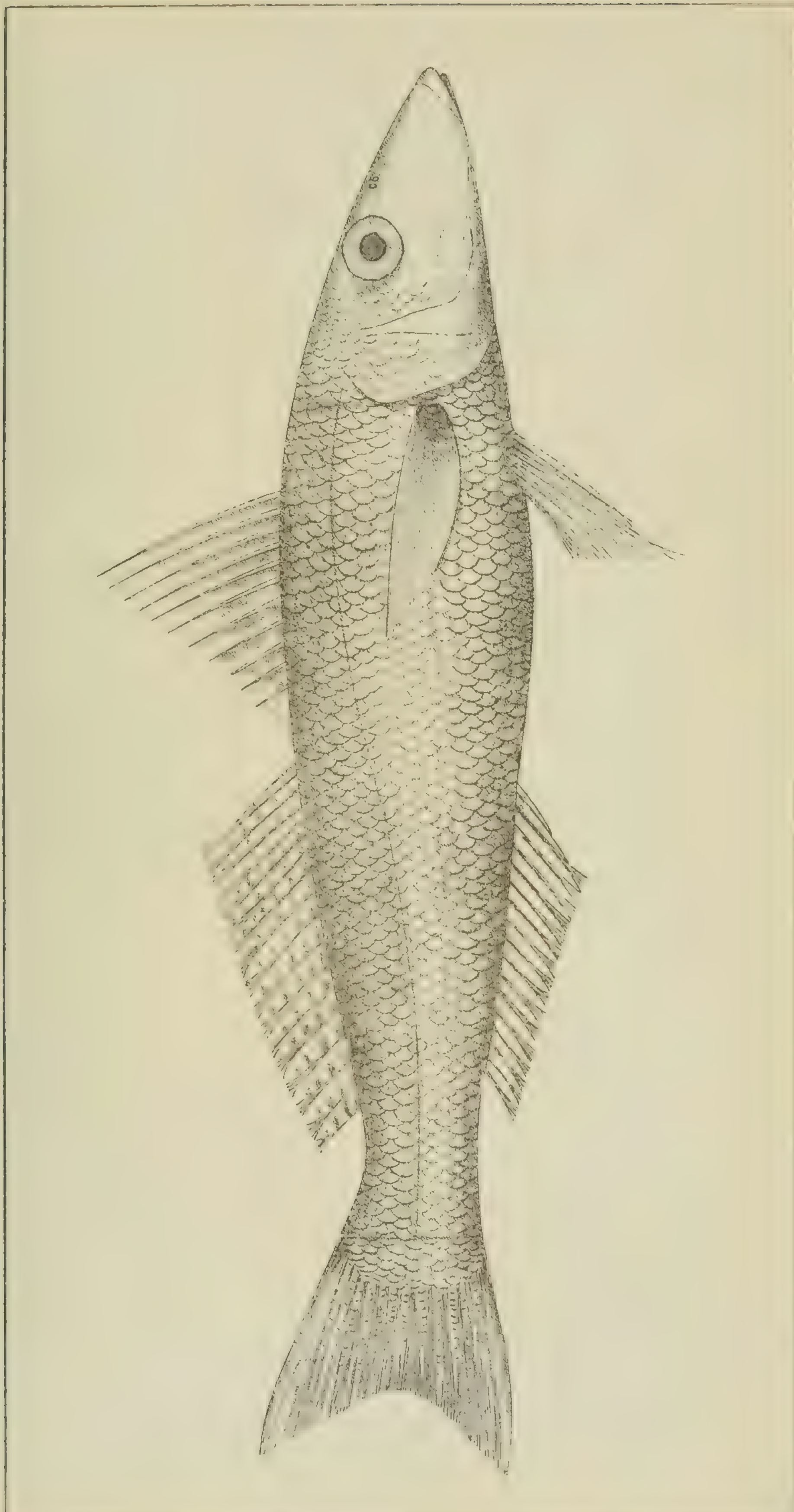

J.R.Tosh del. W.H.Greenfield lith.

PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

QUEENSLAND.

VOLUME XVIII.

PRINTED FOR THE SOCIETY BY
H. POLE & CO., PRINTERS, ELIZABETH STREET, BRISBANE.
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THE

Royal Society of Queensland.

PROCEEDINGS

OF THE

Annual Meeting of Members

HELD ON SATURDAY, 30th JANUARY, 1904.

The Annual Meeting of the Society was held on Saturday, 30th January.

The President (Dr. W. W. R. Love) occupied the chair.

The Minutes of previous Annual Meeting were read and confirmed.

The Hon. Secretary (Mr. J. F. Bailey) read the following report of the Council for the 1903 session:

TO THE MEMBERS OF THE ROYAL SOCIETY OF QUEENSLAND.

Your Council have pleasure in submitting their Report for the Year 1903.

The usual Monthly Meetings have been held during the year, and a list of the Papers read is given in Appendix A.

The attendance at the eleven Council Meetings which have been held during the year is given in Appendix B.

Part 2, of volume 17, of the Proceedings, containing the Papers read during the 1902 Session, was published in March last, and distributed to Members and Institutions and Societies on the exchange list.

The Council have pleasure in expressing their gratification at the honour of Knighthood recently conferred on the first President of the Society, viz., Sir A. C. Gregory, who has done so much for the furtherance of scientific investigations in this, as well as in other States of the Commonwealth.

The good work of binding the many publications which are received by way of exchange has been steadily proceeded with, 136 volumes having been bound during the past year. Mr. Illidge, the Hon. Librarian, is to be commended on the excellent work he is doing in connection with the Library.

As will be seen by reference to the Treasurer's Statement (Appendix C), the funds of the Society are in a satisfactory condition.

The additions to the lantern, mention of which was made in last report, were received in February last, and thanks are due to Mr. J. W. Sutton for his valuable assistance in arranging their purchase during his visit to London.

The Council regret that owing to an accident to the condensers of the lantern, which could not be remedied in the States, the series of popular lectures, which it was proposed to arrange during the winter months, could not be held.

It is with regret that the Council have to record the death of Mr. T. H. Owens, a member who, although not a contributor of papers, was a regular attendant at the meetings of the Society.

WILTON LOVE, M.B.,
President.

J. F. BAILEY,
Hon. Secretary.

8TH JANUARY, 1904.

APPENDIX C.

THE ROYAL SOCIETY OF QUEENSLAND.

FINANCIAL STATEMENT for the Year 1903.

Dr. Cr.

Receipts.	£	s.	d.
Balance last statement	123	3	10
Refund of amount advanced for additions to Lantern	3	10	0
Sale of Proceedings	0	4	0
Government Grant, 1902-3	50	0	0
" " 1903-4	50	0	0
Subscriptions	43	1	0
	£269	18	10

Disbursements.				£	s.	d.
Bookbinding				24	6	6
Postage and Petty Cash				11	13	3
Printing and Stationery				70	14	6
Advertising				5	3	0
Freight on Lantern				0	19	0
Insurance				1	2	6
Rent and Donation Technical College				12	0	0
Bank Charge				0	10	0
Balance per Bank Pass Book	£143	3	4			
Petty Cash in hand ..	0	6	9			
				143	10	1
				£269	18	10

Brisbane, 1st January, 1904. A. Norton, *Hon. Treasurer.*

Examined and found correct,

Alex. J. Turner, *F.I.A.V., Brisbane, 7th January, 1904.*

APPENDIX A.

List of Papers Read During 1903 Session.

DATE.	TITLE.	AUTHOR.
January 17	Australian Wood-boring Cossidae.	Ambrose Quail, F.E.S., and Roland Illidge.
February 19	Aboriginal Magic.	W. E. Roth, M.R.C.S., B.A., Oxon.
March - 14	Contributions to the New Guinea Flora.	F. M. Bailey, F.L.S.
,, ,,	Experiences Among North Queensland Aboriginals.	R. A. Johnstone.
April - 25	Studies in Queensland Ichthyology.	J. D. Ogilby.
May - - 30	Culex mucidus altenans.	W. R. Colledge.
June - 25	Naturalised Plants in Various parts of the World.	Joseph Lauterer, M.D.
August - 2	Some Queensland Plants in Their Native Habitats.	J. F. Bailey.
Sept'mb'r 19	Colour Vision and Colour Blindness.	John Thomson, M.B.
October 17	Notes on Travel in New South Wales, 1859-60.	Hon. A. Norton, M.L.C.
Novemb'r 21	From Sydney to Bathurst in 1822, from Letters by Mrs. Hawkins.	Communicated by Hon. Hon. A. Norton, M.L.C.
December 12	Australian Crocodiles	J. D. Ogilby.
,, ,,	Revision of the Australian Thyrididae and Pyralidae.	A. Jefferis Turner, M.D.

APPENDIX B.

Attendance of Officers at the Eleven Council Meetings held during 1903.

OFFICE.	NAME.	NUMBER ATTENDED.
President	W. Love, M.B.	9
Vice-President ..	J. Cameron, M.L.A.	6
Hon. Treasurer ..	Hon. A. Norton, M.L.C.	9
Hon. Secretary ..	J. F. Bailey	11
Hon. Librarian ..	R. Illidge	7
Members of Council	W. J. Byram	3
	C. J. Pound	8
	A. G. Jackson	5
	J. Shirley, B. Sc.	3
	J. Thomson, M.B.	5

On the motion of the Hon. A. Norton, M.L.C., seconded by Mr. A. J. Turner, the Report was adopted.

The election of officers for the year 1904 then took place with the following result:—*President*, John Cameron, M.L.A.; *Vice President*, J. Brownlie Henderson; *Hon. Treasurer*, Hon. A. Norton, M.L.C.; *Hon. Secretary*, J. F. Bailey; *Hon. Librarian*, Rowland Illidge; *Members of Council*, W. J. Byram, W. W. R. Love, M.B., C. J. Pound, John Shirley, B.Sc., John Thomson, M.B.; *Hon. Auditor*, A. J. Turner, F.I.A.V.

Mr. Cameron then occupied the chair, and after thanking the members for electing him President, called on Dr. Love to read a paper on Australian Crocodiles, by J. Douglas Ogilby.

After the paper had been read the meeting terminated.

INDEX.

CONTRIBUTIONS TO THE NEW GUINEA FLORA.

By F. MANSON BAILEY, F.L.S.
Colonial Botanist.

(Read before the Royal Society of Queensland, 14th March, 1903.)

For some years past I have had the good fortune of including Capt. F. R. Barton, private secretary to the Lieut.-Governor of New Guinea, among my correspondents. This gentleman is a careful observer and a great lover of plants, and through him some new and several interesting plants have come to our knowledge, as well as information regarding the uses to which the plants are applied by the aboriginal inhabitants of that land.

In a small packet of specimens recently to hand from Capt. Barton there are several new species, and thinking that a short paper on the subject might be of interest to the members of the Royal Society, I beg to offer the same to you.

Order Geraniaceæ.

tribe balsamineæ.

Impatiens, Riv. ex Linn. syst. ed. 1.

I. latifolia, Linn. Sp. Pl. 937.

Hab. St. Joseph River, Flowers very brilliant vermillion. Capt. F. R. Barton.

Order Leguminosæ.—Sub-order Cæsalpinieæ.

tribe eucæsalpinieæ.

Cæsalpinia, Linn. Sp. Pl. 380.

C. nuga, Ait. DC. Prod. ii, 481.

Hab. Mekeo. Capt. F. R. Barton.

tribe cassieæ.

Cassia, Tourne. ex. Linn. syst. ed. 1.

C. Bartonii, Bail, Ql. Agri. Journ. ix, 410.

Hab. Mambare River. Sir Francis Winter. (Capt. Barton.)

Order Myrtaceæ.

Tribe Leptospermeæ.

Metrosideros, Banks, ex. Gærtn. Fruct. 1, 170, t. 34.

M. Regelii, F. v. M. Trans. Roy. Soc., Vict.

Hab. Yulu District, at an elevation of about 2,000 ft.; found climbing up the forest trees. Capt. F. R. Barton. First found by Sir. Wm. McGregor, on Mt. Musgrave, at an altitude between 7,000 and 8,000 ft.

Tribe Myrteæ.

Eugenia, Mich. ex. Linn. Syst. ed. 1.

E. Bartonii, Bail.

A small tree; branchlets slender angular-compressed, reddish. Leaves narrow-lanceolate with often long acuminate points, 1 to nearly 4in. long, 3 to 6 lines broad, dark-green above, pale beneath, the erecto-patent lateral nerves somewhat distant, joining an intramarginal one rather distant from the edge. Petioles about 2 to 3 lines long, somewhat thickened and semiterete. Inflorescence racemose about 10in. long, drooping, peduncle flattened, about ½ line broad, rather longer than the rhachis or flower-bearing portion. Bracts minute lanceolate several at the base, a pair of setose ones about three-parts up the peduncle, those under the terminal flowers larger than the rest and lanceolate; bracteoles minute setose, flowers pink, distant, solitary or in pairs one of which is frequently nearly sessile. Calyx-tube turbinate with numerous fine ribs, pink to a light-brown, spreading and recurved at the top, lobes 4, short, broader than high. Petals rotund-ovate, 3 lines long, 2½ lines broad, concave, spreading and separately deciduous, stamens about 1in. long, numerous and fine, pink. Anthers often lunate. Style somewhat longer than the filaments, ovules numerous. Fruit not seen.

Hab. On banks of mountain streams, British N. Guinea. Capt. F. R. Barton.

Order Begoniaceæ.

Begonia, Tourn., Linn. Gen. ed. ii. 516.

B. fulvo-villosa, Warbg. Engl. Bot. Jahr. 386.

Hab. Central districts of British New Guinea at an elevation of about 2,000 feet. Captain F. R. Barton.

Order Bignoniaceæ.

In the packet were a few seeds of some plant of this order, but without further specimens it would only be conjecture to say to what plant they belong.

Nucleus brown, pyriform 8 lines long, surrounded by a border of same colour and consistence, 2 lines broad, which is also surrounded by broad transparent wings, the whole giving a horizontal diameter of from 5 to 6 ins.

Hab. None given. Capt. F. R. Barton.

ORDER EUPHORBIACEÆ.

TRIBE PHYLLANTHEÆ.

Baccaurea, Lour. Flora. Cochinch. ii. 661. Pierardia, *Roxb.*

B. papuana, Bail.

A tree bearing its flowers and fruit upon the trunk and thick branches; branchlets, leaves, and inflorescences all when young more or less puberulent. Branchlets terete, striate. Leaves rather rough, clustered at the ends of the branchlets, broadly ovate and bluntly acuminate, 4 to 7in. long, $2\frac{1}{2}$ to $3\frac{1}{2}$in. broad, tapering towards the base; margins slightly wavy and minutely glandularly toothed. Petioles slender, 1 to $1\frac{1}{2}$in. long, and more or less thickened at each end. Male flowers not seen. Female flowers in racemes on the trunks ot trees, 6 to 8 in. long on peduncles from 1 to 2 in. long. Bracts sharply lanceolate, about 1 line. Flowers crowded, pedicellate, yellow, the segments or sepals coriaceous, about 3 lines long, imbricate. Ovary silky-hairy, hairs nearly silvery, stigmas 3, sessile, 2-lobed, lobes broad and fimbriate. Fruit (not seen quite ripe) slightly exceeding 1 in. in diameter, 3-celled, 2 seeds in each cell, the seeds covered by a thick, fleshy, acid arillode.

Hab. Mekeo District, British New Guinea. Capt. F. R. Barton, who states that both the flowers and fruit are eaten and much appreciated by the natives, and that the flowers which resemble in colour the Laburnum, have a fine fragrance and nut-like flavour; and that the fruit resembles the English gooseberry with a squeeze of lime added.

Dr. Hollrung records *B. dasystachya* Muell. Arg. for German New Guinea, but that Javanese-species, judging from Miguel's description in the Batavia Flora, differs in my opinion considerably from *B. papuana.* Our knowledge of this genus is even at the present very limited on account of the imperfect material botanists have had to work upon. Sir J. D. Hooker found this to be the case when working up the genus for the Flora of British India. It does seem remarkable that a genus named and described about 112 years ago by J. de Loureiro in his Flora of Cochin China ii. 661, and of which several of the species are known to furnish the aborigines of the various countries in which they are found with some of the necessaries of life, should not be better known. One of the great stumbling blocks in the botanists' way has been, and even is now, the natural arrangement of the inflorescence; some species being known to bear separate male and female inflorescences on different parts of the same plants, while in other species they are borne on separate plants, and collectors it would seem have not in all cases attached this very necessary information to their specimens. With regard to the economic features of the genus, some writers state that the leaves are used in dyeing. Of several species the fruit is known to be eaten; the part used being the fleshy arillode, which differs from the true arillus in being a fleshy coating of the seed, not a separate body arising from the placenta, as in the true arillus. It will thus be understood that while the fleshy substance on the seed of Baccaurea is refreshing and agreeable to the palate, it cannot in point of usefulness rank with the true arillus, which can be readily removed and brought into domestic use, like the mace, litchi, and the arils of several of our indigenous trees which are at times collected and utilised for making conserves.

ORDER ORCHIDEÆ.

Dendrobium, Sw. in Nov. Act. Soc. sc. Upsal vi. 82.

Sect. Distichophylla.

D. Montedeakinense, *Bail.*

Stems flattened, scarcely exceeding 1 line broad; the specimen received was a terminal end about 10 ins. long, bearing a few leaves and 2 flowers. Leaves distichous, erecto-patent, 1 to 2 ins. long, almost linear, slightly over 2 lines broad, the apex shortly and unequally 2-lobed, midrib and longitudinal nerves prominent. Flowers solitary, leaf-opposed, distant from the apex of the stem. Pedicel stout and somewhat curved, about 2 lines long. Bracts one large and almost hyaline, the others minute. Dorsal-sepal narrow-ovate, about $2\frac{1}{2}$ lines long, the lateral ones about as long, from a very broad base, all prominently veined. Petals long as sepals, but much narrower. Labellum articulated to the lower elongation of the column, rather thick and longer than the sepals, the middle lobe with a rounded blunt end, the lateral lobes very small. Column short, disk with prominent parallel nerves. Anther-lid muricate outside, pollen-masses only one seen, probably two closely adhering together, the other two being abortive in the flower examined.

Hab. Mount Deakin. Captain F. R. Barton.

Order Filices.

Gleichenia, Sm., Mem. de L'Acad. Turin, v. 418.

G. flagellaris, *Spreng*. Aboriginal name, "Garra." (Barton.)

A narrow segmented form, less glaucous beneath than in the ordinary forms of this species.

Hab. Climbing trees on the hills to the height of 20 ft. or more.

From the glossy-brown outer rind of the smooth stems the natives obtain material which they plait into armlets and bracelets. Capt. F. R. Barton.

STUDIES IN THE ICHTHYOLOGY OF QUEENSLAND.

By J. DOUGLAS OGILBY.

(Read before the Royal Society of Queensland, 25th April, 1903).

i.

SCORPÆNIDÆ (1).

Among the various products of our bays and estuaries, which are apt to make their presence known to the unwary in an unequivocal manner, few are more widely and invidiously known than the small fishes to which the names "Bullrout" and "Fortescue" have been given, and which have been grouped together under the common name *Centropogon* by Dr. Günther and other authors. The genus belongs to the scorpænoid division of the sub-order *Loricati*, or "mail-cheeked fishes," the name being derived from the exceptional development of the third bone of the infraorbital ring, which is in most of the genera produced backwards to the preopercular bone, and so forms an admirable protective covering to the sides of the head.

The family *Scorpænidæ* (Scorpion-Fishes) is abundantly represented throughout all temperate and tropical seas. It is provisionally divisible into three groups—*Sebastinæ*, *Apistinæ*, and *Scorpæninæ*.*

Among other peculiarities the second group is characterised by a strong spinous prolongation of the preorbital bone; this is more or less erectile at will, and can be, and indeed is

*This is not to be considered a natural division, as the whole series, outside of the obviously sebastine and scorpænine forms, requires careful revision, some of those which would here be placed among the *Apistinæ* being, like *Notesthes*, closely related to the *Sebastinæ*, others, like *Liocranium* as closely to the *Scorpæninæ*, while some may have trigloid affinities.

very readily employed as a weapon of offence. Some of the species are also credited with the possession of toxic qualities, and there can be no question as to the acuteness of the pain caused by a stab from either the Bullrout or the Fortescue, which belong to this group.

In 1860 four species were referred to his genus *Centropogon* by Günther. These four species may for convenience be tabulated as follows :—

Second anal spine longer than the third—Species, *australis*.
Second and third anal spines subequal—Species, *robustus*.
Second anal spine appreciably shorter than the third—Species, *fuscovirens*, *leucoprosopon*.

To the first of these three sections the generic name *Centropogon* rightfully belongs, the type being *Cottus australis*, White. *Centropogon robustus*, Günther, the sole representative of the second section, is generically separable, and it is here proposed to establish a genus, *Notesthes*, for its accommodation. The third section will be dealt with further on in connection with an undescribed Queensland fish, which is perhaps allied to its representatives though widely separated from the typical *Centropogon*.

Subsequent to the publication of the second volume of the British Museum Catalogue of Fishes, four more species were added to *Centropogon*, namely :—

C. marmoratus, Günther, Ann. & Mag. Nat. Hist., (3) xi. 1863, p. 136, Moreton Bay.

C. indicus, Day, Fish. India, p. 155, pl. xxxviii. fig. 2, 1875, Madras.

C. echinatus, Macleay, Proc. Linn. Soc. N.S. Wales, v. 1881, p. 436, Endeavour River.

C. nitens, De Vis, Proc. Linn. Soc. N.S. Wales, ix. 1884, p. 459, Coast of Queensland.

According to my views only the first of these is a true *Centropogon*, while of the three remaining species no two are congeneric. To add to these complications Castelnau in 1872 confused *Centropogon australis*, White, with the fish described by Guichenot (Mem. Soc. Imp. Sc. Nat. Cherbourg, xiii. 1868, p. 89) as *Neosebastes scorpænoides*, and in the following year, when seeking to correct his mistake, made matters worse by rejecting the genus *Neosebastes* and relegating Guichenot's fish to the genus *Centropogon*, with which it has not the slightest affinity. (*v.* Proc. Zoöl. & Accl. Soc. Vict., ii.

1873, p. 40). In this he was unfortunately followed by Macleay, who, however, it is but just to say, expressed his doubt as to the propriety of the course followed by Castelnau. Here, so far as this fish is concerned, the matter might have been left for the present, but that Jordan and Evermann (Fish. N. & Mid. Amer., p. 1839) place *Neosebastes* among the synonyms of *Scorpæna*. The type of *Neosebastes* is the South Australian *Scorpæna panda*, a species which, like *N. scorpænoides*, I have never seen. Judging, however, from McCoy's fine figure and description of the latter species (Prodr. Zoöl. Vict., dec. xx, pl. 193) I am inclined to recognise Guichenot's genus, the complete lepidosis of the upper surface of the head and the absence of simple pectoral rays being inimical to its inclusion in *Scorpæna*.

Reverting to the list given above it will readily be seen that the fish described by Day as *Centropogon indicus* differs greatly from that genus as here restricted. Among the characters which separate it may be noted—the difference in the contour of the head and nape, the longer lower jaw, the absence of an enlarged outer series of teeth in the premaxillaries, the decreased number of dorsal spines, the elongation of the third anal spine beyond the second, the pauciradiate pectorals, and the obsolescence of one of the ventral rays.

As I cannot find any other genus in which this combination of characters exists I propose to separate the Indian fish from *Centropogon* under the name *Daia*, in honor of Surgeon-General Francis Day, author of the Fishes of India and other works.*

As to the species to which Macleay gave the name *Centropogon echinatus*, the author's description is of little value in assisting us to determine its affinities. We learn, however, that the lateral line is provided with filaments, and that the second anal spine is greatly enlarged, while the neglect to mention a preorbital spine suggests the absence of that character. Taken together these point to a scorpænine rather than an apistine fish, and I am inclined to believe that Macleay's species will eventually prove to belong to that group.

Finally, with regard to the remaining species, *Centropogon nitens*, the generic identification is greatly hampered by the omission on the author's part of any reference as to the extent of the dorsal lepidosis, and to the comparative length of the

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**Tetraroge rubripinnis* (Schlegel, Faun. Japon., Poiss, p. 49, pl. xxii. fig. 2) may be a *Daia*.

anal spines. Insufficient though the description of this fine species is, two characters nevertheless are noteworthy as serving to separate it from the genus to which it has been referred, namely, the remarkable sculpture of the scales, each of which is said to be traversed by three striæ, which converge from the base towards the margin, thus directly reversing the ordinary procedure; and, secondly, the small size of the eye, which is at variance with the normal character of these fishes.

In addition to the eight species enumerated above as having been referred by various authors to *Centropogon*, Günther includes as doubtful (Catal. Fish., ii. p. 128, note) *Apistus hypselopterus*, Bleeker (Banda, i. 1851, p. 238). No species is figured under this specific name in the Atlas Ichthyologique.

With these general remarks I will now proceed to give detailed generic and specific descriptions of three of our Queensland dagger-cheeked scorpænids, together with such data as to their habits, food, etc., as I have been able to gather. I have failed to obtain any information respecting their breeding habits.

CENTROPOGON.

Centropogon, Günther, Catal. Fish, ii. p. 128, 1860 (*australis*).

Body elliptical, compressed. Scales small, adherent, ctenoid, smooth, arranged in regular series. Lateral line complete, not extending on the caudal fin; the tubes simple, slightly bent upwards posteriorly, separated from one another by a single scale; each tube corresponding in length to about two body scales and raised conspicuously above them. Head rather large, entirely naked, without dermal appendages, its upper profile parabolic; snout short and broad, with slightly convex profile; preorbital pore inconspicuous; a series of large open pores along each side of the lower jaw inside the dentary bone, thence bending upwards along the border of the preopercle. Nape not continuous with the upper profile of the head, rising abruptly above the posterior border of the orbit, naked, as also is a cuneiform band, widest anteriorly, on each side of the spinous dorsal fin, a narrow band behind the head, and the pectoral, thoracic, and ventral areas. Mouth with rather small, slightly oblique cleft; jaws equal; premaxillaries protractile, produced in a skinny lobe which conceals the lower border of the maxillary, the upper and hinder borders of which are exposed. Upper jaw with a continuous band of villiform teeth and an outer row of strong, well separated, curved, conical teeth; villiform teeth on the vomer and palatines; mandibular teeth similar to those of the premaxillaries, but with the enlarged series reduced to two or three on each side of the symphysis. Nostrils large, patent, well separated, tubular, the anterior with a tentacle. Eye large, anteromedian, sublateral, high; interorbital region deeply concave without tentacles. Cranial ridges moderately developed, mostly terminating in a spine; coracoid process with a short stout spine; no suprascapular spine. Preorbital with two exposed spines, the first short, stout, triangular, directed downwards; the second long, strong, acute, and dagger-shaped, reaching far beyond the maxillary, and capable of a wide lateral extension, the membranous attachment to the cheek being narrow. Preopercle with five spines, the upper much the longest and exposed; interopercles widely separated; opercle smooth, with a well developed lobe and two divergent ridges, each of which ends in a small spine; the surface smooth. Gills four, a small cleft behind the fourth; even branchiostegals; gill-rakers reduced to a few spinulose tubercles. Upper pharyngeal bones circular and separate; lower, subpyriform and contiguous; both armed with strong conical teeth. Soft dorsal and anal fins without basal scaly sheath; last ray in each divided to the base. Dorsal fin originating but little behind the eye, elevated in front, emarginate behind, with xvi (xv) 8 or 9 (10) rays, the spines of moderate strength and pungent; spinous portion of fin about thrice as long as the soft portion; interspinous membrane deeply cleft anteriorly; last ray broadly attached to the peduncle. Anal fin with iii 5 or 6 rays; spines strong, the second longer and stronger than the third; last ray nearly free. Caudal fin rounded. Pectoral fins well developed, rounded, symmetrical, undivided; each with 14 rays, the middle the longest; none of the lower rays simple. Ventral fins moderate, approximate, inserted behind the base of the pectorals, each with i 5 rays; the spine strong and rather long; second soft ray longest, the last widely attached to the wall of the abdomen. Posterior processes of premaxillaries in contact with the frontal bone; frontal bone with a pair of conspicuous ridges which are approximate mesially but are divergent in front and behind, and are separated from the tympanic ridges by a shallow transverse preoccipital groove, the anterior border of which is formed by the nearly transverse coronal ridges; no supraoccipita crest for the support of the anterior dorsal spine; suborbital stay with a single smooth ridge. Vertebræ $11+16 = 27$. (κέντρον, a spine ; πώγων, beard.)

East Coast of Australia. Two species.

As will be seen by a comparison of the generic diagnosis given by Macleay (copied for the most part from Günther) and the above definition, the former is far from satisfactory, sins of commission and omission being both plentiful and palpable. For instance, we find that according to it both the head and the body are scaly, whereas the former is wholly, the latter partly naked ; the genus, as regards this character, being intermediate between *Notesthes* and *Pentaroge*. We are also told that there is no preoccipital groove and no cleft behind the fourth gill. A very superficial examination reveals the presence of both groove and cleft, and both these characters, as also the nakedness of the head, were fully recognised by Günther in his description of *Centropogon marmoratus*, and the necessary corrections made. Günther, however, has failed to notice the conspicuously enlarged outer series of premaxillary teeth, which at a glance differentiates this genus from *Notesthes*.

That no reference whatever is made to the extensive naked area on the back and nape, although it forms an important generic character, is the more remarkable because Cuvier and Valenciennes commence their notice of the species with the following paragraph, which plainly shows the importance which they attach to the character:—" A la suite de ces apistes à longues pectorales et à rayons libres, viendra un poisson du Port Jackson, qui a pour caractère particulier la nudité de la partie antérieure et supérieure de son dos, où les écailles manquent, comme à sa tête, tandis que le reste de son corps en a de petites, âpres, sembables à peu près à celles de notre *Scorpæna porcus*." Again, in the description of the fish the following passage occurs :—" L'espace nu de son dos est circonscrit de chaque côté par une ligne qui part du haut de l'orifice branchial, et monte obliquement en se rapprochant de la dorsale jusqu' à son dernier rayon épineux." These authors also give the formula of the dorsal fin in the typical species correctly, a fact to which it is necessary to draw special attention, because Günther has given as normal a formula founded on accidental variation, and this has been copied without comment or verification by Macleay.

Centropogon australis.

Cottus australis, White, Voy. N. S. Wales, p. 266, c. fig., 1790, Port Jackson.

Apistus australis, Cuvier & Valenciennes, Hist. Nat. Poiss., iv. p. 398, 1829.

Centropogon australis, Günther, Catal. Fish., ii. p. 128, 1860, *and* Zoöl. Challenger, i, Shore Fishes p. 28, 1880; Macleay, Proc. Linn. Soc. N. S. Wales, v. 1881, p. 436; Ogilby, Catal. Fish. N. S. Wales, p. 22, 1886.

The Fortescue,* Woods, Fish. and Fisher. N. S. Wales, p. 49, 1882.

Neosebastes australis, Waite, Thetis, p. 103, pl. xxi, 1899.

Fortescue.

D. xvi 9. A. iii 5. Sc. 7/80/41. L. l 28.

Depth of body greatest below the fifth dorsal spine, where it is $2\frac{3}{4}$ to 3 in the total length; length of head $2\frac{4}{5}$ to $3\frac{1}{5}$ in the same. Snout as long as or a little shorter than the diameter of the eye, which is $2\frac{4}{5}$ to 3 in the length of the head. Nasal tentacle fan-shaped and fimbriated. Width of interorbital region $5\frac{1}{2}$ to $5\frac{3}{4}$ in the head. Maxillary extending to or a little beyond the vertical from the anterior border of the pupil, its length 3 in the head, the width of its distal extremity about one third of the diameter of the eye. Preocular, supraocular, postocular, tympanic, parietal, and nuchal spines well developed. Interorbital ridgeswell developed, smooth; temporal region with three short spinose ridges. Posterior preorbital spine extending backwards to or slightly beyond the vertical from the hinder margin of the eye, its length from the base of the anterior spine 2 to $2\frac{1}{2}$ in

* Both Tenison Woods and Macleay have erroneously applied this name to *Pentaroge marmorata*. This is obviously wrong, that species being so rare in Port Jackson that during a residence there of fifteen years I have not seen a single local example. *Apistus marmoratus*, Cuv. & Val. (Hist. Nat. Poiss., iv. p. 416) was founded on a fish said to have been obtained by Péron at Timor. Since that time it has not been found there, nor was it known to Bleeker from any of the isiands of the Indo-Malayan Archipelago; but it, or an allied species, is commonly found on the Tasmanian and Victorian coasts. If the fact be taken into consideration that the members of the Cuvierian genus *Apistus* are, as a rule, greatly restricted in their distribution, it will at once appear to be unlikely that the same species should inhabit the warm waters of tropical Timor and the cold seas of temperate Tasmania. Perhaps two distinct species are confonnded under the one name. Péron was fortunate in his Timor collections; he got *Cnidoglanis macrocephalus* (= *megastoma*) there, but no one has found it since!

that of the head. Upper preopercular spine not so long as the second preorbital spine. Gill-rakers 4 + 9, all tubercular. Third dorsal spine the highest, conspicuously higher than the second or fourth, $1\frac{1}{5}$ to $1\frac{1}{3}$ in the length of the head, and thrice the height of the first spine: last spine higher than the penultimate; outer border of soft dorsal rounded, the highest ray about equaling the fifth spine. Anal fin originating below the fourteenth or fifteenth dorsal spine, its second spine as high as the seventh or eighth dorsal spine, half or a little more than half the length of the head, and as high as or a little lower than the soft portion of the fin, the outer border of which is subtruncate. Caudal fin with 10 branched rays, the middle pair the longest, $3\frac{3}{5}$ to $3\frac{4}{5}$ in the total length. Pectoral fin not reaching beyond the ventral,* its length thrice the width of its base and equal to the length of the head. Ventral fin rounded, $1\frac{1}{5}$ to $1\frac{1}{4}$ in the head, extending to or slightly beyond the vent, its spine as long as the second anal spine. Pale yellowish or ochraceous brown, with six irregular tranverse dark chestnut-brown or black bands; the first through the eyes; the second below the anterior dorsal spines and often reduced to an oblong blotch; the third below the sixth to ninth spines and ceasing beneath the appressed pectoral fin; the fourth below the anterior soft rays, sometimes ceasing at or near the lateral line, sometimes extending to or even upon the anal fin; both this and the preceding band may extend well on the dorsal fin, and both have a tendency to lateral expansion about the middle of the side; the fifth across the base, the sixth across the middle of the caudal fin; a dusky spot is also usually present below the eleventh to thirteenth dorsal spines; outer border of spinous dorsal usually more or less dusky; soft portion with an oblique dark median bar, which is often reduced to a spot near its anterior border; pectoral fins with or without a dark median transverse band and sometimes with narrow parallel bars also; a dark blotch absent or present at the base of the ventral fins. Examples obtained from muddy ground have the body more or less clouded so that the ground color scarcely appears, and in these the basal half of the pectorals and the ventrals are dark. (Lat. *australis*†, southern.)

* In no case, out of scores of examples which have passed through my hands, have I found the pectoral fins to reach back to the "origin of the anal," as stated by Günther and Macleay.

†The specific name "*australis*" is frequently but erroneously used to signify "Australian"; it is almost needless to say that it does nothing of the kind, its sole meaning being neither more nor less than "southern":

Occasionally, but very rarely, one of the dorsal spines is absent, in which case an additional soft ray will almost invariably be found; while it also happens that not unfrequently the short first spine appears to be wanting, having been accidentally broken off and the scar healed over. A specimen in the collection of the Australian Museum, Sydney, has a pungent spine growing outwards and rather downwards from the base of the eighth dorsal spine, of which it is fully half the length; it protrudes well beyond the skin, and was probably caused by an injury when the fish was young.

Length to 135 millimeters. (Head and body 106, caudal fin 29.)

East coast of Australia. I have taken specimens at various points of the coast between Port Hacking to the south and Moreton Bay to the north; it frequents sandy bays in preference to muddy estuaries, and, unlike its relative, the "Bullrout," never ascends rivers into fresh water. It is very common in Port Jackson, every haul of the trawl net bringing up several; it is, therefore, not out of place to warn the inexperienced against rashly plunging the hand into the gatherings of the net from that port, since, between stingarees (*Urolophus*), numbfishes (*Hypnos*), and fortescues, he would probably receive an unpleasant reminder of the evils of curiosity. In the autumn of 1886, I had the pleasure of accompanying Mr. Tryon and the late Captain Fison, on a three days' trip down Moreton Bay, during which we did some dredging and caught several specimens, which differed in no particular from the common Port Jackson species. It appears, therefore, to be tolerably plentiful in suitable localities along our foreshore, and possibly extends its range considerably further northwards. The same may be confidently asserted as to the extension of its range in a south-easterly direction; but it has not as yet been recognised by the naturalists of Tasmania or Victoria.

"*australis*" can only, therefore, be correctly employed when the species so designated is an inhabitant of a more southerly district than any of its congeners at that time known. By this rule White was correct in so naming his fish, no *Cottus* from further south being known. (The *Cottidæ* proper, as now limited, are inhabitants of periarctic regions only). If an author intends to convey the meaning that the product which he is describing is an autochthon of the Australian Region he should employ such a word as "*australiæ*" or "*australianus*" and the like; but the vagueness, of even these terms, owing to the size of the territory comprehended, suggests the advisability of omitting their employment altogether.

Type apparently non-existent.

White's description and figure are so bad that it is impossible to state with absoute certainty that the subject of this article is the actual species of which he obtained specimens; their identity, therefore, rests solely on the negative evidence that there is no other Port Jackson fish at all resembling his species in pattern of coloration. But this is of less importance owing to the accurate description given in the "Histoire Naturelle des Poissons," the authors of which retain White's specific name for specimens collected by Quoy and Gaimard in Port Jackson, during Freycinet's voyage in the "Uranie," associating our species, however, with the Indian genus, *Apistus*, from which it may be distinguished by the absence of a free pectoral ray, etc.

The Fortescue feeds on small crustaceans, mollusks, and the like, and is useless even as food for other fishes, the painful character of the wounds inflicted by the preorbital and preopercular spines acting as a sufficient deterrent to its would-be consumer. Its small size renders it valueless as human food.

The above description is drawn up from an examination of numerous specimens collected in the Sydney district.

If a comparison be instituted between the above description of *Centropogon australis* and Günther's detailed description of *C. marmoratus*, the differences will be found to be very slight. Putting aside the rather unreliable character of coloration, they amount to the (1) lowness of the anterior dorsal spines, the third to sixth being subequal and longest, only half the length of the head and lower than the soft portion of the fin: and (2) the larger scales, which are arranged in 68 transverse series above the lateral line. Though a native of Moreton Bay this species is equally unknown to Mr. De Vis as to myself.*

I cannot close my account of this genus without a few remarks on the figure of *Neosebastes australis*, published in "Memoir iv." of the Australian Museum publications.† Waite's figures of fishes are ordinarily so accurate in every

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*Since writing the above I have received through the kindness of Mr. J. R. Tosh two examples of *Centropogon* from Southport, which belong to the low-finned form. They differ, however, so much *inter se* that I think it advisable to withhold the description until such time as I can obtain a fuller series of specimens.

† "Scientific Results of the Trawling Expedition of H.M.C.S. 'Thetis', off the coast of New South Wales." Sydney, 1899.

detail, that I cannot help suspecting that the fish there figured differs specifically from the common "fortescue" of our litoral fauna. This would account for its capture in what Waite rightly regards as the "unusual depth of 16-19 fathoms."

The following are the more prominent variant characters between the specimen (from Port Jackson) now before me, and Waite's figure :—

In the typical *Centropogon australis* (White) † the body is less robust, the greatest depth in numerous examples being $2\frac{3}{4}$ in length against $2\frac{3}{5}$ in the figure ; the jaws are equal ; the nasal tentacle is larger, and fimbriated, the opercular ridges are more conspicuous and widely divergent ; the third dorsal spine is much higher, never less than $\frac{3}{4}$ of the head and thrice the height of the first spine ; the soft part of the dorsal fin has nine rays, and the last is almost wholly united by membrane to the back ; the second anal spine is much longer and stronger than the third, as high as the 7th or 8th dorsal spine, and half the length of the head ; the pectorals are rounded and symmetrical, the middle (7th and 8th) rays the longest, *not* reaching beyond the ventral and *not* surpassing the head in length ; the ventral is much larger, rounded, reaching beyond the vent, $\frac{4}{5}$ of the length of the head, its spine as long as the second anal spine.

NOTESTHES, gen. nov.

Body elliptical, compressed. Scales small, adherent, ctenoid, concentrically striated, arranged in regular series. Lateral line complete, not extending on the caudal fin ; the tubes simple and straight, forming together a continuous band, each tube corresponding in length to from two to three body scales, and raised conspicuously above them. Head large, entirely naked, without dermal appendages, its upper profile obliquely linear ; snout short and broad, with somewhat declivous profile ; preorbital pore large ; a series of similar pores along each half of the lower jaw inside the dentary bone ; a pore at the root of each preopercular spine. Nape slightly rounded, nearly continuous with the head, naked, as also is the thorax. Mouth with rather large oblique cleft ; lower jaw the longer ; premaxillaries protractile, produced in a skinny lobe, which

† White's specimens would certainly belong to the form "better known in shallow water cruising around the piles of piers and jetties" (Waite), rather than to a deeper sea form which he had no means of capturing in its natural haunts.

conceals the lower border of the rather large maxillary, the upper and hinder borders of which are exposed. Jaws with interrupted bands of villiform teeth; no outer series of enlarged teeth; villiform teeth on the vomer and palatines. Nostrils large, patent, well separated, tubular, without tentacles. Eye rather large, anterior, sublateral, high; interorbital region concave, without tentacles. Cranial ridges rather feeble, with or without a small terminal spine; coracoid process with a strong spine; no suprascapular spine. Preorbital with three spines, the tips of which are exposed; the anterior short, stout, somewhat curved, directed downwards and backwards; the posterior longer, strong, acute, and thorn-like, not nearly reaching to the end of the maxillary, and but moderately erectile, the membranous attachment to the base of the suborbital stay being wide; the median spine when present rises above the base of the last and is directed upwards. Preopercle with five spines, the upper the longest, with exposed tip; interopercles in contact; subopercle with a small spine; opercles with a well developed lobe and two divergent ridges, each of which terminates in a strong spine, the surface conspicuously carinated above the lower ridge. Gills four, a cleft behind the fourth; seven branchiostegals; gill-rakers short and stout, mostly tubercular. Upper pharyngeal bones elongate-pyriform, separate, forming a continuous patch; lower approximate, each patch split up into four distinct sections, which are as distant from one another as they are from those of the opposite side; all are armed with short stout conical teeth. Soft dorsal and anal fins with a partially scaly base, the last ray in each divided to the base. Dorsal fin originating above the upper preopercular spine, evenly rounded in front, emarginate behind, with xv 9 or 10 rays, the spines of moderate strength and pungent; spinous portion of fin more than thrice as long as the soft; interspinous membrane moderately cleft anteriorly; last ray partially attached to the peduncle. Anal fin with iii 5 rays; spines strong, the third as long as or a little longer than the second; last ray nearly free. Caudal fin rounded. Pectoral fins well developed, rounded, symmetrical, undivided; each with 12 rays, the middle the longest; none of the lower rays simple. Ventral fins moderate, approximate, inserted behind the base of the pectorals; each with i 5 rays, the spine strong and rather long; second soft ray longest, the last narrowly attached to the wall of the abdomen. Air bladder large and simple, with thick walls. Pyloric cæca in small numbers. Stomach simple, its entire length interiorly with coarse longitudinal ridges. Intestines folded. Posterior processes of premaxillaries extending to the frontal bone; frontal bone with a pair of conspicuous ridges, which are approximate mesially but divergent in front and behind and are separated from the tympanic ridges by a wide interspace; no preoccipital groove; coronal ridges vestigial, slightly convergent forwards; no supraoccipital nor nuchal crest for the support of the anterior dorsal spine, which is deeply grooved in front; suborbital stay with several smooth, branched carinæ Vertebræ $10 + 17 = 27$. (νῶτον, back; ἐσθής, clothing: in allusion to the complete lepidosis of the dorsal region).

Rivers and estuaries of Eastern Australia. Monotypic.

The genus *Notesthes* outwardly resembles *Neosebastes*, but the latter differs from it in having the entire head covered with scales, in the absence of an elongate defensive preorbital spine, in the reduced number of dorsal spines, in the large twenty-two-rayed pectoral, etc. It is, however, probable that while *Notesthes* has distinct sebastine affinities those of the *Neosebastes* incline to the scorpænine.

NOTESTHES ROBUSTA.

Centropogon robustus, Günther, Catal. Fish., ii. p. 128, 1860, Australian Seas; Krefft, Proc. Zoöl. Soc., 1864, p. 182; Günther, Ann. & Mag. Nat. Hist., (3) xx. 1867, p. 60 *and* Zoöl. Challenger, i, Shore Fishes p. 33, 1880; Macleay, Proc. Linn. Soc. N. S. Wales, v. 1881, p. 436 *and* viii. 1883, p. 203; Ogilby, Catal. Fish. N. S. Wales, p. 22, 1886 *and* Edib. Fish. & Crust. N. S. Wales, p. 67, 1893.

Centropogon troschelii, Steindachner, Sitzb. Ak. Wien, liii. i. 1866, p. 440, pl. iv. fig. 1, Port Jackson.

The Bullrout, Woods, Fish. & Fisher. N. S. Wales, pp. 48, 108, 1882.

Neosebastes robustus, Waite, Thetis, p. 102, 1899.

BULLROUT.

Depth of body greatest below the third dorsal spine, where it is $2\frac{3}{5}$ to $2\frac{4}{5}$ in the total length; length of head $2\frac{1}{2}$ to $2\frac{2}{3}$ in the same. Snout as long as or a little longer than the diameter of the eye, which is $3\frac{4}{5}$ to $4\frac{1}{3}$ in the length of the head. Width of interorbital region $5\frac{4}{5}$ to 6 in the head. Maxillary extending to or not quite to the vertical from the posterior border of the pupil, its length $2\frac{1}{5}$ to $2\frac{1}{3}$ in the head, the width of its distal extremity

$1\frac{1}{3}$ to $1\frac{4}{5}$ in the diameter of the eye. Nasal, preocular, supra-ocular, postocular, parietal, and nuchal ridges each terminating in a spine; an exoccipital spine; interorbital ridges moderately developed, smooth; temporal region with three short spinose ridges. Posterior preorbital spine not extending beyond the vertical from the front margin of the pupil, its length from the base of the anterior spine $6\frac{1}{3}$ to $6\frac{3}{4}$ in that of the head. Upper preopercular spine as long as or longer than the last preorbital spine. Gill-rakers 4 + 12, a few near the hinge claviform, the rest tubercular. Length of soft portion of dorsal fin $3\frac{1}{5}$ to $3\frac{1}{3}$ in that of the spinous; fourth spine the highest, not much higher than the third or fifth, 2 to $2\frac{1}{3}$ in the length of the head, and $2\frac{2}{5}$ to $2\frac{2}{3}$ times the height of the first spine; last spine as high as or a little higher than the penultimate; outer border of soft dorsal rounded, the highest rays equal to or rather less than the fourth spine. Anal fin originating below the thirteenth or fourteenth dorsal spine, its third spine as high as the seventh or eighth dorsal spine, $2\frac{1}{4}$ to 3 in the length of the head, and considerably lower than the soft portion of the fin, the outer border of which is angularly rounded. Caudal fin with 10 branched rays, the middle pair the longest, $3\frac{2}{3}$ to 4 in the total length. Pectoral fin not reaching to the vent, its length thrice or a little more than thrice the width of its base, and $1\frac{1}{5}$ to $1\frac{1}{4}$ in the length of the head. Ventral fin pointed, a little shorter than the pectoral, extending to or nearly to the anal, its spine as long as the third anal spine. Pyloric cœca 4. Brown, irregularly marbled with black, which sometimes takes the form of broad transverse bands, and frequently with bright yellow spots and blotches; a chestnut spot often present on the occiput; fins mottled with blue-gray or yellow and black; a large black blotch usually present in front of the middle of the spinous dorsal. (*robusta*, stout.)

Length to 280 millimeters. (Head and body 222, caudal fin 58.)

East coast of Australia. Its presence has been recorded throughout the district lying between Shoalhaven to the south and the Mary River to the north, but as it is everywhere common within those limits a more perfect acquaintance with our estuarine fauna will probably extend its range considerably. It has not, however, been included in either the Victorian or the Tasmanian lists.

Type in the South Kensington Museum.

The Bullrout is essentially a brack- and fresh-water fish, never voluntarily visiting the open sea, though occasional examples may be caught near the mouths of the larger rivers, having been carried out by floods, as in the case of the specimen trawled in Shoalhaven Bight by the "Thetis." It is common in brackish creeks and lagunes, living at the bottom among weeds and mud, and readily taking any bait of a suitable size, such as a shrimp or small worm. It is also plentiful in most if not all of our eastern rivers, far up towards their sources having successfully ascended rapids and surmounted other obstacles in their passage. I have not, however, succeeded in obtaining any proof of its breeding under such conditions. The young, of less than an inch long, are frequently swept ashore among the debris of a seine, and are beautiful little objects; indeed I do not agree with Woods in his remark that "like all the scorpion fish it is very ugly"; many species of *Sebastes*, *Scorpæna*, etc., are strikingly handsome fishes with beautifully blended colors, while a freshly caught Bullrout, from fairly clean ground and clear water, with its black and gold marmoration contrasting strongly with the deep rich brown of the ground color, is as pretty a fish as one is likely to get in a day's angling. The flesh is excellent.

With regard to the pain caused by a stab from the cephalic spines of this and the preceding fish, I see no reason to change my previously expressed opinion on the subject.* The account given by Woods, and which has unfortunately been reprinted in a recent number of a Brisbane newspaper,† is very highly colored.

Nor do Waite's remarks help matters much. The canaliculation of the spines is no proof of poisonous properties in their possessor, and is common to many fishes which are above reproach; so also as to the mucosity. Therefore, I submit that "the truth" of their "possessing poisonous properties" is not "apparent," whatever appearance of truth there may be in Mr. Waite's assertion. Only a few days ago I received a brace of cuts, right and left, from the mandibular teeth of a wretched little sabre-toothed blenny (*Aspidontus*, sp.), which caused me more pain and subsequent annoyance than any wound from a *Centropogon* or a *Trachinus* ever did; and yet I do not remember having read or heard that these fishes were toxophorous; and far be it from me to make the accusation.

* Edib. Fish. N. S. Wales, p. 68.

† "Queensland Sportsman," January 30, 1903.

The origin of the name, "Bullrout," is unknown, but I do not think it likely to be a corruption of a native word (as suggested by Mr. Woods); more probably it is connected with the noise it makes when hooked, and which might have been bestowed upon it by the early settlers from a fancied resemblance to the distant bellowing of a bull.

If we turn back now to the primary divisions (see p. 8) into which I separated the species referred to *Centropogon* in Günther's Catalogue, we shall find that two species—*C. fuscovirens* and *C. leucoprosopon*—were associated together in my third section. The former species is known to me from the descriptions given by Cuvier and Valencienes and by Günther, the latter only by Günther's description; both species are, however, figured in the Atlas Ichthyologique.* Both are natives of Amboina from whence they were originally described, the one by Cuvier, the other by Bleeker, who placed them in the heterogeneous assemblage of species which were associated under the name *Apistus*. But in a revision of the family published in 1876, the latter author founded for them the genus *Paracentropogon* (Versl. Ak. Amst., (2) ix: p. 297), † taking for his type *Apistus longispinis*, Cuv. and Val., with which he had meanwhile identified *A. fuscovirens*.‡ The synonymy of the species, in the absence of necessary works of reference is somewhat puzzling, but is probably not very different from the following:

PARACENTROPOGON LONGISPINIS.

? *Scorpæna spinosa*, Gmelin.

Apistus longispinis, Cuvier & Valenciennes, Hist. Nat. Poiss., iv. p. 408, 1829, Amboina; Quoy & Gaimard, Voy. Astrolabe, p. 694, Poiss. pl. xi. fig. 4, 1833.

Apistus fuscovirens, Cuvier & Valenciennes, l.c., p. 409, Amboina; Quoy & Gaimard, l.c., p. 695, pl. xi. fig. 5; Bleeker, Amboina & Ceram, p. 269, 1852.

Apistes multicolor, Richardson, Voy. Samarang, Fish. p. 3, pl. iv. figs. 3 & 4, 1848.

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* No letterpress was issued with the plates of the *Scorpænidæ*, and it is quite possible, therefore, that I may not be correct in some of the deductions which I have drawn.

† No copy of this work exists in Australia.

‡ My only grounds for this belief are that *Apistus fuscovirens* is not figured in the Atlas, and that both it and *A. longispinis* have a similar dorsal ornamentation, and that the latter and *A. leucoprosopos* have been united in the one genus.

Centropogon fuscovirens, Günther, Catal. Fish., ii. p. 130, 1860.
Tetraroge longispinis, Günther, l.c., p. 134.
Paracentropogon longispinis, Bleeker, Atl. Ichth., ix, pl. ccccxii. fig. 4, 1877.

PARACENTROPOGON LEUCOPROSOPON.

Apistus leucoprosopos, Bleeker, Act. Soc. Sc. Ind. Neerl., i.p. 35, Amboina.
Centropogon leucoprosopon, Günther, Catal. Fish., ii. p. 130, 1860.
Paracentropogon leucoprosopon, Bleeker, Atlas Ichth., ix, pl. ccccxiii. fig. 2, 1877.

A third species of *Paracentropogon* was described by Dr. Gunther and will stand as follows :—

PARACENTROPOGON NUDUS.

Tetraroge longispinis, var. *nuda*, Gunther, Zoöl. Challenger, i, Shore Fishes p. 66, 1880.

It was necessary for me to refer at some length to my knowledge of these species, because the Queensland fish of which I give a detailed description below has some outward resemblance to Bleeker's figure, but as neither Cuvier and Valenciennes, Bleeker, nor Gunther refer to the presence of simple pectoral rays and the reduced number of ventral rays they cannot be congeneric with our Queensland fish.

LIOCRANIUM, gen. nov.

Body ovate, strongly compressed, the back elevated in front. Scales minute, adherent, cycloid, smooth, arranged in regular series. Lateral line complete, not extending on the caudal fin; the tubes simple, bent upwards posteriorly, forming together a continuous band, each tube corresponding in length to from three to five body scales and raised but slightly above them. Head large, entirely naked, without dermal appendages, its profile declivous and concave in front, parabolic above; snout short and broad, with convex profile; preorbital pore inconspicuous; a large open pore below the chin, behind which a series of similar but smaller pores extends backwards along each half of the lower jaw inside the dentary bone, thence bending upwards along the border of the preopercle. Nape arched, continuous with the upper profile of the head, naked, as also is the dorsal area above the opercles, a narrow band along the base of the dorsal fin, another behind the head, and the pectoral and pelvic areas; thoracic region entirely covered with scales, which are rather smaller than those of the body. Mouth with rather large, oblique cleft; lower jaw a little the longer; premaxillaries protractile, produced in a skinny lobe, which conceals the lower border of the maxillaries, the upper and hinder borders of which are exposed. Jaws with interrupted bands of minute, conical teeth; similar teeth on the vomer; palatine bones edentulous. Nostrils large, patent, well separated, feebly tubular, without tentacles. Eye very large, anterior, sublateral; interorbital region without tentacles. Cranial ridges feeble, smooth; coracoid process and suprascapular bone without spines. Preorbital with two spines, which are concealed in life beneath a thick loose skin; the anterior of moderate length, strong, directed downwards and backwards; the posterior longer, strong, acute, and thorn-like, not reaching to the end of the maxillary, and but moderately erectile, having a wide membranous attachment to the suborbital stay. Preopercle with three to five points, the upper of which is produced to form a stout sharp spine, the others being reduced to blunt tubercles; interopercles in contact; subopercle with a spinate point; opercle with a large triangular lobe, and two smooth, feeble, divergent ridges, which do not end in spines; the surface smooth. Gills four; no cleft behind the fourth; six branchiostegals; gill-rakers short and stout, with densely spinulose tips. Upper pharyngeal bones oval and remote; lower subpyriform and contiguous; both armed with short, stout, crowded, conical teeth. Soft dorsal and anal fins without basal scaly sheath; last ray in each divided to the base. Dorsal fin originating above anterior border of eye, evenly rounded in front, slightly emarginate behind, with xiii 7 rays, the spines flexible but acute; spinous portion of fin more than thrice as long as the soft portion; interspinous membrane moderately cleft throughout; last ray partially attached to the peduncle. Anal fin with iii 5 rays; spines moderate, the third much longer than the second; last ray almost wholly attached to the peduncle. Caudal fin large, slightly rounded. Pectoral fins large, cuneate, symmetrical, undivided; each with 14 rays, the middle the longest; some of the lower rays simple. Ventral fins small, approximate, inserted behind the base of the pectorals, each with i 4 rays; the spine moderately strong and elongate; first soft ray longest, last widely attached to the wall of the abdomen. Air-bladder large, strong, and simple. Intestines folded. Stomach simple, its posterior half with coarse, gizzard-like longitudinal ridges within. Posterior processes of premaxillaries not extending to the frontal bone; frontal bone with a pair of conspicuous ridges which are divergent in front, mesially united by a bony bridge, and abruptly bent outwards so as to form a deep loop with the tympanic ridge; coronal ridges well developed, continuous with the interfrontal bridge, and united posteriorly to form a strong median crest for the first dorsal spine, which is deeply grooved anteriorly; suborbital stay with two smooth parallel ridges, which are branched posteriorly. Vertebræ 8 + 16 = 24. (λεῖος, smooth; κρανίον, skull).

