JOURNAL

AND

PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

NEW SOUTH WALES

FOR

1887.

INCORPORATED 1881.

VOL. XXI.

EDITED BY

THE HONORARY SECRETARIES.

THE AUTHORS OF PAPERS ARE ALONE RESPONSIBLE FOR THE STATEMENTS MADE AND THE OPINIONS EXPRESSED THEREIN.

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1888.

NOTICE.

THE ROYAL SOCIETY of New South Wales originated in 1821 as the "Philosophical Society of Australasia"; after an interval of inactivity, it was resuscitated in 1850, under the name of the "Australian Philosophical Society," by which title it was known until 1856, when the name was changed to the "Philosophical Society of New South Wales"; in 1866, by the sanction of Her Most Gracious Majesty the Queen, it assumed its present title, and was incorporated by Act of the Parliament of New South Wales in 1881.

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VOLUME XXI.

The Royal Society of New South Wales.

OFFICERS FOR 1887-8.

Honorary President:
HIS EXCELLENCY THE RIGHT HON. LORD CARRINGTON, G.C.M.G., &c., &c., &c.

President:
C. S. WILKINSON, F.G.S., F.L.S.

Vice-Presidents:
CHARLES MOORE, F.L.S. CHR. ROLLESTON, C.M.G.

Hon. Treasurer:
ROBERT HUNT, F.G.S., &c.

Hon. Secretaries:
PROFESSOR LIVERSIDGE, M.A. (Cantab.) F.R.S., F.C.S., F.G.S., &c.
F. B. KYNGDON. S. HERBERT COX, F.C.S., F.G.S.

Members of Council:
A. LEIBIUS, Ph.D., M.A., F.C.S.
P. R. PEDLEY.
Sir ALFRED ROBERTS.
J. ASHBURTON THOMPSON, M.D., (Brux.)
PROF. WARREN, M.I.C.E.
H. G. A. WRIGHT, M.R.C.S.E., &c.

Assistant Secretary:
W. H. WEBB.

ROYAL SOCIETY OF NEW SOUTH WALES.

ACT OF INCORPORATION.

An Act to incorporate a Society called "The Royal Society of New South Wales." [16 December, 1881.]

WHEREAS a Society called (with the sanction of Her Most Gracious Majesty the Queen) "The Royal Society of New South Wales" has under certain rules and by-laws been formed at Sydney in the Colony of New South Wales for the encouragement of studies and investigations in Science Art Literature and Philosophy And whereas the Council of the said Society is at the present time composed of the following office-bearers and members His Excellency the Right Honorable Lord Augustus Loftus P.C. G.C.B. Honorary President The Honorable John Smith C.M.G. M.D. LL.D. President and Charles Moore Esquire F.L.S. Director of the Botanic Gardens Sydney and Henry Chamberlaine Russell Esquire B.A. (Sydney) F.R.A.S. F.M.S. London Government Astronomer for New South Wales Vice-Presidents and H. G. A. Wright Esquire M.R.C.S. Honorary Treasurer Archibald Liversidge Esquire Associate of the Royal School of Mines London Fellow of the Institute of Chemistry of Great Britain and Ireland and Professor of Geology and Mineralogy in the University of Sydney and Carl Adolph Leibius Esquire Doctor of Philosophy of the University of Heidelberg Fellow of the Institute of Chemistry of Great Britain and Ireland Honorary Secretaries W. A. Dixon Fellow of the Institute of Chemistry of Great Britain and Ireland G. D. Hirst Esquire Robert Hunt Esquire Associate of the Royal School of Mines London Deputy Master Sydney Branch Royal Mint Eliezer L. Montefiore Esquire Christopher Rolleston Esquire C.M.G. Preamble.

Charles Smith Wilkinson Esquire Government Geologist Members of the Council. And whereas it is expedient that the said Society should be incorporated and should be invested with the powers and authorities hereinafter contained Be it therefore enacted by the Queen's Most Excellent Majesty by and with the advice and consent of the Legislative Council and Legislative Assembly of New South Wales in Parliament assembled and by the authority of the same as follows :—

Interpretation clause

1. For the purposes of this Act the following words in inverted commas shall unless the context otherwise indicate bear the meaning set against them respectively—

"Corporation" the Society hereby incorporated.

"Council" the Members of the Council at any duly convened meeting thereof at which a quorum according to the by-laws at the time being shall be present

"Secretary" such person or either one of such persons who shall for the time being be the Secretary or Secretaries honorary or otherwise of the said Society (saving and excepting any Assistant Secretary of the said Society.)

Incorporation clause

2. The Honorary President the President Vice-Presidents Officers and Members of the said Society for the time being and all persons who shall in manner provided by the rules and by-laws for the time being of the said Society become members thereof shall be for the purposes hereinafter mentioned a body corporate by the name or style of "The Royal Society of New South Wales" and by that name shall and may have perpetual succession and a common seal and shall and may enter into contracts and sue and be sued plead and be impleaded answer and be answered unto defend and be defended in all Courts and places whatsoever and may prefer lay and prosecute any indictment information and prosecution against any person whomsoever and any summons or other writ and any notice or other proceeding which it may be requisite to serve upon the Corporation may be served upon the Secretary or one of the Secretaries as the case may be or if there be no Secretary or if the Secretaries or Secretary be absent from the Colony then upon the President or either of the Vice-Presidents.

Rules and by-laws.

3. The present rules and by-laws of the said Society shall be deemed and considered to be and shall be the rules and by-laws of the said Corporation save and except in so far as any of them are or shall or may be altered varied or repealed under the powers for that purpose therein contained or are

or may be inconsistent or incompatible with or repugnant to any of the provisions of this Act or any of the laws now or hereafter to be in force in the said Colony.

4. The Corporation shall have power to purchase acquire and hold lands and any interest therein and also to sell and dispose of the said lands or any interest therein and all lands tenements hereditaments and other property of whatever nature now belonging to the said Society under the said rules and by-laws or vested in Trustees for them shall on the passing of this Act be vested in and become the property of the said Corporation subject to all charges claims and demands in anywise affecting the same. Power to acquire and hold and to sell lands &c.

5. The ordinary business of the Corporation in reference to its property shall be managed by the Council and it shall not be lawful for individual members to interfere in any way in the management of the affairs of the Corporation except as by the rules and by-laws for the time being shall be specially provided. Ordinary business to be managed by the Council.

6. The Council shall have the general management and superintendence of the affairs of the Corporation and excepting the appointment of President and Vice-Presidents and other honorary officers who shall be appointed as the by-laws of the Society shall from time to time provide the Council shall have the appointment of all officers and servants required for carrying out the purposes of the Society and of preserving its property and it may also define the duties and fix the salaries of all officers Provided that if a vacancy shall occur in the Council during any current year of the Society's proceedings it shall be lawful for the Council to elect a member of the Society to fill such vacancy for the unexpired portion of the then current year The Council may also purchase or rent land houses or offices and erect buildings or other structures for any of the purposes for which the Society is hereby incorporated and may borrow money for the purposes of the Corporation on mortgages of the real and chattel property of the Corporation or any part thereof or may borrow money without security provided that the amount so borrowed without security shall never exceed in the aggregate the amount of the income of the Corporation for the last preceding year and the Council may also settle and agree to the covenants powers and authorities to be contained in the securities aforesaid. Powers of Council.

7. In the event of the funds and property of the Corporation being insufficient to meet its engagements each member thereof shall in addition to his subscription for the Liability of members.

then current year be liable to contribute a sum equal thereto towards the payment of such engagements but shall not be otherwise individually liable for the same and no member who shall have commuted his annual subscription shall be so liable for any amount beyond that of one year's subscription.

Custody of common seal.

8. The Council shall have the custody of the common seal of the Corporation and have power to use the same in the affairs and business of the Corporation and for the execution of any of the securities aforesaid and may under such seal authorize any person without such seal to execute any deed or deeds and do such other matter as may be required to be done on behalf of the Corporation but it shall not be necessary to use the said seal in respect of the ordinary business of the Corporation nor for the appointment of their Secretaries Solicitor or other officers.

Certified copy of rules and by-laws to be evidence.

9. The production of a printed or written copy of the rules and by-laws of the Corporation certified in writing by the Secretary or one of the Secretaries as the case may be to be a true copy and having the common seal of the Corporation affixed thereto shall be conclusive evidence in all Courts of such rules and by-laws and of the same having been made under the authority of this Act.

Elections not made in due time may be made subsequently.

10. In case any of the elections directed by the rules and by-laws for the time being of the Corporation to be made shall not be made at the times required it shall nevertheless be competent to the Council or to the members as the case may be to make such elections respectively at any ordinary meeting of the Council or at any annual or special general meeting held subsequently.

Secretary may represent Corporation for certain purposes.

11. The Secretary or either one of the Secretaries may represent the Corporation in all legal and equitable proceedings and may for and on behalf of the Corporation make such affidavits and do such acts and sign such documents as are or may be required to be done by the plaintiff or complainant or defendant respectively in any proceedings to which the Corporation may be parties.

INDEX TO RULES.

RULES.

(Revised Oct. 1, 1879.)

Additional Rules adopted November 5, 1884, marked thus, XA, *&c.*

Object of the Society.

I. The object of the Society is to receive at its stated meetings original papers on Science, Art, Literature, and Philosophy, and especially on such subjects as tend to develop the resources of Australia, and to illustrate its Natural History and Productions.

Honorary President.

II. The Governor of New South Wales shall be *ex officio* Honorary President of the Society.

Other Officers.

III. The other Officers of the Society shall consist of a President, who shall hold office for one year only, but shall be eligible for re-election after the lapse of one year; two Vice-Presidents, a Treasurer, and one or more Secretaries, who, with six other members, shall constitute a Council for the management of the affairs of the Society.

Election of Officers and Council.

IV. The President, Vice-Presidents, Secretaries, Treasurer, and the six other members of Council, shall be elected annually by ballot at the General Meeting in the month of May.

V. It shall be the duty of the Council each year to prepare a list containing the names of members whom they recommend for election to the respective offices of President, Vice-Presidents, Hon. Secretaries, and Hon. Treasurer, together with the names of six other members whom they recommend for election as ordinary members of Council.

The names thus recommended shall be proposed at one meeting of the Council, and agreed to at a subsequent meeting.

Such list shall be suspended in the Society's Rooms, and a copy shall be sent to each ordinary member not less than fourteen days before the day appointed for the Annual General Meeting.

VA. There shall be elected on the Council for each ensuing year, at least two and not more than three members of the Society who were not members of the Council for the previous year.

VI. Each member present at the Annual General Meeting shall have the power to alter the list of names recommended by the Council, by adding to it the names of any eligible members not already included in it and removing from it an equivalent number of names, and he shall use this list with or without such alterations as a balloting list at the election of Officers and Council.

The name of each member voting shall be entered into a book, kept for that purpose, by two Scrutineers elected by the members present.

No ballot for the election of members of Council, or of new members, shall be valid unless twenty members at least shall record their votes.

Vacancies in the Council during the year.

VII. Any vacancies occurring in the Council of Management during the year may be filled up by the Council.

Candidates for admission.

VIII. Candidates must be at least twenty-one years of age.

Every candidate for admission as an ordinary member of the Society shall be recommended according to a prescribed form of certificate by not less than three members, to two of whom the candidate must be personally known.

Such certificate must set forth the names, place of residence, and qualifications of the candidate.

The certificate shall be read at the three Ordinary General Meetings of the Society next ensuing after its receipt, and during the intervals between those three meetings, it shall be suspended in a conspicuous place in one of the rooms of the Society.

The vote as to admission shall take place by ballot, at the Ordinary General Meeting at which the certificate is appointed to be read the third time, and immediately after such reading.

At the ballot the assent of at least four-fifths of the members voting shall be requisite for the admission of the candidate.

Entrance Fee and Subscriptions.

IX. The entrance money paid by members on their admission shall be Two Guineas; and the annual subscription shall be Two Guineas, payable in advance; but members elected prior to December, 1879, shall be required to pay an annual subscription of One Guinea only as heretofore.

The amount of ten annual payments may be paid at any time as a life composition for the ordinary annual payment.

IXA. The entrance fee and first annual subscription shall be paid within two months from the date of election; otherwise the election shall be void.

The Council may, however, in special cases, extend the period within which these payments must be made.

IXB. Composition fees shall be treated as capital, and shall be devoted to the Building Fund Account, or invested.

New Members to be informed of their election.

X. Every new member shall receive due notification of his election, and be supplied with a copy of the obligation (No. 3 in Appendix), together with a copy of the Rules of the Society, a list of members, and a card of the dates of meeting.

Members shall sign Rules—Formal admission.

XI. Every member who has complied with the preceding Rules shall at the first Ordinary General Meeting at which he shall be present sign a duplicate of the aforesaid obligation in a book to be kept for that purpose, after which he shall be presented by some member to the Chairman, who, addressing him by name, shall say :—"In the name of the Royal Society of New South Wales I admit you a member thereof."

Annual subscriptions, when due.

XII. Annual subscriptions shall become due on the 1st of May for the year then commencing. The entrance fee and first year's subscription of a new member shall become due on the day of his election.

XIIA. Persons elected on or after the first day of October in any year shall pay the annual contribution as in advance for the following year, but in every case within two months after notification of their election has been made to them by the Honorary Secretary.

Members whose subscriptions are unpaid not to enjoy privileges.

XIII. An elected member shall not be entitled to attend the meetings or to enjoy any privilege of the Society, nor shall his name be printed in the list of the Society, until he shall have paid his admission fee and first annual subscription, and have returned to the Secretaries the obligation signed by himself.

Subscriptions in arrears.

XIV. Members who have not paid their subscriptions for the current year, on or before the 31st of May, shall be informed of the fact by the Hon. Treasurer.

No member shall be entitled to vote or hold office while his subscription for the previous year remains unpaid.

The name of any member who shall be two years in arrears with his subscriptions shall be erased from the list of members, but such member may be re-admitted on giving a satisfactory explanation to the Council, and on payment of arrears.

At the meeting held in July, and at all subsequent meetings for the year, a list of the names of all those members who are in arrears with their annual subscriptions shall be suspended in the Rooms of the Society. Members shall in such cases be informed that their names have been thus posted.

XIVA. Any member in arrears shall cease to receive the Society's publications, and shall not be entitled to any of the privileges of the Society until such arrears are paid.

Resignation of Members.

XV. Members who wish to resign their membership of the Society are requested to give notice in writing to the Honorary Secretaries, and are required to return all books or other property belonging to the Society.

Expulsion of Members.

XVI. A majority of members present at any ordinary meeting shall have power to expel an obnoxious member from the Society, provided that a resolution to that effect has been moved and seconded at the previous ordinary meeting, and that due notice of the same has been sent in writing to the member in question, within a week after the meeting at which such resolution has been brought forward.

Honorary Members.

XVII. The Honorary Members of the Society shall be persons who have been eminent benefactors to this or some other of the Australian Colonies, and distinguished patrons and promoters of the objects of the Society. Every person proposed as an Honorary Member must be recommended by the Council and elected by the Society. Honorary Members shall be exempted from payment of fees and contributions: they may attend the meetings of the Society, and they shall be furnished with copies of the publications of the Society, but they shall have no right to hold office, to vote, or otherwise interfere in the business of the Society.

The number of Honorary Members shall not at any one time exceed twenty, and not more than two Honorary Members shall be elected in any one year.

Corresponding Members.

XVIII. Corresponding Members shall be persons, not resident in New South Wales, of eminent scientific attainments, who may have furnished papers or otherwise promoted the objects of the Society.

Corresponding Members shall be recommended by the Council, and be balloted for in the same manner as ordinary Members.

Corresponding Members shall possess the same privileges only as Honorary Members.

The number of Corresponding Members shall not exceed twenty-five, and not more than three shall be elected in any one year.

Ordinary General Meetings.

XIX. An Ordinary General Meeting of the Royal Society, to be convened by public advertisement, shall take place at 8 p.m., on the first Wednesday in every month, during the last eight months of the year; subject to alteration by the Council with due notice.

Order of Business.

XX. At the Ordinary General Meetings the business shall be transacted in the following order, unless the Chairman specially decide otherwise:—

1—Minutes of the preceding Meeting.
2—New Members to enrol their names and be introduced.
3—Ballot for the election of new Members.
4—Candidates for membership to be proposed.
5—Business arising out of Minutes.
6—Communications from the Council.
7—Communications from the Sections.
8—Donations to be laid on the Table and acknowledged.
9—Correspondence to be read.
10—Motions from last Meeting.
11—Notices of Motion for the next Meeting to be given in.
12—Papers to be read.
13—Discussion.
14—Notice of Papers for the next Meeting.

XXA. At the ordinary meetings of the Society nothing relating to its regulations or management, except as regards the election or ejection of members, shall be brought forward, unless the same shall have been announced in the notice calling the meeting, or be otherwise provided for in these Rules.

XXB. A special meeting of the Society may be called by the Council, provided that seven days notice be given by advertisement, or shall be so called on a requisition signed by at least twenty-five members of the Society, to consider any special business thus notified.

Annual General Meeting—Annual Reports.

XXI. A General Meeting of the Society shall be held annually in May, to receive a Report from the Council on the state of the Society, and to elect Officers for the ensuing year. The Treasurer shall also at this meeting present the annual financial statement.

Admission of Visitors.

XXII. Every ordinary member shall have the privilege of introducing two friends as visitors to an Ordinary General Meeting of the Society or its Sections, on the following conditions:—

1. That the name and residence of the visitors, together with the name of the member introducing them, be entered in a book at the time.
2. That they shall not have attended two consecutive meetings of the Society or of any of its Sections in the current year.

The Council shall have power to introduce visitors irrespective of the above restrictions.

Council Meetings.

XXIII. Meetings of the Council of Management shall take place on the last Wednesday in every month, and on such other days as the Council may determine.

XXIIIA. The President or Hon. Secretaries, or any three Members of the Council, may call a meeting of the Council, provided that due notice of the same has been sent to each Member of the Council at least three days before such meeting.

Absence from Meetings of Council—Quorum.

XXIV. Any member of the Council absenting himself from three consecutive meetings of the Council, without giving a satisfactory explanation in writing, shall be considered to have vacated his office. No business shall be transacted at any meeting of the Council unless three members at least are present.

Duties of Secretaries.

XXV. The Honorary Secretaries shall perform, or shall cause the Assistant Secretary to perform the following duties :—

1. Conduct the correspondence of the Society and Council.
2. Attend the General Meetings of the Society and the meetings of the Council, to take minutes of the proceedings of such meetings, and at the commencement of such to read aloud the minutes of the preceding meeting.
3. At the Ordinary Meetings of the members, to announce the presents made to the Society since their last meeting; to read the certificates of candidates for admission to the Society, and such original papers communicated to the Society as are not read by their respective authors and the letters addressed to it.
4. To make abstracts of the papers read at the Ordinary General Meetings, to be inserted in the Minutes and printed in the Proceedings.
5. To edit the Transactions of the Society, and to superintend the making of an Index for the same.
6. To be responsible for the arrangement and safe custody of the books, maps, plans, specimens, and other property of the Society.

7. To make an entry of all books, maps, plans, pamphlets, &c., in the Library Catalogue, and of all presentations to the Society in the Donation Book.
8. To keep an account of the issue and return of books, &c., borrowed by members of the Society, and to see that the borrower, in every case, signs for the same in the Library Book.
9. To address to every person elected into the Society a printed copy of the Forms Nos. 2 and 3 (in the Appendix), together with a list of the members, a copy of the Rules, and a card of the dates of meeting; and to acknowledge all donations made to the Society, by Form No. 6.
10. To cause due notice to be given of all Meetings of the Society and Council.
11. To be in attendance at 4 p.m. on the afternoon of Wednesday in each week during the session.
12. To keep a list of the attendances of the members of the Council at the Council Meetings and at the ordinary General Meetings, in order that the same may be laid before the Society at the Annual General Meeting held in the month of May.

The Honorary Secretaries shall, by mutual agreement, divide the performance of the duties above enumerated.

The Honorary Secretaries shall, by virtue of their office, be members of all Committees appointed by the Council.

Contributions to the Society.

XXVI. Contributions to the Society, of whatever character, must be sent to one of the Secretaries, to be laid before the Council of Management. It will be the duty of the Council to arrange for promulgation and discussion at an Ordinary Meeting such communications as are suitable for that purpose, as well as to dispose of the whole in the manner best adapted to promote the objects of the Society.

XXVIa. The original copy of every paper communicated to the Society, with the illustrative drawings, shall become the property of the Society unless stipulation be made to the contrary; and authors shall not be at liberty, save by permission of the Council, to publish the papers they have communicated, until such papers or abstracts of them, have appeared in the Journal or other publications of the Society.

XXVIb. If any paper of importance is communicated during the recess, the same may be ordered for publication by the Council, without being read to the Society.

Management of Funds.

XXVII. The funds of the Society shall be lodged at a Bank named by the Council of Management. Claims against the Society, when approved by the Council, shall be paid by the Treasurer.

All cheques shall be countersigned by a member of the Council.

*Money Grants.**

XXVIII. Grants of money in aid of scientific purposes from the funds of the Society—to Sections or to members—shall expire on the 1st of November in each year. Such grants, if not expended, may be re-voted.

XXIX. Such grants of money to Committees and individual members shall not be used to defray any personal expenses which a member may incur.

Audit of Accounts.

XXX. Two Auditors shall be appointed annually, at an Ordinary Meeting, to audit the Treasurer's Accounts. The accounts as audited to be laid before the Annual Meeting in May.

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* Applicants for money grants are required to supply the following information:—
1. The nature of the research and the scientific results expected to follow therefrom.
2. The amount asked for.
3. Whether any previous grant has been received from any source, and, if so, with what results.
4. Whether any portion of the grant is to be devoted to personal remuneration.
5. What apparatus (if any) of permanent value will be required.

Property of the Society to be vested in the President, &c.

XXXI. All property whatever belonging to the Society shall be vested in the President, Vice-Presidents, Hon. Treasurer, and Hon. Secretaries for the time being, in trust for the use of the Society; but the Council shall have control over the disbursements of the funds and the management of the property of the Society.

Sections.

XXXII. To allow those members of the Society who devote attention to particular branches of science fuller opportunities and facilities of meeting and working together with fewer formal restrictions than are necessary at the general Monthly Meetings of the Society,—Sections or Committees may be established in the following branches of science:—

Section A.—Astronomy, Meteorology, Physics, Mathematics, and Mechanics.

Section B.—Chemistry and Mineralogy, and their application to the Arts and Agriculture.

Section C.—Geology and Palæontology.

Section D.—Biology, *i.e.*, Botany and Zoology, including Entomology.

Section E.—Microscopical Science.

Section F.—Geography and Ethnology.

Section G.—Literature and the Fine Arts, including Architecture.

Section H.—Medical.

Section I.—Sanitary and Social Science and Statistics.

Section Committees—Card of Meetings.

XXXIII. The first meeting of each Section shall be appointed by the Council. At that meeting the members shall elect their own Chairman, Secretary, and a Committee of four; and arrange the days and hours of their future meetings. A card showing the dates of each meeting for the current year shall be printed for distribution amongst the members of the Society.

Membership of Sections.

XXXIV. Only members of the Society shall have the privilege of joining any of the Sections.

Reports from Sections.

XXXV. There shall be for each Section a Chairman to preside at the meetings, and a Secretary to keep minutes of the proceedings, who shall jointly prepare and forward to the Hon. Secretaries of the Society, on or before the 7th December in each year, a report of the proceedings of the Section during that year, in order that the same may be transmitted to the Council.

Reports.

XXXVI. It shall be the duty of the President, Vice-Presidents, and Honorary Secretaries to annually examine into and report to the Council upon the state of—

1. The Society's house and effects.
2. The keeping of the official books and correspondence.
3. The library, including maps and drawings.
4. The Society's cabinets and collections.

Cabinets and Collections.

XXXVII. The keepers of the Society's cabinets and collections shall give a list of the contents, and report upon the condition of the same to the Council annually.

Documents.

XXXVIII. The Honorary Secretaries and Honorary Treasurer shall see that all documents relating to the Society's property, the obligations given by members, the policies of insurance, and other securities shall be lodged in the Society's iron chest, the contents of which shall be inspected by the Council once in every year; a list of such contents shall be kept, and such list shall be signed by the President or one of the Vice-Presidents at the annual inspection.

Branch Societies.

XXXIX. The Society shall have power to form Branch Societies in other parts of the Colony.

Library.

XL. The members of the Society shall have access to, and shall be entitled to borrow books from the Library, under such regulations as the Council may think necessary.

Alteration of Rules.

XLI. No alteration of, or addition to, the Rules of the Society shall be made unless carried at two successive General Meetings, at each of which twenty-five members at least must be present.

THE LIBRARY.

1. The Library shall be open for consultation and for the issue and return of books daily (except Saturday), from 9·30 a.m. to 1 p.m., and 2 to 6 p.m., and on Saturdays from 9·30 a.m. to 1·30 p.m.

1A. The Library will not be open on public holidays.

2. No book shall be issued without being signed for in the Library Book.

3. Members are not allowed to have more than two volumes at a time from the Library, without special permission from one of the Honorary Secretaries, nor to retain a book for a longer period than fourteen days; but when a book is returned by a member it may be borrowed by him again, provided it has not been bespoken by any other member. Books which have been bespoken shall circulate in rotation, according to priority of application.

4. Scientific Periodicals and Journals will not be lent until the volumes are completed and bound.

4A. Dictionaries, Encyclopædias, and other works of reference and cost, Atlases, Books and Illustrations in loose sheets, Drawings, Prints and unbound numbers of Periodicals and Works, Journals, Transactions and Proceedings of Societies or Institutions, Works of a Series, Maps or Charts, are not to be removed from the Library without the written order of the President or one of the Hon. Secretaries.

5. Members retaining books longer than the time specified shall be subject to a fine of sixpence per week for each volume.

6. The books which have been issued shall be called in by the Secretaries twice a year; and in the event of any book not being returned on those occasions, the member to whom it was issued shall be answerable for it, and shall be required to defray the cost of replacing the same.

7. No stranger shall be admitted to the Library except by the introduction of a member, whose name, together with that of the visitor, shall be inserted in a book kept for that purpose.

8. Members shall not lay the paper upon which they are writing on any Book or Map.

No tracings shall be made without express permission from the Hon. Secretaries.

Form No. 1.

ROYAL SOCIETY OF NEW SOUTH WALES.

Certificate of a Candidate for Election.

Name

Qualification or occupation

Address

being desirous of admission into the Royal Society of New South Wales, we, the undersigned members of the Society, propose and recommend him as a proper person to become a member thereof.

Dated this day of 18 .

FROM PERSONAL KNOWLEDGE.	FROM GENERAL KNOWLEDGE.

Signature of candidate

Date received 18 .

N.B.—This certificate must be signed by three or more members, to two of whom the candidate must be personally known. The candidate must be at least twenty-one years of age. This certificate has to be read at three ordinary general meetings of the Society.

Form No. 2.

ROYAL SOCIETY OF NEW SOUTH WALES.

The Society's House,

Sir, Sydney, 18 .

I have the honour to inform you that you have this day been elected a member of the Royal Society of New South Wales, and I beg to forward to you a copy of the Rules of the Society, a printed copy of an obligation, a list of members, and a card announcing the dates of meeting during the present session.

According to the Regulations of the Society (*vide* Rule No. 9), you are required to pay your admission fee of two guineas, and annual subscription of two guineas for the current year, before admission. You are also requested to sign and return the enclosed form of obligation at your earliest convenience. I have, &c.,

To Hon. Secretary.

Form No. 3.

ROYAL SOCIETY OF NEW SOUTH WALES.

I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the Royal Society of New South Wales, and to observe its Rules and By-laws, as long as I shall remain a member thereof.

Address Signed,

Date

Form No. 4.

ROYAL SOCIETY OF NEW SOUTH WALES.

The Society's House,

Sir, Sydney, 18 .

I have the honour to inform you that your annual subscription of for the current year became due to the Royal Society of New South Wales on the 1st of May last.

It is requested that payment may be made by cheque or Post Office order drawn in favour of the Hon. Treasurer.

I have, &c.,

To Hon. Treasurer.

Form No. 5.

ROYAL SOCIETY OF NEW SOUTH WALES.

The Society's House,

Sir, Sydney, 18 .

I am desired by the Royal Society of New South Wales to forward to you a copy of its Journal for the year 18 , as a donation to the library of your Society.

I am further requested to mention that the Society will be thankful to receive such of the very valuable publications issued by your Society as it may feel disposed to send.

I have the honour to be,

Sir,

Your most obedient servant,

Hon. Secretary.

Form No. 6.

ROYAL SOCIETY OF NEW SOUTH WALES.

The Society's House,

Sir, Sydney, 18 .

On behalf of the Royal Society of New South Wales, I beg to acknowledge the receipt of and I am directed to convey to you the best thanks of the Society for your most valuable donation.

I have the honour to be,

Sir,

Your most obedient servant,

Hon. Secretary.

Form No. 7.

Balloting List for the Election of the Officers and Council.

ROYAL SOCIETY OF NEW SOUTH WALES.

Date........................

BALLOTING LIST for the election of the the Officers and Council.

Present Council.	Names proposed as Members of the New Council.	
	President.	
	Vice-Presidents.	
	Hon. Treasurer.	
	Hon. Secretaries.	
	Members of Council.	

If you wish to substitute any other name in place of that proposed, erase the printed name in the second column, and write opposite to it, in the third, that which you wish to substitute.

LIST OF THE MEMBERS

OF THE

Royal Society of New South Wales.

P Members who have contributed papers which have been published in the Society's Transactions or Journal; papers published in the Transactions of the Philosophical Society are also included. The numerals indicate the number of such contributions.
† Members of the Council.
‡ Life Members.