Coast of Queensland. Monotypic.

In the obsolescence of the first soft ray of the ventral fins this genus agrees with *Daia*.

Liocranium præpositum, sp. nov.

D. xiii 7. A. iii 5.

Depth of body greatest below the fourth dorsal spine, where it is $2\frac{1}{3}$ to $2\frac{1}{2}$ in the total length; length of head $2\frac{1}{2}$ to $2\frac{3}{5}$ in the same. Length of snout $1\frac{1}{3}$ to $1\frac{2}{5}$ in the diameter of the eye, which is $2\frac{3}{4}$ to $2\frac{7}{8}$ in the length of the head. Width of interorbital region $5\frac{1}{3}$ to 6 in the head. Maxillary extending to the vertical from the posterior border of the orbit, its length about 2 in the head, the width of its distal extremity about half the diameter of the eye. Posterior preopercular spine extending backwards to or a little beyond the vertical from the hinder margin of the pupil, its length from the base of the anterior spine $4\frac{3}{5}$ to 5 in that of the head. Upper preopercular spine not quite so long as the second preorbital spine. Gill-rakers 3 + 9, a few near the hinge claviform, the rest tubercular. Length of soft portion of dorsal fin $3\frac{1}{3}$ to $3\frac{1}{2}$ in that of the spinous, the outer border of which is sinuous; third spine the highest, twice as high as the first and conspicuously higher than the second, $1\frac{3}{4}$ in the length of the head; behind the third the spines decrease in height to the sixth or seventh, and then rise to the last, which is but little less than the third and inappreciably more than those immediately preceding it,*

*The tips of the spines are very fragile and easily broken off, but from a comparison of three specimens the above appears to be the normal sequence in height. In all the fourth spine is apparently lower than the third or fifth, but this may not be the case with perfect examples.

soft dorsal rays as high as the spinous ; outer border angularly rounded ; last ray almost wholly attached to the peduncle. Anal fin originating below the twelfth dorsal spine ; the spines evenly graduated, the second intermediate in height between the first and the third, which is $1\frac{3}{5}$ to $1\frac{3}{4}$ times the height of the first, and subequal to the highest dorsal spine and to the rays. Caudal fin with 10 branched rays, the middle pair the longest, 3 to $3\frac{1}{5}$ in the total length. Pectoral fin extending backwards to the vertical from the anterior third of the anal, the upper and eight lower rays simple ; the lowest branched ray subequal to the adjoining simple ray, its length thrice or more than thrice the width of its base and a little more than the length of the head. Ventral fin pointed, $1\frac{2}{5}$ in the head, extending to the origin of the anal ; its spine stronger and longer than or as long as the third anal spine. Pale reddish brown, the head, thorax, and abdomen lighter with a yellowish tinge ; a dusky band below the second and third dorsal spines, passing downwards through the eye, where it forks, the anterior moiety extending to the base of the preorbital spine, the posterior to that of the upper preopercular spine ; a broad black band from the sixth and seventh spines to the middle of the appressed pectoral fin ; an oval, or oblong black spot below and upon the basal half of the last two spinous and first two soft rays, not reaching to the lateral line ; behind this spot, and occasionally in contact with it is a much less conspicuous spot, which crosses the lateral line, but does not reach to the dorsal fin. Dorsal, caudal, anal, and pectoral fins with numerous small brown spots or dark edged ocelli ; ventral fins uniform gray. (*præpositus*, an officer : in allusion to the black shoulder bands).

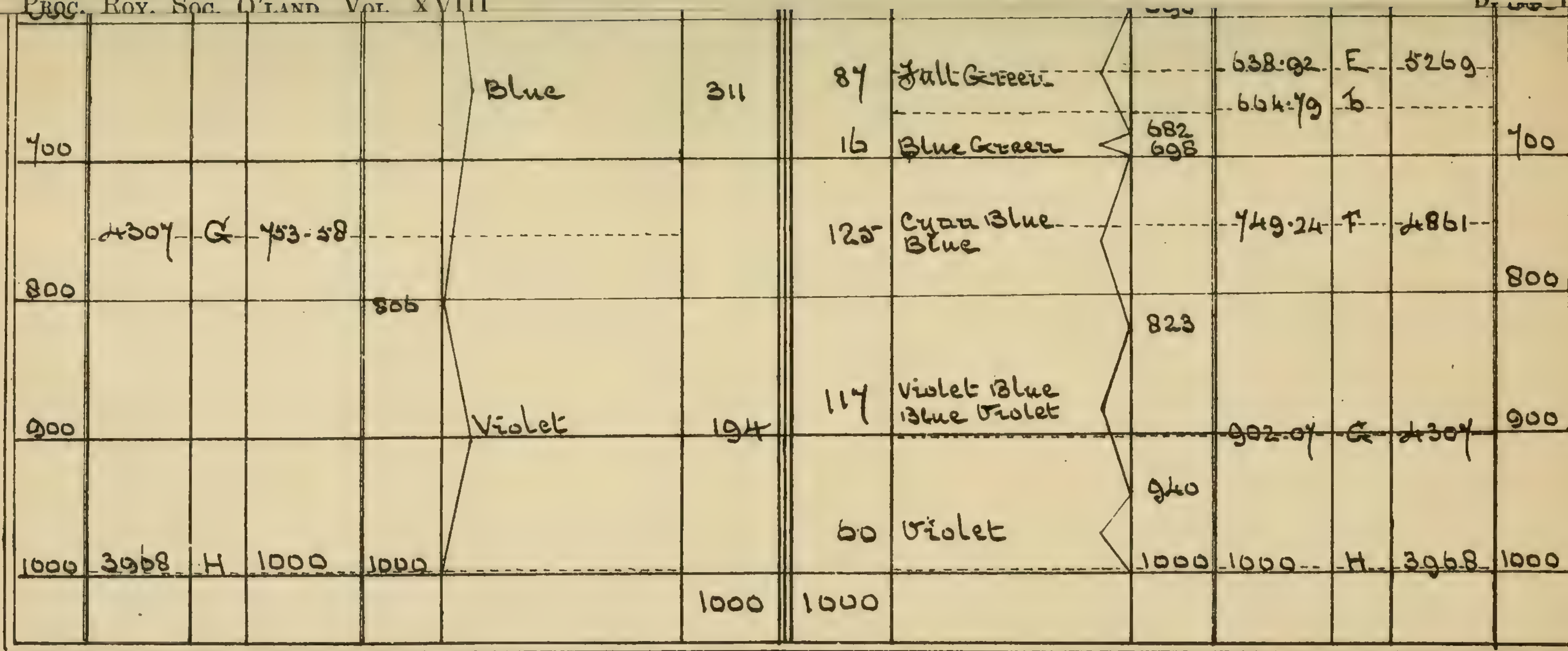
Length to 120 millimeters. (Head and body 90, caudal fin 30). Coast of Queensland.

Type in the Queensland Museum, Brisbane.

Note :—In the " Records of the Australian Museum " (vol. iv., pp. 181-184, 1902) Waite describes as *Hypoplectrodes armatus* and gives an outline drawing of a fish which he identifies with *Serranus armatus*, Castelnau. He has, however, somehow neglected to notice that it is the same fish that I had previously described (Proc. Linn. Soc. N.S. Wales, xxiv. 1899, p. 169 et seq.) as *Epinephelides leai*. The characters which he notices as separating his fish from *Gilbertia* and *Hypoplectrodes*, and which induced him to propose the subgenus

Gilbertella,* are alluded to in almost precisely the same words as those in which I pointed them out; as there can be no question as to the identity of the two fishes, my description having been taken from an immature, his from an adult example, the name *Gilbertella* is fortunately unnecessary. Whether it is Castelnau's *Serranus armatus* or not, it is impossible to decide, unless the type be in existence; if this be not the case, his description is so bad that the name should be ignored.

* My friend Mr. Waite appears to have become inoculated with some of the prevailing topsyturvydom of Australian nomenclature, since he proposes the diminutive appellation for the larger fish.



Compiled by J. THOMSON from the measurements of ROOD and HURST.

A Comparison of the Two Spectra.

The Refraction.

Spectrum divided into 1000 parts.	Wave length in ten-millionths of a millimetre.	Fixed Lines. Fraunhofer's	Positions of the Fixed Lines	Positions of the Colours.	Colours.	Spaces occupied by the Colours.
0	7594	A	0	0		
		a	40·03			
	6867	B	74·02		Red	149
100						
	6562	C	112·71			
				149	Orange Red	45
200				194	Orange	16
	5892	D	220·31	210	Orange Yellow	20
				230	Yellow	10
				240		
300					Greenish Yellow Yellowish Green	104
				344		
	5269	E	363·11			
400		b	389·85		Green	103
					Blue Green	
				447	Cyan Blue	48
500	4861	F	493·22	495		
600						
					Blue	311
700						
	4307	G	753·58			
800				806		
900					Violet	194
1000	3968	H	1000	1000		
						1000

The Diffraction.

Spaces occupied by the Colours.	Colours.	Positions of the Colours.	Positions of the Fixed Lines	Fixed Lines. Fraunhofer's	Wave length in ten-millionths of a millimetre.	Spectrum divided into 1000 parts.
		0	0	A	7594	0
						100
			113·74	a		
330	Red					
			201·61	B	6867	200
			285·05	C	6562	300
		330				
104	Orange Red					400
25	Orange	434				
26	Orange Yellow	459	468·38	D	5892	
13	Yellow	485				
		498				500
97	Greenish Yellow Yellowish Green					
		595				600
87	Full Green		638·92	E	5269	
			664·79	b		
16	Blue Green	682				
		698				700
125	Cyan Blue Blue		749·24	F	4861	
						800
		823				
117	Violet Blue Blue Violet		902·07	G	4307	900
		940				
60	Violet	1000	1000	H	3968	1000
1000						

Compiled by J. THOMSON from the measurements of ROOD and HURST.

ation for Colour Vision by
ication of Holmgren's Test.

		2. PINK										3. RED									
	Very Pale Brown or Fawn	Bright Red Pink magenta	Rich Blue	Bright Red Pink shade darker than 21	Rich Blue Violet	Bright Red Pink shade lighter than 21	Rich Blue	Pale Pink. Test.	Bluish Grey	Pinkish Yellow	Greyish Blue	Bright Red. Test.	Reddish Brown	Bright Red shade lighter than 31	Greenish Brown	Deep Red shade darker than 31	Greenish Brown	Reddish Orange shade lighter than 31	Brownish Green	Rich Orange	Yellow.
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	1							2	2			3		3	3		3	3			
	1					2		2	2			3			3		3				
	1																				
		2	2		2	2	2				2	3		3	1	3	1			1	
	1					2		2	2			3		3		3		3	3		
								2	2			3		3		3		3			
			2				2	2				3	1	3	1	3			1		
	1	2		1		2		2	2	1		3	1	3	1	3	1	3	1	3	
		2				2			2			3	1 3		3	3			3		
			2				2	2	2		2	3		3	1		1	3	1		
						2		2	2			3			3				3		
								2	2		2	3		3		3		3			
	1	2	2	2	2	2	2	2	2		2	3								1	
	1	1	..	1		1		2	2			3	3	3	3	3	3		3		
								2	2			3				3			3		
			2				2	2	2		2	3		3	1	3	1	3	1		
	1		2		2		2		2	1	2	3		1 3	3	3			3		
2		2	2	2	2	2	2	2	2		2	3	3	3	1 3	3	1	1	1 3	1	1
2	1	2				2		2	2			3		3	3	3	3	3			
2			2				2	2	2		2	3	3	3		3			3		

cates. chosen when Green or No 1 was asked to be matched

Pink 2 - -

Red 3 - -

Details of Examination for Colour Vision by Professor Thomson's modification of Holmgren's Test.

No. & Date	1. GREEN 1.																				2. PINK										3. RED									
	Bright Green. Test	Light Fawn	Blue Green	Pale Grey	Medium Olive Green	Pale Grey same as 4	Blue Green shade darker than 3	Light Yellow Brown	Light Olive Green	Light Yellow Brown	Blue Green shade darker than 7	Medium Coffee Brown	Blue Green shade lighter than 3	Light Yellow Brown shade lighter than 8	Very Pale Blue tint of green	Very Pale Brown shade lighter than 18	Pale Blue	Very Pale Brown or Fawn shade lighter than 14	Rich Green shade darker than 11	Grey Brown	Bright Red Pink magenta	Rich Blue	Bright Red Pink shade darker than 21	Rich Blue Violet	Bright Red Pink shade lighter than 21	Rich Blue	Pale Pink. Test	Bluish Grey	Pinkish Yellow	Greyish Blue	Bright Red. Test	Reddish Brown	Bright Red shade lighter than 31	Greenish Brown	Deep Red shade darker than 31	Greenish Brown shade lighter than 34	Reddish Orange	Brownish Green	Rich Orange	Yellow
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1 6.8.98								1		1										1							2	2			3		3	3		3	3			
2 21.8.98	1	1						1		1										1					2		2	2			3			3		3				
3 24.8.98	1									1				1						1																				
4 10.9.98									1												2	2		2	2	2				2	3		3	1	3	1			1	
5 4.10.98	1		2		1		2	1			2	3	1	1	2		2			1					2		2	2			3		3		3		3	3		
6 2.12.98					1			1		1		1			2												2	2			3		3		3		3			
7 24.12.98					1			1	1			1					2					2				2	2				3	1	3	1	3			1		
8 2.9.99	1		1		1		1	1		1		1	1		2			1	1	1	2		1		2		2	2	1		3	1	3	1	3	1	3	1	3	
9 17.3.00			2		1 3		2					1 3					2			1	2				2			2			3	1 3		3	3			3		
10 18.6.00	1				1			1		1			1				2					2				2	2	2		2	3		3	1		1	3	1		
11 21.7.00	1				3			1		1 3		3		1	2					1					2		2	2			3			3				3		
12 27.8.00	1	1	2			1		1		1	2		1 2	1			2			1							2	2		2	3		3		3		3			
13 30.8.00	1	3	3	3	3	3	3	1 3	1	1		3	1	1				1			2	2	2	2	2	2	2	2		2	3								1	
14 28.1.01	1	1	1	2		2	1						1 2		2			1		1	1		1		1		2	2			3	3	3	3	3	3		3		
15 18.4.01			2					1		1				1						1							2	2			3				3			3		
16 19.6.01					1			1		1												2				2	2	2		2	3		3	1	3	1	3	1		
17 6.5.02	1	1					1	1		1			1	1				1		1		2		2		2		2	1	2	3		1 3	3	3			3		
18 2.5.02	1				1			1	1	1	2			1	2		2			1	2	2	2	2	2	2	2	2		2	3	3	3	1 3	3	1	1	1 3	1	1
19 2.6.01								1		1				1		1	2	1	2	1	2				2		2	2			3		3	3	3	3	3			
20 24.6.01		1	2		1			1		1	2	3		1			2			3		2				2	2	2		2	3	3	3		3			3		

Whenever 1 appears on the table, it indicates the skein chosen when Green or No 1 was asked to be matched
" 2 " " " " " " " Pink 2 " "
" 3 " " " " " " " Red 3 " "

PRESIDENTIAL ADDRESS.

COLOUR-SIGHT AND COLOUR-BLINDNESS.

(Plates I. and II.)

By JOHN THOMSON, M.B.

(Read before the Royal Society of Queensland, 19th September, 1903)

On two occasions, in 1900 and again in 1902, the Royal Society of Queensland did me the distinguished honour of appointing me its president—an honour, I need hardly tell you, I very much value.

To the honour, however, is attached the responsibility—not the pleasing duty of piloting the Society during the year of office, for that, thanks to the energies of the Treasurer and the Secretary and the able assistance of the Council, is a labour of love—but the task—the responsibility—of the Presidential Address.

I take it that the functions of a Royal Society are to encourage original work in every department of physical science, and the purely physical need not be the boundary line, explorations should be conducted even into the uncanny.

I also take it that the chair of the president permits him to engage in the popular, and in acknowledgement of my indebtedness to the Society for its courtesy to me and in fulfilment of my obligation I have selected for my address to-night the somewhat popular, yet I trust interesting, subject,

"COLOUR-SIGHT AND COLOUR-BLINDNESS."

To discuss this, I must lead up to it by endeavouring to explain briefly some of the physical properties of light and the physiological conditions of vision.

Light and its Composition.

Sir Isaac Newton (1642-1727) said "White light is composed of rays differently refrangible."

If a beam of sunlight be admitted to a dark room through a very narrow slit in a shutter and received on the edge of a triangular prism—the drop of a chandelier will do—it will be bent from its straight course and may be projected on a screen as a brilliant rainbow-like band of many coloured lights—the spectrum. The beam has been decomposed or dispersed by refraction and the seven so-called primary colours result—red, orange, yellow, green, blue, indigo and violet; red being the colour of least refraction, violet of most. This division into seven is purely arbitrary, and Professor Leslie suggests that Newton "in the choice of that number was apparently influenced by some lurking disposition towards mysticism."

If the solar beam be examined through a spectroscope, the spectrum obtained is broken up by numerous fine transverse lines, named after their discoverer Frauenhofer's (1787-1826) lines. The more prominent of these are lettered, A being at the extreme end of the red and H of the violet, and, as their positions are fixed, they are the standards by which places in the spectrum are located and referred to. In the spectrum mentioned, the red, orange, yellow and green are crowded up, making together half the luminous band, while the blue, indigo and violet are extended, and make the other half.

Spectra are produced by other means than prismatic refractions; by a diffraction grating, the polariscope, phosphorescent and fluorescent bodies, thin films and the action of coloured bodies.

The diffraction spectrum is not so brilliant nor so pure as the refraction one; but the distances between the colours are in proportion to their wave lengths, hence it is called the normal spectrum and yellow is in the middle of it.

The spectrum has been divided into a thousand (1000) parts; the positions of the colours and the spaces occupied by them have been defined and the fixed lines of Frauenhofer have their allotted places, even to decimal points. Then as difference of wave length gives rise to difference of colour, these waves have been calculated to the ten-millionths of a millimetre and so also with the fixed lines.

Sir David Brewster (1781-1868) reduced Newton's primaries to three:—red, yellow, and blue, and this seemed practically to solve the colour problem, for it suited every kind of worker in every kind of pigment. The secondaries were easily obtained. Red and yellow gave orange; yellow and blue produced green, while blue and red made the violets; the tertiaries—russet, buff, citron, sage, slate, and plum were readily accounted for, even if it has to be admitted that they were but primaries or secondaries dulled with grey.

Scientific enquiry demonstrated that pigments, the finest and the best of them in their perfection did not compare in purity with the simple colours of the spectrum, and that a blending of any of these gave different results from the mixing of similarly named paints or dyes.

Every one knows that in painting yellow and blue make green, but what every one does not know is that the pure yellow and blue of the spectrum when blended, instead of green, give a pure white, and that green cannot be formed by a mixture of any two colours, and that yellow can, for a mixture of red and green gives yellow, therefore yellow is not a primary while green is.

Dr. Thomas Young (1773-1829), nearly a century ago, founded his theory "that white light is composed of a mixture of three colours only—red, green, and violet." Von Helmholtz (1821-1894) more fully developed this theory, which is now known as the "Young-Helmholtz," and is generally accepted by physicists as satisfactory.

Professor Clark-Maxwell (1831-1879) modified Young's by differing as to the hues of the primaries. His colours were—pure red or scarlet, pure green, and pure blue. A solution of sulphocyanide of iron fairly well matches the first; chloride of copper, the second; and ammoniacal sulphate of copper, the third; and with troughs of these and three lanterns, satisfactory experiments with this theory may be made.

Hering of Vienna, in 1878, investigated the subject and proposed a theory of six primaries:—White, black, red, yellow, green and blue; these were arranged in complementary pairs—white and black, red and green, yellow and blue. This theory was founded on "fundamental or native sensations," on a purely physiological—not physical—basis, and was supposed to represent common experience.

The Eye.

The photographic camera and the human eye are both optical picture producers and have many things in common;

and as the construction of the former and the uses of its various parts and attachments are fairly well understood, it shall be taken as the standard of comparison. The protective wood and leather of the camera have their homologue (structure) and analogue (function) in the selerotic, the tough, fibrous outer coat of the eye; the optical part is represented by the crystalline lens and other refractive media; the focussing gear by the ciliary muscles; the iris-diaphragm by the iris and pupil; the time and instantaneous shutter by the eyelids; the blackening (to prevent refections, etc.) by the choroid, the pigmentary or middle coat of the eye; and the sensitive gelatine bromide of silver plate by the sensory retina, the inner lining of the globe.

The retina is exceedingly complex and although less than $\frac{1}{100}$ inch in thickness is described as composed of ten layers, the outer of which, Jacob's membrane, the bacillary or layer of rods and cones, is the most important and is looked upon as "undoubtedly the true perceptive layer," for where rods and cones are absent as at the entrance of the optic nerve, there is the blind spot, and where the cones are thickest, as at the yellow spot, there vision is most acute.

The resemblance to photography goes still further, and assumes a photo-chemical or photo-chemico-vital aspect; for just as the sensitive plate undergoes photo-chemical changes on exposure to light, so in the eye is a substance which is similarly affected. This is a colouring matter or pigment which coats the tips of the rods—the visual purple or rhodopsin, and is quickly bleached by light to be restored by rest and darkness. And the photographic comparison is completed—for as the exposed plate can be developed to yield a picture and then fixed, so permanent optograms can be obtained from the retina. "That images of objects can be formed on the retina owing to the bleaching of the visual purple has been proved by experiment. The purple is first changed to a yellow colour and then passes into white. These optograms, as they are called, can be fixed in an excised eye if the retina be detached and then treated with a weak solution of alum."

The particular function of this purple has not been determined; it is confined to the outer segments of the rods; the cones are devoid of it and as there are but cones in the area of most acute vision, it is difficult to understand how sight can be dependent upon this retinal purple.

In fact the mechanism by which light is transformed into nervous action has not been satisfactorily explained.

Unlike the photographic plate the retina is not uniformly sensitive. Omitting the blind spot (the entrance of the optic nerve) the sensitiveness of the retina diminishes as the yellow spot or macula is departed from ; but even this is not constant, it varies for light, form and colour. A white object is seen at a greater distance from the centre than a blue, a blue than a red, and a red than a green, and these distances again vary with the amount of illumination. They can be recorded by an instrument called a perimeter on diagrams showing concentric circles, which correspond to parallels of latitude on a globe, with radiating lines for longitude, but it must be remembered these circles and lines are in the concavity of the globe not on its convexity—"on the inner surface of a hemisphere whose pole is the point of fixation." The mapped out area is the field of vision for the particular light, form or colour.

Vision.

This includes—

1. The form sense—visual acuity or the power of distinguishing objects. This is roughly and somewhat arbitrarily estimated as the ability to define sharply under good illumination objects at from about ten (10) inches to infinite distance from the eye, seen under an angle of five (5) minutes.
2. The light sense—or the faculty of recognising different luminous intensities.
3. The colour sense—or the appreciation of the smallest differences of perceptible contrast of colours or of tones.

The Colour Sense.

Theories of the mechanism of colour vision are chiefly based on the theories of light, and attempts are made to blend the physical and the physiological—colour mixtures and colour sensations.

The "Young-Helmholtz" and the "Maxwell" are trichromic theories and assume three sets of nerve filaments in the retina ; these filaments correspond to and are excited by the three spectral primaries—red, green and violet, or blue according to Maxwell—but each colour besides acting upon its own particular nerves influences to a certain extent the others. If the three are equally excited at once, white is the result ; if there is no excitation the sensation is one of blackness or rather absence of white and according to the nerves irritated and the degrees of irritation so are all the colours produced.

And colour-blindness is supposed to be due to the depravity or absence of one or more of the nerve elements.

Hering's theory of six fundamental sensations in pairs, though claimed to be trichromic is surely tetrachromic for it supposes four principal and pure colours, red and green, yellow and blue, besides white and black. The pairs are at once complementary and antagonistic and are presumed to act upon three substances which are somewhat similar to, or are constituents of, the visual purple. Rays of light affect metabolic changes —perhaps photo-chemico-vital—on these visual substances in different ways—some promoting constructive changes (changes of assimilation or anabolic) others promoting destructive changes (changes of dissimilation or katabolic) and when these changes are in equilibrium no sensation is experienced. Red is a dissimilative change, green an assimilative ; yellow dissimilative, blue assimilative. All the colours act upon the white-black substance, but the red-green does not effect the yellow-blue nor vice versa.

And colour-blindness is the absence of one or more of these fundamental sensations.

There are other theories :—Ebbenhaus, based upon the supposed decomposition of the visual purple and Parinaud, upon the action of the rods and cones—stimulation of the former causing a sensation of non-coloured light and of the latter all possible sensations of colour.

But " no theory is satisfactory in character and no facts up to the present seem sufficient to explain the mechanism of colour vision." As one author says, " this subject has not yet found its Newton." As another says, " no colour-blind retina has been secured for microscopical examination."

Dr. Hugo Magnus, of Breslau, in 1877, advanced a somewhat curious theory :—That primitive man was colour-blind ; starting life with one positive perception, namely, light ; and one negative, namely, not-light, or darkness ; in fact that he saw nothing except light and dark and had no sense of colour. And Magnus recognised four stages in the march of educational development which has given us our present perfect colour perceptions :—

1st stage.—The ability to distinguish red from black.

2nd stage.—The recognition of the sense of colour apart from the sense of light; the reds, oranges, and yellows being apparent.

3rd stage.—The perception of green, with its varieties.

4th stage.—The detection of blue.

In connection with red, its recognition in the first stage may be due to its being the most brilliant of the colours. It is certainly the colour manufacturers recognise as preferred by uncivilised races in their desire for something pronounced. It is the colour early acquired by the primitive painter in his art, and in the costume of potentates it survives as the choice for spectacular effects of their long departed predecessors.

To the second stage are referred the Homeric poems and the earlier books of the Old Testament. [*See Appendix I.*]

The third stage is not further referred to; but it is stated of the fourth "that it is not even now reached universally, for in Burmah a striking confusion between green and blue is a perfectly common phenomenon, and a like confusion is sometimes observable among ourselves as to these two colours when seen by candle-light."

Dr. Edridge Green has recently introduced another theory of the evolution of the colour sense. He starts like Magnus believing in the colour-blindness of the primeval man, but he takes a different view of the order in which the perception of colour is acquired. According to Magnus the evolution was in the order of refrangibility; according to Edridge Green the extremes of the spectrum are first perceived. He quotes very largely from Gladstone's article (*See Appendix I.*) and seems to build his fancy on Gladstone's finding that Homer was possibly a dichromic, seeing red and violet, and on a patient who colour-blind in one eye saw with it "the two ends of the spectrum tinged with colour and the remainder grey." He believes in a hexachromic theory apparently, because in the normal colour-sighted "six definite points of difference (colour) are distinguished in the spectrum." He expresses his disbelief in the trichromic theory "in the sense that there are three fundamental sensations which are capable of acting independently of each other." Those who see seven or six colours in the spectrum he calls hexachromic; five, pentachromic; four, tetrachromic ; three, trichromic ; two, dichromic, and the totally colour-blind monochromic. The order on which, according to him the colours are evolved, may be seen in this table :

Position of colour in spectrum	1	2	3	4	5	6
Name of colour	Red :	Orange :	Yellow :	Green :	Blue :	Violet :
Order of evolution	1	6	4	3	5	2

And when there is a paucity of colours recognised, the missing one is the latest in development, thus—a pentachromic would not recognise orange ; a tetrachromic, blue ; a trichromic would mix up the yellows and greens ; and "a dichromic confuse red, orange, yellow and yellow-green on the one hand and blue-green, blue and violet on the other."

In illustration of this, Green has published some ten (10) coloured spectra, which he supposes represent seven (7) different types of colour perception—from the achromic or monochromic to those who can see seven or six colours in the solar spectrum, the hexachromic or perfect colour-sighted.

Abney also issued coloured charts to represent a normal spectrum, and one each as seen by the green-, the red-, and the violet-blind.

But it does not strike me that the authors agree or that their charts are a true solution of the colour difficulty.

Colour Blindness,

Or Daltonism, as it was for a long time called, because John Dalton (1766-1844), an English chemist and physicist, himself colour blind, described his defects of vision (1794).

A capital article on the Life and Work of John Dalton appears in the "British Medical Journal" of the 16th of May, this year, and an extensive excerpt from his papers on Colour Blindness is given in Dalton's own words.

When a person can see seven or six colours in the spectrum he is admittedly colour perfect ; when he can see five he might be classed as fairly normal sighted ; but when he perceives only four or fewer or none there is a marked defect in his colour perception and he may be partially or completely colour-blind.

The usual classification is—

I.—Total Colour-Blindness. Achromatopsia.

When all intensities of lightness and darkness may be thoroughly recognised, but no colour perceived.

II.—Partial Colour-Blindness.

1. Complete Partial. Dyschromatopsia.

   In which one of the primaries (adopting the trichromic theory) is totally awanting.

   a. Red blindness—complete.
   b. Green ,, ,,
   c. Violet ,, ,,

2. Incomplete Partial.

   Where one or more of the three primaries is defective or inferior in excitability.

   a. Red blindness—incomplete.
   b. Green ,, ,,
   c. Violet ,, ,,
   d. Feeble chromatic sense.

This classification is purely arbitrary, far too exacting, and signally fails to account for the overlapping cases which I have seen and recorded but of which I am unable to determine the exact defect. As one author puts it, "there is no such sharp and absolute distinctions in any case as the hobby-riding colour theorist sometimes avers."

I have now examined for colour vision 1128 candidates for employment in the Queensland Government Railways, but I am sorry to admit that I have only exact records of the last 782, and I discovered among these 18 colour blind individuals or 2·3 per cent., which is considerably under the usual returns of 4 or 5 per cent.

In no case have I found a candidate with normal colour vision in one eye and colour blindness in the other; nor have I met with a case of total colour-blindness except possibly one; nor a case of feeble chromatic sense. All my cases have been well marked, as will be seen from the accompanying table—a table which I believe to be unique. I have hunted in vain through British literature for such a record. Odd and vague statements are constantly to be met with referring to the mistakes of the colour-blind, but this is the only table I am aware of where are to be found, in minute and scientific detail, the blunders of twenty (20) colour-blind individuals, tested on a trichromic basis. This table gives the details of the examination of twenty (20) men who have been certified colour-blind—two (2) of these were not railway men.

The method of testing is by showing the examinee a skein of coloured worsted—a test skein—and asking him to point out any skeins among the lot presented to him which in his opinion resemble the test skein.

The lot presented are in three (3) groups. Group 1 consists of twenty (20) skeins; ten (10) green in varying shades and intensities, and ten (10) so-called confusion colours, which, owing to *hue* or colour, *luminosity* or brightness and *purity* or admixture of another colour or white or black (in this case undoubted *impurity*) may be confounded or confused with the green. The confusion colours are greys, fawns and browns.

Group 2 has ten (10) skeins; five (5) pinks, varying from rich red pink to yellow pink and five (5) confusion colours chiefly blues and grey-blues and violet.

Group 3 is also made up of ten (10) skeins; five (5) reds of various kinds and five (5) confusion colours, reddish and greenish browns and a yellow.

An analysis of the table shows that all the examinees—twenty (20)—were green-blind, and that although eleven (11) of them selected skein 1, or a green identical with the test skein, all of these and others also selected browns. Sixteen (16) examinees picked out skein 8, a light yellow brown. Fifteen (15) selected skein 10, also a yellow brown; and thirteen (13) skein 20, a grey brown; besides six (6) selections were made from group 2 or the pinks, and twenty-five (25) from group 3 or the reds.

In the pink group, although sixteen (16) examinees selected 27 or the test colour, all twenty (20) were colour defective in this group, and thirty (30) selections were made from among the greens in the green group.

In the red group, nineteen (19) examinees chose skein 31, or the test, and six (6) examinees 4, 6, 7, 8, 12, and 16, had normal vision for red, but the other fourteen (14) were red-blind, and made sixteen (16) selections from among the green group.

Some examinees selected the same skein as representing two groups—green and red.

Examinee 9, selected skein 5—a medium olive green.
,, 9, ,, ,, 12—a medium coffee brown.
,, 9, ,, ,, 32—a reddish brown.
,, 11, ,, ,, 10—a light yellow brown.
,, 13, ,, ,, 8—a light yellow brown.
,, 17, ,, ,, 33—a bright red.
,, 18, ,, ,, 34—a greenish brown.

One (1) bright red, skein 33; one (1) red orange, skein 37; three (3) rich orange, skein 39; and one (1) yellow, skein 40, were selected by examinees in quest of green. The same examinee 18, selected skeins 37, 39, and 40. Some in quest of red, made selections from among the greens; one (1) chose skein 3, a blue-green; three (3) chose skein 5, a medium olive green; one (1) chose skein 7, a blue-green; the same examinee, 13, choosing skeins 3, 5, and 7; that is to say, four (4) green-blind included reds in their choice, and three (3) red-blind, included greens.

No pink or group 2 selection was made among the reds, and no red or group 3 selection from among the pinks.

There is no difficulty in detecting a colour-blind individual; he usually betrays himself before he even makes a selection, by taking the test skein in his hand turning it over and over and examining it as if he hoped to obtain some inspiration through another faculty than that of sight. This is often very marked. But I find a very great difficulty in classifying the colour-blind, and I ought not to, seeing how definite (?) are the directions and exact (?) the colour cards indicating different types of colour blindness.

It is quite in doubt what a colour-blind man sees, for he cannot communicate his perceptions otherwise than by suggestion and when he uses certain terms, say *red* or *green*, there is no evidence that his impressions are similar to ours with reference to these particular colours for he confounds them.

Two notable cases are recorded by Hippel and Edridge Green of patients who had normal colour perception in one eye and were colour blind in the other. In both instances they recognised the extremes of the spectrum; Hippel's case saw yellow and blue, Green's saw red and violet but confounded yellow and blue.

None of my cases confounded the ends of the spectrum, reds with violets, and this is in support of Gladstone's finding with reference to Homer's colour perception and in keeping with Edridge Green's theory of the evolution of the colour sense.

With the colour-blind a great deal of guessing goes on when selections are being made, and although the defect will invariably assert itself, for one or more of the confusion colours will always be chosen, there will certainly be a variety in the skeins selected and no two examinations will give the same result.

It frequently appears that not hue nor colour but intensity—brightness or shade—influences the choice; that skeins totally different in colour, but somewhat the same in depth are chosen.

Remembering the photo-chemico-vital action of light on the visual purple or rhodopsin and the photo-chemical action of light on the photographic gelatine plate, I experimented with the railway red and green flags. I got some official bunting, samples of both colours and photographed them first on a white background and then on a black. The results are thrown on the screen direct from the negative, for some of the contrast might have been exaggerated if a lantern slide positive had been used. With an Ilford's ordinary plate the actinic exertion of neither red nor green is much; what there is, is distinctly in favour of green, but considering the intense differences suggested by the two flags photographic results show no great contrast. With Ilford's chromatic plates the difference is much more apparent. These, the chromatic or correct-colour-value plates might be likened to the normal sighted, while the ordinary plates would represent the partially colour-blind.

By throwing a red light on the screen from a red glass which cuts off the green rays of the spectrum the audience becomes temporarily green-blind and is supposed to see things as the green-blind are suspected to see them; while by using a blue-green light which absorbs all the red rays the audience, deprived of red, is temporarily red-blind and sees as it is fancied the red blind should see.

Abney is responsible for this experiment but I doubt its truth. With the red light the green flag certainly reflects no colour and looks black, but the red is depraved; and with the green light the red flag is black and the green is hardly recognisable. The experiment proves too much; in each instance it destroys one colour and materially disturbs the other.

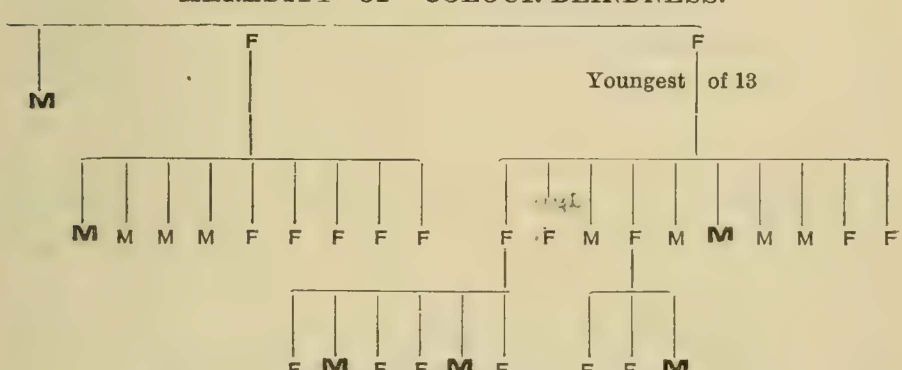
Some time ago I thought I was in the fair way of solving the colour-blind problem. Those of you who photograph must remember an old recommendation, namely, to view your intended landscape picture through deep blue glass so as to get your colour values. Doing this it struck me how very identical in colour was a red brick wall with the green leaves of the creeper that clung to it, and working the experiment out I found that a blue vision would fairly account for such of the colour-blind blunders as I was acquainted with. I turned to all the available authorities on the subject and finding no reference whatever to a blue theory was beginning to congratulate myself, when opening an old tome "that had long lain hid" I discovered that Dalton had suggested that the red rays in his case were absorbed by the vitreous humour which might have a blue colour or by the retina itself having a blue tint. An examination of Dalton's eyes was made after death, "but no blue vitreous humour, nor blue retina was there, thus affording a refutation of both these conjectures."

I think the blue theory might be revived; it is about as good as any at present; and it might be worked in, in connection with a cyanic depravity of the visual purple.

Cases of colour-blindness are also classified as Congenital and Acquired.

Congenital.—I believe those in my table are all congenital and were in no way induced or aggravated by habit or disease. Whether they were hereditary it is impossible to say. Eighteen (18) of the men were certainly unaware of any defect until after examination and all declared they never heard of colour-blindness among their relatives. The other two (2) knew of their abnormality, but did not regard this as hereditary. Yet in the case of examinee 20, a solicitor, it is very distinctly so. A nephew of his, a bright lad of 11, is colour-blind and in an astonishing way followed the mistakes of the maternal uncle; and further enquiry elicited the fact that defective colour perception is very distinctly hereditary in this well-known Brisbane family, for of thirteen (13) males appearing in five (5) branches during three (3) generations, six (6) are known to be colour-blind, with in every instance the transmission, as to be expected, through the mothers, all of whom are said to enjoy normal colour sight.

HEREDITY OF COLOUR-BLINDNESS.



(The black letters **M** indicate the colour-blind.)

Congenital cases are permanent, are not amenable to any treatment, and educational training has no effect.

Acquired.—I have not detected a case of acquired colour-blindness. It is stated "to commence as a rule in the centre of the field and is an almost pathognomonic sign of what is commonly called '*toxic amblyopia*,' that is to say, of a neuritis which is limited (at the beginning) to the macular fasciculus of retinal fibres, and caused by the excessive use (excess either absolute or relative to the idiosyncrasy of the patient) of tobacco, of alcohol and possibly of other agents, either singly or in combination." Mr. Priestly Smith has pointed out "that as a rule the disease is not produced by tobacco alone but by some cause of depression acting upon a large consumer, such as shipwreck and its attendant hardships upon a sailor, or financial anxieties upon a great smoker who is engaged in trade."

As the disturbed retinal area may be limited, the colour of a large object may be easily perceived by the unaffected areas, while that of a small one, falling within the diseased limits, cannot be seen.

Dangers from Colour-Blindness.

That there are colour-blind people, people who cannot see red or green or confuse the two is undoubted ; and it would be a grave danger to travellers by sea or land if these defective-sighted individuals were in charge of our ships or our trains.

The side lights of all vessels of all countries are green (blue-green) and red (rich ruby). Green for the starboard, or right side of the ship ; red for the port, or left.

On land, on the railways, green is the safety light ; red, the danger signal.

In the Report of the Committee on Colour Vision, presented to both Houses of the Imperial Parliament in June, 1892, it is said "The direct evidence before them (the Committee) is not sufficient to cause them to say that accidents, either by sea or land, have conclusively been traced to defective colour vision ; yet this by no means disproves the high probability that accidents have really occurred from such defects." And the safety of the travelling public is made secure so far as defective colour perception is concerned by insisting upon the employment of those only who possess a normal colour sense. And this of course necessitates careful and scientific examination and selection.

Dr. Jay Jeffries, of Boston, U.S.A., in his work on Colour-Blindness is more assertive and declares that railway and marine accidents have occurred from it and cites instances.

Someone has suggested the impossibility of getting at the truth, of subsequently proving or disproving colour-blindness, owing to the individual responsible for the catastrophe being lost with his ship or wrecked with his train.

It has been proposed to alter the lights and employ those not likely to be mistaken by partially or completely colour-blind people; colours from the extremes of the spectrum, red, orange or yellow, and blue, blue-violet, and violet.

Orange and yellow are out of the question, for they would readily be confounded with other lights which are not signals chiefly in the vicinity of towns, just as white was—and *it* has been discarded as the "clear" or safety signal on the railways. Red alone remains; it is a saturated and brilliant colour; a red glass transmits about 10 per cent. of the luminosity of the lamp behind it; in red theory and practice agree; experiment and experience force its use.

Blue, blue-violet and violet are impracticable owing to lack of brilliancy and indistinctness when viewed from a distance; glasses of these hues only transmit from 2 to 4 per cent. of the light behind.

The red and green must remain; they cannot be altered to suit the individual; he must be selected to recognise them, and in the selection "the greatest severity should be observed, or, in other words, the least defect in the sense of colour should be a sufficient ground for rejection." (Regulations for the management of State railways in Sweden).

Testing for Colour-Blindness.

The test adopted is the one recommended in the report of the committee on colour vision, *i.e.*, Holmgren's, introduced in 1878, the well known coloured wool-matching test. A complete set of Holmgren's wools runs into many dozens of skeins, and many of these are difficult to procure, and are unnecessary. Professor Thomson, of Philadelphia, suggested a modification of Holmgren's methods, and this was adopted and successfully by the Pennsylvania and other American railways. I have used it for some twelve years; it is the scheme I have already referred to and on which my table is based, and I have confidence in it. But practically it still remains Holmgren's, and Holmgren's has been adopted by almost every country—European and American

—as the standard for the determination of colour vision. "The great point in a test is to cause the candidate to *do something* to show that he appreciates colour. It is this *doing something and saying nothing* which is the important feature of the Holmgren test. A man may be ignorant of the names of colours—colour ignorant, it is called—but he cannot be ignorant of the colours themselves if he has normal colour vision."

So when a candidate is handed a single skein and asked to match it or pick out from the many skeins before him all he thinks like it he is subjected to a very practical test. He may —he very often does—say when handed the test skein "Oh, that is a green." The answer is, "Then pick out all the greens you see." But he is not requested or even encouraged to name colours.

Quite recently, 1902, at a meeting of ophthalmologists in England an attempt was made to throw discredit upon the wool test and a resolution was proposed that "the employment of the Holmgren test for colour-blindness by the Board of Trade is most unsatisfactory, as the inefficiency of this test is now well-known." Twenty-four members were present but only seven voted and the motion was lost by one vote.

There are other wool arrangements, Jeaffreson's frame, Roberts table and Dorffel's sets. Then there are the War Office cards, Rumble's gelatine discs and the double lamps. Each lamp is like a signal one, but instead of only white, red and green lights it has about a dozen. The examiner takes one lamp; the candidate is given the other; the former turns on a coloured sector, the latter has to shew a similar one. No questions are asked and no colours are mentioned.

Stilling used coloured cards, the colours dark and light green alternately being in numerous (357) small squares each bounded by black lines, a checker pattern. On the card was a letter in red squares, the red being equal in intensity to the light green. The different shades of green with the black edging were said to baffle the colour-blind who failed to see the red letter.

Edridge Green uses a lantern with seven coloured glasses and atmospheric effects can be produced by the ingenious addition of six modifying glasses, four neutral to suggest varying degrees of fog, one ground to represent mist and a ribbed one pretending rain.

Abney employs what he calls a colour-patch-apparatus, a contrivance by which rays from sun- or arc-light are first parallelised and then partially refracted and partially reflected; the former, the refracted, pass through two prisms and are focussed on a screen to form a spectrum, or by using a slit, any ray of a spectrum, or by employing a collective lens, a white image; the latter, the reflected, fall on a mirror and by means of a lens can be thrown on the same screen and alongside the colour patch.*

In cases of acquired colour-blindness, a condition I have already said I have no experience of, with the affected retinal area or areas small, the wool test would fail, for the skeins being large their images would be received on parts of the retina not diseased and colours would be correctly matched.

To provide for this Sir Wm. Abney says: "I have had a set of brick-clay pellets some $\frac{3}{10}$ inch in diameter, painted with water colours mixed with soluble glass solution of the same colours as the wools. These are placed in a shallow tray and presented to patients affected with this central blindness to pick out all the pellets which match reds and greens. They will tell you they see neither the one nor the other, though they will pick out the blue pellets unerringly. A red pellet they will match with a red, green, grey or a brown one, and a green one with the same. If, however, you instruct them to direct their eyes a few degrees away from the tray, they will tell you they see all the colours, and as they endeavour to pick thom out, they, with a natural instinct, direct their eyes again to the collection when once more the colours vanish. It is almost piteous sometimes to see the distress which this simple test occasions."

Watching a colour-blind individual stumbling over his mistaken skeins is a rather painful sight, but there are occasionally some amusing incidents.

Examinee 4 was a fine strapping fellow, and I was anxious to get him for the Railways, and I was also anxious to experiment with him to discover if possible any method which might be adopted to correct his defective colour sense. Time and again

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* NOTE.—I referred to *a* leading, perhaps *the* leading, firm of opticians in London, and received answer:—" 7/9/03. The only coloured tests that seem to be in demand are the ordinary sets of wools. Nearly all the tests you mention in your letter have not been manufactured for many years; we could let you have them if you wish, but it is doubtful whether you would consider that they would be worth the carriage to send."

I tested him and each time he was worse than before. One day in the most delicate *role* I could assume I questioned him as to the existence of—

"A dearer one still, and a nearer one yet, than all other?"

He blushingly answered—there was; and I bade him bring her on her Sunday out. She had never heard of colour-blindness and being particularly sharp herself was astonished, aye, vexed at her lover's mistakes. I told her to get a lot of skeins of coloured worsted similar to those I had and to coach her friend for a future examination. She did so and the couple returned to me two or three weeks later jubilant with the certainty of the youth's success—and in a fashion he was successful. Try him as I pleased and shuffle *his* wools as I might he never faltered, he never failed; then I bethought me to test him with *my* wools. He was hopelessly colour-blind.

Examinee 14 was a sturdy married man who had the chance of employment on our railways. Finding he was colour-blind I said nothing but told him to present himself for re-examination and to bring his wife with him. When she arrived I told her I had sent for her to see fair play. I warned her to say nothing no matter what she saw else I would send her from the room. Poor woman! She knew nothing of colour-blindness. For a time she watched the blunders of her better half, but when he selected a coffee-brown skein for a bright green she could contain herself no longer but whacked her hubby on his head with her "brolly," called him a —— fool and bounced from my office.

Examinee 16 was a fireman, who, through colour-blindness, had lost his place on the "foot-plate." Some considerable time after he came to me with a certificate from an ophthalmic surgeon wherein it was stated the late fireman had normal colour perception. After showing me this he threatened me with the vengeance of some association to which he belonged. I retested him then and said nothing to him beyond advising him to go about his business. From me he went to the office of the Chief Mechanical Engineer and showing his document declared he was an ill-used man, having lost his billet through my mistake. I was asked to re-examine him and consented to do so if a responsible officer of the department was present. The candidate and the witness arrived together; I showed the former the green test skein and asked him to pick out from the lot anything like it carefully avoiding the mention of any colour names. He struck an attitude, at least I thought he did, and picking up a skein thundered "this is the only green one in the pack." He chose a brown. I havn't seen him since.

Examinee 19 was not a railway candidate but a very distinguished personage who permitted me to test his colour sense on two or three occasions. Shortly after his arrival in Brisbane he gave himself away by saying to a distinguished official at a garden party "Who is that lady with the green feather in her hat?" The feather was red! He was heard to speak of the lovely purple-violet blossoms of the jacaranda as red; and he admitted to me that he saw no difference in colour between the turkey-red bracts and the green leaves of the poinsettia. He was totally green-blind, and insisted to the last that skeins 8 and 10, both brown, were green. His wife who knew of his colour defect told me his taste was exquisite, and that when he criticised the appointments of his own table and the toilettes of his guests he was invariably correct.

Suggestions

for the employment of coloured skeins in testing vision may be of value. I am not aware that any of these are to be found in any Manual or are laid down in any set of Regulations, but they are the result of my experience in testing 1128 candidates; I am sure they are fair as between the examined and the examiner. I submit them for what they are worth.

1. The examination should be conducted in daylight.
2. The skeins should be spread on a white or black background; a towel or white table cover.
   - (*a.*) A many-coloured table cloth, cushion, or curtain should not be used as a background; the colours might be confused.
3. Candidates should be given time and dealt with patiently.
   - (*a.*) The majority select quickly.
   - (*b.*) Some seem stupid or get confused or fail to understand what is expected of them.
   - (*c.*) A few get nervous and seem to imagine a trick is being played or that there is something mystic about the test.
   - (*d.*) Those who are colour-blind soon betray themselves.

4. Candidates should not be requested or encouraged to name colours.
   (*a.*) The idea of colour testing is to do something and to say nothing; to match skeins not to name them.
   (*b.*) Colour-ignorance and colour-blindness are two very different things.
   (*c.*) The ignorance can be corrected.
   (*d.*) The blindness cannot, and it is for the blindness only the test has been established.
5. No candidate should be pronounced colour-blind until he has been examined twice or even oftener.
   (*a.*) I believe a congenital colour-blind person is incurable.
   (*b.*) I have tested some of the rejected candidates quite a dozen times.
   (*c.*) I have had them under tuition.
   (*d.*) I have had them purchase skeins; these in a short time they would learn all about and would glibly rattle off their names, but when shown fresh or strange skeins their blindness was as apparent as ever.
6. No candidate should be pronounced colour-blind unless examined before a witness.
   (*a.*) A colour-blind person when first told of his defect does not not understand it and cannot believe it.
   (*b.*) Neither do his friends.
   (*c.*) It is well that his blunders should be witnessed by one or more of his own people.
7. The test and confusion colours should all be numbered, so that candidate's mistakes may be recorded for future reference.
   (*a.*) I look upon this as important, although I recognise the fact that the colour-blind with every examination vary their selections, so that no two examinations will give the same results.

APPENDIX I.

That extraordinary man, the late Mr. W. E. Gladstone, in an article in Vol. 2 of the "Nineteenth Century" for 1877 dealt with the colour sense of

"The Blind Old Man of Scio's Rocky Isle."

and his conclusions were, "that Homer's system of colour or rather his system in lieu of colour was founded upon light and upon darkness, its opposite or negative: and that the organ of colour was but partially developed among the Greeks of his age." And "that although Homer has used light in its various forms for his purposes with perhaps greater splendour and effect than any other poet, yet the colour adjectives and colour descriptions of the poems were not only imperfect but highly ambiguous and confused." In a learned, classical, and logical fashion he critically analyses the various uses of the words—eruthros, xanthos, chloros, kuaneos, porphureos and others, and suggests that Homer had a partial recognition of the extremes of the spectrum in that he had discovered an affinity between what lies next to light, viz., red and orange—eruthros and xanthos—and what lies next at the other end of the scale to not-light, *viz.*, violet, porphureos: recognising red and orange at the one end and violet at the other, but failing in the yellows, greens and blues.

In a very interesting letter I received from Mr. R. H. Roe, head master of our Grammar School, he says "There can be no certainty that Homer was blind, because the best modern critics are about equally divided whether there was a single poet Homer at all; but there is no doubt that the ancient sculptors represented their Homer as blind, and that ancient historians and poets spoke of him as blind. In the Homeric hymn quoted by Thucydides (Bk. iii., cap. 104) appears—

τυφλὸς ἀνήρ, οἰκεῖ δὲ Χίῳ ᾿ένι παιπαλοέσσῃ

("A blind man, he dwells in rocky Chios,")

which line Thucydides considers evidently to be written by Homer himself; and upon it is based the popular belief of antiquity about the poet's blindness. Still I presume that even the ancients only considered him blind in mature or late life, for otherwise he could not have described the scenes of nature with such an artist's eye as he has done. The words which in my reading of Homer I have always found used in the most indefinite way are kuaneos, xanthos and glaukos, though eruthros and porphureos are very loosely used also. You will find in a large *Liddell and Scott* that kuaneos is applied to the deep sea, to the blue corn-flower, blue steel, to lapis lazuli, to the hair of Ulysses, to the swallow and to the clouds—evidently covering a wide range between dark blue and black.

"Xanthos again is used of ripe corn, chestnut horses, lions, gold, golden hair, blushing, wine—ranging thus from yellow to red.

"Glaukos, gray, again is used of the eyes, the olive, the sea, the vine, the beryl and the topaz—ranging from gray to light blue and green.

"Eruthros, red, ranges from vermilion and scarlet to copper and blood.

"Porphureos, violet, is used of the sea, wine, rainbow, hair and cheeks, the two latter being post-Homeric.

"Still I do not think too much should be made of this vague use of epithets by the ancients, or that we should infer they *could* not distinguish between the different colours. The right inference would rather be that they had very few words to express finer shades of colour, and few pigments to act as standard names; hence their few epithets had to do duty for a variety of things. We, in our day, have seen a variety of new names for colours added to our language, *i.e.*, mauve, magenta, cerise—but I think we should be wrong in saying that our fathers were unable to distinguish these shades from others because they had no name for them.

"A black fellow would probably be able to see a difference between them all though his vocabulary would not enable him to discrimate between them in speech.

"These were the feelings which Gladstone's book raised in me on the question. The subject, however, is very interesting and the old man may claim the merit of having started it."

In the life of Homer, attributed to the Greek historian Herodotus of Halicarnassus (484 B.C.), the poet's real name is given as Melesigenes, and it is stated that during his travels he became blind and that the Cumœans nick-named him "Homeros"—the blind man—literally "one who follows a guide."

Gladstone, in the magazine article referred to, further says:—"I understand from an able Hebraist that the Old Testament offers much evidence of the imperfect conception of colour in early times."

Dr. Wm. Scott, in his Dictionary of the Bible, 1860, in a considerable article on Colours says :—" Among the Jews, who fell even below their contemporaries in the cultivation of the fine arts and to whom painting was unknown until a later period, the knowledge of artificial colours was very restricted. . . . The highest development of colour in the mind of the Hebrew was light and hence the preponderance given to white. . . . Next to white, black, or rather dark, holds the most prominent place. . . . Red was a colour of which the Jews had a vivid conception. . . . Yellow is very seldom noticed ; it was apparently regarded as a shade of green. . . . Green is frequently noticed, but an examination of the passages in which it occurs will show that the reference is seldom to colour but applies to what is *vigorous, flourishing, out-spreading, sprouting, fresh, young, moist, sappy and unripe.* Thus it may be said that green is never used in the Bible to convey the impression of a proper colour."

Besides white and black, I find on reference to Cruden's Concordance that the following colours are mentioned in the Old Testament so many times :—

Red	21	Yellow	4	Green	25
Blue	14	Violet	2	Brown	4
Vermilion	2	Crimson	5	Scarlet	34
		Purple	16		

Magnus has sought in ancient descriptions of the rainbow a support for his theory and naturally makes out a good case. Homer (? 1000 B.C.), he thinks, dealt with it as one-coloured, red or purple ; the ancient Arabs described it as red ; Ezekiel (588 B.C.), Chap. I., v. 28, says it has an appearance of brightness ; Xenophanes (? 550 B.C.) sees three colours in the bow—red, blue, and yellow-green ; Aristotle (384 B.C.) is for a tricolour ; Ovid (43 B.C.) is vague ; Seneca (B.C.-A.D.), ditto ; Suedas and Galen (36 A.D.) support the triad of colours and so do the Eastern and later Arabian literatures.

APPENDIX II.

The following were thrown on the screen during the lecture.

1—The refraction spectrum—10 feet long. Arc lamp, and two bisulphide of carbon prisms.
2—The diffraction spectrum—6 feet long. Arc lamp and grating.
3—Solar spectrum—diagram.
4—The two spectra—refraction and diffraction diagram.
5—A comparison of the two spectra.
6—Brewster's theory of colour.
7—Chromatic circle ; Maxwell's theory.
8—Horixontal section of left eye—diagram.
9—Vertical section of retina—diagram.
10—Vertical section of retina, photo-micrograph, by Dr. Thomson, x 300.
11—9 and 10 compared.
12—Perimetric chart ; Gibson and Russell ; right eye.
13—Perimetric chart ; Brudenell Carter ; left eye.
14—Perimetric chart ; Abney ; for red.
15—Perimetric chart ; Abney ; for green.
16—Carter's perimeter.
17—Young-Helmholz theory—diagram.
18—Colour table of Maxwell—diagram.
19—Colour curves of Maxwell—diagram.
20—Colour curves of a dichromatic, after Maxwell.
21—Dr. Magnus' theory of colour sensation.
22—Dr. Edridge Green's theory of colour sensation.
23—Dr. Edridge Green's spectra of the colour-blind.
24—Likeness of John Dalton from B.M.A., 16/5/03.
25—Table of colour blind.
26—Red and green bunting on a white background ; Ilford's ordinary.
27—Red and green bunting on a white background ; Ilford's chromatic.
28—Red and green bunting on a black background ; Ilford's ordinary.
29—Red and green bunting on a black background ; Ilford's chromatic.
30—Red light—Experiments with : effects of.
31—Green light—Experiments with : effects of.
32—Blue light—Experiments with : effects of.
33—Heredity of Colour Blindness.
34—Stilling's Test Card.
35—Colour Patch Apparatus ; Abney.
36—Colour Patch Apparatus ; Abney—diagram.
37—*London Punch*—red, white, blue. 29/4/03.

APPENDIX III.

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NATURALISED AND ACCLIMATISED PLANTS IN VARIOUS PARTS OF THE WORLD.

By JOSEPH LAUTERER, M.D.

(Read before the Royal Society of Queensland, 25th June, 1903.

Acclimatisation in the widest sense, as intended artificial introduction, and as unintended (natural or occasional) immigration of organisms, has very different results. The self-acclimatising power of plants and animals is also very different. There are plants occurring only in an area of a hundred square miles. Mr. F. M. Bailey, discovered a new sassafras tree on the Blackall Ranges, named by him *Cinnamomum Oliveri*, which is probably confined to an exceedingly small district. Other plants are found from pole to pole all round the globe. The vegetation of lakes and rivers, in and upon the water and on the shores, is marvellously uniform on the whole earth. The same genera, and even the identical species of aquatic plants, were seen by me in the Wakatipu of New Zealand, the Chuzenji and Biwa in Japan, the Chapala in Mexico, and the Titicaca in Peru. The same waterlilies (*Nymphaea*), bladderworts (*Utricularia*), frogbits (*Hydrocharis*), *Vallisnerias*, pondweeds (*Potamogeton*), quilworts (*Isoetes*), watermilfoils (*Myriophyllum*) hornworts (*Ceratophyllum*), duckweeds (*Lemna*), *Naias* and pilworts (*Pilularia*), are growing there in the water; plants which I gathered thirty years ago in the Malar lake in Sweden, and in the post-tertiary glacier lakes of Switzerland and the Black Forest. An European who comes to Australia and finds himself surrounded by a flora altogether different from what he has been accustomed to, is surprised in the highest degree, to find on the sources of the Macquarie River, in lonely places scarcely trodden before by a human foot, plants which were familiar to his eye in the old country. The water-plantain (*Alisma plantago*), the water pepper (*Polygonum hydropiper*), the blinks (*Montia rivularis*), the clubrush (*Scirpus lacustris* and *maritimus*— *Heleocharis acicularis*), the twig-rush (*Cladium Mariscus*), the reed mace (*Typha augustifolia*), the sedge (*Carex Buxbaumi*, *acuta*, *paniculata*), and the galingale (*Cyperus flavescens*), all of them, at least 72 species, have been gathered by me twenty years ago on the Upper Macquarie, together with European aquatic grasses, like the reeds *Arundo phragmites*, *Glyceria fluitans*, and *Leersia hexandra*. And on my last journey I fell in with the same plants, on still waters, in many parts of the globe.

The flora of high mountains is equally uniform, derived, according to Sir Joseph Hooker, from the glacial period of post-tertiary age, when Arctic plants migrated to the Southern Hemisphere. Horned trefoil (*Lotus corniculatus*), winter cress (*Barbarea vulgaris*), hairy bitter cress (*Cardamine hirsuta*), speedwell (*Veronica*), eye-bright (*Euphrasia*), sun dew (*Drosera*), crow-foot (*Ranunculus*), and many other genera are found on the mountains of Norway and Switzerland, as well as on the South American Andes and the eastern ranges of Australia. *Grammitis rutæfolia*, a small fern growing on our Queensland rocks, was gathered by me also in New Zealand, Spain, Italy, Mexico, Peru and Chili.

A large percentage of East Australian plants came down from India in post-tertiary times, when our Continent was still connected with Asia.

There exist exceptional spots in many countries where soil and climate are relished so much by certain plants, that many rare and pretty herbs, shrubs and trees seem to flock to such secret places. When I wrote my little "Flora of Freiburg" more than thirty years ago, I noticed such a spot on the Kaiserstuhl. Mr. F. M. Bailey, the first botanical authority in the southern hemisphere, discovered a small area on palaeozoic soil between Yandina and Eumundi, on our North Coast line, where in a tropical-like scrub he found a world of ferns, mosses, trees and climbers occuring nowhere else round Brisbane, many of them not previously described or named. The spot, recognisable from the train by the high and smooth stems of the Australian feather palm (*Ptychosperma Cunninghami*) ought to be protected by Government, otherwise it will soon be taken up by settlers and transformed into cornfields and pasture paddocks.

In opposition to solitary plants in exceptional corners, there are many cosmopolitic genera and species which are not bound to lakes, rivers, or high mountains, but have found their home everywhere. They belong mostly to the lower classes of the vegetable kingdom. Ferns like the Adder's-tongue (*Ophioglossum vulgatum*), the bracken (*Pteris aquilina* and *longifolia*), the maiden-hair (*Adiantum capillus Veneris*, *A. formosum*), the shield-fern (*Aspidium aculeatum*) and the spleen-root (*Asplenium trichomanes*) are found all over the world, and the same holds good for many other plants like the club-mosses (*Lycopodium Selago*, *L. clavatum*), the woodrush (*Luzula campestris*), the self-heal (*Prunella vulgaris*), the brook-weed (*Samolus valerandi*), the Jersey cud-weed (*Gnaphalium luteo-album*), the purple salicaria (*Lythrum salicaria*), the agrimony (*Agrimonia Eupatorium*) and the silver-wheel (*Potentilla anserina*).

Of our Australian plants, I found everywhere, with the exception of Europe, the following species :—The white mangrove (*Avicennia officinalis*) along the coasts, *Cocos nucifera* (the cocoa-nut palm), *Psilotum triquetrum* (allied to club mosses), *Cassia mimosoides* (a small senna), *Phaseolus truxillensis* (a bean), *Centipeda orbicularis* (a composite), and *Zornia diphylla* (a small yellow flowered leguminous herb), which I met on the Andes and which I had previously seen in the Belmont scrub, near Brisbane. Along the Panama Canal I was greeted by the familiar face of the pretty blue flower of *Commelyna cyanea*, which grows in our yards here, but occurs only in Australia and America. The climbing laurel (*Cassytha filiformis*), which covers whole trees in the bush, while it occurs nowhere else in Australia except in Queensland, is found all over Asia, Africa and America. The same holds good for *Cissampelos Pereira*, a small Menispermaceous medicinal plant.

The farmers sow grain and vegetables all over the world, and according to Scripture, the devil sows the weeds. Some of them are true cosmopolites and have been in the places before grain was introduced. So *Hibiscus trionum*, belonging to the troublesome family *Malvaceae*, as well as *Malvastrum tricuspidatum* and *Sida rhombifolia*, *spinosa* and *cordifolia*. I hated these plants in Brisbane, but greeted them like old acquaintances in the barren fields of the Mexican plateau.

Eragrostis pilosa, a beautiful little grass occupying the spaces between the pavement stones in Europe, has also a cosmopolitic range. In Queensland it is scarcely recognizable ; it looks so high and spreading and is like a giant compared with the European plant and not half as pretty.

Cyperus rotundus, the hateful Nutgrass, is to be found all over the world. It occurred in Australia very likely before the arrival of the white settlers. Other weeds followed the footsteps of men all over the globe. The New Zealand spinach (*Tetragonia expansa*) is looked upon as a culinary vegetable in many poor countries, though it contains some saponin and is not altogether harmless. The black nightshade, in spite of its solanin, is boiled and eaten like spinach in Peru. *Portulacca oleracea*, the pigweed, is sold in the markets of North Germany and Scandinavia. The yellow wood-sorrel (*Oxalis corniculata*) has run all over the world. Many weeds have been imported, especially to Australia, and did not propagate much in another country. I have met with many of them in their old home. Some plants have followed the railway line. The evening primrose (*Œnothera biennis*) appears wherever a train runs; like the yellow wood-sorrel it was introduced from America into Europe as a garden plant. The Canadian fleabane (*Erigeron canadense*) is also a railway line plant. I saw it on the Tokaido line in Japan.

Some of our worst weeds came out as pot plants or useful and ornamental plants. Governor Phillip committed a great mistake by importing the prickly pear from Brazil. It was introduced for the sake of its fruit, and has covered, as a troublesome weed, many square miles in Australia, but has proved to be of some value in times of drought. The sensitive plant (*Mimosa pudica*), a native of South America, an interesting little wonder and imported as such, became a troublesome spinous weed in some gardens. The devil's fig (*Argemone mexicana*), a poisonous, prickly, but very nice looking poppy with yellow flowers, came as a garden plant, and is now a weed on the Brisbane river, but it has not spread much to other parts of Queensland. On the Turon river, in New South Wales, it covers many square miles, whereas it behaves quite decently in Mexico, its native habitat. The poke weed or inkberry (*Phytolacca octandra*) was imported from America for the dying properties of the fruit, but it has spread on the upper Logan and Albert, occupying the whole banks of these rivers. So does the bad smelling weed (*Tagetes glandulifera*), brought from America as a garden plant and a brother of the French marigold (*Tagetes patula*). The ladies' thistle (*Silybum marianum*), of South Europe, has run out of the gardens and become a troublesome weed. I met it in the back streets of Naples. *Datura stramonium* (the thorn apple), imported as a medicinal plant from Europe, has been seen by me in New South Wales covering large tracts in Hill End and Tambaroora gold mining districts. I noticed horses and cattle eating it ; they can stand a good deal of the poison which it contains.

The red-head (*Asclepias curassavica*) was brought as a pot plant from South America, together with a brown butterfly, *Danae Erippus.* It is quite naturalised in Queensland. I have seen it in Argentina and Brazil. The butterflies, and some other species of the same genus, hovered round the flower exactly like they do here.

Some plants revel in a strange country, and find it better to their taste than their home. *Lantana Camara*, brought to us as an ornamental shrub, has run all over Queensland, greatly to the detriment of our beautiful scrub-flora. In South America it behaves very decently and keeps its place. The leaves are dried by the Indians of Uruguay, and used instead of tea. It affected my risorial nerves when I saw the hateful plant growing and attended carefully in the public gardens of Chile and Argentina ; but how much was I surprised when I found it in my own garden in old Freiburg, growing in a storm-protected corner, and admired by everybody ? My indignation prevailed—I pulled it out. All the gardens in Europe have it, mostly of the yellow variety. It is kept down by pruning, and is taken in the warm-house during the winter.

Another troublesome weed of Queensland, *Ageratum mexicanum*, brought here from Mexico as a garden plant, has overrun many parts of Queensland. I have seen it in Central America where it has flowers of a prettier blue and larger than in Brisbane. I did not see it again until I arrived in Switzerland. There it was in the gardens of Zurich, highly prized as a fashionable pot plant. I was tempted to weed it out, as I did in my Brisbane home. I did not meet with the "Old Maid"—*Vinca rosea*—of East India, which is naturalised all along the Queensland coast.

Plants with hooks and stiff hairs on the fruit are liable to be carried far and wide and to become naturalised. When I first came here it surprised me to find the bur-weed (*Xanthium strumarium*). It is a native of Asia and Europe, and when I was a student I journeyed many miles to look for the rare plant, but never found it, until I came to Queensland. In the southern and western states of America I saw the plant naturalized. It is called "cocklebur" there and it makes its first appearance in the spring. The pigs are very fond of the young plants, but almost invariably die after eating them. *Xanthostrumarin*, a poisonous substance, has been isolated from the alcoholic extract. The castor oil plant (*Ricinus communis*), a native of Arabia and North America, so common in the waste places of Brisbane, adorns the gardens of Europe and North America. Other than here, I have seen it as a weed only in Spain. The seeds contain a deadly *toxalbumin*, 10 or 12 of the seeds will kill a man, and it is a miraculous thing that more accidents do not happen where the plant is naturalized; the poison is not contained in the oil. *Panicum crus galli*, the loose panic-grass of Europe, has become naturalized in Queensland.

A water plant only lately introduced into Queensland, and already naturalized, *Eichhornia crassipes*, has a pretty but short-lived flower and beautiful green leaves. I saw rivulets, ponds and small lakes in Mexico and South America, its original home, full of it.

A plant which has become familiar to our eye at home looks like a friend if we meet it in a strange country. When I came down from the north of the United States to New Orleans and saw in the public gardens the same ornamental plants which grow in Brisbane, I felt myself at home, and missed Mr. Bailey. I missed him more, I must say, in the Botanical Gardens in Havana, because there were no labels on any plants, except on a *Ficus religiosa*, the chief ornamental tree of Cuba, and that one was wrong, it belonged to the tree in the opposite corner.

The Australian eucalypts are now found acclimatised over a large part of the world, and even in the warmer places of Germany. In hot dry countries, like California, Texas, Arizona, Mexico, and South America, *Eucalyptus globulus* is an inmate of all public squares and gardens. I have read in several books that it thrives on the Western slopes of the Andes, but it is a mistake. There nothing grows except a few straggling Cacti. In the Alameda of Mexico city the chief ornamental trees are the high Eucalypts, towering over the whole crowd of other plants. Our large Indo-Australian staghorn ferns (*Platycerium grande* and *P. alcicorne*) and the nest fern (*Asplenium nidus*) are fastened high up in their branches. The Paseo di Riforma, the fashionable carriage drive from the City to the residence of the President in the castle on Chapultepec, the "hill of the grasshopper," is shaded on both sides by gigantic specimens of *Eucalyptus globulus.* No shade however reaches the avenue. In Santiago de Chile, a bald Andesite-hill has been transformed into a splendid public garden with walks, rockeries, carriage drives, and shrub-covered romantic paths. Monuments as well as a theatre are there, and a magnificent view is laid out to the eye from the top. About thirty years ago the hill-sides were covered with young trees of *Eucalyptus globulus.* These have grown so high that they obstruct the view. In the Cliffhouse Gardens in San Francisco it was just the same, the Eucalypts have run up so high. The gardener remedied it by cutting their heads of, but the trees look mutilated in the dense globe of branches with gray-green, opposite, obtuse leaves, like they come out on shoots of young plants. Another friend from Australia is met with before the Cathedral of Santiago de Chile. It is *Casuarina quadrivalvis*, looking well and delighting a botanist's eye. Not so the Australian wattles, which, in the Golden Gate Park in San Francisco, are mixed with very similar wattles from the Pacific coast, driving a botanist to desperation. The best Australian wattle tree abroad is *Acacia dealbata*, with globular fragrant flower-heads and delicate bipinnate leaves. It grows as well on the plateau of Mexico as it does on the elevated country behind the Blue Mountains of New South Wales. Other Australian Acacias which I found to be in favour were *Acacia decurrens*, *A. Cunninghami* (one of the nicest of the Brisbane species), *A. vestita* and *A. verniciflua.* All European greenhouses are full of them. Our maiden-hair ferns (*Adiantum formosum*, *A. aethiopicum* and *A. hispidulum*), as well as the spleenwort (*Asplenium falcatum*), are favourites everywhere. The fern tree (*Alsophila australis*) adorns open gardens in the warm countries, and hot houses in Europe and North America. *Aneilema gramineum*, a common bush plant round Brisbane, is to be seen as a pot plant in Germany. So is *Arthropodium laxum*, a small liliaceous plant, and not at all ornamental. Our nice bush lilies (*Dianella coerulea*, *Geitonoplesium cymosum*, *Anguillaria dioica*, *Bulbine bulbosa*, *Thysanotus Patersoni* with pretty fringed petals) are to be met with in the gardens everywhere. *Cordyline australis*, with slender stems, grows in the open air in San Francisco. The fleshy roots make propagation easy.

As a rule the Australian plants are very difficult to shift. Taken out of their home, they decline to grow again. There are no grass trees and no Australian honeysuckles or banksias to be met with in the open gardens of warm countries. In the greenhouses of Europe and America they are considered very interesting. Seeds are sown in summer in sandy peat, and seedlings potted of as soon as they can be handled. Banksias are generally propagated by cuttings of the ripened shoots. In the hothouses of the botanical gardens in Paris (*Jardin des Plantes*) I saw a nice plant of the Australian cork tree (*Duboisia myoporoides*). The plant is wanting in many of the gardens of Australia. The bottle tree (*Sterculia rupestris*) is much admired in the public walks of South America.

Many plants of the Brisbane gardens were met with by me in their native habitat. The pepper tree (*Schinus molle*) looks very pretty in Queensland, but it cannot be compared with the plant in its own home on the plateau of Mexico and on the irrigated coasts of Peru and Chili, where the elegant drooping branches with the delicate foliage and the shiny red berries hang over the Indians, and their thatched hovels which are supported by the knarled stems of the trees.

One of our best ornamental trees is the camphor laurel. It grows well on the coast and high up on the ranges in Queensland, and in company with *Platanus occidentalis* has been selected as a shade tree in Toowoomba, Warwick and other places. It looks lovely, but compare it with the Japanese camphor laurels above the Suna Temple in Nagasaki ! Higher than our forest mahogany (*Eucalyptus microcorys*), and resembling it a little, are the old trees which have been standing there for many centuries protected by the abode of the gods.

The feather palm (*Cocos plumosa*), the common palm in the public and private gardens of Brisbane, grows luxuriantly between Santos and San Pablo in Brazil on hill sides and on level country. There were small rivulets along the road and huts of the half-caste population, half Indians, half mulattoes, with not at all a prepossessing appearance. I thought I was walking in a flower garden ; different kinds of begonias were in blossom—too many of one species I thought, but then it was not a garden, it was uncultivated ground. The begonias had become weeds. Over all hung the feathery leaves of *Cocos plumosa*.

Trees with a very slow growth will never show to the generation of man who planted them, the awe-inspiring majesty and grandeur, displayed to the eye by their brothers which have seen millenniums. Most of them have been sacrificed to the avarice as timber and only sections of the stem are to be seen in the museums.

The *Wellingtonias* in the Yosemite Valley, the specimens of the Mexican cedar (*Taxodium mucronatum*) on the Hill of the Grasshopper, and the Japanese cypress (*Cryptomeria japonica*) in the grove round the temples of Nikko, the "Splendour of the sun," are of overwhelming beauty, whereas the specimens in our Brisbane Gardens look only like gigantic Christmas trees.

During the last 20 years, many plants have been naturalised in Germany which I had never seen there before. *Mimulus maculatus*, a native of South America, is not frightened by the cold climate of Baden. *Impatiens japonica*, a very pretty touch-me-not, with red flowers, borders the rivulets between Germany and Switzerland. I saw it first on the Daiagawa, near Nikko, and admired it much. It surprised me to find it afterwards stronger than in Japan, covering a large area on the road to Constanz.

Acclimatisation of useful plants means to render them capable of yielding the production desired from them in a climate different to that in which they are natives. It is easier to enable a plant to endure lower temperatures than inducing the natives of colder regions to live in our latitudes.

Some plants improve in a strange country under altered climatic conditions. The fruit-producing power of the Californian soil is astonishing; nearly all useful plants of a moderate and warm sky have been acclimatised. Lemons, oranges, dates, olives and grapes grow there with apples, pears, apricots, peaches and cherries in abundance, and of first quality. The North American persimmon (*Diospyros virginiana*) yields a very good native fruit. I was told in the University Hospital of St. Louis, that it is found very useful in diabetes. The fruit is very sweet, but no sugar goes in the water after eating it. The tree is a large one with spreading branches, and may be seen in our gardens.

The small farmers can do nothing in California; the dry soil requires costly irrigation. Rain is scanty. The markets of San Francisco (as well as of Saint Louis, Mo.), sell gigantic apples and strawberries. There are monstrous sugar turnips (*Beta vulgaris*) as big as a man's body, soft and succulent to the innermost part. Potatoes and cabbages are wonderful.

The loquat (*Eriobotrya japonica*) yields much better fruit in Brisbane than in Japan, its native country. Some plants produce best in their home. Nowhere such splendid custard apples, cherimoya, and sour sops can be obtained as in Vera Cruz and Rio de Janeiro The Chinese litchis (*Nephelium litchi*) are best in China. The date produces well in Dr. Bancroft's garden here, but does not possess the delicate taste and sweetness of those grown on the Canary Islands. Like the date palm, many plants become easily acclimatised and grow well, but never produce a first-class fruit. In Colombo the oranges are hard and sour, the pineapples dry and tasteless, and so is the passion fruit. In Japan cherries do not thrive at all, grapes are only middling and not sweet, pears and apples, though the best varieties have been selected for acclimatisation, are not to be compared with ours from Tasmania and the Darling Downs. At the same time it can be laid down as a rule that all Japanese plants will do well in the southern coast districts of England. There is a climber growing in Japan belonging to the order of *Berberideae*, with ternate leaves (*Akebia lobata*); the fruit looks like a small cylindrical melon; the fragrant pulp contains many seeds, and is very cooling, so that the fruit comes on the table in the fashionable hotels of the cities. The plant—if not here already—deserves to be acclimatised.

Mexico produces the best radishes in the world, juicy and tender, of a pretty flesh colour and more than a foot long. The Japanese radishes, called "daikon," while of a monstrous size, up to a weight of 50lbs., are of a disagreeable taste.

In acclimatisation, nothing is better than experiment. Frequently quite unexpected results are obtained.

The Paraguay tea grows well around Brisbane, and produces leaves in abundance. It is a pity we cannot make the proper use of it. People are too refined here. In South America they have little gourds, dried and hollowed. The powdered leaves are then put in up to the margin, and sugar and hot water are added. Only one gourd, to which a small tube is attached, is needed for a company of 10 or 12 persons. They dip the small tube in and suck the liquid slowly into the mouth; nobody gets much and nobody must take much, as tube and all must pass to the neighbour, till all have their share. No wonder consumption is spreading horribly in South America. In Uruguay I examined the leaves of *Ilex paraguayensis* and found them to contain a much higher per centage of caffeine than those I examined here. For the latter I had to use the ether process to obtain the pure alkaloid. In Uruguay, microsublimation showed the crystals well. Coca leaves are chewed freely in the districts of both sides of the Andes. The deck of the coast steamer is full of them sometimes. The shrub (*Erythroxylon coca*) does well only in high and moist situations, and declines to grow vigorously near Brisbane. Scrub land might be the right place; the extraction of cocaine would certainly pay well.

There are, of course, very different ways of cultivating the soil in the different parts of the globe. In countries like China and Japan, where no meat, butter, milk, grape wine, cane sugar, or bread is consumed or even known, the production of rice and vegetables is alone desirable. The rice is a half aquatic plant. It wants a swampy soil. The rice fields with the pretty plants half submerged under the water give a picturesque look to the landscape. There are no fences; the Japanese fear God and the police. There are no straight lines between the fields, the borders are graciously bent. The culture of taro (*Colocasia antiquorum*), of the egg-plant (*Solanum melongena*), of the oil producing *Sesamum orientale* (with foxglove-like flowers), of the different beans, and of the large pink water-lily, the roots of which are eaten, make a very strange impression on the traveller in Japan.

In Chile I saw the highest fences in the world. Italian poplar trees are planted near to each other and a blackberry (*Rubus ulmifolius*, Professor Philippi in Santiago gave me the name) from Europe is allowed to climb up to the high branches. No bullock can break through.

The best public gardens that I met with are in Buenos Ayres, in Argentina. I never saw in my lifetime such an astonishing variety of plants displayed. The same shrub or tree is very seldom duplicated.

The citizens of Buenos Ayres are a funny people. They have the grandest cemetery on earth, the most magnificent necropolis on the globe. There are no graves. The dead are placed in little temples, one or two stories high. Altars in them are decorated with flowers and burning candles. The photo. or picture of the deceased is hung up over the altar and a great variety of plants is used for decorating purposes.

In Europe agriculture and horticulture are very different from what they were twenty years ago. Better fruit is grown and better vegetables are produced. People are not so easily satisfied as they were. In my home the farmers want more than milk and potatoes. They now like rye less than wheat, brown bread less than white bread. Better products are to be seen on the markets. Viticulture has declined ; in many districts which yielded renowned wine, the grape vines have been eradicated, as too much expense is required to combat with the *Oidium albicans*, a fungus on the leaves. I learned by my visit that a quarter of a century can alter the look of a country and the conditions for the welfare of a whole nation.

NOTES ON THE "SCOTS GRAY" MOSQUITO.

Culex Mucidus Alternans, Westwood.

PLATES III—VII.

By W. R. COLLEDGE.

(*Read before the Royal Society of Queensland, 30th May, 1903.*)

This insect is the most conspicuous of the mosquitoes found in Queensland. Four varieties of large fawn and gray coloured insects are included in the popular name, but the kind I refer to was described by Skuse under the name of *Culex Hispidosus*, but now known as *C. Mucidus Alternans.* They are handsome insects to an unprejudiced eye.

THE EGG

is comparatively large, and differs much from those of the common insect. In shape it is like a double cone, partly flattened on one side, as is seen in fig. 1. Jet black in colour, it is invested by a delicate membrane which rises in beaded vesicles upon its surface. Unlike the common variety, whose eggs are cemented into a beautiful floating raft, these are deposited singly on the surface of the water; they look like little black granules, if a white surface is beneath them.

They vary a good deal in number. One lady, who breakfasted on my arm, deposited sixty-four eggs five days afterwards. Another laid one hundred and sixty, seven days after a sanguine feed.

At first, by the help of the vesicles and adhering film of air, they float, but a little agitation causes them to sink to the bottom of the vessel or pool upon which they are placed. If they lie some time a flocculent algæ of the *Nostoc* variety attaches itself, and helps to anchor them to any object in close proximity. The period of incubation depends chiefly upon the temperature, and is hastened during close damp thundrous weather. The eggs of the ordinary kind may hatch in thirty-six hours, but these require under favourable circumstances, seven days. One striking peculiarity is, that if the temperature falls below 70 deg. Fah. in this latitude, they may lie in the water for many months, but still retain their vitality, and emerge when circumstances are more favourable to their incubation. On February 24th I got a batch and placed them in a cage; they deposited a large number of eggs the same night. On March 5th, two larvæ were seen, on the 7th another, and on the 8th two more. Then on May 7th twelve emerged, and the next day six more, and on the 10th another half-dozen; a lull then took place, and on October 31st one appeared. November 6th six more, on the 29th nine came out; December 4th, one; and on the last day of the year, a swarm of one hundred broke cover. Then one more was seen on January 16th. These all came from the eggs of the batch laid on February 24th. They were kept in a case to which no insects could have access, so that there could be no possibility of the experiment being vitiated by other eggs being deposited there. The last one, therefore, was nearly eleven months' old before it appeared.

The Larva

when ready, by its internal struggles bursts the shell at a point about one-third from the end, as is seen in fig. 2, where one is partially extruded. It is strong and lively, and easily distinguished by its colour and appendages from other kinds. Fig. 3 is a photo. of a newly-born baby. The head and the tips of the tracheal tube are black, the thorax white, and the abdomen yellowish, and on the vertex of the head is a large dark spot, as large as and equidistant from the eyes.

The mouth brushes are black and set horizontally. Four very long natatory bristles project from the last section in a line with the body. A common practice is for them to use the tracheal tube as a pivot, and by the aid of the mouth brushes, whirl round in a circular direction on the surface of the water. Their position is usually horizontal in this first stage.

On the second day, generally the first moult occurs, but it may be prolonged to the fourth. The whole of the skin and appendages are thrown off entire, and it assumes the appearance of fig. 4. So great is the difference that a casual observer would not think they belonged to the same species. The head, instead of being black, is now pale-yellow, and is so transparent that the muscles can be traced back to their insertion in the posterior part. Two dark spots indicate the eyes, and the mouth brushes instead of being broad and set horizontally, are now composed of a bundle of bristles equal in length, and which lie reflected backwards on the outside of the cheek like a pair of heavy moustachios; and the tracheal tubes may be seen like silver cords gleaming as they interlace the various structures of the body.

This first moult is a serious one for the larvæ in captivity. In nature, with suitable food, sunshine and freshly oxygenated water, they may do better than did my babies, for the most of these did not survive the change more than a few days. The transformation seems to cause physical exhausation from which many do not recover, while some, during their weakness become the prey of the numerous predatory creatures which infest fresh-water pools. Water bears may be seen boring their way through the intestines and brain of the helpless larvæ, the muscles twitching to prove that sensation was not extinct. Those that do survive grow rapidly and are distinguished for a while by their transparent bodies, and their size being about thrice the bulk of ordinary larvæ. They are rarely found in considerable numbers together, owing to the scattering of the eggs and the numerous obstacles to their development. Six is the largest number I have found in one pool. The head brushes are composed of stout curved bristles nearly equal in length. The inner curvature is lined by a row of short teeth so that each bristle resembles a comb. This structure is traceable in fig. 5, which is a photo of one of the oral brushes. A pair of these are hinged to the upper angles of the mouth, and they usually lie reflected against the cheek like a pair of black moustachios. Four sets of muscles are attached to them and adjacent mouth organs, and these can be traced to their insertion in the back part of the head. By their means these brushes are worked backwards and forwards in a curved sweep. The jaws are so extensible that on contraction these large brushes both disappear into the interior of the mouth. They carry the animalculæ and much vegetable debris with them. In order to prevent the fine teeth from becoming clogged, a pair of mandibles, one of which is seen in fig. 6, are hinged to the lower corner of the mouth. These organs resemble the large claw of a crab. They are tipped by several powerful teeth, also several strong bristles stretched out like the fingers of a hand. These are placed so that they can sweep through the brushes as they are withdrawn from the mouth, and also retain the food before it is swallowed. In the next picture (fig. 7) the mentum or chin is seen in the centre. It is armed with a formidable row of teeth, one side only being in view. They project upwards and outwards. At the sides are the mandibles. Like the claws of a crab they can approach each other so as to interlock. Below them are a pair of organs of the shape of carving knives, with deeply serrated edges, so that they resemble miniature cross-cut saws. The whole forms a formidable armature for the mouth. When the common larvæ are feeding their brushes are in continuous exercise, but it is not so with this species. They lie along the cheeks, and are only occasionally used. The length of time occupicd by the larval stage varies with atmospheric conditions, and I have not been able to rear them in sufficient numbers to form an ccurate opinion. A second moult occurs when they attain their full larval growth.

The Pupa

is the next stage. It is seen in fig. 8, and does not differ much except in size from that of the common mosquito. In its interior the body of the insect is completed, and this occupies about five days. Fig. 9 is interesting, as it represents a thin section cut right through the pupa, where the parts of the insect are seen as they lie before it breaks through the pupa skin.

The male and female insects differ from each other mostly in the shape of the appendages of the head. The male is rarely seen in human habitations in this district. I have only known of one instance this year, when Mr. Colclough, of Wynnum, sent me a specimen which had been attracted to his breakfast table. But the females have been caught in large numbers.

A Male Head

is seen in fig. 10. Its chief peculiarity is the length, shaggy appearance and peculiar curvatures of the joints of the palpi, with the deep fringe of hairs depending from the last joint but one. The antennæ do not differ much from those of the common mosquito. It is a well established fact that these organs are musical instruments responding to the tones of the female voice. Sir Hiram Maxim states that one of the electric lamps at Saratoga emitted a musical note similar to that of the female mosquito. Instantly all the males in the neighbourhood clustered round it. About four hundred were counted. No doubt they were much disappointed when they discovered how grossly they had been deceived.

The Female Head

is seen in fig. 11. The central organ is the proboscis in which the lancets lie. Closely attached are the palpi, which extend for two-thirds of its length. Numerous black scales are scattered over them on a yellow ground. At the base and tips a few snowy scales arise. Beyond these stretching out to the sides of the picture are the antennæ. Their basal joints are yellow and globular and are capable of being moved in any direction. In feeding, to keep them out of the way of the introduction of the lancets into the flesh, they are turned up towards the top of the head. The fourteen joints of which they are composed are slender and regular in length. The bases are black and adorned with a slender whorl of black hairs, the colour then lightens to a pale yellow, with a few white scales here and there, growing more abundant towards the tip. Very fine yellow hairs are likewise interspersed, occuring more thickly on the three apical joints.

The proboscis is a muscular sheath, ending into two lips. It is certainly an organ of feeling and may also be of taste. It is used as an elephant uses its trunk, passing it over the surface to ascertain its character. The upper surface is slit and in the groove there lie six lancets. Their structure is not correctly described in the text books. The central one, known as *labrum epipharynx*, is a prolongation of the throat, and is the only one of a tubular form, and is the means by which the blood is drawn into its stomach. Another, called the *hypo-*

pharynx, is described as tubular, but I do not think it is so. Like the rest of the lancets it is a longitudinal section of a tube, and with the others clasps the central one closely so that the whole appears like one organ, and as such is inserted into the skin; but when separated in dissection its elastic sides roll together into a tubular form, and if immersed, by capillary attraction the liquid will find its way into the interior, but if it is traced down to its root its flat or slightly curved character will be apparent. The other two pairs of lancets, the two maxillæ and the two mandibles, differ also in structure. The former are strong stylets armed at the point with a dozen saw-like teeth, and having a strong central rib like a feather. The sides of these lancets have also a wavy appearance, the lines running at right angles to the rib. The mandibles are much finer, almost transparent, and so delicate that it is difficult to move them on the slide without damage. One is perfectly plain but the other is pierced by a fine tubule, to which reference will be made when dealing with the poison glands. In fig. 12, the lancets partially separated at the base of the *labrum epipharynx* are seen. The flat ribbon-like form of the separated organs is apparent.

THE VACUUM PUMP.

It is interesting to trace the ingenious method by which blood or plant juice is drawn into the stomach. When the lancets have been inserted a vacuum pump, placed in the middle of the head, is brought into play. A view of it, with its connection with the lancets is seen in fig. 13. The organ or æsophagial bulb, as it is called, lies just below the lobes of the brain. Fig. 14 is a longitudinal section of the head, showing the actuas disposition of the parts. This pump is separable into three longitudinal sections, as in fig. 15. These sections have hard chitinous walls, but thin down at the edges where they curl away from each other, and are there united by elastic tissue. Broad ligamentous bands unite the plates to the upper and lower parts of the head. By their contraction the bulb of the pump is dilated, and the blood rushes up to fill the vacuum. On relaxation the walls close and force the fluid into the gullet, which is surrounded by ringed muscles, and so it is passed into the stomach. This pumping work is evidently an enjoyable one to the insect. While it proceeds the hind legs are elevated and move in the air with at first a quivering motion, as if thrilled with pleasure, and then move slowly up and down until the work is finished.

From a lateral view, the bulb appears to be oval, and presumably like an egg, and I was much surprised one day on turning it on end to find from that point it resembled the letter Y. Fig. 16 shows how it appears in that position. The lower portion is composed of two concave plates set together with their concave surfaces directed outwards. Then a V shaped piece let into the top, completes the organ. Thus all the inner surfaces are in close touch everywhere, and no residual liquid can be found in the pump when at rest. On the æsophagial end there are a number of coarse branching fibres as in fig. 17. But what their function is I do not know; they are too numerous to be mere points of attachment for the gullet.

The Poison Glands.

are seen in fig. 18. Three glands united at one end form a set. And there are two pairs, one on the left, the other on the right side of the chest. They are long in the Scots Gray, curl, and have a tendency to enlarge at their free ends. A good idea of their size is gained by fig. 19. This is a single gland from one of the sets. To prevent it from being crushed on the microscope by the cover glass, I placed two little pieces of hair from my head on each side, on lowering the glass the gland swung round until it touched one of the hairs, which now projects across the picture, the gland apparently hanging from it. It is thus seen to be about the thickness of a human hair. Those belonging to smaller mosquitoes are still less in size. Right through the centre of each gland runs a fine tubule, and attached to it at right angles are a series of long oval cells ; they are arranged like the hairs on a bottle brush, the tube taking the place of the wire. In these cells the salivary and poison fluids are secreted, and discharged into the central tubule. Thence after coalescing with the tubules of the other two glands of its set, it passes up to the neck where it unites with the tube of the opposite set, it continues along the neck and under part of the head until it reaches the base of the proboscis, and there it dips into the centre of a little cup on the base of one of the lancets. It is not the large central one through which the blood is pumped. If it were so, then the incoming current of blood would divert it into its own stomach. But it unites with one of the mandibles on whose root the cup is placed. The cup measures the five-hundredth part of an inch across from edge to edge and its open mouth is directed towards the body. Fig. 20 represents it. Thence it passes into a fine tube running down the centre of the mandible to the point, where it is discharged into the puncture. The injecting power is found, I think, in the muscular lining of the cup, which spreads out to embrace the end of the poison tube, thus forming a little reservoir for the poison until it is ready for injection. Fig. 21 shows the tip of this mandible with the central tube, also the tip of the larger lancet through which the blood passes.

Attached to the lower end of the bulb are the gullet, stomach and intestines, also there springs from it a large transparent air sac filled with globules of air. This lies in the lower part of the thorax extending into the abdomen. These are seen in fig. 22. The stomach is very large and muscular; it is separable into five distinct coats, and from its lower end arise five long blind tubes. These contain a number of glandular bodies and are believed to fufil similar functions to the liver in animals.

Proceeding from the stomach is the intestinal canal. It is long in this species and is usually found contracted into longitudinal folds. Near the anus it expands into a pear shape and within this cavity lie, attached to the inner wall, half-a-dozen curious bodies each shapen like a heart. Their functions are not yet known, see fig. 23. On each side of the intestine lie the

Egg Sacs.

They are filled in the unimpregnated state with little globes, like two bunches of white grapes. They are well provided with trachial tubes. After impregnation the eggs grow rapidly, and ultimately fill up the whole of the abdominal cavity. This is seen in fig. 24, which is a thin longitudinal slice through the body of a female. The powerful muscles attached to the wings are seen in the section of the thorax. The eggs here have assumed their characteristic shape.

The Eye

like most other diptera, occupies the largest portion of the head, and consists of a number of circular cells closely set together, and bordered by white scales. In certain lights they appear violet black. The anterior portion, if detached, is seen to consist of colourless globes each absolutely perfect in contour. When lit up on the microscope it is an object of great beauty. There are one thousand five hundred such cells in the eye. It is said that each cell is a perfect eye, containing both a crystalline lens and also a separate branch of the optic nerve. That this is really the case is proved by fig. 25, which is a portion of the eye containing about one hundred and fifty cells. In photographing it I used a lamp with an argand burner, and each facet of the eye has reproduced the image of the lamp flame, showing that every minute cell of its compound eye is itself a complete optical instrument.

The Wings

spring from the posterior sides of the thorax, extending to the last segment but one of the abdomen. They are best seen on dark ground, as in fig. 26. They measure 6.8 by 1.8 mm, and appear to be spotted, but that arises from the grouping of particolored scales, which are mostly of a battledore form. Dividing the wing into one hundred equal parts, and measuring from the point of insertion into the body—

The auxiliary vein extends to 67.

The marginal cross one is at 15.

The first longitudinal extends to 99.

The second longitudinal starts at 40, begins to fork at 74, the fork measuring 26; the lower branch, almost straight, joins the apex of the wing at the centre; the upper branch arcuates slightly, the space between the two limbs being 4.

The third longitudinal begins at 26, sloping gently to join a little below the apex at 99.

The fourth longitudinal springs from the base, forks at 71; the upper branch, almost linear, extends to 94, the lower one, 89; the space between the branches is slightly wider than the fork of No. 2 vein.

The fifth longitudinal, springing from the axilla, is thickly incrassated for the whole of its length; curving downwards it ends at 68, a thin branch shoots out at 50, joining the lower border at 80.

The sixth longitudinal ends at 56.

The second, third, fourth and fifth are all connected by cross veins at point 60, forming a slightly zigzag line somewhat clouded.

The lower border of the wing is fringed by deep sword shaped scales, in bands alternately dark and light in colour. Each scale is inserted at regular intervals in a socket on the wing border; against these another row is set, about half their length. These are crossed diagonally by a row of still shorter ones. This confers on the fringing scales great strength and elasticity. The field of the wing is much mottled by the irregular distribution of parti-coloured brown and yellow scales.

The Tracheal System

is well developed. On the pro-thorax are two large spiracles of an elongated shape. One is represented by fig. 33. The pressure of the cover glass has rendered the opening much wider than it is in nature. The inner edge is furnished with a row of hairs like an eyelash to keep dust and minute animals from entering the tube, and around the sides are muscles capable of widening or closing the aperture. It is by the adjustment of this opening that the song of the insect is produced. Internally wide tubes proceed carrying air to all parts of the body. On the mesothorax two more spiracles are placed. The tubes proceeding from them divide and subdivide until they become exceedingly minute. In fig. 30 is seen the network as it ramifies on the outside of the stomach. The remarkable way in which they subdivide, as well as the spiral structure of the tubes is clearly seen, if one is broken across, the fibre uncoils, and may be drawn out like a spiral spring.

The Scales

invest the outward portion of the body and appendages like a species of cellular clothing. They are light and being only inserted at their basal point, while fulfilling the part of armour, yet they interfere little with their freedom of movement. They are arranged on the wings and other parts of the body like shingles on a house-roof, the base of one being overlaid by the blade of another, the only exception is on the back of the head, where they are set perpendicularly. The pleura are often found denuded by rough contact with objects in its somewhat awkward movements. Each scale is traversed by a series of longitudinal ribs. These ribs being thicker than the body create minute channels which are filled with air. The specific gravity is thus reduced, and they are kept dry during rain. The variety of shapes they assume is seen in fig. 31. Some are curved like boomerangs, others spatulate or sword-like, a few are triangular, but the most are of the battledore form with great variations in length and width. Very strong spiny bristles, yellow, and fluted longitudinally are scattered over various portions of the body, their roots being recessed in hollow sockets formed in the chitinous covering of the insect.

The Halteres,

of which one is represented by fig. 2 , are pale yellow, and placed immediately behind the wings. Not much is known about their functions, although there has been a good deal of speculation on the subject. They are hinged at the base, and when the insect is at rest, may be seen to move up to a horizontal position, then slowly sink to the sides, the process being repeated every few seconds. Probably the motion is in unison with the perisaltic action of the intestines, and may help in directing the current of air through the tracheal tubes.

The Male

is seen in fig. 35. Its body is narrower and longer than the female, from which it is easily distinguished by the feathery antennæ and long plumed palpi. The males are usually the first to appear in any batch of eggs of the same age. They have less vigour and succumb more easily to unsuitable conditions than the other sex. The last segment is seen in fig 38. From it two muscular lobes spring armed with long claspers. At the base of these pillars on their internal aspect another pair of hooks are placed with their curved points turned from each other. They extend two-thirds the length of the lobes. Also equidistant from the base of the pillars, a narrow central organ arises ending in a double hook, whose points also turn away from each other. The latter is likely an outer sheath for the penis, and its hooks as well as the mid pair are probably for the purpose of expanding the vaginal tube to ensure the passage of the spermatic fluid during copulation. A very excellent description of the male is given by Skuse in S.A.C., p. 1726, but he states that he was unable to obtain a female specimen.

The Female.

is seen in fig. 37. The proboscis is long and straight, thickest at the base. This portion is thickly set with dark scales on a yellow ground. The middle is yellow darkening towards the tip where it appears almost black. Over its base the clypeus, a semilunar plate of chitin, projects. The palpi, fig. 36, spring from the sides of the proboscis, running parallel for two-thirds the length. They are set with black scales on a yellow ground except at the tips and on the base where a few white ones are found. Above these like large amber beads are the basal joints of the antennæ. A few minute white scales are traceable on their upper sides. The joints are slender, regular in length, with bases having narrow black borders, outspringing from which is a slender whorl of black hairs. The rest of each joint is pale yellow over which a few white scales are scattered more abundantly at the tip. Fine yellow, short hairs are also interspersed, growing denser on the three apical joints, which curve in opposite directions.

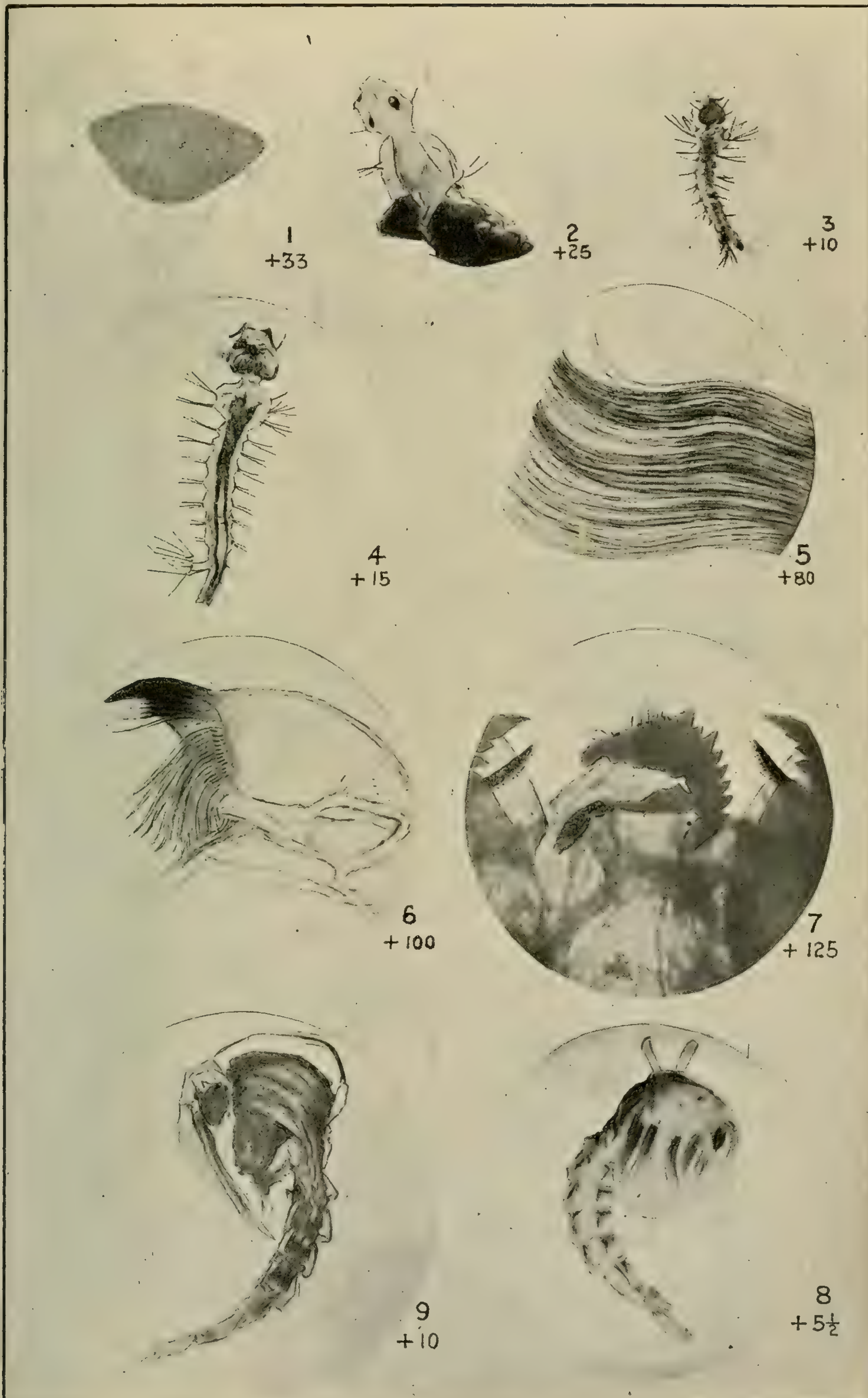
The Thorax,

which is similarly clothed, is deeply arched, white scales being most abundant. These are usually rubbed off on the projecting centre of the pleura, which is often bare. The segments of the abdomen increase in width up to the fourth, from whence they taper rapidly down. The last one is loosely inserted, so that it can be telescoped into the preceding segment, or bent downwards to a considerable angle. It ends in two ovipositors, fig. 34, which are shaped like flattish spoons; they are thinner and less hairy in this species than in the common Culex. The abdomen ventrally, has the upper half of each segment covered with snowy scales, and the lower half with golden ones. On the dorsal aspect the golden ones predominate. The fore legs are long, mid longer, and the hind ones the longest of all. The femur of the prolegs is golden, with the under side set with white scales. On the tibia three dark and three broad white patches alternate. The tarsus is banded with golden and white scales mingled with dark ones. Each leg ends in a stout claw split into two hooks of equal length, fig. 29, with a tooth projecting beneath.

In the last segment in a central cavity lie three organs, fig. 32. Two are alike round, and the third, slightly larger, is oval. They are of a very dark brown colour, have a short neck like a flask, from which a tube several times their length proceeds into the preceding segment; the latter contains a dense glutinous material which resists the action of most aniline dyes. In those species which form their eggs into rafts, it is believed to be the material which cements them together; but as the Scots Gray lays its eggs separately, it is not required for that purpose, but it may form a protective varnish for them. The former organs are the *spermathecæ*, and in one of them I found male *spermatozoa*. These are like fine hairs tapering to a point at the tail, while the head portion is a little blunter, but with no sensible mark of division at the neck.

DESCRIPTION OF PLATES OF CULEX MUCIDUS ALTERNANS.