Elected		
1877		Abbott, Joseph Palmer, M.L.A., 6 Wentworth Court, Elizabeth-street.
1877	P 1	Abbott, Thomas Kingsmill, S.M., Central Police Office, Sydney.
1877	P 3	Abbott, W. E., Abbotsford, Wingen.
1877		Adams, Francis, Australian Joint Stock Bank, Sydney.
1864		Adams, P. F., Surveyor General, Kirribilli Point, St. Leonards.
1878		Alexander, George M., Hunter-street.
1868		Allerding, F., 25 Hunter-street.
1873		Allerding, H. R., 25 Hunter-street.
1856		Allwood, Rev. Canon, B.A. *Cantab.*, "Rorklands," Edgecliff Road, Woollahra.
1885		Allworth, Joseph Witter, District Surveyor, East Maitland.
1881		Amos, Robert, "Renneil," Elizabeth Bay Road.
1887		Anderson, H. C. L., M.A., "Aberfeldie," Summer Hill.
1887		Armstrong, William Harvey, "Woodlawn," Henrietta-street, Waverley.
1873		Atherton, Ebenezer, M.R.C.S. *Eng.*, Macquarie-street, North.
1878		Backhouse, Alfred P., M.A., District Court Judge, "Melita," Elizabeth Bay.
1877		Baker, E. A., M.L.A., Erith Colliery, Bundanoon.
1878		Balfour, James, National Bank of Australasia, 60 Pitt-street.
1881		Barff, H. E., M.A., Registrar, Sydney University.
1878		Barker, Francis Lindsay, 86 Pitt-street.
1886		Barker, W. Mandeville, Longueville Chambers, Young-street.
1884		Barry, The Most Rev. Alfred, D.D., D.C.L., Primate, Bishopscourt, Randwick.
1875		Bartels, W. C. W., Richmond Terrace.
1876		Bassett, W. F., M.R.C.S., *Eng.*, Bathurst.
1878		Bayley, George W. A., Railway Department, Phillip-street.
1884		Baynes, Richard B., Victoria Barracks.
1875		Bedford, W. J. G., M.R.C.S. *Eng.*, "Waratah," Newtown, Hobart, Tasmania.

Elected.		
1868		Beilby, E. T., 91 Pitt-street.
1875		Belgrave, Thomas B., M.D. *Edin.*, M.R.C.S. *Eng.*, "Hazelmere," George-street, Burwood.
1877		Belfield, Algernon H., Eversleigh.
1875		Belisario, John, M.D., Lyons' Terrace.
1876		Benbow, Clement A., 30 College-street.
1869	P 2	Bensusan, S. L., 44 Castlereagh-street.
1877		Bennett, George F., C.M.Z.S., Toowoomba, Queensland.
1878		Berney, Augustus, H. M. Customs, Sydney.
1884		Binstead, W. H., "Glenthorne," Boulevard, Petersham.
1878		Black, Reginald James, M.L.A., "Traveleyn," Darling Point Road, Woollahra.
1878		Black, Morrice A., F. I. A., Actuary, Australian Mutual Provident Society, Pitt-street.
1886		Blacket, Arthur, Architect, Bond-street.
1880		Blackmann, C. H. E., 375 George-street.
1877		Bladen, Thomas, c/o Mr. Frank Bladen, Government Printing Office.
1883		Blaxland, Herbert, M.R C.S.E., L R.C.P. *Lond.*, Hospital for the Insane, Callan Park.
1887		Blaxland, Ernest Gregory, M.R.C.S. *Eng.*, L.R.C.P. *Lond.*, Prince Alfred Hospital.
1872		Bolding, H. J., P.M., Raymond Terrace, Hunter River.
1879		‡Bond, Albert, Bell's Chambers, Pitt-street.
1886		Bowker, R. S., L.R.C.P. *Edin.*, M.R.C.S. *Eng*., 17 Clarence-street.
1886		Bowman, Arthur, 163 Phillip-street.
1876		Brady, Andrew John, Lic. K. & Q. Coll. Phys. *Irel.*, Lic. R. Coll. Sur. *Irel.*, 3 Lyons' Terrace.
1871	P 1	Brazier, John, F. L. S., C. M. Z. S., Corr. M.R.S., Tas., 82 Windmill-street.
1879		Brindley, Thomas, "Marsden," Tupper-street, Marrickville.
1878		‡Brooks, Joseph, F.R.G.S., "Hope Bank," Nelson-street, Woollahra.
1886		Brown, David, "Kallara," Bourke.
1876		Brown, Henry Joseph, Newcastle.
1877		Bundock, W. C., "Wyangarie," Casino.
1877		Burnell, Arthur, "Clapton," Forbes-street.
1875		Burton, Edmund, Land Titles Office, Elizabeth-street North.
1880		Bush, Thomas James, Engineer's Office, Gas Works, Sydney.
1876		Cadell, Alfred, Vegetable Creek, New England.
1876		Cadell, Thomas, Australian Club.
1880		Caird, George S., "Lillingstone," Ocean-street, Woollahra.
1876		Campbell, Allan, L.R.C.P *Glasgow*, Yass.
1876		Campbell, The Hon. Alexander, M. L. C., "Rosemont," Woollahra.
1868		Campbell, The Hon. Charles, M.L.C., c/o F. Campbell, Esq., "Yarralumba," Queanbeyan.
1879		Campbell, Revd. Joseph, M.A., F.G.S., "The Parsonage," Glen Innes.
1876		Cape, Alfred J., M.A. *Syd.*, "Karoola," Edgecliff Road.

Elected.		
1886		Carey, John R., "Caprera," Milson's Point, St. Leonards.
1886		Carrington, His Excellency The Right Hon. Lord, G.C.M.G., &c., &c., &c., *Hon. President*.
1882		Carruthers, Charles Ulic, L.K. and Q.C.P., L.R.C.S., *Irel.*, "Glenara," Montague-street, Balmain.
1885		Chadwick, Robert, "Arlington," Edgecliff Road, Woollahra.
1882		Chambers, Thomas, F.R.C.P., F.R.C.S. *Edin.*, 1 Lyons' Terrace.
1879	P 1	‡Chard, J. S., Surveyor, Armidale.
1878		Chatfield, Captn. William, Smith-street, Parramatta.
1884		Chesterman, Alfred H., L.S., Ournie P. O., Upper Murray, viâ Albury.
1878		Chisholm, Edwin, M.R.C.S., *Eng.*, L.S.A., &c., "Abergeldie," Victoria-street, Ashfield.
1885		Chisholm, William, M.D., *Lond.*, 199 Macquarie-street North.
1876		Codrington, John Frederick, M.R.C.S. *Eng.*; Lic. R.C. Phys., *Lond.*; Lic. R.C. Phys., *Edin.*, Orange.
1878	P 1	Collie, Revd. Robert, F.L.S., "The Manse," Wellington-street, Newtown.
1886		Collingwood, David, M.D. *Lond.*, F.R.C.S. *Eng.*, "Airedale," Summer Hill.
1878		Colquhoun, George, "Rossdhu," 72 Darlinghurst Road.
1880		Colyer, Henry Cox, M.A., "Clinton," Liverpool-street, Darlinghurst.
1876		Colyer, John Ussher Cox, "Eastwell," Bellevue, Waverley.
1856		Comrie, James, "Northfield," Kurrajong Heights.
1876		Conder, W. J., Chairman, Local Land Board, Cooma.
1882		Conlan, George Nugent, F.R.G.S., care of Mr. C. E. Riddell, Union Club.
1882		Cornwell, Samuel, Australian Brewery, Bourke-street, Redfern.
1878		Cottee, W. Alfred, 2 Spring-street.
1880		Cox, The Hon. George Henry, M.L.C., "Winbourn," Penrith.
1859	P 1	Cox, James, M.D. *Edin.*, C.M.Z.S., F.L.S., 73 Hunter-street.
1884	P 2	†Cox, S. Herbert, F.C.S., F.G.S., 1 Victoria Terrace, Miller-street, North Shore, *Hon. Secretary*.
1865	P 2	Cracknell, E. C., M.I.C.E., Superintendent of Telegraphs, Telegraph Office, George-street.
1886		Crago, W. H., M.R.C.S. *Eng.*, L.R.C.P. *Lond.*, 82 William-street.
1869		Creed, The Hon. J. Mildred, M.L.C., M.R.C.S. *Eng.*, L.R.C.P., *Edin.*, Wallis-street, Woollahra.
1870		Croudace, Thomas, Lambton.
1881		Crummer, Henry, 47 Rialto Terrace, Darlinghurst.
1885		Dalton, James Neale, Head Master, The Queen's School, Sydney.
1875		Danger, Frederick H., "Grantham," Pott's Point.
1876		Darley, Cecil West, "Erinagh," Elizabeth Bay Road.
1877		Darley, Sir F. M., K.C.M.G., B.A., Chief Justice, Supreme Court, King-street.
1887		Davey, T. G., M.E., Emmaville, New South Wales.
1886		David, T. W. Edgeworth, B.A., F.G.S., Geological Surveyor, Department of Mines, Phillip-street.
1878		Dean, Alexander, J.P., 54 Castlereagh-street.

Elected.		
1885		Deane, Henry, C.E., Gladesville.
1877		Deck, John Feild, M.D., Ashfield.
1856		Deffell, George H., Chief Commissioner, Insolvency Court, Phillip-street.
1881		Delarue, Leopold H., 378 George-street.
1875		De Salis, The Hon. Leopold Fane, M. L. C., "Tharwa," Queanbeyan.
1876		Dight, Arthur, Richmond.
1875	P 9	Dixon, W. A., F.C.S.. Fellow and Member Inst. of Chemistry of Great Britain and Ireland, Lecturer on Chemistry, The Technical College, School of Arts, Pitt-street, Sydney.
1882		Dixon, Fletcher, English, Scottish, and Australian Chartered Bank, George-street.
1880		Dixson, Craig, M.B., C.M. *Edin.*, M.R.C.S. *Eng.*, M.D. *Syd.*, 2 Clarendon Terrace, Elizabeth-street.
1880		Dixson, Thomas, M.B., Mast. Surg. *Edin.*," Ellalong," Ashfield.
1876		Docker, Ernest B., M.A. *Syd.*, " Carhullen," Granville.
1879		Docker, Wilfred L., " Nyrambla," Darlinghurst Road.
1882		Donkin, J. B., The Exchange, Sydney.
1879		Dowling, Neville, " Brougham," Wallis-street, Woollahra.
1884		Dowling, Edward, Secretary, Board of Technical Education, 129 Phillip-street.
1873		Du Faur, Eccleston, F.R.G.S., " Marfa," Croydon.
1876		Eales, Hon. John, M.L.C., Duckenfield Park, Morpeth.
1886		Edmunds, Percy James, Public Training School, Fort-street.
1876		Egan, Myles, M.R.C.S. *Eng.*, 136 Elizabeth-street.
1874		Eichler, Charles F., M.D. *Heidelberg*, M.R.C.S. *Eng.*, Bridge-street.
1876		Eldred, W. H., 62 Margaret-street.
1881		Elliott, F. W., Elizabeth Bay.
1885		Ellis, Henry A., M.B., Ch. B. Univ. *Dub.*, 3 Bayswater Houses, Double Bay.
1876		Evans, George, " Springfield," Darlinghurst Road.
1881		Evans, Thomas, M.R.C.S. *Eng.*, 211 Macquarie-street North.
1881		Ewan, John Frazer, M.B., Mast. Surg. Univ. *Edin.*, c/o Messrs. John Frazer & Co., York-street.
1877		‡Fairfax, Edward R., 145 Macquarie-street.
1868		Fairfax, James R., *Herald* Office, Hunter-street.
1887		Faithfull, R. L., M.D., L.R.C.P., 5 Lyons' Terrace.
1881		Fiaschi, Thomas, M.D., M. Ch., Univ. *Pisa*, 39 Phillip-street.
1876		Firth, Rev. Frank, Wesleyan Parsonage, Waverley.
1874		Fischer, Carl F., M.D., M.R.C.S. *Eng.*; L.R.C.P. *Lond.*; F.G.S.; F.L.S.; F.R.M.S.; Member Imp. Botanical and Zoological Society, Vienna; Corr. Member Imperial Geographical Society, Vienna; c/o the Manager of the Bank of New Zealand, Pitt-street.
1856		Flavelle, John, 340 George-street.

Elected.		
1880		Forbes, Alexander Leith, M.A., Dept. of Public Instruction.
1879		‡Foreman, Joseph, M.R.C.S. *Eng.*, L.R.C.P. *Edin.*, 161 Macquarie-street.
1881		Foster, W. J., Q.C., M.L.A., Temple Court, King-street.
1878		Fraser, Robert, c/o Rev. J. G. Fraser, Rose Villa, Glebe Point.
1883	P 1	Fraser, John, B.A., *Edin.*, LL.D., Délégué Général (pour l'Océanie), de l'Institution Ethnographique de Paris, Associate of the Victoria (Philosophical) Institute of Great Britain, c/o Rev. James Benvie, Manse, West Maitland.
1881		Furber, T. F., "Clifton," Burwood.
1880		Gardiner, Rev. Andrew, M.A., "Paxton House," Glebe Point.
1877		Garnsey, Rev. C. F., Christ Church Parsonage, Sydney.
1868	P 1	Garran, The Hon. Andrew, M.L.C., LL.D., "Strathmore," Glebe Point.
1883		Garrett, H. E., M.R.C.S. *Eng.*, 37 Wynyard Square West.
1877		Garvan, J. P., M.L.A., East St. Leonards.
1878		Gedye, Charles Townsend, "Eastbourne," Darling Point.
1876		George, W. R., 346 George-street.
1879		Gerard, Francis, care of Messrs. Du Faur & Gerard, Box 690, G.P.O.
1884		Gibbs, J. Burton, Hosking Place, 84A Pitt-street North.
1876		Gilchrist, W. O., c/o Messrs. Gilchrist, Watt, & Co., Spring-street.
1884		Gill, Rev. W. Wyatt, B.A., *Lond.*, "Persica," Illawarra Road, Marrickville.
1875		Gilliat, Henry A., Chief Inspector of Public Watering Places, Department of Mines, Phillip-street.
1876	P 4	Gipps, F. B., C.E., "Maida," Chandos-street, Ashfield.
1878		Goddard, William C., Norwich Chambers, Hunter-street.
1876		Goode, George, M.A., M.D., M. Ch. Trin. Coll., *Dub.*, Orange.
1883		Goode, W. H., M.A., M.D., Ch. M., Diplomate in State Medicine, *Dub.*, Surgeon Royal Navy, Corres. Mem. Royal Dublin Society, Mem, Brit. Med. Assoc., Lecturer on Medical Jurisprudence, University of Sydney, 159, Macquarie-street North.
1859		Goodlet, John H., "Canterbury House," Ashfield.
1887		Gordon, C. E., H. M. Customs, Sydney.
1886		Graham, James, M.A., M.B., C.M., Prince Alfred Hospital, Sydney.
1876		Grahame, Hon. W., M.L.C., "Strathearn House," Waverley.
1885		Griffin, Gilderoy Wells, Consul for the United States of America, 12 Beresford Chambers, Castlereagh-street.
1878		Griffiths, Frederick C., "Greenknowe," 56 Macleay-street.
1877		Griffiths, G. Neville, 10 O'Connell-street.
1886		Grut, Percival de Jersey, English, Scottish, and Australian Chartered Bank, Melbourne.
1877		Gurney, T. T., M.A. *Cantab.*, late Fellow of St. John's College, Cambridge, Professor of Mathematics and Natural Philosophy, University of Sydney.

Elected,		
1880		Haege, Hermann, 93 Pitt-street.
1878		Hall, Richard T., 85 Macleay-street.
1880		Halligan, Gerald H., C.E., "Eugowra," Hunter's Hill.
1887	P 1	Hamlet, William M., F.C.S., Member of the Society of Public Analysts, Government Analyst, Treasury Buildings.
1882		Hammond, Mark J., "Endymion," Ashfield.
1882		Hankins, G. T., M.R.C.S. *Eng.*, 3 Lyons' Terrace, Hyde Park.
1877	P 5	Hargrave, Lawrence, "Ravensbourne," Rushcutter's Bay Road
1881		‡Harris, John, M.L.A., "Bulwarra," Jones-street, Ultimo.
1877		‡Harrison, L. M., Macquarie Place.
1884		Haswell, William Aitcheson, M.A., B.Sc., F.L.S., Demonstrator of Comparative Anatomy and Physiology, University of Sydney, Australian Club.
1877	P 1	Hawkins, H. S., M.A., Balmain.
1874		Hay, The Hon. Sir John, K.C.M.G., M.L.C., A.M. *Aberdeen*, President of the Legislative Council, Rose Bay, Woollahra.
1876		Heaton, J. H., M.P., St. Stephen's Club, Westminster, London.
1881		Helms, Albert, Ph. D., *Berlin*, Sydney University.
1877		Henry, James, 750 George-street.
1884		Henson, Joshua B., C.E., Assistant City Engineer, Town Hall, Sydney.
1878		Herborn, E. W. L., "Flinton," Burwood.
1878		Herborn, Eugene, Licensed Surveyor, Beresford Chambers, 52 Castlereagh-street.
1878		Hewett, Thomas Edward, Technical College, Sydney.
1879		Higgins, R. G., Kickabell Station, Quirindi.
1879		Hills, Robert, Elizabeth Bay.
1879		Hitchins, Edward Lytton, "Florence," Victoria-street North, Darlinghurst.
1876	P 2	Hirst, George D., 377 George-street.
1886		Holmes, Spencer Harrison, "The Wilderness," Allandale, Hunter River.
1879		Houison, Andrew, B.A., M.B., C.M. *Edin.*, 128 Phillip-street.
1886		Hozier, Charles H. S., F.R.C.S. *Irel.*, L.K. and Q.C.P. *Irel.*, Windsor, N.S.W.
1877		Hume, J. K., "Beulah," Campbelltown.
1878		†Hunt, Robert, F.G.S., Deputy Master of the Royal Mint, Sydney, *Hon. Treasurer.*
1882		Hurst, George, M.B., Univ. *Lond.*, Mast. Surg. Univ. *Edin.*, 28 College-street, Hyde Park.
1886		Hutchinson, W. A., Bond-street.
1887		Huxtable, L. R., M.B., C.M., 47 Phillip-street.
1879		Inglis, The Hon. James, M.L.A., "Craigo," Redmyre.
1878		Jackson, Arthur Levett, Govermennt Printing Office.
1876		Jackson, Henry Willan, M.R.C.S. *Eng.*, Lic. R. C. Phys. *Edin.*, 146 Phillip-street.
1885		Jackson, Rev. H. L., M.A. (Cantab.), St. James's Parsonage, Macquarie-street.

Elected.		
1879		Jefferis, Rev. James, LL.D., Vestry, Congregational Church, Pitt-street.
1884		Jenkins, Edward Johnstone, M.A., M.D., *Oxon,* M.R.C.P., M.R.C.S., L.S.A. *Lond.,* 213 Macquarie-street North.
1879		Johnson, James W., "Brooksby," Double Bay.
1876		Jones, James Aberdeen, Lic. R. C. Phys. *Edin.,* Booth-street, Balmain.
1876		Jones, Richard Theophilus, M.D. *Sydn.,* L.R.C.P. *Edin.,* "Caer Idris," Ashfield.
1867		Jones, P. Sydney, M.D. *Lond.,* F.R.C.S. *Eng.,* College-street.
1877		Jones, Edward Lloyd, "Bickley," Burwood.
1874		Jones, James, "Miltonia," Randwick.
1879		Jones, John Trevor, C.E., "Tremayne," North Shore.
1884		Jones, Llewellyn C. Russell, 33 Castlereagh-street.
1887		Jones, G. Mandor, M.R.C.S. *Eng.,* L.R.C.P. *Lond.,* Collins-street, North Annandale.
1863		Josephson, Joshua Frey, F.G.S., Bellevue Hill, Double Bay.
1876	P 2	Josephson, J. P., Assoc. Mem. Inst. C.E., George-street, Marrickville.
1878		Joubert, Numa, Hunter's Hill.
1883		Kater, H. E., "Mount Broughton," Moss Vale.
1873		Keele, Thomas William, Harbours and Rivers Department, Phillip-street.
1877		Keep, John, "Broughton Hall," Leichhardt.
1884		Kendall, Theodore M., B.A., F.R.C.S., F.R.C.P., F.M., 36 College-street, Hyde Park.
1887		Kent, Harry C., Bell's Chambers, 129 Pitt-street.
1874		King, Hon. Philip G., M.L.C., "Banksia," William-street, Double Bay.
1878		Knaggs, Samuel T., M.D. *Aberdeen,* 16 College-street.
1881	P 1	Knibbs, G. H., Denison Road, Petersham.
1874		Knox, George, M.A. *Cantab.,* Phillip-street.
1875		Knox, Edward, The Hon., M.L.C., O'Connell-street.
1877		Knox, Edward W., "Rona," Bellevue Hill, Double Bay.
1877		Kopsch, G., 8 Boulevard, Petersham.
1878		†Kyngdon, F. B., F.R.M.S. *Lond.,* 69 Darlinghurst Road, *Hon. Secretary.*
1878		Kyngdon, Frederick H., M.D. *Aberdeen;* L.S.A. *Lond.;* M.R.C.S. *Eng.;* C.M. *Aberdeen,* "Bon Accord," North Shore.
1884		Kyngdon, Boughton, L.S.A., Medl. Assoc. King's Coll. *Lond.,* 69 Darlinghurst Road.
1884		Lackey, The Hon. John, M.L.C., Warrigal Club.
1883		Lane, William H. H., 6 Bligh-street.
1874	P 1	Latta, G. J., "Mountsea," Burlington Road, Homebush.
1859	P 6	†Leibius, Adolph, Ph. D. *Heidelberg,* M.A., F.C.S.; Senior Assayer to the Sydney Branch of the Royal Mint.
1885		Leverrier, Frank, B.A., B.Sc., "Tarnagulla," Waverley.
1874		Lenehan, Henry Alfred, Sydney Observatory.

Elected.		
1883		Lingen, J. T., M.A. *Cantab.*, 101 Elizabeth-street.
1872	P 29	†Liversidge, Archibald, M.A. "*Cantab.*" F.R.S.; Assoc. Roy. Sch. Mines, *Lond.*; F.C.S.; Fel. Inst. Chemistry of Gt. Brit. and Irel.; F.G.S.; F.L.S.; F.R.G.S.; Mem. Phy. Soc. London; Member of Mineralogical Society, London; Cor. Mem. Roy. Soc. Tas.; Cor. Mem. Roy. Soc. Queensland; Cor. Mem. Senckenberg Institute, Frankfurt; Cor. Mem. Soc. d'Acclimat. Mauritius; Hon. Fel. Roy. Hist. Soc. Lond.; Mem. Min. Soc. of France; Professor of Chemistry and Mineralogy in the University of Sydney, *Hon. Secretary.* The University, Glebe.
1874		Lloyd, The Hon. George Alfred, M.L.C., F.R.G.S., "Scottforth," Elizabeth Bay.
1881		Lloyd, Lancelot T., "Eurotah," William-street East.
1887		Long, Alfred Parry, Land Titles' Office.
1876		Lord, The Hon. Francis, M.L.C., North Shore.
1882		Lovell, R. Haynes, M.R.C.S., L.R.C.P. *Lond.*, 26 Wynyard Sq.
1878		Low, Hamilton, H. M. Customs.
1880		Low, Andrew S., "Osborne," North Geelong, Victoria.
1881		Lowe, Edwin, Wilgar Downs Station, *viâ* Girilambone.
1887		Lyden, M. J., M.D., M. Ch., Q.U. *Irel.*, 44 College-street.
1887		MacAllister, John F., M.B., B.S. *Melb.*, Prince Alfred Hospital, Camperdown.
1884		MacCormick, Alexander, M.D., M.B., Ch. M. *Edin.*, M.R.C.S. *Eng.*, Demonstrator of Anatomy, University of Sydney, 205 Macquarie-street North.
1887		MacCulloch, S. H., M.B., C.M. *Edin.*, 376 Pitt-street.
1876		M'Culloch, A. H., jun., M.L.A., 121 Pitt-street.
1874		M'Cutcheon, John Warner, Assayer to the Sydney Branch of the Royal Mint.
1886		MacDonald, John A., Roads Department, Public Works, Sydney.
1878		MacDonald, Ebenezer, "Kamilaroi," Darling Point.
1868		MacDonnell, William J., F.R.A.S., Bank of New South Wales, Port Macquarie.
1877		MacDonnell, Samuel, 312 George-street.
1886		MacFarlane, Edward, District Surveyor, Bourke.
1882		MacGillivray, P. H., M.A., M.R.C.S., F.L.S., Sandhurst, Victoria.
1876		M'Kay, Charles, M.D. Univ. *St. Andrew*, L.R.C.S. *Edin.*, Belmont House, Wynyard Square.
1880	P 2	M'Kinney, Hugh G., M.E., Mem. Inst. C.E., Athenæum Club, Castlereagh-street.
1876		MacLaurin, Henry Norman, M.A., M.D. Univ. *Edin.*, Lic. R. Coll. Sur. *Edin.*, 155 Macquarie-street.
1872		Mackenzie, John, F.G.S., Examiner of Coal Fields, Newcastle.
1876		Mackenzie, Rev. P. F., "Sydenham," Reserve-street, North Annandale.
1880		Mackenzie, R. M., Bond-street.
1887		Mackenzie, G. S., Ph. D., *Heidelberg*, F.I.C., c/o Messrs. Caird Maxwell & Co., 58 Margaret-street.

Elected.		
1876		Mackellar, The Hon. Charles Kinnard, M.L.C., A.M., M.B., C.M. *Glas.*, Macquarie-street.
1882	P 1	Madsen, Hans. F., "Hesselmed House." Queen-st., Newtown.
1885		Maher, W. Odillo, M.D., Queen's Univ. *Irel.*, 20 College-street, Hyde Park.
1883	P 1	Maiden, Joseph H., F.R.G.S., Technological Museum, Sydney.
1878		Maitland, Duncan Mearns, "Afreba," Stanmore Road.
1873		Makin, G. E., Berrima.
1880		Manfred, Edmund C., Montague-street, Goulburn.
1877		Mann, John F., "Kerepunu," Neutral Bay.
1881		Manning, The Hon. Sir W. M., LL.D., M.L.C., "Walleroy," Edgecliff Road, Woollahra.
1876		Manning, Frederic Norton, M.D. Univ. *St. And.*, M.R.C.S. *Eng.*, Lic. Soc. Apoth. *Lond.*, Hunter's Hill.
1869		Mansfield, G. A., 121 Pitt-street.
1880		Marano, G. V., M.D., Univ. *Naples*, Clarendon Terrace, Elizabeth-street.
1885		Marks, James Surfleet, The City Bank, Sydney.
1872		Marsden, The Right Rev. Dr., The Woodlands, Tyndall's Park, Clifton, Bristol.
1876		Marshall, George, M.D. Univ. *Glas.*, Lic. R. Coll. S. *Edin.*, Lyons' Terrace.
1886		Marshall, George A., M.B., 241 Elizabeth-street.
1886		Martin, Thomas M., L.R.C.P., L.R.C.S. *Edin.*, 241 Elizabeth-street.
1879		Masters, Edward, "Lurlei," Marrickville.
1875		Mathews, R. H., J.P., L.S., Singleton.
1879		Matthews, Robert, Sheridan-street, Gundagai.
1887		Max, Rudolph, LL.D., Univ. *Heidelberg*, Lecturer in Modern Languages, Sydney University, German Club.
1873		Milford, F., M.D. *Heidelberg*, M.R.C.S. *Eng.*, 3 Clarendon Terrace, Hyde Park.
1876		Millard, Rev. Henry Shaw, Newcastle Grammar School.
1885		Miller, W. Valentine, C.E., Bach. Eng. Queen's Univ. *Irel.*, "Bohrhurst," Timaru, New Zealand.
1884		Mills, Walter Wallace, East-street, Marrickville.
1882		Milson, Alfred G., "Coreena," East St. Leonards.
1882		Milson, James, "Elamang," North Shore.
1887		Miles, George E., L.R.C.P. *Lond.*, M.R.C.S. *Eng.*, Hospital for the Insane, Callen Park.
1887		Mitchell, J. S., "Etham," Darling Point.
1875		Moir, James, 58 Margaret-street.
1875		Montefiore, E. L., Darlinghurst.
1856	P 5	†Moore, Charles, F.L.S., Director of the Botanic Gardens, Sydney. *Vice-President.*
1879		Moore, Frederick H., Exchange Buildings, Pitt-street.
1886		Morgan, Dr. Edward H., Imperial Hotel, Mount Victoria.
1883		Morley, Frederick, 47 Surry-street, Darlinghurst.
1865	P 1	Morrell, G. A., C.E., 156 Pitt-street.
1877	P 1	Morris, William, Fel. Fac. Phys. and Surg. *Glas.*, F.R.M.S. *Lond.*, Burwood.
1880		Moses, David, J.P., Tenterfield.
1882		Moss, Sydney, "Kaloola," Richmond Terrace, Milson Point, St. Leonards.
1879		Mountain, Adrian C., City Surveyor, Town Hall, Melbourne.
1877		‡Mullens, Josiah, F.R.G.S., Eldon Chambers, Pitt-street.

Elected.

1879 Mullins, John Francis Lane, M.A., 2 Macleay Heights, Potts' Point.
1885 Munro, A. Watson, M.B., C.M., 131 Macquarie-street North.
1887 Munro, W. J., M.B., Ch. M., M.R.C.S. *Eng.*, 72 Glebe Road, Glebe.
1865 Murnin, M. E., "Eisenfels," Nattai.
1876 ‡Murray, W. G., 93 Pitt-street.
1876 Myles, Charles Henry, "Dingadee," Burwood.

1873 Neill, William, City Bank, Pitt-street.
1874 Neill, A. L. P., City Bank, Pitt-street.
1885 Newbery, William, M.A. *Cantab.*, "The Hermitage," South Head Road, Double Bay.
1886 Newmarch, Bernard J., L.R.C.P. *Lond.*, M.R.C.S. *Eng.*, Bowral.
1882 Norrie, Andrew, M.D., Mast. Surg. *Aberdeen* Univ., 171 Liverpool-street, Hyde Park.
1873 Norton, Hon. James, M.L.C., solicitor, O'Connell-street.
1875 Nott, Thomas, M.D. *Aberdeen*, M.R.C.S. *Eng.*, Ocean-street, Woollahra.
1878 Nowlan, John, "Eelah," West Maitland.

1879 O'Connor, Dr. Maurice, 26 College-street, Hyde Park.
1878 Ogilvy, James L., Commercial Bank of Australia, Pitt-street, Sydney.
1883 Oram, Arthur Murray, M.D., Univ. *Edin.*, 1 Hyde Park Terrace, Liverpool-street.
1875 O'Reilly, W. W. J., M.D., M.Ch., Q. Univ. *Irel.*, M.R.C.S. *Eng.*, Liverpool-street.
1882 O'Reilly, Rev. A. Innes, B.A. *Cantab.*, Hayfield, Parramatta.
1883 Osborne, Benjn. M., J.P., Berrima.

1880 Paling, W. H., 356 George-street.
1875 Palmer, J. H., Legislative Assembly.
1880 Palmer, Joseph, 133 Pitt-street.
1882 P 1 Palmer, Edward, (M.L.A., Queensland), c/o Messrs. B. D. Morehead & Co., Brisbane.
1885 Park, Archibald John, Chairman, Local Land Board, Hay.
1876 Parrott, Major Thomas S., C.E., c/o Messrs. Parrott & Cameron, Mercantile Mutual Chambers, 118 Pitt-street.
1878 Paterson, Hugh, 229 Macquarie-street.
1877 Paterson, James A., Union Bank, Pitt-street.
1878 Paterson, Alexander, M.D., M.A., "Hillcrest," Stanmore Road.
1877 †Pedley, Perceval R., 201 Macquarie-street.
1884 Perdriau, Stephen E., Lugar-street, Waverley.
1877 Perkins, Henry A., "Barangah," Homebush.

Elected.		
1881		Philip, Alexander, L.K. and Q.C.P. *Irel.*, L.R.C.S. *Irel.*, 540 Park View Terrace, Crown-street, Surry Hills.
1876		Pickburn, Thomas, M.D. *Aberdeen*, Ch. M., M.R.C.S. *Eng.*, 40 College-street.
1879		Pittman, Edward Fisher, L.S., Department of Mines, Sydney.
1881		Poate, Frederic, Government Surveyor, Dubbo.
1879		Pockley, Thomas F. G., Commercial Bank, Singleton.
1887		Pollock, J. A., B.E. Royal Univ. *Irel.*, Sydney Observatory.
1882	P 2	Porter, Donald, Tamworth.
1878		Potts, F. H., "Hydebrae," Coventry Road, Homebush.
1886		Provis, John, "Poldice," Barton Terrace West, North Adelaide.
1876		Quaife, Frederick Harrison, M.D., Mast. Surg. Univ. *Glas.*, "Hughenden," Queen-street, Woollahra.
1886		Quaife, William Francis, B.A., M.B., Ch. M., 30 Waverley Road, Woollahra.
1886		Quayle, Edwin, "Lezayre," Toxteth Road, Glebe Point.
1876		Quodling, W. H., "Couranga," Redmyre Boulevard, Strathfield.
1865	P 1	‡Ramsay, Edward P., LL.D. (Univ. St. And. *Aberdeen*), F.L.S., Curator of the Australian Museum, College-street.
1876		‡Ratte, A. Felix, "Ingen. Arts et Manuf." *Paris*, "Officier d'Acad." *Paris*, Australian Museum, Sydney.
1868		Reading, E., Mem. Odont. Soc. *Lond.*, Elizabeth-street, Hyde Park.
1886		Redfearn, William, Conder-street, Burwood.
1881		Reid, William, J.P., Australian Joint Stock Bank, Sydney.
1881	P 3	Rennie, Edward H., M.A. *Syd.*, D.Sc. *Lond.*, Professor of Chemistry, University, Adelaide.
1870		Renwick, The Hon. Arthur, M.L.C., B.A., *Syd.*, M.D. *Edin.*, F.R.C.S. *Edin.*, 295 Elizabeth-street.
1880		Riddell, C. E., Union Club.
1886		Rigg, Thomas S. J., B.A. *Syd.*, Secretary's Branch, General Post Office, Sydney.
1856		Roberts, J., 340 George-street.
1868	P 3	†Roberts, Sir Alfred, M.R.C.S. *Eng.*, Hon. Mem. Zool. and Bot. Soc. *Vienna*, 205 Macquarie-street North.
1881		Roberts, The Hon. C. J., C.M.G., M.L.A., "Chatsworth," Potts' Point.
1871		Robertson, Thomas, solicitor, Hay.
1856	P 9	†Rolleston, Christopher, C.M.G., Palmer-street, St. Leonards East, *Vice-President*.
1885		Rolleston, John C., C.E., "Northcliff," Milson's Point.
1865		Ross, J. Grafton, O'Connell-street.
1884		Ross, Chisholm, M.B., C.M., Hospital for the Insane, Gladesville.
1885		Ross, Elsey Fairfax, M.D. *Brux.*, 145 Macquarie-street North.
1882		Rothe, W. H., Union Club.

Elected.		
1885		Roth, Reuter Emerich, M.R.C.S. *Eng.*, 42 College-street, Hyde Park.
1876		Rowling, Charles, L.R.C.P. *Edin.*, M.R.C.S. *Eng.*, Parramatta.
1864	P 34	Russell, Henry C., B.A. *Syd.*, F.R.S., F.R.A.S., F.R.Met.S., Hon. Mem. Roy. Soc. S. Aust., Government Astronomer, Sydney Observatory.
1886		Sager, Edmund E., Secretary to the Board of Health, 127 Macquarie-street North.
1875		Sahl, Charles L., German Consul, Consulate of the German Empire, Wynyard Square.
1876		Saliniere, Rev. E. M., St. John's Parsonage, Glebe.
1884		Sands, Robert, 374 George-street.
1887		Schwarzbach, B., M.D. *Würzburg*, L.F.P. and S. *Glasgow*, 151 Macquarie-street North.
1856	P 1	‡Scott, Rev. William, M.A. *Cantab.*, Hon. Mem. Roy. Soc. Vic., Kurrajong Heights.
1886		Scott, Walter, M.A. *Oxon.*, Professor of Classics, Sydney University.
1880		Scrivener, Charles Robert, Survey Department, Minto, G.S.R.
1887	P 1	Seaver, Jonathan C. B. P., C.E., F.G.S., M.L.A., Norwich Chambers, Hunter-street.
1876		Sedgwick, W. Gillet, M.R.C.S. *Eng.*, King-street, Newtown.
1877		Selfe, Norman, C.E., M.I.C.E., "Rockleigh," Balmain.
1876		Sharp, Henry, Green Hills, Adelong.
1878	P 1	Sharp, Revd. W. Hey, M.A. *Oxon.*, Warden of St. Paul's College, University.
1883	P 1	Shellshear, Walter, Assoc. M. Inst. C.E., "Trentham," Holt-street, Stanmore.
1879		Shepard, A. D., Shepard's Town.
1875		Sheppard, Rev. G., B.A., Berrima.
1882		Shewen, Alfred, M.B., M.D. Univ. *Lond.*, M.R.C.S. *Eng.*, 6 Lyons' Terrace, Hyde Park.
1882		Sinclair, Eric, M.B., C.M. Univ. *Glas.*, Lunacy Department, Gladesville Hospital for the Insane.
1883		Sinclair, Sutherland, Secretary, Australian Museum.
1884		Skirving, Robert Scot, M.B., C.M., Elizabeth-street, Hyde Park.
1877		Slattery, Thomas, M.L.A., Premier Terrace, 169 William-street, Woolloomooloo.
1877		Sloper, Frederick Evans, 360 Liverpool-street.
1875		Smith, Robert, M.A. *Syd.*, solicitor, O'Connell-street.
1874		‡Smith, John M'Garvie, Assayer, &c., Denison-st., Woollahra.
1878		Smith, E. E., "Clytie," 70 Darlinghurst Road.
1883		Smith, Robert Burdett, M.L.A., 203 Macquarie-street North.
1884		Smith, Frederic Moore, M.D., M.R.C.S. *Eng.*, Coast Hospital, Little Bay.
1886		Smith, Walter Alexander, A.M.I.C.E., Roads and Bridges Department, Newcastle.
1879		Spry, James Monsell, Union Club.
1881		‡Starkey, John T., 61½ Castlereagh-street.
1882		Steel, John, L.R.C.P., L.R.C.S. *Edin.*, 149 Elizabeth-street, Hyde Park.

Elected.		
1872	P 1	Stephen, George Milner, B.A., Mem. Geol. Soc. of Germany; Cor. Mem. Nat. Hist. Soc. *Dresden;* F.R.G.S. of *Cornwall.*
1879		‡Stephen, The Hon. Septimus A., M.L.C., South Kingston.
1879		Stephen, Alfred F. H., Audit Department, Bligh-street.
1857		Stephens, William John, M.A. *Oxon.*, Professor of Natural History in the University of Sydney, 71 Darlinghurst Road.
1883		Stephen, Cecil B., M.A., 101 Elizabeth-street.
1884		Strange, Frederick R., Burwood.
1878		Street, John Rendell, M.L.A., "Birtley," Elizabeth Bay Road.
1876		Strong, W. Edmund, M.D., *Aberdeen*, M.R.C.S. *Eng.*, Government Medical Officer and Vaccinator for Sydney, 108 Phillip-street.
1876		Stuart, Clarendon, M.I.S., Cross-street, Double Bay.
1883		Stuart, T. P. Anderson, M.D., Univ. *Edin.*, Professor of Anatomy and Physiology in the University of Sydney.
1883		Styles, G. Mildinhall, Commercial Bank, George-street.
1887		Sulman, John, F.R.I.B.A., 375 George-street.
1884		Sunderland, Rev. J. P., 19 Wentworth Court, Elizabeth-street.
1876		Suttor, The Hon. William Henry, M.L.C., "Cangoura," Bathurst.
1884		Syer, Frank Weston, 89 Pitt-street.
1879		Tarrant, Harman, M.R.C.S. *Eng.*, 207 Macquarie-street.
1862	P 12	Tebbutt, John, F.R.A.S., Observatory, Windsor, N.S.W.
1879		Thomson, Dugald, care of R. Harper & Co., 409 George-street.
1875		Thompson, Joseph, "Trahlee," Bellevue Hill, Double Bay.
1877		Thompson, Thomas James, Eldon Chambers, Pitt-street.
1885		†Thompson, John Ashburton, M.D *Brux.*, Dipl. Publ. Health *Cambridge*, Health Department, 127 Macquarie-street N.
1878		Thomas, F. J., Hunter River. N.S.N. Co., Sussex-street.
1882		Thornton, Hon. George, M.L.C., 377 George-street.
1886	P 1	Threlfall, Richard, B.A. *Cantab.*, Professor of Physics, University of Sydney.
1876		Tibbits, Walter Hugh, M.R.C.S. *Eng.*, "Belchester," Manly.
1876		Toohey, J. T., "Moira," Burwood.
1884		Townsend, G. W., C.E., Rooty Hill.
1882		Traill, Mark W., L.R.C.P. *Lond.*, M.R.C.S. *Eng.*, Burwood.
1873	P 1	Trebeck, Prosper N., 91 Pitt-street.
1879		Trebeck, P. C., 91 Pitt-street.
1883		Trebeck, T. B., M.A., *Syd.*, 4 Brighton Terrace, Prospect-street, Waverley.
1885		Trickett, The Hon. W. J., M.L.C., "Fairlight," Edgecliff Road, Woollahra.
1876		Trouton, F. H., Clifdale House, Balmain.
1877		‡Tucker, G. A., Ph. D., "Minnesota," Johnston-street, Annandale.
1868		Tucker, William, "Clifton," North Shore.
1875		Tulloh, W. H., "Airlee," Greenwich Point Road, North Shore.
1883		Tuxen, Peter Wilhelm, L.S., Silverton.
1882		Twynam, George Edward, L.R.C.P. *Lond.*, M.R.C.S. *Eng.*, 38 Bayswater Road, Darlinghurst.

Elected.		
1883		Vause, Arthur J., M.B., C.M. *Edin.*, Bay View House, Tempe.
1884		Verde, Felice, 16 Prione, Spezia, Italy.
1885		Vernon, Walter N., M.S.A., "Clytha House," Neutral Bay, St. Leonards.
1876		Voss, Houlton H., J.P., Goulburn.
1879		Walker, H. O., Australian General Assurance Co., 97 Pitt-st.
1867		Walker, Philip B., Telegraph Office, George-street.
1867		Ward, R. D., M.R.C.S. *Eng.*, North Shore.
1883		Wardell, W. W., Fellow Royal Institute of British Architects, *Lond.*, Member Institute Civil Engineers, *Lond.*, "Upton Grange," St. Leonards.
1877		Warren, William Edward, M.D. and M.Ch., Queen's Univ. *Irel.*, 243 Elizabeth-street, Sydney.
1883	P 1	†Warren, W. H., M.I.C.E , Professor of Engineering, University of Sydney, "Madeley," London-street, Enmore.
1876		Watkins, John Leo, B.A. *Cantab.*, M.A. *Syd.*, 105 Elizabeth-street.
1876		Waterhouse, J., M.A. *Syd.*, "Sauchie House," Church-street, West Maitland.
1876		Watson, C. Russell, M.R.C.S. *Eng.*, "Morevale," Newtown.
1877		Watt, Alfred Joseph, 528 George-street.
1859		Watt, Charles, Parramatta.
1876		Waugh, Isaac, M.B., M.C., T.C.D., Parramatta.
1876		Webster, A. S., Gresham Chambers.
1867		Weigall, Albert Bythesea, B.A. *Oxon.*, M.A. *Syd.*, Head Master of the Sydney Grammar School, College-street.
1881		‡Wesley, W. H.
1878		Westgarth, G. C., solicitor, "Tresco," Elizabeth Bay.
1879		‡Whitfeld, Lewis, M.A. *Syd.*, Judges' Chambers, Supreme Court.
1874		White, Rev. James S., M.A., LL.D. *Syd.*, "Gowrie," Singleton.
1875		White, Hon. James, M.L.C., "Cranbrook," Double Bay.
1877		‡White, Rev. W. Moore, A.M.. LL.D., T.C.D.
1883		Whitelegge, Thomas, Australian Museum, College-street.
1884		Wiesener, T. F., 334 George-street.
1874	P 1	†Wilkinson, C. S., F.G.S., F.L.S., Government Geologist, Department of Mines, *President.*
1880		Wilkinson, Robert Bliss, M.L.A., 12 Spring-street.
1878		Wilkinson, Rev. Samuel, "Regent House," Regent-street, Petersham.
1883		Wilkinson, W. Camac, M.D., M.R.C.P. *Lond.*, M.R.C.S. *Eng.*, M.L.A., "Hereford House," Glebe Point Road.
1876		Williams, Percy Edward, Treasury, Sydney.
1884		Williamson, William Cotter, M.D., Hospital for the Insane, Parramatta.
1879		Wilshire, F. R., P.M., Berrima.
1878		Wilshire, James Thompson, J.P., "Havilah," Burwood.
1879		Wilson, F. A. A., Mercantile Bank, Sydney.
1876		Windeyer, W. C., M.A. *Syd.*, Puisne Judge, King-street.
1878		Wise, Henry, Savings' Bank of N.S.W., Barrack-street.
1884	P 1	Wood, Arthur Pepys, C.E., Roads and Bridges Dept., Sydney.

Elected.		
1873		Wood, Harrie, J.P., Under Secretary for Mines, Department of Mines.
1887		Wood, W. E. Ramsden, M.A. *Cantab.*, M.D., M.R.C.P., and F.R.C.S. *Edin.*, "Clunes," Cambridge-street, Stanmore.
1879		Woodhouse, E. B., "Mount Gilead," Campbelltown.
1876		Woolrych, F. B. W., 11 Hill-street, Newtown.
1886		Worrall, Ralph, M.D., C.M., Queen's Univ. *Irel.*, 34 College-street.
1881		Wright, Frederic, M.P.S., Harnett-street.
1872		†Wright, Horatio G. A., M.R.C.S. *Eng.*, L.S.A. *Lond.*, Wynyard Square.
1884		Yeomans, Allan, Gilgoin, *viâ* Byrock.
1879		Young, John, "Kentville," Johnston-street, Leichhardt.

Honorary Members.

Limited to Twenty.

M. recipients of the Clarke Medal.

1875		Agnew, Dr., Hon. Secretary, Royal Society of Tasmania, Hobart.
1884		Airy, Sir George Biddell, K.C.B., M.A., D.C.L. *Oxon.*, LL.D., *Cantab. et Edin.*, F.R.S., &c., The White House, Croom's Hill, Greenwich Park, S.E.
1875		Bernays, Lewis A., F.L.S., F.R.G.S., Brisbane.
1876	P 1	Cockle, His Honor Sir James, late Chief Justice of Queensland, M.A., F.R.S., Ealing, London.
1875		Ellery, Robert F., F.R.S., F.R.A.S., Government Astronomer of Victoria, Melbourne.
1887		Foster, Michael, M.D., F.R.S., Professor of Physiology, University of Cambridge.
1875		Gregory, The Hon. Augustus Charles, C.M.G., M.L.C., F.R.G.S. Geological Surveyor, Brisbane.
1875	P 1 M	Hector, Sir James, K.C.M.G., M.D., F.R.S., Director of the Colonial Museum and Geological Survey of New Zealand, Wellington, N.Z.
1880	M	Hooker, Sir Joseph Dalton, K.C.S.I., M.D., C.B., F.R.S., &c., Director of the Royal Gardens, Kew.
1879	M	Huxley, Professor, F.R.S., LL.D., F.G.S., F.Z.S., F.L.S., &c., &c., Professor of Natural History in the Royal School of Mines, South Kensington, London.
1875	M	M'Coy, Frederick, C.M.G., D.Sc., F.R.S., F.G.S., Hon. M.C.P.S., C.M.Z.S., Professor of Natural Science in the Melbourne University, Government Palæontologist, and Director of the National Museum, Melbourne.
1875	P 4 M	Mueller, Baron Ferdinand von, K.C.M.G., M.D., Ph.D., F.R.S. F.L.S., Government Botanist, Melbourne.

Elected.		
1879	M	Owen, Professor Sir R., K.C.B., M.D., D.C.L., LL.D., F.L.S., F.G.S , V.P.Z.S., &c., &c., The British Museum, London, W.C.
1883		Pasteur, Louis, M.D., Paris
1875		Schomburg, Dr., Director of the Botanic Gardens, Adelaide, South Australia.
1884		Tyndall, John, D.C.L. *Oxon.*, LL.D., *Cantab.*, F.R.S., F.G.S., &c., Professor of Natural Philosophy in the Royal Institution, Albemarle-street, London.
1875		Waterhouse, F. G., F.G.S., C.M.Z.S., Adelaide, S. Australia.
1875	P 14 M	Woods, Rev. Julian E. Tenison-, F.G.S., F.L.S., Hon. Mem. Roy. Soc., Victoria; Hon. Mem. Roy. Soc., Tasmania; Hon. Mem. Adelaide Phil. Soc.; Hon. Mem. New Zealand Institute; Hon. Mem. Linnean Soc., N.S.W., &c., Union Club, Sydney.

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Limited to Twenty-five.

1880	P 1	Clarke, Hyde, V.P. Anthropological Institute, 32 St. George's Square, London, S.W.
1879	P 3	Etheridge, Robert, junr., 233 Macquarie-street, Sydney.
1883	P 1	Feistmantel, Ottokar, M.D., Bohemian Polytechnic High School, Prague, Austria.
1886		Marcou, Professor Jules, F.G.S., Cambridge, Mass., United States of America.
1880	P 1	Ward, Major-General, Sir Edward, K.C.M.G., R.E., Cannes, France.

Obituary, 1887.

Ordinary Members.

1875		Busby, Hon. William, M.L.C.
1877		Cunningham, Andrew.
1873		Daintrey, Edwin.
1882		Duckershoff, August, M.D. *Leipzig.*
1876		Holroyd, Arthur T., M.D. *Edin.*, F.L.S., F.Z.S.
1873		Manning, James.
1878		Markey, James, L.R.C.S. *Irel.*, L.R.C.P. *Edin.*
1876		Sharp, James Burleigh, J.P.
1877		Weston, W. J.

Honorary Members.

1876		De Köninck, Prof. L. G., M.D. *Liége.*
1875		Haast, Sir Julius von, K.C.M.G., Ph.D., F.R.S., &c.

Corresponding Member.

1880		Miller, F. B.

AWARDS OF THE CLARKE MEDAL.

Established in memory of

THE LATE REVD. W. B. CLARKE, M.A., F.R.S., F.G.S., &c.,

Vice President from 1866 *to* 1878.

To be awarded from time to time for meritorious contributions to the Geology, Mineralogy, or Natural History of Australia, to men of science, whether resident in Australia or elsewhere.

1878. Professor Sir Richard Owen, K.C.B., F.R.S., Hampton Court.

1879. Mr. George Bentham, C.M.G., F.R.S., The Royal Gardens, Kew.

1880. Professor Huxley, F.R.S., The Royal School of Mines, London, 4 Marlborough Place, Abbey Road, N.W.

1881. Professor F. M'Coy, F.R.S., F.G.S., The University of Melbourne

1882. Professor James Dwight Dana, LL.D., Yale College, New Haven, Conn., United States of America

1883. Baron Ferdinand von Mueller, K C.M.G., M.D., Ph.D., F.R.S., F.L.S., Government Botanist, Melbourne.

1884. Alfred R. C. Selwyn, LL.D., F.R.S., F.G.S., Director of the Geological and Natural History Survey of Canada, Ottawa.,

1885. Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., &c., Director of the Royal Gardens, Kew.

1886. Professor L. G. De Koninck, M.D. University of Liege, Belgium.

1887. Sir James Hector, K.C.M.G., M.D., F.R.S., Director of the Geological Survey of New Zealand, Wellington, N.Z.

1888. Rev. Julian E. Tenison-Woods, F.G.S., F.L.S., Union Club, Sydney.

ANNIVERSARY ADDRESS.

By Christopher Rolleston, C.M.G., President.

[*Delivered to the Royal Society of N.S.W., 4 May, 1887.*]

It was with no little diffidence that I accepted the honour conferred upon me at our last Anniversary Meeting, by my election to the office of President for the year, and I have to ask your indulgence for my shortcomings in the fulfilment of the task which that honourable position imposed upon me. I am not insensible to the deficiencies which must necessarily appear in the case of one whose training has hardly qualified him for the discharge of the duties of the Presidential Chair, and less so for his appearance before you this evening to deliver the inaugural address of the Session, which before he vacates the Chair, custom imposes upon your President. The design of the Society in making this claim upon the occupant of the Chair is to obtain from him a review of the history and progress of the Society during the preceding Session, whilst at the same time it is expected of him that he should deal with some one or more of the prominent scientific advances which have formed the distinguishing features of the year that has passed. With your permission I will endeavour to satisfy the latter expectation first.

Although I have no original discoveries of transcendent magnitude to place before you, it has appeared to me that a cursory review of the progress of scientific inquiry during the past year will be found to furnish a subject of very general interest. Firstly, then I will take occasion to point out the unusual activity which Nature herself has exhibited in her own great laboratory. Not for a long period have her experiments been on so grand and wide-spread a scale. All over the face of the earth the mysterious forces of nature have been actively displayed to the great terror of those within their influence. The two great European Volcanoes, Etna and Vesuvius have been both active and threatening. In Mexico there have been outbursts of some magnitude, while Java, that great centre of volcanic activity has found fresh issues for the restless forces which underlie her surface. Sub-oceanic commotions have been reported in the Atlantic, the Pacific and in the Mediterranean, giving birth, it is said, in the South Pacific to a new island. But greatest, most destructive, and most lamentable of all was the sudden and most unexpected catastrophe that befel the wonderland of our Sister Colony of New Zealand, destroying her famous terraces, and burying beneath many feet of volcanic mud the most beautiful features of that picturesque country.

The Eastern States of America were for weeks kept in a chronic state of apprehension by the almost daily series of earthquakes which had their centre in the neighbourhood of Charleston. In Japan, in Switzerland, in Germany, in Italy, in the Eastern Mediterranean, in the Pacific, in West Africa there has been experienced, more or less, a quaking of the earth, whilst in the case of our own land suspicious rumours have reached our ears of a similar occurrence in certain localities, and more recently the news of a serious earth tremor attended by considerable loss of life, has been reported from the Riviera.

These manifestations of Nature's subterranean forces whilst they cause terror in the hearts of ordinary humanity are in the eyes of scientific workers of the deepest interest. At the centres of greatest activity, Science was ready with her observers and her instruments, and both from the United States earthquakes and the New Zealand outburst she may be able to add considerably to her store of data.

Professor Milne in his volume on "Earthquakes," published last year, has gathered together much information as to the nature and causes of these freaks on the part of our Mother Earth. In Japan he has been busy observing the almost daily earth tremors of that interesting region. The crater of Assamayama, one of the most active of Japanese volcanoes was sounded by him. Five different times, and from five different points, did this daring Professor endeavour to touch the bottom of what by many was believed to be a bottomless pit, the result was that at the fourth sounding the line after striking the bottom when 800 feet had run out, suddenly became slack, and Professor Milne's conclusion is that the depth at this particular place did not exceed 750 feet. The end of the line for several feet was thoroughly carbonized, shewing as was expected, that the temperature of the lower region of the crater is tolerably high. What the "bottom" means, Professor Milne does not profess to know. Still whatever the gain to Science, the attempt deserves to be recorded in the scientific work of the year.

In Geological research there does not appear to have been much advance calling for special notice, although there has been no diminution in the amount of work carried on. Advantage was taken of the occupation of Egypt to make some explorations by way of boring in the Delta of the Nile, to the results of which Geologists attached great importance. A deep bore had been made and carried to a depth of 190 feet from the surface, or 164 feet below the mean sea level, yet nothing had been reached but sand and clay with small pebbles. A derangement of the boring apparatus prevented further progress, but the work is to be continued so as, if possible, to get down to the rock. Letters have lately appeared in the Sydney Press, from the pen of one of our ablest Geologists, descriptive of his journeys in the northern portion of this Continent but little known to explorers; and, on the return of the Rev. J. Tenison-Woods from his recent travels, we may hope to hear the result of his investigations into the geology of the Islands of the Eastern Archipelago which he has visited. Much interesting information may be looked for from the pen of so close and able an observer.

I should here invite attention to the success which has attended the exploration carried on by the Mining Department in our own Colony. The persevering efforts of Mr. W. H. J. Slee, the Superintendent of Diamond Drills have led to the discovery of a copious supply of water, at a depth of 960 feet, at a distance of 75 miles from Bourke. The water is flowing at the rate of 33,000 gallons in the 24 hours, and rises to a height of 10 feet above the surface of the ground. North of Bourke again, within the Queensland border the discovery has been reported of an artesian supply of water at a depth of over 1,000 feet, yielding a supply of 24,000 gallons per day, and rising 20 feet above the surface. It has further been reported from South Australia, that water has been obtained by the diamond drill at Bruce, on the Great Northern line, at a depth of 215 feet, and is flowing over the surface at the rate of 200 gallons an hour.

Mr. Wilkinson has kindly supplied me with the following interesting particulars of the explorations referred to, and the geological formation through which the diamond drill was driven in the case of the boring near Bourke :—

Section of strata passed through in Bore 51½ miles West of Bourke

	Ft.	in.	Thickness of Strata.
Tertiary Formation.	0	6	Loose sand
	21	6	Grey and yellow clay
	15	0	Clayey sand with *salt water* drift
	11	8	Fine drift sand with *salt water*
	17	0	Clayey sand and drift
Cretaceous Form.	6	0	Blue sandy clay
	10	0	Blue and yellow clay
	20	0	Blue and green rotten sandstone
	3	10	Black and green rock with quartz pebbles and clay
	8	6	Grey sandstone and clay
	5	0	Sandstone grit and clay with fossil shells
Cretaceous Formation.	7	0	Sandstone and clay
	27	0	Grey and black sandstone and shells with clay
	0	11	Very hard rock
	33	1	Grey and black sandstone, shale and clay containing fossil shells
	6	0	Grey shale, gravel and clay
	4	0	Granite, cement pebbles and conglomerate
	1	6	Hard rock
	2	2	Hard granite
	200	8	Total depth.

Remarks.—*Salt Water* tapped at 20 ft. stood at 20 ft. below surface.

Fresh Water	tapped	at 80 ft.,	rose to	10 ft. over surface			
,,	,,	100 ft.,	,,	,,	at rate of	1,900 gal.	per day
,,	,,	106 ft. 6 in.	,,	,,			
,,	,,	122 ft. 6 in.	,,	,,	,,	14,400	,,
,,	,,	192 ft.,	,,	,,	,,	15,000	,,

At 116 feet passed through layer of fossil bivalve shells.

SECTION OF BORE ON WANAARING ROAD, 75 MILES WEST OF BOURKE.