Fig. 1.—Egg, x 33.
2.—Larva escaping from egg, x 25.
3.—Larva newly born, x 10.
4.—Larva after first moult, x 15.
5.—One of larval mouth brushes with toothed bristles, x 80.
6.—Larval mandible, x 100.
7.—Larval mouth organs, mentum or chin in centre, mandibles at sides with serrated lancets between, x 125.
8.—Pupa, x 5½.
9.—Long section through pupa, showing insect fully developed, x 10.
10.—Male Head, x 10.
11.—Female Head, x 10.
12.—Lancets partly separated from central sucking tube, showing their flattish form, x 25.
13.—Pump with portion of lancets, x 30.
14.—Pump in situ in long section of head, x 25.
15.—Pump separated into its three parts, x 35.
16.—Pump, transverse or end view, x 30.
17.—Pump, end showing chitinous fibres, x 133.
18.—Poison glands, x 27.
19.—Single gland suspended from human hair, x 25.
20.—Poison cup or reservoir on base of mandible, x 133.
21.—Tips of labrum epipharynx, through which the blood passes, and of mandible with fine poison tube in centre, x 100.
22.—Air sac, stomach, egg sacs and intestinal organs of female, x 8
23.—Bowel expansion, with six heart-shaped organs, x 25.
24.—Long section, showing wing-muscles in thorax, and eggs filling the whole of the abdomen, x 10.
25.—Portion of eye with image of lamp flame in each cell, x 77.
26.—Wing on dark ground, x 5½.
27.—Fringing scales on wing edge, x 166.
28.—Haltere, x 100.
29.—Claw on foreleg, x 100.
30.—Tracheal tubes on exterior of stomach, x 100.
31.—Scales, x 100.
32.—Spermathecæ and mucus gland, x 83.
33.—Prothoracic spiracle showing internal hair fringe, x 100.
34.—Ovipositor, x 83.
35.—Male insect, x 2.
36.—Proboscis and palpi, x 14.
37.—Female insect, x 2.
38.—Last segment of male, showing claspers and hooks, x 25.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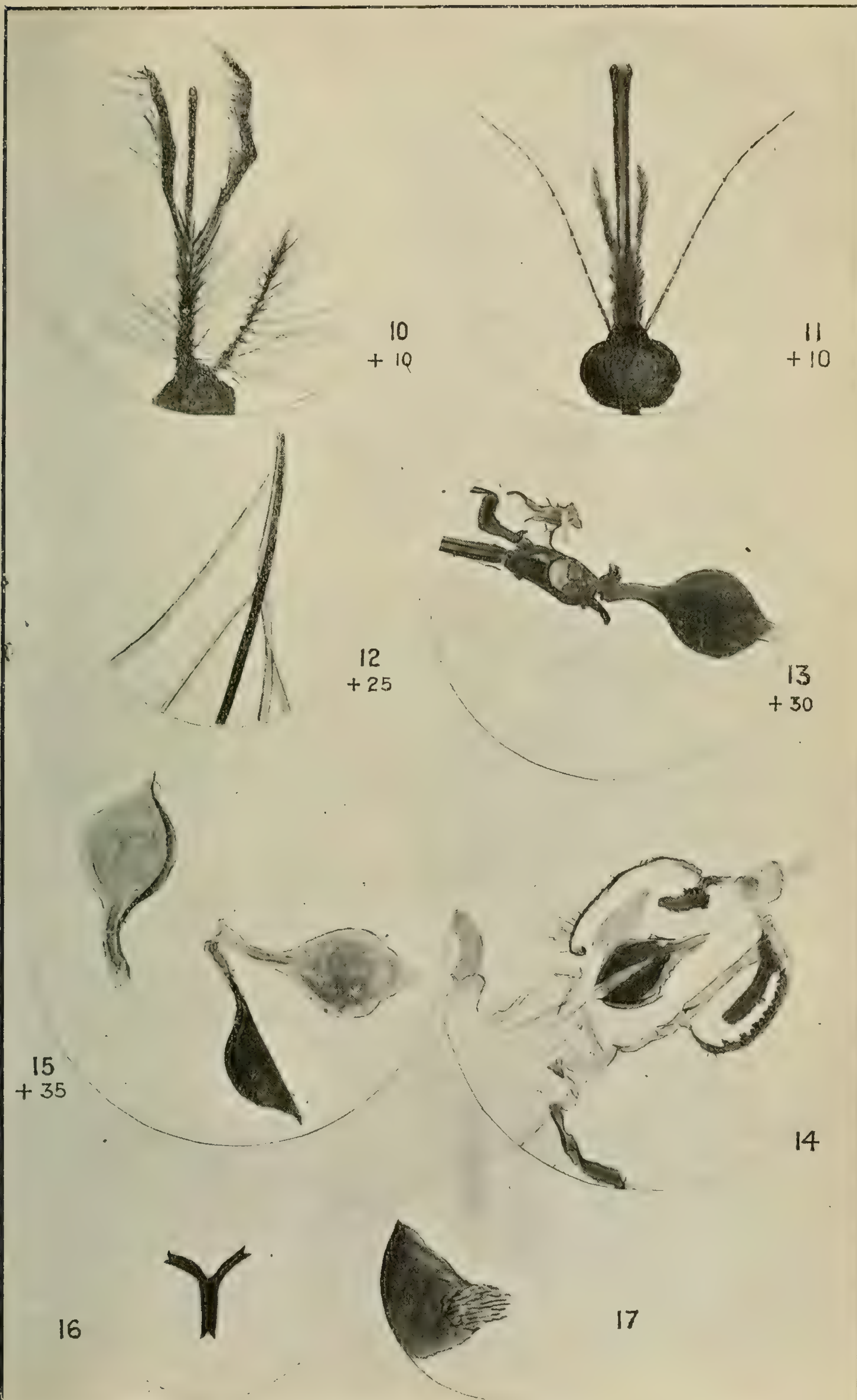
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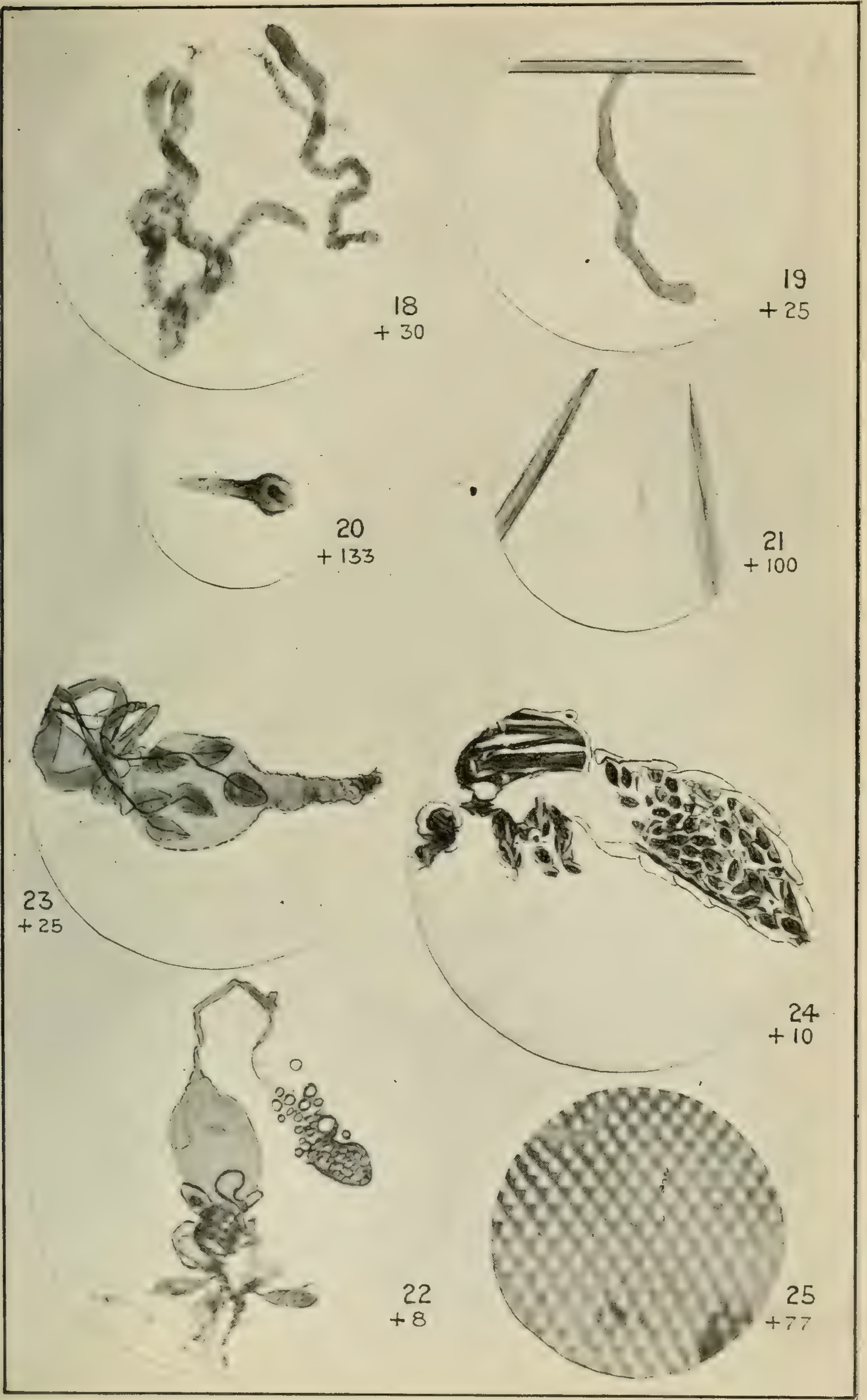
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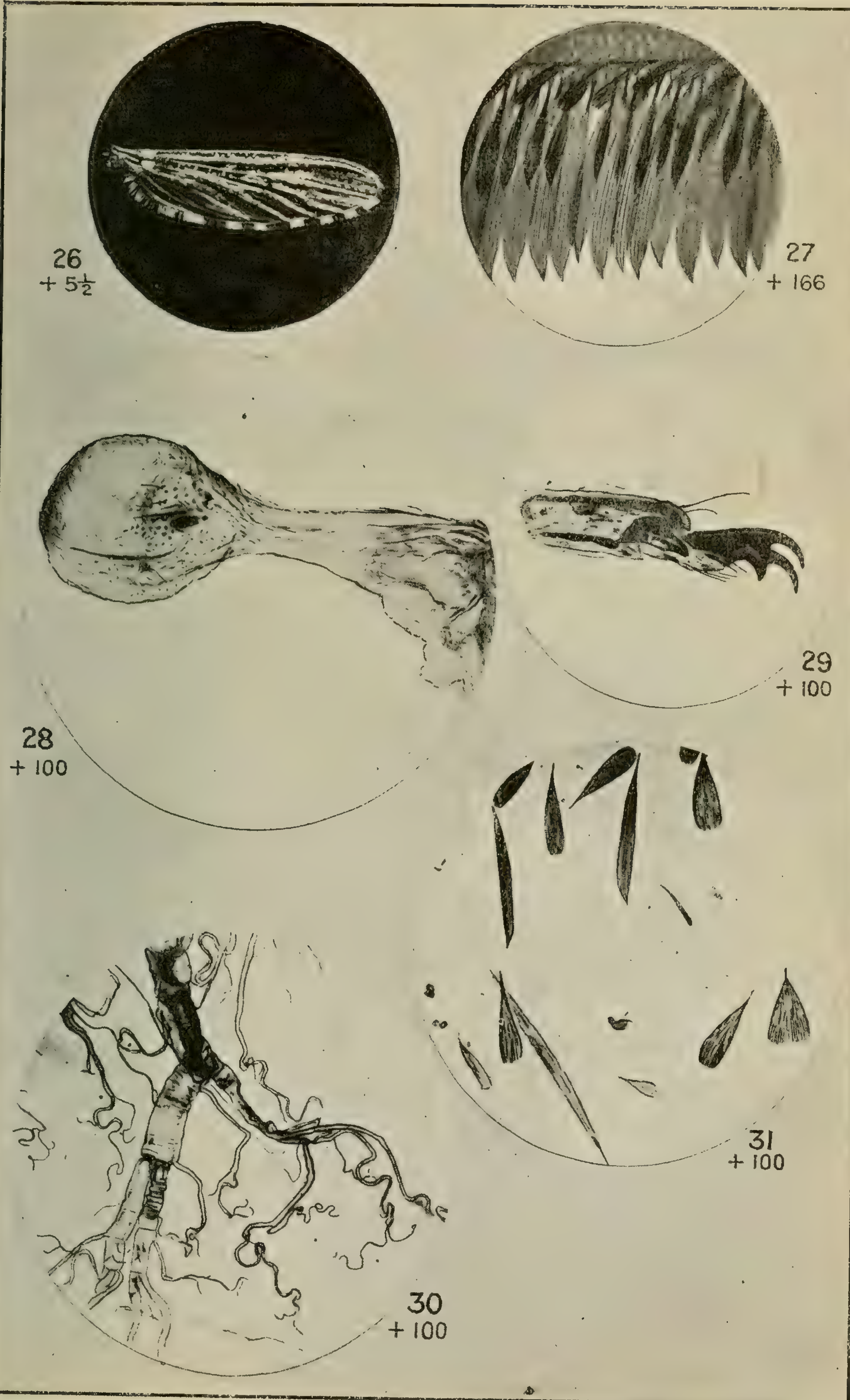
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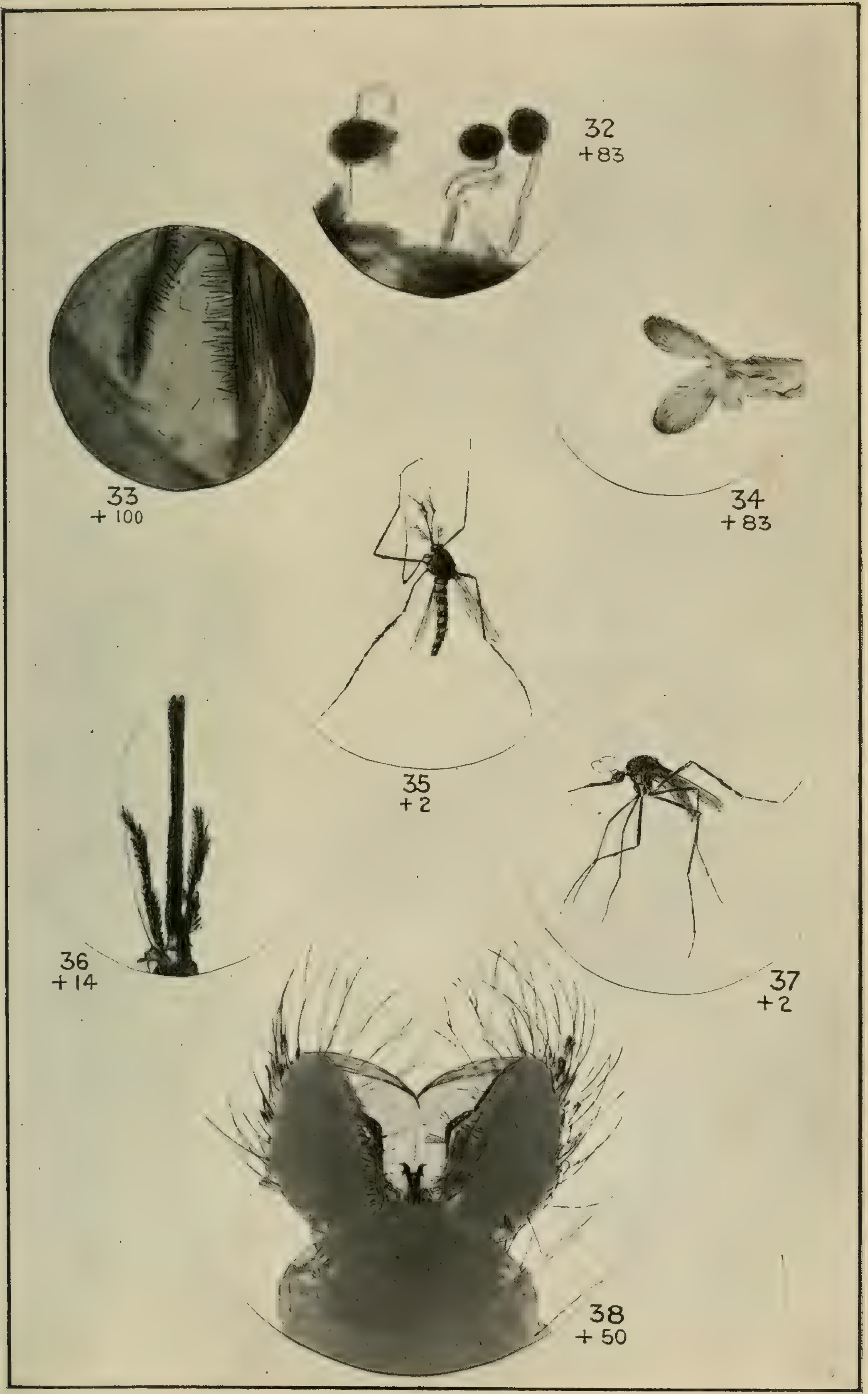
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NOTES OF TRAVEL—1859-60.

FROM SYDNEY WESTWARDS, AND DOWN THE DARLING RIVER.

By Hon. A. NORTON, M.L.C.

(Read before the Royal Society of Queensland, 17th October, 1903.)

WHEN I was in Melbourne in 1859, a friend, whose business required his constant presence in town, asked me if I was disposed to take a long journey westward from Sydney? He had money invested in what was then the "Never-Never" of New South Wales, and was anxious to obtain a reliable report upon the condition of the property. I had just arrived from Deniliquin, where I had handed over a draft of store bullocks that I had brought from the Clarence River, and was uncertain as to my next move; my friend's request just fitted in with my convenience and my mood. Our arrangements were speedily completed, and I took boat to Sydney, at which place I was to be supplied with all details as to road, &c., by the well-known firm of Peel Raymond and Co. "We really know very little about the road," Mr. Raymond said in answer to my inquiries, "but you go through Bathurst and down the Macquarie River as far as you can get; then follow the Barwon and Darling Rivers down until you get to Mitchell's old Fort Bourke. Not very far below it the station, Tooralle, is situated. The Warrego River unites with the Darling somewhere thereabouts, and the nearest post office is at Walgett, on the Namoi." Then he added, with a warning note, "You had better be careful when you are out there, for the blacks are said to be very bad." I knew Peel Raymond, and was sure any information which came from him would be reliable, so far as he was concerned. I engaged George Davis, a smart young fellow who had lived all his life on the

Clarence River, except when he was travelling with me on two trips from Grafton to Victoria with store cattle, and on 12th September, 1859, we started on our long journey. The three horses which I had selected specially for the trip were fine animals in splendid condition, and proved to be well fitted for the work they had before them. On the first evening we put up at the Red Cow Hotel, at Parramatta, where I had engaged to meet a few friends. A brother of my own was one of them; the others were Dr. and Mrs. Walter Brown, who at that time were settled in Parramatta, and Mr. and Mrs. William Henry Walsh, the latter a sister of Mrs. Brown, but at that time resident at Degilbo, on the Burnett River. The Walshes afterwards settled in Brisbane, Mr. Walsh having honorably acquitted himself, not only as a Member of Parliament, but also as Speaker and as a Minister of the Crown.

On 13th September we passed through Penrith, made the ascent of Lapstone Hill, and pulled up for the night at Wascoe's. There, Nelson Lawson, an old schoolfellow, overtook me, and on the following day we travelled together over the old Blue Mountain road. From Blackheath, on the following morning, we started in snow and sleet, and had similar weather on the two next days. Lawson took the Mudgee road from Wallerawang, I and my man keeping along the mountainous track to the Fryingpan, and thence across the plains to Bathurst, on the head of the Macquarie; after passing Wallerawang the country was all new to me, but in many respects it resembled New England, where I had resided for five years. The town of Bathurst at this time was not very large; it is prettily situated on the left bank of the Macquarie River. Most of the buildings were of brick, with shingled roofs, which were green-tinted by the moss that grew on them as they became old. From Bathurst we journeyed on to Orange, a country town situated under the Canoblas, near the summit of which, at that time, were large patches of snow. Between Bathurst and Orange we passed through Gulgong. From Orange we made a short day to Molong, as one of my horses was lame. The following day, however, we had lunch at the Black Rock, and then passed on to Wellington, in all 39 miles, and on 21st September we reached Dubbo, having had a wet ride during the afternoon. Here the country was almost level; the resemblance to New England had disappeared; other trees became plentiful in the forest; other flowers showed themselves in the grass; other birds flitted amongst the branches; human habitations beside the bush roads were less frequent. We were still on the Macquarie River, but the country west of Dubbo was of a quite different character to that near the coast. Twice before the time I write about I had passed through Dubbo, and had found kind friends there; they knew my father, they told me, and they gave a hearty welcome to the son for his father's sake. After leaving Sydney, tales of treacherous blacks became frequent, and took a more or less definite shape; two Commissioners for Crown Lands had charge of districts in the "wild west," but these they visited only when compelled to do so; they lived—one at Molong, the other at some other pleasant spot, but, having at this time to visit their respective districts, they had combined their forces and so formed a strong party as a protection against aboriginal aggression. I had brought no firearms with me; I had still to travel about 350 miles, and the hotel at which I had put up in Dubbo was the last I should see on the route I had to follow. Nearly every night in future we must camp out; the horses must be hobbled and forage for themselves. Under the circumstances it would have been folly to continue our journey without carrying protective weapons of some kind. I therefore visited the stores kept by Mr. Serissier, whom I regarded as quite an old friend. He had no personal knowledge of the blacks, but the tales he had heard suggested that persons who went any distance west were exposed to exceptional danger. I did not place absolute faith in these reports, but a gun of some description might prove useful, at any rate it would help to supply our limited larder, so I purchased a fowling-piece and powder and shot. We left Dubbo on 22nd September, and went about 25 miles to a station occupied by Mr. Christie; he too was a friend of my father and made me welcome; he was, or had been a partner with Wentworth in the station he managed. On the following day we rode through country which was remarkably level, the timber a kind of box, which, on account of its pipiness, was described as rotten box. In the morning, however, we passed through a belt of trees which, when I came to Queensland, the broad-leaved ironbark reminded me of. That afternoon we reached a station belonging to W. Lawson, who was away from home; young Morrisett, was, I think, in charge. After this, we camped every night until I found myself amongst friends on the Barwon. The Macquarie River, which has a wide channel at Dubbo, became very narrow as we followed it westwards. We found plenty of good grass near its banks, but the country was dry in most places and grass was scanty; there was abundance of stunted saltbush, but this the horses would not touch. About 90 miles from Dubbo, at Youngenbill, we left the river and crossed in 12 miles to Gunendaddy on Duck Creek. The country became more and more bare of grass as we travelled down the creek. At Brown's Station, where was a large dam, they gave me as much salt beef as I cared to take, and the people who lived at the stations we passed were most hospitable and considerate. At Brown's I learnt that the Commissioners, having completed their work of inspection, had returned. I had missed them, but was informed that they had not been molested by the blacks; they had seen a camping place, however, which the blacks had deserted shortly before they reached it. I was glad of my gun, though, for although no blacks attempted any tricks upon my party of two, it helped to supply us with very fine game, and this was infinitely more to our taste than the everlasting salt junk that the occupants of stations so readily supplied us with. From Duck Creek we crossed in about 20 miles on to the Marra. There was no road here, but we kept a pretty good course and struck a track near Marra Creek which took us on in the right direction. The country we passed over between the creeks was partly scrubby and partly plain, and we saw here large numbers of emus and red kangaroos as well as the ordinary gray ones. Owing to the dryness of the country small birds, budgerygars and galas excepted, and quadrupeds were scarce and I observed very few insects. That night we camped on the Marra, but our slumbers were disturbed by a heavy fall of rain accompanied by lightning which was very vivid, and as we had no tent our dunnage suffered. The heat next day soon dried our belongings and we continued our journey through country which, owing to an insufficient rainfall, looked very desolate. It seemed, indeed, that the horses would starve; they would not touch the small saltbush, but what grass they found must have been exceptionally nutritious, for hungry as they undoubtedly were, they did not suffer seriously in condition. It is easy, having seen the country as it then was, to realize the dismay of early explorers who regarded such extensive areas as little better than a desert. I had to think of my horses, which, up to the time we left Dubbo, had been stabled and cornfed. With the thought in my mind of what they might soon be reduced to, I expressed my feelings curtly enough in the rough diary I kept—" Came 20 miles to-day without seeing enough grass to feed a bandicoot," and again—" 25 miles along the creek to-day. It is most desolate and wretched looking country." There were few human habitations along the route I had chosen, and these were of the most primitive character—small huts constructed of rough split slabs with shingled roofs. The floor, if it could be so called, was the natural formation trampled by rough boots into a dusty smoothness ; the openings, which were by courtesy called windows, in some cases were supplied with wooden shutters, others were open to such breezes as chose to enter. The furniture consisted of a table of split slabs nailed together, two or more three-legged wooden stools, and one or two wooden bunks formed of ill-fitting split battens. These huts were occupied by stockmen who had learnt in this droughty country to use water sparingly. A tin dish held the salt junk, and a butcher's knife to cut it, a tin billy the tea, and tin pints to drink from, the bread was damper. These places they spoke of as their " home." On a previous occasion, when I rode up to a blacks' camp in more civilized country, a blackboy, with extremely scant clothing was playing " Home, sweet home," on a jewsharp as he squatted on the ground under the shelter of a bark humpy —I should have felt more at home where he sat, than in those stockmens' huts on the Marra Creek. George Davis, like myself, was born in New South Wales, and an open camp suited us admirably ; the brilliancy of the stars never interrupted our slumbers, and we received no attention from those treacherous blacks against whom we had been so particularly warned.

On the evening of October 1st, twenty days after we had left Sydney, we selected our camp on the left bank of the Barwon River. The channel of the Macquarie continues to contract after leaving Dubbo, until at last it becomes lost in the reedbeds which give shelter to innumerable wild fowl. Below these, a narrow channel conducts the overflow water, when there is any, to the Barwon, a river worthy of the name. From our camp that evening we looked down into a magnificent sheet of water of considerable width and depth. Giant gumtrees grew beside and overhung the banks ; the river flats were covered with abundant grass and herbage in fairly good condition, and the horses showed unmistakably their appreciation of it. On the clear water hundreds of ducks and other aquatic birds floated lazily, having no thought of a possible fowlingpiece; numbers of white cockatoos screamed discordantly at us from the branches above our heads, and some of the budgerygars and galas, which were so numerous along our track through the dry country, were there to give us a welcome. Of crows and hawks we saw but few, but pretty crested pigeons were not uncommon, especially in close proximity to the polygonum country; the little shepherd's companions, called jericajerica by the blacks, were with us always. To lie down by the camp fire amidst such surroundings was joy indeed, especially as each of us, according to an honoured custom which was never omitted when we had a sufficiency, had just comforted the inner man with a plump Barwon River duck; and such ducks they were, too! George, I knew, was very contented that evening. I knew it was so because he gave us the song which he reserved for his most blissful moments. It began about carelessly straying into "yon blue meadow" and beholding a "maiden fair and a young sailor gay" who was going to cross the sea to fight "the proud Chinee." This, of course, "lovely Soo-oo-san" strongly objected to, but the hero must go at any price. A musical critic might have condemned the song. I had heard it many times during the last eighteen months, and on such occasions the camp was always in a happy mood. I liked it therefore, and best of all when it had come to an end; nobody ever asked George to sing it a second time. Cockatoos have no appreciation of music. On this particular evening they seemed to become uneasy, and as the song proceeded they gave vent to their feelings in loud screams. When George had finished he remarked wonderingly: "What the jakers is they birds squalling at? I could hardly keep in tune for them." I suggested it might be their way of applauding. "By jakers, I never thought of that. I'll give 'em a hencore!" The birds had not had eighteen months' training, however, and after some further protest they left their perches and flew wildly into the darkness. They would not allow us to approach them closely on the following day!

Travelling down the Barwon next morning I was very much struck by the appearance of a station called Nulcumbiddy. The gentleman manager, or perhaps proprietor, was Mr. Burton Gaden. "Tom" Gaden, of the Commercial Banking Co. of Sydney, "Harry," "Bob," "Ted" Gaden—these are brothers of his; David Abercrombie, of Commercial Bank, Brisbane, a half-brother. Burton Gaden was an exceptional man. In this country, which was fiery hot all the time I was there, he got up an appearance of coolness by keeping his station buildings brilliantly white. Along the river banks there were outcrops of silenite ; this he collected and burnt and no lime could have looked whiter. And then it made the homestead look clean as no other looked. In spite of the excessive heat too, he had a patch of watermelons growing beside his hut. He did not carry the water for them from the river, but he had sufficient energy to tell the blacks to do so and to see that his instructions were carried out. When I had passed out of sight of Nulcumbiddy I felt better and happier for having seen a place that reminded me of the civilisation I had parted with. Anyone, I was told, could grow melons as Burton Gaden did. I did not doubt the assertion, but I travelled several hundred miles up and down the Barwon and its tributaries without seeing whitewashed huts or luxuriant melon vines at any other station. All honor then to Burton Gaden, to whom it is due.

I did not stop at Nulcumbiddy as I was anxious to reach my destination, but camped the night below Breewarrina, otherwise called the Fisheries, so called because of the stone-walled yards which at this spot the blacks had built up in the river bed and into which they drove the fish just as stockmen drive cattle into a stockyard. It was one of the few places where a bar of rocks crossed the channel and the loose stones were utilized for building up small yards with openings from above and guiding wings between which the fish passed to the opening of the upper, or receiving yard. Captain Cadell, the first river navigator of New South Wales, had ascended so far in 1858, and a board fixed up on one of the large river gums recorded the fact, also the date of arrival, the name of vessel, list of passengers, etc. Sixteen miles onwards, I struck a station called Haraden, which had been stocked up by Joseph Sharp, of the Clarence River, and was under the management of my good friend, Archie Shannon, whom I had last seen on the same river. Some dirty blacks had a camp near the station, and these and others like them, Shannon told me, were the only blacks he had so far met with. Whites, however, had been killed in the district by the aboriginals, and others were murdered afterwards, among these an old schoolfellow of my own whose skull was smashed as he lay asleep at his camp fire. I had no difficulty of any kind with them during my sojourn in that country, and only on one occasion caught sight of blacks who would hold no communication with me.

Near Haraden was a stony hill called Mount Druid. It was formed of loose stones which gave forth a metallic sound when struck together; the height of this mass of rock in an almost stoneless country, which for hundreds of miles is a dead level, was I should think about 300 feet. Oxley's Tableland showed up in the distance, but the course of the Bogan River, which lay between Mount Druid and it, could not be distinguished from its summit. There was capital feed for the horses on the Barwon at Shannon's, although the country away from the river banks was as dry as tinder, and I gave them two days' rest before continuing my journey; we then crossed the river and followed it down on its right bank. Our journey that day was 25 miles, and in 45 miles on the next day we reached Perry and Dowling's station, passing a stockman's hut at the Gidya, and one called Bunnawarnah, the only habitations between it and Haraden. Dowling, who was an old schoolfellow of mine, gladly welcomed me to Prinibougyra, and accompanied me to Tooralle next evening. The distance was 22 miles, and in consequence of the intense heat and the myriads of tormenting flies, we did not start till sunset. The river for many miles—in fact from the time I struck it just below the point where Marra creek empties into it—flows through vast plains with here and there patches of box forest, which is as level as the plains; there are great scrubs of mulga (*Acacia aneura*) back from the river. Often our journeys were made by night, for even where there were no well defined roads little difficulty was experienced in keeping the right course. I was told of the cold weather which prevailed during the winter months; all the months were summer, and extremely hot summer, while I was there.

We arrived at Tooralle about 9 p.m., on 8th October. I had then travelled about 626 miles in twenty seven days, two of which I spent with Shannon at Haraden. On the Blue Mountains we had sleety weather, and snow as we approached Bathurst, but after passing Dubbo the heat began to be oppressive, and the last part of the journey was most trying. There was almost no break in the heat, and the hot winds were almost continuous: whirlwinds rushed across the plains raising immense clouds of dust and rubbish, chiefly dry rolly-polly bushes, which careered along in columns often more than a hundred feet in height; and, in addition to all this, millions of small black flies pestered one's life from the early dawn until night closed in. My labours, however, had by no means come to an end, even temporarily. I was disappointed at finding no letters and had therefore to go to the nearest postoffice, which was at Walgett, according to instructions. Walgett, which was then a "paper" township, is situated on the Namoi, at its junction with the Barwon, about 200 miles from Tooralle. I rode back to Prinibougyra with Dowling on the day after my arrival at Tooralle, and on the following day, he having found me a fresh horse, I retraced my steps up the Barwon. That night I camped above the Gidya, and next day reached Shannon's, having pulled up just long enough for a snack of the usual dainty bush fare at Bunnawarnah. Shannon found me another horse, and next day I pushed on to Nulcumbiddy, where I spent the night. My horse was of course, hobbled, there being no paddocks at any of the stations. Next morning I had to walk five miles back along the road I had come before I overtook him. That night I stopped at Bree. It was an exceedingly rough shop. The hut was dirty in the extreme, the two men who occupied it were equally so, and, horrible thought! How could the food which they handled and cooked be cleaner than themselves? As for sleeping, one might as well have tried to sleep on an antbed, and there the company would have been less objectionable. I was glad enough about mid-day on the following day to accept the more cleanly hospitality of Breewun, also a stockman's hut, and after a thirty-five miles ride came to Mooraby in the evening. Here was a store, and a respectable white woman presided over the establishment and kept everything clean. That morning I had crossed a narrow, dry watercourse, a mere channel for the flow of water when there was any to flow. This was the Macquarie River, the strength of which had become exhausted as it passed through the level country west of Dubbo. Next day, after riding thirty miles, I struck the township in time for dinner. The Namoi, like the Macquarie, was quite a narrow watercourse, very different from the fine river which bears that name where the Peel River unites with it below Tamworth; however, it had plenty of water in it, more than enough for the inhabitants of the one broken-backed hut which was used as a store, a post office, and a dwelling combined, and constituted the township.

As I had come so I returned, except that as I rode carelessly away amongst the ill-defined roads after starting from Walgett, I did not for a time notice that my horse had taken a track which brought me on to the Castlereagh River, in consequence of which I had to ride five miles across the country to reach the road I ought to have followed. Bree I carefully avoided, and camped, without food, at a spot where once there had been a hut, rather than face the army of fleas which had tortured me a few nights before. I took a day's rest at Shannon's, and completed in fourteen days the four hundred miles I had travelled for one letter, an average of nearly twenty-nine miles daily.

Shortly after my return from Walgett there arrived at Prinibougyra, where I was for a time time staying, George Perry, well known as the "Overlander," because of the large numbers of stock he bought in the Northern districts of New South Wales and sold in Riverina and Victoria. This overlanding business had been overdone and Perry had purchased the Tooralle Station and also an unstocked run adjoining it on the river. By these purchases he became the owner of 60 miles frontage to the Darling in addition to the half interest he held with Dowling in Prinibougyra. He therefore controlled 90 miles frontage in one long stretch on the right or western side of the river. The letter Perry brought me from my principal in Melbourne asked me to help to take delivery for Perry, a request which he repeated, and also to inspect and report on the unoccupied country below Tooralle. I was glad to consent to this, nothwithstanding the trying conditions of the climate and the flies and other abominations which it seemed to suit so remarkably well. William Sly, who afterwards came to Queensland, was employed as overseer at Tooralle at that time, and he and I rode over the whole of the run and counted over the sheep. As for the unoccupied run lower down the river, I had to inspect it all by myself. The inspection of country which consists almost wholly of plains with a river frontage is a comparatively easy matter where the character of the whole is similar. The scorching heat, the myriads of extremely familiar flies, the whirlwinds with their accompanying dust, and the general dryness of the country--these never failed, and they combined to make life less agreeable than it might, under other circumstances, have been. The Warrego River empties into the Darling below Tooralle, and as I proceeded with my work of inspection I crossed a dry, narrow water-channel about nine miles from that station; this was the Warrego. Tooralle head station I believe was afterwards removed from its original site on to the

Warrego. No roads were needed here, for on my left the tortuous course of the Darling could be traced by the river gums which grew on its banks, and on my right the distant Berkeley Range was always visible; as I rode on I could see Mount McPherson in the far distance. I made a fairly long day, and at night found shelter and tucker at the last shepherd's hut below Tooralle. The poor fellow, who lived there by himself, made much of me; the man who brought his rations, and now and then counted his flock, was almost the the only fellow-being he saw for months. He had not been troubled by blacks, he told me, but it was evident that some visited the country occasionally, for, beside the depressions which filled with the backwater from the river in flood time there were many old humpies at their camping places. These depressions were, to a considerable extent, covered with polygonum, beside which there were bare patches on which pigweed grew in abundance. This the blacks collected for food, and on almost every old humpy some that had been gathered for that purpose still lived, though in a somewhat withered condition. My horse, like myself, had felt the heat very much as we travelled over the plains, but a night's rest and plenty of surprisingly good grass had revived him by morning; so I had some of the shepherd's homely damper and mutton, and started once more on my journey. The weather was again furiously hot (it was the twenty-eighth of December, and I think hot for that time of year); right away down river I travelled through mile after mile of plain, until about midday I halted for a while beside a patch of polygonum and took some light refreshment in the form of pigweed, which helps to cool one's mouth and quench one's thirst. After an hour or so I turned my horse's head up the river again, and before night set in had hobbled my weary nag beside the hut of the friendly shepherd. I had had a long ride and my face was terribly scorched by the pitiless sun; almost the only living objects I had seen were some white hawks, which had a dark patch on each wing; these busied themselves all day in their search for marsupial mice, which seem to be their principal food. The plains were too hot during the day for other native animals. Even the heat did not disturb my rest that night.

When I got back to Prinibougyro, Dowling was arranging for a trip down the river to take horses to Percy Simpson, who was bringing a mob of bullocks up the river to the unoccupied country which Perry had recently bought. On the lower Darling there was no grass near the frontage, but plenty of the small saltbush and also plenty Darling pea. The latter Simpson's horses ate greedily and they became mad. Poor wretches, they deliberately walked into the river and were drowned. Having collected about a dozen suitable animals, we started down the river on the left bank where there were larger patches of box forest and mulga than on the western side. Not very far down we passed Hamilton's station. Here was a hut of the usual kind in which two or three men lived. When about a year back Captain Cadell brought the first boat up the river from the Murray, these men were greatly surprised one evening by the unusual sounds which reached them. They had no thought of a steamboat and the only way they could account for the strange noises was by attributing them to blacks; so they barred their door, loaded their guns, and sat up all night expecting an attack which did not come off. Soon after sunrise, however, to their great delight the boat steamed round the point which had previously concealed it. Our business did not admit of delay and we pushed on, camping always at night, until we met Simpson close to a station opposite Mount Murchison. We were comfortably quartered that night by the hospitable owner, whose name I am unable to recall.

My business in this part of the world was now drawing to a close. George Davis entered Dowling's service, and I presented him with the fowling-piece which had helped us to many a good meal on our outward journey. My horses I sold to Dowling, making the condition, however, that I should have one to ride as far as Molong, where I was to leave him with the Lands Commissioner.

Near Prinibougyra some posts of Mitchell's Fort Bourke, erected in 1835, were still standing. The town of Bourke had not an existence at that time. Many persons were hurrying out to secure runs in the country that I was only too willing to hurry away from. One station only on the lower Warrego was occupied; the owner was a Scotchman, and I think his name was Mackenzie. Of flowering plants there were few when I was there; the rain had been insufficient, and the only specially rare bird I remember to have seen was a black and white wren. Time does not permit of further reference to the objects of interest with which I became acquainted, nor can I say anything about the people whose country the whites had taken from them. In January, 1860, the first mail was run by horse from Walgett down the river.

In March, 1860, I bid my western friends good-bye, and rode in as far as Molong, where I delivered my horse to the Crown Lands Commissioner, who was to send him to Dowling, when an opportunity offered. I then took coach and got as far as Bathurst without delay, but in those good old times the gold from the mines was sent by coach to Sydney, and no others but the escort were allowed to accompany it; as there was only one coach daily, I had to spend a night and day in Bathurst. On the following afternoon we however made a fresh start. The roads were rough, exceptionally so in those places which had been "corduroyed"; the coach was rough also, and the language of some of the passengers was quite in keeping with our surroundings. Still all things have an end, and we were safely landed at Penrith in time for breakfast. Thence we had a train to travel by to Sydney, to which good town I was not sorry to return after an absence of six months in the western districts.

FROM SYDNEY TO BATHURST IN 1822.

A Description, by the late Mrs Hawkins, of Bathurst, of the experiences on their journey of the first family of free immigrants (to New South Wales) who settled in that town.

Communicated by Hon. A NORTON, M.L.C.

(Read before the Royal Society of Queensland, 21st November, 1903.)

In order that the letters to which this forms a preface may be properly understood, the conditions under which the journey described therein was made must be clearly recognised. Even at the present time the father of so large a family who had just arrived from the mother country, would be glad to obtain the fullest information from old residents before he attempted to convey the whole party from Sydney to Bathurst by means of horse and bullock drays. Yet there are well-beaten roads from one point to the other, and along the whole route settlement has taken place to a large extent; fresh food and milk can be obtained day by day, and camping out would not be necessary. Besides, the settlers to whom bush life in all its phases is familiar, would always give their ready help to the wayfarers who found themselves in a country of which they had no knowledge. Such difficulties as new-comers might now meet with—real difficulties to them—would be overcome for them, and they might wonder at all they saw without being troubled. In 1822, however, people had to travel under quite different conditions. Think for a moment of this enterprising immigrant landing at Sydney, the penal settlement to which convicts of all kinds were sent that the mother country might be rid of them. The number of free settlers at that time was limited, and the immigrant found himself amongst a people composed almost exclusively of officials, soldiers, and convicts whose dress proclaimed their unhappy condition. With him, he has his wife, seven children, and his wife's aged mother; he had left the country which Britishers never cease to speak of as "Home," with the expectation of forming a new home in the new southern continent; but how little he can see to remind him of the country and the people amongst whom he had spent the earlier part of his life. After due enquiry, it is decided that Bathurst shall be the land of promise, and the Government of the day find him employment. So far good; but how to get there, that is the then momentous question. He is told of the attempts which had been made from time to time to cross the Blue Mountains—that formidable barrier which he has to cross—and failed. Then he learns that in 1813, only nine years ago, Lawson, Wentworth, and Blaxland had penetrated the hitherto unknown sterile land, and from Mount York had seen open valleys in the distance. He learns, too, that towards the close of the same year, Deputy Surveyor-General Evans, taking advantage of this discovery, had crossed the range and followed the Macquarie River downwards to a point 100 miles due west of the Nepean River; that two years later a road had been formed, and Bathurst laid out at its terminus. The little bush town of Bathurst had only been founded seven years when this new-comer was called upon to convey, as best he could, his somewhat large family from Sydney over the ranges to the place where they were to be permanently located; he had also to take such furniture as they needed, their cooking utensils, their food, their bedding, and sufficient clothing to last until that quite indefinite time when they could obtain more. And the conveyances by which they and their lares and penates were to be transported to Bathurst were rough drays drawn by bullocks and horses; their servants were all convicts and their escort consisted of soldiers, none of whom could have had much experience of travelling over the rough roads they had to use. And, in addition to all the difficulties here indicated, came tales of hostile natives and still more hostile runaway convicts who claimed for themselves whatever they could lay their hands upon, and sometimes brutally treated those unfortunates who fell into their power. Mr. Hawkins must at the very outset have realised that the success of his arduous undertaking rested almost wholly upon himself. The result proved that he was not only a brave man animated by noble aspirations, but that he possessed abundant commonsense, a high intelligence, and an enterprising spirit which could overcome exceptional difficulties by exceedingly hard work. I will now proceed with the narrative in which Mrs. Hawkins tells her sister in England of their fatiguing journey and its successful accomplishment. I have made a few verbal corrections and have omitted some short passages which referred to private matters and could have no general interest.

The journey commenced on 5 April, 1822.

The following explanatory memo. stands at the commencement of the first letter:—"The following is a copy of a letter written by Mrs. Elizabeth Hawkins, on her first arrival in the colony in 1822, to her sister."

"I told you in my last letter of our intended journey across the Blue Mountains. We have accomplished it, and, as I think it may prove interesting to you, I shall be very particular in my account of it.

"It took some time after my last letter to make the necessary arrangements here (*i.e.*, Bathurst) for a house to receive us, and for us to be certain of the necessary assistance from the Governor before we could leave Sydney. All was ready on the fourth of April (being Good Friday), and in the morning of the fifth we commenced our journey. We had many presents and kind wishes from those around us.

"You will hardly credit it when I tell you the number of horses, bullocks, carts, &c., &c., requisite to convey us, for we possessed no other furniture than one table and twelve chairs; these with our earthenware, cooking utensils, bedding, a few agricultural implements, groceries and other necessaries to last us a few months, with our clothes, constituted the whole of our luggage. We had a waggon with six bullocks, a dray with five, another with three horses, a cart with two, and, last of all, a tilted cart with my mother, myself, and seven children, with two horses for my husband and Tom, my son, to ride on.

"The cavalcade moved slowly on. The morning was fine and the road equal to any turnpike road in England, with a forest each side; but the sun is not prevented cracking the earth, as all the trees here are lofty and only branch out from the top. When within a few miles of Parramatta my husband and Tom rode on to the Factory for a female servant who had been selected for us; they rejoined us while we were partaking of dinner at the root of a tree.

"We arrived rather late in the evening at Rooty Hill, a distance of 25 miles. The Government House was ready to receive us. The next day being Sunday we rested, partly to recover our own fatigues which we had had previous to leaving Sydney, and because the general orders are: 'There should be no travelling on Sundays.' I could have been contented to remain there for ever; the house was good and the lands all around like a fine wooded park in England. On Monday we recovered our fatigue, and for nine miles found the road the same as before. We had now reached the Nepean River, which you cross to Emu Plains where there is a Government house and depot, but beyond there are no habitations until you reach Bathurst, excepting a solitary house at the different places where people stop. We had to wait many hours until horses and carts were ready on the opposite side, as those which brought us from Sydney were to return. We could only get part of our luggage over that night, and Sir John Jamison who resides near, sent his head constable to guard the rest during the night. The next day it rained hard, but through fear that it might continue, when the water rushing from the mountains often makes all the rivers in this country dangerous and impassable, we had the rest of our things brought over. The next day was occupied in getting things dried, and the following one in making every necessary preparation for the journey, unpacking many things to ensure their greater safety, arranging our provisions and bedding to enable us conveniently to get at them. This being done, at five o'clock my husband and myself went to dine with Sir John Jamison, who had invited a lady and two gentlemen to meet us. There we partook of a sumptuous dinner, consisting of mock turtle, boiled fowl, round of beef, delicious fish of three kinds, curried duck, goose and wildfowl, Madeira, Burgundy, and various liqueurs and English ale. I mention all this to show you his hospitality and to convince you that it is possible for people to live here as well as in England.

"I was delighted with his garden, the apples and quinces were larger than I ever saw before (it is now autumn in this country), and many early trees of the former were again in blossom; the vines had a second crop of grapes, the figtrees a third crop; the peaches and apricots here are standing trees. He has English cherries, plums and filberts; these with oranges, lemons, limes, citrons, medlars, almonds, rock and watermelons, with all the common fruits of England and vegetables of every kind and grown at all seasons of the year, which shows how fine the climate is.

"The next morning, Friday, 12th April, we reloaded. Sir John came to see us off and presented us with a quarter of mutton, a couple of fowls, and some butter. I had now before me this most tremendous journey. I was told I deserved to be immortalised for the attempt, and the Government could not do too much for us for taking a family to a settlement where no family had gone before. I mean no family of free settlers, and very few others. Everything that could be done for us was done by the officers to make it as comfortable as possible.

"In addition to our luggage we had to take corn for the cattle, as in the mountains there is not sufficient grass for them, and provisions necessary for ourselves and the nine men who accompanied us; in consequence of this we were obliged to leave many things behind.

"We now commenced with two drays with five bullocks, and one dray with four horses, and our own cart with two; they had no more carts to give us. Amidst the good wishes of all, not excepting a party of natives who had come to bid us farewell, we commenced our journey. We had not proceeded more than a quarter of a mile before we came to a small stream of water, with sandy bottom and banks. Here the second dray with the bullocks sank. The storekeeper, superintendent, and overseer from Emu Plains, witnessing our stoppage, came to our assistance. The two latter did not leave us until night. It employed us an hour to extricate the dray, and this was not accomplished without the horses of the other being added to it. We now proceeded about a quarter of a mile further; and now imagine me at the foot of the tremendous mountains, the difficulty of passing which is, I suppose, as great as or greater than any known road in the world, not from the badness of the road, which has been entirely made and which is hard all the way, so much as from the extreme steepness of the ascent and descent. For forty miles the hills are barren of herbage for cattle, but as far as the eye can reach, even to the summit of the highest, every hill and dale is covered with wood, lofty trees and small shrubs, many of them blooming with delicate flowers, the colours so beautiful that even the highest circles of England would prize them. These mountains appear to be solid rock, with hardly any earth upon the surface. This land seems as if it was never intended for human beings to inhabit. There are no roots as a substitute for bread, no fruit or vegetables on which man could subsist ; but almost anything will grow which is brought to it. We now began our ascent up the first Lapstone Hill (so called from all the stones being like a cobbler's lapstone) ; the horses got on very well, but the bullocks could not. We were obliged to unload, have a cart from Emu Plains, and send back some of our luggage ; even then the horses were obliged when they reached the top to return and assist them. We could proceed no further that night, having performed a distance of only one mile and a-half that day. Our tent was pitched for the first time. The fatigue to my mother and myself was very great every night after the journey in preparing the beds and giving the children their food, and the little ones were generally very tired and cross. It was a lovely moonlight night, and all was novelty and delight to the children ; immense fires were made in all directions ; we gave them their supper, and after putting the younger ones to bed, I came from the tent in front of which was a large fire, our drays and carts close in view. The men, nine in number, were busily employed in cooking their supper at one place, our own man roasting a couple of fowls for our next day's journey at another. The men, all convicts, not the most prepossessing in their appearance, with the glare of the fires and the reflection of the moon shining on them in the midst of the trees, formed altogether such a scene as I cannot describe ; it resembled more a horde of banditti such as I have read of than anything else. I hurried from the view, took the arm of my husband, who was seated at the table with the storekeeper, and went to the back of the tent. Here we saw Tom and the three eldest girls trying who could make the largest fire, and as happy as it was possible to be. Here I seemed to pause ; It was a moment I shall never forget ; for the first time for many a long month I seemed capable of enjoying and feeling the present moment without a dread of the future. 'Tis true we had in a manner bade adieu to the world, to our country and to our friends, but in one country we could no longer provide for our family, and the world from that cause had lost all its charms ; you and all my friends and acquaintances I thought of with regret ; but the dawn of independence was opening upon us, my husband was once again an officer under Government, we had a home to receive us, and the certainty, under any circumstances, of never wanting the common necessaries of life.

"After a little while we returned to the table; these were moments of such inward rest that my husband took up a flute belonging to one of the party, and one of our daughters who we called to us, danced in a place where perhaps no one of her age ever trod before. The next morning we took our breakfast and packed up our beds and provisions to depart; but during the night our team of bullocks and my husband's horse had returned to Emu. It was thought desirable that we with two drays, with Tom for our guard, should proceed to Springwood, as there was a house there to go into. From the difficulty they had had the preceding day with the bullocks, they took from our cart our two horses, and gave us two bullocks. After a most fatiguing journey of nine miles we arrived; the house was inhabited by a corporal and two soldiers, kept there I believe to superintend the Government stock. Formerly a greater number of men had lived there, and there was a large room or store where provisions had been kept. A great barn in England would have been a palace to this place; there was a large kitchen with an immense fireplace, and two small rooms behind. With the exception of a green in front, the house was completely in a wood. The corporal's wife, an old woman who had been transported about twenty years, with frowning manners, came forward to show us in. We entered the kitchen, which contained a long table and form, and some stumps of trees to answer the purpose of chairs, of which there was not one in the house; several people were here to rest for the night, journeying from Bathurst to Sydney. We were next shown the small back room, which had nothing in it but a sofa with slips of bark on it for the seat. Here I felt desolate and lonely; it was nearly dark, and still my husband did not arrive, we got quite miserable. At length the storekeeper from Emu came to us to say he could not get in without horses being sent to his assistance. It was nearly 9 o'clock before he arrived. I went out. It was dark, but such confusion as there appeared from the glare of the fires, the carts and drays, men, tired with their days work, swearing as they were extricating the bullocks and horses. It was long before I could distinguish my husband, but I felt comparatively safe when I did. The old woman, a most depraved old character and a well-known thief, with a candle held high above her head, screamed out, "Welcome to Springwood, sir!" He said when he looked round he was assured his welcome would be the loss of whatever she could steal from us. He was much fatigued, not having had any refreshment all day. It was my intention on my first arrival to have pitched the tent on the green, but it was unfortunately on the top of the dray left with my husband. Having my mattresses I spread them in the storeroom. The earth was dirty, cold and damp. We could not think of undressing the children and when in bed it looked most miserable. I lay down with my baby and a very few minutes convinced me I should get no rest. The bugs were crawling by hundreds and the children were restless with them and the confinement of their clothes. The old woman had contrived to steal some spirits from our provision basket which, with what had been given her, made the soldiers tipsy. All was noise and confusion within doors, swearing and wrangling with the men without. Never did I pass a night equal to it. My husband remained all night on the green or in the cart watching. In addition to the other noises, a flock of sheep had been driven round the yard, and to avoid the men they came close to the house and kept up a continual pat-pat with their feet. You may be certain we were happy when the morning came; we got our breakfast, packed up our beds, and bade adieu to the house at Springwood. Mother, myself, and the three girls, as the morning was fine, walked on before. It was such a relief to get away from that place that I never enjoyed a walk more; we gathered most delicate nosegays from the shrubs that grew amongst the trees. You must understand that the whole of the road from the beginning to the end of the mountains is cut entirely through a forest, nor can you go in a direct line to Bathurst from one mountain to another, but are obliged often to wend along the edges of them, and often look down on such precipices as would make you shudder. We ascended our carts, and we had now three bullocks as we had so much trouble to get on with two; but we were worse off than ever, as the ascent became worse. They reformed the dray, but every few minutes first one would lie down and then another. The dogs were summoned to bark at them and bite their noses to make them get up. The barking of the dogs, the bellowing of the bullocks, and the swearing of the men made our heads ache and kept us in continual terror. This was exactly the case every day of the journey with the bullocks. Frequently we all had to get out, and more frequently our fears made us scream out. At length we got to a hill so bad it seemed we never could get up it. We alighted and seated ourselves on a fallen tree, and waited the event. We were on the side of the hill; in front it rose almost perpendicularly; behind was a valley so deep that the eye could hardly distinguish the trees at the bottom. To gain the top of this mountain the road wound round along the side. The first day the horses got up. They were then brought back to assist the rest with the bullocks, but they could not succeed in rising from one piece of rock to another. With great whipping a sudden effort was made, and one shaft was broken. This had to be repaired as well as we could manage it. Some of the baggage was taken off, and with the assistance of the other horses, &c., &c., it was got up; the rest was got up in like manner. When at the top the men, who were much fatigued, sought for a spring of water, and with the addition of a bottle of rum were refreshed. We again set off, and for the next two miles it was perfectly dark, attended with heavy rain. You can imagine the danger and the misery we rode in not being able to see where we went, but we were obliged to go on till we were near to water. Our tent was pitched in the road and we were obliged to remain in our cart until the bedding was got into the tent; of course we again lay down in our clothes. During this very fatiguing day's journey we had only accomplished six miles. For fear I should tire you with a repetition of the same scenes, I will tell you that every day of our journey from Emu to Bathurst we were subject to the same things, such as our bullocks constantly lying down, while others not being able to draw their loads compelled us to have the assistance of the horses, which caused us great delay. Our provisions consisted of half a pig, which was salted for us at Emu Plains, and some beef; we had flour to make bread with, tea, sugar, butter, etc., etc., and when we stopped at night we made some tea and had some cold meat. It was our man's duty every night to boil a piece of meat for the next day, and bake a cake under the iron pot; breakfast and supper were the only meals we had. I used to take in the cart with me a little just to keep us from starving, and some drink for the baby, and during eleven nights that we remained in the woods my husband never lay down until about three in the morning, when the overseer would get up and watch; never but twice did he take off his clothes; as we occupied the tent, his only resting place was the cart. It rained the next morning and everything was very uncomfortable; the men sent in search of the cattle, which had to be turned loose at night to get water and grass, could not find all of them. After waiting some time we thought it best to proceed, excepting one dray which the overseer was to watch whilst the men sought for the bullocks. As the road this day was something better, we got nine miles to two bark huts that had been erected by the men employed in mending the road, but were never empty. We were very glad to take possession of one of them, and our men of the other, as it had rained all night and all day.

"As in England you never saw anything like these huts, I fear from my description you will not understand them. Some stumps of trees were stuck in the ground, the outside bark from the trees was tied to them with narrow slips of what is called "stringy bark"; being tough it answers the purpose of cord; the roof is done in the same manner. They had a kind of chimney, but neither windows nor doors—only a space left to enter. As many men were obliged to sleep here, all round inside the hut stakes were placed, and across and on the top were laid pieces of bark so as to form berths to sleep on."

At this point there is a break in the story. The account of the rest of the journey and the reception of the party by residents in Bathurst, for reasons therein given, is completed in a letter addressed by Mrs. Hawkins to her grandchildren nearly fifty years after the event. The second letter is dated Sydney, 19th October, 1871, and is as follows:—

"That it may be understood why I write what I am about to do, after nearly fifty years since the foregoing was written, I must explain that I arrived in this colony in January, 1822, and in April, with my mother, my husband and family, we left Sydney to go to Bathurst, a place then but little known. It was a tedious journey, and everything was so new and strange to me, that on my arrival I wrote an account of it to my sister in England. At that time any information of the colonies was interesting, and my letter was sent to the *Times* office for publication, but before it went one of my nieces copied the first part of it, and as they never received back the original from the office, the account the family now have is unfinished; and, feeling a wish for the conclusion, I am asked if I can write it, which to the best of my recollection, I will.

"I will now describe my journey from the Bark Huts where we had to remain until the bullocks were found, as they had again strayed away. At this distance of time, I cannot enter into all the details of each days' journey. At length we reached Cox's River. Here we remained two days ; the children had the benefit of bathing, and their clothes were washed, our tent was pitched, some fowls cooked, and we all were much refreshed. Nothing but the usual difficulties occured until we reached Mount York. It was awful to look on the road we had to descend, and as it was thought the drays would be long in getting down, it was thought advisable that the cart with the family should proceed ; the children that could walk did so, and we all reached the bottom at two o'clock, a most wild and desolate place. Here, seated on fallen trees, we remained hour after hour ; one of the children had a small pannikin, and we found water to drink. In this state we remained until seven o'clock and the children got very tired ; at that time some of the men came from the drays bringing such things and refreshments as we required. I then put the children to bed, some in the cart and some on the ground in the open ir. The reason we had been so long left to ourselves was that one of the drays had nearly gone over the precipice, and every man was required to help to save it. It was ten o'clock before all got safely down, and our tent was put up. The next morning my spirits gave way. I suppose it was from the fatigue and fright of the day before that had overcome me. I sat in the tent and cried and sobbed like a child. They all left me to myself for a little time and I recovered. I went outside the tent; it was a most lovely morning ; everything looked bright, and the children all cheerful and happy. At a little distance seated on a hill were two gentlemen, and my husband went to them ; one was Mr. Marsden, the chaplain of the colony, returning from his first visit to Bathurst. "Oh," he said, "I congratulate you ; you are all giong to the land of Goshen." Again we started, and at length arrived at O'Connell's Plains ; a woman who was there very kindly gave the children milk and such food as they wanted. It was such a comfort to see a house and a woman in it. We next reached Bathurst Plains, and what joy we felt, what spirits it put us all in to see an open country and home in view! It was nearly dark when we arrived at the River Macquarie, which we had to cross ; this was rather a serious undertaking, the banks on each side being steep and the water rather deep. I believe everyone in the settlement came to witness the sight ; we crossed in safety and got to our "Home" ; and such a home after a six months' voyage and eighteen days' travelling over the mountains! It consisted of three rooms—brick floors—two rooms in front, a skillion room behind one and a pantry behind the other; the front door opened into the sittingroom, the back door directly opposite with a ladder between that led up to a loft. It was the former storekeeper's residence, and my husband had come to take charge of the Government stores.

"Our family consisted of my mother, 70 years of age, and eight children—the eldest 12½ years, the youngest one year—my husband and myself, and a woman servant. How we all that night got supper, or how we all slept, I really cannot tell. Mr. Lawson was at that time the Commandant; he came to see us the next morning, and promised to do all he could to make us more comfortable, and this he did by adding two rooms, one in front and the other at the back, but it took seven months to finish them. In the meantime we gave my mother the front room and put two beds in it, and as many of the elder children as possible. I had the skillion, and when the winter came we suffered much from cold, as it was not ceiled but open to the shingles. Little Ann had a cot in the loft, and the woman took charge of her; Tom and George had the sitting room. When the new ones were finished we gave up ours to the boys, but we had to pass through that and the one for the girls to get to our own. I mention all these trifles, my dear children, that should you ever in your journey through life have similar hardships to encounter you may bear them as well as I did. I never looked on these things as a trouble. In England I had always had a comfortable home, and I came here to seek one for my children. I made the best I could of it, and was contented.

"The settlement, as it was then called, at Bathurst, consisted of Government House of four rooms, our own of three, a courthouse, barracks for a few soldiers, Government stores, and a good garden from which we were well supplied, huts for some prisoners who were employed by Government about their land and stock, and a good barn. Here it was Sir Thomas Brisbane, the Governor, Major Goulburn, Mr. Oxley, Dr. Douglas, and the principal people in the colony came to see us in our humble home. We had a grant of 2,000 acres of land on the other side of the river, about two miles from the settlement, which we named Blackdown, and after two years we went to live on it. There I lived for nearly 18 years, contented and happy, and brought up eleven children.

"My letter home, I believe, ended with my safe arrival at Bathurst, so I will end here as my life since is known to all my family. I will only add that my troubles then began. I lost my husband, my home and three sons, but I have never felt the want of kindness from all connected with me, and whatever I might have thought at the time, it has pleased God to spare my life until I can now say from my heart, all things have been wisely ordered. I am now in my eighty-ninth year. I have 7 children, 44 grandchildren, and 59 great-grandchildren living in many parts of the world—England, Denmark, India, New Zealand, New South Wales, Victoria, and the Fiji Islands. This day the marriage of one of my grandsons is being celebrated and he takes his bride to the Fiji Islands. The God who has protected me through all these long years, may He be the God of them all, protect and bless them for ever.

"(Signed.) ELIZABETH HAWKINS,

"19th October, 1871."

"MEMO.—I have stated what the settlement of Bathurst was in 1822. I will now say what it was in 1871. It is a city, and has its Bishop, several churches, its Mayor and Corporation, sends its member to the Legislative Assembly, has its banks and fine buildings, its School of Arts, its market; it will soon be lighted with gas, and the railway from Sydney is within 30 miles of it. Surely this is great progress, showing energy, wealth, and enterprise."

A PRELIMINARY REVISION OF THE AUSTRALIAN THYRIDIDAE AND PYRALIDAE.

PART I.

By A. JEFFERIS TURNER, M.D., F.E.S.

(*Read before the Royal Society of Queensland, 12th December, 1903.*)

THE present attempt is based on Sir Geo. Hampson's Revision of the *Thyrididae* and *Pyralidae* (excepting the *Phycitinae* and *Gallerianae*) of the World. Where I have differed from this I have in most cases drawn attention to the fact, and have usually indicated my reasons; but in the main I have followed it rather closely. It was indeed indispensable, and perhaps I may be excused, if I express my admiration for the immense amount of minutely accurate work which it contains. I have also endeavoured to make full use of the valuable papers of Mr. Edw. Meyrick, who laid the foundations of the present classification of the *Pyralidae* both of Australia and Europe. Unfortunately, except in the case of the *Crambinae*, Mr. Meyrick's material appears to have been rather scanty.

For the purposes of this revision I have examined the British Museum collection. For many species I have to thank kind and esteemed correspondents. Many named species are, however, unknown to me; these are indicated by the sign ††. The sign † prefixed to a species indicates that I have seen examples, but have not been able to examine their structure.

I have not thought it necessary to transcribe much of the synonymy, which may be found in Sir Geo. Hampson's papers, but have endeavoured to give references to the original descriptions, and to the best available descriptions of each species. I am unable to give references for some of the names obtained from the British Museum.

The localities are accurate so far as I know, but are of course very incomplete. I have transcribed localities given by other writers, mostly by Mr. Meyrick, whenever there seemed no reason to regard them as doubtful; and have added many of my own. It has been unfortunately necessary to omit or query many of Mr. Lower's localities. This author appears to have sometimes attached to specimens received by him locality labels, which do not correspond to the places where the specimens were captured. This has certainly been done in the case of some of his types which I have had an opportunity of examining. That it has been done in other instances appears a very reasonable conjecture, which explains some apparent anomalies in distribution.

I give here a list of a few species described by Dr. Lucas. Unless the types are forthcoming I fear these names will have to be dropped as unidentifiable·

Epicrocis seminigra, P.R.S.Q., 1891, p. 93.

Homoeosoma delineata, P.L.S.N.S.W., 1892, p. 265.

Aphomia erumpens, P.R.S.Q., 1898, p. 79.

Diptychophora torva, P.R.S.Q., 1898, p. 79.

Diptychophora (?) *kuphitincta*, P.R.S.Q., 1898, p. 80.