	Ft.	in.	
Tertiary deposit.	8	0	Grey clay
Cretaceous Formation.	12	0	Red and white rock
	16	0	White sandstone
	6	0	White clay
	8	0	Red clay
	55	0	Clays
	23	0	Grey and yellow clay veins and rotten sandstone
	42	0	Black clay
	45	0	Ditto, with grey streaks
	13	0	Black and grey clay
	10	0	Ditto ditto, with layers of black slate
	7	0	Black and grey clay
	0	6	Stone
	14	6	Black clay
	1	6	Grey clay
	1	6	Stone and grey clay
	3	0	Grey granitic rock
	9	0	Blue and grey sandstone
	15	6	Fine blue clay shale
	5	0	Do. do. with green copper stains
	14	6	Sandy clay shales
	10	0	Blue and black shales
	48	4	Blue shale with thin seam of sandstone
	34	6	Black clayey shale
	5	0	Blue clayey shale
	38	4	Black clay shale
	30	10	Blue clayey sandy shale
	23	10	Black clay shale
	33	0	Blue and black shale with thin layers of sand
	34	2	Sandstone and white rock and boulders
	25	6	Hard blue clay with sandstone and boulders
	11	0	Grey and dark sandstone
	22	6	Rock and shale
	16	6	Blue rock and sandstone
	25	10	Bluish grey sandstone with clay and shells
	5	8	Blue rock

	Ft.	in.	
Cretaceous Formation.	8	0	Grey stone
	16	0	Grey sandstone and black clay shale with small fossil wood
	26	3	Grey and black sandstone and clay
	15	3	Grey and black sand and clay
	4	9	Black shaly clay
	16	0	Black and grey strata with waterworn pebbles, with ½ inch seam of pyrites
	10	4	Light grey sand and black shaly clay
	12	0	Grey sandstone and black shaly clay in layers
	7	7	Black and reddish brown clay shale
	4	10	Black and light grey sand
	1	6	Clay and sandstone with small shells
	7	1	Sandy strata
	24	9	Grey sandy and black clay
	2	10	Light grey rock
	7	0	Black sandy clay
	1	10	Light grey rock
	3	2	Black sandy clay
	28	3	Dark clay and sand
	16	3	Dark grey and brownish sand
	26	8	Light grey sand and brown clay
	2	9	Grey clay with decayed wood
	12	7	Grey loam, quartz pebbles
	11	9	Brown clay and grey sand with vegetable matter
	14	7	Light grey sandy loam, 4 in. carbonaceous matter
	3	0	White sand and clay: water channel cut at 958 feet rising over surface
	960	0	Total depth

REMARKS.—*Salt Water* tapped at 8 feet, stood at 8 ft., 4,000 gallons per day.

The *fresh artesian water* tapped at 942 feet continued to flow at an increasing rate, until at 958 feet, after cutting through a tight layer, the rate of supply reached 33,000 *gallons* per day and continued to increase. Strata from the water channel at 958 feet were driven up over the surface by the force of the water.

"The question of water supply for the arid conntry in the interior of Australia is one of the greatest importance, more especially in connection with the future occupation of such country for pastoral purposes. In his official report to the Water Conservation Commission, Mr. Wilkinson states that there are 138,500 square miles in the western portion of New South Wales dependent upon artificial means for providing permanent water supply. Of this area 22,000 square miles are occupied by geological formations, from which, with but few exceptions, water probably cannot be obtained by sinking or boring, and the necessary supply can only be afforded by the rainfall conserved in tanks or dams. But in the Upper Darling District, from a few miles above Wilcannia to the Queensland Border, the cretaceous formation containing water-bearing strata, embraces no less than 40,000 square miles of pastoral country, producing salt-bush and other good herbage, yet naturally destitute of surface water, except in rainy seasons. And as the annual rainfall over this district is very irregular, varying according to the records of Mr. H. C. Russell, Government Astronomer, from only nine inches in some localities to eighteen inches in others, and subject to very great evaporation, this supply cannot be depended upon; consequently squatting pursuits here have been very precarious, and in some cases, attended with disastrous results to the stock in seasons of drought, such as we have recently experienced. The geological formation, however, of this large area being favourable for the existence of water-bearing strata, the Department of Mines, on the advice of the Government Geologist, commenced to put down a series of bores to obtain water along a proposed stock route from the Mount Brown Diggings in the far north-west to the railway terminus at Bourke. At 51 miles west from Bourke, artesian water was struck at a depth of 192 feet, and flowed from the pipes at a height of 10 feet above the surface at the rate of 15,000 gallons per day. Near Wanaring, on the Paroo, about 24 miles further west, another bore has recently been successful in piercing, at a depth of 942 feet, the water-bearing strata, from which the water rose in the pipes and flowed from them 15 feet above the surface of the ground, affording a daily supply of 33,000 gallons of pure fresh water. This discovery is of the greatest importance; for from the success of this deep boring may be inferred the certainty of obtaining an artesian and permanent supply of water within the great cretaceous area, and of this naturally arid country being converted into a well watered pastoral district. The first artesian water in this part of the Colony was obtained in the year 1881, on the Messrs. Officer's Killara Station, by the Manager, Mr. David Brown, who, in a bore sunk to a depth of 144 feet, struck water which rose 26 feet above the surface. This bore, however, was put down at the side of a "mud spring," which is a natural artesian spring. There are several such "mud springs" in the district, and they are considered by Geologists as further evidence of the existence of vast stores of water pent up under great pressure in the cretaceous strata below, but here and there finding its way to the surface through natural fissures in the over-lying almost impervious blue clay beds. This important water-bearing formation extends, it is believed, from New South Wales northerly through the western part of Queensland almost to the Gulf of Carpentaria, and westerly into South Australia where, in different localities, artesian water has been proved at depths of from 320 feet to 1,200 feet; from the former depth it rose 60 feet above the surface. At Thurlngoona, in Queensland, Mr. J. S. Longhead, for the Squatters' Investment Company, put down an eight-inch bore to a depth of 1,080 feet from which the water rose to a height of nine feet above the surface, flowing at the rate of 30,000 gallons per day. Mr. Russell long ago pointed out that all the rainfall in the watershed of the Darling cannot be carried away by the channel of the Darling River, or by evaporation, and that to a large extent there must be underground drainage; the geology of the country indicates the position of these underground stores of water; and the recent boring enterprises of private individuals and of our own Government have verified the predictions based on geological and meteorological observations to the great advance and the welfare of the Colonies, and of the pastoral industry in particular."

The discovery, by Mr. W. B. Spencer, of a median eye in the back of the head of the Hatteria lizard, has been regarded by the students of Morphology as being very remarkable and significant in relation to the pineal gland. The wonderful experiments of the celebrated French chemist, M. Pasteur, in the prevention of hydrophobia, continued throughout the year, have attracted the greatest attention, and although the scientific world still withholds its unreserved assent, there is evidently a growing conviction that the final results may confirm the predictions so cautiously and philosophically put forward by M. Pasteur. It may be remembered that this Society conferred on itself the distinction of electing M. Pasteur to its foreign membership in 1883. In Chemistry the event which perhaps excited the greatest interest among the scientific public, was the address of that patient Chemist, Mr. W. Crookes, delivered at the Meeting of the British Association, in which he endeavoured to propound a theory of the formation of the elements, and at all events offered some valuable spectroscopic results. The search for new elements by means of the spectroscope provided him with material for several important papers.

Julius Thomsens' concluding volume on his Thermo-chemical experiments has added much new matter to the already voluminous data referring to this subject, and must certainly be regarded as an important chemical event. The determination of the Vapour Density of Zinc, by V. Meyer and Mensching, has shewn that the vapour is "monatomic," and is in every way noteworthy owing to the extreme difficulty of the experimental problem. In Organic Chemistry we have a great discovery by Ladenburg, viz., the production of an optically active alkaloid "Conine," identical with that found in nature, which is thus known to be "α-propyl-piperidine." An alkaloid has been obtained by Brieger from liquids used to cultivate a certain Bacillus, and this alkaloid in virtue of its toxic action has received the name of Tetanine. This discovery appears to be the first actual demonstration of the modus operandi of a Bacillus as to its Pathological effect. An important paper, by Liebreich, as to the re-action of certain chemical re-agents, as modified apparently by capillarity, may be regarded as opening up a new field of experimental research to chemists. The experiments of Messrs. Ramsay and Young on the Physical Properties of Substances and their Vapours have earned a well merited degree of attention, and may be mentioned here alongside of a notice as to the valuable Dissociation results obtained by Berthelot, Natanson, and others. Dissociation by a feeble induction spark, passing through gases and vapours at low pressures, has been made the subject of some valuable work by J. J. Thomson.

Physics is not a subject in which the public are accustomed to hear of startling discoveries, but, nevertheless, much of value has been added to our knowledge of Natural Phenomena during the year. Mention may be made of the researches of S. P. Langley with the Bolometer, Professor Rowland with his gratings, and Abney and Festing with their colour photometer. Professor Tait has made several valuable investigations as to the basis of the Kinetic Theory of Gases. The Self-induction of wires has claimed a considerable amount of attention, partially owing to the importance of the results in the theory of telephones, electric cables, and lightning conductors. Perhaps it is not too much to assert that we now know a great deal more than we did a year ago about the cause of the too frequent failure of lightning conductors. For instance, solid iron rods or pipes may be considered as almost useless for lightning-rod purposes. The greater part of the work n this department, however, is too mathematical to admit of satisfactory treatment within the limits of an address.

In Astronomical science, the most striking event of the past year was the solar eclipse of last August, to observe which a party was sent from England under the direction of Mr. Norman Lockyer. The detailed results of this expedition have not yet, I believe, appeared. Although we are by no means so dependent for solar investigations on eclipses as in former times, for every day when the sun is visible he and all his appendages may be analysed by that most wonderful of modern instruments—the spectroscope,—still there are certain points which can only be cleared up satisfactorily, when the glory of the sun is hidden, after Nature's old-fashioned method. Some of the latest results of solar work, and the inferences supposed to be warranted thereby, were given in a paper read at a Meeting of the Royal Society in England, in May last, by Mr. Lockyer, in which the work carried on under his superintendence at his Laboratory for Solar Physics at South Kensington, was fully set forth. It is evident from this paper that though remarkable advances have been made in our knowledge of the great centre of light and heat, under improved methods of observation, with greatly improved instruments, we are still in some respects only groping after a solution.

Without the aid of Photography it may be safely said that such astronomical work would be impossible. The photography of sun spots by M. Janssen of Paris, and the photography of nebulæ by the Brothers Henry, mark one of the greatest conquests achieved by this method of work. It is hopeless to attempt to describe the Comets now being discovered. With the increased number of observers, and the greatly improved instruments, the sky is seen to swarm with these erratic bodies. The most notable are those of Fabry, Barnard, and Brooks, and all of them essentially telescopic. At the Paris Observatory a splendid new telescope has been erected, designed for their special observation, and already very useful results have been achieved.

When our able Astronomer and highly esteemed member, Mr. H. C. Russell, returns to Sydney, we may hope to hear from him much that is most interesting in connection with Astronomical Science. As you know, at the instigation of Admiral Mouchez, the director of the Paris Observatory, backed up by the opinion and approval of the learned societies of Europe, it was determined that a conference of Astronomers of various nations should be invited to be held in Paris in the spring of this year with a view to taking concerted action for obtaining on a uniform plan a complete map of the whole starry heavens. To attend this Conference Mr. Russell left these shores early in March last. His temporary absence from our meetings during the present session, whilst the interesting papers he was wont to submit to the society will be much missed, will, we may expect, be amply compensated for by the abundance of new matter which he will acquire and be able to afford us on his return.

The application of photography to the delineation of celestial objects has made such rapid strides of late years, that the question is now seriously entertained whether it may not be trusted for the formation of star maps and catalogues. It has been found that by the power of photography objects altogether invisible to the eye through the most powerful telescopes have been revealed. It was mentioned, as an instance at the meeting of the Royal Society in November last, that one of the stars of the Pleiades was found to be surrounded by a nebula, which could not be seen with telescopes, the reason given being that with the eye an object is either seen or not seen *at once*, whilst with the photographic plate feebleness of intensity is made up for by length of exposure. Dr. Gill, a Fellow of the Royal Society, is contemplating, if not engaged at the present time at the Cape Observatory, in taking photographs—so Professor Stokes tells us—of the whole starry heavens of the Southern Hemisphere. The success of the Messrs. Henry in their photograph of the Pleiades, suggested to them that it was possible, to survey the entire heavens in the same manner. Such a survey could not be carried out by any single observatory, but by five or six acting in unison, it is believed to be quite possible, before the close of the present century to survey the entire heavens on a scale, which will give us the positions and magnitudes of probably not fewer than twenty millions of stars. Such a record of the heavens seemed a few years ago to be entirely beyond our reach, but the discoveries by means of photography leave but little doubt that the prospect of an entire sweep of the heavens is brought within our grasp.

In Geography and Anthropology there has been much to interest. To the improvement of geographical education, the Royal Geographical Society has devoted its untiring energies. The exhibition of geographical appliances and the result of this and other modes of action, has caused a pretty wide-spread interest in the subject. The question of establishing a geographical lectureship has been discussed by the Oxford Hebdomadal Council, and still further steps are likely to be taken by the Society. The Colonial and Indian Exhibition was a notable event, tending greatly to the advancement of knowledge in the departments of geography and anthropology.

So far as Exploration goes, there is nothing very striking to record. The Afghan Boundary Commission has no doubt collected much geographical information, but, for State reasons it has not been divulged. There have been considerable explorations carried on in Central Asia, amongst them that well known traveller Mr. Elias, has lately returned to England from an interesting journey, during which he visited Kokonor Lake and other little known districts, whilst another adventurous Englishman, Mr. Carey, has been wandering about the frontiers of Thibet, and is still, it is believed continuing his explorations in those unknown parts of Central Asia.

In Africa much has been doing. While in Belgian hands the Congo Free State threatens to collapse, explorers have been busy working out the hydrography of that great river. Messrs. Kund and Tappenbeck in the South, and Mr. Grenfell in the North have been able to add much to our knowledge of its tributaries. Dr. Lenz the Austrian traveller though he seems to have failed in reaching Emin Pasha has been doing valuable work in his journey up the Congo. We may hope that before the year is out to hear of the relief of that eminent naturalist and friend of General Gordon, through the exertions of Mr. H. M. Stanley, who has lately left England with that object in view. Mr. Last who has been sent out by the Royal Geographical Society to explore the region East of Lake Nyassa, is laying himself out for work which promises results that may bring a rich gain to Science. In New Guinea the Germans are engaged in exploring the resources of their new territory, while on our own side little has yet been done, but we are awaiting with interest the publication of the results of M. N. de Miklouho-Maclay's long residence in this Island. Perhaps the most notable geographical work during the past year has been the exploration of Patagonia which the Argentine Government is continuing so energetically.

Of Polar work generally, there is nothing to record, but considerable attention has been excited by the proposals for the re-opening of Antarctic Exploration, and the Australian Geographical Societies are very keen about it. There would seem to be a probability that before long, through their exertions an expedition may be formed to resume the explorations of Captain Ross and Sir Geo. Nares in the South-polar regions. A progress report has lately been issued by the Antarctic Exploration Committee of the Royal Society of Victoria evidencing very active interest in the question on the part of that Society, and on the part of the Royal Geographical Society of Australasia, Victorian Branch. The resumption of Antarctic exploration is advocated not only on scientific grounds, but for the lucrative field it presents for the prosecution of the Whaling and Sealing Trade which it opens to our Maritime interests in the Southern Seas. It is proper that I should here inform you, that at the request of the Victorian branch of the Royal Geographical Society of Australasia, and in conjunction with Sir Edward Strickland, K.C.B., the President of the Sydney Branch, I have made application through Sir Henry Parkes, for the countenance and support of the Government of New South Wales towards the carrying out of the proposals.

And now, gentlemen, although I have barely skimmed the surface of the wide field of scientific inquiry, time will not serve me to follow more exhaustively the interesting records of the progress of Science during the past year all over the world. I must now ask your indulgence for a brief period whilst I deal with matters connected more immediately with the working of our own Society. But, before doing so, I must not pass over without notice the effort made in the course of the past year by our late energetic President, Professor Liversidge (to whose untiring exertions the Society owes in a great measure the high position it has attained), to bring the Australasian Societies together, and to form an Australasian Association for the Advancement of Science. Delegates from Victoria, New Zealand, and Queensland, met the Delegates of kindred Societies in New South Wales in these Rooms, in the month of November last, under the presidency (in my absence) of Mr. H. C. Russell. Letters were laid on the table by Professor Liversidge from the principal Australasian Societies, agreeing to the proposal. A resolution for the formation of the Society was carried unanimously. The rules of the British Association were adopted, and it was resolved that the first election of officers should be held in Sydney in March, 1888. Professor Liversidge was appointed convener of the Meeting, and a hearty vote of thanks was recorded to him for the steps he had taken towards the formation of the Association.

Professor Huxley, in his Presidential Address in 1885, had expressed the hope that the Royal Society of England might in some way associate with itself all English-speaking Men of Science, that it might recognise their work in other ways than those afforded by the rare opportunities of election to its Foreign Membership. We are proud to have had the services of three of our Members distinguished in this way, and it is not presumptuous to hope that the formation of the Australasian Association for the Advancement of Science may open the way to the realization of the idea thus propounded by Professor Huxley, in so far at least as the Australasian Colonies are concerned.

It is satisfactory to be able to inform you that the numerical strength of the Society has been pretty well maintained during the past year, and that the finances are in a favourable condition. It is particularly pleasing to announce that the Society's House is free from debt, as a glance at the Honorary Treasurer's Statement will show.

The number of members on the roll on 30th April, 1886, was 492; during the past year 34 new members have been elected, and two names have been restored to the roll. Against this increase the Society lost by death, 13; by resignation, 13; 12 names have been struck off the roll under Rule XIV., and two elections have been cancelled for the same reason; making the total number of members on the 30th April, 1887, 488. Obituary—Ordinary Members: Dr. E. H. Bestic, elected 1878; Dr. J. Le Gay Brereton, elected 1868; Hon. W. A. Brodribb, M. L. C., elected 1876; Alfred Chandler, elected 1876; Andrew Cunningham, elected 1877; Hugh George, elected 1878; Karl W. Goergs, elected 1881; Rev. A. Milne Jarvie, 1879; Dr. W. F. Mackenzie, elected 1874; Rev. Peter MacPherson, M.A., elected 1878; Dr. Rudolph Schuette, elected 1876; Hon. Sir Alexander Stuart, M.L.A., elected 1874; H. A. Thompson, elected 1870. Honorary Member: Thomas Walker, elected 1878. The vacancy in the list of Honorary Members, caused by the death of Thomas Walker, Esq., Yaralla, Concord, to whom the Society is indebted for the munificent donation of £500, is proposed to be filled by the election of Michael Foster, Esq., M.D., F.R.S., &c., Professor of Physiology in the University of Cambridge, and one of the Secretaries of the Royal Society of London.

The conditional offer made by Mr. Edward Ross Fairfax (through Professor Liversidge on the 27th Oct. 1886) of £200 as a donation to the Building Fund, resulted in the sum of £437 being subscribed by the members, which together with the liberal grant from Government of pound for pound, enabled the balance of the mortgage upon the building (viz., £800) to be cleared off by the 31st December, 1886, leaving a balance in hand of £175 5s. 1d. to the credit of the fund. The total amount subscribed by members to the Building Fund, from its inauguration on the 11th Sept. 1877 to the 31st Dec., 1886, was £1,904 12s. On the 24th Nov., 1886 the Council unanimously agreed that Mr. E. R. Fairfax be made a Life Member of the Society, in recognition of his very generous and opportune gift.

During the past year the Society has received 1192 volumes and pamphlets, 16 charts and 6 portfolios of Geological Maps as donations. The Society has presented its Journal and Proceedings Vol. XIX., for 1885 to 337 kindred Institutions, as per printed list, and this publication has likewise been distributed to all the members entitled to it. Vol. XX., is in type and will soon be ready for distribution. Since last year the following new Societies have entered into an exchange of publications viz. :—The Queensland Branch of the Geographical Society of Australasia, Brisbane ; The Academy of Sciences, Christiania ; The Meteorological Institute of Roumania, Bucharest ; The Royal Meteorological Institute, Berlin ; The California Academy of Sciences, San Francisco ; The Imperial University of Japan, Tokio. The Society has subscribed to 49 Scientific Journals and Periodicals, and has purchased 153 vols. at a cost of £147 1s. 3d.

During the past session the Society held seven meetings, at which the following papers were read :—1886, May 5—Presidential Address, by Prof. Liversidge, F.R.S., &c. June 2—"On an unrecorded Ardisia from New Guinea," by Baron Ferd. von Mueller, K.C.M.G., F.R.S., &c. ; "A comparison of the Dialects of E. and W. Polynesian, Malay, Malagasy and Australian," by Rev. George Pratt, communicated by the Rev. W. Wyatt Gill, B.A. (Lond.) ; "Preliminary notes on some new Poisonous Plants discovered on the Johnstone River, N. Queensland," by T. L. Bancroft, M.B., F.L.S., communicated by Prof. T. P. Anderson Stuart, M.D. July 7—"Further additions to the Census of the Genera of Plants hitherto known as Indigenous to Australia," by Baron F. von Mueller, K.C.M.G., F.R.S. &c. ; "Notes on the process of polishing and figuring 18 inch Glass Specula by hand, and Experiments with Flat Surfaces," by H. F. Madsen. August

4—"On the Tin Deposits of New South Wales," by S. Herbert Cox, F.C.S., F.G.S.; "On the Aboriginal names of Rivers in Australia philologically examined," by the late Rev. Peter MacPherson, M.A. September 1—"Our Lakes and their uses," by Fredk. B. Gipps, C.E. November 3—"Notes on the History of the Floods in the River Darling," by H. C. Russell, B.A., F.R.S.; "Notes on the sweet principle of Smilax Glycyphylla (Abstract)," by Prof. E. H. Rennie, M.A., D.Sc.; "On a new Filar Micrometer," by H. C. Russell, B.A., F.R.S. December 1—"Notes on the Theory of Dissociation of Gases," by Prof. Threlfall, B.A. (Cantab); "Results of the Observations of Comets Fabry, Barnard, and Brooks, (No. 1) 1886, at Windsor, N.S.W.," by John Tebbutt, F.R.A.S.; "Notes on some Rocks and Minerals from New Guinea and Polynesian Islands," by Prof. Liversidge, F.R.S.; "Notes on some New South Wales Silver and other Minerals," by Professor Liversidge, F.R.S.; "On the composition of Pumice from the Pacific," by Professor Liversidge, F.R.S.; "Metallic Meteorite, Queensland (Preliminary Notice) by Professor Liversidge, F.R.S.; "On the Strength and Elasticity of Iron-bark Timber as applied to works of Construction," by Prof. Warren, A.M.I.C.E.; "Notes upon Floods in Lake George," by H. C. Russell, B.A., F.R.S.

The Medical Section held seven meetings, at which 21 papers were read. The Microscopical Section held eight meetings, at which eight papers were read. The Sanitary Section held five meetings, at which six papers were read. A very successful Conversazione was held at the Great Hall of the University on the 6th October last, which was attended by between 900 and 1,000 members and their friends.

At the Council Meeting held on the 8th December, 1886, it was unanimously resolved to award the Clarke Medal for the year 1887 to Dr. James Hector, C.M.G., F.R.S., &c., Director of the Geological Survey of New Zealand, in recognition of his long continued scientific labours, and more particularly on account of his invaluable contributions to the geology and natural history of New Zealand. In response to the offer of prizes and its medal by the Society for communications containing the results of original research or observation upon given subjects, the following were received :—"On the Chemistry of the Australian Gums and Resins," nil.; "On the Tin deposits of New South Wales," one paper; "On the Iron Ore deposits of New South Wales," one paper; "List of the Marine Fauna of Port Jackson, with descriptive notes as to habits, distribution, &c.," nil. The Council, at its meeting on the 30th June, 1886, awarded the prize of £25 and the Society's medal, which had been offered for the best communication on "The Tin deposits of New South Wales," to Mr. S. Herbert Cox, F.C.S., F.G.S., of North Shore. The Council has since issued the following list of subjects, with the offer of the Society's bronze medal and a prize of £25 for each of the best researches, if of sufficient merit:—Series VI.—To be sent in not later than 1st May, 1887: No. 20. On the Silver Ore deposits of New South Wales. No. 21. Origin and mode of occurrence of Gold-bearing veins and of the associated Minerals. 22. Influence of the Australian climate in producing modifications of Diseases. 23. On the Infusoria peculiar to Australia. Series VII.—To be sent in not later than 1st May, 1888: No. 24. Anatomy and Life History of the Echidna and Platypus. No. 25. Anatomy and Life History of Mollusca peculiar to Australia. No. 26. The chemical composition of the products from the so-called Kerosene Shale of New South Wales. Series VIII.—To be sent in not later than 1st May, 1889: No. 27. On the Chemistry of the Australian Gums and Resins. No. 28. On the Aborigines of Australia. No. 29. On the Iron Ore deposits of New South Wales. No. 30. List of the Marine Fauna of Port Jackson, with descriptive notes as to habits, distribution, etc.

You will be gratified to learn that the amount collected for the purpose of painting a portrait, in oil colours, of the late Professor Smith is £113 7s. 6d. (subscribed by 105 individuals). The order for the portrait was sent to England in June last, to be executed under the personal supervision of Mrs. Smith, and it is hoped that it will not be long before it will be received and placed upon the walls of this building as a memorial of our late esteemed Vice-President.

And now, gentlemen, it only remains for me to thank you for the indulgence which has been accorded to me in the performance of the duties of President for the past year, and to express the hope that the Royal Society may continue to flourish and increase its usefulness under the auspices of your new President, Mr. C. S. Wilkinson, who it is my privilege and pleasure now to introduce to you.

RECENT WORK ON FLYING-MACHINES.

By Lawrence Hargrave.

[*Read before the Royal Society of N.S.W., 1 June, 1887.*]

Since communicating the paper "On a form of Flying-machine" more efforts have been made to determine the relation between the weight, area and power that is necessary for the successful designing of large and similar structures. One power has been adhered to throughout viz., 24 red elastic bands of the same strength as those previously tested : the weight has been reduced to 1·18 lbs., and the area varied in numberless ways, resulting in the dimensions shewn in Fig. 7. B. & C. which are the best that can be suggested for the power. Fig. 7 A., is the one previously described.

It is observed in B. and several earlier models that they do not descend as the power is decreasing, but keep approximately horizontal until the wings stop flapping ; the cause is thought to be that the power used at starting is excessive for the weight and area, and that if the terminal power were to be maintained throughout, a far greater distance would be passed over ; and that the superabundant power at the commencement of the flight is expended in uselessly forcing the speed ; therefore C has a fusee winder.

The absence of the head in C is a marked improvement, as any reduction in the number of parts must be, and it was not discovered without considerable labour.

The centres of gravity and effort have both been brought further forward, resulting in a much easier and more graceful motion of the apparatus.

The mean result of the three models is seen by the table to be that 161·4 foot-pounds of energy propels a weight of 1·29 pounds horizontally 163·7 feet when supported by trochoided surfaces, having a total area of 1265 square inches. The foot-pounds of energy represent the actual power stored in the stretched elastic bands and not the thrust of the wings, the two powers are related to one another as the pounds of coal burnt in the furnace of a marine boiler are to the thrust of the screw. The flight of A has a fall of 8 feet, B has a slight rise, and C flies to all intents and purposes horizontally; a recomputation of the foot-pounds of energy stored in A reduces them from 168·8 as previously stated to 155·7. Thus, it is obvious, the formula for proportioning machines of any other power is nearly as far off as ever, but the evolution of C from those crude efforts, exhibited here previously, has clearly foreshadowed the principle and essential features of one form of the flying-machine of the future; it is hoped to give these shadowy outlines a tangible form by communicating them through your Journal to the public, so that it will be possible for any practical man if disposed, to make a machine on a large scale with the certainty of some success, without waiting for the completion of a series of experiments that may easily occupy a lifetime when conducted single handed.

It is interesting to point out how far this trochoidal action of the wing bears out the views of Borelli, Marey, and Pettigrew. Borelli attributes flight to the elevation and depression of the wing in one plane, and says the pressure of the air on the feathers bends the plane of the wing sufficiently to produce thrust enough for flight; the interposition of the crank and connecting-rod does this wholly mechanically, if the plane has an equal pressure before and behind the midrib; if the pressure on the after part of the trochoided plane exceeds that on the forward part, the variations in the angle of the plane are produced, partly by the torsion of the midrib, and partly by the crank and connecting-rod.

Marey adopts Borelli's idea with regard to insect flight, but by experimenting on a living flying bird, arrives at a close approximation to the plane trochoided conically, (Figs. 6 and 7 Trochoided Plane see page 263 of the third edition of his work on "Animal Mechanism," the distortion of the figure seems attributable to the cramped position and forced action of the bird.) This is peculiarly significant as a similar result is arrived at by an anatomist and by a mechanic.

Both Marey and Pettigrew observe the figure of eight in insect flight, or rather in the wing flapping whilst the body is stationary, and reproduce it by the torsion and bending of the midrib; the trochoided plane develops the same figure if the wing socket is imperfectly fitted or the midrib too thin.

It is frequently asked how such flying-machines are to be steered: this is like asking a skate-maker why he does not fit rudders to skates. It is a matter of certainty that if the structure has horizontal motion, and the centre of gravity is moved to one side, the machine will turn to that side; and if the centre of gravity is moved forward, the machine will plunge downwards. This is quite independent of any mechanism for varying the area of the wings or tail, which will, of course, come to the same thing, but is objectionable, as it increases the number of parts.

It has been remarked that the wings of these machines differ from birds' wings in having no membrane or web on the portion of their length near the body. If the triangle contained between the forestay, backstay, and strut were covered with paper, and the strut were supposed to have no weight or area, the wing would oscillate about a neutral axis near the middle of the midrib —that is, as the triangular portion of the wing descended the four-sided part would ascend, and the two parts would mutually trochoid one another, each acting and re-acting as the two boats (Fig. 2, Trochoided plane). This would shorten the effective length of the wing, so that material, and consequently weight, is economised by attaching the triangular part of the wing rigidly to the strut, incorporating it, as it were, with the body and tail. The blue and red disks on the wing of the model shew this. A red disk is on the top of the wing near the tip and a blue one underneath, a blue disk is on the top of the wing near the strut and a red one underneath. As the wing descends both red disks are visible, as the wing ascends both blue ones are seen from a position nearly in a line with the axis of the model; the surfaces with the same colours are thrusting at the same time. This form of machine is not being experimented with, as it is thought to be more easily injured than that shewn in the drawings.

In birds it is noticeable that the inner portion of the wing does not move through the same angle as the tip, when the wings are up both portions are in a straight line, when the inner part is horizontal the tip is considerably below it, and when the wing has reached its lowest position the outer part is nearly vertical; it is thought that the identity of the actions of the trochoided plane flying-machine and a flying bird might easily be proved if such an investigation would be of any practical utility.

It was long doubtful whether an impulse was not unconsciously given to the 24-band models when they were started; it is now clear they spring from the hand, as several have smashed when the winder was released, and dropped nearly vertically, so that the flight is still measured from the starting point.

Before describing the large machine on wheels, particular attention is drawn to the detail drawing of the 24 band machine (Fig. 8), it embodies all the latest improvements and will well repay a careful scrutiny; it is drawn double size for plainness and is a sister model to C, hitherto it has been particularly unfortunate. It is to be understood that in all places where metal is required to join metal rigidly, soft solder forms the union; and also that all woodwork and lashings are glued, there are no nails or wood-screws in any part of the machine. [The form of connecting rod is now discarded for a composite structure made of two long eye-bolts, stiffened against compression by a slip of pine lashed between them; the brasses are adjusted by nuts above and below.]

A piece of wood about $2'' \times \frac{3}{8}'' \times \frac{1}{2}''$ will be seen in the end view, this is not shewn in the longitudinal section or plan, it is glued and lashed under the strut about the middle of its length, its use is to keep the bands in a line with the strut and so prevent it hogging; in effect it shortens the length of the strut by half when considering it as a hollow column under a crushing strain.

The large machine on wheels (Figs. 1, 2, 3.) was made to ascertain

1. The weight of a machine sufficiently strong to bear a man's weight and transmit his power.
2. The most convenient form and arrangement of parts for the first named object.
3. The area of wing that can be trochoided at about twenty revolutions per minute.
4. The amount and distribution of the thrust.

The weight of the machine and carriage is distributed thus: on the caster $7\frac{1}{2}$ lbs; on each of the two hind wheels 5 lbs, = 10 lbs; total $17\frac{1}{2}$ lbs. Weight of carriage 8 lbs; weight of machine alone $9\frac{1}{2}$ lbs. The body plane has not been made, as its area depends on the speed the machine and carriage can be driven, but following the method of construction adopted for the wings 10 lbs. will amply cover its weight. The apparatus has sufficient strength to bear a weight of about 170 lbs, turning the handle 20 times a minute, though many parts of it cannot have a higher factor of safety than 2. It was thought that the best method of applying the power was by turning a handle, as no simple means of trochoiding the wings by a reciprocating motion, as in pulling a pair of sculls, suggested itself.

The caster is put on merely to show if inaccuracies in the construction of the machine make it turn to one side. The main vertical supports under the seat are hollow, with a light rod inside sliding up through the ends of the seat; this is so constructed that if the machine is propelled fast enough to lift itself off the carriage, the light rods can be withdrawn from the machine, and leave it quite free of the carriage. The forward vertical supports have slides so that the machine can be tilted up at any angle required. The three main beams of the carriage, and the outer portion of the wing midribs are built of laths one-eighth of an inch thick. The rigid connections between the various parts are tin ; the braces and ties are piano wire. It is thought that a lighter structure could hardly be made, though the distribution of the material might be improved.

The wings were first made 29 inches wide, but it was found they could only be flapped 16 times a minute, their length being limited by the height of the room where the experiments were carried on ; it is thought better results could be obtained with longer and narrower wings. The length of each wing is 7′ 3″ from the socket to the tip, and the length of the membrane is 4′ 8″, the area of each is a little over $8\frac{1}{2}$ square-feet ; this area, or the number of revolutions must be largely increased, if the machine is allowed to run along the ground. Thin tissue paper is undoubtedly the best material for the wings, it is impossible to burst any of the compartments by flapping.

To measure the thrust of the wings a post was provided with a vertical lever, the machine pushed against the short arm of the lever and the long arm of the lever was hooked to a spring balance and also carried a pencil that recorded the variations of pressure on a sheet of paper pinned on a small table ; tolerably uniform motion was given to the small table by a clock and fan. A weight was put on a cross lever attached to the long arm of the vertical one, that stretched the balance spring an amount corresponding to a thrust of 21 pounds, so that negative pressures could be recorded. The pressures corresponding to four points in each revolution were determined by a link that was dropped on the top of the pencil by a system of levers actuated by four cams on the crank shaft.

This apparatus showed that there was a positive and negative pressure due to the swaying backwards and forwards of the body of the experimenter, the amount of which had to be determined by taking some diagrams, whilst turning the handle with the wings unshipped. These diagrams showed such unaccountable distortions, that it was thought advisable to construct an apparatus similar to Richard's Steam Engine Indicator, a weight being used instead of a watch-spring to pull the drum backwards, as the crank pin slacked the cord ; the wire backstay of the left wing was carried over a block and fastened to a spring balance, and moved the parallel motion of the indicator : the forestay of the wing was removed to a point near the upper end of the connecting rod, as the angular thrust and pull backwards of the connecting rod masked the true thrust in the diagrams : counterpoises (not shewn in the drawings) were also put to the wings.

The scale of the diagrams was determined by weights of one, two, and three pounds hung direct on to the centre of the length of the wing membrane, the wing being horizontal and the weight cord passing over a pulley. Fig. 4 is the mean of six cards and shows that the total mean thrust of both wings is 3·07 pounds.

Fig. 5 is the best card of the six from which Fig. 4 was constructed.

To arrive at the interpretation of these diagrams with an accuracy corresponding to the roughness of the whole experiment, the arc the wing moved in (90°) and the length of the diagram were divided into eight parts (Fig. 6), the angles the plane of the wing made with the direction of the thrust were plotted at their seven respective positions; the thrust pressures from the diagrams (Fig. 4) were set off, half-size for convenience, on these angular lines; and the right-angled triangles of forces completed: then the sum of the hypothenuses was multiplied by the distance in feet traversed by the centre of the wing during one-eighth of its down or up stroke, that is 0·96 feet, and this multiplied by 20 for the revolutions per minute, and then by 2 for the other wing, gives 3338 as the foot-pounds of power per minute expended on the handle. The same process was carried out with the thrust pressures and lost powers, giving 920 foot-pounds per minute or 27 per cent., as useful work done. The right hand side of the diagrams (Figs. 4 and 5) corresponds with the position of the wings represented in (Figs. 1, 2, 3).

Turning to D. K. Clark's tables to check the accuracy of the observations, we find Mr. Smeaton gives the ordinary power of a labourer to be 3762 foot-pounds per minute. Mr. John Walker says the power of a man turning a handle is 3080 foot-pounds per minute. Mr. Glynn says the power of a man at a crane handle is 3300 foot-pounds per minute. Mr. G. B. Bruce says the power of a man at a pile-driver, presumably winding up the monkey, is 4320 foot-pounds per minute. Mr. Joshua Field has some tabulated observations, amongst which is one shewing that a tall Irishman with extreme labour exerted a force at a crane handle of 21,427 foot-pounds per minute for 2·83 minutes; whilst yet another tall Irishman at the same job did 27,562 foot-pounds per minute for 2·2 minutes. It is therefore thought, that 920 foot-pounds per minute fairly represents the amount of thrust the machine is capable of, and that the diagrams delineate its distribution.

As to what effect this thrust would have if the machine were on a good stretch of permanent way or clean ice, there is nothing to draw a comparison from but experiments connected with the resistance of trains. According to D. K. Clark the frictional resistance per ton of engine, tender and train for speeds of 5, 10, 15, 20, 30, 40, 50, 60 miles per hour are 12·2, 13, 14, 15·5, 20, 26, 34, 43 lbs; these are, let it be understood, with an average side wind, so that all the front ends of the carriages add to the resistance. Taking this machine to weigh one-tenth of a ton, the continuous thrust of 3·07 lbs would keep it going at a speed exceeding 40 miles per hour.

Bicycles also show a racing speed of about 20 miles per hour, but no record has been seen of what power produces this effect, although a very simple apparatus could be made to record the strain on the treadle at every point of its revolution.

As no tabular statement of the resistances of flat surfaces moving horizontally and set at a sharp angle to the direction of motion were available, though doubtless such have been computed, it was thought a few independent observations would throw some light on this subject. A whirling machine of simple construction was therefore made, capable of moving a plane of one square foot area at various speeds and angles, with an indicator for recording at once on the same diagram, the lifting power and horizontal resistance. The radius of the circle the centre of the plane moved in was 6 feet $2\frac{1}{4}$ inches, and the speed was determined by counting the revolutions made during one minute of each observation.

Four sets of observations were made with the plane at angles of 5°, 10°, 15°, 20°, 25° with the horizon, the first of each set had the full driving power on the whirling machine; the second, third and fourth had the speed reduced by taking off successively weights of 16, 34 and 52 pounds from the full driving weight.

The scale of the diagrams was carefully determined by a balance in the form of a cross, which was clamped to the arm carrying the indicator and plane, so that weights in the pans on the horizontal beam of the balance, either lifted or displaced horizontally the centre of the plane.

Angle of the Plane.	Revolutions per Minute.	Miles per Hour.	Feet per Second.	Observed Horizontal Resistance in Grains per Square Foot.	Computed Horizontal Resistance in Grains per Square Foot.	Observed Lift in Grains per Square Foot.	Computed Lift in Grains per Square Foot.
5°	23	10·16	14·9		27	300	311
5°	20·25	8·91	13·2		21	230	244
5°	17·25	7·6	11·2		15	220	175
5°	13·50	5·9	8·8		9	200	109
10°	22	9·7	14·3		100	600	564
10°	20	8·8	13·0		82	460	466
10°	16·75	7·4	10·9		58	336	329
10°	13	5·7	8·5		35	228	199
15°	20	8·8	13·0	158	183	775	684
15°	18	7·9	11·7	144	148	650	554
15°	15·25	6·7	9·9		106	540	397
15°	11·75	5·2	7·6		53	360	223
20°	17·25	7·6	11·2	184	235	890	649
20°	15·12	6·7	9·8	168	180	750	496
20°	13·12	5·8	8·5	140	135	570	374
20°	10·75	4·7	6·98		92	420	254
25°	15·33	6·7	10·0	216	286	840	621
25°	13·	5·7	8·5	182	206	660	446
25°	11·5	5·1	7·5	156	160	550	349
25°	9·25	4·1	6·0		103	360	223

These observations were plotted (Fig. 9) and tabulated, after which computations were made from the formula $P = \cdot 0023 V^2 \times \sin X$, relating to finding the force of wind impinging on a flat surface where P = pressure in pounds per square foot. V = velocity of wind in feet per second. X = angle of incidence of direction of the wind with the plane of the surface. The results were plotted on the same diagram (Fig. 9) in dash and cross curves, so that a comparison can be made at a glance between the theoretical curves and the actual observations.

It will be remarked how closely the observations at 5° and 10° agree with the theoretical curves and diverge at 15°, 20°, and 25°. Instrumental errors would be most likely to show at the higher speeds and fine angles, where the difficulty of measuring small quantities is greatest. Centrifugal force is not answerable for the non-agreement, that would, if it was appreciable at all, tend to bring the observations closer to the computed curves, as the movable arm carrying the plane was above and behind the radius of the whirling machine when recording the higher pressures, all the other parts being carefully counterpoised.

The difference is therefore understood to show graphically that the actual resistance of the air is greater than is given by theory, (see Brande and Cox : *Dic. Science, Literature, and Art*, article on Parachute) and that when the resistances are resolved, the horizontal resistance is less than the theoretical resistance, and the observed lift is greater than the theoretical lift.

It may be interesting to state the view taken of the possibility of a man driving a machine similar to Figs. 1, 2, 3, fast enough to lift his own weight, viz,, that a powerful athlete exerting a force of 25,000 foot-pounds per minute, could create for a short time with a machine similar to Figs. 1, 2, 3, a thrust of 23 pounds or 6,750 foot-pounds per minute ; and that if the total area of the planes was 400 square-feet, and the weight of the machine and man was 225 pounds, the 23 pounds thrust would theoretically have to drive the planes at 5° angle with the horizon, at a speed of 122 miles per hour in order that the machine and man might be air-supported.

Supposing the plane to be perfect, a thrust of 19·6 pounds would be absorbed in driving it alone, without counting the resistance of the body of the experimenter and the framework of the carriage, which at a speed of 122 miles per hour would be theoretically 73 pounds per square-foot.

Discussion.

Professor Threlfall said :—With reference to the relation between speed and resistance in the wings that are moving through the air: hydro-dynamical considerations, in which the viscosity of the air is neglected, lead to a certain mathematical relation between the speed of the wings and the resistance which they experience. Mr. Hargrave finds by his experiment that the observed relation does not exactly coincide with the calculated relation, *especially when the wings are associated so as to set great quantities of air in motion.** In this case viscosity would have a great effect, and if the formulæ employed by Mr. Hargrave had been calculated without taking this viscosity into account, the discrepancy between theory and experiment might be accounted for, amongst others, in this way.

Mr. Hargrave replied that the viscosity of the air had not been taken into account in his calculations.

The thanks of the Society were accorded to Mr. Hargrave for his paper.

LIST OF DRAWINGS.

Figure 1. Plan of large machine. Scale 3″ to the foot.
" 2. Side elevation of large machine. Scale 3″ to foot.
" 3. End elevation of large machine. Scale 3″ to foot.
" 4. Mean of 6 indicator cards. Scale, Full size.
" 5. The best of 6 indicator cards. Scale, Full size.
" 6. Diagram of Forces.
" 7. Half-plans of three Flying-machines, A. B. C. Scale, 3″ to the foot.
" 8. 24-band Flying-machine. Scale 24″ to the foot.
" 9. Whirling plane. Scale 6″ to the foot.

SOME NEW SOUTH WALES TAN-SUBSTANCES.

PART I.

By J. H. MAIDEN, F.R.G.S.

[*Read before the Royal Society of N.S.W., 1 June, 1887.*]

THIS paper is the first of a series which I hope to be able to complete, on the Tans or astringents of New South Wales. There is no doubt that there are many barks, (especially of species of Acacia), which contain the tanning principle in quantity sufficient for them to be rendered useful to man, and which are either not in use at all, or are not generally known. It will also be useful

* NOTE.—The difference between observation and a rough formula is only noted in the experiment of a plane of 1 sq. ft. area moving at a maximum speed of 10·16 miles per hour.

to determine the amount of tanning principle in those barks which do not contain it in sufficient abundance for the purposes of the tanner; we shall thus know which to avoid. As regards the kinos, although they are usually rich in tannic acid, they will probably come into extensive use in the future in medicine, and as ingredients in pigments and coloured varnishes &c., rather than as tans, for they usually make but indifferent leather.

Dates.—Notwithstanding the well-known facts, (1) that in most cases, barks, especially those from species of Acacia, improve in tanning power if they are properly stored for a period, and (2) that after a further more or less variable period they diminish in tanning power,—it has not been the practice, as far as I am aware, to give dates with analyses, in order to make them comparable with others. I propose in every instance not only to give the dates of collection of the substances analysed, but also of the analyses themselves. This, in my humble opinion, is a matter of the highest importance. (Experiments giving the percentages of tannin in the same bark at regular intervals, will of course take years to complete).

In the case of kinos, it is very desirable to know approximately the dates at which they were exuded. The present samples were all fairly new, with the exception of that of *E. siderophloia*, when collected; I can state nothing more definite in these instances. Kinos while attached to the trees are liable to alteration, firstly, from rain, which washes out more or less of their soluble constituents, and secondly, from the air, as under its action they tend to become insoluble; for instance, some kinos which are freely soluble in water become more or less insoluble in that liquid, and even insoluble in alcohol.

Species Names.—Fully sensible that if there be the slightest doubt as to the identity of any species an analysis may be even worse than useless, as it may be misleading, every care has been taken to ensure perfect accuracy in the names of species. Flowering or fruiting specimens (or both) have been taken in each case. Specimens from the exceedingly difficult genus Eucalyptus have in all cases been referred to Baron Mueller for determination or confirmation, and I take this opportunity of expressing my indebtedness to him.

Allowance for Moisture.—The percentages of tannic acid and extract have in all cases been determined upon substances thoroughly dried at 100° C. The amount of moisture in freshly stripped bark (as compared with bark dried at 100° C.) may, for practical purposes, be assessed at from a quarter to one-third of its weight.

Selection of Samples.—Of the kinos I have had from 3 to 4 lbs of each to select from. From each parcel I have endeavoured to make a thoroughly *average* sample by hand-picking. Of the barks I have had from 7 to 14 lbs of each. From each parcel I have taken a strip which appeared to me to be an average specimen. Abnormal specimens, or obviously superior or inferior ones, whether of barks or kinos, have therefore been rejected. The barks have (prior to grinding) been cut truly horizontal into thin sections with a small guillotine, in order that the samples tested may contain the proper proportions of outer and inner bark.

The quantity operated upon for quantitative purposes has been 5 grammes in each case.

Qualitative Tests.—Notes.

1. All tests were performed in the cold unless stated to the contrary.
2. Ammoniacal Picric Acid gives no precipitate with any of the extracts, but deepens the tint of the liquid in all cases.
3. The tests show the great similarity between the extracts of the barks of *Acacia decurrens* and *A. penninervis*, and the kinos of *Eucalyptus amygdalina* var. and *E. Sieberiana* var.
4. It is often necessary to filter, and even wash, before the colours of precipitates can be observed.

ACACIA SENTIS, (F. v. M.) N.O. Leguminosæ, B. Fl. ii., 360.

Found—In all the colonies except Tasmania, (usually in arid country) Locality of the particular specimen now under examination:—Ivanhoe, viâ Hay, N.S.W.

Remarks—The bark of the trunk. Diameter of Stem 3 feet from ground, 6 to 8 inches. Height of tree, 8 to 10 feet (low-spreading). Date of Collection, 2nd Oct. 1886. *Date of Analysis, 17th and 19th May, 1887.

Bark fissured, but not deeply so. Of a dirty grey colour. Epidermis scaly, and, when removed, showing a dark brown colour underneath. Bast not readily separable; of a light-brown colour. Average thickness of bark $\frac{3}{8}''$. Yields 18·02 per cent. of extract to water at 100° C. Catechu-tannic acid 6·32 per cent.

Qualitative Tests.—(Dilute Extract)

1. Reaction faintly acid.
2. Equal volume of sulphuric acid (1 in 5). *In the cold*, yellowish ppt. *On boiling*, slight salmon ppt.
3. Bromine water—Slight canary yellow ppt.
4. Dilute ferric chloride—Light indigo purple colour. Ppt on standing. Add Ammonia—Dark brownish purple colour to ppt.
5. Baric hydrate—Dirty brown ppt.
6. Ammonium sulphide—Dirty yellowish colour.

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* Experiments were commenced on the first date and finished on the second.

7. Potassium bichromate—Ppt similar to, but slightly darker than that of *A. melanoxylon.*
8. Tartar emetic—No change. Add Ammonium chloride—Whitish-brown ppt.
9. Copper sulphate.—Slight dirty green ppt. (a little darker than that of *A. melanoxylon*). Add Ammonia—Vandyke brown ppt.
10. One drop of strong sulphuric acid to one drop extract (on a white glazed tile). Like the colour yielded by *A. aneura*, only a little more intense.
11. Lead nitrate—Slight orange-brown ppt.
12. Manganese sulphate—Turbidity.
13. Chrome alum—Slight turbidity.
14. Mercuric chloride—Light stone-coloured ppt.
15. Hydro-disodic phosphate—Slight purplish ppt.
16. Potassium ferrocyanide—Light orange-brown ppt.

ACACIA PENNINERVIS, (Sieber), N. O. Leguminosæ, B. Fl. ii., 362, "Hickory," "Blackwood."

Found—In all the Colonies except South and Western Australia. Locality of the particular specimen now under examination :—Monga, near Braidwood, N.S.W.

Remarks—A. Bark of the trunk ; B. bark of the branches. Diameter of stem 3 feet from ground, 10 inches. Height 20 to 30 feet. Date of Collection, 19th Oct., 1886. Date of Analysis, 16th and 23rd May, 1887.

A. *Bark of trunk.*—Smoothish bark, of a dirty brown colour. The epidermis peels off in scales, showing a bright reddish-brown colour. Bast very fibrous. Average thickness of bark as stripped $\frac{3}{8}''$. Yields 45·5 per cent. of extract to water at 100° C. (a remarkably high percentage) ; or 55·5 per cent. of residue. Of this residue a portion equal to 2·4 per cent. of the total quantity of bark acted upon, is soluble in alcohol at 60° F. Catechu-tannic acid 16·96 per cent.

B. *Bark of branches.*—Smoother than that of the trunk, yet not perfectly smooth. Outwardly of a dirty grey colour, with patches of white, or very light grey. Inner bark of a very bright colour, being, even when thoroughly dry, of a warm red brown. (I would especially draw attention to this as a pigment-yielding species). Bast available for coarse tying material. Average thickness of bark $\frac{1}{16}''$. Yields 22·88 per cent. of extract to water at 100° C. Catechu-tannic acid 16·24 per cent.

Qualitative Tests.—(Dilute extract of trunk-bark).

1. Reaction slightly acid
2. Equal volume of sulphuric acid (1 in 5) *In the cold*, yellowish ppt. *On boiling*, dark salmon ppt in small quantity.

3. Bromine water—Dirty yellow ppt.
4. Dilute ferric chloride—Reaction same as *A. decurrens.* Add Ammonia—Same as *A. decurrens.*
5. Baric hydrate—Dark brown ppt, same as *A. decurrens.*
6. Ammonium sulphide—Light olive-brown colour. (Decidedly different in tint to that of *A. decurrens*).
7. Potassium bichromate—Same as *A. decurrens.*
8. Tartar emetic—No change. Add Ammonium Chloride—Pink gelatinous ppt.
9. Copper sulphate—Same as *A. decurrens.* Add Ammonia—Same as *A. decurrens.*
10. One drop of strong sulphuric acid to one drop of extract (on a white glazed tile).—Magenta colour, by no means so vivid as that of *A. decurrens.*
11. Lead nitrate—Same as *A. decurrens.*
12. Manganese sulphate—No change.
13. Chrome alum—Same as *A. decurrens.*
14. Mercuric chloride—Ditto.
15. Hydro-disodic phosphate—Ditto.
16. Potassium ferrocyanide—Ditto.

ACACIA MELANOXYLON, (R. Br.), N. O. Leguminosæ, B. Fl. ii., 388. "Blackwood," "Lightwood."

Found—In all the Colonies except Queensland and Western Australia. Locality of the particular specimen now under examination:—Monga, near Braidwood, N.S.W.

Remarks—The bark of the trunk. Diameter of stem 3 feet from the ground, 1 foot. Height 40 to 50 feet. Date of Collection, 29th Sept., 1886. Date of Analysis, 12th and 23rd May, 1887.

This tree does not attain its full luxuriance in New South Wales. The bark now under examination is, judging from its appearance, apparently from an old tree. It is of a dirty brown colour, with whitish patches, giving the whole a silvery appearance. Has irregular vertical fissures, and this circumstance, with the small horizontal cracks, causes the outer bark to be readily detached in small flakes. The inner bark or bast is very strong, and would form an excellent coarse tying material for local use. Where it joins the outer bark it is of a reddish-brown colour, but yellowish near the wood. In passing, I may mention that many of the inner barks of our Acacias show a rich red colouring when newly stripped. It usually requires a little exposure to bring out the colour in its full intensity, but prolonged exposure to the air destroys it. Other barks are of a white colour when newly stripped, but turn yellowish or drab on exposure to the atmosphere—doubtless from oxidation.

It yields 20·63 per cent. of extract to water at 100° C. Catechu tannic acid 11·12 per cent.

Qualitative Tests—(Dilute Extract)

1. Reaction faintly acid.
2. Equal volume of sulphuric acid (1 in 5). *In the cold*, cloudiness. *On boiling*, yellowish-brown ppt.
3. Bromine water—Bright yellow ppt.
4. Dilute ferric chloride—Dark indigo purple colour. Ppt on standing. Add Ammonia—Ppt becomes dark purplish-brown.
5. Baric hydrate—Dirty brown ppt.
6. Ammonium sulphide—Orange colour.
7. Potassium bichromate—Orange brown ppt.
8. Tartar Emetic—No change. Add Ammonic Chloride—Whitish-brown ppt.
9. Copper Sulphate—Slight dirty green ppt. Add Ammonia—Copious Vandyke-brown ppt.
10. One drop of strong Sulphuric acid to one drop extract (on a white glazed tile)—Light brown colour.
11. Lead nitrate—Slight orange-brown ppt.
12. Manganese sulphate—Whitish-brown ppt.
13. Chrome alum—Turbidity.
14. Mercuric Chloride—Whitish ppt.
15. Hydro disodic phosphate—Turbidity.
16. Potassium ferrocyanide—Light purplish-brown ppt.

Acacia aneura, (F.v.M.), N. O. Leguminosæ, B. Fl. ii., 402. (The normal species). The common "Mulga" forming the chief portion of the scrub of that name. Occasionally called "Myall."

Found—In all the Colonies except Tasmania, but only in the dry interior. Locality of the particular specimen now under examination :—Ivanhoe, viâ Hay, N.S.W.

Remarks—The bark of the trunk. Diameter of stem 3 feet from the ground, 6 to 8 inches. Height of tree, 25 or 30 feet. Date of Collection, 26th Sept. 1886. Date of Analysis, 17th and 21st May, 1887.

This bark is very deeply furrowed, flaky, and pulverulent, and apparently from a very old tree. Outer bark grey; the inner bark of a pale drab. Average thickness $\frac{3}{8}''$. Yields 10 per cent. of a slightly mucilaginous extract to water at 100° C. (This round number is the exact mean of several careful determinations). Catechu-tannic acid 4·78 per cent.

Qualitative Tests.—(Dilute extract—normal species only used, as the variety gives similar reactions).

1. Reaction faintly acid.
2. Equal volume of sulphuric acid (1 in 5). *In the cold*, no change *On boiling*, slight bleaching, and faint turbidity.

3. Bromine water—Slight yellow turbidity.
4. Dilute ferric chloride—Hardly any change with the exception of a faint greenish tint. No further change on standing. Add Ammonia—Yellowish ppt, turning to a warm brown on standing.
5. Baric hydrate—Brown ppt.
6. Ammonium sulphide—Slight yellow ppt.
7. Potassium bichromate—No change.
8. Tartar emetic—No change. Add Ammonium Chloride—Slight milkiness.
9. Copper sulphate—Slight greenish ppt. Add Ammonia—Ppt dissolved in the Ammonio-cupric sulphate.
10. One drop of strong sulphuric acid to one drop of extract (on a white glazed tile)—Slight reddish colour.
11. Lead nitrate—Light brown ppt.
12. Manganese sulphate—Slight brownish ppt.
13. Chrome alum—Slight ppt.
14. Mercuric chloride—Slight drab ppt.
15. Hydro disodic phosphate—No change.
16. Potassium ferrocyanide—Darkens colour.

ACACIA ANEURA, var: (F.v.M.) N.O. Leguminosæ, (the narrow-leaved variety). B. Fl. ii., 402. "Narrow-leaved Mulga."

Found—It has about the range of the normal species. Locality of the particular specimen now under examination:—Ivanhoe, viâ Hay, N.S.W.

Remarks—The bark of the trunk. Diameter of stem 3 feet from the ground, 6 to 8 inches. Height of tree, 25 or 30 feet. Date of Collection, 30th Sept., 1886. Date of Analysis, 17th and 23rd May, 1887.

A moderately fissured bark of a dark grey colour, sometimes nearly black. Removal of epidermis shows a light-brown colour. Bast not readily separable; light coloured, being yellowish or drab when dry. A thin, poor bark, not exceeding $\frac{3}{16}''$ in average thickness. Yields 20·72 per cent. of extract to water at 100° C. Catechu-tannic acid 8·62 per cent.

ACACIA DECURRENS, (Willd.) N.O. Leguminosæ. B. Fl. ii., 414. The "Green Wattle," of the older New South Wales Colonists. Called also "Silver Wattle," but usually "Black Wattle."

Found—In all the Colonies except Western Australia. Locality of the particular specimen now under examination:—Cambewarra, New South Wales.

Remarks—The bark of the trunk. Diameter of stem 3 feet from the ground, 6 to 8 inches. Height 20 to 30 feet. Date of Collection, 10th August, 1886. Date of Analysis, 12th and 23rd May, 1887.

A more than ordinarily smooth, homogeneous bark. Small fissures and irregularities rarely occur in it except around buds. Of an umbery colour, with greyish patches. Is very tough, the bast yielding a fair fibre. Average thickness of outer and inner bark together, $\frac{1}{8}$—$\frac{3}{16}$″. It is excessively hard when dry. Yields 42·16 per cent. of extract to water at 100° C., and therefore 57·84 per cent. of woody fibre &c. Of this residue, a portion equal to 6·96 per cent. of the total quantity of bark acted upon, is soluble in alcohol at 60° F. Catechu-tannic acid 32·08 per cent.

Qualitative Tests—(Dilute extract).

1. Reaction slightly acid.
2. Equal volume of sulphuric acid (1 in 5). *In the cold*, cloudiness. *On boiling*, reddish-brown ppt.
3. Bromine water—Dirty yellow ppt.
4. Dilute ferric chloride—Dark purple colour. Brown ppt on standing. Add Ammonia—Deepens the tint.
5. Baric hydrate—Dark brown ppt.
6. Ammonium sulphide—Darkens the colour slightly.
7. Potassium bichromate—Coffee-coloured ppt.
8. Tartar emetic—No change. Add Ammonium Chloride—Pink gelatinous ppt.
9. Copper sulphate—Pinkish ppt, turning reddish-brown on exposure. Add Ammonia—Ppt more copious, and colour intensified (copper brown).
10. One drop of strong sulphuric acid to one drop extract (on a white glazed tile)—Bright magenta colour.
11. Lead nitrate—Slight reddish purple ppt.
12. Manganese sulphate—No change.
13. Chrome alum—Slight purple-brown ppt.
14. Mercuric chloride—Light purplish-brown ppt.
15. Hydro disodic phosphate—Slight purplish ppt.
16. Potassium ferrocyanide—Purplish-brown ppt.

EUCRYPHIA MOOREI, (F.v.M.) N.O. Saxifrageæ, B. Fl. ii., 447. Often called "Acacia," by country people, as when not in flower the tree resembles some of the larger species of Acacia. Other vernacular names are "Plum Tree," and "White Sally."

Found—In Victoria and New South Wales (Southern districts). Locality of the particular specimen now under examination:—Monga, near Braidwood, N.S.W.