FAM. THYRIDIDAE.

Palpi slender; maxillary palpi absent; proboscis present. Forewing with vein 1A forming a fork with 1B; 5 from, or from near lower angle of cell; 6 to 11 usually from the cell. Hindwing with vein 1c absent; 5 usually from near lower angle of cell; 8 approximated to 7 at upper angle of cell, or approximated to or anastomosing with it after the angle. (*Hampson.*)

A small family allied to the *Pyralidae* and mostly confined to the tropics. Some of the species are very variable.

A. Hindwings with vein 5 from near lower angle of cell.

B. Forewings with 8 and 9 stalked ... 1. *Hypolamprus.*

B.B. Forewings with all veins separate 2. *Rhodoneura.*

AA. Hindwings with 5 from middle of cell 3. *Addaea.*

Gen. 1. HYPOLAMPRUS, *Hmps.*

Hypolamprus, Hmps., Moths Ind. I p. 364. P.Z.S., 1897, p. 614.

HYPOLAMPRUS MARGINEPUNCTALIS.

marginepunctalis, Leech.

Hypolamprus pallescens, Hmps., P.Z.S., 1897, p. 614.

N.Q., Cooktown, Cardwell. N.W.A. *(Hampson).* Also from Louisiades, Borneo, Japan and India.

†HYPOLAMPRUS COSTISCRIPTUS.

Pharambara costiscripta, Warr., Ann. Mag. Nat. Hist. (6), xvii. p. 209.

Queensland *(Warren)*. Also from Louisiades and New Guinea.

HYPOLAMPRUS HEMICYCLUS.

Siculodes hemicycla, Meyr., Tr. E.S. 1886, p. 216.

Q., Brisbane. Also from Fiji.

Gen 2. RHODONEURA.

Rhodoneura, Gn. Hmps., P.Z.S. 1897, p, 615.

I do not think the distinction given by Hampson between this genus and *Striglina*, Gu., which he bases on the origin of veins 9 and 10 of the forewings to be satisfactory in practice. In his definition of *Rhodoneura* be describes the tibiae as smooth-scaled, but I find them to be hairy in several of the species included by him in the genus. The genus is a very large one and may prove to be divisible by trustworthy characters, but it would be premature to make the attempt in this paper,

RHODONEURA PYRRHATA.

Arhodia pyrrhata, Wlk., Brit. Mus. Cat. xxxv., p. 1575.

Striglina pyrrhata, Meyr., Tr. E.S., 1887, p. 199.

Q., Brisbane; N.S.W., Sydney; V., Warragul, Gisborne.

RHODONEURA CENTIGINOSA.

Striglina centiginosa, Luc., P.R.S.Q., 1898, p. 81.

♂ ♀ 21-28 mm. Head, palpi, antennae, thorax and abdomen, pale ochreous-reddish. Legs, ochreous-reddish, tarsi annulated with ochreous-whitish. Forewings triangular, costa straight, apex tolerably acute, termen slightly sinuate beneath apex, strongly bowed on vein 4, excavated above tornus; pale ochreous-reddish, or rarely grey, with ochreous-reddish strigulae, or rarely with fuscous strigulae; costa narrowly whitish-ochreous more or less strigulated with dull reddish; sometimes a reddish, more rarely a fuscous terminal line; cilia whitish more or less mixed with fuscous. Hindwings with termen rounded towards apex, nearly straight towards tornus; colour, strigulation, and cilia as forewings. Underside as upper, but forewings with a large dark fuscous tornal blotch, strigulated with reddish, and hindwings with a dark fuscous spot beneath mid-costa.

Var. An interrupted more or less developed median fuscous band in both wings, in forewings angulated.

Type in Coll. Lucas.

N.Q., Townsville; Q., Brisbane. From December to February.

RHODONEURA CYPHOLOMA, *n. sp.*

κυφολωμος, with bowed margin.

♀ 29 mm. Head and thorax pale-grey. Palpi ochreous-fuscous. Antennae grey. Abdomen ochreous-grey, base of dorsum tinged with reddish. Legs ochreous-fuscous, irrorated, and tarsi annulated with whitish. Forewings triangular, costa straight, apex tolerably acute, termen slightly sinuate beneath apex, strongly bowed on vein 4, excavated above tornus; pale-grey strigulated with darker grey and tinged with pale-reddish along veins; costa narrowly ochreous-whitish with numerous small bars of mixed blackish and pale reddish; cilia bases reddish, apices whitish barred with fuscous. Hindwings with termen slightly rounded; colour and cilia as forewings. Underside as upperside, but centre of discs with darker fuscous and reddish strigulae.

Type in Coll. Turner.

Q., Brisbane, in November; one specimen.

RHODONEURA SCITARIA.

Drepanodes scitaria, Wlk., Brit. Mus. Cat. XXVI., p. 1488.

(?) *Striglina stramentaria*, Luc., P.R.S.Q., 1898, p. 81.

N.Q., Thursday Island, Geraldton, Townsville. Q., Brisbane, Mount Tambourine. Also from New Guinea, Solomons, Fiji, Borneo, Formosa, Japan, Amur, Ceylon and India.

†† RHODONEURA GLAREOLA.

Siculodes glareola, F. and R., Reise Nov., Pl. 134, f. 11.

Attributed to Australia by Hampson. I do not know on what authority. Also from Java, Borneo, Ceylon and India.

RHODONEURA MYRSALIS.

Pyralis myrsusalis, Wlk., Brit. Mus. Cat. XIX, p. 892.

A very variable species in coloration and in the presence or absence of hyaline spots on forewings.

N.Q., Townsville, in January and February; six specimens received from Mr. F. P. Dodd. Also according to Hampson from the tropical zone of both hemispheres.

RHODONEURA SEMITESSELLATA.

semitessellata, Wlk., J. Linn. Soc. VII., p. 73.

Q., Brisbane, one specimen in February. Also from Borneo and India.

†† RHODONEURA HYALOSPILA.

Siculodes hyalospila, Low, Tr. R.S.S.A., 1894, p. 87.

Q., South Barnard Island.

RHODONEURA THEORINA.

Siculodes theorina, Meyr., Tr. E.S. 1887, p. 200.

N.Q., Geraldton (Johnstone River).

† RHODONEURA DISSIMULANS.

dissimulans, Warr, Ann. Mag. Nat. Hist (6) XVII., p. 227.

N.Q., Cooktown. Also from New Guinea, Bali, Borneo, Malay Peninsula and India.

† RHODONEURA AURATA.

Pharambara aurata, Butl., Ann. Mag. Nat. Hist (5), X., p. 233.

Siculodes bydreuetis, Meyr, P.L.S., N.S.W., 1886, p. 253.

† RHODONEURA CRYPSIRIA.

Pharambara reticulata, Butl., Tr. E.S. 1886, p. 420, *praeocc.*

Siculodes crypsiria, Meyr., Tr. E.S. 1887, p. 201.

Q., Peak Downs, Duaringa,

† RHODONEURA ALBIFERALIS.

Pyralis albiferalis, Wlk., Brit. Mus. Cat. xxxiv., p. 1524.

N.Q. Cooktown. Also from New Guinea and Batchian.

RHODONEURA IRIAS.

Striglina irias, Meyr., Tr. E.S. 1887, p. 199.

Q., Rockhampton, Gayndah, Brisbane, Dalby.

† RHODONEURA POLYGRAPHALIS.

Pyralis (?) *polygraphalis*, Wlk., Brit. Mus. Cat. XXXIV., p. 1240.

Siculodes rhythmica, Meyr., Tr. E.S. 1887, p. 201.

N.A., Port Darwin. Queensland (*Hampson*). Also from Solomons, Ceylon, and India.

RHODONEURA FURCIFERA.

furcifer, Hmps.

N.Q., Townsville. Q., Brisbane.

Gen. 3. ADDAEA.

Addaea. Wlk., Brit. Mus. Cat. XXXIV., p. 1201. Hmps. P.Z.S., 1897, p. 632.

Mesopempta, Meyr., Tr. E.S., 1886, p 217.

ADDAEA SUBTESSELLATA.

Addaea subtessellata, Wlk., Brit. Mus. Cat. XXXIV., p. 1201.

Q., Nambour, Brisbane, Mount Tambourine. Walker's locality for this species (Swan River, West Australia), is an error.

ADDAEA CHARIDOTIS *nom nov.*

χαριδωτις, cheerful.

Pyralis (?) *polygraphalis*, Wlk., Brit. Mus. Cat. XXXIV., p. 1245, praeocc.

A variable species in colour and details of marking. Walker has used the same specific name in the genus *Pyralis* twice within a few pages.

N.Q., Geraldton (Johnstone River), Townsville. Walker has made the same error in the locality of this species as with regard to the preceding and many others collected by the late Mr. Diggles.

Also from Solomons and Borneo.

Fam. PYRALIDAE.

Proboscis and maxillary palpi usually well developed; frenulum present. Forewing with vein 1A usually free, sometimes forming a fork with 1B; 1C absent; 5 from near lower angle of cell; 8, 9 almost always stalked. Hindwing with veins 1A, B, C present; 5 almost always from near lower angle of cell; 8 approximated to 7 or anastomosing with it beyond the cell (Hampson).

An immense family especially well represented in warm regions, where it rivals in number the *Noctuidae* and *Geometridae.* The tabulation of the sub-families will be given with the concluding instalment of this revision.

Subfam. PHYCITINAE.

A very large group, the species being most numerous within or near the tropics. They are for the most part of small size and obscure in colour and marking. Species structurally different are often superficially very similar. It should be recognised that descriptions of species in this group are quite useless unless accompanied by accurate structural determination. The classification of the sub-family by neural characters is for the most part easy and natural, but the group containing the large genera *Phycita*, *Nephopteryx*, and *Epicrocis* forms an exception. The definitions I have adopted of these genera I regaɹd as merely provisional.

I have unfortunately not been able to consult Ragonot's great work on the *Phycitinae* and *Gallerianae*, and I have probably committed many omissions and not a few errors in consequence. The deficiency has been partly supplied by the tabulation in Hampson's Moths of India, and by much generous assistance received from this author in the determination of species.

For the convenience of study I have divided the tabulation of the genera into three section. The first of these corresponds to the *Anerastianae* of Hampson, which I am not inclined to regard as a distinct subfamily.

I have not been able to find the references for some of the generic and specific names.

A. Tongue minute or absent (*Anerastianae*, Hampson).
 B. Palpi well-developed, projecting above or beyond frons.
  C. Hindwings with vein 5 absent.
   D. Forewings with vein 5 absent.
    E. Forewings with 8, 9, 10 stalked ... 1. *Hypsotropha.*
    EE. Forewings with 10 separate.
     F. Palpi ascending ... ... 3. *Ampycophora.*
     FF. Palpi porrect ... ... 4. *Anerastia.*
   DD. Forewings with 4 and 5 stalked.
    E. Palpi ascending ... ... 5. *Saluria.*
    EE. Palpi porrect... ... ... 6. *Poujadia.*
  CC. Hindwings with vein 5 present.
   D. Palpi ascending ... ... 8. *Papua.*
   DD. Palpi porrect ... ... 9. *Polyocha.*
 BB. Palpi short, closely appressed to frons, not nearly reaching vertex ... ... 10. *Anerastidia.*

The genera *Fissifrontia* and *Parramatta* are not included in this tabulation, as I do not know their characters.

Gen. 1. HYPSOTROPHA.

Hypsotropha, Zel., Isis., 1848, p. 591. Hmps., Moths Ind. iv., p. 54.

HYPSOTROPHA PLEUROSTICHA, *n. sp.*

πλευροστιχος, with a costal line.

♂ 21 mm. Head fuscous. Palpi long (4), porrect, terminal joint slightly down-curved; fuscous, beneath whitish. Antennae ochreous-whitish; in ♂ with basal joint thickened with a short tooth on outer side of distal end, basal joints beyond this with long pectinations, terminal half simple, ciliated. Thorax whitish, anteriorly fuscous. Abdomen ochreous; tuft whitish. Legs fuscous; posterior pair mixed with whitish. Forewings narrow-elongate, apex rounded, somewhat dilated posteriorly; costa nearly straight, apex rounded, termen obliquely rounded; whitish sparsely irrorated with fuscus; base of costa fuscous to $\frac{1}{5}$; a broad subcostal streak from base to apex, upper edge defined, lower suffused; a suffused outwardly oblique line from streak at $\frac{1}{4}$ to dorsum at $\frac{1}{3}$; and an inwardly oblique similar line from streak at $\frac{3}{4}$ to dorsum at $\frac{2}{3}$; a fine interrupted line close to termen; cilia whitish. Hindwings with termen slightly sinuate, whitish; a fine fuscous terminal line obsolete towards tornus; cilia whitish.

Type in Coll. Turner.

N.Q., Townsville, in September; one specimen.

HYPSOTROPHA ICASMOPIS, *n. sp.*

εικασμα, a likeness.

♂ 18 mm. Head fuscous. Palpi long (4), fuscous, porrect, terminal joint slightly down-curved. Antennae fuscous; in ♂ basal joint thickened but not toothed, shaft beyond basal joint expanded antero-posteriorly and somewhat twisted, beyond this simple, ciliated. Thorax whitish, anteriorly fuscous. Abdomen whitish, base of dorsum ochreous. Legs fuscous. Forewings narrow-elongate, not dilated, costa rather strongly arched, apex round-pointed, termen slightly rounded, very oblique; whitish irrorated with fuscous and pale reddish; a well-defined dark-fuscous costal streak to $\frac{1}{4}$ continued by scattered scales nearly to apex; a subcostal streak from base to apex, narrow at extremities, broad in middle, upper edge defined, lower suffused; a fuscous spot above $\frac{1}{4}$ dorsum; an interrupted inwardly oblique fuscous line from streak at $\frac{3}{4}$ to dorsum at $\frac{3}{4}$; a terminal series of fuscous dots; cilia whitish. Hindwings rather narrow but broader than forewings, termen slightly sinuate; whitish, towards apex greyish; cilia whitish.

At first sight this presents a very deceptive resemblance to the preceding, though the male antennae and shape of wings are quite different.

Type in Coll. Turner.

N.Q. Townsville, in January; one specimen received from Mr. F. P. Dodd.

HYPSOTROPHA EURYZONELLA.

euryzonella, Meyr.

Very similar to *H. pleurosticha* but ♂ antennae ciliated.

N.Q., Thursday Island, Townsville; N.W.A., Roeburne.

† HYPSOTROPHA PAPUASELLA.

papuasella, Rag.

HYPSOTROPHA RHODOSTICHA, *n. sp.*

ῥοδοστιχος, rosy-streaked.

♀, 14-20 mm. Head and thorax ochreous whitish pinkish tinged. Palpi long (4), porrect, terminal joint down-curved. Antennae ochreous-whitish. Abdomen, whitish, base of dorsum ochreous. Legs whitish; anterior pair, pinkish-fuscous. Forewings elongate, costa gently arched, apex round-pointed, termen obliquely rounded; pinkish; veins outlined with whitish; cilia pinkish, bases whitish. Hindwings with termen rounded; whitish; cilia whitish.

Very similar in coloration to *Anerastria virginella*, Meyr.

Type in Coll. Turner.

Q., Brisbane, in March ; eight specimens.

HYPSOTROPHA ZOPHOPLEURA, *n. sp.*

ζοφόπλευρος, with dark costa.

♂ 20 mm. Head, thorax and palpi fuscous. Antennae fuscous ; in ♂ slightly serrate, minutely ciliated ($\frac{1}{3}$). Abdomen ochreous fuscous. Legs fuscous. Forewings moderate, costa rather strongly arched, apex rounded, termen obliquely rounded, dull, pinkish ; base and costa broadly suffused with fuscous ; a fuscous dot on dorsum at $\frac{1}{3}$; several fuscous dots on termen ; cilia pinkish. Hindwings with termen rounded ; whitish ; cilia whitish, at apex grey.

Type in Coll. Turner.

Q., Burpengary, near Brisbane ; one specimen.

HYPSOTROPHA ACIDNIAS, *n. sp.*

ἀκιδνος, weak, feeble.

♂ 12 mm. Head and thorax ochreous-whitish with some fuscous scales. Palpi long (4), porrect ; ochreous-whitish. Antennae whitish ; in ♂ simple, slightly serrate towards apices, shortly ciliated ($\frac{1}{3}$). Abdomen ochreous-whitish. Legs ochreous-whitish ; anterior pair fuscous. Forewings narrow-elongate, somewhat dilated posteriorly, apex rounded, termen obliquely rounded ; ochreous-whitish sparsely irrorated with dark fuscous, especially along veins ; dark fuscous dots above dorsum at $\frac{1}{3}$ and $\frac{2}{3}$, and a larger dot beneath end of cell ; cilia whitish. Hindwings with termen rounded ; whitish ; cilia whitish.

Type in Coll. Turner.

N.Q., Townsville in October ; one specimen received from Mr. F. P. Dodd.

Gen. 2. FOSSIFRONTIA.

Fossifrontia, Hmps.

† FOSSIFRONTIA LEUCONEURELLA.

Fossifrontia leuconeurella, Hmps.

N.Q., Cooktown.

Gen. 3. AMPYCOPHORA.

Ampycophora, Meyr., P.L.S.N.S.W., 1882, p. 158.

† AMPYCOPHORA APOTOMELLA.

Pempelia apotomella, Meyr., P.L.S.N.S.W., 1879, p. 224.

Q., Duaringa.

AMPYCOPHORA HAPLOSCHEMA, *n. sp.*

ἁπλοσχημος, of simple pattern.

♂ 20 mm. Head and thorax fuscous. Palpi (2), erect, exceeding vertex, fuscous. Antennae fuscous ; in ♂ with basal joint dilated and with a small tooth on outer side of distal end, beyond basal joint strongly dilated antero-posteriorly, thence simple, towards apex slightly serrate, ciliated. Abdomen ochreous-whitish, base of dorsum ochreous. Legs, anterior pair fuscous [middle and posterior pair broken]. Forewings narrow-elongate, scarcely dilated, apex rounded, termen obliquely rounded; fuscous, towards dorsum paler; a white costal streak from base to apex, attenuated at extremities; cilia pale fuscous. Hindwings with termen slightly wavy; whitish, towards apex greyish; cilia whitish with a faint grey line at $\frac{1}{3}$.

Type in Coll. Turner.

Q., Ballandean, near Stanthorpe, in February; one specimen.

Gen. 4. ANERASTRIA.

Anerastria, Hb., Verz., p. 367. Meyr., P.L.S.N.S.W., 1882, p. 160. Hmps., Moths Ind. IV., p. 55.

ANERASTRIA ENERVELLA.

enervella, Rag.

N.Q., Cooktown. Q., Nambour, in December; one specimen. N.W.A., Sherlock River. Also from Louisiades.

ANERASTRIA VIRGINELLA.

Anerestria virginella, Meyr., P.L.S.N.S.W., 1880, p. 233.

This species is so similar to *Hypsotropha rhodosticta*, Turn., that it must be distinguished by structural characters.

N.Q., Townsville. Q., Peak Downs, Duaringa, Brisbane, Stradbroke Island.

ANERASTRIA PULVERULELLA.

Anerastria pulverulella, Hmps., Moths Ind. IV., p. 56.

My example has been identified by Sir George Hampson. It does not appear to correspond quite exactly to the description.

N.Q., Townsville, in April; one specimen received from Mr. F. P. Dodd. Also from Ceylon.

†† ANERASTRIA METALLACTIS.

Anerastria metallactis, Meyr, Tr. E.S. 1887, p. 262.

N.S.W. Bathurst, Meyrick.

† ANERASTRIA BISERIELLA.

Anerastria biseriella, Hmps.

N.Q. Cooktown; N.W.A. Sherlock River.

† ANERASTRIA METAMELANELLA.

Anerastria metamelanella, Hmps.

N.Q. Geraldton.

†† ANERASTRIA PSAMATHELLA.

Anerastria psamathella, Meyr, P.L.S.N.S.W. 1880, p. 234.

Anerastria nitens, Butl., Tr. E.S. 1886, p. 440.

Q., Peak Downs, Brisbane; N.S.W. Sydney; V., Fernshaw.

ANERASTRIA MINORALIS.

Anerastia minoralis, Low., Tr. R.S.S.A. 1903, p. 52.

♂ 13 mm. Antennae dentate, shortly ciliated (½), basal joint with a slight apical posterior tooth. Forewings whitish; a pure white costal streak narrowing at base and apex; defined beneath by a median fuscous streak, which is suffused on its dorsal aspect. Hindwings whitish.

These particulars are noted from the type.

N.Q. Mackay ? (Lower).

†† ANERASTRIA XIPHOMELA.

Anerastria xiphimela, Low., Tr. R.S.S.A. 1903, p. 52.

I have examined a specimen supposed to be the type of this species. It is in perfect condition, but does not correspond in detail to Mr. Lower's description. Furthermore, it belongs to the genus *Poujadia*, and Sir Geo. Hampson, who examined Mr. Lower's types, is hardly likely to have made a mistake as to the genus. I cannot therefore accept it as the type, although so labelled.

ANERASTRIA EURYSTICHA, *n. sp.*

ἐυρυστιχος, with broad line.

♂ 19 mm. Head fuscous. Palpi long (3), porrect, terminal joint down-curved; fuscous. Antennae fuscous; in ♂ with basal joint enlarged, shaft beyond basal joint dilated antero-posteriorly, thence simple with very short ciliations. Thorax fuscous. Abdomen ochreous, sides and apex pale fuscous. Legs fuscous. Forewings narrow elongate, posteriorly dilated, costa moderately arched; apex rounded, termen obliquely rounded; whitish, irrorated with fuscous; a fuscous streak on costa from base to middle, posteriorly suffused; a median fuscous streak from base to apex, dilated towards termen, upper edge defined, lower suffused; cilia whitish. Hindwings with termen rounded; whitish towards apex tinged with grey; cilia whitish.

Type in Coll. Turner.

N.Q., Townsville, in January; one specimen received from Mr. F. P. Dodd.

Gen. 5. SALURIA.

Saluria, Rag.

†† SALURIA NEOTOMELLA.

Saluria neotomella, Rag.

SALURIA RHODOESSA.

ῥοδοεις, rosy.

♂ ♀ 28-29 mm. Head pale purplish fuscous. Palpi pale purplish fuscous ascending; in ♂ moderately long (2), in ♀ very long (5). Antennae purplish fuscous, towards apices whitish; in ♂ with basal joint dilated, shaft beyond basal joint much dilated, antero-posteriorly shortly ciliated (¼). Thorax reddish ochreous. Abdomen ochreous, at base and apex whitish. Legs whitish, tinged with pink; anterior pair fuscous. Forewings narrow—elongate, not dilated, costa moderately arched, apex rounded, termen obliquely rounded; rosy pink with a few scattered dark fuscous scales; a conspicuous white costal streak, attenuated at extremeties and irrorated with purplish scales towards costal edge; a narrow dark fuscous line from base to apex limits this beneath dividing it from a broad suffused ochreous streak from base nearly to termen, giving off some fine streaks along veins towards termen; several minute dark fuscous terminal dots; cilia pink. Hindwings with termen slightly wavy; whitish; a fine grey terminal line from apex not reaching tornus; cilia whitish, with a fine grey line near bases at apex.

Type in Coll. Turner

N.Q., Townsville, in March; three specimens received from Mr. F. P. Dodd.

Gen. 6. POUJADIA.

Poujadia, Rag., Nouv. Gen., p. 42 (1888). Hmps., Moths Ind. iv., p. 58.

POUJADIA ERODELLA.

Poujadia erodella, Rag.

N.Q., Townsville, in September; one specimen received from Mr. F. P. Dodd.

POUJADIA OPIFICELLA.

opificella, Zel.

My examples are females, and it would be desirable to examine the male to make out the species with certainty.

N.Q., Townsville, in December and April; two specimens received from Mr. F. P. Dodd.

POUJADIA CALLIRRHODA, *n. sp.*

καλλιρροδος, beautifully rosy.

♀ 28 mm. Head, thorax, and palpi pink. Antennae pink, towards apices whitish. Abdomen whitish. Legs whitish, partly pinkish-tinged. Forewings elongate, costa moderately arched, apex rounded, termen obliquely rounded; deep crimson-pink; a broad, white costal streak, from base to apex, narrowing at extremities; costal edge in centre pinkish-tinged; a narrow fuscous line along lower margin of costal streak, best marked towards base; cilia pink. Hindwings with termen rounded; whitish; cilia whitish.

Type in Coll. Turner.

N.Q., Townsville, in March; one specimen received from Mr. F. P. Dodd.

POUJADIA HOLOCHRA, *n. sp.*

ὁλωχρος, wholly pale.

♂ 27mm. Head and thorax whitish. Palpi very long (5); grey, irrorated with whitish. Antennae whitish; in ♂ with well-marked dentations and moderately ciliated (1). Abdomen whitish. Legs whitish, mixed with grey. Forewings elongate, costa moderately arched, apex rounded, termen obliquely rounded, whitish; costal edge ochreous-whitish towards base; a fine fuscous subcostal line from base to apex; beneath this disc is ochreous-tinged, except on veins and near dorsum, where a grey irroration replaces the ochreous suffusion; cilia whitish, irrorated with grey; hindwings with termen rounded; whitish; cilia whitish.

Type in Coll. Turner.

V. Birchip, in January; one specimen received from Mr. D. Goudie.

Gen. 7. PARRAMATTA.

Parramatta, Rag.

† PARRAMATTA ENSIFERELLA.

Eucarphia ensiferella, Meyr, P.L.S.N.S.W. 1878, p. 208.

V. Melbourne.

Gen. 8. PAPUA.

Papua, Rag.

PAPUA LATILIMBELLA.

Papua latilimbella, Rag.

Antennae of ♂ strongly laminate.

Q. Brisbane and Southport, in November and January; three specimens, N.S.W., Ben Lomond (4,500 feet), in January. Also from New Guinea.

PAPUA LONGIRAMELLA.

longiramella, Hmps.

Antennae of ♂ with long pectinations.

N.Q. Cooktown; Q. Brisbane, in December and January.

PAPUA LEUCOCINCTA.

brambus (?) *leucocinctus*, Wlk., Brit. Mus. Cat. xxvii, p. 169.

Polyocha leucocincta, Hmps, Moths Ind. iv, p. 62.

N.Q. Cairns, Townsville; Q. Stradbroke Island, Southport. Also from Borneo and India.

Gen. 9. POLYOCHA.

Polyocha, Zel., Isis, 1848, p. 876, Hmps. Moths Ind. iv, p. 61.

POLYOCHA RHABDOTA.

ῥαβδωτος, striped.

♂ ♀ 20-28 mm. Head dull reddish-purple; face fuscous. Palpi long (4), porrect, terminal joint down-curved; fuscous. Antennae of ♂ simple, with base not distorted [partly broken]. Thorax pale reddish. Abdomen whitish, towards apex greylsh. Legs pale greyish; anterior pair fuscous. Forewings elongate, slightly dilated posteriorly, costa gently arched, apex rounded, termen obliquely rounded; whitish more or less irrorated with pinkish; a broad white costal streak from base to apex, attenuated at extremities; beneath this a broad fuscous median streak from base to apex; cilia pinkish white. Hindwings with termen slightly wavy; whitish, towards apex greyish; cilia whitish.

Type in Coll. Turner.

N.Q. Townsville; Q. Brisbane, Stanthorpe. Three specimens in January and February.

POLYOCHA ACHROSTA, *n. sp.*

ἀχρωστος, colourless.

♀ 27 mm. Head, thorax, palpi, antennae, abdomen, and legs ochreous-whitish. Forewings elongate, costa nearly straight, apex rounded, termen obliquely rounded; ochreous-whitish; a pale fuscous subcostal line from base to apex, giving off a short branch to costa before apex; cilia ochreous-whitish. Hindwings with termen rounded; grey-whitish; cilia whitish.

Type in Coll. Turner.

Q., Dalby; one specimen.

Gen. 10. ANERASTIDIA.

Very different in appearance to the preceding genera, and superficially resembling the *Gallerianae*.

ANERASTIDIA EBENOPASTA, *n. sp.*

ἐβενοπαστος, sprinkled with ebony.

♂ 16mm, Head, grey; palpi, whitish; antennae, simple, not thickened, minutely ciliated ($\frac{1}{2}$); gray-whitish, annulated with blackish; thorax blackish; patagiae pale-gray; abdomen gray; legs white, irrorated with blackish; forewings elongate-oval; costa rather strongly arched; apex rounded; termen very obliquely rounded; gray-whitish sparsely irrorated with blackish; two outwardly-curved interrupted transversed blackish lines, first from $\frac{1}{3}$ costa to beyond $\frac{1}{3}$ dorsum, second from $\frac{2}{3}$ costa to before tornus; an interrupted blackish terminal line; cilia gray-whitish. Hindwings broad (2); termen deeply sinuate; gray; cilia whitish; underside with a large central dull-ochreous blotch.

♀ 16mm. Differs as follows:—Head, thorax, and forewings, whitish; hindwings narrower, whitish, without ochreous blotch beneath.

Type in Coll. Turner.

N.Q., Townsville, in September and November; two specimens received from Mr F. P. Dodd.

AA. Tongue well developed (*Phycitinae*, Hampson).
B. Hindwings with vein 5 absent.
C. Hindwings with 4 absent ... ... 11. *Ernophthora*
CC. Hindwings with 4 present.
D. Forewings with vein 9 absent.
E. Forewings with 5 absent.
F. Palpi ascending ... ... 12. *Ephestia.*
FF. Palpi porrect ... ... 13. *Plodia.*
EE. Forewing with 4 and 5 stalked.
F. Forewings with 8 and 10 stalked 14. *Ecbletodes.*
FF. Forewings with 8 and 10 separate.
G. Palpi ascending ... ... 15. *Homoeosoma.*
GG. Palpi porrect ... ... 16. *Eucampyla.*
DD. Forewings with 8 and 9 stalked.
E. Forewings with 5 absent.
F. Forewings with 3 and 4 stalked ... 17. *Euzopherodes.*
FF. Forewings with 3 and 4 separate.
G. Palpi ascending ... ... 18. *Unadilla.*
GG. Palpi porrect ... ... 19. *Crocydopora.*
EE. Forewings with 5 present.
F. Hindwings with 2 from well before angle of cell, which is long.
G. Forewings with 4 and 5 stalked 20. *Euzophera.*
GG. Forewings with 4 and 5 separate 21. *Hyphantidium.*
FF. Hindwings, with 2 from or from near angle of cell, which is short.
G. Forewings with 4 and 5 stalked 22 *Tylochares.*
GG. Forewings with 4 and 5 separate.
H. Forewings with 5 from above angle of cell, well separated from 4 23. *Pempelia.*
HH. Forewings with 4 and 5 closely approximated at base.
J. Palpi ascending ... ... 24. *Trissonca.*

JJ. Palpi porrect.
K. Maxillary palpi minute ... 25. *Ancylosis.*
KK. Maxillary palpi well developed, ending in a pencil-shaped hair-tuft 26. *Hypergryphia.*

Gen. 11. ERNOPHTHORA.

Ernophthora, Meyr., Tr. E.S., 1887, p. 268.

††ERNOPHTHORA PHOENICIAS.

Ernophthora phoenicias, Meyr., Tr. E.S., 1887, p. 268.

Q.

Gen. 12. EPHESTIA.

Ephestia, Gn., Eur. Microlep., p. 81. Meyr., Brit. Lep., p. 372. Hmps., Moths Ind. iv., p. 66.

The species of this and the following genus feed on maize, dried fruits, etc., and appear to be of world-wide distribution.

EPHESTIA ELUTELLA.

elutella, Hb.

Ephestia elutella, Meyr., Brit. Lep., p. 373. P.L.S.N.S.W. 1878, p. 215.

N.S.W., Sydney, Cooma. V., Gisborne. W.A., Perth, Geraldton.

EPHESTIA FICULELLA.

ficulella, Barrett.

Ephestia ficulella, Meyr., Brit. Lep., p. 373, P.L.S.N.S.W., 1880, p. 234.

I think *Ephestia cautella*, Wlk. (Hmps., Moths Ind. iv., p. 66) is the same species.

Q., Brisbane; infesting dried maize. W.A., Northampton. Carnarvon.

†† EPHESTIA CAHIRITELLA.

cahiritella, Zcl.

Ephestia cahiritella, Meyr., Brit. Lep., p. 373.

Gen. 13. PLODIA.

Plodia, Gn., Meyr., Brit. Lep., p. 371.

PLODIA INTERPUNCTELLA.

interpunctella, Hb.

Plodia interpunctella, Meyr., Brit. Lep., p. 372. P.L.S.N.S.W. 1878, p. 216.

Q., Brisbane. N.S.W., Sydney. Infesting dried maize, currants, etc.

Gen. 14. ECBLETODES, *nov.*

ἐκβλητωδης, of unattractive appearance.

Face flat. Tongue well developed. Palpi rather long, slender, recurved, ascending, reaching vertex; second joint long, terminal joint very short. Antennae of ♂ unknown, of ♀

slightly serrate towards apex. Forewings with veins 3 and 4 short-stalked, 5 absent, 9 absent, 8 and 10 stalked. Hindwings with vein 2 from near angle, 3 and 4 stalked, 5 absent, 7 anastomosing with 8 almost to extremity.

Apparently a development of *Homoeosoma*, Curt.

ECBLETODES PSEPHENIAS, *n. sp.*

ψεφηνος, obscure.

♀ 14 mm. Head dark fuscous mixed with ochreous-whitish. Palpi ochreous-whitish, irrorated with dark fuscous especially on external surface. Antennae pale fuscous. Thorax and abdomen brown-whitish mixed with fuscous. Legs fuscous; tarsi obscurely annulated with ochreous-whitish. Forewings elongate, posteriorly somewhat dilated, costa gently arched, apex rounded, termen obliquely rounded, dark fuscous sparsely irrorated with whitish; lines whitish; antemedian line outwardly curved from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum; postmedian line from $\frac{5}{6}$ costa, indented first inwardly, then outwardly, to dorsum at $\frac{5}{6}$; cilia fuscous. Hindwings with termen rounded and slightly wavy; pale fuscous; cilia fuscous-whitish, with a whitish basal line.

Type in Coll. Turner.

Q. Brisbane, in April; one specimen.

Gen. 15 HOMOEOSOMA.

Homoeosoma, Curt., Ent. Mag. i., p. 190. Hmps. Moths. Ind. iv., p. 66.

HOMOEOSOMA VAGELLA.

Homoeosoma vagella, Zel., Isis, 1848, p. 863. Meyr., P.L.S.N.S.W. 1878, p. 214.

N.Q., Kuranda, Townsville; Q., Brisbane; N.S.W., Glen Innes, Sydney, Bathurst, Cooma; V., Melbourne; S.A., Adelaide; W.A., Geraldton, Carnarvon.

HOMOEOSOMA FORNACELLA.

Homoeosoma fornacella, Meyr., P.L.S.N.S.W. 1880, p. 219.

N.Q., Kuranda, in October, one specimen; N.S.W., Sydney, Ben Lomond (4,500 ft.), T., George's Bay.

HOMOEOSOMA MELANOSTICTA.

Homoesoma (?) *melanosticta*, Low., Tr. R.S.S.A., 1903, p. 58.

♂ ♀. 17-25 mm. Head white. Palpi recurved, ascending, not reaching vertex; fuscous, internal surface and apex white. Antennae in ♂ stout, simple, not distorted at base, minutely ciliated ($\frac{1}{6}$); fuscous, basal joint white. Thorax, white.

Abdomen, ochreous-whitish. Legs grey, irrorated with whitish. Forewings elongate-oblong, scarcely dilated, costa gently arched, apex rounded, termen obliquely rounded ; white towards dorsum and termen ochreous-tinged ; markings fuscous ; a minute linear dot in disc at $\frac{1}{3}$, and two transversely placed rounded dots in disc at $\frac{2}{3}$, of these the upper is frequently obsolete ; a dot on fold beneath first dot and a second on fold at $\frac{3}{4}$, the two sometimes connected by a fine line ; costal edge towards base dark fuscous ; a fine streak on costa from middle nearly to apex ; a straight row of five or six dots from $\frac{7}{8}$ costa to second dot on fold ; a series of terminal dots ; cilia, whitish. Hindwings with termen rounded ; pale-grey ; cilia whitish, with a fine grey line near base.

Q., Brisbane and Mount Tambourine, in November, March, and April ; six specimens, N.S.W., Sydney (Lyell). Mr. Lower's locality *may* be correct, but a specimen of his labelled "Derby," undoubtedly hails from a well-known Queensland source.

HOMOEOSOMA STENOPIS, *n. sp.*

στενωπις, narrow looking.

♀ 21 mm. Head, thorax, and palpi grey with fine whitish irroration. Antennae grey. Abdomen and legs grey. Forewings elongate, costa strongly arched, apex round-pointed ; termen straight, oblique ; grey irrorated with whitish and fuscous ; without any distinct markings ; cilia grey irrorated with whitish. Hindwings with termen rounded ; thinly scaled ; whitish, veins and termen grey ; cilia whitish with a pale grey basal line.

This obscure species may be distinguished from *H. vagella* by the much more strongly arched costa of forewings. The frons is also more prominent.

Type in Coll. Turner.

V., Birchip, in March ; one specimen received from Mr. D. Goudie.

HOMOEOSOMA FARINARIA, *n. sp.*

Farinarius, floury.

♀ 27 mm. Head and thorax whitish irrorated with grey. Palpi grey. Abdomen ochreous-whitish. Legs whitish irrorated with grey. Forewings elongate, costa nearly straight, apex rounded, termen obliquely rounded ; grey irrorated with white ; a strong white suffusion in costal portion of disc from $\frac{1}{4}$ to $\frac{4}{5}$; a white line strongly angulated outwards from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, a dark grey dot in disc at $\frac{1}{3}$, and a second transversely elongate in disc at $\frac{2}{3}$; a dentate grey line from $\frac{4}{5}$ costa to $\frac{4}{5}$ dorsum, succeeded by a white line; cilia grey-whitish. Hindwings with termen rounded; pale grey; cilia white.

Type in Coll. Lyell.

T., Strahan, in January; one specimen.

Gen. 16. EUCAMPYLA.

Eucampyla, Meyr., P.L.S.N.S.W. 1882, p. 159.

† † EUCAMPYLA ETHEIELLA.

Eucampyla etheiella, Meyr., P.L.S.N.S.W. 1882, p. 171.

N.S.W., Sydney.

Gen. 17. EUZOPHERODES.

EUZOPHERODES ALBICANS.

albicans, Rag.

Mr. F. P. Dodd informs me that the larvæ feed in the small round capsular fruit of a tree that grows near salt water, it spins a slight hood to this, when it pupates, and leaves a small slit for emergence. The fruit is then suspended on a long thread, sometimes as long as six feet, and swings thus on the tree. These cocoons frequently get blown off by the wind, and are carried away with the threads, which become attached often to other trees many yards distant.

N.Q., Townsville; Q., Brisbane; in January and February.

† † EUZOPHERODES ALLOCROSSA.

Euzopherodes allocrossa, Low., Tr. R.S.S.A. 1903, p. 57.

N.Q., Mackay ? (Lower).

EUZOPHERODES LEPTOCOSMA, *n. sp.*

λεπτοκοσμος, slightly ornamented.

♂ ♀ 15-17 mm. Head grey. Palpi recurved, ascending, not reaching vertex, apex acute: dark fuscous finely irrorated with whitish. Antennae grey; in ♂ simple, not distorted at base, minutely ciliated ($\frac{1}{2}$). Thorax grey. Abdomen ochreous whitish, mixed with grey on dorsum. Legs white, irrorated with dark fuscous; posterior pair mostly white. Forewings narrow elongate, costa slightly arched, apex rounded, termen obliquely rounded; whitish grey mixed with darker grey and fuscous; a median fuscous suffusion from base to $\frac{3}{5}$, interrupted at mid-disc; a blackish crescentic spot in disc at $\frac{3}{5}$, placed transversely with concavity anterior; a broad pinkish subcostal streak from $\frac{1}{5}$ to $\frac{4}{5}$, in ♀ this is absent; a series of minute linear dark fuscous dots along fold; a fine acutely dentate transverse line from $\frac{5}{6}$, costa not quite reaching dorsum, this is followed by some longitudinal streaks on veins; a series of terminal dots; cilia whitish, bases grey. Hindwings with termen rounded; translucent, whitish, towards apex and termen grey; cilia whitish, with a fine grey line near base.

Type in Coll. Turner.

N.Q., Townsville, in November and December; two specimens received from Mr. F. P. Dodd.

Gen. 18. UNADILLA.

Unadilla, Hulst.

UNADILLA DISTICHELLA.

Homoeosoma distichella, Meyr., P.L.S.N.S.W., 1878, p. 215.

Q., Brisbane, Stanthorpe; N.S.W., Newcastle, Bowenfels; V., Gisborne.

UNADILLA ALBICOSTALIS.

Homoeosoma albicostalis, Luc., P.R.S.Q., 1891, p. 93.

N.Q., Townsville; Q., Bundaberg, Brisbane, Stradbroke Island.

Gen. 19. CROCYDOPORA.

Crocydopora, Meyr., P.L.S.N.S.W., 1882, p. 158.

CROCYDOPORA CINIGERELLA.

Nephopteryx cinigerella, Wlk., Brit. Mus. Cat. xxxv., p. 1719.

Nephopteryx stenopterella, Meyr., P.L.S.N.S.W., 1878, p. 200.

Q., Duaringa, Brisbane, Mt. Tambourine; N.S.W., Glen Innes, Newcastle, Sydney, Bathurst, Bowenfels, Cooma; V., Gisborne, Fernshaw. Also from New Zealand.

Gen. 20. EUZOPHERA.

Euzophera, Zel., Tr. E.S., 1867, p. 453. Hmps. Moths Ind. iv., p. 72.

EUZOPHERA SUBARCUELLA.

Myelois subarcuella, Meyr., P.L.S.N.S.W., 1878, p. 211.

N.S.W., Glen Innes, Sydney, Katoomba; V., Gisborne, Melbourne; S.A., Mt. Lofty, Ardrossan.

††EUZOPHERA HOLOPHRAGMA.

Euzophera holophragma, Meyr., Tr. E.S., 1887, p. 256.

W.A., Carnavon.

EUZOPHERA THERMOCHROA.

Euzophera (?) *thermochera*, Low., Tr. R.S.S.A., 1896, p. 160.

N.S.W., Sydney.

Gen. 21. HYPHANTIDIUM.

Hyphantidium, Scott, P.Z.S., 1859, p. 207.

Cateremna, Meyr., Brit. Lep., p. 375.

†† HYPHANTIDIUM SERICARIUM.

Hyphantidium sericarium, Scott, P.Z.S., 1859, p. 207, Pl. 61.

Unfortunately I do not know this species, which is the type of the genus.

HYPHANTIDIUM QUADRIGUTTELLUM.

Acrobasis quadriguttella, Wlk., Brit. Mus. Cat., XXXV., p. 1711.

N.Q., Townsville, in September; one specimen received from Mr. F. P. Dodd.

†† HYPHANTIDIUM MICRODOXUM.

Euzophera microdoxa, Meyr., P.L.S.N.S.W. 1880, p. 231.

Q., Duaringa. T. Launceston.

HYPHANTIDIUM LEUCARMUM.

Euzophera leucarma, Meyr., P.L.S.N.S.W., 1880, p. 230.

Q., Brisbane. N.S.W., Sydney.

†† HYPHANTIDIUM METALLOPS.

Cateremna metallopa, Low., P.L.S.N.S.W., 1898, p. 46.

N.Q., Mackay? (Lower).

HYPHANTIDIUM APODECTUM, *n. sp.*

ἀποδεκτος, acceptable.

♀. 19 mm. Head, fuscous. Palpi, dark fuscous. Antennae fuscous. Thorax, purplish-fuscous. Abdomen, purplish-fuscous, towards base of dorsum mixed with pale brownish-ochreous. Legs white, irrorated with dark fuscous. Forewings elongate-oblong, dilated posteriorly, costa straight, apex rounded, termen slightly oblique, slightly rounded; purplish-fuscous irrorated with dark-fuscous; a broad white costal streak from near base to near apex, irrorated with a few dark-fuscous scales, its lower edge ill-defined and interrupted at $\frac{2}{3}$ by a transverse dark-fuscous discal spot, middle third of costal edge dark-fuscous; cilia pale-fuscous. Hindwings with termen rounded; pale brownish-ochreous; cilia concolorous, at apex rather darker.

Type in Coll. Turner.

Q., Brisbane; one specimen.

HYPHANTIDIUM SEMINIVALE, *n. sp.*

Seminivalis, half-snowy.

♀ 18 mm. Head fuscous mixed with white. Palpi fuscous, bases of second and terminal joints white. Antennae grey. Thorax fuscous. Abdomen grey. Legs fuscous annulated with white. Forewings rather elongate, posteriorly somewhat dilated, costa slightly arched, apex rounded, termen slightly oblique, rounded beneath; fuscous; costal half of disc broadly suffused with white; a dark fuscous basal spot; an elongate dark fuscous dot on costa at $\frac{2}{5}$, and a larger spot beneath it partly interrupting white suffusion; two dots placed transversely in mid-disc; a dark fuscous line from $\frac{4}{5}$ costa to $\frac{2}{3}$ dorsum, succeeded by a parallel line; a triangular blackish spot on costa just before apex; a series of blackish terminal dots; cilia grey, at apex white. Hindwings with termen rounded; thinly scaled and translucent; grey, towards base whitish; cilia grey.

The forewings resemble *H. apodectum*, but the hindwings are very different.

Type in Coll. Turner.

Q., Brisbane; one specimen.

HYPHANTIDIUM PAMPHAËS, *n. sp.*

παμφαης, all-shining.

♂ 10 mm. Head ochreous-brown. Palpi short, ascending, recurved, not reaching middle of frons; fuscous. Antennae ochreous-brown; in ♂ slightly serrate, not distorted at base, minutely ciliated ($\frac{1}{6}$). Thorax ochreous-brown. Abdomen ochreous-whitish. Legs dark fuscous; posterior pair whitish, mixed with fuscous on lower surface. Forewings elongate triangular, costa straight to near apex, apex rounded, termen slightly oblique, slightly rounded; pale brownish ochreous, in certain lights bright iridescent purple; cilia concolorous. Hindwings with termen nearly straight; thinly scaled, whitish, suffused with grey; veins outlined in grey; cilia pale grey with a whitish basal line.

Type in Coll. Turner.

N.Q., Townsville, in February; one specimen received from Mr. F. P. Dodd, who informs me that he found the larvæ feeding on the webs of abandoned nests of the green ant.

Gen. 22. TYLOCHARES.

Tylochares, Meyr.

TYLOCHARES COSMIELLA.

Myelois cosmiella, Meyr., P.L.S.N.S.W. 1878, p. 212.

Q., Duaringa; N.S.W., Moruya; V., Melbourne; Birchip, Murtoa.

TYLOCHARES SCEPTUCHA, *n. sp.*

σκηπτουχος, bearing a wand or staff; in allusion to central streak of forewings.

♂ 19 mm. Head ochreous-whitish, face fuscous. Palpi recurved, ascending, rather densely scaled anteriorly; fuscous, internal surface ochreous-whitish. Antennae fuscous; in ♂ slightly serrate, not distorted towards base, minutely ciliated ($\frac{1}{4}$). Thorax ochreous-whitish. Abdomen pale-ochreous, towards apex greyish. Legs dark-fuscous, irrorated with whitish except tarsi. Forewings narrow-elongate, costa nearly straight, apex rounded, termen oblique, slightly rounded; brown-whitish with a few scattered dark-fuscous scales; a median streak of dark-fuscous irroration from base to $\frac{3}{4}$, widening posteriorly; a dark-fuscous spot at apex continued as a line along termen; cilia pale-grey mixed with white especially towards bases. Hind-wings with termen rounded; grey; cilia pale-grey with a darker line near bases.

Type in Coll. Turner.

Q., Ballandean, near Stanthorpe, in February, one specimen; V., Gisborne.

Gen. 23. Pempelia.

Pempelia, Hb., Meyr., P.L.S.N.S.W. 1882, p. 157.

PEMPELIA OPIMELLA.

Nephopteryx opimella. Meyr., P.L.S.N.S.W. 1878, p. 201.

Q., Brisbane, Mt. Tambourine, Stanthorpe. N.S.W., Sydney, Katoomba.

PEMPELIA CANILINEA.

Lasiocera canilinea, Meyr., P.L.S.N.S.W. 1878, p. 209.

Distinguishable from the preceding by the peculiar antennae of the ♂, but not I think to be separated generically.

N.S.W., Sydney, Goulburn, Katoomba.

†† PEMPELIA ANTELIA.

Lasiocera antelia, Meyr., Tr. E.S. 1885, p. 455.

V., ————. S.A., Ardrossan.

†† PEMPELIA HEMICHLAENA.

Pempelia? hemichlaena, Meyr,, Tr. E.S. 1887, p. 260.

V., ————.

†† PEMPELIA MICROCOSMA.

Lasiosticha microcosma, Low., Tr. R.S.S.A. 1893, p. 166.

Referred to this genus conjecturally.

S.A., Adelaide.

Gen. 24. Trissonca.

Trissonca, Meyr., P.L.S.N.S.W., 1882, p. 158.

I think *Heterographis*, Rag. (Ent. Mo. Mag., 1885, p. 31), is the same genus.

†† TRISSONCA MESACTELLA.

Spermatophthora mesactella, Meyr., P.L.S.N.S.W., 1879, p. 225.

N.S.W., Sydney.

†† TRISSONCA IANTHEMIS.

Tylochares (?) *ianthemis*, Meyr., Tr. E.S., 1887, p. 260.

Mr. Meyrick gives no locality.

TRISSONCA PROLEUCA.

Heterographis proleuca, Low., Tr. R.S.S.A., 1903, p. 58.

N.Q., Townsville, in November; one bred specimen from Mr. F. P. Dodd in Coll. Lyell, corresponding exactly with Mr. Lower's type. This species very probably occurs in Mackay, but the type was certainly not taken there. This observation applies *mutatis mutandis* to many of Mr. Lower's localities which I have not thought worthy of notice.

TRISSONCA MOLYBDOPHORA.

Heterographis molybdophora, Low., Tr. R.S. S.A., 1903, p. 57.

♂ ♀ 13-17 mm. Head white. Palpi grey-whitish. Antennae ochreous-whitish; in ♂ not distorted towards base, simple, minutely ciliated ($\frac{1}{4}$). Thorax whitish-ochreous. Abdomen, ochreous whitish. Legs grey finely irrorated with white. Forewings narrow-elongate-triangular, costa nearly straight, apex rounded, termen oblique, scarcely rounded; whitish-ochreous somewhat brownish tinged; costal edge near base fuscous; a narrow median white streak from base to $\frac{5}{6}$, edged above by a fine blackish line, beneath by a grey streak containing a few blackish scales; a suffused grey streak mixed with blackish along fold, and a finer similar streak on middle part of dorsum; a grey suffusion along terminal half of costa; a short oblique blackish streak from apex; a streak along termen of mixed white, grey, and dark fuscous; cilia whitish with a grey line near base. Hindwings with termen slightly wavy; pale-grey; cilia whitish with a grey line near base.

A neatly marked and attractive species.

N.Q., Townsville in April and July; two specimens received from Mr. F. P. Dodd. Cooktown (British Museum).

TRISSONCA EPITERPES, *n. sp.*

ἐπιτερπης, pleasing.

♀ 14 mm. Head and thorax ochreous-whitish. Palpi ochreous-whitish mixed with fuscous. Antennae grey. Abdomen ochreous-whitish, partly suffused with grey. Legs whitish; anterior pair with some fuscous scales. Forewings moderately elongate, costa slightly arched, apex rounded, termen obliquely rounded; grey, mixed with whitish and ferrugineous; a whitish streak containing some dark scales along costa to $\frac{5}{6}$; a ferrugineous basal blotch divided by a grey suffusion; a narrow white fascia straight and outwardly oblique from $\frac{1}{4}$ costa to $\frac{2}{5}$ dorsum; a similar slightly waved white line from $\frac{5}{6}$ costa to $\frac{5}{6}$ dorsum; a terminal ferrugineous suffusion; termen grey; cilia grey-whitish. Hindwings with termen rounded; grey; cilia whitish, with a grey basal line.

Type in Coll. Lyell.

N.Q., Townsville, in January. One specimen received from Mr. F. P. Dodd.

TRISSONCA CAPNOESSA, *n. sp.*

καπνοεις, smoky.

♂ 20 mm. Head, thorax, and palpi dark-fuscous. Antennae dark fuscous; in ♂ thickened and minutely ciliated ($\frac{1}{6}$). Abdomen fuscous, apices of segments whitish-ochreous. Legs fuscous irrorated with whitish. Forewings elongate, costa scarcely arched, apex rounded, termen somewhat oblique, rounded beneath; dark-fuscous minutely irrorated with whitish; an obscure whitish transverse line at $\frac{1}{3}$; a second similar but augulated line from $\frac{5}{6}$ costa to $\frac{5}{6}$ dorsum; cilia fuscous with minute whitish irroration. Hindwings with termen rounded, faintly sinuate beneath apex; thinly scaled; grey towards base paler; cilia grey-whitish with a grey basal line.

An obscure species although the type is in excellent condition.

Type in Coll. Lyell.

N.S.W., Bulli Pass, in April, one specimen.

Gen. 25. ANCYLOSIS.

Ancylosis, Zel., Isis. 1839., p. 178. Hmps. Moths Ind., iv., p. 71.

ANCYLOSIS LAPSALIS.

Dosara lapsalis, Wlk., Brit. Mus. Cat. xix, p. 829.

Ancylosis lapsalis, Hmps., Moths Ind. iv, p. 71.

N.Q. Townsville, in April; two specimens received from Mr. F. P. Dodd. Also from Ceylon.

Gen. 26. HYPOGRYPHIA.

Hypogryphia, Rag.

HYPOGRYPHIA RUFIFASCIELLA.

Hypogryphia rufifasciella, Hmps.

In coloration this species is suggestive of the *Anerastianae*, but the tongue is well developed.

N.Q., Townsville. Q., Peak Downs, Gayndah, Brisbane.

BB. Hindwings with vein 5 present.
C. Palpi ascending.
D. Hindwings with 4 and 5 stalked.
E. Hindwings with 2 from well before angle.
F. Forewings with 4 and 5 stalked.
G. Forewings with 2 and 3 stalked ... 27. *Symphonistis*.
GG. Forewings with 2 and 3 separate... 28. *Hypargyria*.
FF. Forewings with 4 and 5 closely approximated towards base.
G. Hindwings with cell extending to about $\frac{1}{2}$ ... ... 29. *Odontarthria*.
GG. Hindwings with cell not exceeding $\frac{1}{3}$.
H. Palpi with 2nd joint very large in both sexes ... ... 30. *Sthenobela*.
HH. Palpi with 2nd joint moderate ... 31. *Phycita*.
FFF. Forewings with 4 and 5 not approximated ... ... 34. *Epicrocis*.
EE. Forewings with vein 2 from close to angle
F. Palpi with terminal joint bent forwards at an angle with second... 32. *Tephris*.
FF. Palpi with terminal joint not bent forwards ... ... 33. *Nephopteryx*.
DD. Hindwings with 4 and 5 separate.
E. Hindwings with cell not exceeding $\frac{1}{5}$ 35. *Spatulipalpia*
EE. Hindwings with cell about $\frac{1}{3}$.
F. Forewings smooth ... ... 36. *Cryptoblabes*.
FF. Forewings with strong antemedian ridge of raised scales ... ... 37. *Ceroprepes*.
CC. Palpi porrect.
D. Hindwings with 3 stalked or closely approximated to $4+5$ for half its length ... ... 38. *Sclerobia*.
DD. Hindwings with 3 not approximated to $4+5$ ... ... 39. *Etiella*.

In addition to these there are eight genera whose characters are unknown to me.

Gen. 27. SYMPHONISTIS, *nov.*

συμφωνος, harmonious.

Face flat. Tongue well developed. Palpi recurved, ascending, barely reaching vertex. Antennae of ♂ thickened, simple, minutely ciliated ($\frac{1}{6}$), not distorted towards base. Forewings in ♂ with a glandular thickening on lower surface at end of cell; veins 2 and 3 on a long stalk from angle, 4 and 5 stalked, 8 and 9 stalked. Hindwings with veins 3, 4, 5 stalked, 7 anastomosing strongly with 8.

Type *Nephopteryx monospila*, Low.

SYMPHONISTIS MONOSPILA.

Nephopteryx monospila, Low., P.L.S.N.S.W. 1901, p. 662.

N.Q., Townsville, in July, January, and February; three specimens received from Mr. F. P. Dodd, who has found the larvae on *Loranthus*. I consider Mr. Lower's locality very dubious.

Gen. 28. HYPARGYRIA.

Hypargyria, Rag., Nouv. Gen., p. 9 (1888); Hmps., Moths Ind. iv., p. 87.

HYPARGYRIA METALLIFERELLA.

Hypargyria metalliferella, Rag., Nouv. Gen. p. 9; Mon. Phyc., p. 123, Pl. iv., f. 22; Hmps. Moths Ind. iv., p. 88.

N.Q., Townsville, in November; Q., Brisbane and Southport, January to April.

Gen. 29. ODONTARTHRIA.

Odontarthria, Rag.

ODONTARTHRIA ALMELLA.

Ceroprepes almella, Meyr., P.L.S.N.S.W., 1878, p. 210.

N.S.W., Sydney; V., Melbourne.