Remarks—The bark of the trunk. Diameter of stem 3 feet from the ground, 3 to 4 feet. Height 40 to 60 feet. Date of Collection, 3rd October, 1886. Date of Analysis, 12th and 23rd May, 1887.

This tree flourishes in moist valleys, and the bark is consequently often moss-grown. It is not fissured, but is more or less finely tuberculated. Colour of outer bark that of the bark of the cork-tree. Brittle, and inside of a reddish-brown colour. Average thickness about $\frac{3}{16}''$. Inner bark very smooth, of about half the thickness of the outer-bark, very tough, and evidently available for coarse fibre. My attention was directed to this bark through learning that in the neighbourhood of Braidwood it is used by the settlers for tanning, "with excellent results." It yields 21·4 per cent. of extract to water at 100° C. Per centage of tannic acid 7·74.

Qualitative Tests—(Dilute extract).

1. Reaction faintly acid.
2. Equal volume of sulphuric acid (1 in 5). *In the cold*, yellowish turbidity. *On boiling*, no change.
3. Bromine water—Ochrey yellow ppt.
4. Dilute ferric chloride—Blackish-green colouration. Add Ammonia—Reddish-purple ppt.
5. Baric hydrate—Copious reddish-brown ppt.
6. Ammonium sulphide—Orange turbidity.
7. Potassium bichromate—Coffee-coloured ppt.
8. Tartar emetic—No change. Add Ammonic chloride—Brownish-white ppt.
9. Copper sulphate—Hardly to be distinguished from *A. aneura* Add Ammonia—Light brownish-green ppt.
10. One drop of strong sulphuric acid to one drop extract (on a white glazed tile)—Yellowish-brown colour.
11. Lead nitrate—Pale dirty brown ppt.
12. Manganese sulphate—Slight brownish ppt.
13. Chrome alum—Ditto.
14. Mercuric chloride—Slight whitish-brown or stone coloured ppt
15. Hydro disodic phosphate—Turbidity.
16. Potassium ferrocyanide—Orange-brown ppt.

EUCALYPTUS STELLULATA, (Sieber), N.O. Myrtaceæ, B. Fl., iii., 200. Usually called "Black Gum," or "Black Sally."

Found—In Victoria and New South Wales. Locality of the particular specimen now under examination :—Blue Bell, near Braidwood, New South Wales.

Remarks—The bark of the trunk. Diameter of stem 3 feet from the ground, 2 feet. Height 30 to 40 feet. Date of Collection, 17th Oct., 1886. Date of Analysis, 16th and 21st May, 1887.

An "Ironbark," of a blackish or dark-grey colour. Exceedingly hard, moderately fissured, and portions of it almost smooth. Average thickness $\frac{1}{2}''$. No kino visible to the naked eye. Inner bark of a light brown colour when dry. (Note.—From decortication, this tree often appears of a greenish or leaden colour, and smooth). Yields 27·64 per cent. of extract to water at 100° C. Kino-tannic acid 12·86 per cent.

Qualitative Tests—(Dilute extract).

1. Faintly acid reaction.
2. Equal volume of sulphuric acid (1 in 5). *In the cold*, faint salmon ppt. *On boiling*, ppt. darkens, and becomes flocculent.
3. Bromine water—Faint yellow ppt.
4. Dilute ferric chloride—Indigo liquid, with faint purplish tinge. Add Ammonia—Dirty brown purplish ppt.
5. Baric hydrate—Dark olive-brown ppt.
6. Ammonium sulphide—Slight dirty yellow ppt.
7. Potassium bichromate—Orange-brown ppt.
8. Tartar emetic—Slight brownish turbidity. Add Ammonium chloride—Increased ppt, like that of *E. leucoxylon* only a little lighter.
9. Copper sulphate—Dirty greenish-brown ppt, very like that of *A. sentis* and *A. melanoxylon*. Add Ammonia—Light Vandyke-brown ppt.
10. One drop of Sulphuric acid to one drop extract (on a white glazed tile)—Light brown colour.
11. Lead nitrate—Pale dirty brown ppt with a grey tint.
12. Manganese sulphate—Light drab ppt. The most copious ppt obtained with this reagent amongst all the substances referred to in this paper.
13. Chrome alum—Slight brownish ppt.
14. Mercuric chloride—Stone ppt.
15. Hydro disodic phosphate—Bark brown ppt.
16. Potassium ferrocyanide—Same as *A. melanoxylon*.

Eucalyptus amygdalina, var., (Labill.) N.O. Myrtaceæ, B. Fl. iii., 202. "Ribbon Gum," from the circumstance that the bark can be peeled off in thin sheets, or ribbons. The botanical synonyms and vernacular names of the normal species are very numerous.

Found—In South Eastern New South Wales (range not co-extensive with that of the normal species). Locality of the particular specimen now under examination:—Nelligen, Clyde River, N.S.W

Remarks—Part of tree, kino. Diameter of stem 3 feet from ground, 2 feet, 6 inches. Height 80 to 100 feet. Date of Collection, 21st and 22nd Sept., 1886. Date of Analysis, 20th April and 17th May, 1887.

A clear port-wine coloured kino, which is very friable, forming a sparkling powder. Dissolves readily in cold water, forming a clear liquid, and with but little residue. Water at 100° C. dissolves 99·22 per cent. extract, leaving 0·78 per cent. of a brownish resin. Of this residue a portion equal to 0·46 per cent. of the total quantity of kino acted upon, is soluble in alcohol at 60° F. 97·32 per cent. of the kino is soluble in alcohol at 60° F. The kino yields 57·76 per cent. of kino-tannic acid.

Qualitative Tests—(Dilute extract).

1. Distinctly acid reaction.
2. Equal volume of sulphuric acid (1 in 5). *In the cold,* dense salmon ppt. *On boiling,* clear ruby liquid.
3. Bromine Water—Light brown ppt, with streaks or coagulated masses of a bright yellow colour which rise to the top of the liquid like a scum.
4. Dilute ferric chloride—Deep purple colour. Neither this nor the other kinos form ppts on standing. Add Ammonia—Claret colour with brownish tinge.
5. Baric hydrate—Mauve ppt.
6. Ammonium sulphide—Brownish colour.
7. Potassium bichromate—Very abundant dirty greenish-brown ppt.
8. Tartar Emetic—Pink gelatinous ppt. Add Ammonium Chloride—The ppt condensed.
9. Copper sulphate—Slight turbidity. Add Ammonia—Dense dirty olive-green ppt.
10. One drop of strong sulphuric acid to one drop extract (on a white glazed tile). Orange-brown colour, with slight tinge of magenta.
11. Lead nitrate—Reddish-brown ppt.
12. Manganese sulphate—No change.
13. Chrome alum—Turbidity.
14. Mercuric chloride—Gelatinous salmon ppt.
15. Hydro disodic phosphate—Slight pink gelatinous ppt.
16. Potassium ferrocyanide—Reddish-brown ppt.

EUCALYPTUS SIEBERIANA, (F.v.M.), N.O. Myrtaceæ, (*E. virgata,* Sieb., is the species name in B. Fl. iii., 202, vide also Dec. 2, F.v.M., "Eucalyptographia.") "Cabbage Gum," is the name by which this tree is known in the Braidwood district of N.S.W., owing to the perishable nature of the wood. The wood of Victorian trees appears to be more durable. Called also "Mountain Ash," "Gum Top," &c.

Found—In all the Colonies except Queensland and Western Australia. Locality of the particular specimen now under examination:—Monga, near Braidwood, N.S.W.

Remarks—The bark of the trunk. Diameter of stem 3 feet from the ground, 1 foot to 2 feet. Height, 60 to 80 feet. Date of Collection, 1st and 2nd Oct., 1886. Date of Analysis, 20th April, 17th and 21st May, 1887.

This kino as taken from the trees has very much the appearance of that of *E. amygdalina,* except that it is perhaps a shade duller in colour. But the difference between them is perceptible directly each is tapped with the pestle, the large pieces of the kino now under examination readily becoming dulled by a coating of their own powder. This kino is rather tenacious, adhering readily to pestle and mortar, and yielding a dull, orange-coloured powder. It dissolves readily, and almost entirely, in cold water. Mr. Bauerlen who collected this kino, informs me that it is the most readily soluble one he has met with, the least shower of rain softening it on the trees. However true this may be of the fresh substance, six-months old *E. amygdalina* kino is unmistakeably more soluble than *E. Sieberiana* kino of similar age. Extract—Water at 100° C. dissolves 95·04 per cent. leaving 4·96 per cent. of a liver-coloured resin greatly resembling broken stick lac in appearance. Of this resinous residue a portion equal to 0·94 per cent. of the total quantity of kino acted upon, is soluble in alcohol at 60° F. 91·8 per cent. of the kino is soluble in alcohol at 60° F. The kino yields 36·96 per cent. of kino-tannic acid.

Qualitative Tests—(Dilute extract).

1. Reaction distinctly acid.
2. Equal volume of sulphuric acid (1 in 5). *In the cold*, dense salmon ppt. *On boiling*, clear dark ruby liquid.
3. Bromine water—Like *E. amygdalina*. Ppt perhaps a little more dense.
4. Dilute ferric chloride—Like *E. amygdalina*. Add Ammonia —Ditto.
5. Baric hydrate—Like *E. amygdalina*.
6. Ammonium sulphide.—Ditto
7. Potassium bichromate—Ditto
8. Tartar emetic—Ditto.—Add Ammonium chloride—Ditto
9. Copper sulphate—Ditto. Add Ammonia—Copious brownish-black ppt.
10. One drop of strong sulphuric acid to one drop extract (on a white glazed tile). Same as *E. amygdalina* only less intense.
11. Like *E. amygdalina*.
12. Manganese sulphate—No change.
13. Chrome alum—No change.
14. Mercuric chloride—Like *E. amygdalina*.
15. Hydrodisodic phosphate—Copious pink gelatinous ppt, in this respect different to *E. amygdalina*.
16. Potassium ferrocyanide—Like *E. amygdalina*.

Eucalyptus leucoxylon, F. v. M., (*E. sideroxylon*, A. Cunn.) N.O. Myrtaceæ, B. Fl. iii., 209. "Red-flowering Ironbark."

Found—In all the Colonies except Tasmania and Western Australia. Locality of the particular specimen now under examination:— Near Richmond, N.S.W.

Remarks—The bark of the trunk. Diameter of stem 3 feet from the ground, up to 12 inches. Height of tree, 40 to 50 feet. Date of Collection, July, 1886. Date of Analysis, 17th and 23rd May, 1887.

I am indebted to Rev. Dr. Woolls for this bark. It is deeply fissured; the kino is in more or less distinct small cavities in the bark, giving it a pitted or beaded appearance. The bark dull-looking and pulverulent, the kino in dull, never large, masses. This bark readily yields its kino to water, forming a liquid of a very intense reddish-brown colour. It yields 67 per cent of extract to water at at 100° C., or 33 per cent. of residue. Of this residue a portion equal to 0·26 per cent. of the total quantity of bark acted upon, is soluble in alcohol at 60° F. The bark is soluble in alcohol at 60° F. to the extent of 18·84 per cent., forming a rich garnet liquid. Kino-tannic acid, 41·9 per cent.

Qualitative Tests.—(Dilute Extract).

1. Reaction distinctly acid.
2. Equal volume of sulphuric acid (1 in 5). *In the cold*, light brown ppt. *On boiling*, ppt. darkens and rises to the top as a scum.
3. Bromine water—Reddish-brown ppt.
4. Dilute ferric chloride— Brownish-purple colour. Add Ammonia—Slight ppt.
5. Baric hydrate—Reddish-brown ppt.
6. Ammonium sulphide—Reddish-brown colour.
7. Potassium bichromate—Dark brown ppt.
8. Tartar emetic—No change. Add Ammonium chloride—Orange-brown ppt.
9. Copper sulphate—Slight pale-brownish ppt. Add Ammonia—Vandyke-brown ppt.
10. One drop of strong sulphuric acid to one drop extract (on a white glazed tile). Warm brown colour.
11. Lead nitrate—Brown ppt.
12. Manganese sulphate—No change.
13. Chrome alum—No change.
14. Mercuric chloride—Light brown gelatinous ppt.
15. Hydro disodic phosphate—Abundant purple ppt.
16. Potassium ferro-cyanide—Darkens the colour.

Eucalyptus siderophloia, Benth., (*E. resinifera*, A. Cunn.) N.O. Myrtaceæ, B. Fl. iii., 220. "Broad-leaved" or "Red Ironbark."

Found—In New South Wales and Queensland. Locality of the particular specimen now under examination:—Richmond, N.S.W.

Remarks—*A.* bark of trunk, with adherent kino. *B.* bark of trunk; no kino visible to the naked eye. *C.* kino. Diameter of stem 3 feet the ground, up to 12 inches. Height of tree, 40 to 50 feet, (a small tree of its kind). Date of Collection, July 1886. Date of Analysis, 17th and 23rd May, 1887.

I am indebted to Rev. Dr. Woolls for this kino yielding bark. It is more or less foliaceous. The kino is not uniformly distributed throughout the bark-mass as in *E. leucoxylon*, but in masses of a pure reddish-brown, and almost transparent. As I received the kino *in situ*, it occurred to me that it would be practically useful and convenient to present the results of examination in three different ways, viz. :—A. Bark of trunk, with adherent kino; an average sample *i.e.*, exhibiting the kino and bark in about the proportions in which they usually exist in nature. B. Bark of the trunk; no kino visible to the naked eye. C. Kino; all woody matter has been carefully removed. This is therefore about the state in which "best selected kino" will be sent to market in the future.

A.	Extract, soluble in water at 100° C.,	68·1	per cent.
	Kino-tannic acid	26·48	"
B.	Extract, soluble in water at 100° C.,	26·56	"
	Kino-tannic acid	10·4	"
C.	Extract, soluble in water at 100° C.,	97·56	"
	Soluble in alcohol at 60° F. ...	13·98	"
	Kino-tannic acid	35·1	"

Qualitative Tests.—(Dilute extract of kino).

1. Reaction distinctly acid.
2. Equal volume of sulphuric acid (1 in 5). *In the cold*, no change. *On boiling*, clear pale ruby liquid.
3. Bromine water—No change.
4. Dilute ferric chloride—Dark brownish purple liquid. Add Ammonia—No change, except perhaps more intense colour.
5. Baric hydrate—Light purplish-brown gelatinous ppt.
6. Ammonium sulphide—Orange-brown colour.
7. Potassium bichromate—Very dense ppt. of a coffee colour.
8. Tartar emetic—No change. Add Ammonium chloride—Café-au-lait ppt.
9. Copper sulphate—No change. Add Ammonia—Intense Vandyke-brown ppt.
10. One drop of strong sulphuric acid to one drop extract (on a white glazed tile). Warm brown colour.
11. Lead nitrate—No change.
12. Manganese sulphate—No change.
13. Chrome alum—No change.
14. Mercuric chloride—Faint whitish ppt.
15. Hydro disodic phosphate—No change.
16. Potassium ferrocyanide—Darkens colour.

EUCALYPTUS CORYMBOSA, (Smith), N.O. Myrtaceæ, B. Fl. iii., 256. "Bloodwood."

Found—In New South Wales to Northern Australia. Locality of the particular specimen now under examination :—Cambewarra, N.S.W.

Remarks—The kino. Diameter of the stem 3 feet from the ground, 3 to 4 feet. Height, 80 to 100 feet. Date of Collection, 28th August, 1886. Date of Analysis, 20th April and 17th May, 1887.

This kino is obtainable in irregular pieces as large as a fist. Before they have been bruised, they have the appearance of a very pulverulent, purplish-red haematite (such, for instance, as is common in the Elba mines). To say that it resembles a low-grade Dragon's blood also gives a very good idea of its appearance. It readily makes an impalpable powder of a Venetian-red colour, soiling everything with which it comes into contact. Water at 100° C. dissolves 72·28 per cent., leaving 27·72 per cent. of residue, strikingly resembling powdered Brazil-wood in appearance. The solution in hot water readily becomes turbid if it be either slightly lowered in temperature or partly evaporated. The particles suspended in the water are in such a fine state of division that they readily pass through a filter-paper. The solution in boiling-water is of a deep garnet colour. The ligneous, insoluble (in water) residue, yields 2·16 per cent. (calculated on the total weight of kino operated upon) of a rich red colouring matter to alcohol at 60° F. Cold water (60° F.) dissolves 35·38 per cent. of the kino. Alcohol at 60° F. dissolves 71·14 per cent. of the kino.

Bloodwood kino can be delivered in Sydney for about 3d. per ℔. and there is no doubt that it is a cheap and efficient substitute for the lower grades of Dragon's blood. Both the aqueous and alcoholic solutions form excellent wood-stains. (Samples of wood stained by them were exhibited). Experts will probably pronounce the colour to be too "fiery," but it can be brought to the required tint by admixture with Burnt Sienna or Vandyke Brown. As a matter of fact, most wood-stains are compound substances, and the most I claim for this kino at present is that it will form a useful *base* for stains and varnishes. Whether it will, (and in what measure), supersede the beautiful aniline dyes which now form part of the "material" of the painter and polisher, remains to be seen. Some enterprising firm should put it to serious test without unnecessary delay.

This kino yields 28·44 per cent. of kino tannic acid. This percentage of tannin is of course low (for a kino); nevertheless the abundance of the raw material, and the readiness with which its excellent colouring matter is available, will render this one of the most useful of our kinos.

Qualitative Tests.—(Very dilute extract, prepared by treating the kino with cold water, and filtering.

1. Reaction distinctly acid.
2. Equal volume of sulphuric acid (1 in 5). *In the cold*, no change. *On boiling*, no change.
3. Bromine water—Orange-yellow ppt.
4. Dilute ferric chloride—Brownish purple ppt. Add Ammonia—Deepens the colour.
5. Baric hydrate—Brown ppt.
6. Ammonium sulphide—Slight yellowish turbidity.
7. Potassium bichromate—Coffee-coloured ppt.
8. Tartar emetic—Slight turbidity. Add Ammonium chloride—Whitish ppt.
9. Copper sulphate—Greenish ppt. Add Ammonia—Light Vandyke-brown ppt.
10. One drop strong sulphuric acid to one drop extract (on a white glazed tile). Slight reddish colour.
11. Lead nitrate—Reddish-brown ppt.
12. Manganese sulphate—No change.
13. Chrome alum—Reddish ppt.
14. Mercuric chloride—Salmon ppt.
15. Hydro disodic phosphate—No change.
16. Potassium ferrocyanide—Darkens colour.

Discussion.

Rev. S. Wilkinson, in proposing a vote of thanks to Mr. Maiden for his paper, said he considered it to be exceedingly valuable, both for commercial and practical uses in the Colony, and the investigations were likely to have results of very great importance. Some tanners felt themselves very dependent upon the bark they had been importing from other colonies. Leathers were imported largely from Europe, and this also was done to the disadvantage of the whole colony. The kino extracts were also of great value for polishers &c. At present our dyers import nearly everything they use, while probably the Colony contains all that is necessary for their trade.

Mr. J. T. Wilshire seconded the motion and said he had been identified with the tanning business through his parent, who was the first to establish the industry here. He was glad to be able to testify to the excellence of the paper read by Mr. Maiden, and asked that gentlemen, through the chair, if the percentage of tannin contained in the Acacia, would bear comparison with that of the Oak.

Mr. Maiden in reply, stated that there were some 336 species of Acacia in Australia. He spoke from memory when he said that oak bark contained between 10 and 12 per cent. of tannin. The percentage of tannin in species of Acacia is on the average, far higher.

Hon. L. F. de Salis, remarked that in 1885, £17,500 worth of bark was brought into this country. Mr. Maiden had spoken of the value of the Eucalypts for tanning purposes; this was a valuable discovery. A practical tanner of England had mentioned to him the delight with which he was receiving the Acacia bark, which he considered of more value than the Oak. This gentleman, however, knew nothing about the Eucalypts possesing such excellent tanning properties. The colony imported something like £600,000 of foreign leather. As we have the hides and the means of tanning them, it is a great pity that this should take place. He hoped Mr. Maiden would persist in his efforts, as the results of the analyses would be of great value to the country.

The President in presenting the thanks of the Society to Mr. Maiden, said that all the members would feel gratified that this was only the first of a series of papers on the same subject. Mr. Maiden had chosen an almost untrodden path, and there being so many species of Acacia in the colony, shows the importance of the work. It would have special value as a work of reference in the Society's Proceedings, and the specimens will be labelled and placed in the Technological Museum.

Mr. Maiden acknowledged the compliment, and said that as the word discovery had been used, he might state that the value of Eucalyptus bark for tanning purposes was no discovery. In 1823 an extract of wattle bark was sent to England and realised a very high price. By sending it in the form of an extract a considerable saving was effected in freight charges. An objection to wattle bark is that it makes a reddish leather, and we cannot at present make the finer kinds of leather with it. The bark would be more valuable if it could be decolorised without destroying its tannic acid. The Government had planted a great many wattle trees, especially on the railway lines, but there were difficulties in the way of the cultivation of them, as in some places they would not flourish, because water could not be regularly applied to them, and where they grew luxuriantly they were said to interfere with the telegraph wires, and were cut down in consequence.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF NEW SOUTH WALES.

WEDNESDAY, 4 MAY, 1887.

ANNUAL GENERAL MEETING.

CHRISTOPHER ROLLESTON, C.M.G., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following Financial Statement for the year ending 31 March, 1887, was presented by the Hon. Treasurer and adopted :—

GENERAL ACCOUNT.

RECEIPTS.	£	s.	d.	£	s.	d.
To Subscriptions { One Guinea	275	2	0			
To Subscriptions { Two Guineas	333	18	0	648	18	0
To Subscriptions { Arrears	39	18	0			
,, Entrance Fees				67	4	0
,, Parliamentary Grant on Subscriptions and Entrance Fees received during 1886 ...				360	3	0
,, Sundries				3	16	6
Total Receipts				£1,080	1	6
Balance on 1st April, 1886...				43	11	8
				£1,123	13	2

PAYMENTS.	£	s.	d.
By Advertisements...	31	17	0
,, Assistant Secretary	250	0	0
,, Books and Periodicals	211	14	3
,, Bookbinding	109	8	1
,, Conversazione	119	1	9
,, Engraving and Lithographing	6	0	0
,, Freight Charges, Packing, &c.	21	15	1
,, Furniture and Effects	44	7	0
,, Gas	17	6	7
,, Housekeeper	10	0	0
,, Interest on Mortgage	34	19	5
,, Insurance	7	5	0
,, Prize Essay Award	25	0	0
Carried forward	£888	14	2

PAYMENTS—*continued.*	£	s.	d.
Brought forward	888	14	2
„ Postage Stamps...	42	12	7
„ Petty Cash Expenses	18	19	3
„ Printing	29	7	0
„ Rates	27	9	0
„ Refreshments, &c., at Meetings	9	16	0
„ Repairs	17	15	11
„ Stationery	40	8	11
„ Sundries	9	7	9
„ Australasian Association for the Advancement of Science	18	5	7
Total Payments	£1,102	16	2
Balance on 31st March, 1887	20	17	0
	£1,123	13	2

Audited—W. C. W. BARTELS.
H. O. WALKER.

ROBERT HUNT, Honorary Treasurer.
W. H. WEBB, Assistant Secretary.

Sydney, 22nd April, 1887.

BUILDING FUND.

RECEIPTS.	£	s.	d.
To Subscriptions and Donations...	452	10	0
„ Rent of Hall	111	1	8
„ Parliamentary Grant on Subscriptions and Donations received during 1886	466	4	0
„ Interest on Fixed Deposit	3	11	0
Total Receipts	£1,033	6	8
Balance on 1st April, 1886	69	12	5
	£1,102	19	1

PAYMENTS.	£	s.	d.
By Repairs to Building	27	14	0
„ Savings Bank of New South Wales, in Redemption of Mortgage	900	0	0
Total Payments	£927	14	0
Balance on 31st March, 1887	175	5	1
	£1,102	19	1

Audited—W. C. W. BARTELS.
H. O. WALKER.

ROBERT HUNT, Honorary Treasurer.
W. H. WEBB, Assistant Secretary.

Sydney, 22nd April, 1887.

CLARKE MEMORIAL FUND.

	£	s.	d.
To Amount of Fund on 1st April, 1886...	247	7	1
„ Interest accrued to 31st March. 1887	9	3	8
	£256	10	9

	£	s.	d.
By Fixed Deposit in Union Bank	211	3	9
,, Balance due from Oriental Bank	45	7	0
	£256	10	9

Audited—W. C. W. Bartels.
H. O. Walker.
Sydney, 22nd April, 1887.

Robert Hunt, Honorary Treasurer.
W. H. Webb, Assistant Secretary.

SMITH MEMORIAL FUND.

	£	s.	d.
To Amount of Fund on 1st April, 1886...	88	9	6
,, Subscriptions since received	24	18	0
	£113	7	6

	£	s.	d.
By Amount towards purchase of Plaster Bust	1	1	0
,, Fixed Deposit in Union Bank	112	6	6
	£113	7	6

Audited—W. C. W. Bartels.
H. O. Walker.
Sydney, 22nd April, 1887.

Robert Hunt, Honorary Treasurer.
W. H. Webb, Assistant Secretary.

Messrs. J. F. Mann and G. D. Hirst were elected Scrutineers for the election of officers and members of Council.

A ballot was then taken, and the following gentlemen were duly elected officers and members of Council for the current year :—

Honorary President:
HIS EXCELLENCY THE RIGHT HON. LORD CARRINGTON, G.C.M.G., &c., &c., &c.

President:
C. S. WILKINSON, F.G.S., F.L.S.

Vice-Presidents:
CHARLES MOORE, F.L.S. CHR. ROLLESTON, C.M.G.

Hon. Treasurer:
ROBERT HUNT, F.G.S., &c.

Hon. Secretaries:
PROFESSOR LIVERSIDGE, F.R.S., &c. F. B. KYNGDON.
S. HERBERT COX, F.C.S., F.G.S.

Members of Council:
A. LEIBIUS, Ph.D., M.A., F.C.S.
P. R. PEDLEY.
Sir ALFRED ROBERTS.
J. ASHBURTON THOMPSON, M.D., (Brux.)
PROF. WARREN, M.I.C.E.
H. G. A. WRIGHT, M.R.C.S.E., &c.

The following gentlemen were duly elected ordinary members of the Society :—

Gordon, Charles Edward ; North Shore,
MacCulloch, Stanhope H., M.B., C.M., Edin. ; Sydney.

Max, Rudolph, LL,D., Univ. Heidelberg ; Sydney.
Sulman, John, F.R.I.B.A. ; Sydney.

The certificates of two new candidates were read for the second time, and of five for the first time.

The Chairman stated that the Conncil recommended that Michael Foster, M.D., F.R,S., &c., Professor of Physiology in the University of Cambridge, and one of the Secretaries of the Royal Society of London, be elected an honorary member of the Society.

The election was carried unanimously.

The names of the Committee-men of the different Sections were announced, viz. :—

Microscopical Section.—Chairman : F. B. Kyngdon. Secretary: Percy J. Edmunds. Committee : H. G. A. Wright, M.R. C.S.E., Dr. Eric Sinclair, G. D. Hirst, and S. MacDonnell.

Medical Section.—Chairman: Dr. P. Sydney Jones. Secretaries: Dr. MacCormick, and Dr. Jenkins. Committee : Prof. Anderson Stuart, M.D., Dr. Knaggs, Dr. Chambers, Dr. Crago, Dr. W. Chisholm, Dr. E. Fairfax Ross.

Sanitary Section.—Chairman: Dr. H. N. MacLaurin. Secretary: Reuter E. Roth, M.R.C.S,E. Committee : Dr. W. H. Goode, Dr. Quaife, Dr. E. Fairfax Ross, J. B. Henson, C.E. E. E. Sager, F. B. Kyngdon.

The following letter was read from James Hector, C.M.G., M.D. F.R.S., &c., Director of the Geological Survey of New Zealand :—

Colonial Museum of New Zealand,
Wellington, 31 December, 1886.

My dear Sir,

I have the pleasure to acknowledge the receipt of your letter of the 8th December, conveying to me the Clarke Memorial Medal which the Council of the Royal Society of New South Wales have been pleased to award to me.

I beg that you will convey to the Council my sincere appreciation of the great and unexpected honour which has been thus conferred upon me, and of their kind recognition of the services which I have been able to render to the best of my ability towards the progress of science in the Australasian Colonies. I beg that you will assure them of the continuance of my cordial sympathy with the well-organised efforts which the Royal Society have initiated for the purpose of developing scientific research in these Colonies.

I have the honour to remain, my dear Sir,
Yours most obediently,
JAMES HECTOR.

The Hon. Secretary, Royal Society of N.S.W.

Mr. C. Rolleston, C.M.G., President then read his address.

A vote of thanks was passed to the retiring President, and Mr. C. S. Wilkinson, F.G.S., F.L.S., &c., was installed as President for the ensuing year.

It was unanimously resolved that the Council be empowered to prepare a congratulatory address to Her Majesty The Queen, on attaining the Jubilee year of her reign, to be submitted to the members for their approval.

About thirty members were present.

The following Donations received since the last meeting were laid upon the table.

(The Names of the Donors are in *Italics.*)

TRANSACTIONS, JOURNALS, REPORTS, &c.

The publications distinguished by an asterisk are received monthly.

AMSTERDAM—Association Coloniale Neerlandaise à Amsterdam. * Revue Coloniale Internationale, Tome III., Nos. 5 and 6. Tome IV., Nos. 1, 2, 3. *The Association.*

AUCKLAND—Auckland Institute and Museum. Report for 1886-87. *The Institute.*

BALLAARAT—School of Mines. Annual Report for 1886. *The School of Mines.*

BALTIMORE—Johns Hopkins University. American Chemical Journal, Vol. VIII., Nos. 1, 2, 3. Historical and Political Science Studies in (4 Ser) Nos. 4, 5, 6. American Journal of Mathematics. Vol. IX., No. 1. American Journal of Philology, Vol. VII., No. 1. Studies from the Biological Laboratory, Vol. III., Nos. 6, 7. University Circulars, Vol. V., No. 49. *The Johns Hopkins University.*

BERLIN—Koniglich Preussische Akademie des Wissenschaften. Sitzungsberichte Nos. 23—39. *The Academy.*

K. Preuss. Meteorologischen Institut. Ergebnisse der Meterologischen Beobachtungen im Jahre 1885. *The Institute.*

BERNE—L'Aménagement des Eaux en Suisse. *The Director.*

BIRMINGHAM—Philosophical Society. Proceedings Vol. V., Part 1. *The Society.*

BISTRITZ (in Siebenburgen)—Director der Gewerbeschule. Jahresbericht XII. *The Director.*

BOSTON—American Academy of Arts and Sciences. Proceedings New Ser. Vol. XIII., (Whole Ser. Vol. XXI.) Part 2. *The Academy.*

Boston Society of Natural History. Memoirs Vol. III., Nos. 12 and 13, Proceedings Vol. XXIII., Part 2. *The Society.*

BRISBANE—Geographical Society of Australasia, (Queens land Branch). Proceedings and Trans. Vol. II., Part 1. ,,

BROOKVILLE—Brookville Society of Natural History. Bulletin No. 2. ,,

BRUSSELS—Musée Royal d' Histoire Naturelle de Belgique. Bulletin Tome IV., Nos. 3 and 4. *The Museum.*

Société Royal Malacologique de Belgique. Annales Tome XX., (Ser. III.), Tome 5 1885. Procès Verbal Tome XIV., pp. 81 to 144; Tome XV., pp. 1 to 96, and Statuts. *The Society.*

CALCUTTA—Asiatic Society of Bengal. Journal, Vol. LV., Part 1, No. 3, and Part 2, No. 3. *Proceedings Nos. 8 and 9, 1886. ,, CALCUTTA—*continued*

Geological Survey of India. Catalogue of the Remains of Siwalik Vertebrata, in Geologl. Dept. of Indian Museum, Calcutta, Parts 1 and 2. Catalogue of the remains of Pleistocene and Pre-Historic Vertebrata. Records of the Geological Survey of India, Vol. XX., 1887. Memoirs (Palæontologia Indica) Ser. X., Vol. IV., Part 2 and Addendum to Part 1; Ser. XII., Vol. IV., Part 2; Ser. XIII., Vol. I., Part 6; Title page and contents of Vol. I., Ser. VII. and XIV. *The Superintendent of the Geological Survey of India.*

Government of India. Scientific Results of the Second Yarkand Mission viz,, Memoir of the Life and Work of Ferdinand Stoliczka, Ph.D., by V. Ball, M.A., F.R.S. &c. *The Government of India.*

CAMBRIDGE—Philosophical Society. Proceedings, Vol. V., Part 6. *The Society.*

University Library, 32nd Annual Report of the Library Syndicate. *The Library.*

CAMBRIDGE (MASS.)—Cambridge Entomological Club. *Psyche*, Vol. III., Nos. 103-104; Vol. IV., Nos. 125-137. *The Club.*

Museum of Comp. Zoology, Harvard College. Annual Report of Curator, 1885-86. Bulletin, Vol. XII., No. 6; Vol. XIII., No. 1. *The Museum.*

CASSEL—Vereines für Naturkunde zu Cassel. Bericht, XXXII., and XXXIII., and Festchrift. *The Society.*

CHRISTIANIA—Norwegian North-Atlantic Expedition, 1876 to 1878. Zoology Crustacea II., Vol. XV.; Mollusca II., Vol. XVI. *The Editorial Committee.*

CINCINNATI—Cincinnati Society of Natural History. Journal, Vol. IX., Nos. 3 and 4. *The Society.*

CORDOBA—Academia Nacional de Ciencias. Boletin, Tomo VIII., Entrega 4a. *The Academy.*

DAVENPORT (IOWA)—Academy of Natural Sciences. Proceedings, Vol. IV., 1882-1884. *The Academy.*

DUBLIN—Royal Geological Society. Journal, Vol. XVII., Part 1; N.S. Vol. VII., Part 1. *The Society.*

EDINBURGH—Royal Observatory. Astronomical Observations, Vol. XV., 1877-1886. *The Observatory.*

Royal Physical Society. Proceedings, Vol. IX, Part 1. *The Society.*

Royal Scottish Geographical Society. *Scottish Geog. Magazine*, Vol. II., Nos. 11 and 12; Vol. III., Nos. 1 and 2. ,,

FIRENZE—Società Italiana di Antropologia e di Etnologia. Vol. XVI., Fasc 2. ,,

Società Africana d'Italia. Bullettino, Vol. II., Fasc 8. ,,

FRANKFURT, a/M.—Senckenbergische Naturforschende Gesellschaft. Abhandlungen, Band XIV., Heft 1. ,,

GLASGOW—Geological Society. Transactions, Vol. VIII., Part 1. ,,

University. Calendar for the Year 1886-87. *The University.*

HALLE—K. Deutsche Leopoldinisch-Carolinische Akademie der Naturforscher zu Halle a/s. Leopoldina. Heft XX., and XXI. Nova Acta, Vols. 44, 47, 48. *The Academy.*

HAMBURG—Naturhistorisches Museum. Bericht für das Jahr, 1885. *The Museum.*

HARLEM—Société Hollandaise des Sciences. Archives Néerlandaises, &c. Tome XXI., Liv. 2 and 3. *The Society.*

HELSINGFORS—Société des Sciences de Finlande. Observations publicés par L'Institut Météorologique Central. Vol. I., Liv. 1; Vol. II., Liv. 1. ,,

HOBART—Royal Society of Tasmania. *Abstract of Proceedings, 22 Nov., 1886. ,,

HONGKONG—Observatory. Observations and Researches in 1886. *The Observatory.*

LAUSANNE—Société Vaudoise des Sciences Naturelles. Bulletin, Vol. XXII., No. 94. *The Society.*

LEIPZIG—K. Säch. Gesellschaft der Wissenschaften. Bericht über die Verhandlungen, Supplement, 1886. ,,

LIEGE—Société Royale des Sciences. Mémoires (Serie III.), Tome XIII. ,,

LIVERPOOL—Literary and Philosophical Society. Proceedings, Vols. 39 and 40. ,,

LONDON—Anthropological Institute. Journal Vol. XVI., Nos. 2 and 3. *The Institute.*

Geological Society. Quarterly Journal, Vol. 42, Part 4; Vol. 43, Part 1. *The Society.*

Linnean Society. Journal (Botany) Vol. XXII., Nos. 146, 147; Zoology, Vol. XIX., Nos. 114, 115; Vol. XX., No. 116; Vol. XXI., No. 126. ,,

Meteorological Office. Hourly Readings, Part 4, 1883; Parts 1 and 2, 1884. Weekly Weather Report, Vol. III., Nos. 28 to 52, Appendix 1st and 2nd Quarter. * Monthly Weather Report, March to Aug. 1886, (Offi. No. 68). Quarterly Weather Report, Part 1, 1878, (Offi. No. 55). Meteorological Observations at Stations of the Second Order for year 1882. "On the Working of the Harmonic Analyser at the Meteorological Office," by R. H. Scott, F.R.S., and R. H. Curtis, F.R.M.S. *The Meteorological Office.*

Mineralogical Society. Journal, Vol. VII., No. 33. *The Society.*

Pharmaceutical Society. * Journal and Trans., Parts 195, 196, 197, 198, 199. ,,

Physical Society. Proceedings, Vol. VIII., Parts 2 and 3. ,,

Quekett Microscopical Club. Journal (Ser. 2) Vol. III., No. 17. *The Club.*

Royal Agricultural Society. Journal (Ser. 2), Vol. XXII., Part 2, No. 44. *The Society.*

Royal Asiatic Society. Journal (New Ser.) Vol. XVIII., Parts 3 and 4; Vol. XIX., Part 1. ,,

Royal Astronomical Society. * Monthly Notices, Vol. 46, No. 9; Vol. 47, Nos. 1, 2, 3. ,,

Royal Geographical Society. * Proceedings N.M.S., Vol. VIII., Nos. 10, 11, 12; Vol. IX., Nos. 1 and 2. ,,

Royal Historical Society. Transactions N.S., Vol. III., Parts 3 and 4, Report of the Council, 1885-6. ,, LONDON—*continued.*

Royal Meteorological Society. Quarterly Journal, Vol. XII., No. 60 and Record Vol. VI., No. 22. *The Society.*

Royal Microscopical Society. Journal (Ser. 2), Vol. VI., Parts 5 and 6; Vol. VII., Part 1. ,,

Royal United Service Institution. Journal Vol. XXX., Nos. 136, 137. *The Institution.*

Zoological Society. Proceedings, Part 3, 1886. *The Society.*

LUXEMBOURG—Institut Royal Grand Ducal. Publications, Tome XX. *The Institute.*

MARBURG—University. Sixty-one (61) Inaugural Dissertations &c. *The University.*

MELBOURNE—Government Statist. Australasian Statistics for year 1885; Statistical Register of the Colony of Victoria for 1885, Part 5; Victorian Year Book for 1885-6. *The Government Statist.*

Mining Department. Gold-fields of Victoria. Reports of Mining Registrars for Quarters ended 31 March, 1885; 31 March, 30 Sept., and 31 Dec., 1886. *The Secretary for Mines and Water Supply.*

Public Library, Museum, &c. Report of the Trustees for 1885. *The Trustees.*

Royal Society of Victoria. Transactions and Proceedings Vol. XXII. *The Society.*

MEXICO—Observatorio Astronomico Nacional de Tacubaya ano de 1887. Anuario. *The Observatory.*

MODENA—Académie Royale des Sciences, Lettres et Arts. Memorie (Ser. 2) Vol. III. *The Academy.*

MONTREAL—Natural History Society. Canadian Record of Science, Vol. II., Nos. 4 and 5. *The Society.*

MULHOUSE—Société Industrielle. * Bulletin, August to December, 1886. ,,

NAPLES—Società Africana d'Italia. * Bollettino Anno V., Fasc 9 to 12. Anno VI., Fasc 1 and 2. ,,

Stazione Zoologica. Mittheilungen Band VII., Heft 1. *The Station.*

NEWCASTLE-UPON-TYNE — North of England Institute of Mining and Mechanical Engineers, Trans. Vol. 35, Part 4; Vol. 36, Part 1. *The Institute.*

NEW YORK—American Chemical Society. Journal, Vol. VIII., Nos. 6, 7. *The Society.*

American Geographical Society. Bulletin, 1885, Nos. 3, 4, 5; 1886, No. 2. ,,

New York Academy of Sciences. Annals, Vol. III., Nos. 9 and 10; Trans. Vol. V., Nos. 2, 3, 4, 5, 6. *The Academy.*

* "*Science*" (Editors of) Vol. VIII., Nos. 194 to 203; Vol. IX., Nos. 205 to 213. *The Editors.*

* New York Microscopical Society. Journal, Vol. II., No. 8. *The Society.*

School of Mines, Columbia College. *School of Mines Quarterly*, Vol. VIII., No. 1 and 2. *The School of Mines.*

OTTAWA—Geological and Nat. Hist. Survey. Descriptive Catalogue of Economic Minerals of Canada. Colonial and Indian Exhibition, London, 1886. *The Director.*

OXFORD—Radcliffe Observatory. Results of Astronomical and Meteorological Observations in 1883. *The Trustees.*

PALERMO—R. Accademia di Scienze Lettere e Belle Arti. Bollettino, Anno III., Nos. 1-3, 1886. *The Academy.*

PARIS—Academie des Sciences de l'Institut de France. Comptes Rendus, Tome 103, Nos. 12-26; Tome 104, Nos. 1-7. ,,

L'Institut Pasteur. Annales, No. 1, 25 Jan., 1887. *The Institute.*

Société d'Anthropologie de Paris. Bulletins (Ser. III.,) Tome VIII., Fasc 1; Tome IX., Fasc 3. *The Society.*

Société de Biologie. *Comptes Rendus (Sêrie VIII.), Tome III., Nos. 36-47; Tome IV., Nos. 1-10. ,,

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WEDNESDAY, 20 MAY, 1887.

C. S. Wilkinson, F.G.S., &c., President, in the Chair.

The minutes of the Special Meeting of the Council held on the 11th May, were read.

The congratulatory Jubilee Address to Her Majesty The Queen which had been drawn up by the Council and illuminated by

Messrs. S. T. Leigh & Co., was approved, and afterwards signed by the President on behalf of the Society.

It was resolved that the address be suitably bound in morocco, and presented to His Excellency the Governor for transmission to Her Majesty as soon as possible.

WEDNESDAY, 1 JUNE, 1887.

C. S. Wilkinson, F.G.S., President, in the Chair.

The minutes of the last meeting were read and confirmed.

The following gentlemen were duly elected ordinary members of the Society :—

Long, Alfred Parry ; Sydney.
Mackenzie, George Stephen, Ph.D.(Heidelberg)F.I.C.; Sydney

The certificates of five new candidates were read for the second time, and of five for the first time.

The President on behalf of the Council, stated that in consequence of new regulations having been introduced in the Government departments, the Society's proceedings would no longer be printed at the Government Printing Office, and it was therefore necessary that the Society should publish its own Journal. The Society was very much indebted to the Government for the assistance hitherto afforded in printing its Proceedings. The Council had decided to issue the Journal monthly ; he believed that this would prove of great advantage to the members, and authors will be able to have their papers ten days after delivery. Mr. Wilkinson also stated that the Jubilee Address adopted at a special meeting of members on the 20th ultimo, the text of which is as follows, was open for inspection :—

"To the Queen's Most Excellent Majesty,

"May it please your Majesty—

"We, the members of the Royal Society of New South Wales, "desire to approach your Majesty with our hearty congratulations on the "happy Jubilee of your Majesty's Reign, and to express our earnest and "respectful hope that your Majesty's benificient reign may be prolonged "for the promotion of the happiness of your loving and loyal subjects.

"On behalf and in the name of the Royal Society of N.S.W.,

"C. S. WILKINSON, President."

Mr. Lawrence Hargrave read a paper on "Recent work on Flying Machines," which was illustrated by a model and six large diagrams.

Some remarks upon the same were made by Professor Threlfall.

Mr. J. H. Maiden, F.R.G.S., read a paper on "Some New South Wales Tan-substances." A collection of barks and kinos, lent by the Trustees of the Technological Museum to illustrate the paper were exhibited.

A discussion ensued in which the following gentlemen took part, viz.:—Rev. S. Wilkinson, Mr. J. T. Wilshire, the Hon. L. F. De Salis and the Chairman.

The thanks of the Society were accorded to the authors for their valuable papers.

Remains of Plesiosaurus.

Mr. R. Etheridge, F.G.S., exhibited "Remains of Plesiosaurus from Queensland."—The two bones presented to the notice of the Society this evening, were forwarded to the Government Geologist, Mr. C. S. Wilkinson, by Mr. H. S. W. Crummer, of the Surveyor General's Office, and were found in the bed of a dry lake on Mr. Barrington's Station, Pitchery Creek, Central Queensland. They are portions of the vertebral column of an extinct reptile, *Plesiosaurus*. This genus is characteristic of the Secondary rocks, extending in range of time from the Lias to the Cretaceous series. From the transverse elongation of the portions preserved, they partake more of the facies of Plesiosauri of the Cretaceous than of those found on the Lower Mesozoic Deposits. Prof. McCoy was the first to record the occurrence of Enaliosaurian Reptiles from Australian rocks; and of the two species of *Plesiosaurus* described by him from North Queensland, the present bones appear to correspond better with the description of his *Plesiosaurus macrospondylus*, than they do with any other. This portion of the subject will however be entered on more fully hereafter. The great point of interest attached to the present exhibit is the relation these fossils bear to the Cretaceous group of *Plesiosauri*, rather than to those of an earlier date, thus corroborating the age which has usually been assigned to the secondary deposits of Queensland.

Electric Storage Battery.

Mr. David Miller exhibited a new electric storage battery consisting of five cells, by which he is enabled to store 10 per cent. more electricity than by any previous arrangement. The battery will give out two volts electro-motive power, and shows a commercial efficiency of 72½ per cent. with an electro-motive force of 1·8 volts per cell. The Excelsior motor used, takes 7½ Ampere, and 30 volts at 1500 revolutions per minute, and is one-third of one horse power. As a dynamo driven at 1500 revolutions per minute it supplies six 15-candle lamps. It can drive a small 16-foot dingy. The electric lighting of Sydney could be done with such batteries at a less cost than gas, and the light would of course be superior.

About thirty members were present.

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NOTES ON THE EXPERIENCE OF OTHER COUNTRIES IN THE ADMINISTRATION OF THEIR WATER SUPPLY.

By H. G. McKINNEY, M.E., M. Inst. C.E.

[*Read before the Royal Society of N.S.W., 6 July, 1887.*]

Now whilst the importance of the question of water conservation in New South Wales is beginning to be understood, and the necessity for legislation regarding it is generally admitted, a concise statement of the lessons in administration which may be learned from the experience of other countries appears opportune. It may be suggested by some that in dealing with such a question I am trespassing on ground which properly belongs to gentlemen of the legal profession; but this is an opinion which I cannot agree to. I maintain that no one is more entitled to be heard on the general principles of administration of the water supply of a country than an engineer, who has had practical experience both of the value of good laws and the mischief caused by bad ones. Legal technicalities and questions of legal detail do not, in fact, come within the bounds of an inquiry into the general principles with which I now propose to deal.

The countries from which the most useful lessons in water administration can be obtained are Spain, Italy, India, France, and the colony of Victoria; while America and England furnish striking instances of mistakes which we should do our utmost to avoid. There are other countries from which some useful hints can be obtained and which will be incidentally referred to; but those enumerated will supply nearly all the information now brought forward.

The scanty rainfall and high temperature in Spain early led to the introduction of irrigation in that country, while the smallness

ERRATUM, Vol. XXI.

Page 61, Sixteenth line from top, for "1366" *read* "1866."

of the available supply of water necessitated the framing of regulations for its use. Hence we find that during the occupation of Spain by the Moors irrigation was widely practiced, works for this purpose having been constructed then which even now occupy an important position both from an engineering and from a utilitarian point of view. The value of the customs and laws under which irrigation works were managed by the Moors was fully recognized by their conquerors. An excellent instance of this occurred early in the thirteenth century, when the King of Arragon by whom the Moors had been expelled, issued a decree that the customs observed by them in regard to the utilization of water should be adopted and adhered to. In short, the Spaniards were indebted to the Moors, not only for their irrigation work, but for their system of administration and their sound and practical methods of dealing with the water rights. The Spanish Law of Water which was passed in 1366, and which is probably the most comprehensive Act of its kind in existence, is little more than a codification of previously existing laws and a legalization of established customs. Generally speaking, every irrigation work in Spain has a code of rules for its management, and the administration of these rules is in the hands of the irrigators. The Law of Water deals with the general question of the rights of the State and of individuals to water, and is sufficiently wide in its scope to provide as well for the most ancient irrigation work in the land as for those recently carried out by English Companies. This Law consists of 300 Articles or Clauses ; but the first 29 of these relate to the waters of the sea, and deal with coastal works and with the belt of sea throughout which Spanish jurisdiction extends. In the remaining 271 Clauses, the subject of rights to rain water, and to rivers, lakes, and subterranean supplies is treated exhaustively. The basis of this Law briefly stated is that all large natural supplies of water are public property. Article 31 declares that "There pertains to the public property the rain water which flows through torrents or watercourses the channels of which belong to the same public property." Article 33 proclaims that "There pertain to the public or public property—

(1) The waters which spring perennially or intermittently within the public lands.
(2) Those of the rivers.
(2) Those whether perennial or intermittent which flow through their natural channels."

Article 44 dealing with the stagnant water declares that "There pertain to the public property the lakes and marshes formed by nature, covering public land and fed by public streams." In the case of subterranean waters, these belong to the owner of the land under which they are obtained. Article 45 on this subject states

"There pertain to the owner of an estate in full possession the subterranean waters which have been obtained in it by means of ordinary wells, whatever may be the apparatus employed to draw it."

Among the numerous points provided for in the Spanish Law of Water, one of the most important is the power to obtain a right of way for water for irrigation purposes. It is at once obvious that in a case where extensive irrigation works are constructed, it is absolutely necessary that all persons owning property within a reasonable distance of the works, and to whom it is desirable that a supply of water should be afforded, should have a right to construct the necessary channels on payment of fair compensation to the owners of the land through which these channels have to be taken. Another very important subject dealt with is the provision of regulations under which concessions can be granted to companies or to individuals for the construction of works for irrigation or for water supply to towns. As an instance of the terms on which concessions have been granted, the case of the Iberian Irrigation Company may be quoted. The principal conditions under which the concession was granted to this Company were that it would at its own cost and risk construct canals for irrigation purposes, that it would not have authority to charge at a higher rate than 28s. per acre of land watered, and that after 99 years the canals would become the property of the State, to which they should be made over in good working order. The following remarks of Moncrieff on this concession are suggestive :—"In return for all this what the Government give is the use of a river running to waste, and which they themselves could not employ ; and this use is in order to benefit their own country, increasing the general prosperity of the district, and directly swelling the revenue by enabling them to impose on the watered lands a heavier assessment."

Legislation on the subject of water rights in the various states which are now combined in Northern Italy, dates back in some instances as far as the tenth century. The laws and customs of these states have been altered and improved on as occasion required ; but the general basis of the enactments in force is that the State is the owner of the rivers and of all of their tributaries of any importance. This point is enunciated in the Code of Victor Emmanuel, which was passed on the union of the Italian States, and which proclaims that the rivers and torrents form part of the public domain. Starting with this position, most complete regulations are laid down in regard to the utilization of the national supply of water. All owners and occupiers of land are bound to obtain sanction from the authorities before any works can be constructed by them for this purpose. The works must be carried out and the water used in the manner sanctioned, and no alteration of existing works can be made without first obtaining approval. The owners or users of canals are bound to maintain them in good working order, and have to provide for the escape of all surplus water, which, if not required for use by other irrigators, has to be allowed to flow to the river from which it originally came.

The portion of the Civil Code of Italy which treats of water rights is very comprehensive, and holds a corresponding position there to that occupied by the Law of Waters in Spain. The conditions exisiting in these two countries differ materially, and the legislation to provide for these conditions naturally exhibits a corresponding difference. In Italy the rainfall is much higher and the supply of water in the rivers more abundant and more regular. Hence the necessity for drainage works in connection with the irrigation in Northern Italy is felt in a degree unknown in Spain. On this account the subject of drainage is dealt with more exhaustively in the Italian enactments. Among points relating to drainage provided for in these, the most important are—(1) the right of way for drainage water, (2) the obligation to keep drainage works in repair, and (3) the right of an owner or occupier of land to enter the lands of others in order to repair any drainage work, from the condition of which he has reason to apprehend danger or loss. Under the Italian laws no man has a right to waste water. When a supply of water is granted to any person for the irrigation of a certain plot of land, the surplus left after that land is watered belongs to the person or authority from whom the supply was obtained.

The same reasons which in Italy called for special provisions regarding drainage also necessitated comprehensive regulations in regard to right of way for water. Not only is a right of way for water through public or private lands and over or under canals provided for, but even cases in which it may be desirable to conduct water into and for a certain distance through a canal or channel already in operation has not been overlooked.

The canals of Italy having been constructed under a great variety of conditions, and, in most cases, many centuries ago, there is considerable diversity in the nature of their ownership. Hence we find that some of these works are the property of Government, others of corporations or of associations of irrigators, and others of private individuals or companies. Since the union of the Italian States, the principle of having irrigation and drainage works constructed and managed by the persons interested has been fostered and encouraged. Still the only great irrigation work constructed within a comparatively recent period—namely the Cavour Canal—was carried out by an English company under a special concession from the Government. But the system of management by associations, which corresponds closely with what we should term "Irrigation Trusts," is in full operation and works very satisfactorily as might be expected. The Italian Civil Code not only sanctions voluntary associations for the management of irrigation and drainage works and prescribes regulations for their guidance, but it provides for the compulsory formation of associations of this description for the public benefit when a majority of the land-holders of a district so desires. It is necessary to add that in cases of the latter description an association can be formed only when the majority of the land-holders who are in favour of it represents more than half of the total interests involved.

The procedure laid down for cases in which a supply of water from a river or lake is required is, in the main, similar to that adopted in France as will presently be explained. Applications for such supplies have to be made to the Government through the local authorities, and every application must state the nature and extent of the concession asked for, explain the objects in view and show their utility, and must be accompanied by plans and sections in explanation and support of the claims advanced. To deal with such proposals and with the management of the water supply generally, there is a staff of highly trained hydraulic engineers in the service of the Government. Projects for the diversion of water from the rivers, or for drainage, or for the alteration of existing works for irrigation or drainage purposes. are referred to those engineers who have to inquire into not only the engineering aspect of the proposed works, but also as to the benefits likely to arise from them and the actual or possible objections to their construction. The local authorities are also called on to furnish their opinions. The information and opinions thus obtained are considered by the Government, and if it be decided to grant the concession asked for, the terms on which it can be allowed are arranged in detail.

The Cavour Canal, which has already been referred to, being a national work in importance, magnitude, and cost, was to have been constructed by Government; but owing to the state of the public finances, an advantageous offer made by a Company composed chiefly of Englishmen to carry out the works was gladly accepted. The terms of the concession were so favourable to the Government that, as has been tersely stated by Moncrieff, the canal has proved a source of wealth and prosperity to all connected with it except the shareholders. The principal points in the agreement were that the Company should, within a given period, carry out a project the main features of which had already been determined on for the construction of a canal from the River Po, that this canal should be capable of discharging a stated quantity of water, and that its main object should be to augment the supply in several existing canals. The Company was to manage and maintain the works and to receive the revenue from them for 50 years, after which period it was to hand them over in good repair to the Government. The charges for water made by the Company were not to exceed rates which had obtained the approval of the Government; but the latter guaranteed a return of 6 per cent. on what it recognized as the capital of the Company. It is manifest that an agreement of this description carries with it a certain advantage free from risk to the Government which makes it, and to the land-holders on whose behalf it is made, while the risk all falls on the Company which undertakes to construct and maintain the works.

In France, questions relating to irrigation and navigation have to be considered together when dealing with the rivers. The system of inland navigation in that country has long been one of the most important in the World, and holds a very prominent position in promoting trade by reducing the cost of carriage. The extent to which the value of the rivers and canals of France are appreciated may be judged from the fact that not many years ago the sum of forty millions sterling was voted for their improvement and development.

Although irrigation is practised in almost all parts of France and over extensive areas, and although its general effect is to raise the value of land by 50 per cent., still it is not of such vital importance as in Spain, nor is it even so much of a necessity as in Italy. Hence it is not surprising that the Laws of France relating to Water Supply, having to deal with all the requirements of both navigation and irrigation, are more complicated than those of Spain or Italy. But the principle of the State right to streams is made sufficiently clear, and the rights of the public are so defined as to prevent the obstruction of useful works. The Code of Napoleon declares that rivers and streams which will carry floats or rafts are considered as dependencies on the public domain, and a subsequent enactment specifies the streams and parts of streams which were to be deemed navigable or raftable. In cases where rights to supplies of water had been acquired previous to the passing of these enactments, compensation was allowed to the owners of these rights. Subject to such conditions, the Government also reserves to itself the right to declare streams or parts of streams navigable or raftable in addition to those already proclaimed.

When any private individuals or syndicates propose to obtain a supply of water from a river, the matter has to be referred to the prefect of the district in which the supply is required.

Investigations are made by him into the circumstances of the proposal, and the subject is then made over to the engineer of the Department, who reports on the merits of the project from an engineering standpoint. As in Italy, applications for water privileges must be accompanied by plans and sections, and also as in that country, the engineer to whom they are made over for report is a highly trained Government officer. Having investigated the application, the engineer returns it with his report to the prefect who adds any remarks he may consider necessary, and then forwards all the papers to the Central Government where they are considered by the Council of State. If the application be granted, the proposed works must be carried out under terms prescribed by Government, and subject to the supervision and approval of the Government engineers. [The foregoing is the procedure in the case of large works or claims, but for water privileges of minor importance the prefect has discretionary powers to grant claims which are recommended by the engineer.]

The fact that the State does not lay claim to rivers and streams which are not navigable, has led indirectly to difficulties in the way of irrigation enterprise. Another cause of injury to irrigation prospects has been the difficulty and expense attendant on obtaining a right of way for water, and a right to abut a dam on the property of others. These difficulties have in a great measure been surmounted by the system of having works constructed and managed by syndicates or associations composed of the persons directly interested in them. Two kinds of such syndicates are recognized by the Laws, the one termed "free," because its members in all cases join it voluntarily and are at liberty to leave it if they desire; the other termed "authorized," because it is empowered by the State to exercise certain rights, and among others to acquire any land which may be necessary for its purposes. On the whole a free syndicate bears to an authorized syndicate nearly the same relation as a Progress Committee in this Colony bears to a Municipal Council. The main principle of either kind of syndicate is purely that of local government, the construction and management of irrigation or other kindred works being in the responsible charge of a body elected by those directly interested.

In Upper India, the Canal Act of 1873 deals in a concise, as well as comprehensive manner with the question of water conservation and supply. This Act is the outcome of two excellent reports, which were furnished to the Indian Government at different times by two engineers, who were specially deputed to visit irrigation works in the South of Europe, and to report on their character and administration. The countries drawn on for information and experience were Italy, Spain, and France, and there can be no doubt that these were the countries which could furnish the most valuable suggestions and present examples most worthy of imitation.

The Northern India Canal and Drainage Act commences with the announcement of the right of the State "to use and control for public purposes the water of all rivers and streams flowing in natural channels, and of all lakes and other natural collections of still water." Part I. of this Act is of a preliminary nature, and furnishes a statement of the territories to which it applies, specifies the previous Acts which it supersedes, and defines the application of the terms used in it. Part II., relating to the application of water for public purposes, describes the procedure to be adopted when a supply is proposed to be utilized, and states the powers of canal officers, the conditions under which compensation may or may not be awarded, and the method of inquiry into claims. Part III., dealing with the construction and maintenance of works, gives to canal officers the power of entry on private lands, and describes the procedure followed when granting supplies of water from a canal and the responsibilities of the persons to whom such supplies are granted. Part IV. on the Supply of Water, describes the cases under which a supply may be stopped, forbids the subletting of such supply and ordains that any contract for water between the Government and a land-holder shall be transferable with the land. Part V. dealing with Water Rates, distinguishes between the occupier's rate and the owner's rate, and describes the mode of treatment of each. The remaining six parts into which the Act is divided deal respectively with Canal Navigation, Drainage, Obtaining Labour for Canal and Drainage Works, Jurisdiction, Offences and Penalties, and Subsidiary Rules.