ODONTARTHRIA SUBFUSCELLA.

Odontarthria subfuscella, Hmps.

N.Q., Townsville; Q., Toowoomba.

†† ODONTARTHRIA SEBASMIA.

Ceroprepes sebasmia, Meyr., Tr. E.S., 1887, p. 253.

S.A., Quorn.

Gen. 30. STHENOBELA, *nov.*

σθενοβελος, with strong weapons; in allusion to the palpi.

Tongue well developed. Labial palpi of both sexes very large; in ♂ with second joint very greatly dilated and bent outwards, exposing the maxillary palpi which end in a brush-like tuft, terminal joint very small; in ♀ very long (6), second and terminal joints obliquely ascending, not recurved, much dilated with long scales which conceal the apex. Antennae in ♂ with basal joint enlarged, somewhat thickened beyond, simple, very minutely ciliated ($\frac{1}{8}$). Forewings with veins 4 and 5 closely approximated for a short distance near base, 8 and 9 stalked. Hindwings with vein 3 diverging from angle, 4 and 5 long-stalked, 7 anastomosing strongly from 8.

Distinguished from *Phycita* by the peculiar palpi of both sexes. Sir Geo. Hampson, who however has only seen the ♂, regards it as a new section of that genus.

STHENOBELA NIPHOSTIBES, *n. sp.*

νιφοστιβης, snow-beaten; in allusion to the forewings.

♂ ♀ 22-24 mm. Head and palpi whitish-grey. Antennae grey. Thorax whitish-grey. Abdomen whitish-grey, apices of segments whitish-ochreous; terminal segments pale ochreous. Legs white irrorated with fuscous; tarsi dark-fuscous. Forewings elongate, posteriorly slightly dilated, costa gently arched near base thence straight, apex rounded, termen slightly rounded, slightly oblique; pale fuscous irrorated with darker fuscous; costal half of disc from near base to apex white with a few scattered fuscous scales; costal edge fuscous at base and again from $\frac{1}{2}$ to $\frac{3}{4}$; a small dark-fuscous discal dot at $\frac{1}{3}$, and a larger dot at $\frac{2}{3}$; a fine slightly dentate fuscous line from apex to $\frac{4}{5}$ dorsum; a fuscous terminal line; cilia pale-fuscous at apex mixed with white. Hindwings with termen rounded; fuscous whitish, darker towards termen; cilia whitish with a fuscous line near base.

Type in Coll. Turner.

Q., Brisbane; two specimens received from Mr. F. P. Dodd.

Gen. 31. PHYCITA.

Phycita, Curt., Brit. Ent. vi, p. 233. Hmps., Moths Ind. iv, p. 90.

I have had considerable difficulty in separating this genus from *Nephopteryx* by the neuration. The character given by Hampson—the approximation of vein 3 of hindwings to base of 4 and 5—is liable to insensible gradation, and I have not found it possible by its means to draw a satisfactory line. Meyrick relies on the length of cell of hindwings being less than $\frac{1}{3}$ and nearly $\frac{1}{2}$ respectively. If this were adopted nearly all the species here ascribed to both genera would fall in the former category. The character I have used—the origin of vein 2 from the angle of cell in *Nephopteryx*—seems to me to give a better criterion than either of these.

The genus as here defined may ultimately be broken up by using characters derived from the ♂, but at present the Australian species are too imperfectly known to permit this.

PHYCITA IMPARELLA.

Magiria imparella, Zel., Stett. Ent. Zeit, 1867. p. 393, Pl. ii, f. 2. Hmps., Moths. Ind. iv., p. 96.

Hindwings with vein 3 diverging from angle.

Q., Brisbane, in November and April, two ♀ specimens. I sent an example to Sir Geo. Hampson, who informs me that it exactly resembles Indian specimens.

PHYCITA EULEPIDELLA.

Phycita eulepidella, Hmps., Moths Ind. iv, p. 94.

Hindwings with vein 3 approximated to 4 + 5 for a short distance near base.

N.Q., Townsville, in January ; one ♀ specimen from Mr. F. P. Dodd

PHYCITA CEROPREPIELLA.

ceroprepiella, Hmps.

Hindwing with vein 3 very shortly approximated to 4 + 5 near base.

N.Q., Cooktown (British Museum), Townsville, in November and March. Three ♀ specimens received from Mr. F. P. Dodd.

†† PHYCITA PIRATIS.

Tetealopha piratis, Meyr., Tr. E.S. 1887, p. 257.

Q.

PHYCITA ACTIOSELLA.

Aurana actiosella, Wlk., Brit. Mus. Cat. xxvii., p. 122.

Myelois actiosella, Meyr., Tr. E.S., 1887, p. 255.

Rhodophaea actiosella, Hmps., Moths Ind. iv., p. 100.

Hindwings with vein 3 diverging from angle.

Q., Brisbane, in November and February ; also from Ceylon, India and Africa.

PHYCITA LEUCOMILTA.

Phycita leucomilta, Low., Tr. R.S.S.A., 1903, p. 53.

N.Q., Townsville, Mackay ; Q., Brisbane. I have found the larvae feeding in the young shoots of the creeping fig, spinning the leaves together.

PHYCITA FLAVITINCTELLA.

Phycita flavitinctella, Rag., Mon. Phyc., p. 418, Pl. xvii., f. 9 ; Hmps., Moths Ind. iv., p. 97.

Hindwings with vein 3 closely appressed to 4 and 5 for some distance.

N.Q., Townsville, in September. One ♀ received from Mr. F. P. Dodd. Also from Ceylon and India.

PHYCITA CHRYSERYTHRA.

Nephopteryx chryserythra, Low., P.L.S.N.S.W., 1902, p. 662.

N.Q., Townsville (Dodd).

†† PHYCITA PYRRHOPTERA.

Euzophera (?) *pyrrhoptera*, Low., Tr. R.S.S.A., 1896, p. 159.

This, which appears from the description to be a very distinct species, is unknown to me. I refer it here conjecturally.

Q., Brisbane (?) (Lower).

PHYCITA CORETHROPUS, *n. sp.*

κορηθροπους, brush-footed.

♂ 16-18 mm. Head, thorax and palpi dark purple-fuscous. Antennae whitish, barred above with blackish, basal joint purple-fuscous; in ♂ with a strong backward-projecting tooth on basal joint, thence simple, laterally compressed, and very minutely ciliated. Abdomen pale-grey, apices of segment and tuft whitish-ochreous. Legs fuscous irrorated and annulated with whitish; posterior femora and base of tibiae whitish; posterior tibiae in ♂ with a pencil-like tuft of whitish hairs from upper surface near base, and a tuft of hairs on upper surface near apex. Forewings elongate-triangular, costa nearly straight, apex round-pointed, termen somewhat oblique, scarcely rounded; fuscous somewhat purplish-tinged, and irrorated with whitish; a transverse whitish suffusion near base; a triangular whitish suffusion on costa beyond middle; a transverse ridge of raised scales at $\frac{1}{3}$, dark with brassy lustre; a finely dentate dark fuscous subterminal line; a dark-fuscous oblique mark at apex; a series of dark-fuscous terminal dots; cilia grey with whitish irroration. Hindwings with termen rounded; vein 3 approximated to 4 + 5 at base for a short distance; translucent and thinly scaled; grey-whitish; cilia whitish.

Type in Coll. Turner.

N.Q., Townsville, in June and July; two specimens received from Mr. F. P. Dodd, bred from *Acacia aulacocarpa*.

PHYCITA HEMICALLISTA.

Phycita hemicallista, Low., P.L.S.N.S.W. 1901, p. 663.

♀. 20-22 mm. Head and thorax whitish-ochreous. Palpi fuscous, outer surface of second joint suffused with whitish towards base. Maxillary palpi white. Antennae ochreous-fuscous. Abdomen leaden-fuscous, apices of segments and lower surface pale ochreous. Legs fuscous mixed with whitish. Forewings elongate, posteriorly dilated, costa nearly straight, apex rounded, termen scarcely oblique, scarcely rounded; an outwardly curved fuscous or reddish fuscous line from mid-costa to beyond mid-dorsum, prolonged along dorsum towards base; beyond this the whole of disc is suffused with leaden fuscous except a whitish spot resting on median line above middle, and a pale-ochreous blotch opposite mid-termen; termen narrowly leaden-fuscous; cilia ochreous-whitish, at apex and tornus fuscous-tinged. Hindwings with termen rounded; grey; cilia ochreous-whitish with a grey basal line.

A very distinct and unmistakable species.

N.Q., Geraldton, in May. Q., Brisbane, in January.

PHYCITA DELTOPHORA.

Phycita deltophora, Low., Tr. R.S.S.A. 1903, p. 53.

♂ ♀ 27-28 mm. Head and palpi whitish mixed with grey; palpi in ♂ with second joint strongly dilated, barely reaching vertex, terminal joint very short; in ♀ second joint exceeding vertex, terminal joint moderate. Antennae whitish mixed with grey; in ♂ with basal joint enlarged and bent, strongly ciliated in tufts ($1\frac{1}{2}$). Thorax grey. Abdomen whitish-grey. Legs whitish mixed with fuscous. Forewings elongate, strongly dilated posteriorly, apex rounded, termen moderately oblique, slightly rounded; grey mixed with whitish except in basal third, which is darker and contains some brownish scales; a blackish slightly dentate line of raised scales from $\frac{1}{4}$ costa to $\frac{1}{4}$ dorsum; a narrow whitish fascia limiting basal area from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum, posteriorly ill-defined towards costa, but limited by a fine grey line towards dorsum; a very faint grey linear discal mark; a fine whitish postmedian line from costa at $\frac{5}{6}$, acutely angled inwards, thence finely dentate to $\frac{5}{6}$ dorsum, preceded by minute grey dots on veins; an interrupted blackish terminal line; cilia grey mixed with whitish, apices whitish, sometimes with a subapical pinkish line. Hindwings with termen rounded; vein 3 diverging from angle of cell; translucent, fuscous-whitish, darker towards termen; cilia fuscous-whitish with a fuscous line at $\frac{1}{3}$.

N.Q., Townsville, one ♂ in October (Dodd); Q., Brisbane, one ♀ in May.

PHYCITA THERMOLOPHA.

Nephopteryx thermalopha (misprint), Low., Tr. R.S.S.A. 1903, p. 55.

♂ ♀. 20-21 mm. Head fuscous mixed with reddish; in ♀ whitish. Palpi fuscous mixed with whitish; in ♂ with second joint greatly dilated, terminal joint short, naked, with two minute terminal bristles. Antennae grey; in ♂ much swollen beyond basal joint, thence slightly serrate, moderately ciliated ($\frac{2}{3}$). Thorax grey mixed with whitish. Abdomen grey mixed with whitish, apices of segments whitish; in ♂ first three segments except a median strip reddish above. Legs whitish mixed with fuscous; middle tibiae in ♂ with a large tuft of reddish hairs on internal surface. Forewing elongate, posteriorly dilated, costa moderately arched, apex rounded, termen slightly oblique, slightly rounded; whitish mixed with grey and fuscous; a transverse ridge of raised blackish scales in disc at $\frac{1}{3}$ not reaching either margin; an obscure fuscous dentate line from $\frac{1}{3}$ costa to mid-dorsum; a fuscous dot beneath costa at $\frac{2}{3}$, and a second in disc obliquely below and beyond first; a whitish line preceded by a broken fuscous line from $\frac{5}{6}$ costa, angulated first inwards, then outwards, to before tornus; a blackish terminal line interrupted by whitish on veins; cilia grey, two fine lines and apices whitish, sometimes with a subapical pinkish line. Hindwings with termen slightly rounded; vein 3 diverging from angle; fuscous-whitish, thinly scaled; cilia whitish with a fuscous line near base. Under side of wings in ♂ streaked with reddish towards base.

Allied to *P. ceroprepiella*, Hmps., from which the ♀ may be distinguished by the discal dots, and by the ridge of raised scales not reaching dorsum. The sexual differences in the abdominal colouring are curious.

N.Q., Townsville, in February; two specimens received from Mr. F. P. Dodd.

PHYCITA ADIACRITIS, *n. sp.*

ἀδιακριτος, of ordinary or undistinguished appearance.

♂ ♀ 21-22 mm. Head whitish-grey. Palpi whitish irrorated with fuscous; in ♂ with second joint much dilated, terminal joint minute. Antennae grey; in ♂ much swollen beyond basal joint, thence simple, very minutely ciliated ($\frac{1}{8}$). Thorax grey. Abdomen whitish-ochreous, bases of segments grey. Legs whitish mixed with fuscous. Forewings elongate, posteriorly dilated, costa moderately arched, apex rounded, termen slightly oblique, slightly rounded; whitish mixed with grey and fuscous; a whitish median line edged on both sides with dark fuscous, sometimes obsolete; a dark fuscous dot beneath costa at $\frac{2}{3}$, with a second longitudinally elongate dot beneath it in disc; an outwardly curved obscure whitish line more or less edged with fuscous on both sides from $\frac{3}{4}$ costa to before tornus; an interrupted blackish terminal line; cilia grey, apices and a fine median line whitish, sometimes pinkish before apices. Hindwings with termen slightly rounded; veins 3 shortly approximated to 4 + 5 near base; whitish and thinly scaled; veins and termen fuscous; cilia whitish with a fuscous line near base.

Type in Coll. Turner.

N.Q., Townsville, in October; four specimens received from Mr. F. P. Dodd. Q., Brisbane, in December; one specimen.

PHYCITA HADES.

*Nephopteryx hades**, Low., Tr. R.S.S.A., 1903, p. 54.

♀ 20 mm. Head, thorax, palpi and antennae fuscous. Abdomen fuscous, apices of segments whitish. Legs fuscous wlth some whitish scales. Forewings elongate, posteriorly dilated, costa rather strongly arched, apex rounded, termen rounded, slightly oblique; fuscous; markings dark-fuscous; a transverse line in disc at $\frac{2}{5}$, not reaching margins; an irregular suffused blotch at mid-disc; a line from $\frac{3}{4}$ costa, first inwardly, then outwardly, and again inwardly waved to $\frac{5}{6}$ dorsum; this is closely followed by a parallel slightly brownish line from apex to tornus; a series of terminal dots; cilia fuscous, apices and two fine lines whitish. Hindwings with termen rounded, slightly sinuate beneath apex; vein 3 closely applied to 4 + 5 for some distance from origin; whitish, thinly scaled; a suffused fuscous terminal line; cilia whitish, with a fuscous line near base.

The type, though in perfect condition, is more obscurely marked than my specimen. After careful comparison I think they are the same species.

N.Q., Townsville, in January. One specimen received from Mr. F. P. Dodd.

PHYCITA EREBOSCOPA.

Nephopteryx ereboscopa, Low., Tr. R.S.S.A. 1903, p. 54.

♀ 26 mm. Head pale-fuscous. Palpi pale-fuscous, internal surface whitish. Thorax fuscous irrorated with darker fuscous, slightly purplish-tinged. Abdomen fuscous mixed with

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*A singularly unfortunate name even in entomology, where silly, ugly, and inappropriate names are so common.

whitish-ochreous. Legs ochreous-whitish mixed with fuscous. Forewings strongly dilated posteriorly, costa moderately arched, apex round-pointed, termen rounded, slightly oblique; ochreous-whitish densely suffused with dull purple-fuscous, towards base and margins irrorated with dark-fuscous; a transverse ridge of elongate raised scales across disc from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum; cilia whitish mixed with fuscous. Hindwings with termen rounded; pale-grey, thinly scaled; vein 3 only approximated to 4 + 5 close to origin; a narrow suffused fuscous terminal line; cilia pale-grey.

Q., Brisbane, in April; one specimen.

PHYCITA TRACHYSTOLA, *n. sp.*

τραχυστολος, rough-cloaked.

♀ 20 mm. Head ochreous-whitish. Palpi fuscous (partly broken). Antennae fuscous. Thorax pale fuscous. Abdomen pale fuscous; apices of segments pale-ochreous. Legs whitish mixed with dark fuscous. Forewings elongate-triangular, costa nearly straight, apex rounded, termen nearly straight, slightly oblique; pale-fuscous irrorated with white; a rounded tuft of raised scales in mid-disc near base; a transverse ridge of raised scales from dorsum at $\frac{1}{3}$ to fold; a series of dark fuscous terminal dots; cilia pale fuscous with a fine whitish line at $\frac{1}{3}$. Hindwings with termen rounded; vein 3 only approximated to 4 + 5 close to base; pale grey, veins and termen darker; cilia pale-grey with a darker line near base.

Allied to the preceding, but the transverse ridge of raised scales is less developed, and there is an additional raised tuft near base.

Type in Coll. Turner.

Q., Brisbane, in January; one specimen.

PHYCITA MIXOLEUCA, *n. sp.*

μιξολευκος, partly white.

♀ 22 mm. Head white with a few grey scales. Palpi white; external surface of apical part of second joint, and terminal joint exeept base, dark-fuscous. Antennae ochreous-whitish. Thorax white with fuscous irroration and a central dark-fuscous spot. Abdomen pale-ochreous, bases of segments irrorated with dark-fuscous. Legs white banded with dark-fuscous, tarsi dark-fuscous; anterior pair dark-fuscous anteriorly except base of coxae. Forewings elongate, posteriorly dilated, costa nearly straight, apex rounded, termen rounded, slightly oblique; clear-white, towards dorsum suffused with pale-fuscous;

markings dark-fuscous ; a dot on base of costa, another on mid-base, and a third in disc near second ; a small triangular blotch on dorsum at $\frac{1}{3}$, its apical portion composed by a strong tuft of raised scales ; an oblique fascia from $\frac{1}{3}$ costa to mid-dorsum, attenuated towards dorsum ; a few dark fuscous scales on mid-costa ; a discal dot beneath costa beyond middle, and another in mid-disc rather posterior to first ; a broad inwardly oblique wedge-shaped streak from apex, continued as a fine dentate line to before tornus ; a series of terminal dots ; cilia white partly suffused with pale-fuscous. Hindwings with termen rounded ; vein 3 approximated to 4 + 5 near base ; grey ; cilia pale-grey with a darker line near base.

Type in Coll. Turner.

Q., Brisbane, in November ; one specimen.

PHYCITA RECONDITA, *n. sp.*

Reconditus, concealed, inconspicuous.

♂ ♀ 16 mm. Head grey. Palpi ascending, recurved, exceeding vertex, second joint not dilated in ♂, terminal joint moderate, acute ; fuscous mixed with whitish. Antennae grey ; in ♂ with a wide sinus containing a large tuft of scales immediately succeeding basal joint, thence thickened, simple, minutely ciliated ($\frac{1}{6}$). Thorax grey, with a double posterior reddish-purple spot. Abdomen pale-grey with a small reddish-purple spot on base of dorsum. Legs fuscous mixed with whitish. Forewings moderate, posteriorly somewhat dilated, costa and veins on posterior part of disc irrorated with reddish-purple ; an obscure whitish grey-margined fascia from $\frac{1}{4}$ costa to $\frac{2}{5}$ dorsum ; a dark-grey longitudinally elongate discal dot at $\frac{2}{3}$; an obscure whitish subterminal line ; a series of dark-grey terminal dots ; cilia grey finely irrorated with whitish, and with a subapical purplish tinge. Hindwing with termen rounded ; vein 3 closely applied to 4 + 5 for a short distance ; grey, towards base whitish ; cilia whitish-grey with a rather darker line near base.

Type in Coll. Turner.

N.Q., Townsville, in January ; two specimens received from Mr. F. P. Dodd.

PHYCITA ATIMETA *n. sp.*

ἀτιμητος, unesteemed.

♀ 18 mm. Head whitish-grey. Palpi and antennae fuscous. Thorax whitish-grey irrorated with fuscous. Abdomen ochreous-whitish, mid-dorsum near base grey. Legs whitish-grey irrorated with dark-fuscous. Forewings narrow-elongate, slightly dilated posteriorly, costa slightly arched, apex rounded, termen rounded, slightly oblique; whitish-grey mixed with fuscous; a dark basal area, followed by a pale area, which extends to mid-disc; a series of dark-fuscous terminal dots; cilia grey with fine whitish irroration. Hindwings with termen rounded; cell very short, vein 3 diverging from angle; fuscous-whitish, thinly scaled, darker towards termen; cilia whitish with a darker basal line.

Type in Coll. Turner.

Q., Brisbane, in January; one specimen.

Gen. 32. Tephris.

Tephris, Rag., Mon. Phyc., p. 446. Hmps. Moths Ind., iv. p. 106.

Allied to *Nephopteryx*, from which it differs in the peculiar palpi.

TEPHRIS GLAUCOBASIS.

Tephris glaucobasis, Low., Tr. R.S.S.A., 1903, p. 56.

Slightly variable in its markings.

N.Q., Geraldton, in May; one ♂ received from Mr. Harold Brown. Townsville, in February; one very perfect ♀ received from Mr. F. P. Dodd, agreeing closely with type.

Gen. 33. Nephopteryx.

Nephopteryx, Hb., Verz., p. 370. Hmps. Moths Ind. IV., p. 76.

I distinguish this genus from *Phycita* by the origin of vein 2 of hindwings, which arises from angle, or from close before angle of cell.

Whether the first six species come under this definition I cannot of course decide.

† NEPHOPTERYX ATRISQUAMELLA.

Nephopteryx atrisquamella, Hmps.

N.Q., Cooktown.

† NEPHOPTERYX FLAVEOTINCTA.

Myelois flaveotincta, Luc., P.L S.N.S.W. 1892, p. 265.

Q., Duaringa, Brisbane.

†† NEPHOPTERYX INFUSELLA.

Nephopteryx infusella, Meyr., P.L.S.N.S.W., 1880, p. 218.

Q., Duaringa.

†† NEPHOPTERYX EURAPHELLA.

Nephopteryx euraphella, Meyr., P.L.S.N.S.W., 1880, p. 217.

N.S.W., Wollongong.

†† NEPHOPTERYX MELANOSTYLA.

Nephopteryx melanostyla, Meyr., P.L.S.N.S.W., 1880, p. 220.

N.S.W., Sydney.

†† NEPHOPTERYX PETALOCOSMA.

Nephopteryx petalocosma, Meyr., P.L.S.N.S.W., 1882, p. 169.

N.S.W., Sydney.

NEPHOPTERYX PAUROSEMA.

Thylacoptila paurosema, Meyr., Ent. Mo. Mag. 1885, p. 106. Hmps., Moths Ind. iv, p. 81.

N.Q., Townsville, in October; one ♂ received from Mr. F. P. Dodd. Also from Ceylon, India, and Africa.

NEPHOPTERYX LEUCOPHAEELLA.

Nephopteryx leucophaeella, Zel., Stett. Ent. Zeit., 1867, p. 390. Hmps., Moths Ind., iv, p. 83.

N.Q., Cairns, in August; one ♀. Also from India.

NEPHOPTERYX DASPYTERA.

Nephopteryx daspytera, Low., Tr. R.S.S.A. 1903, p. 55.

I have examined the type and compared it with a small series in my own collection.

Q., Brisbane, in March, April and May.

†† NEPHOPTERYX PLACOXANTHA.

Salebria placoxantha, Low., P.L.S.N.S.W. 1898, p. 45.

N.S.W., Broken Hill.

NEPHOPTERYX MINUTELLA.

Nephopteryx minutella, Rag., Bull. Soc. Ent. Fr. 1885, p. 150.

Mon. Phyc. p. 326, Pl. xiv. f. 16. Hmps., Moths Ind. iv. p. 81.

N.Q., Townsville. one ♀ in August. Q., Brisbane; Southport; three ♀ in February and March.

NEPHOPTERYX SYNTARACTIS.

(συνταρακτος, confused.)

♂ ♀ 22-24 mm. Head ochreous-whitish. Palpi slightly exceeding vertex, terminal joint short, acute; grey, posteriorly ochreous-whitish. Antennae grey; in ♂ with basal joint enlarged and succeeded by a groove containing a large tuft of scales, thence thickened, simple, and minutely ciliated ($\frac{1}{10}$). Thorax grey. Abdomen ochreous-whitish; three basal segments in ♂ dark-fuscous, in ♀ only with median basal fuscous dots. Legs grey mixed with whitish; middle pair in ♂ suffused with dark-fuscous; middle and posterior femora and tibae in ♀ with an oblique median fuscous band. Forewings elongate, strongly dilated posteriorly, costa moderately arched, more strongly towards apex, apex rounded, termen obliquely rounded; grey mixed with whitish; base of dorsum and mid-disc more or less suffused with brownish; in ♂ a blackish suffusion on base of dorsum; a whitish line from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum, edged posteriorly by a variably developed fuscous line; a discal dot beneath $\frac{2}{3}$ costa, and a second in mid-disc posterior to first, the two sometimes connected; a whitish line from $\frac{5}{6}$ costa angled acutely inwards, then outwards, and slightly dentate to before tornus, this line is more or less distinctly edged with grey or fuscous on both sides; a series of dark-fuscous terminal dots; cilia whitish. Hindwings with termen rounded, slightly wavy; whitish towards termen suffused with pale grey; cilia whitish.

Type in Coll. Turner.

Q., Bundaberg; Brisbane, in November, December, March, and April. N.S.W., Sydney. Seven specimens, of which six are females.

NEPHOPTERYX METASARCA.

Nephopteryx metasarca, Low., Tr. R.S.S.A. 1903, p. 56.

♂ 15-20 mm. Head whitish. Palpi grey; in ♂ with second joint dilated and upper half of inner surface excavated, leaving a wide cup-like space between the palpi, terminal joint moderate. Antennae ochreous-whitish; in ♂ with basal joint enlarged, and succeeded by a groove containing a large tuft of scales, thence thickened, simple, minutely ciliated ($\frac{1}{3}$). Thorax grey. Abdomen ochreous-whitish, somewhat pinkish-tinged. Legs whitish, irrorated and annulated with dark-fuscous. Forewings elongate, posteriorly dilated, costa strongly arched before apex, apex rounded, termen obliquely rounded; grey finely irrorated with whitish; a small patch of blackish scales on base of dorsum; a suffused line more or less blackish from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum; a blackish dot beneath costa beyond middle, connected with a second dot below and posterior; a short whitish erect streak from dorsum at $\frac{2}{3}$, sometimes preceded by a quadrate whitish blotch on mid-dorsum; a fine dentate whitish line from $\frac{5}{6}$ costa bent first inwardly, then outwardly, not reaching dorsum; a series of dark-fuscous terminal dots; cilia grey, apices and a fine median line whitish. Hindwings with termen somewhat sigmoid; ochreous-whitish, pinkish-tinged; towards termen irrorated with dark-fuscous; cilia pinkish-whitish.

Var. The two Townsville specimens are smaller, lack the blackish suffusion, but have a well-marked whitish blotch on mid-dorsum.

This species is referable to *Palibothra*, Rag., which may be tenable as a distinct genus.

N.Q., Townsville, in December; two specimens received from Mr. F. P. Dodd. Q., Sandgate, near Brisbane, in December; one specimen.

NEPHOPTERYX EPICRYPHA *n. sp.*

ἐπικρυφος, hidden, inconspicuous.

♀. 25 mm. Head, thorax, and palpi pale-brown, mixed with fuscous. Antennae grey. Abdomen ochreous-whitish, irrorated with pale-grey. Legs whitish, finely irrorated with grey. Forewings elongate, gradually dilated, costa nearly straight, arched before apex, apex round-pointed, termen obliquely rounded; pale-brownish irrorated with whitish and fuscous; an indistinct dentate whitish partly fuscous-edged line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum; an obscure fuscous discal dot beyond middle; an inwardly oblique dentate fuscous line from $\frac{5}{6}$ costa to tornus, edged posteriorly by a whitish line; a series of blackish terminal dots; cilia pale-brownish with fine whitish irroration. Hindwings with termen rounded; whitish; a fine fuscous line along termen; cilia whitish wlth a fuscous line near base.

Type in Coll. Turner.

N.Q., Townsville, in April; one specimen received from Mr. F. P. Dodd.

Gen. 34. EPICROCIS.

Epicrocis, Zel., Isis. 1848, p. 878. Hmps., Moths Ind. iv., p. 85.

†† EPICROCIS OPPOSITALIS.

Trachonitis oppositalis, Wlk., Brit. Mus. Cat. xxvii., p. 41.

N.S.W., Sydney.

EPICROCIS SUBLIGNALIS.

Trachonitis sublignalis, Wlk., Brit. Mus. Cat. xxvii., p. 41.
Nephopteryx patulalis, Wlk., Brit. Mus. Cat. xxvii., p. 70.
Pempelia strigiferella, Meyr., P.L.S.N.S.W. 1878, p. 202.
Pempelia rufitinctella, Meyr., P.L.S.N.S.W. 1878, p. 203.
Pempelia caliginosella, Meyr., P.L.S.N.S.W. 1880, p. 221.
Pempelia oculiferella, Meyr., P.L.S.N.S.W. 1880, p. 222.

I may be wrong in putting all these names together, but they appear to me to represent one very variable species.

N.Q., Kuranda, Townsville, Mackay; Q., Bundaberg, Brisbane, Stradbroke I., Southport, Stanthorpe; N.S.W., Newcastle, Sydney, Kiama, Moruya.

†† EPICROCIS AMAURA.

Oligochroa amaura, Low., P.L.S.N.S.W. 1901, p. 662.

Q., Brisbane.

† EPICROCIS DIGRAMMELLA.

Pempelia digrammella, Meyr, P.L.S.N.S.W. 1880, p. 223.

N.S.W., Sydney.

†† EPICROCIS MESEMBRINA.

Epicrocis mesembrina, Meyr, Tr. E.S., 1887, p. 259.

W.A., Albany.

EPICROCIS FESTIVELLA.

Epicrocis festivella, Zel. Isis., 1848, p. 878. Hmps. Moths Ind. iv., p. 87.

N.Q., Townsville. Q., Nambour, Brisbane. Also from Java, Ceylon, India and Africa.

EPICROCIS SATURATELLA.

saturatella, Mab.

N.Q., Thursday Island, Townsville.

†† EPICROCIS AEGNALIS.

Pyralis ? aegnusalis, Wlk., Brit. Mus. Cat., xix., p. 905.

Canthelea aegnalis, Meyr, Tr., E.S., 1887, p. 254.

N.Q. . Also from Sumatra, Ceylon, India, China and Madagascar.

EPICROCIS ORTHOZONA.

Nephopteryx orthozona, Low., Tr. R.S.S.A., 1903, p. 53.

♂ ♀ 19-20 mm. Head and thorax pale-grey. Labial palpi pale-grey; second joint irrorated with dark fuscous anteriorly; slender, recurved, not reaching vertex, alike in both sexes. Antennae grey; in ♂ with a small notch on upper surface some distance beyond basal joint, no tuft of scales, serrate, with short ciliations ($\frac{1}{4}$). Abdomen pale grey. Legs whitish; anterior pair, tarsi, and an oblique subterminal band on mid-tibiae dark fuscous. Forewings elongate-triangular, costa gently arched, apex round pointed, termen rounded, oblique; grey mixed with whitish with a very few scattered blackish scales; a fine outwardly curved blackish line from $\frac{2}{3}$ costa to mid-dorsum; a similar slightly sigmoid line from $\frac{4}{5}$ costa to tornus; midway between these lines towards costa is an oblique oval grey spot; a series of blackish terminal dots; cilia pale-grey with fine whitish irroration. Hindwings with termen rounded; whitish; termen greyish tinged; cilia whitish.

This species will probably be ultimately separated from the genus.

N.Q., Townsville, in December; two specimens received from Mr. F. P. Dodd. Q. Goodna near Brisbane, in March; one specimen.

Gen. 35. SPATULIPALPIA.

Spatulipalpia, Rag., Mon. Phyc. p. 19. Hmps., Moths Ind. iv., p. 101.

SPATULIPALPIA FLABELLIFERA.

Spatulipalpia flabellifera, Hmps., Moths Ind. iv., p. 102.

N.Q., Townsville, in February and March; three specimens received from Mr. F. P. Dodd. Also from Ceylon.

SPATULIPALPIA PALLIDICOSTALIS.

Nephopteryx pallicostalis, Wlk., Brit. Mus. Cat. xxvii., p. 63. Hmps., Moths Ind. iv. p. 103.

Q., Brisbane; two specimens. Also from Ceylon and India.

SPATULIPALPIA SOPHRONICA, *n. sp.*

σωφρονικος, sober, moderate.

♂ 20 mm. Head, thorax, and palpi pale grey irrorated with fuscous. Antennae dark fuscous; basal joint and shaft just beyond basal joint enlarged, but constricted at junction; remainder of shaft simple, minutely ciliated. Abdomen whitish-grey, apices of segments whitish-ochreous. Legs pale grey irrorated with dark fuscous. Forewings elongate, costa slightly arched, apex rounded, termen obliquely rounded; pale grey with a few dark fuscous scales; a dark fuscous basal suffusion; a few dark scales representing antemedian line; an indistinct subterminal line at $\frac{5}{6}$; a series of dark fuscous terminal dots; cilia pale grey. Hindwings with termen rounded; thinly scaled and translucent; whitish; slightly suffused with grey along veins and termen; cilia whitish with a grey basal line.

♀ 18 mm. Forewings with costa more arched, basal suffusion absent, antemedian and subterminal lines much better marked.

Type in Coll. Turner.

N.Q., Townsville; two specimens apparently bred received from Mr. F. P. Dodd.

Gen. 36. CRYPTOBLABES.

Cryptoblabes, Zel., Isis., 1848, p. 644. Hmps. Moths. Ind. iv., p. 101.

CRYPTOBLABES OENOBARELLA.

Myelois oenobarella, Meyr, P.L.S.N.S.W. 1880, p. 228.

N.Q., Townsville. Q., Brisbane. N.S.W., Sydney.

†† CRYTOBLABES FERREALIS.

Cryptoblabes ferrealis, Low., P.L.S.N.S.W. 1901, p. 663.
Q., Brisbane (Lower). N.W.A., Derby (Lower).

CRYPTOBLABES PLAGIOLEUCA, *n. sp.*

πλαγιολευκος, obliquely white.

♀ 14 ɱɱ. Head and thorax reddish purple ; face and palpi fuscous. Antennae ochreous whitish, annulated with dark fuscous. Abdomen, fuscous. Legs, fuscous, irrorated with whitish and reddish purple. Forewings elongate, slightly dilated, costa moderately arched, apex rounded, termen obliquely rounded, reddish purple mixed with fuscous, the purple being best marked on veins and towards base of dorsum ; a conspicuous straight white fascia from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum ; a whitish discal dot beneath $\frac{2}{3}$ costa, with a few whitish scales between it and costa ; a whitish line from $\frac{5}{6}$ costa obliquely inwards forming a short angle inwards and again outwards before mid-disc, angled again inwards near dorsum, ending at $\frac{4}{5}$ dorsum ; a series of fuscous terminal dots preceded by some whitish irroration : cilia pale purple, at apex and tornus grey. Hindwings with termen rounded, whitish grey, darker on apex and termen ; cilia pale grey.

Type in Coll. Turner.

N.Q., Townsville, in October ; one specimen received from Mr. F. P. Dodd.

CRYPTOBLABES ADOCETA *n. sp.*

ἀδοκητος, plain, inglorious.

♂ ♀ 14-16 ɱɱ. Head, thorax, and palpi fuscous. Antennae fuscous ; in ♂ thickened, simple but slightly serrate towards apex, very minutely ciliated. Abdomen pale grey. Legs fuscous irrorated with whitish. Forewings moderately elongate, costa at first straight, rather strongly arched beyond middle, apex rounded, termen obliquely rounded ; fuscous with whitish irroration, towards termen obscurely reddish-fuscous ; a pale oblique fascia from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum ; a dark discal dot at $\frac{2}{3}$, sometimes a second dot between this and costa ; a narrow dark angulated fascia from $\frac{5}{6}$ costa to $\frac{4}{5}$ dorsum ; a subterminal dark blotch ; a series of dark fuscous terminal dots ; cilia grey irrorated with whitish. Hindwings with termen rounded ; whitish, slightly suffused with grey at apex and along termen ; cilia whitish.

Type in Coll. Turner.

N.Q., Townsville, in May; one ♂ (type) received from Mr. F. P. Dodd. Q., Brisbane, in March and April; two ♀♀. Warwick, in April; one wasted ♀.

Gen. 37. CEROPREPES.

Ceroprepes, Zel., Stet. Ent. Zeit. 1867, p. 401. Hmps., Moths Ind. iv., p. 103.

CEROPREPES MNIAROPIS, *n. sp.*

μνιαρωπις, mossy.

♀ 22 mm. Head and thorax ochreous-whitish, greenish-tinged. Palpi brown-whitish irrorated with dark fuscous. Antennae ochreous-whitish annulated with dark fuscous. Abdomen whitish irrorated with pale fuscous. Legs whitish, greenish-tinged, femora, tibiae, and tarsi banded with dark-fuscous. Forewings strongly dilated posteriorly, costa rather strongly arched, apex rounded, termen slightly oblique, slightly rounded; whitish irrorated with pale green; disc between $\frac{1}{4}$ and $\frac{1}{2}$ wholly suffused with pale green; a pale fuscous suffusion at base; a dark fuscous line, somewhat outwardly curved from $\frac{2}{5}$ costa to mid-dorsum; closely preceded by a parallel line, which is similar towards costa, but between fold and dorsum consist of a very elevated ridge of raised scales; a fine indistinct fuscous dentate line from $\frac{3}{4}$ costa, abruptly inwardly bent above dorsum, on which it ends at $\frac{4}{5}$; this line is edged posteriorly with reddish-brown, and succeeded by a fuscous suffusion towards apex; a series of wedge-shaped fuscous terminal dots; cilia whitish. Hindwings with termen rounded; pale-grey, darker towards termen; cilia whitish.

Type in Coll. Turner.

Q., Mt. Tambourine, in February; one specimen.

Gen. 38. SCLEROBIA.

Sclerobia, Rag.

SCLEROBIA TRITALIS.

Hypochalchia tritalis, Wlk., Brit. Mus. Cat. xxvii., p. 47.

Eucarphia vulgatella, Meyr., P.L.S.N.S.W. 1878, p. 207.

Q., Bundaberg, Nambour, Brisbane, Stanthorpe. N.S.W., Tenterfield, Ben Lomond, Sydney, Bowenfels. V. Melbourne. T., Hobart. W.A., Perth.

†† SCLEROBIA NEOTOMELLA.

Eucarphia neotomella, Meyr., P.L.S.N.S.W. 1879, p. 226.

N.S.W., Sydney.

†† SCLEROBIA CNEPHAEELLA.

Sclerobia cnephaeella, Meyr., P.L.S.N.S.W. 1879, p. 227.

N.S.W., Sydney.

Gen. 39. ETIELLA.

Etiella, Zel., Isis., 1846, p. 733. Hmps., Moths Ind. iv., p. 108.

† ETIELLA ZINCKENELLA.

Etiella zinckenella, Treit., Schmett. Eur ix. 50, p. 201. Hmps., Moths Ind. iv., p. 108.

There is one wasted specimen (type *anticalis*, Wlk.) of this cosmopolitan species in the British Museum, said to be from Australia. The locality requires confirmation.

ETIELLA BEHRII.

Etiella behrii, Zel. Isis. 1848, p. 883. Meyr., P.L.S.N.S.W. 1878, p. 205.

N.A., Port Darwin. Q., Brisbane, Mt. Tambourine, Stanthorpe. N.S.W., Glen Innes, Newcastle, Sydney, Bathurst, Katoomba, Cooma. V., Melbourne, Gisborne, Kewell. S.A., Adelaide. W.A., Albany, Perth.

ETIELLA CHRYSOPORELLA.

Etiella chrysoporella, Meyr., P.L.S.N.S.W. 1878, p. 206.

N.Q., Townsville. Q., Duaringa, Brisbane, Toowoomba. N.S.W., Bathurst. V., Melbourne. S.A., Adelaide. W.A., Geraldton, Carnarvon.

ETIELLA SINCERELLA.

Etiella sincerella, Meyr., P.L.S.N.S.W. 1878, p. 204.

N.Q., Townsville. Q., Brisbane, Stanthorpe. N.S.W., Sydney.

ETIELLA WALSINGHAMELLA.

Etiella walsinghamella, Rag.

N.A., Port Darwin (Coll. Lyell). N.Q., Townsville (Dodd).

ETIELLA MELANELLA.

Etiella melanella, Hmps.

N.A., Port Darwin, in May; two specimens received from Mr. G. Lyell.

ETIELLA HOLOZONA.

Etiella holozona, Low., Tr. R.S.S.A. 1903, p. 57.

Q., Brisbane ? (Lower).

Gen. 40. BALANOMIS.

Balanomis, Meyr., Tr. E.S. 1887, p. 264.

†† BALANOMIS ENCYCLIA.

Balanomis encyclia, Meyr., Tr. E.S. 1887, p. 265.

N.S.W., Newcastle.

Gen. 41. OXYDISIA.

Oxydisia, Hmps.

† OXYDISIA HYPERYTHRELLA.

Oxydisia hyperythrella, Hmps.
Q., Peak Downs.

Gen. 42. LOPHOTHORACIA.

Lophothoracia, Hmps.

† LOPHOTHORACIA OMPHALELLA.

Lophothoracia omphalella, Hmps.
Q., Peak Downs.

Gen. 43. SEMPRONIA.

Sempronia, Rag.

†† SEMPRONIA STYGELLA.

Sempronia stygella, Rag.

Gen. 44. VINICIA.

Vinicia, Rag.

† VINICIA GYPSOPA.

gypsopa, Meyr.
W.A., Albany, Perth, York, Carnarvon.

† VINICIA MACROTA.

Epicrocis macrota, Meyr., Tr. E.S. 1887, p. 258.
W.A., Carnarvon.

† VINICIA EUCOMETIS.

Salebria eucometis, Meyr., P.L.S.N.S.W. 1882, p. 168.
Salebria squamicornis, Butl., Tr. E.S. 1886, p. 439.
Q., Peak Downs, Brisbane.

Gen. 45. MEYRICKIELLA

Meyrickiella, Rag.

† MEYRICKIELLA HOMOSEMA.

Hypophana homosema, Meyr., Tr. E.S. 1887, p. 264.
W.A. Perth, York, Geraldton, Carnarvon.

Gen. 46. CONOBATHRA.

Conobathra, Meyr., Tr. E.S. 1887, p. 271.

†† CONOBATHRA AUTOMORPHA.

Conobathra automorpha, Meyr., Tr. E.S. 1887, p. 271.
N.Q. Also from New Guinea.

Gen. 47. TETRALOPHA.

Tetralopha, Zel., Meyr., Tr. E.S. 1887, p. 256.

†† TETRALOPHA PIRATIS.

Tetralopha piratis, Meyr., Tr. E.S. 1887, p. 257.
Queensland.

Sub. Fam. GALLERIANAE.

A group of small size but almost universal distribution, which is proportionately well represented in Australia.

A. Forewings with veins 7 and 8 stalked.
B. Hindwings with vein 5 absent.
C. Hindwings with cell open.
D. Forewings with 5 absent. ... ... 1. *Corcyra.*
DD. Forewings with 5 present.
E. Forewings of ♂ with costa folded over beneath and bearing a large glandular swelling ... ... 2. *Hypolophota.*
EE. Forewings of ♂ not folded over beneath.
F. Forewings with 9 arising from 8 before 7.
G. Forewings narrow-elongate; hindwings with 7 anastomosing with 8 nearly to apex ... 3. *Paralipsa.*
GG. Forewings not narrow-elongate; hindwings with 7 anastomosing with 8 not more than half its length.
H. Forewings elongate-oval, apex and termen rounded... ... 4. *Melissoblaptes.*
HH. Forewings rather broad, apex rounded - rectangular, termen straight. ... ... 5. *Doloëssa.*
FF. Forewings with 7 arising from 8 before 9.
G. Hindwings with 7 anastomosing strongly with 8. ... ... 6. *Heteromicta.*
GG. Hindwings with 7 connected with 8 at a point only. ... ... 7. *Tirathaba.*
CC. Hindwings with cell closed. ... 8. *Meliphora.*
BB. Hindwings with 5 present.
C. Hindwings with cell open.... ... 9. *Lamoria.*
D. Forewings with 7 from 8 before 9.... 10. *Eucallionyma.*
DD. Forewings with 9 from 8 before 7. 11. *Galleria.*
AA. Forewings with 7 and 8 separate. ... 12. *Balaenifrons.*

The genera *Galleristhenia* and *Eldana* are not included in this tabulation, as I do not know their characters.

Gen. 1. CORCYRA.

Corcyra, Rag. Meyr, *Brit.* Lep., p. 384.

CORCYRA ASTHENITIS, *n. sp.*

ἀσθενος, feeble.

♂ ♀ 14-18 mm. Head, thorax and palpi grey whitish. Antennae grey. Abdomen ochreous-whitish. Legs, whitish, anterior pair fuscous; middle pair irrorated with fuscous. Forewings elongate-oval, costa moderately arched, more strongly in ♀, apex, round-pointed; termen very obliquely rounded; grey whitish irrorated with fine blackish scales, which form a fine median streak from base to middle, and some imperfect streaks on veins; an interrupted blackish terminal line; cilia grey whitish. Hindwings with termen somewhat sinuate; whitish; cilia whitish.

Type in Coll. Turner.

N.Q., Townsville, in August; two specimens received from Mr. F. P. Dodd.

Gen. 2. HYPOLOPHOTA, *nov.*

ὑπολοφοτος, crested beneath.

Face with a conical hairy tuft directed forwards. Tongue very small. Palpi of ♂ short, ascending, closely appressed to frons, not reaching vertex; of ♀ well-developed, porrect. Antennae, of ♂ simple, minutely ciliated. Forewings of ♂ with basal half of costa enlarged and bent underneath, terminating in a large glandular swelling covered with long hairs. Forewings with vein 2 from $\frac{4}{5}$, 3 from angle, 4 and 5 well separated at base, 9 arising from 8 before or after 7, or absent. Hindwings with cell open, 3 and 4 stalked, 7 anastomosing with 8.

Type *H. oödes*, Turn.

The genus is well characterised by the structure of the forewings of the ♂, which is the same in both species, though the variation in the neuration is certainly baffling to the systematist.

HYPOLOPHOTA OÖDES, *n. sp.*

ὠωδης, oval; in allusion to the forewings.

♂ ♀ 15-22 mm. Head, thorax, palpi, and antennae grey. Palpi in ♀ moderate ($1\frac{3}{4}$). Abdomen grey-whitish. Legs grey irrorated with dark-fuscous. Forewings oval, costa rather strongly arched, apex rounded, termen obliquely rounded; vein 9 absent; pale-grey, irrorated and veins streaked with dark-fuscous, a broad suffused outwardly curved dark fuscous line from $\frac{1}{5}$ costa to $\frac{2}{5}$ dorsum; a similar line from $\frac{3}{5}$ costa, forming a strong outward projection below middle to before tornus; a fine dark fuscous terminal line; cilia grey, basal half irrorated with dark fuscous, extreme apices whitish. Hindwings with termen rounded, slightly sinuate beneath apex; grey-whitish; cilia grey-whitish, towards tornus and inner margin whitish.

Type in Coll. Turner.

N.Q., Townsville, in September and October; seven specimens received from Mr. F. P. Dodd.

HYPOLOPHOTA AMYDRASTIS, *n. sp.*

ἀμυδρος, dim, indistinct.

♂ ♀ 18-25 mm. Head, thorax, palpi and antennae, grey or whitish grey. Palpi in ♀ rather long ($2\frac{1}{2}$). Abdomen, grey-whitish. Legs grey, irrorated with fuscous; posterior pair whitish. Forewings ovate-oblong, costa moderately arched, apex rounded, termen obliquely rounded; pale grey finely irrorated with darker grey; without distinct markings; sometimes an indistinct pale line at $\frac{5}{6}$, parallel to termen; cilia, whitish grey, with an imperfect grey median line. Hindwings with termen rounded, slightly sinuate; grey whitish; cilia, grey whitish.

In one ♂ and one ♀ vein 9 arises from 8 beyond 7; in another ♂ 9 arises from well before 7.

Type in Coll. Turner.

N.Q., Townsville, in September and October; three specimens received from Mr. F. P. Dodd.

Gen. 3. PARALIPSA.

PARALIPSA STENOPEPLA, *n. sp.*

στενοπεπλος, narrow-cloaked.

♀. 23 mm. Head, thorax, palpi, antennae, and abdomen pale grey. Legs whitish; anterior pair grey; middle pair with some dark fuscous irroration. Forewings very elongate-oval, costa rather strongly arched, apex round-pointed, termen very obliquely rounded; pale-grey irrorated with whitish, and, especially towards base, with blackish scales; an elongate blackish median discal dot or short streak, surrounded by whitish irroration; some blackish scales on termen; cilia grey-whitish. Hindwing with termen slightly sinuate; whitish-grey; cilia whitish.

Type in Coll. Turner.

N.Q., Townsville, in September; one specimen received from Mr. F. P. Dodd.

Gen. 4. MELISSOBLAPTES.

Melissoblaptes, Zel.

Meyr., Brit. Lep., p. 384.

MELISSOBLAPTES BARYPTERA.

Melissoblaptes baryptera, Low., P.L.S.N.S.W. 1901, p. 659.

V. Birchip. S.A., Adelaide.

† MELISSOBLATES SORDIDELLA.

Gyrtona sordidella, Wlk., Brit. Mus. Cat., xxxv, p. 1723.

Melissoblaptes sordidella, Meyr., Tr. E.S. 1887, p. 252.

N.S.W., Katoomba.

† MELISSOBLAPTES HILAROPIS.

hilaropis, Meyr.

†† MELISSOBLAPTES AGRAMMA.

Melissoblaptes agramma, Low., Tr. R.S.S.A. 1903, p. 49.

N.Q., Cooktown, Mackay (?) (Lower). Also from Louisiades.

†† MELISSOBLAPTES AEGIDIA.

Melissoblaptes aegidia, Meyr., Tr. E.S. 1887, p. 252.

S.A., Mt. Lofty.

Gen. 5. DOLOËSSA.

Doloëssa, Rag.

† DOLOËSSA HILAROPIS.

Doloëssa hilaropis, Meyr.

N.Q., Cooktown.

DOLOËSSA CASTANELLA.

Thagora castanella, Hmps., Moths Ind., iv, p. 4.

Q., Brisbane, one ♀ which Sir Geo. Hampson has identified with his species and referred to this genus. Also from Ceylon.

Gen. 6. HETEROMICTA.

Heteromicta, Meyr.

HETEROMICTA TRIPARTITELLA.

Aphomia tripartitella, Meyr., P.L.S.N.S.W. 1879, p. 236.

N.A., Port Darwin. Q., Brisbane, Mount Tambourine. N.S.W., Sydney.

HETEROMICTA PACHYTERA.

Aphomia pachytera, Meyr., P.L.S.N.S.W. 1879, p. 237.

Q., Brisbane, Warwick. N.S.W., Tenterfield, Sydney. V., Melbourne. T., Hobart. S.A., Quorn. W.A., Geralton.

HETEROMICTA LATRO.

Melissoblaptes latro, Zel., zool-bot. v., 1873, p. 213.

Aphomia latro, Meyr., P.L.S.N.S.W. 1879, p. 238.

Although very different in appearance to the preceding species, there appears to be no structural difference to justify generic separation.

Q., Brisbane. N.S.W., Sydney. V., Gisborne. S.A., Adelaide.

† HETEROMICTA OCHRACEELLA.

Heteromicta ochraceella, Hmps.

N.Q., Cooktown.

†† HETEROMICTA NIGRICOSTELLA.

Heteromicta nigricostella, Hmps.

Q.,

HETEROMICTA POLIOSTOLA, *n. sp.*

πολιοστολος, grey-cloaked.

♀ 25 mm. Head, thorax, palpi, and antennae pale-grey. Palpi of ♀ porrect, rather long (2½); terminal joint downcurved. Abdomen whitish. Legs whitish, irrorated with pale grey. Forewings elongate-oval, costa rather strongly arched, apex rounded, termen very obliquely rounded; whitish irrorated with grey; a broadly suffused grey line from ⅓ costa to ⅓ dorsum; a grey median discal dot; a postmedian grey line ⅔ costa to ⅔ dorsum, angled outwards in middle; cilia grey mixed with whitish. Hindwings with termen rounded; whitish; towards apex and termen suffused with pale grey; cilia whitish.

Allied to *H. pachytera*, Meyr., but the lines of forewings are broader and more suffused, the postmedian line not dentate, the discal dot single and not dark fuscous, and there is no dark fuscous terminal line. The palpi of the ♀ are longer.

Type in Coll. Turner.

Q., Brisbane; one specimen received from Mr. F. P. Dodd.

Gen. 7. TIRATHABA.

Tirathaba, Wlk., Brit. Mus. Cat., xxx., p. 961.

Mucialla, Wlk., Brit. Mus. Cat., xxxv., p. 1739. Hmps., Moths Ind., iv., p. 5.

TIRATHABA RUFIVENA.

Lamoria (?) *rufivena*, Wlk., Brit. Mus. Cat., xxx., p. 960.

Mucialla rufivena, Hmps., Moths Ind., iv., p. 5.

N.Q., Townsville, from December to March; three specimens received from Mr. F. P. Dodd. Also from New Guinea, Borneo, Ceylon and India.

TIRATHABA HEPIALIVORA.

hepialivora, Hmps.

Melissoblaptes parasiticus, Luc., P.R.S.Q. 1898, p. 85.

N.Q., Townsville ; Q., Brisbane.

† TIRATHABA COMPLANA.

Aphomia complana, F. & R., Reise Nov. Pl., 137, f. 6.

N.Q., Geraldton. Also from Louisiades and Amboyna.

† TIRATHABA ACROCAUSTA.

acrocausta, Meyr.

N.Q., Cooktown. Also from Louisiades and Sangir.

Gen. 8. MELIPHORA.

Achroia, Hb., Verz., p. 163. Hmps., Moths Ind., iv., p. 6. (praeocc).

Meliphora, Gn., Meyr, Brit. Lep., p. 383.

MELIPHORA GRISELLA.

grisella, Fab.

Achroia grisella, Hmps., Moths Ind. iv., p. 6.

Dr. Thos. Bancroft has bred this species from larvae feeding on dried figs.

Q., Nambour, Brisbane. N.S.W., Sydney. V., Melbourne.

Gen. 9. LAMORIA.

Lamoria, Wlk., Brit. Mus. Cat. xxvii, p. 87. Hmps., Moths Ind., iv., p. 6.

LAMORIA ADAPTELLA.

Pempelia? adaptella, Wlk., Brit. Mus. Cat. xxvii, p. 74. Hmps., Moths Ind., iv., p. 7.

N.Q., Townsville. Also from Ceylon, India, Africa and Europe.

† LAMORIA PACHYLEPIDELLA.

pachylepidella, Hmps.

N.Q., Cooktown.

Gen. 10. EUCALLIONYMA.

Callionyma, Meyr., P.L.S.N.S.W. 1882, p. 161 (praeocc.).

Eucallionyma, Rag.

EUCALLIONYMA SARCODES.

Callionyma sarcodes, Meyr., P.L.S.N.S.W. 1882, p. 172.

Q., Brisbane, Warwick. N.S.W., Murrurundi, Sydney.

† EUCALLIONYMA MEDIOZONALIS.

Eucallionyma mediozonalis, Hmps.

N.W.A., Sherlock River.

Gen. 11. GALLERIA.

Galleria, Fab., Syst., Suppl., p. 462. Meyr., P.L.S.N.S.W. 1882, p. 160. Hmps., Moths Ind. iv., p. 8.

GALLERIA MELLONELLA.

Phalaena mellonella, Lin., Syst. Nat. (ed. x) i , p. 537.
Galleria mellonella, Hmps., Moths Ind. iv., p. 9.
Q., Brisbane, Dalby. V., Gisborne. W.A., Perth.

Gen. 12. BALAENIFRONS.

Balaenifrons, Hmps., Moths Ind. iv., p. 9.

† BALAENIFRONS HAEMATOGRAPHA.

Balaenifrons haematographa, Hmps.
N.Q., Cooktown.

† BALAENIFRONS PHOENICOZONA.

Balaenifrons phoenicozona, Hmps.
N.Q., Cooktown.

Gen. 13. GALLERISTHENIA.

Galleristhenia, Hmps.

† GALLERISTHENIA MELLONIDIELLA.

Galleristhenia mellonidiella, Hmps.
Q.

Gen. 14. ELDANA.

†† ELDANA LEUCOSTICTALIS.

Eldana leucostictalis, Low., Tr. R.S.S.A. 1903, p. 50.
Q., Brisbane ? (Lower).

SUBFAM. CRAMBINAE.

The *Crambinae* are probably the best known subfamily of the Australian *Pyralidae*. This region is remarkable for the very few species of the large cosmopolitan genus *Crambus*, and for the large development of *Talis* which appears to take its place. The species of the last genus are almost wholly confined to the temperate portions of the continent.

A. Hindwings with vein 6 from upper angle of cell.
  B. Forewings with vein 7 absent
    C. Forewings with 11 anastomosing with 12 ... ... 1. *Ptochostola.*
    CC. Forewings with 11 free ... ... 2. *Culladia.*
  BB. Forewings with 7 and 8 stalked
    C. Hindwings with 8 closely approximated to cell.
      D. Forewings with 2 and 3 stalked ... 3. *Autarotis.*
      DD. Forewings with 2 and 3 separate.
        E. Forewings with 10 and 11 stalked 4. *Neargyria.*
        EE. Forewings with 10 and 11 separate 5. *Crambus.*
    CC. Hindwings with 8 not approximated to cell.
      D. Forewings with vein 11 absent ... 6. *Anaclastis.*

DD. Forewings with vein 11 present ... 7. *Mesolia.*

BBB. Forewings with vein 7 present and separate.

C. Hindwings with 4 and 5 connate or stalked.

D. Frons rounded.

E. Tongue weak or absent. Antennae in ♂ pectinate, in ♀ serrate 9. *Ubida.*

EE. Tongue well-developed. Antennae simple

F. Hindwings with vein 8 not closely approximated to cell ... 8. *Argyria.*

FF. Hindwings with vein 8 closely approximated to cell ... 10. *Thinasotia*

DD. Frons with conical protuberance

E. Forewings with 11 straight and oblique ... ... 11. *Camuza.*

EE. Forewings with 11 curved and approximated to 12 ... 12. *Chilo.*

CC. Hindwings with 4 and 5 separate

D. Frons with strong conical protuberance ... ... 13. *Sedenia.*

DD. Frons rounded.

E. Forewings not incised. Antennae of ♂ pectinated ... ... 14. *Eurhythma.*

EE. Forewings incised beneath apex. Antennae of ♂ simple ... 15. *Diptychophora.*

AA. Hindwings with 6 from well below angle of cell.

B. Forewings with 7, 8, 9, stalked ... 16. *Ancylolomia.*

BB. Forewings with 7 separate ... 17. *Talis.*

Gen. 1. PTOCHOSTOLA.

Ptochostola, Meyr., P.L.S.N.S.W. 1882, p. 154.

Sir Geo. Hampson describes and figures vein 7 as present in the forewings; according to my observations Mr. Meyrick is correct in stating its absence. Vein 5 appears to be constantly absent in both wings. The genus should probably be restricted to the single species; two South American forms associated with it by Hampson differ in neuration.

PTOCHOSTOLA MICROPHAEELLA.

Crambus microphaeellus, Wlk., Brit. Mus. Cat. xxxv., p. 1758.

Crambus dimidiellus, Meyr., P.L.S.N.S.W. 1878, p. 190.

Q., Rockhampton, Brisbane, Stradbroke Island, Toowoomba, Dalby, Stanthorpe; N.S.W., Newcastle, Sydney, Katoomba, Bathurst; V., Gisborne, Melbourne; T., Launceston, Hobart; S.A., Penola; W.A., Albany.

Gen. 2. CULLADIA.

Culladia, Moore, Lep. Ceyl. iii., p. 382.

The neuration varies, vein 5 may be stalked or coincident with 4 in both wings.

CULLADIA ADMIGRATELLA.

Araxes admigratella, Wlk., Brit. Mus. Cat. xxvii., p. 192.

Culladia admigratella, Hmps., Moths Ind. iv., p 11.

N.Q., Cairns and Townsville, in August. Also from Borneo, China, Ceylon, India and Africa.

Gen. 3. AUTAROTIS.

Autarotis, Meyr., Tr. E.S. 1886, p. 269.

AUTAROTIS EURYALA.

Autarotis euryala, Meyr., Tr. E.S. 1886, p 270.

N.Q., Townsville, in December; one specimen received from Mr. F. P. Dodd. Cooktown.

Also from Louisiades and Fiji.

Gen. 4. NEARGYRIA.

Neargyria, Hmps., P.Z.S. 1895, p. 923.

Argyria, Meyr., P.L.S.N.S.W. 1882, p. 154, *nec* Hb.

NEARGYRIA ARGYRASPIS.

Argyria argyraspis, Meyr., P.L.S.N.S.W. 1879, p. 216.

N.Q., Cairns, Kuranda. Q., Brisbane, Mt. Tambourine, Warwick, Killarney. N.S.W., Bulli, Kiama, Wollongong.

Gen. 5. CRAMBUS.

Crambus, Fab., Ent. Syst. Suppl. p. 464. Hmps., P.Z.S. 1895, p. 925.

A very large genus but scantily represented in Australia, where its place is taken by *Talis*, Gn. In it I include *Calamotropha*, Zel., to which the first five species might be referred.

CRAMBUS DIELOTUS.

Calamatropha dielota, Meyr., Tr. E.S. 1886, p. 268.

N.A., Adelaide River; N.Q., Thursday Island. Also from Fiji and Ceram.

CRAMBUS ANTICELLUS.

Ancylolomia ? anticella, Wlk., Brit. Mus. Cat. xxxv., p. 1751.

Crambus anticellus, Hmps., Moths Ind. iv., p. 13.

N.A., Port Darwin; N.Q., Cooktown, Townsville. Also from Ceylon, India and Africa.

CRAMBUS LEPTOGRAMMELLUS.

Chilo parramatellus, ♀, Meyr., P.L.S.N.S.W. 1878, p. 178.

Chilo leptogrammellus, Meyr., P.L.S.N.S.W. 1879, p. 207.

Q., Brisbane, Dalby; N.S.W., Tenterfield, Sydney; N.W.A., Roebourne (Coll. Lyell).

CRAMBUS PARRAMATTELLUS.

Chilo parramattellus, ♂, Meyr., P.L.S.N.S.W. 1878, p. 178.

Readily distinguished from the preceding by the absence of terminal dots on forewings.

Q., Brisbane, Stradbroke Island; N.S.W., Sydney.

CRAMBUS DELATALIS.

Crambus delatalis, Wlk., Brit. Mus. Cat. xxvii, p. 176. Hmps, Moths, Ind. iv., p. 13.

N.Q., Townsville; Q., Brisbane; V., Gisborne; also from Ceylon and Africa.

† CRAMBUS MEDIORADIELLUS.

Crambus medioradiellus, Hmps.

N.Q., Cooktown.

CRAMBUS MALACELLUS.

Crambus malacellus, Dup., Lep. Fr, vii., p. 61.

Crambus hapaliscus, Zel., K. Vet. Ak. Handl., Stockholm, 1854, p. 71.

Crambus conciunellus, Wlk., Brit. Mus. Cat., xxvii, p. 165. Meyr., P.L.S.N.S.W., 1878, p. 182.

N.Q., Cooktown; Q., Rockhampton, Brisbane, Mount Tambourine, Stanthorpe; N.S.W., Sydney; also from New Guinea, Borneo, Ceylon, India, Africa and Europe.

CRAMBUS CUNEIFERELLUS.

Crambus cuneiferellus, Wlk., Brit. Mus. Cat. xxvii, p. 175. Meyr., P.L.S.N.S.W., 1878, p. 189.

N.Q., Kuranda, Geraldton, Mackay; Q., Rockhampton, Peak Downs, Nambour, Brisbane, Stradbroke Island, Stanthorpe; N.S.W., Newcastle, Sydney, Katoomba; V., Melbourne; also from Norfolk Island, New Hebrides and Tonga.

CRAMBUS PHOTOLEUCUS.

Crambus photoleuca, Low., Tr. R.S.S.A. 1903, p. 51.

♀ 18 ♏♏. Head white, base of side-tufts ochreous; face rounded, slightly projecting. Palpi white, external surface pale brownish-ochreous. Antennae grey. Thorax white. Abdomen whitish-grey. Legs white; tarsi, anterior, and middle tibiae pale-brownish. Forewings elongate, posteriorly dilated, costa gently arched, apex rounded, termen obliquely rounded;

veins 4 and 5 connate or short-stalked; snow-white; markings pale brownish-ochreous; a short outwardly oblique streak from costa beyond middle; a similar streak from costa at $\frac{4}{5}$ continued as a fine line obliquely outwards towards mid-termen, then bent inwards to dorsum before tornus; a third streak from costa before apex, continued as a fine line to termen above middle; a fine darker terminal line; cilia bases white barred with fuscous except towards apex and tornus, apices pale brownish-ochreous. Hindwings with termen slightly sigmoid; whitish; cilia white.

N.Q., Townsville, in January and March; two specimens received from Mr. F. P. Dodd.

†† CRAMBUS DIANIPHUS.

Crambus dianipha, Low., P.L.S.N.S.W. 1891, p. 660.

N.W.A., Derby (Lower).

Gen. 6. ANACLASTIS, *nov.*

ἀνακλαστος, broken; in allusion to termen of forewings.

Face with a conical anterior projection. Tongue present. Labial palpi long (5), porrect, densely clothed with long hairs. Antennae of ♂ somewhat thickened, shortly ciliated ($\frac{1}{2}$). Forewings with veins 5, 7, and 11 absent. Hindwings with vein 5 absent, 7 anastomosing strongly with 8, 8 well separated from cell.

A development of *Mesolia*, Rag., of which genus Sir Geo. Hampson considers it a section; but it appears to me sufficiently distinct.

ANACLASTIS APICISTRIGELLA.

Crambus apicistrigellus, Meyr., P.L.S.N.S.W. 1879, p. 209.

Q., Brisbane; N.S.W., Sydney.

Gen. 7. MESOLIA.

Mesolia, Rag., Ann. Ent. Soc. Fr. 1888, p. 282. Hmps., P.Z.S. 1895, p. 962.

MESOLIA SCYTHRASTIS, *n. sp.*

σκυθρος, gloomy.

♀ 20-22 mm. Head, thorax, palpi and antennae dark-fuscous. Abdomen fuscous. Legs whitish; anterior pair suffused with fuscous. Forewings elongate, costa nearly straight, apex rounded, termen slightly oblique, indented at $\frac{1}{3}$ from apex, beneath rounded; veins 4 and 5 long-stalked; fuscous; towards termen paler; dorsal area beneath fold irrorated with whitish; a transverse dark-fuscous streak between fold and mid-dorsum; a whitish spot edged with dark-fuscous beneath costa at $\frac{2}{3}$; a posterior line of dark-fuscous spots edged posteriorly with whitish, sometimes partly obsolete, first on costa at $\frac{5}{6}$, three or four on veins near termen, last on tornus; a fine dark-fuscous terminal line; cilia fuscous with a fine whitish basal line, succeeded by an indistinct darker fuscous line, and this again by a whitish line only developed near apex. Hindwings with termen rounded, faintly sinuate beneath apex, veins 4 and 5 long-stalked; grey; cilia whitish with a fine grey line near bases.

Type in Coll. Turner.

N.Q., Townsville, in November; two specimens.

Gen. 8. ARGYRIA.

Argyria, Hb., Verz, p. 372.

Platytes, Gn., Ind Meth, p. 86. Hmps., P.Z.S., 1895, p. 943.

ARGYRIA PLUMBEOLINEALIS.

Platytes plumbeolinealis, Hmps., P.Z.S. 1895, p. 947.

N.Q., Townsville in December; five bred specimens received from Mr. F. P. Dodd. Also from Bali, Ceylon, India and Africa.

ARGYRIA AMOENALIS.

amoenalis, Snel.

Very closely resembling the preceding species, best distinguished from it by the different form of antemedian line of forewings, which is not indented in middle. Mr. F. P. Dodd, who bred both species, tells me that the larvae and food-plants differ.

N.Q., Townsville, in December. Q., Brisbane, in January. Also from New Guinea and Bali.

Gen. 9. UBIDA.

Ubida, Wlk., Brit. Mus. Cat. xxvii., p. 185. Hmps., P.Z.S. 1895, p. 954.

Crunophila, Meyr., P.L.S.N.S.W. 1882, p. 152.

UBIDA RAMOSTRIELLA.

Crambus ramostriellus, Wlk., Brit. Mus. Cat. xxvii., p. 172.

Chilo ? schistellus, Meyr., P.L.S.N.S.W. 1879, p. 207.

Q., Duaringa, Brisbane, Stradbroke Island; N.S.W., Sydney.

UBIDA HOLOMOCHLA, *n. sp.*

ὁλομοχλος, with unbroken bar.

♂. 24 mm. Head whitish. Labial and maxillary palpi fuscous, white on upper surface. Antennae grey; in ♂ shortly pectinated ($1\frac{1}{2}$) to apex. Thorax white; patagiae except apices fuscous. Abdomen white. Legs whitish ; anterior and middle pairs fuscous on anterior surface. Forewings oblong, costa slightly arched, apex rounded, termen slightly oblique, slightly rounded : white, markings fuscous-grey ; a broad streak from base of costa to apex leaving a broad white streak along costa ; the posterior part of subcostal streak gives off two fine streaks parallel to veins to termen ; an unbroken median streak from base to termen beneath middle ; a dot on termen above tornus ; cilia white. Hindwings with termen rounded ; white ; cilia white.

Very neatly marked and readily distinguished from the preceding by the median bar not being interrupted by oblique white streaks.

Type in Coll. Turner.

N.Q., Townsville, in January ; one specimen received from Mr. F. P. Dodd.

Gen. 10. Thinasotia.

Thinasotia, Hb., Verz. p. 366.

I do not know the type of this genus, nor whether the following species is rightly referred here. It agrees with *Chilo* except in the rounded frons, but consorts ill with *Argyria* (*Platytes*, *Gn.*) to which Sir Geo. Hampson refers it. I hope the distinction given in the table may prove sufficient.

THINASOTIA PENTADACTYLA.

pentadactylus, Zel., Mon. Cramb., p. 38.

Aquita claviferella, Wlk., Brit. Mus. Cat. xxxv., 1765.

V., Melbourne ; T., Hobart ; also from New Zealand.

Gen. 11. Canuza.

Canuza, Wlk., Brit. Mus. Cat. xxxv, p. 1771. Hmps., P.Z.S. 1895, p. 949.

Erotomanes, Meyr., P.L.S.N.S.W. 1882, p. 152.

† CANUZA EUSPILELLA.

Canuza euspilella, Wlk., Brit. Mus. Cat. xxxv, p. 1771.

Anerastia mirabilella, Meyr., P.L.S.N.S.W. 1879, p. 213.

N.S.W., Sydney.

†† CANUZA ACMIAS.

Canuza acmias, Meyr., Tr. E.S. 1897, p. 379.

N.S.W., Sydney.

Gen. 12. Chilo.

Chilo, *Zinck.*, Germ. Mag. ii, 36 (1817). Hmps., P.Z.S. 1895, p. 954.

CHILO LATIVITTALIS.

Crambus lativittalis. Wlk., Brit. Mus. Cat. xxvii., p. 171, Meyr., P.L.S.N.S.W., 1878, p. 183.

Q., Stradbroke Island; N.S.W., Sydney, Katoomba; V., Melbourne, Gisborne; T., Deloraine, George's Bay; S.A., Ardrossan; W.A., Albany, Perth.

† CHILO TORRENTELLUS.

Crambus torrentellus, Meyr., P.L.S.N.S.W., 1878, p. 184.

Q., Duaringa. Also from India and Africa.

† CHILO STRIGATELLUS.

Chilo strigatellus, Hmps.

N.W.A., Sherlock River.

CHILO OXYPRORA.

ὀξυπρωρος, with pointed prow; in allusion to the frontal process.

♂. 20 mm. Head and thorax ochreous-whitish; frons with a conical protuberance ending in a sharp slightly down-curved point; tongue weakly developed. Palpi long (4); ochreous-whitish mixed with fuscous. Antennae fuscous; in ♂ dentate with short ciliations ($\frac{1}{4}$). Abdomen ochreous-whitish. Legs ochreous-whitish; anterior and middle pairs annulated with fuscous. Forewings elongate, posteriorly dilated, costa straight except close to base and apex, apex rounded, termen obliquely rounded; fuscous mixed with dark-fuscous and ochreous-whitish; an ochreous-whitish fascia from $\frac{1}{3}$ costa, moderately broad, not reaching dorsum, edged posteriorly by a dark-fuscous line, which gives off a sharp posterior tooth in mid-disc; a fuscous discal dot beyond middle; a well-marked sigmoid whitish line from $\frac{3}{4}$ costa to $\frac{2}{3}$ dorsum; a series of dark-fuscous terminal dots; cilia fuscous. Hindwings with termen rounded; ochreous-whitish with some greyish suffusion; cilia whitish with a pale grey basal line.

Not nearly allied to any Australian species.

Type in Coll. Lyell.

V., Murtoa, in March; two specimens.

Gen. 13. SEDENIA.

Sedenia, Gn., Lep. viii, p. 249. Meyr., Tr. E.S. 1884, p. 341. Hmps., P.Z.S. 1895, p. 974.

SEDENIA CERVALIS.

Sedenia cervalis, Gn., Lep. viii, p. 250, Pl. iii, f. 3.

Q., Brisbane, Toowoomba, Dalby, Warwick; N.S.W., Sydney; V.——————; T., Hobart; S.A., Mt. Lofty, Wirrabara.

SEDENIA RUPALIS.

Sedenia rupalis, Gn., Lep. viii, p. 250.

Q., Toowoomba, Stanthorpe ; N.S.W., Murrurundi, Bowenfels ; V., Melbourne, Gisborne ; T., Hobart ; S.A., Quorn, Kangaroo Island, Pt. Lincoln.

SEDENIA XEROSCOPA.

Sedenia xeroscopa, Low., P.L.S.N.S.W. 1900, p. 37.

Sedenia achroa, Low., P.L.S.N.S.W. 1901, p. 660.

I have examined the type of *achroa* (labelled Derby), which Mr. Lower informs me is probably identical with *xeroscopa* from Broken Hill.

SEDENIA POLYDESMA.

Sedenia polydesma, Low., P.L.S.N.S.W. 1900, p. 38.

N.S.W., Broken Hill.

†† SEDENIA ERYTHRURA.

Sedenia erythrura, Low., Tr. R.S.S.A. 1893, p. 165.

S.A., Adelaide.

Gen. 14. EURHYTHMA *nov.*

ἐυρυθμος, well-proportioned.

Frons rounded. Tongue well-developed. Palpi porrect, reaching well beyond frons, shortly hairy. Maxillary palpi triangularly scaled. Antennae in ♂ pectinated. Forewings not incised beneath apex ; vein 3 from before angle, 7 separate, 8 and 9 stalked Hindwings with veins 4 and 5 separate at base, 7 anastomosing with 8.

Differs from *Argyria* in the separation of veins 4 and 5 of the hindwings, and from *Diptychopora* in the forewings not being incised, and the pectinated antennae of the ♂.

EURHYTHMA LATIFASCIELLA.

Platytes latifasciella, Hmps.

I do not know the reference, but saw a specimen from Port Darwin in the British Museum which bore this name.

N.A., Port Darwin, in January ; one specimen in Coll. Lyell.

Gen. 15. DIPTYCHOPHORA.

Diptychophora, Zel., Stett. Ent. Zeit. 1866, p. 153. Meyr., P.L.S.N.S.W. 1882, p. 153.

DIPTYCHOPHORA STENURA, *n. sp.*

στενουρος, with narrow tails.

♂ ♀ 10-12 mm. Head ochreous-whitish. Palpi moderate (2), ochreous-whitish mixed with fuscous hairs. Antennae ochreous-whitish ; in ♂ simple, minutely ciliated ($\frac{1}{3}$). Thorax whitish. Abdomen pale-ochreous. Legs ochreous-whitish. Forewings triangular, costa moderately arched, apex round-pointed, termen oblique, straight, slightly indented above and less distinctly beneath middle; dorsum in both sexes with a fringe of long pale-ochreous hairs; whitish, sparsely irrorated with brownish and dark fuscous scales; two fine indistinct fuscous lines from $\frac{3}{4}$ costa, strongly outwardly-curved so as to closely approach termen, then slightly inwardly-curved to before termen; apical area ochreous-tinged, traversed by an outwardly oblique whitish sub-apical streak; four or five blackish dots separated by ochreous streaks on lower half of termen; cilia fuscous. Hindwings with termen rounded, deeply incised before termen in both sexes, leaving a linear tornal lobe fringed with long hairs in both sexes; vein 3 absent in both sexes; pale-ochreous; cilia whitish ochreous.

Type in Coll. Turner.

Q., Nambour, Brisbane, Mount Tambourine, in November, December and January; five specimens.

DIPTYCHOPHORA OCHRACEALIS.

Cataclysta ochracealis, Wlk., Brit. Mus. Cat. xxxiv., p. 1338.

Eromene praematurella, Meyr., P.L.S.N.S.W. 1878, p. 198.

Q., Nambour, Brisbane, Stradbroke Island, Mount Tambourine; N.S.W., Sydney; T., Hobart (Lyell).

DIPTYCHOPHORA DILATELLA.

Eromene dilatella, Meyr., P.L.S.N.S.W. 1878, p. 199.

N.S.W., Sydney; V., Gisborne.

DIPTYCHOPHORA MICROXANTHA.

Diptychophora microxantha, Meyr., Tr. E.S. 1897, p. 380.

V., Birchip.

DIPTYCHOPHORA MOLYDOCROSSA *n. sp.*

μολυβδοκροσσος, leaden-bordered.

♀ 12 mm. Head whitish. Palpi moderately long ($2\frac{1}{2}$), ochreous broadly barred with fuscous before middle and at apex, upper surface whitish. Antennae pale-grey. Thorax whitish, patagia pale-brown. Abdomen pale-grey. Legs whitish; anterior and middle pairs fuscous on anterior surface; middle and posterior tarsi fuscous annulated with whitish. Forewings elongate-triangular, costa straight, apex rounded, termen oblique, sharply indented at $\frac{1}{4}$ and again in middle, rounded beneath; whitish irrorated with pale-brownish and fuscous; three outwardly curved lines commencing as short fuscous streaks on costa at $\frac{1}{3}$, middle, and before $\frac{2}{3}$, the first two lines very indistinct in disc; postmedian line slender, strongly outwardly-curved above, ending at $\frac{3}{4}$ dorsum, followed by a pale line; a series of fine ochreous streaks on veins in posterior part of disc, not reaching termen; a triangular whitish subapical costal spot; subterminal part of disc whitish strigulated with dark-fuscous scales; a series of 7 or 8 minute blackish terminal dots separated by short ochreous streaks, extending equally from apex to tornus; cilia with bases forming a thick leaden-fuscous line, succeeded by a fine ochreous line, apices fuscous, at tornus whitish. Hindwings with termen somewhat indented; vein 3 present; pale-grey becoming whitish towards bases; cilia whitish with a leaden basal line becoming obsolete towards tornus.

Type in Coll. Turner.

Q., Nambour, in April; one specimen.

DIPTYCHOPHORA ALYPOPHANES, *n. sp.*

ἀλυποφανης, of cheerful appearance.

♂ ♀ 8-10 mm. Head ochreous-whitish. Palpi moderate (2); ochreous-whitish with some fuscous hairs. Antennae ochreous-whitish (in ♂ broken). Thorax ochreous-whitish. Abdomen ochreous-whitish, base of dorsum whitish. Legs whitish; anterior pair partly fuscous. Forewings triangular, costa moderately arched, apex round-pointed, termen oblique, straight, slightly indented at $\frac{1}{4}$ and less distinctly in middle; whitish suffused with pale ochreous-brown and partly irrorated with fuscous; an indistinct transverse whitish basal line; another better marked from $\frac{1}{4}$ costa to $\frac{1}{4}$ dorsum, straight, followed by a dark line, which is again edged posteriorly with whitish; a median slightly outwardly-curved line of fuscous scales; a similar line from $\frac{3}{4}$ costa, first curved outwards then parallel to termen to $\frac{4}{5}$ dorsum; three blackish dots on lower part of termen; cilia with a leaden-fuscous basal line, succeeded by a fine whitish line, apical halves fuscous. Hindwings with termen rounded, not indented; vein 3 present in both sexes; whitish; a slight fuscous suffusion at apex; cilia whitish, with a basal fuscous line at apex.

Type in Coll. Turner.

N.Q., Geraldton, in November, one specimen; Q., Brisbane, one specimen.

DIPTYCHOPHORA DIALEUCA n. sp.

διαλευκος, marked with white.

♀. 8 mm. Head whitish-ochreous. Palpi moderately long (3); whitish-ochreous with some fuscous hairs. Antennae grey. Thorax brownish-ochreous. Abdomen grey. Legs whitish;

anterior pair partly fuscous. Forewings triangular, costa nearly straight, apex round-pointed, termen oblique, straight, slightly indented at $\frac{1}{4}$ and again in middle; fuscous mixed with whitish; a whitish line from $\frac{1}{4}$ costa to mid-dorsum, angulated outwards beneath costa and inwards on fold, edged posteriorly with fuscous and followed by a whitish spot on fold; a conspicuous snow-white circular spot in mid-disc, preceded by a fuscous suffusion; a whitish line from $\frac{3}{4}$ costa, first curved outwards, then parallel to termen to $\frac{3}{4}$ dorsum, edged on both sides with fuscous, and preceded by a whitish spot on costa; a white subapical costal spot; an interrupted blackish terminal line not reaching costa; cilia with a leaden-fuscous basal line, succeeded by a fine whitish line, apices brownish-fuscous. Hindwings with termen rounded, slightly sigmoid beneath apex and again towards tornus; vein 3 present; grey; cilia whitish with a grey basal line.

Type in Coll. Turner.

Q., Stradbroke Island, in October, one specimen.

Gen. 16. ANCYLOLOMIA.

Ancylolomia, Hb., Verz. p. 363. Hmps., P.Z.S. 1895, p. 966.

ANCYLOLOMIA CHRYSOGRAPHELLA.

chrysographella, Koll., Hüg. Kasch. iv., p. 494.

Ancylolomia westwoodi, Zel., Mon. Cramb. p. 11. Meyr., P.L.S.N.S.W. 1879, p. 208.

N.Q., Thursday Island, Townsville. Said also to occur in Tasmania, but I think this may be an error.

Also from China, Ceylon, India and Africa.

Gen. 17. TALIS.

**Talis*, Gn., Ind. Micr. p. 86 (1845). Hmps., P.Z.S. 1895, p. 967.

Hednota, Meyr., Tr. E.S. 1886, p. 270.

Surattha, Wlk., Brit. Mus. Cat. xxvii., 75. Hmps., P.Z.S. 1895, p. 965.

TALIS TERMIA.

Thinasotia termia, Meyr., Tr. E.S. 1885, p. 452.

Q , Duaringa, Brisbane.

TALIS PANTEUCHA.

Thinasotia panteucha, Meyr., Tr. E.S. 1885, p. 453.

V. Birchip, Murtoa, Nhill; S.A., Mount Lofty.

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*. It should hardly be necessary to point out that unlike *Crambus Talis* [ταλις, a maiden] is a feminine substantive.

† TALIS BRUNNEA.

Surattha brunnea, Hmps.

N.W.A., Roeburne.

†† TALIS BATHROTRICHA.

Surattha bathrotricha, Low., P.L.S.N.S.W. 1901, p. 661.

N.S.W., Broken Hill.

†† TALIS DIACENTRA.

Talis diacentra, Meyr., Tr. E.S. 1897, p. 379.

V., Gunbower.

TALIS HOPLITELLA.

Crambus hoplitellus, Meyr., P.L.S.N.S.W. 1878, p. 188.

N.S.W., Sydney.

† TALIS RECURVELLA.

Crambus recurvellus, Wlk., Brit. Mus. Cat. xxvii, p. 171.

Crambus bivittellus, Meyr., P.L.S.N.S.W. 1878, p. 186, ***nec.*** Don.

W.A., Albany.

TALIS BIVITTELLA.

bivittellus, Don., Ins., N.H.

Crambus trivittatus, Zel., Mon. Cramb., p. 34. Meyr., P.L.S.N.S.W. 1888, p. 185.

Q., Rockhampton, Nambour, Brisbane, Stradbroke Island, Warwick; N.S.W., Sydney, Katoomba; V., Melbourne, Gisborne; T., Launceston; S.A., Adelaide.

TALIS AURANTIACA.

Crambus aurantiacus, Meyr., P.L.S.N.S.W. 1878, p. 184.

N.Q., Cardwell, Townsville; N.S.W., Newcastle.

TALIS MILVELLA.

Crambus milvellus, Meyr., P.L.S.N.S.W. 1878, p. 181.

N.S.W., Sydney.

TALIS PLENIFERELLA.

Crambus pleniferellus, Wlk., Brit. Mus. Cat. xxvii, 173. Meyr., P.L.S.N.S.W. 1878, p. 187.

Crambus aurosus, F. and R., Reise Nov. Pl. 137, f. 31.

Q., Toowoomba, Stanthorpe; N.S.W., Tenterfield, Sydney; V., Melbourne, Gisborne; T., Deloraine.

TALIS IMPLETELLA.

Crambus impletellus, Wlk., Brit. Mus. Cat. xxvii., p. 175. Meyr., P.L.S.N.S.W 1879, p. 210.

T., Hobart.

TALIS LONGIPALPELLA.

Eromene longipalpella, Meyr., P.L.S.N.S.W. 1878, p. 196.

Q., Toowoomba, Stanthorpe; V., Melbourne, Brentwood.

TALIS BIFRACTELLA.

Crambus bifractellus, Wlk., Brit. Mus. Cat. xxvii., p. 174.

Eromene bifractella, Meyr., P.L.S.N.S.W. 1878, p. 197.

Thinasotia argyroëles, Meyr., P.L.S.N.S.W. 1882, p. 163.

Q., Duaringa, Peak Downs, Brisbane, Warwick; N.S.W., Sydney; S.A.,————. Also from New Guinea.

TALIS PERLATALIS.

Crambus perlatalis, Wlk., Brit. Mus. Cat. xxvii., p. 174.

Meyr., P.L.S.N.S.W. 1879, p. 213.

T., Launceston, Hobart.

TALIS RELATALIS.

Crambus relatalis, Wlk., Brit, Mus. Cat. xxvii., p. 172. Meyr., P.L.S.N.S.W. 1878, p. 191.

Crambus argyroneurus, Zel. Mon. Cramb., p. 47.

Q., Warwick, Stanthorpe; N.S.W., Clarence River, Sydney, Katoomba, Mittagong; V., Melbourne, Gisborne; T., Hobart; S.A., Adelaide.

TALIS PANSELENELLA.

Thinasotia panselenella, Meyr., P.L.S.N.S.W. 1882, p. 165.

N.S.W., Katoomba; V., Gisborne; T., Hobart.

TALIS OPULENTELLA.

Crambus opulentellus, Zel., Mon. Cramb., p. 46. Meyr., P.L.S.N.S.W. 1878, p. 192.

N.S.W., Sydney, Moruya; V., Narracan, Gisborne; T., Hobart.

TALIS GRAMELLA.

Grambus grammellus, Zel., Mon. Cramb., p. 46.

Crambus enneagrammos, Meyr., P.L.S.N.S.W. 1878, p. 194.

N.S.W., Sydney, Katoomba; V., Melbourne, Gisborne; T., Hobart.

†† TALIS INVALIDELLA.

Crambus invalidellus, Meyr., P.L.S.N.S.W. 1878, p. 193.

T.

TALIS ACONTOPHORA.

Thinasotia acontophora, Meyr., P.L.S.N.S.W. 1882, p. 167.

Q., Warwick; N.S.W., Mittagong, Moruya; V., Gisborne, Murtoa; T., Hobart: S.A., Adelaide.

TALIS PEDIONOMA.

Thinasotia pediononoma, Meyr., Tr. E.S. 1885, p. 453.

N.S.W., Bathurst; V., Melbourne, Gisborne, Birchip; T., Launceston, Hobart; S.A., Mount Lofty.

†† TALIS MEGALARCHA.

Thinasotia megalarcha, Meyr., Tr. E.S. 1885, p. 454.

N.S.W., Mt. Kosciusko.

TALIS TOXOTIS.

Hednota toxotis, Meyr., Tr. E.S. 1887, p. 249.

V., Melbourne.

†† TALIS GELASTIS.

Hednota gelastis, Meyr., Tr. E.S. 1887, p. 250.

T., Campbelltown.

†† TALIS ASTERIAS.

Hednota asterias, Meyr., Tr. E.S. 1887, p. 250.

W.A., Albany.

†† TALIS XYLOPHEA.

Hednota xylophaea, Meyr., P.L.S.N.S.W, 1886, p. 1038.

S.A., Mt. Lofty.

TALIS ENCHIAS.

Talis enchias, Meyr., Tr. E.S. 1897, p. 380.

V., Melbourne, Gisborne ; T. Hobart.

† TALIS SUBFUMALIS.

Talis subfumalis, Hmps., P.Z.S., 1895, p. 968.

N.A., Port Darwin.

TALIS CRYPSICHROA.

Hednota crypsichroa, Low., Tr. R.S.S.A. 1893, p. 166.

V., Gisborne, Birchip ; S.A., Adelaide, Mount Lofty.

TALIS CYCLOSEMA.

Talis cyclosema, Low., Tr. R.S.S.A. 1896, p. 158.

Antennae of ♂ with fine pectinations of moderate length (2).

V., Trafalgar ; S.A., Hoyleton.

†† TALIS MACROGONA.

Talis macrogona, Low., P.L.S.N.S.W. 1901, p. 661.

S.A., Exeter.

†† TALIS MACROURA.

Talis macroura, Low., Tr. R.S.S.A. 1902, p. 233.

S.A., Penola.

TALIS STENIPTERALIS.

Talis stenipteralis, Low., Tr. R.S.S.A. 1903, p. 51.

V., Birchip ; N.S.W., Broken Hill.

†† TALIS EREMENOPA.

Talis eremenopa, Low., Tr. R.S.S.A. 1903, p. 51.

V., Stawell.

†† TALIS MESOCHRA.

Talis mesochra, Low., Report Horn Expedition 1896.

Central Australia.

TALIS ISODETA, *n. sp.*

Talis isodeta, Meyr., M.S.

ἰσοδετος, with equal lines.

♂ 11 mm. Head and thorax grey. Palpi long (6); grey. Antennae grey; in ♂ shortly ciliated (½). Abdomen (broken). Legs pale grey. Forewings triangular, costa gently arched, apex rounded, termen rounded, oblique; grey mixed with whitish; an outwardly curved whitish line from ⅓ costa to ⅓ dorsum, its outer edge marked by a suffused grey line; a minute grey discal dot above middle; a whitish line from ¾ costa to ¾ dorsum, slightly crenulate and outwardly curved in disc, its inner edge marked by a suffused grey line, its outer by a very fine grey line; cilia grey with a darker basal line, apices whitish. Hindwings with termen rounded; veins 4 and 5 stalked; grey; cilia whitish with a grey line near bases.

A small and inconspicuous species with comparatively broad forewings.

Type in Coll. Lyell.

V., Gisborne, in February; one specimen.

TALIS XIPHOSEMA *n. sp.*

ξιφοσημος, bearing a sword-like mark.

♂. 22-24 mm. Head with frons rounded and somewhat protuberant; brownish-ochreous. Palpi long (5), brownish-ochreous. Antennae pale-grey; in ♂ slightly dentate, shortly ciliated (⅓). Thorax pale brownish-ochreous. Abdomen pale-ochreous, Legs fuscous; posterior tibiae and tarsi pale-ochreous, the latter fuscous-tinged towards apices. Forewings elongate-triangular, costa scarcely arched, apex round-pointed, termen straight, oblique; pale brownish-ochreous; a pale costal streak from ¼ to near apex, attenuated at extremities; a well-marked white median streak from base to end of cell, with a fuscous spot beneath distal extremity, its upper edge marked by dark-fuscous irroration, which is continued as a fine streak to termen; a fine white line edged with dark-fuscous irroration from median streak along fold towards tornus; four fine lines from median streak along veins, with a few dark-fuscous scales between; a well marked white terminal streak from apex to tornus; which leaves a fine terminal line of ground-colour, interrupted by 4 or 5 fine blackish dots on veins; cilia whitish, apices and a faint antemedian line pale-fuscous. Hindwings with termen rounded; veins 4 and 5 stalked; pale-ochreous; cilia pale-ochreous.

Type in Coll. Lyell.

V., Mount Macedon, near Gisborne, in April; two specimens received from Mr. G. Lyell.

TALIS EUCRASPEDA *n. sp.*

ευκρασπεδος, with handsome border.

♂ ♀ 18-22 mm. Head with short conical frontal process; whitish. Palpi long (6); fuscous, on upper surface whitish. Antennae pale-grey; in ♂ shortly pectinated (1). Thorax pale-fuscous. Abdomen pale-fuscous, basal segment, apices of segments, and tuft whitish. Legs whitish; anterior pair fuscous anteriorly. Forewings elongate-triangular, costa gently arched, in ♀ almost straight, apex acute, termen oblique, indented in middle; pale-fuscous; a broad white costal streak from base nearly to apex, attenuated at extremities, costal edge sometimes fuscous-tinged; beneath this a broad pale-fuscous streak from base to apex containing some darker fuscous scales on each margin; a suffused white median streak from about $\frac{1}{4}$, dividing posteriorly into 3 or 4 branches divided by fuscous irroration; dorsal area very pale-fuscous inclining to whitish with darker-fuscous irroration; a well-defined white terminal streak from apex to tornus, its lower half crossed by 4 or 5 narrow black bars parallel to veins; terminal edge narrowly pale-fuscous; cilia white with a fuscous line before middle, bases showing metallic reflections. Hindwings with termen rounded; veins 4 and 5 stalked; whitish; cilia whitish.

Allied to *Talis enchias*, Meyr., from which it may be distinguished by the indented termen, well-defined terminal streak and line, and metallic cilia.

Type in Coll. Turner.

Q., Warwick, in March; four specimens.

TALIS ORTHOTYPA, *n. sp.*

ὀρθοτυπος, with straight markings.

♂ 29 mm. Head pale ochreous-brown; frons with an obtuse conical protuberance. Palpi (broken). Antennae pale-grey; in ♂ dentate, shortly ciliated ($\frac{1}{3}$). Thorax pale ochreous-brown. Abdomen ochreous-whitish. Legs grey; posterior pair ochreous-whitish. Forewings elongate, somewhat dilated, costa gently arched, apex round-pointed, termen slightly sinuate, moderately oblique; pale ochreous-brown; a very narrow white costal streak; basal fifth of costal edge fuscous; a sub-costal white streak from $\frac{1}{5}$ gradually broadening to costa immediately before apex; a white median streak from base to midtermen, broad throughout, partly margined with fuscous on both sides, giving off a short tooth on lower surface shortly before termen; minute dark-fuscous terminal dots on veins; cilia white with a very faint fuscous line before middle. Hindwings with termen rounded, slightly sigmoid beneath apex; veins 4 and 5 stalked; grey-whitish; cilia whitish.

Allied to *T. opulentella*, Zel., from which it differs in the complete absence of streaks on fold and towards termen.

Type in Coll. Turner.

N.S.W., Katoomba district, in February; one specimen in good condition except palpi.

TALIS HAPLOTYPA, *n. sp.*

ἁπλοτυπος, simply marked.

♂ 25-29 ♏♏. Head and thorax ochreous-grey. Palpi moderately long (5); grey, bases white. Antennae dark-fuscous; in ♂ slightly serrate, shortly ciliated (½). Abdomen whitish, base suffused with grey; a dark-fuscous transverse bar on dorsum of each segment; tuft whitish. Legs grey; posterior femora and tibiae whitish. Forewings elongate, costa very slightly arched, apex acute, termen slightly sinuate, very oblique; ochreous-grey; a narrow whitish costal streak from near base to near apex; beneath this is a sharply defined ochreous-grey streak from base to apex; a median whitish streak from base broadening slightly to termen, its lower edge ill-defined; cilia whitish; slightly greyish-tinged above tornus. Hindwings with termen rounded; vein 5 absent; whitish-grey, darker towards termen; cilia whitish, with a grey basal line obsolete towards apex.

Type in Coll. Turner.

N.S.W., Ben Lomond (4500 ft.), in January; four specimens.

SUB FAM. CHRYSAUGINAE.

A group of moderate size mostly confined to South America, but with a few Indo-Malayan and Australian species. It is distinguished from the *Pyralinae* by the absence of maxillary palpi.

A. Palpi ascending ... ... 1. *Curicta.*
AA. Palpi porrect.
B. Forewings with vein 10 absent ... 2. *Drymiarcha.*
BB. Forewings with vein 10 present ... 3. *Anemosa.*

Gen. 1 CURICTA.

Curicta, Wlk., Brit. Mus. Cat. xxxiv, p. 1129. Hmps., P.Z.S. 1897, p. 682.

CURICTA OPPOSITALIS.

Curicta oppositalis, Wlk., Brit. Mus. Cat. xxxiv, p. 1130.

N.Q., Cairns; one specimen taken by Mr. C. J. Wild (Queensland Museum).

Also from New Guinea.

Gen. 2 DRYMIARCHA.

Drymiarcha, Meyr., Tr. E.S. 1885, p. 441. Hmps., P.Z.S. 1897, p. 645.

DRYMIARCHA EXANTHES.

Drymiarcha exanthes, Meyr., Tr. E.S. 1885, p. 441.

N.S.W., Sydney; V., Gisborne, in September (Lyell).

Gen. 3 ANEMOSA.

Anemosa, Wlk., Brit. Mus. Cat. xix, p. 849. Meyr., Tr. E.S. 1887, p. 193. Hmps., P.Z.S. 1897, p. 682.

ANEMOSA ISADALIS.

Anemosa isada(as)alis, Wlk., Brit. Mus. Cat. xix, p. 849. Meyr., Tr. E.S. 1887, p. 194.

N.Q., Townsville; Q., Brisbane; N.S.W., Newcastle, Sydney.

SUB FAM. PYRALINAE.

A sub-family of moderate size which is proportionately well represented in Australia. I have included here the *Epipaschianae*, *Pyralinae*, and *Endotrichinae* of Sir Geo. Hampson. The distinctions between these groups, though convenient for purposes of tabulation, are, I think, of not more than generic value. In the difficult *Epipaschia* group I have departed from Hampson's classification. His tabulation contains characters which, as pointed out by Mr. Meyrick (Tr. E.S. 1887, p. 187), vary within the limits of the same species, and the distinctions given by him between the genera *Macalla*, *Stericta*, and *Orthaga*, are not easy to apply in practice. Here, as in some other groups, a classification founded on the sexual characters will, I think, prove more natural and more convenient.

A. Forewings without raised scales.
  B. Hindwings with vein 7 anastomosing with 8 (*Endotrichinae*, Hampson)
    C. Palpi ascending.
      D. Forewings with 11 anastomosing with 12 ... ... 1. *Persicoptera.*
      DD. Forewings with 11 free.
        E. Forewings with 4 and 5 stalked or closely approximated for some distance towards base.

F. Palpi stout, second joint thickened with scales anteriorly. ... 2. *Endotricha.*

FF. Palpi slender, second joint not thickened.

G. Palpi exceeding vertex, second joint with tuft of hair on inner side of apex ... ... 5. *Gauna.*

GG. Palpi not reaching vertex, second joint without apical tuft ... 3. *Scenedra.*

EE. Forewings with 4 and 5 separate and diverging from base.

F. Palpi short, not nearly reaching vertex, second joint rough-scaled 4. *Scenidiopis.*

FF. Palpi reaching vertex, second joint smooth-scaled ... ... 6. *Curena.*

CC. Palpi porrect.

D. Palpi with second joint bearing an apical tuft ... ... 7. *Diplopseustis.*

DD. Palpi with second joint not tufted.

E. Maxillary palpi with long apical tuft.

F. Palpi down-curved at extremity and hollow to receive the brush-like maxillary palpi ... ... 8. *Trieropis*

FF. Palpi not down-curved nor hollow 9. *Trichophysetis*

EE. Maxillary palpi strongly dilated with scales.

F. Forewings with basal half of cell constricted ... . . 11. *Syntonarcha.*

FF. Forewings with basal half of cell not constricted ... ... 10. *Myrmidonistis*

EEE. Maxillary palpi filiform or but slightly dilated at apex.

F. Palpi with 2nd joint bearing long hairs beneath ... ... 13. *Oenogenes.*

FF. Palpi not hairy.

G. Forewings with 10 anastomosing with 9 ... ... 12. *Centropseustis.*

GG. Forewings with 10 free ... 14. *Cotachena.*

BB. Hindwings with vein 7 not anatomosing with 8 (*Pyralinae* Hampson).

C. Palpi ascending.

D. Forewings with 4 and 5 stalked or closely approximated for some distance towards base.
E. Palpi with terminal joint less than ½ second.
F. Tongue absent ... ... 15. *Aglossa.*
FF. Tongue present.
G. Palpi with terminal joint ascending in a line with second.
H. Forewings with 9 from 8 before 7 16. *Hypsopygia.*
HH. Forewings with 7 from 8 before 9 ... ... 17. *Pyralis.*
GG. Palpi with terminal joint bent forwards at an angle with second... 18. *Herculia.*
EE. Palpi with terminal joint nearly as long as second ... ... 19. *Vitessa.*
DD. Forewings with 4 and 5 separate and diverging from base ... ... 21. *Cardamyla.*
CC. Palpi porrect ... ... 22. *Bostra.*
AA. Forewings with raised scales (*Epipaschianae*, Hampson).
B. Palpi ascending.
C. Hindwings with 7 anastomosing with 8 for some distance.
D. ♂ with long antennal process reaching beyond thorax ... ... 23. *Titanoceros.*
DD. ♂ with moderate antennal process not reaching beyond mid-thorax 24. *Nyctereutica.*
DDD. ♂ without antennal process ... 25. *Arnatula.*
CC. Hindwings with 7 free or rarely anastomosing only very shortly with 8.
D. Forewings with 4 and 5 stalked ... 26 *Spectratrota.*
DD. Forewings with 4 and 5 separate.
E. ♂ antennae with basal process.
F. ♂ maxillary palpi brush-like, and received into dilated labial palpi 28. *Macalla.*
FF. ♂ maxillary palpi filiform, labial palpi alike in both sexes ... 29. *Epipaschia.*
EE. ♂ antennae without basal process.
F. ♂ maxillary palpi brush-like, and received into dilated labial palpi 27. *Heterobela.*

FF. ♂ maxillary palpi filiform, labial
palpi alike in both sexes ... 30. *Orthaga.*

BB. Palpi porrect ... ... 31. *Doddiana.*

I have not been able to examine the characters of *Hypsidia*, Roths.

Gen. 1. PERSICOPTERA.

Persicoptera, Meyr., Tr. E.S. 1884, p. 283. Hmps., Tr. E.S. 1896, p. 487.

PERSICOPTERA PULCHRINALIS.

Endotricha pulchrinalis, Gn., Lep. viii, p. 220, Pl. iii., f. 7.

Scopula gavisalis, Wlk., Brit. Mus. Cat. xxxiv., p. 1475.

N.S.W., Sydney, Bathurst; V., Bendigo; T., ———; S.A., Mount Lofty; W.A., Perth.

Gen. 2. ENDOTRICHA.

Endotricha, Zel., Isis. 1847, p. 593. Hmps., Tr. E.S. 1896, p. 481.

ENDOTRICHA DISPERGENS.

Endotricha dispergens, Luc., P.L.S.N.S.W. 1891, p. 306.

Q., Brisbane.

†ENDOTRICHA LOBIBASALIS.

Endotricha lobibasalis, Hmps.

N.Q., Cooktown.

ENDOTRICHA MESENTERIALIS.

Doththa mesenterialis, Wlk., Brit. Mus. Cat. xvii. p. 285.

Endotricha obscura, Butl., Tr. E.S. 1886, p. 427.

Endotricha mesenterialis, Hmps., Moths Ind. iv., p. 133.

N.Q., Townsville, Mackay; Q. Rockhampton, Brisbane; Also from Java, Borneo, Formosa, Ceylon and India.

ENDOTRICHA PYROSALIS.

Endotricha pyrosalis, Gn., Lep. viii, p. 219.

Endotricha ignealis, Gn., Lep. viii, p. 220.

Messatis sabirusalis, Wlk., Brit. Mus. Cat. xix., p. 918.

Pacoria albifimbiralis, Wlk., Brit. Mus. Cat. xxxiv., p. 1255.

Tricomia auroralis, Wlk., Brit. Mus. Cat. xxxiv., p. 1259.

Rhodaria robina, Butl., A.M.N.H. (5) x., p. 26.

Q., Duaringa, Brisbane, Toowoomba, Stanthorpe; N.S.W., Newcastle, Gosford, Sydney; V., Melbourne; T., Launceston, Hobart; W.A., Albany, Perth, Northampton.

ENDOTRICHA DOCILIS.

Pyralis docilisalis, Wlk., Brit. Mus. Cat. xix., p. 913.

Endotricha aethopa, Meyr., Tr. E.S. 1884, p. 79.

Q., Brisbane, Killarney; N.S.W., Sydney.

† ENDOTRICHA STILBEALIS.

Pyralis stilbealis, Wlk., Brit. Mus. Cat. xix., p. 913.

Endotricha heliopa, Meyr., Tr. E.S. 1884, p. 78.

I am unable, owing to lack of material, to be certain as to the distinctness of this species.

N.S.W., Sydney.

ENDOTRICHA COMPSOPA.

Endotricha compsopa, Meyr., Tr. E.S. 1887, p. 195.

Q., Duaringa, Brisbane, Toowoomba.

ENDOTRICHA PUNCTICOSTALIS.

Rhisina puncticostalis, Wlk., Brit. Mus. Cat. xxxiv., p. 1324.

Endotricha ustalis, Snel., Tijd. v. Ent. 1880, p. 201, and 1883, Pl. vi., f. 7.

Endotricha puncticostalis,, Meyr., Tr. E.S. 1884, p. 79.

N.Q., Geraldton, Townsville; Q., Duaringa, Peak Downs, Bundaberg, Brisbane, Stradbroke I., Rosewood, Dalby; N.W.A., Roeburne. Also from Java and Celebes.

†† ENDOTRICHA CROBULUS.

Endotricha crobulus, Luc. P.L.S.N.S.W. 1891, p. 305.

Q., Rockhampton, Peak Downs.

†† ENDOTRICHA AGLAOPA.

Endotricha aglaopa, Meyr., Tr. E.S. 1887, p. 196.

Victoria.

ENDOTRICHA DESMOTONA.

Endotricha desmotona, Low., Tr. R.S.S.A. 1903, p. 60.

N.Q., Townsville, in April; two specimens received from Mr. F. P. Dodd. With regard to Mr. Lower's locality compare notes under *Homoeosoma melanosticta* and *Trissonca proleuca*.

ENDOTRICHA PYROCAUSTALIS.

Endotricha pyrocaustalis, Low., Tr. R.S.S.A. 1903, p. 60.

♂ antennal ciliations long (4).

I have seen the type. The forewings are very like *E. psammitis*, but the ♂ antennal ciliations are much longer, and the hindwings have a well-defined median band obsolete towards costa only.

Q., Brisbane, in October.

ENDOTRICHA CHIONOCOSMA.

χιονοκοσμος, with snowy ornament.

♀ 28 mm. Head, palpi, thorax, and abdomen dull purplish somewhat ochreous-tinged. Antennae ochreous-whitish. Legs whitish-ochreous mixed with dark fuscous and reddish-purple. Forewings elongate-triangular, costa straight, slightly arched before apex, apex round-pointed; termen bowed, oblique finely waved; reddish-purple, towards dorsum inclining to fuscous; distal half of disc finely irrorated with dark-fuscous; costal edge dark-fuscous interrupted by numerous small whitish spots each of which has a minute central dark-fuscous dot; a faint whitish line from $\frac{1}{4}$ costa slightly outwards, then bent inwards beneath costa to end in $\frac{1}{4}$ dorsum; an inconspicuous subcostal fuscous dot in middle; an elongate whitish mark on costa near apex, bordered by fuscous, and giving rise to a fine double fuscous line to tornus; a fine interrupted dark-fuscous terminal line; cilia bases reddish-purple, apices whitish, with a dark-fuscous apical hook, and interrupted median line. Hindwings with termen rounded, finely waved; colour, irroration, and cilia as forewings; a broad fascia before middle, finely edged with dark-fuscous; its centre clear white, both extremities irrorated with reddish-purple and ferrugineous. Underside similar, but forewings with discal dot more distinct and with a large dark-fuscous terminal blotch, bounded by a fine whitish dentate line, which is much bent inwards in disc; hindwings with much dark-fuscous irroration on each side of fascia, and a fine dentate whitish line beyond fascia.

Type in Coll. Turner.

N.Q., Cairns, in June, one specimen.

ENDOTRICHA PSAMMITIS *n. sp.*

ψαμμιτις, sandy.

♂ 22 mm. Head, thorax and palpi dull-ochreous. Antennae dull-ochreous; in ♂ moderately ciliated (1). Abdomen with lateral and dorsal tufts on last three segments of ♂; dull-ochreous with a few reddish-purple scales, middle segments suffused with fuscous. Legs dull-ochreous sparsely irrorated with fuscous and reddish-purple. Forewings elongate triangular, costa slightly concave in middle, rather strongly arched towards apex, apex round-pointed, termen bowed, oblique; dull-ochreous sparsely irrorated with reddish-purple and fuscous; a costal series of dull-ochreous spots, interrupted and edged by dark fuscous; a pale line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum bounding a darker basal area; a fuscous subcostal spot in middle; an indistinct pale line from $\frac{5}{6}$ costa to tornus; a fine interrupted fuscous terminal line; cilia bases reddish-purple, apices whitish, with a fuscous apical dot at apex. Hindwings with termen rounded; colour and irroration as forewings; four suffused reddish-purple spots on inner margin, and two short curved lines of similar colour in mid-disc; cilia with a dark-fuscous median line towards tornus.

Type in Coll. Turner.

N.Q., Townsville, in September; two specimens received from Mr. F. P. Dodd.

ENDOTRICHA HEMICAUSTA, *n. sp.*

ἡμικαυστος, half-burnt, scorched.

♂ 18 mm. Head, palpi and thorax whitish-ochreous mixed with dark-fuscous and dull-purplish. Antennae grey-whitish; in ♂ moderately ciliated (1). Abdomen dark-fuscous, base and apex mostly dull-ochreous. Legs dark-fuscous mixed with whitish-ochreous. Forewings triangular, costa straight except just before apex, apex round-pointed, termen bowed, oblique; whitish-ochreous mixed with dark-fuscous and dull-purplish; costal edge dark-fuscous interrupted by pale dots; a dark triangular basal patch bounded by an indistinct pale somewhat dentate line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum; a pale median area; posterior area much suffused with dark-fuscous; an interrupted dark-fuscous terminal line; cilia (imperfect but apparently as in hindwings). Hindwings with termen rounded; pale-ochreous; narrowly suffused near termen with reddish-purple; an interrupted dark-fuscous terminal line; cilia whitish, bases purplish-tinged, with a broad median fuscous line.

Type in Coll. Turner.

N.Q., Townsville, in April; one specimen received from Mr. F. P. Dodd.

Gen. 3. SCENEDRA.

Scenedra, Meyr., Tr. E.S. 1884, p. 75. Hmps., Tr. E.S. 1896, p. 486.

SCENEDRA DECORATALIS.

Pyralis decoratalis, Wlk., Brit. Mus. Cat. xxxiv., p. 1242.

Pyralis (?) contentalis, Wlk., Brit. Mus. Cat. xxxiv., p. 1247.

Scenedra decoratalis, Meyr., Tr. E.S. 1884, p. 76.

Q., Duaringa, Brisbane; N.S.W., Newcastle, Sydney; V., Melbourne.

Gen. 4. SCENIDIOPIS, *nov.*

σκηνιδιον, a little tent; from its resting with tilted wings.

Frons smooth. Palpi upturned, short, not nearly reaching vertex. Antennae of ♂ ciliated. Patagia in ♂ not elongated. Middle tibiae in ♂ densely scaled. Forewings with vein 1 not furcate at base, 4 and 5 separate and diverging from base; 7, 8, 9 stalked; 10, 11 free. Hindwings with 4 and 5 separate, not approximated, 7 anastomosing shortly with 8.

Closely allied to *Scenedra*, Meyr.

SCENIDIOPIS CHIONOZYGA.

Persicoptera chionozyga, Low., Tr. R.S.S.A. 1903, p. 60.

♂ 16 mm. Head brown. Palpi dark fuscous, apical joint brown. Antennae ochreous-whitish; in ♂ with long ciliations (3). Thorax and abdomen whitish-ochreous mixed with fuscous. Legs dark fuscous, irrorated and tarsi annulated with whitish-ochreous. Forewings triangular, costa straight, slightly arched near apex, apex rounded, termen bowed, oblique; fuscous; two fine, white, slightly outwardly curved lines, first from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, second from $\frac{3}{4}$ costa to $\frac{3}{4}$ dorsum; an obscure ferrugineous suffusion near base, and two others before apex and tornus; terminal area paler; an interrupted dark-fuscous terminal line; cilia fuscous with a grey-whitish median line. Hindwings with termen rounded; dark-grey; a fine whitish line beyond middle; terminal line and cilia as forewings.

N.Q., Geraldton, in November; one specimen. Mackay? (Lower).

Gen. 5. GAUNA.

Gauna, Wlk., Brit. Mus. Cat. xxxiv., p. 1252. Hmps., Tr. E.S. 1896, p. 486.

Oedematophaga, Meyr., Tr. E.S. 1884, p. 73.

GAUNA AEGALIS.

Pyralis aegusalis, Wlk., Brit. Mus. Cat. xix, p. 912.

Gauna subferralis, Wlk., Brit. Mus. Cat. xxxiv., p. 1253.

Oedematophaga aegalis, Meyr., Tr. E.S. 1884, p. 74.

Q., Brisbane; V., Melbourne.

Gen. 6. CURENA.

Curena, Wlk., Brit. Mus. Cat. xxxiv., p. 1253. Hmps., Tr. E.S. 1896, p. 516.

In two specimens I have examined vein 7 of hindwings anastomoses shortly with 8. Sir Geo. Hampson describes them as separate. Possibly this point may be variable, but if so Hampson's subfamilies *Endotrichinae* and *Pyralinae* can hardly be kept separate.

CURENA EXTERNALIS.

Curena externalis, Wlk., Brit. Mus. Cat. xxxiv., p. 1253.

Scenedra ? externalis, Meyr., Tr. E.S. 1884, p. 77.

Oedematophora cacaalis, Luc., P.L.S.N.S.W. 1891, p. 306.

Q., Brisbane; N.S.W., Sydney.

Gen. 7. DIPLOPSEUSTIS.

Diplopseustis, Meyr., Tr. E.S. 1884, p. 284; Hmps., Tr. E.S. 1896, p. 489.

DIPLOPSEUSTIS PERIERESALIS.

Ambia ? perieresalis, Wlk., Brit. Mus. Cat. xix., p. 958.

Cymoriza minima, Butl., P.Z.S. 1880, p. 684.

Diplopseustis minima, Meyr., Tr. E.S. 1884, p. 285.

Q., Bundaberg, Brisbane; N.S.W., Sydney; V., Melbourne. Also from New Zealand.

†† DIPLOPSEUSTIS PROPHETICA.

Diplopseustis prophetica, Meyr., Tr. E.S. 1887, p. 198.

V., Warragul.

Gen. 8. TRIEROPIS.

Trieropis, Meyr., Tr. E.S. 1886, p. 218. Hmps., Tr. E.S. 1896, p. 490.

† TRIEROPIS NESIAS.

Trieropis nesias, Meyr., Tr. E.S. 1886, p. 218.

N.Q., Cooktown (British Museum); also from Tonga.

Gen. 9. TRICHOPHYSETIS.

Trichophysetis, Meyr., Tr. E.S. 1884, p. 287. Hmps., Tr. E.S. 1896, p. 491.

TRICHOPHYSETIS CRETACEA.

Hydrocampa cretacea, Butl., Ill. Het. iii., p. 75, Pl. 59, f. 8.

Trichophysetis neophyla, Meyr., Tr. E.S. 1884, p. 287.

Trichophysetis crocoplaga, Low., Tr. R.S.S.A. 1903, p. 61.

Trichophysetis fulvifusalis, Low., Tr. R.S.S.A. 1903, p. 61.

Very variable in coloration, details, and intensity of marking. Mr. Lower's types are extreme examples, and I reserve my final opinion as to their distinctness.

N.Q., Cooktown, Townsville; Q., Brisbane, Rosewood, Mount Tambourine, Killarney; N.S.W., Sydney; also from Norfolk Island, Japan, and Amur.

Gen. 10. MYRMIDONISTIS.

Myrmidonistis, Meyr., Tr. E.S. 1887, p. 196. Hmps., Tr. E.S. 1896, p. 494.

†† MYRMIDONISTIS HOPLORA.

Myrmidonistis hoplora, Meyr., Tr. E.S. 1887, p. 197.

Q.

Gen. 11. SYNTONARCHA.

Syntonarcha, Meyr., P.L.S.N.S.W. 1889, p. 1107. Hmps., Tr. E.S. 1896, p. 496.

SYNTONARCHA IRIASTIS.

♂ *Syntonarcha iriastis*, Meyr., P.L.S.N.S.W. 1889, p. 1107.

♀ *Syntonarcha vulnerata*, Luc., P.L.S.N.S.W. 1893, p. 157.

The two sexes are very different, but Mr. F. P. Dodd has proved their relationship by rearing both from the larvae. The ♀ is variable.

The larvae were, I am informed, found on the flowers and young foliage of a small-leaved variety of *Melaleuca*. They cut holes in the papery bark to pupate in.

N.A., Port Darwin; N.Q., Geraldton, Townsville; Q., Brisbane, Southport.

Gen. 12. CENTROPSEUSTIS.

Centropseustis, Meyr., P.L.S.N.S.W. 1889, p. 1105. Hmps., Tr. E.S. 1896, p. 496.

† CENTROPSEUSTIS ASTRAPORA.

Centropseustis astrapora, Meyr., P.L.S.N.S.W. 1889, p. 1106.

N.S.W., Sydney.

Gen. 13. OENOGENES.

Oenogenes, Meyr., Tr. E.S. 1884, p. 75; Hmps., Tr. E.S. 1896, p. 497.

OENOGENES FUGALIS.

Botys ? fugalis,, F. and R., Reise Nov. Pl. 134, f. 37.

Oenogenes fugalis, Meyr., Tr. E.S. 1884, p. 75.

V., Melbourne, Gisborne; T., Launceston, Deloraine, Hobart; S.A., Mt. Graham.

Gen. 14. COTACHENA.

Cotachena, Moore, Lep. Ceyl. iii., p. 275; Hmps., Tr. E.S. 1896, p. 497.

A genus apparently related to the *Pyraustinae*.

COTACHENA HISTRICALIS.

Botys histricalis, Wlk., Brit. Mus. Cat. xviii., p. 655; *Cotachena histricalis*, Hmps., Ill. Het. ix. Pl. 172, f. 5, Moths Ind. iv., p. 142.

N.Q., Townsville, in April; one specimen received from Mr. F. P. Dodd. Also from China, Ceylon, and India.

COTACHENA ALUENSIS.

Cotachena aluensis, Butl., A.M.N.H. 1887, p. 123.

Q., Brisbane; one specimen received from Mr. F. P. Dodd. Also from Solomon Islands.

Gen. 15. AGLOSSA.

Aglossa, Latr., Gen. Ins., p. 145. Hmps., Tr. E.S. 1896, p. 505.

AGLOSSA PINGUINALIS.

Phalaena pinguinalis, Linn., Faun, Suec., p. 351.

Aglossa pinguinalis, Meyr., Brit. Lepid., p. 428.

V., Melbourne; T. Hobart; also from India, Western Asia and Europe. An introduced species.

AGLOSSA CUPREALIS.

Aglossa cuprealis, Hb., Verz., p. 348. Meyr., Brit. Lepid., p. 428.

Q., Brisbane; N.S.W., Newcastle, Sydney; also from Central Asia, Europe, and North America. An introduced species.

Gen. 16. HYPSOPYGIA.

Hypsopygia, Hb., Verz., p. 348. Hmps., Tr. E.S. 1896, p. 507.

HYPSOPYGIA MAURITIALIS.

mauritialis, Bdv., Faun. Madag., p. 119, Pl. xvi., f. 8.

Pyralis ducalis, Wlk., Brit. Mus. Cat. xvii., p. 1242.

Asopia ducalis, Meyr., Tr. E.S. 1887, p. 192.

N.Q., Cooktown, Townsville, Mackay; Q., Brisbane; also from Java, Celebes, Sumatra, China, India, and Madagascar.

Gen. 17. PYRALIS.

Pyralis, Linn., Syst. Nat. xii., p. 881. Hmps., Tr. E.S. 1896, p. 507.

†† PYRALIS CAUSTICA.

Asopia caustica, Meyr., Tr. E.S. 1884, p. 282.

Q., Duaringa.

PYRALIS FARINALIS.

Pyralis farinalis, Linn., Meyr., Brit. Lep., p. 427.

Q., Nambour, Brisbane, Toowoomba, Stanthorpe; N.S.W., Glen Innes, Sydney; V., Melbourne, Gisborne; S.A., Adelaide; W.A., Albany, York.

Also from New Zealand, Japan, Western Asia, Europe, North America, and South America. An introduced species probably now cosmopolitan.

PYRALIS MANIHOTALIS.

Pyralis manihotalis, Gn., Lep. viii, p. 121.

Pyralis gerontesalis, Wlk., Brit. Mus. Cat. xix, p. 896.

N.Q., Cooktown; Q., Brisbane; also from India and South America.

Gen. 18. HERCULIA.

Herculia, Wlk., Brit. Mus. Cat. xix, p. 807. Hmps., Tr. E.S. 1896, p. 517.

Ocrasa, Wlk., Brit. Mus. Cat. xxxiv, p. 1212. Meyr., Tr. E.S. 1884, p. 72.

HERCULIA DECOLORALIS.

Asopia decoloralis, Led., Wien. Ent. Mon. 1863, p. 343, Pl. vi, f. 10.

N.Q., Geraldton, Townsville; Q., Duaringa, Brisbane; N.S.W., Sydney.

HERCULIA ALBIDALIS.

Ocrasa albidalis, Wlk., Brit. Mus. Cat. xxxiv, p. 1212. Meyr., Tr. E. S. 1884, p. 73.

Spilodes (?) rhodocryptalis, Wlk., Brit. Mus. Cat. xxxiv, p. 1474.

Q., Peak Downs, Nambour, Brisbane; N.S.W., Sydney; V., Birchip; S.A., Mt. Lofty.

HERCULIA ACERASTA.

ἀκεραστος, unmixed; without markings on wings.

♂ ♀, 26-32 mm. Head and palpi dull-pinkish mixed with ochreous. Antennae whitish-ochreous, ciliations in ♂ 2. Thorax and abdomen whitish-grey tinged with ochreous. Legs dull-pinkish; anterior femora of ♂ without tuft. Forewings triangular, costa straight except close to base and apex, apex rounded, termen oblique, slightly rounded; whitish-grey tinged with ochreous, in ♀ with pinkish; costa narrowly ochreous; cilia dull-pinkish, bases ochreous-tinged, a median fuscous line, apices whitish. Hindwings with termen rounded, colour and cilia as forewings.

Extremely similar to *H. albidalis*, but the forewings are entirely devoid of discal dot and transverse lines. The ♂ is distinguishable with certainty by the absence of an anterior femoral tuft.

Type in Coll. Turner.

Q., Brisbane, from November to January, four specimens; V., Gisborne, in March; one specimen received from Mr. G. Lyell.

Gen. 19. VITESSA.

Vitessa, Moore, Lep. E. I. Co., p. 299. Hmps., Tr. E.S. 1896, p. 502.

† VITESSA GLAUCOPTERA.

Vitessa glaucoptera, Hmps.

N.Q.

Gen. 20. HYPSIDIA.

Hypsidia, Roths.

† HYPSIDIA ERYTHROPSALIS.

Hypsidia erythropsalis, Roths.

N.Q., Cooktown.

Gen. 21. CARDAMYLA.

Cardamyla, Wlk., Brit. Mus. Cat. xvii., p. 282. Hmps., Tr. E.S. 1896, p. 513.

CARDAMYLA CARINENTALIS.

Cardamyla carinentalis, Wlk., Brit. Mus. Cat, xvii., p. 282.

N.Q., Townsville ; Q., Duaringa, Brisbane, Dalby, Killarney ; N.S.W., Newcastle, Sydney, Kiama.

CARDAMYLA DIDYMALIS.

Cardamyla didymalis, Wlk., Brit. Mus. Cat. xvii., p. 283.

Balanotis ? didymalis, Meyr., Tr. E.S. 1884, p. 69.

Balanotis arctandalis, Luc., P.L.S.N.S.W. 1889, p. 1098.

N.Q., Cape York ; Q., Nambour, Brisbane, Killarney ; N.S.W., Newcastle.

†† CARDAMYLA HERCOPHORA.

Balanotis hercophora, Meyr., P.L.S.N.S.W. 1884, p. 281.

N.A., Port Darwin.

Gen. 22. BOSTRA.

Bostra, Wlk., Brit. Mus. Cat. xxvii., p. 123 ; Hmps., Tr. E.S. 1896, p. 583.

BOSTRA DISTICHA. *n. sp.*

διστιχος, with two lines.

♀. 29 mm. Head, thorax, palpi, and antennae, dull purplish-brown. Abdomen ochreous-whitish irrorated with fuscous ; apices of segments faintly pinkish-tinged. Legs purplish irrorated with dark-fuscous ; tarsi whitish-ochreous ; anterior tarsi dark-fuscous anteriorly. Forewings triangular, costa straight except near base and apex, apex rounded, termen oblique, rounded ; purplish-brown, finely and sparsely irrorated with fuscous ; a fuscous discal dot above middle ; two whitish transverse lines : first slightly dentate, from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum ; second slightly waved from $\frac{2}{3}$ costa to $\frac{1}{4}$ dorsum ; cilia fuscous mixed with whitish-ochreous and pinkish. Hindwings with termen rounded ; whitish-ochreous suffused with fuscous, towards termen pinkish-tinged ; cilia as forewings.

Type in Coll. Turner.

N.Q., Townsville, in January ; one specimen received from Mr. F. P. Dodd ; Q., Brisbane ; one specimen in Coll. Illidge, and another in the Queensland Museum.

Gen. 23. TITANOCEROS.

Titanoceros, Meyr., Tr. E.S. 1884, p. 62.

A small but very natural Australian genus, which Sir Geo. Hampson merges with the South American genus *Jocara*, Wlk., in which the male antennal processes are short, the maxillary palpi brush-like, and the labial palpi dilated. In *Titanoceros* the maxillary palpi are filiform.

TITANOCEROS CATAXANTHA.

Titanoceros cataxantha, Meyr., Tr. E.S. 1884, p. 63.

Q., Brisbane. N.S.W., Sydney.

TITANOCEROS THERMOPTERA.

Jocara thermoptera, Low., Tr. R.S.S.A. 1903, p. 59.

Q., Brisbane, two specimens received from Mr. F. P. Dodd. According to Mr. Lower also from Broken Hill, N.S.W., but I have no doubt that this is an error.

TITANOCEROS POLIOCHYTA, *n. sp.*

πολιοχυτος, suffused with grey.

♂ ♀ 18-21 mm. Head whitish. Palpi whitish irrorated with dark-fuscous. Antennae whitish; in ♂ with very long basal process reaching beyond thorax, fuscous mixed with whitish; ciliations $2\frac{1}{2}$. Thorax whitish. Abdomen whitish suffused with grey. Legs whitish mixed with fuscous. Forewings triangular, costa straight, arched towards apex, apex rounded, termen moderately oblique, slightly rounded; whitish partly suffused with grey; a subcostal ridge of long raised whitish and blackish scales; a broad costal streak to $\frac{2}{3}$, fuscous mixed with whitish and purple-reddish scales; a fuscous dot on midcosta giving rise to a very faint undulating fuscous line to mid-termen; a similar line from $\frac{3}{4}$ costa to $\frac{3}{4}$ termen angled outwards in disc, and dentate beneath angulation; this is bounded posteriorly by a pale line; cilia whitish, bases barred with fuscous. Hindwings with termen rounded; colour as forewings; a patch of long raised whitish and blackish scales in mid-disc, continued along veins towards termen; cilia as forewings.

Type in Coll. Turner.

N.Q., Townsville, in December; two specimens received from Mr. F. P. Dodd, who found the larvae feeding gregariously on the leaves of *Melaleuca leucodendron*, which they fastened together with silk.

Gen. 24. Nyctereutica, *nov.*

νυκτερευτικος, dark, nocturnal.

Frons flattened. Tongue well developed. Labial palpi ascending, slightly exceeding vertex. Antennae in ♂ with densely scaled process from basal joint not reaching mid-thorax. Forewings with cell open, 2 from $\frac{2}{3}$, 3 from near 2, 4 and 5 approximated at base, 7, 8 and 9 stalked, 7 arising before 9. Hindwings with 4 and 5 stalked, 7 anastomosing strongly with 8.

Type *N. asbolopis.*

†NYCTEREUTICA ELASSOTA.

Catamola elassota, Meyr., Tr. E.S. 1884, p. 280.

S.A., Quorn ; N.W.A., Sherlock River (British Museum).

NYCTEREUTICA CAPNOPIS.

Catamola capnopis, Meyr., Tr. E.S. 1885, p. 438.

N.S.W., Mt. Kosciusko (4500 ft.), Ben Lomond (4500 ft.), in January.

NYCTEREUTICA ASBOLOPIS, *n. sp.*

ἀσβολωπις, like soot.

♂. 13-15 mm. Head, thorax, palpi, and antennal processes black. Antennae grey annulated with black; in ♂ simple, moderately ciliated ($\frac{2}{3}$). Abdomen dark fuscous, apices of segments whitish. Legs dark fuscous irrorated with whitish. Forewings triangular, costa moderately arched, apex rounded, termen slightly rounded, oblique ; in ♂ with a rounded glandular swelling on costa at $\frac{1}{3}$; blackish ; a few white scales above $\frac{1}{4}$ dorsum indicating antemedian line ; a postmedian erect white line from $\frac{3}{4}$ dorsum, slightly indented inwards below middle, not reaching costa ; a few scattered white scales in costal and terminal portions of disc ; cilia dark fuscous. Hindwings with termen rounded ; fuscous ; cilia fuscous.

Type in Coll. Turner.

N.Q., Townsville, in January and May ; three specimens received from Mr. F. P. Dodd.

Gen. 25. Arnatula.

Arnatula, Staud., Iris. vi., p. 78 (1893). Hmps., Tr. E.S. 1896, p. 454.

†† ARNATULA TORNOTIS.

Stericta ? tornotis, Meyr., Tr. E.S. 1887, p. 188.

Q., Helidon.

ARNATULA TYMPANOPHORA, *n. sp.*

τυμπανοφορος, bearing a tympanum or drum.

♂ 22 mm. Head and thorax whitish mixed with grey. Labial palpi fuscous finely irrorated with whitish; second joint in ♂ dilated and considerably exceeding vertex. Maxillary palpi not visible in type but probably brush-like and concealed in second joint of labial palpi. Antennae brown-whitish; in ♂ without process from basal joint, simple, moderately ciliated (1). Abdomen whitish irrorated with dark-fuscous, towards base suffused with pale brownish. Legs whitish irrorated with dark-fuscous; tarsi dark-fuscous annulated with whitish. Forewings elongate-triangular, costa gently arched, apex rounded, termen rounded, oblique; in ♂ with a small glandular thickening preceded by a tuft of scales on mid-costa, beneath this in disc is a depressed, oblong, thinly scaled, translucent area, which on under surface is preceded by a tuft of dark-grey scales; whitish-grey with scattered dark-fuscous scales; costal tuft and a spot beneath it in disc dark-fuscous; a very faint outwardly curved dark-fuscous postmedian line from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum; cilia whitish mixed with fuscous. Hindwings with termen rounded; grey; towards base whitish; cilia whitish, with a median fuscous line towards apex.

Sir Geo. Hampson suggests that this may be the ♂ of the preceeding, but from the description this does not appear likely.

Type in Coll. Turner.

Q., Eumundi, near Nambour, in November; one specimen.

Gen. 26. SPECTRATROTA.

Spectratrota, Warr., A.M.N.H. (6) vii., p. 426 (1891). Hmps., Tr. E.S. 1896, p. 462.

SPECTRATROTA FIMBRIALIS.

Spectratrota fimbrialis, Warr., A.M.N.H. (6) vii. p. 427 (1891).

N.Q., Townsville; Q., Brisbane, Toowoomba, Dalby, Warwick; T. Hobart.

Gen. 27. HETEROBELLA, *nov.*

ἑτεροβελος, with different weapons; in allusion to the palpi of the sexes.

Tongue well-developed. Labial palpi ascending; in ♀ reaching vertex; in ♂ with second joint much elongated and dilated, concealing maxillary palpi. Maxillary palpi in ♂ brush-like, immensely dilated by long hairs, but usually completely concealed. Antennae in ♂ ciliated; without basal process. Forewings with veins 4 and 5 closely approximated towards base; in ♂ with a small grandular swelling on mid-costa, beneath which in disc is an oblong thinly scaled fovea, round which veins are distorted. Hindwings with veins 4 and 5 closely approximated towards base, veins 7 and separate, or very shortly anastomosing.

I view this as a development of *Macalla* with exaggerated palpi and loss of antennal processes. In structure it approaches *Arnatula*, but differs in the hindwings.

HETEROBELA TRIGLOCHIS *n. sp.*

τριγλωχις, three-forked; in allusion to the posterior line.

♂ ♀ 27-32 mm. Head, thorax and palpi grey. Antennae fuscous; in ♂ simple, moderately ciliated ($\frac{2}{3}$). Abdomen ochreous-whitish irrorated with fuscous. Legs whitish irrorated with grey; anterior and middle tarsi dark-fuscous annulated with whitish. Forewings triangular, costa scarcely arched, apex rounded, termen slightly rounded, moderately oblique; grey-whitish irrorated with dark-grey and some dark-fuscous scales; lines dark-fuscous; antemedian straight, from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, sometimes suffused; postmedian from $\frac{2}{3}$ costa obliquely outwards, forming three acute teeth in disc, then sharpely indented inwards before ending on $\frac{3}{4}$ dorsum; a more or less interrupted line from costal end of antemedian to indentation of postmedian; an interrupted dark-fuscous terminal, line; cilia whitish, bases mixed with fuscous and reddish. Hindwings with termen rounded; whitish, with a broad suffused dark-fuscous terminal band; cilia whitish with a fuscous basal line.

Var. a. Space between lines of forewings suffused with dark-fuscous.

Type in Coll. Turner.

Q., Brisbane, in October, January, February, and March, sixteen specimens.

Gen. 28. MACALLA.

Macalla, Wlk., Brit. Mus. Cat. xvi., p. 155.

Stericta, Led. Wien, Ent. Mon. vii, p. 340 (1863). Meyr., Tr. E. S. 1887, p. 187.

It will be noted that I use this and the following two generic names in a different sense to that in which they are employed by Sir Geo. Hampson.

MACALLA NUBILALIS.

Stericta nubilalis, Hmps., Ill. Het., ix, p. 157. Pl. 172, f. 9.

Sir Geo. Hampson informs me that specimens from Ceylon and Australia are exactly alike.

N.Q., Townsville, in December; two specimens received from Mr. F. P. Dodd.

MACALLA RECURVALIS.

Salma recurvalis, Wlk., Brit. Mus. Cat., xxvii, p. 107.

Balanotis recurvalis, Meyr., Tr. E.S., 1894, p 70 = *crypsaula*, Meyr, Tr. E.S., 1887, p 191.

Stericta recurvalis, Meyr., Tr. E.S., 1887, p. 189.

My material does not enable me to form any opinion as to whether Sir Geo. Hampson is correct in regarding *crypsaula*, as a synonym of *recurvalis*. Mr. Meyrick describes them as distinct.

N.S.W., Sydney; V., Melbourne; T., Launceston, Hobart.

MACALLA MARMOREA.

Stericta marmorea, Warr., A.M.N.H. (6), vii, p. 432 (1891).

T., Launceston, Hobart.

MACALLA CHOLICA.

Cacozelia cholica, Meyr., Tr. E.S. 1884, p. 66.

Q., Duaringa, Brisbane; N.S.W., Sydney; V., Melbourne, Gisborne.

† MACALLA DEMOTIS.

Stericta ? demotis, Meyr., Tr. E.S. 1887, p. 187.

W.A., Geraldton; N.W.A., Sherlock River (British Museum).

MACALLA CONCISELLA.

Matalia concisella, Wlk., Brit. Mus. Cat. xxxv., p. 1728.

N.Q., Cooktown, Townsville; Q., Nambour, Brisbane, Mount Tambourine.

†† MACALLA PRASINA.

Stericta ? prasina, Warr., A.M.N.H. (6) xvi., p. 462 (1895).

Queensland.

MACALLA THYRIDALIS.

Bertula thyrisalis, Wlk., Brit. Mus. Cat. xvi., p. 167.

Catamola thyridalis, Meyr., Tr. E.S. 1884, p. 64.

Q., Bundaberg, Brisbane; N.S.W., Sydney; W.A., Albany.

MACALLA XANTHOMELALIS.

Acrobasis ? xanthomelalis, Wlk., Brit. Mus. Cat. xxvii, p. 32.

Catamola xanthomelalis, Meyr., Tr. E.S. 1884, p. 64.

N.S.W., Sydney.

†† MACALLA FERRUGINEA.

Balanotis ferruginea, Luc., P.L.S.N.S.W. 1893, p. 156.

Q., Brisbane.

MACALLA AERUGINOSA.

Stericta aeruginosa, Luc., P.L.S.N.S.W. 1893, p. 155.

Q., Brisbane.

MACALLA ALEUROPA.

Stericta aleuropa, Low., Tr. R.S.S.A. 1903, p. 59.

♀ 31 mm. Head and thorax white finely irrorated with fuscous. Palpi white; terminal joint fuscous. Antennae grey. Legs white, with dark-fuscous spots on upper surface. Forewings triangular, costa scarcely arched, apex rounded, termen slightly rounded slightly oblique; white finely irrorated with fuscous; markings fuscous; a dot on $\frac{1}{4}$ costa from which can be traced an indistinct antemedian line; a dot on mid-costa, and another beneath it on disc; two closely approximated, nearly straight, finely dentate lines from costa about $\frac{3}{4}$, the anterior not quite reaching dorsum, the posterior thickened beneath and ending on tornus; an oval spot on termen above middle, and two dots on termen between this and apex; cilia white, bases barred with fuscous. Hindwings with termen rounded; grey; cilia grey with a whitish basal line.

Somewhat resembles *consicella*, but the postmedian line is straight, and the cilia have no pinkish tinge.

Mr. Lower's type is also a ♀.

N.Q., Mackay ? (Lower); Q., Brisbane, in October; one specimen.

MACALLA ZOPHERA *n. sp.*

ζοφερος, dusky.

♂ 25 mm. Head, thorax, and antennal processes fuscous mixed with ochreous-whitish and pale-reddish. Palpi dark-fuscous. Antennae dark-grey; in ♂ slightly serrate with short ciliations ($\frac{1}{3}$). Abdomen fuscous. Legs dark-fuscous annulated with ochreous-whitish. Forewings triangular, costa slightly arched, apex rounded, termen slightly rounded, slightly oblique; dark-fuscous mixed with ochreous-whitish and reddish scales; markings dark-fuscous; an elongate spot on costa near base; a spot on costa at $\frac{1}{4}$ from which proceeds an ill-defined interrupted line to $\frac{1}{3}$ dorsum; a discal spot beneath costa before middle; a third costal spot beyond middle giving rise to a sharply dentate line to $\frac{3}{4}$ dorsum, deeply indented above dorsum; an interrupted terminal line; cilia whitish, tinged with reddish and barred with fuscous. Hindwings with termen rounded; fuscous; cilia as forewings but less distinctly marked.

Type in Coll. Turner.

Q., Burpengary near Brisbane, in December, one specimen.

MACALLA EBENINA, *n. sp.*

ἐβενινος, black like ebony.

♂ ♀ 32-36 mm. Head, thorax, palpi and antennal processes blackish, with a few ochreous-whitish scales. Antennae dark fuscous; in ♂ simple, shortly ciliated ($\frac{1}{2}$). Abdomen ochreous-whitish, irrorated with dark fuscous. Legs, dark fuscous, irrorated and annulated with whitish. Forewings triangular, costa scarcely arched, apex rounded, termen slightly rounded, moderately oblique; blackish finely irrorated with whitish scales, which are sometimes reddish-tinged; a whitish dentate, outwardly curved line from $\frac{2}{3}$ costa to $\frac{3}{4}$ dorsum; cilia ochreous-whitish barred with dark fuscous. Hindwings with termen rounded; whitish, with a broad suffused fuscous terminal band; cilia whitish with a fuscous line at $\frac{1}{3}$.

In coloration resembles *Epipaschia costigeralis*, but the ♂ lacks the costal gland, and has structurally different palpi and antennae.

Type in Coll. Turner.

Q., Brisbane, in February; two specimens.

Gen. 29. EPIPASCHIA.

Epipaschia, Clem., Proc. Nat. Sci. Phil. 1860, p. 14· Meyr., Tr. E.S. 1887, p. 187.

EPIPASCHIA FUNEREA.

Acrobasis funerea, Wlk., Brit. Mus. Cat. xxvii., p. 31.

Catamola funerea, Meyr., Tr. E.S., 1884, p. 65.

Q., Brisbane, Southport; N.S.W., Glen Innes, Sydney; V., Melbourne; S.A., Ardrossan; W.A., Perth.

† EPIPASCHIA PYRASTIS.

Stericta pyrastis, Meyr., Tr. E.S. 1887, p. 190.

Q., Brisbane; N.S.W., Newcastle.

EPIPASCHIA SABURALIS.

Pyralis ? saburalis, Wlk., Brit. Mus. Cat. xix., p. 914.

Astrapometis saburalis, Meyr., Tr. E.S. 1884, p. 67. Hmps., Tr. E.S. 1896, p. 861.

In two out of three specimens which I have examined veins 4 and 5 of the hindwings are stalked; both Meyrick and Hampson state them to be separate. In all three examples vein 7 of hindwings anastomoses very shortly with 8.

N.S.W., Sydney; V., Melbourne, Gisborne.

† EPIPASCHIA PICTA.

Stericta picta, Warr., A.M.N.H. (6) xvi., p. 461 (1895).

Queensland.

† EPIPASCHIA HABITALIS.

Glossina habitalis, Gn., Lep. viii., p. 125.

Tasmania.

EPIPASCHIA NAUPLIALIS.

Pyralis ? nauplialis, Wlk., Brit. Mus. Cat. xvii., p. 272.

Q., Brisbane; N.S.W., Sydney; V., Gisborne, Birchip; S.A., Mount Lofty, Ardrossan; W.A., Albany, Geraldton, Carnarvon.

EPIPASCHIA COSTIGERALIS.

Pyralis costigeralis, Wlk., Tr. E.S., (3), i, p. 121.

Cacozelia costigeralis, Meyr., Tr. E.S. 1885, p. 439.

? Catamola inuncta, Luc., P.R.S.Q. 1898, p. 80.

Q., Brisbane, Stradbroke Island; N.S.W., Sydney, Mt. Kosciusko; V., Melbourne, Fernshaw, Gisborne, Birchip; T., Hobart.

EPIPASCHIA ATRIBASALIS.

Stericta atribasalis, Warr., A.M.N.H. (6), xvi, p. 461 (1895).

Stericta leucodesma, Low., Tr. R.S.S.A. 1896, p. 156.

N.Q., Townsville; Q., Brisbane.

EPIPASCHIA SEMINIVEA.

Stericta ? seminivea, Warr., A.M.N.H. (6), xvi, p. 463 (1895). *Stericta chionopa*, Low., Tr. R.S.S.A. 1896, p. 155.

I have found a larva feeding on *Phyllanthus ferdinandi*

Q., Nambour, Brisbane.

EPIPASCHIA LITHOCHLORA.

Epipaschia lithochlora, Low., Tr. R.S.S.A. 1896, p. 154.

Orthaga polialis, Hmps.

Q., Brisbane, Toowoomba.

† EPIPASCHIA RUBRIDISCALIS.

Orthaga rubridiscalis, Hmps.

N.Q., Cooktown.

EPIPASCHIA CRYPSERYTHRA, *n. sp.*

κρυψερυθρος, with hidden red.

♂ ♀. 26 mm. Head, thorax and palpi brown-whitish mixed with fuscous and reddish scales. Antennae ochreous-whitish annulated with fuscous; in ♂ simple, moderately ciliated ($\frac{1}{2}$). Forewings triangular, costa slightly arched, apex rounded, termen rounded, moderately oblique; brown-whitish densely irrorated with fuscous and reddish scales; markings dark fuscous, costal edge dark fuscous towards base; traces of an antemedian line; a discal dot beneath costa before middle; a fine dentate outwardly curved line from $\frac{3}{5}$ costa to $\frac{3}{4}$ dorsum; a series of ill defined terminal dots; cilia whitish with fuscous and reddish scales. Hindwings with termen rounded; whitish; towards termen suffused with pale fuscous; cilia whitish with a faint fuscous antemedian line.

T., Hobart, in March; two specimens in Coll. Lyell, the ♀ type and a wasted ♂.

Gen. 30. ORTHAGA.

Orthaga, Wlk., Brit. Mus. Cat. xvi, p. 191.

Balanotis, Meyr., Tr. E.S., 1884, p. 69.

†† ORTHAGA MNESIBRYA.

Balanotis mnesibrya, Meyr, Tr. E.S. 1884, p. 71.

N.S.W., Murrurundi.

ORTHAGA ORCHIDIVORA, *n. sp.*

Orchidivorus, orchid-eating.

♂ ♀ 19-20 mm. Head and thorax ochreous-whitish, mixed with brown. Palpi whitish, terminal joint sometimes with a dark fuscous anterior dot. Antennae whitish; in ♂ markedly dentate, with rather long ciliations ($1\frac{1}{2}$). Abdomen whitish, irrorated with dark-fuscous, tuft ochreous-tinged. Legs dark-fuscous irrorated and annulated with whitish. Forewings elongate-triangular, costa scarcely arched, apex round-pointed, termen slightly rounded, oblique; whitish-ochreous with scattered brown scales; dark-fuscous costal spots towards base, before middle, and at $\frac{2}{3}$; similar dots on dorsum at $\frac{1}{3}$ and $\frac{2}{3}$; and one in disc beneath mid-costa; a large fuscous-brown apical blotch, and a similar blotch on tornus; an interrupted dark-fuscous terminal line; cilia pale-brown with a double series of fuscous dots. Hindwings with termen rounded; grey, towards base paler, towards termen darker; cilia whitish with a grey basal line.

Type in Coll. Turner.

Q., Burpengary, near Brisbane; three specimens received from Dr. Thos. Bancroft, who informs me that the larvae were destructive to the pseudobulbs of native orchids in his bush-house.

Gen. 31. DODDIANA.

Doddiana, Turn., Tr. R.S.S.A. 1902, p. 187.

DODDIANA CALLIZONA.

Stericta ? callizona, Low., Tr. R.S.S.A. 1896, p. 155.

Doddiana callizona, Turn., Tr. R.S.S.A. 1902, p. 188.

N.Q., Townsville, Mackay.

AUSTRALIAN CROCODILES.

By J. DOUGLAS OGILBY.

Read before the Royal Society of Queensland, 30th January, 1904.

BEFORE proceeding to deal with the subject of this article it will be advantageous to devote a few words to the consideration of the affinities and classification of Reptiles in general as accepted at the present day.

Popularly speaking, Reptiles are cold-blooded vertebrate animals, breathing throughout existence by means of lungs, having the body protected by scales or scutes, the skull articulated with the atlas vertebra by a single convex condyle, and the heart divided into two auricles and an usually incompletely divided ventricle ; the blood of the arterial and venous systems mingles either in the heart or at the origin of the aortic arches ; and the thoracic and abdominal cavities are but rarely separated by a complete diaphragm. All Reptiles are either oviparous or ovoviviparous, the eggs in the former and much more numerous section being enclosed within a shell, which is either hard and calcareous like that of a bird, or soft and pliable. The fœtus, like that of mammals and birds, is surrounded by an amnion and an allantois, and is nourished from the yoke of the egg.

Reptiles are more closely allied to birds than to any other class of vertebrate animals ; with them they agree in the presence of a single basioccipital condyle, the absence of branchiæ at any period of postfœtal existence, the articulation of the complex lower jaw to the cranium through the medium of a quadrate bone, and the nucleated blood corpuscles.

Reasoning from these data the majority of biologists now accept Huxley's theory, that the reptilian type is that from which the avian originated. The most obvious distinctions between recent reptiles and birds are of course the presence in the latter of an epidermal covering consisting of feathers, the transformation of the fore limbs into wings, the reduction of the tail from the normally long reptilian type to a short coccyx, and the complete absence of teeth; but the importance of these seemingly insurmountable differences is greatly minimised by the discovery within recent years of fossil forms absolutely intermediate between the two classes, such as the *Archæopteryx*, a fossil feathered organism from the lithographic beds of Solenhofen, Bavaria, belonging to the oölitic period, whose avian affinities are now universally recognised, notwithstanding the presence of a long reptilian tail; and of the adontornithean fossils from the Mesozoic beds of the Rocky Mountains, which are extinct birds, furnished with functional teeth in both jaws. With data such as these before us, it is impossible to deny that birds are the descendants of some branch or branches of the reptilian type, in which the power of flight was developed, and along with it other anatomical characters by which birds are distinguished from existing reptiles.

Four orders of reptiles are represented in the present geological epoch, one of which, the *Rhynchocephalia*, still lingers on in the single species *Sphenodon punctatus*, the limit of whose range is restricted to the islands in the Bay of Plenty, North Island, New Zealand, where it is known to the Maoris as the "*Tuatera*," and lives in holes in the ground, either excavated by itself, or for nesting purposes by the Mutton Birds, upon the young of which, with other small animals, it subsists. The three remaining recent orders are the *Emydosauria* (Gharials, Crocodiles, Alligators, &c.), the *Chelonia* (Tortoises, Turtles, Terrapins, &c.), and the *Squamata*, which is divisible into two readily distinguishable suborders, the *Lacertilia* (Lizards) and the *Ophidia* (Snakes).

With regard to the geological distribution of reptiles, the earliest remains at present known belong to the Upper Carboniferous deposits of Nova Scotia, and consist of a pair of deeply amphicœlous vertebræ, believed to be those of a labyrinthodont animal, to which the name *Eosaurus acadicus* has been applied. During the Permian era reptiles belonging to the rhynchocephalian type appear, in all of which the vertebræ still continue amphicœlous. Coming to Mesozoic times we find reptiles in great abundance, and in a high state of development, so much so that this has been called the "Age of Reptiles." Among the Triassic forms worthy of notice may be mentioned the predecessors of the existing crocodilians, but differing from them in having amphicœlous vertebræ and anterior choanæ, as also in lacking the dilatation of the palatine and pterygoid bones so characteristic of the present species. These Triassic forms increase in number and variety, and become more enormously developed in size during the Jurassic period, which is also remarkable in possessing the earliest chelonian remains, and these not materially differing from the existing families. It is, however, to the Cretaceous period that we must look for the greatest variety of reptilian life and the culminating point in its development; during this era there appeared gigantic marine monsters, having a snake-like body and very short limbs, and attaining a length of at least eighty feet. Here also the first extinct crocodiles having procœlous vertebræ and posterior choanæ occur. Marine chelonians, allied to the Leathery Turtle (*Dermatochelys coriacea*), also make their appearance. Towards the close of this period, however, its abundant reptilian life was almost totally annihilated. With the exception of a few genera allied to the dinosaurians the Tertiary reptiles belong to the present faunic type; here the more ancient forms of the *Emydosauria* are entirely superseded by true crocodiles, gharials, and alligators, and the earliest ophidian remains occur in the Pleistocene deposits of France, and more especially of India; while during the Eocene period several innocuous genera, mostly of large size, appear. Chelonian remains are numerous throughout all the Tertiary formations, and approximate so closely to recent types as to be in many cases specifically indistinguishable.

The geographical distribution of reptiles is a subject too large and complex to receive more than a passing mention here; it is sufficient, therefore, to point out that being cold-blooded, air-breathing animals, their natural home is to be looked for in the tropical and subtropical zones, and accordingly we find that it is within those limits that they have attained their highest development whether as regards size, variety of form, or beauty of coloration, while beyond these limits reptiles rapidly decrease in numbers, and entirely disappear within the polar circle.

The *Emydosauria*, to which subclass the subjects of this article belong, may be briefly described as having a lacertiform body and long powerful tail adapted for swimming, while the ventricle of the heart is divided by a complete septum, and the vertebræ of all the recent species are procœlous, that is hollowed out in front and convex behind.

The reptiles belonging to this subclass have been very generally subdivided by recent systematists into three families—the *Gavialidæ*, *Crocodilidæ*, and *Alligatoridæ*—distinguished chiefly by the form of the snout, the position of the enlarged maxillary tooth, and the sheathing or otherwise of certain of the anterior mandibular teeth. But the differences on which these families have been constituted are of too trivial a nature to justify such division, and it is therefore preferable to retain all the members of the subclass in the single original family *Crocodilidæ*. By the interposition of the genus *Tomistoma*, the range of which is restricted to Borneo, the gulf existent between the East Indian *Gavialidæ* and the tropically cosmopolitan *Crocodilidæ* is completely bridged over. Thus the position of the former as diagnostically separable from the latter family is untenable. Further, the only character which separates the true crocodiles from the alligators is the slightly increased number of mandibular teeth in the latter group, these teeth rarely exceeding fifteen in *Crocodilus* and the West African *Osteolæmus*, while in the Chinese and North American *Alligator*, and the tropical American *Caiman* the minimum is seventeen, and the number rises as high as twenty-twc in *Caiman trigonatus* ; and since in *Tomistoma*, which, without doubt, is more closely allied to the gharial, and the slender-snouted crocodiles such as the Australian *Crocodilus johnstonii*, Krefft, the African *C. cataphractus*, and the South American *C. interm dius*—the increased number also prevails, it follows that this character, when unsupported by others, is not of sufficient value to warrant a separation of the two groups. The well-known character originally pointed out by Cuvier on which so much stress has been laid, namely—that in *Crocodilus* the enlarged fourth mandibular tooth fits into a notch in the upper jaw, while in *Alligator* it is completely sheathed within a pit, is not absolutely diagnostic, since specimens of the short-snouted *Crocodilus palustris* of India, Burma, and the Malay Archipelago occur, which agree in this respect with the alligators. On the other hand, the late Prof. Cope has described a supposed alligator in which the fourth tooth on one side fits into a notch, on the other into a pit, this, however, is of course an accidental variation.

All the *Crocodilidæ* are oviparous, and the eggs, which are enclosed in a hard calcareous shell, vary in number from twenty to sixty, according to the age of the individual; considering the bulk of the animal producing them, the eggs are extraordinarily small, not exceeding in size those of a goose. With the majority of species they are simply deposited in shallow troughs scraped in the sand or mud, covered up, and left to be hatched out by the heat of the sun, but at least a few species hasten the process by piling vegetable matter upon the nests, the decomposition of which furnishes more quickly and surely the requisite heat. Although guarded assiduously by the mother, the young on their emergence from the egg have to run the gauntlet of many dangers from mammals, birds, fishes, and reptiles, and among the latter none are credited with so discriminating a partiality as the male parent; in the egg state their situation is every whit as precarious, all sorts of animals seeking them out and devouring them; indeed the Egyptians deified a species of *Ichneumon* because of its dexterity in ferreting out and consuming the contents of the nests.

Crocodiles' eggs are held in high estimation as food by the native population of all the regions in which they are plentiful, and in many countries, notably Siam and Upper Egypt, the reptiles themselves are utilised as an article of food, though according to Sir Samuel Baker's account, the flavor is "a compound of stinking fish, rotten flesh, and concentrated musk," and would hardly therefore meet the requirements of a civilised palate.

The food of crocodiles consists of fishes, reptiles, birds, &c., of dead bodies carried down the current or backwards and forwards in a tideway, and of such mammals as their strength permits them to drag into deep water and drown; their method is to lie concealed beneath the surface near the watering places of wild or domestic animals, and stealthily approaching to seize the unsuspecting drinker by the muzzle, and by the exertion of their enormous strength drag the victim into water of sufficient depth to enable them to hold it beneath the surface and so in time suffocate it; and since by means of muscular valves both to the nostrils and the gullet, which can be closed and opened at will, they can remain submerged for some considerable time without inconvenience to themselves, they are enabled to keep the head of the victim beneath the water for such a time as generally suffices to suffocate it, while, if on their part the necessity for breathing should arise, the superior aspect of the nostrils and the ingenious method by which the respired air is conveyed to the lungs by means of a passage, bordered below by the firmly ankylosed nasal, palatine, and pterygoid bones—which passage only opens far back in the throat—enable them to breathe, and at the same time retain their hold on the prey. Should this be of too large a size to permit of its being conveniently torn to pieces at once, it is, when dead, dragged upon a sand-or mud-bank and there secreted until the advent of putrefaction so softens the tissues as to make them easily separable by the powerful jaws of their destroyer.

All the crocodilians are wholly aquatic, only leaving the water to bask in the sun on sand-or mud-banks, or to devour the prey which they have previously brought thither. When any river, pond, or marsh inhabited by these reptiles is about to become dry, as is so often the case in tropical countries, they bury themselves in the mud, and there remain quiescent until the return of moisture recalls them to active existence, at which time hunger makes them exceptionally savage and indifferent to danger. This is not, however, an invariable habit, since the East Indian *Crocodilus palustris* or Marsh Crocodile, is known to leave its usual haunts on the approach of drought and travel in search of water, secreting itself in the day time, and continuing its journey during the hours of darkness only; whether its instinct, like that of the fresh-water eels (*Anguilla*) under similar circumstances, leads it by the most direct route to the nearest water, is a point on which no evidence is forthcoming, but it is more than probable that such is the case; nor do we know whether the same instinct impels them, on the advent of rain, to return to their former home; this also is not improbable, for it is well known that birds and fishes will always, if it be physically possible, return year after year to the same place.

A favorite method of approaching their prey is by submerging the head and tail, leaving only the dorsal surface—and of course the extreme tip of the snout in which the nostrils are pierced, and which is too small to attract attention—exposed, and in this manner floating motionless with the current, when they bear so close a resemblance to a floating log as frequently to deceive even those well acquainted with their habits.

The majority of the *Crocodilidæ* are inhabitants of the rivers and marshy lagunes of tropical and subtropical countries;

a few species, however, frequent the estuaries of large rivers, and have even been found in the open sea many miles from land.

In all the members of the family the skull is exceptionally solid, and the roof of the mouth exceeds in completeness even that of all mammals except the anteaters and cetaceans (whales, dolphins, &c.), being composed of the suturally united maxillary, palatine, and pterygoid bones.

Touching the limital range of the emydosaurians towards either pole and their capacity of enduring cold it may be mentioned that the North American alligator (*A. mississipiensis*) is resident as far north as North Carolina, while the most southerly latitudes to which they extend are found to be—in Africa to the southern portion of the Cape Colony, where *Crocodilus niloticus* occurs, and in South America to the Rio de la Plata, in which both *Caiman latirostris* and *C. sclerops* are resident; *C. niger* and *C. trigonatus* both ascend the Rio Amazons to its head waters in Eastern Peru, and the East Indian marsh crocodile (of which mention has been previously made) follows up the course of the rivers which have their source in the Himalayas to such an altitude that ice forms upon the streams.

Only two *species of crocodile have been recorded with certainty from Australia, both of which belong to the Queensland fauna; these may be briefly diagnosed as follows:—

Long-snouted crocodile; pond crocodile; fresh-water crocodile (*Crocodilus johnstonii*, Krefft). Snout about three times as long as broad at its base; postoccipital scutes well developed; nuchal scutes subcontinuous with the dorsal.

Short-snouted crocodile; estuary crocodile; coast crocodile (*Crocodilus porosus*, Schneider). Snout from one and a third to two and a fourth times as long as broad at the base; postoccipital scutes usually absent; nuchal scutes distinctly separated from the dorsal.

The first of these species has so far been recorded only from Central Queensland, where it is partial to the still waters of ponds, billabongs, and lagunes; it attains a length of at least seven feet. Little or nothing is positively known of its habits, but it is reported to be quite harmless, and judging from the

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*The example obtained by Capt. Stokes on the Victoria River and recorded by Grey (Stokes, Discoveries in Australia, i, p. 503) as *Crocidilus palustris* was *C. porosus*. The skull is still in the South Kensington Museum.

configuration of its snout we may safely conclude that its chief if not its only food is fishes. As a species it is much less numerically abundant that *C. porosus*, nevertheless it is said to be plentiful in certain restricted districts.

Whether as to dimensions, distribution, or ferocity the case is widely different as regards the short-snouted Crocodile, which when adult averages a length of eighteen feet ; it grows, however, to a much larger size, a specimen, the skull of which is in the South Kensington Museum, London, having been recorded from Bawisaul in the Bengal Presidency, which measured when killed no less than thirty-three feet.

Its range also is very extensive and forms a marked contrast with that of Johnston's Crocodile, as it is found in all the estuaries and along the coast line of Northern Australia, New Guinea, the Solomon and the Fiji Islands, and westward throughout Malaysia to Burma, Southern China, the east coast of India, and Ceylon.

That the southern range of this crocodile on the mainland of Australia is gradually but surely being pushed northwards, seems from facts to which reference will hereafter be made, incontrovertible, and is in direct variance with the contentions of Indian zoologists, who hold that it is an immigrant from the west to our shores. Judging from analogous cases we should have expected, were this contention correct, that it would have spread from the common centre, which these authors take to be the east coast of India, equally as far to the westward as to the eastward ; but this is not the case, since this species does not inhabit the west coast of the great peninsula. It is, therefore, necesary to look elsewhere for the metropolis and original birth place of the Estuary Crocodile, and these, in the author's opinion, are naturally to be found in the Malaysian subregion, among the many islands of which it acquired its partiality for an estuarine and even marine existence, and from whence, owing to this peculiarity, it was able to extend its range in every direction, even to the successful colonisation of such distant islands as those of the Fijian group, after having successfully negotiated a journey which must have proved fatal to the majority of related species. Nor does the fact of its greater extension in an eastern direction from the proposed centre of origin militate against this theory, since such increased extension is doubtless due to the lack of competition in that direction. To sum up then—from the centre indicated above, it would be an easy matter for this crocodile, if we keep in view its ability of existing for what might possibly be a lengthened period in the open sea—and we must not lose sight of the fact that this habit would be naturally initiated and finally perfected by its residence among the islands of the Malay Archipelago—to extend its range eastwards through New Guinea to the Solomon Islands and ultimately to Fiji, and westwards through Burma down the east coast of India to Ceylon, at present its westerly limit. This would not necessarily, or even probably be the case, were the contention of Indian writers correct.

The southern range of *C. porosus* in Australia at the present time coincides very fairly with the Tropic of Capricorn ; they are abundant in all the rivers of Queensland south to the Fitzroy and Raglan, less common in the Calliope, and so rare in the Boyne that, though the district had been settled for upwards of forty years, its existence was unsuspected until an example was shot in 1887 ; while in the Baffle River, still further south, the only evidence of its presence is a single skeleton found upon the bank.*

This abrupt termination of their southerly range is probably connected with the absence of the numerous islands and coral reefs which fringe the coast to the north of Facing Island, off the embouchure of the Boyne. Should they wander further to the south they would of necessity be compelled to face the waves of the open ocean, whereas to the northward they could creep along the coast from river to river and lagune to lagune under the shelter of the Great Barrier and its satellite reefs.

As regards their food I am informed that those who are intimately acquainted with the animal in its natural haunts are agreed in stating that the most dainty morsel which can be offered to this reptile is a dog, a fact which many observers have recorded of the allied African Crocodile (*C. niloticus*) ; but I am unaware as to whether the Queensland dog has as yet learnt the lesson which long ages of persecution has taught his Egyptian brother, who, when thirsty, sits down at the water's edge and howls for several minutes, by this means attracting all the crocodiles in the vicinity to that place, whereupon the dog quietly trots along the bank for a couple of hundred yards or so and is thus enabled to reap the reward of his cleverness by quenching his thirst in peace ; though this has been affirmed by

* One is stated to have been shot lately in the Mary River.

several writers on the Nile, who claimed to be eye-witnesses of this comedy, one does not care to vouch for the truth of the story. North Queensland farmers attribute to the "*Alligators*," as they are there universally but erroneously called, the loss of many a calf or sheep, and even horses are occasionally to be seen the scars on whose quarters attest the terrible struggles which must have taken place between them and these reptiles. Wallabies and other indigenous mammals, while drinking or swimming a creek, frequently fall a prey to them, and birds also contribute in some degree to their bill of fare, for Mr. Charles Hedley, to whom I am indebted for much interesting information respecting their habits, tells me that he has frequently seen little heaps of the feathers of the "Blue Crane" (*Ardea novæhollandiæ*) in their camps; these feathers are probably stripped off the victim by means of the reptiles' paws, in the use of which they are very expert; ducks and other waterfowl also fall victims to their cunning, while birds which when shot happen to fall in the water are often snapped up immediately by crocodiles.

It is quite possible, though contrary to generally accepted opinion, that these reptiles, like the larger *Carnivora*, only acquire a taste for human flesh in exceptional cases, and this habit may be brought into existance in various ways, the most common of which is some disability such as increasing age, or an injury, which prevents the individual competing on equal terms with his fellows, and it therefore falls back upon such prey as in its natural state is least able to defend itself against attack. The following incident seems to bear upon this theory: A duck having been shot and fallen in the water, the sportsman, while swimming out to retrieve his game, was actually touched by a crocodile of this species, which was also bent upon seizing, and in fact did immediately afterwards seize and carry off the struggling quarry, thus rejecting the man, though absolutely at his mercy, in favour of the bird; needless to say, however, the swimmer lost no time in placing the "good dry land" beneath his feet again.

Their large nests are constructed in the dense mangrove swamps which line the banks of our northern rivers, and are composed of "grape-vines, reeds, grasses, and other rubbish of a somewhat similar nature to those of the brush turkey" (Mr. T. Wyndham, *in literâ*); and in the same manner the eggs are hatched out by means of the heat engendered through the fermentation of the decaying mass. The aborigines eagerly seek for and plunder the nests of the eggs, which are considered a delicacy.

In an earlier part of this article mention is shortly made of the different methods of oviposition resorted to by the different species of crocodilians, and it is there stated that the majority of species simply deposit their eggs in shallow troughs scraped in the sand or mud; as an example of hatching out the eggs, in contradistinction to the elaborate nests formed by our estuary crocodile, the following account will be read with interest; it is abstracted from a paper entitled, "On the Oviposition and Embryonic Development of the Crocodile" (*Ann. and Mag. Nat. Hist.* (6) ix. *1892*, *p. 66*), and is from the pen of Dr. A. Voeltzkow, who, writing on the breeding habits of *Crocodilus niloticus*, as observed by him in Madagascar, remarks:

"The nest consists of a pit, excavated in the earth to a depth of from a foot and a half to two feet, with partially steep walls. At the bottom of the pit the walls are undermined, and here the eggs are placed. The floor of the pit is raised slightly in the middle, so that the eggs, as they are laid by the female, roll by themselves into the hollowed-out places Very rarely one or two eggs are found in the middle of the pit, which may well be taken as proving that the mother does not herself push the eggs into the hollows with her feet, for in that case no eggs would ever be found in the centre of the pit. After the eggs are laid the pit is filled in, and no sign of it can be detected from above. The old Crocodile sleeps upon the nest, and this enables the natives to find the eggs, since they follow the tracks of the animal from the water. Further on Dr. Voeltzkow continues:—"When the young are ready to emerge, the female scrapes the sand out of the pit." He then proceeds to relate how the mother knows that the eggs are sufficiently developed and that it is time to scrape out the pit. This from personal observation he proves to be due to the noise produced by the young animal while still imprisoned within the as yet unbroken shell; these sounds can be heard at a considerable distance, and the mother while lying on the nest hears them and acts accordingly. "They are," he continues "produced with the mouth closed, apparently by powerful contraction of the ventral muscles, much as we make a noise when hiccoughing. The sound too is similar." According to the same authorities, the young are unable to extricate themselves from the sand, and if not soon released by the mother, perish by suffocation. The development of the embryo takes about three months'.

Both species of Australian Crocodiles are represented in the mounted cyllection in the Queensland Hall of the local Museum.

An accouut of the Crocodile would scarcely be complete without some notice being taken of the "Crocodile-bird," of the Nile. This is a species of spur-winged Plover (*Hoplopterus spinosus*, Linn), which is credited with habitually entering the mouth of the crocodiles, when sunning themselves on the sandbars of that river, for the purpose of extracting the portions of food which may have become wedged between the teeth of the reptile. The habit was first noticed by Aristotle, who was followed by Herodotus and Ælian, all these authors claiming to give their narratives directly from the accounts of eye-witnesses. From the time of the latter author there is a hiatus in the history of the relations existing between the bird and its host until the time of Giovanni Leone, who about the year 1600 A.D. reiterates the story, apparently from personal observation. Some 119 years later Paul Lucas again claims to have witnessed the entry of the bird and the closure of the crocodile's mouth upon it, the reptile, according to the natives, being subsequently induced to open its mouth to allow of the bird's escape on account of the irritation caused by the infliction of wonnds on the inside of the mouth by the sharp wing-spur. The most recent and detailed account is that of Mr. Cook (*Ibis, 1893, p. 275*), which at once sets at rest all doubts which may have been entertained as to the older accounts being mere "travelers' stories." After giving the reasons which induced him and his companion to watch the reptiles and their satellites and the means employed for making such observations without frightening the principals he goes on to say:—"We watched patiently until about noon, when two large crocodiles came out of the water on to the bank, and apparently were soon asleep. Several crocodile birds commenced flitting over them, and through our field glasses we watched one bird and saw it deliberately go up to a crocodile, apparently asleep, which opened its jaws. The bird hopped in, and the crocodile closed its jaws. In what appeared to be a very short time, probably not more than a minute or two, the crocodile opened its jaws, and we saw the crocodile bird go down to the water's edge. As the sand bank was, I should say, at least half-a-mile across, and the bird's back was turned towards us, we could not see whether it vomited in the water or drank, but in the course of a few seconds it returned to the crocodile, which opened its mouth again, and the bird again entered. The mouth was closed, and in a short time was opened again for the bird to come out, and the same operation was repeated at the river-bank. We saw the same bird enter the crocodile's mouth three times, and on three occasions run to the water to either vomit or drink." This succinct account incontrovertibly establishes the fact that the Nile Crocodile at least is attended by a useful avian satellite, and this being the case it would be strange indeed if it were the only species so favored; and so we find that Descourtilz relates a somewhat similar story of the West Indian species (*Crocodilus americanus*, Laur.) No such habit has as yet been noticed in connection with our species, but that is no proof of the absence of such habit; and it would be interesting if residents of places where the reptiles abound would keep a careful watch in order to detect any such tendency to play the host, especially as we too have a couple of native spur-winged plovers (*Lobivanellus lobatus* and *L. miles*), which could surely fill the rôle with equal facility to the Egyptian bird. One point in Mr. Cook's narrative must at once strike the reader, namely, that although "several" of the Crocodile-birds were present, one only appears to have entered a crocodile's mouth; this leads us to surmise whether the habit is general, or simply acquired by or transmitted to certain individuals or family parties.