It is well to call attention here to the title of this Act, which shows that it applies only to Northern India. Madras which has a Governor and Government of its own, is much behind the northern provinces in regard to such legislation and, in this respect, at least, justifies the name of "the Benighted Presidency," which is frequently applied to it.

For the administration of the Act described, the engineers in charge of canals in full operation are required to pass a qualifying examination to show that they have acquired the requisite proficiency in knowledge of Canal Law and of the Code of Criminal Procedure. On passing this examination they are gazetted as Canal Magistrates with powers to try and to pass judgment on offences against the Canal Act. Appeal can be made in such cases to the District Magistrate; but this is very seldom resorted to. The position of canal engineer is thus one of very considerable responsibility, as he has not only to see that the main canals and distributaries are in thorough working order, but he has to supply the water without fail to the cultivators according to an appointed rotation, to punish any attempt to interfere with this rotation, to decide regarding applications for new supplies or for the transfer of the position of outlets, and to prevent any kind of waste. The canal engineers, whether they be Royal Engineers or civilians, are the outcome of the competitive system, the only exceptions to this rule being furnished in the cases of a few civilians and Staff Corps Officers of long service. For many years past the first step towards the attainment of an appointment in the Department of Public Works in India, whether the candidate proposes to enter the service as a Royal Engineer or as a civilian, is the passing of an open competitive examination. The course of training necessarily differs, as the curriculum for civilians includes only civil and mechanical engineering, and subjects bearing on these, while that of the military cadet, though involving these subjects to an important extent, embraces also the studies necessary to qualify for the higher scientific branch of the military service.

The canal and other great irrigation works in India are in all cases constructed by Government and managed in the manner described. The success of the system of canal administration in Upper India is beyond question, though the attempt to engraft the principle of local government on it proved a failure. The management of branch canals and distributaries will probably in the course of time be placed with satisfactory results in the charge of local associations of landholders. It does not, however, seem surprising that a nation which has been the victim of successive conquests from time immemorial and which has never hitherto been permitted to have a voice in the administration of its own affairs, should be slow to develop a talent for governing itself. The present system is undoubtedly that best suited to the conditions of the people, though it is not altogether in accordance with the spirit of the present tendency of European nations. Hence while we can learn useful lessons from the principles of Indian Canal Law, there are many points in its administration which we are not likely to imitate. The great principle which lies at the root of the legislation in Northern India, as well as in Spain, Italy, and France, is that all great natural supples of water belong to Government, and that it is the duty of the Government to deal with them in the manner most advantageous to the public. This is the principle on which was based the Draft Bill given in the First Report of the late Royal Commission on the Conservation of Water in this colony, it is the principle adopted (avowedly from that Draft Bill) in recent legislation in Victoria, and, so far as can be judged from the experience of other countries, it is the only sound basis on which the natural water supply of a country can be administrated.

Spain, Italy, France and India take the leading positions in regard to administration of rivers and other sources of water supply, and furnish the best examples for our information and guidance. But there are other nations which afford corroborative evidence of the soundness of the systems which they follow. For instance, in Prussia, Bavaria, and Saxony, the Government claims absolute ownership of the rivers, and will not permit even the tributary streams to be interfered with until sanction has been granted. The general principles adopted in the management of the rivers in these countries bear much resemblance to those acted on in France, and the result is equally satisfactory.

In America the various states are permitted to deal with the rivers and lakes within their boundaries; but, as a general rule, the British Law of Riparian Rights is still recognized. One exception to this rule is furnished by Colorado, in which a law was passed regarding the rivers which might be summed up in the familiar expression "first come first served." The immediate effect of this law was that a rush was made by speculators to secure the right to every important river. In this way individuals and companies obtained rights which placed them in a position to utilize the waters or not as they pleased, to prevent others from making use of the waters, and to make their own terms with those who required supplies. It is not surprising that under these conditions Colorado soon became an unrivalled field for the irrigation lawyer, and that irrigation enterprise was checked and even threatened with extinction. In California the operation of the British Law of Riparian Rights has been at least as mischievous in its effects as the attempt at legislation in Colorado. With reference to this point, the following quotation from Mr. Deakin's very instructive report places the question in a clear light:—"According to the last message of the Governor of California to its Legislature, 'rights to use water under the Civil Code are undefined and unproven claims, the extent and dates of which are known only to their holders or claimants,' a state of affairs which necessarily involves all parties interested in doubt and loss. How serious the loss is, owing to this unsatisfactory condition of legislature, may be better judged when it is recollected that almost the whole of the 150,000 people who inhabit Southern California are directly or indirectly dependent upon irrigation for their support. The value of the property in irrigation lands and works threatened in this State is publicly stated at £40,000,000. The injurious results of the uncertainty as to the position of appropriators are discovering themslves on every hand. The splendid fruits of irrigation upon desert lands have all sprung from schemes commenced before this issue was raised. From that hour all projects for new works or the enlargement of works in existence have been paralyzed, Canals which have a capacity for supplying 40,000 acres, with but little addition, continue to supply only 20,000 acres, as they did when the doubt was first raised. Only under most exceptional circumstances or on the smallest scale are any new projects being carried out in California. Where, as at Ontario or Redlands, extensive expenditure is being incurred, it is because the question of riparian rights cannot be raised. The proprietors of existing canals are, many of them, involved in a web of litigation; the legal expenses on one canal alone, which is not a special subject of contention, having added £4,000 a year to its cost of maintenance." Since these words of Mr. Deakin were written, the public of California has been thoroughly aroused to the pitch of exasperation by a decision of the highest legal tribunal of that State. This decision, which considerably aggravated the state of uncertainty so lucidly described by Mr. Deakin, resulted in the establishment of anti-riparian leagues, the members of which were pledged to use their best exertions to have the Law of Riparian Rights repealed, and something more reasonable substituted for it.

When we turn to England for information on the subject of water conservancy we are confronted by a state of affairs which, on this point at least, justifies the statement that the English laws are the best in the world for the lawyers. A concise statement of the British Law of Riparian Rights appeared some time ago in the columns of the "Sydney Morning Herald," under the well-known initials of Mr. Oliver, the Parliamentary Draftsman, who has made a special study of this subject. According to this law, a riparian proprietor has a right only to what one authority terms the "ordinary use," and what another terms the "reasonable use" of the water. All authorities seem to agree that no person has a right to take so much of the water of a river as will injuriously affect the supply lower down; and some appear to lay down the general rule that every riparian owner who makes use of the water of a river is bound to return the water undiminished in quantity and unaltered in quality. One high authority is of opinion that a person has a right to put a dam across a stream in his own property, and another equally high authority has ruled that no person has any right to obstruct the flow of a stream. Where large interests are involved, the question as to the exact meaning of the terms "ordinary" and "reasonable" as applied to the use of water, would afford a wide field for legal hair-splitting. Then the question as to what quantity of water, if any, could be taken out of a stream without injuriously affecting interests lower down, would present another series of difficulties. Take, for instance, the case of such a river as the Macquarie, which is frequently dry at Warren when there is a good supply flowing past Dubbo. On such occasions the stream beyond the latter place gradually diminishes till it disappears altogether. It will be easily understood that under these circumstances the abstraction of a very moderate supply at Dubbo would reduce by miles the distance traversed by the stream. Such considerations as these show that wherever the British Law of Riparian Rights is in force the opportunities for raising difficulties in the way of making any use whatever of the water of rivers are practically endless. It is particularly interesting to note that a person who wishes to construct a dam has a high legal authority in support of his right to do so, while his neighbour who is determined to prevent the construction of any dam has an equally high authority to rely on. It is, on the whole, a matter for regret that when Charles Dickens was in the vein for writing such a sketch as that on the Circumlocution Office and How Not to Do It, he was not brought into collision with this remarkable jumble of vague and discordant opinions known as the British Law of Riparian Rights. But it may be urged that while this so called Law is unsuitable to the requirements of countries which have a hot climate and a scanty rainfall, it may be sufficient to meet the requirements of the country in which it originated and where these conditions are, in a great measure, reversed. It would be well for the credit of English administration if this were so, but the facts are far different. In Spain, Italy, and Northern India the rights of the State and of individuals are clearly defined, so that the initiation of works for water conservancy, or the development of existing works, presents no legal difficulties, and affords no ground for heavy preliminary expenses or for unreasonable delay. In England, on the other hand, it is impossible to interfere in the slightest degree with a stream, lake, or marsh, without first setting in motion the whole cumbrous machinery of the legislature and stirring up afresh the muddy waters of riparian rights. I have not been able to obtain a statement of the number of English enactments relating solely to water conservation, but I have ascertained, on good authority, that the number of public and private Acts of Parliament which deal with rivers, canals, harbours, and docks is little if anything short of 4,000. The confusion, uncertainty, and loss necessarily arising from such multiplicity of laws are greatly increased by the number and variety of the boards which have been created to administer them. The chief objects of river conservancy in England are (1) protection against floods, (2) facilitating navigation, (3) reclamation of swamps, (4) industrial purposes, and (5) fish breeding. Such a list of objects has resulted in much piecemeal legislation and called into existence a great variety of boards or commissions whose interests are widely divergent. Very little consideration is required to show that the interests of residents on one part of a river frequently differ entirely from those of residents on another part. For instance persons residing on the higher part of a river in England naturally desire to afford every facility for the rapid discharge of flood water, while those on the low land near the mouth of the river view with apprehension any steps taken with this object, as the violence of floods on the lower part of the river would be thereby increased. Divergent interests such as these afford a wide field for disagreement between different boards, and it is, therefore, not surprising that when one board or commission desires to carry out works for water conservancy or for river improvements of any kind, it generally finds several other boards standing in the way to oppose it. As an instance of the result of this state of affairs, the feuds between the different boards on the little River Nene have, during the last fifty years, cost £100,000. In the case of the Ouse the amount expended merely in obtaining parliamentary powers for carrying out necessary improvements has been £150,000. Nearly the whole of these sums can be put down as direct loss or waste, and there can be no doubt that the indirect loss due to the retardation of enterprise and the delay in carrying out useful improvements must have been much greater.

The extent to which responsibility in regard to river conservancy in England has been divided is almost incredible. In the case of the little river Witham there are seventeen separate authorities which have more or less jurisdiction over its banks and main tributaries, and these do not include the Drainage Commissioners in the fen lands near the river's mouth. These if added would make altogether forty different boards possessed of jurisdiction over the Witham and its tributaries. Another notable instance of divided authority is that furnished by the River Nene. In the length of thirty miles between Peterborough and the sea that river is under the charge of fourteen Boards of Commissioners. Three of these boards have jurisdiction over the river channel, five over the north bank, and six over the south bank. It would be easy to furnish numerous instances of the pernicious effects of multiplying administrative boards in this haphazard manner and dealing piecemeal with the great question of river conservancy; but a few will suffice to illustrate the manner in which such effects make themselves felt. In one case necessary improvements at the mouth of a river were carried out only after the question had remained in dispute for eighty years. In another a sum of £150,000 was expended in improving a portion of a river, but as the authorities possessed of jurisdiction on other parts of the river refused to make corresponding improvements, no benefit whatever was derived from this expenditure. In a third case a disastrous inundation was prevented by persons acting on their own responsibility, while the authorities directly interested in preventing the inundation had no jurisdiction over the river banks.

The engineers who have had the most extensive experience in connection with water conservation and supply in England are fully alive to the glaring defects of the administration in regard to these matters, and are unanimous in the opinion that sweeping reforms are necessary. Two eminent engineers, who were appointed as a Royal Commission to enquire into and report on this subject, gave the opinion that all the rivers should be under one jurisdiction, with a central office in London, and a Cabinet Minister at its head. But the difficulties in the way of carrying out useful legislation have prevented any such measure from being passed. Besides in a country like England, where numerous and complicated rights to water have been acquired, the difficulties to be encountered and overcome in passing such laws as would place the question of water conservation on a sound basis, would be very great. In a new country, where settlement is incomplete and the development of the natural resources has only commenced, the obstacles in the way of passing suitable laws dealing exhaustively with the general principles of water conservation and supply are comparatively trifling. But delay in this matter is dangerous, and the cases of England and America show the nature of the danger and the fate of the water supply when enterprise is fettered by the British Law of Riparian Rights—the law which is still in force in New South Wales as some of our most enterprising pastoralists know to their cost.

WEDNESDAY, 6 JULY, 1887.

Dr. Leibius M.A., F.C.S., in the Chair.

The minutes of the last meeting were read and confirmed.

The certificates of five new candidates were read for the third time, of five for the second time, and of seven for the first time.

The ballot for the election of the candidates whose certificates had been read for the third time was postponed to the next monthly meeting on account of there being one deficient of the required number to make a quorum.

The Chairman announced that an advanced copy of the new monthly issue of the Society's Journal for the present year lay upon the table for the inspection of the members, and would be ready for distribution in the course of a few days.

A letter was read from the proprietors, inviting the members to visit the Aquarium at Manly.

In the absence of the author, the Hon. Secretary (Mr. F. B. Kyngdon) read a paper by Mr. H. G. McKinney, M.E., M.I.C.E., entitled "Notes on the Experience of other Countries in the Administration of their Water Supply."

The thanks of the Society were accorded to Mr. McKinney for his valuable paper, and it was resolved that the discussion upon the same be postponed until the following meeting.

Exhibit.

Professor Warren exhibited and described the following apparatus :—

"An apparatus for measuring minute strains occurring within the limits of Elasticity, devised by Mr. P. V. Appleby and Prof. Kennedy, also an Autographic Stress-strain apparatus, devised by Mr. A. G. Ashcroft and Professor Kennedy"; described and exhibited by Professor Warren.

During the last few years a considerable amount of work has been done with regard to the effect of stresses in producing strains in materials, under a great variety of conditions. The materials which have been more thoroughly investigated in this direction are steel and iron. Several ingenious contrivances have been devised by various experimenters for measuring such small strains as $\frac{1}{10000}$ part of an inch in a steel or iron test piece. The extension produced by stresses within the limit of elasticity is a measure of the modulus of elasticity.

According to Prof. Unwin an error of $\frac{1}{10000}$ part of an inch in the extension of a steel bar 10 inches long with a load varying from 0 to 10 tons, would mean an error of 2 per cent. in the modulus of elasticity, and in trying to determine the extension from ton to ton, an error of $\frac{1}{10000}$ part of an inch would make an error of 20 per cent. in the extension per ton. Hence the importance of using instruments capable of measuring small elongations accurately in all experiments on modulus of elasticity. The little instrument which I have the pleasure of shewing you, has been in use for the last two years at the University of Sydney in determining the modulus of elasticity of a great variety of materials, including iron, steel, brass, muntz metal, aluminium, bronze and New South Wales timbers. It was devised by Mr. P. V. Appleby and was sent to me by Prof. Kennedy. It consists of a lever by means of which the elongations in the test specimen are multiplied from 100 to 200 times according to the degree of accuracy desired. These extensions are measured between two small holes in the test piece which in metal specimens are usually 10 inches apart. Two steel points fit into these holes, one of which is fixed and the other moveable by the stretching of the specimen. The whole apparatus is slung on the test piece and is totally unaffected by its motions as a whole, and of course by any change of form in the frame of the machine. The instrument as you see requires delicate handling, but it possesses the advantage of being easily calibrated and checked from time to time on vernier callipers, such as the ones exhibited. There are many methods of measuring minute elongations, but the present apparatus commends itself from its simplicity.

I am also indebted to Prof. Kennedy for the beautiful piece of apparatus which I am able to show you this evening which is called an Autographic Stress-strain apparatus as it draws a diagram which shows clearly the strain produced by stresses which vary from 0 to that required to break the bar. The form of the diagram for a piece of mild steel is somewhat as sketched upon the board, but which is more correctly represented by the photographs lying upon the table. It will be observed, that the extension produced by a given load is represented as an abscissa, while the load itself is represented as a curved ordinate. The diagram represents the behaviour of the specimen during the test, in the first place the application of the load from zero to 14·44 tons per square inch produced an extension which was proportional to the stress producing it. This point is therefore termed the limit of elasticity as between 0 and 14·44 tons the material is perfectly elastic. But for stresses exceeding this amount a considerable change takes place in the diagram, the extensions are proportionately greater, and at 16·65 tons per square inch there is a drop in the curve showing a sudden yield in the specimen. The further application of load causes the material to draw out until at 25·38 tons per square inch the specimen fractures.

The curve not only indicates the limit of elasticity, yield point, breaking load, and the amount of extension which occurs at these points, but it is seen by inspection that the local extension which occurs at the breaking point is measured by drawing ordinates at the commencement and termination of the curve drawn during the time the specimen is undergoing local extension. Again the area of the diagram represents the gross mechanical value of the material as it represents the work done in breaking the bar, which of course depends upon its breaking strength and ductility. Like the apparatus for measuring small extensions it is obvious that it should be handled carefully.

The principle of the apparatus is as follows: the test piece is placed in the machine with a stronger bar, which is called a spring piece, the material of this bar must be ascertained by previous experiments, to be perfectly elastic, so that its extensions are strictly proportional to the pull, and therefore to the pull on the test piece, and moreover it should be of such an area that its limit of elasticity occurs only at a load greater than that which will break the test piece. By a simple arrangement, a very light pointer is made to swing about an axis through an angle proportionate to the extension of the spring piece and proportional therefore to the pull on the test bar. The end of this pointer in its motion always touches a piece of smoked glass, to which is given a travel in its own plane proportional to the extension of the test piece. In this way the diagram is drawn. After the test, the glass is varnished to fix the black and the necessary particulars about the test are written on it with a scriber. The glass is then used as a negative and copies produced by photography.

The thanks of the Society were conveyed to Prof. Warren for his interesting and instructive exhibit.

Nineteen members were present.

Donations Received during the Month of June, 1887.

(The Names of the Donors are in *Italics.*)

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NOTES ON SOME INCLUSIONS OBSERVED IN A SPECIMEN OF QUEENSLAND OPAL.

By D. A. Porter, Esq., Tamworth.

[*Read before the Royal Society of N.S.W., 3 August, 1887.*]

Recently while examining a specimen of "Opal-matrix" from Queensland (exact locality not known) I noticed several included vegetable remains, apparently portions of the stems of aquatic plants. As there is no record, so far as I am aware, of such having been before observed in Opal, perhaps a few observations on the specimen above referred to may not be without interest. This stony material (matrix) is of a rich chestnut-brown colour, and quite opaque, except where cavities have existed and have since become filled with Opal. These portions are translucent and of rich purple, blue and green colours. Many of the opal segregations are cylindrical in form, and penetrate the specimen in various directions. Cross sections of these cylindric deposits show that the places now containing the opal, were (in some instances at least) originally formed by embedded stems or other portions of plants. In many cases portions of the vegetable tissue remain, completely incased in and preserved by the silicious matter. The structure of the air cells in the remains is easily seen with an ordinary good pocket magnifier. The accompanying figures 1, 2, 3, 4, are good representations of four of the inclusions observed. The figures are however very much enlarged, Nos. 1 and 2 about 10 diameters, and 3 and 4 about 40 diameters. I made an attempt to cut a section, but failed through the brittleness of the stone, and my want of experience in manipulation.

Should it be found that the opal bearing rocks of Queensland contain any large quantities of the remains of plants, it would seem to indicate the probability of the opal silica—in that particular locality at least—having been gathered from the soil in the first instance by plant life. Silica in the hydrated form being, as we know, taken up in no small quantities (comparatively) by certain plants, and in some instances in greater quantities than the plant is capable of using up; as an instance I may mention the "Tabasheer" of the Bamboo, a jelly-like substance, which is found in the joints of some species of that plant, and which is composed of over 80 per cent. of hydrous silica. Our coal beds also give upon analysis a mean return of about 3 per cent. for silica contained therein. Organic silica is yet again found in considerable quantities in several places, as diatomaceous earth. Thus to me it does not seem improbable that in many instances the opals may have been formed by the solution and re-solidification of the skeletons of diatoms and of the silicious coatings and segregations of plants higher in the scale than the diatomaceæ.

SOME NEW SOUTH WALES TAN-SUBSTANCES.

Part II.

By J. H. Maiden, F.R.G.S.

[*Read before the Royal Society of N.S.W., August 3, 1887.*]

Notes—(First Supplement).

1. Only that vernacular name which a tree bears in the locality from which the bark &c. has been obtained, is, and has been given in each case. That is to say, the practice of giving a list of vernacular names used in different places (in exceptional cases amounting to a dozen or more) has not been followed.

2. Botanical names are the same in the "Flora Australiensis," and "Census of Australian Plants," (Mueller) unless the contrary is indicated.

3. The diameters of trees are taken at a height of three feet from the ground.

4. The results afforded by the few Eucalypts (taken almost at random) which have now been examined, prove that the barks of this genus are worthy of earnest consideration by the tanner. These barks should be made to yield their tannin in the form of extract. Where trees have to be felled and burnt, the bark can be removed, and boiled down in water kept heated by the burning of the tree which yields the bark. The only cost would be the work of supervision. The extract could be sent to market or exported in kerosene tins, which are usually abundant enough. These should of course be soldered down.

5. The desirability of looking farther afield for fresh tan-substances is illustrated by the scarcity of good wattle barks. The bark of *Acacia decurrens* is the great stand-by of tanners in New South Wales, Victoria, and Tasmania, but I can show barks so similar in appearance as to deceive an expert, and the difficulty is of course immensely increased when the bark is chopped and powdered. In the latter case, barks of wattles next to worthless for tanning purposes are added to increase the bulk.

6. For reference, I give percentages of tannin of the following renowned tan-substances of the Old and New Worlds:—

Oak bark	8 to 13
Hemlock bark (*Abies canadensis*)	10 to 12

7. In the report of the Board of Enquiry on Wattle Bark, appointed by the Victorian Government (1878), allusion is made to the character of the soil on which the wattle trees grow. It is shown that (as far as the experiments go) limestone country produces wattles comparatively weak in tannin. The subject is interesting, and should be followed up. I have therefore put the geological formation in each case.

8. The tabular form for the presentation of qualitative results has been adopted for two reasons. Firstly, unnecessary repetition of the names of re-agents &c., is avoided, and secondly, the work of comparing the various barks will be greatly facilitated.

9. Mr. W. Bauerlen has collected the material from the Southern and Mr. K. H. Bennett from the Western Districts. Mr. H. G. Smith has afforded me much assistance during the progress of my work.*

14. ANGOPHORA INTERMEDIA, *DC.*, N.O. Myrtaceæ, B. Fl. iii., 184.

Found in Victoria, New South Wales and Queensland.

Vernacular Name—"Apple-tree" (in common with other species of the same genus).

Locality whence this particular specimen was obtained—Colombo, near Candelo, N.S.W.

Geological Formation—Granite.

Part of Tree Examined—Kino.

Particulars of the trees whence it was obtained—Height 30 to 50 feet, diameter 2 to 4 feet.

Collected 30th June, 1887. Analysed 13th to 22nd July, 1887.

A kino of a reddish-brown colour, and of a brittle nature. From this circumstance, the small masses in which it is obtained speedily lose their bright fresh appearance. It forms a dull-looking powder.

Extract.—Dissolves in water at 100° C. to the extent of 90·7 per cent., leaving a residue of a yellow-ochre colour. The solution becomes turbid on standing. On again raising the temperature, the suspended matter gradually aggregates, until, when the boiling point is reached, it collects into a few large flocculent masses, which eventually re-dissolve in the boiling liquid, though with difficulty.

* These series of notes, as also the qualitative ones, are jotted down as they occur to me, and, except a particular reference is made, are intended to apply generally to the substances referred to in the papers.

Kino-tannic acid—46·95 per cent.

NOTE.—Mr. Kirton states that a single tree of this species will yield as much as two gallons of liquid kino.

15. EUCALYPTUS MACRORRHYNCHA, *F.v.M.*, N.O. Myrtaceæ, B. Fl. iii., 207.
Figure Dec. 1 of Baron Mueller's "Eucalyptographia."
Found chiefly in Victoria, but also in Southern New South Wales.
Vernacular Name—"Stringybark." The wood is used for fencing and wheelwrights' work locally.
Locality whence this particular specimen was obtained—Amboyne, Delegate, 22 miles from Bombala, N.S.W.
Geological Formation—Limestone.
Part of the Tree Examined—Kino.
Particulars of the trees whence it was obtained—Height 80 to 100 feet, diameter 2 to 4 feet.
Collected 25th May, 1887. Analysed 4th to 18th July, 1887.

Kino of a rich ruby colour. It is readily friable, and for this reason usually appears of a dull colour, unless it has been very little handled. It reminds one somewhat of some specimens of seed lac. It appears only to differ from *E. hæmastoma* kino in its greater friability. The samples taken for analysis have been freed from woody matter, as far as possible, by hand-picking.

Extract.—Dissolves in water at 100° C. to the extent of 97·54 per cent., leaving 2·46 per cent. of a dark garnet-coloured resin.*
Kino-tannic acid—78·72 per cent.

16. EUCALYPTUS HÆMASTOMA, *Smith, var.*, N.O. Myrtaceæ, B. Fl. iii., 212.
Figure Decade ii., of Baron Mueller's "Eucalyptographia."
Found from Eastern Gippsland through Eastern New South Wales to the littoral portion of Central Queensland.
Vernacular Name—"Rough or Small-leaved Stringybark." This is the variety with persistent stringy bark. It also differs in the leaves and kino from the *E. hæmastoma* found further north. The wood is used for slabs and fencing purposes about Colombo (Candelo).

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* I am not dealing with these insoluble residues in this series of papers, preferring to keep closely to my subject. I hope, however, to report on these substances later on.

Locality whence this particular specimen was obtained—Colombo, near Candelo, N.S.W.
Geological Formation—Granite.
Part of the Tree Examined—Kino.
Particulars of the trees whence it was obtained—Height 40 to 60 feet, diameter 2 feet.
Collected 24th December, 1886. Analysed 4th to 15th July, 1887.

This kino is of a rich ruby colour. When freshly exuded it is of a clear light ruby colour, becoming more or less opaque, and of a Vandyke-brown colour, if it remains sufficiently long on the trees. It is clean to handle, powders fairly readily, forming a light purplish-brown powder. The resemblance to the kino of *E. macrorrhyncha* is most marked when they are both in powder. This kino has been freed, as far as possible, from woody fibre by hand-picking.

Extract.—95·53 per cent. of this kino is soluble in water at 100° C., leaving 4·47 per cent. of residue, chiefly consisting of a dark coloured resinous substance.

Kino-tannic acid—54·12 per cent.*

17. Eucalyptus rostrata, *Schlecht.*, N.O. Myrtaceæ, B. Fl. iii., 240.
Figure, Decade iv., of Baron Mueller's "Eucalyptographia."
Found in all the Colonies.
Vernacular Name—"Red Gum," (the "Red Gum" *par excellence*, and so called from the colour of the wood).
Locality whence these particular specimens were obtained—Colombo, near Candelo, N.S.W.
Geological Formation—Granite.
Part of the Tree Examined—Insect galls from saplings, causing the abortion of leaf-buds and flower-buds. None of these are the ordinary leaf-galls, in which cases the leaf-tissue is more or less developed.
Collected 28th June, 1887. Analysed 13th to 23rd July, 1887.

These galls are more or less perforate, the perfect insect having in most cases taken its departure. They are all more or less weather-worn and pulverulent. The colour is from yellowish to a dirty yellowish-brown. Average diameter about ½ inch. Owing

* In the Catalogue of Queensland Woods Exhibited at the Colonial and Indian Exhibition, 1886, this kino is said to yield 64·51 per cent. of tannin but no particulars in regard to it are given.

to the lengthened period they have been on the trees, they contain but a small proportion of essential oil.

Extract.—Dissolve in water at 100° C. to the extent of 70·22 per cent., leaving 29·78 per cent., of residue of an umber colour. The colour of the extract is the same as that of *A. decurrens*, with an olive shade added. I would direct attention to the great difficulty of removing the last portions of extractive matter from these galls, by means of boiling water—a period of from three to five days being necessary for the purpose.

Kino-tannic acid—43·4 per cent.

18. Eucalyptus Gunnii, *Hooker, fil. var.*, N.O. Myrtaceæ, B. Fl. iii., 246.

Figure, Decade iv., of Baron Mueller's "Eucalyptographia."

Found chiefly in Tasmania, but also in Eastern Victoria, and in New South Wales, as far as Berrima. Always found in more or less damp situations.

Vernacular Name (of this variety)—"Flooded Gum," or "Bastard Gum." Timber brittle, not used.

Locality whence this particular specimen was obtained—Delegate, near Bombala, N.S.W.

Geological Formation—Mudstone (Silurian).

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—Height 60 to 80 feet, diameter 2 to 3 feet.

Collected 8th May, 1887. Analysed 5th to 18th July, 1887.

A dark grey or nearly black, deeply fissured bark. Portions of the outer bark are almost as hard as those of some Ironbarks, others, however, are flaky and friable. Inner bark or bast thick but short and brittle, therefore useless as a fibre. Average thickness of bark $\frac{3}{4}$ inch. This bark is remarkable for the essential oil it contains, which causes it to be exceedingly fragrant. It forms a dull light-brown powder. Colour of residue (after treatment with water to extract soluble portion), light brown. The solution has a whitish appearance, owing to the presence of essential oil in a fine state of division.

Extract.—19·4 per cent. to water at 100° C.

Kino-tannic acid—9·45 per cent.*

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* Baron Mueller gives (Decade iv., "Eucalyptographia.") 3·44 per cent. of tannin for *E. Gunnii* bark, as the result of "a solitary experiment." My lowest percentage with the Delegate variety was 9·44 per cent., with the Bombala variety 11·2. These analyses are all reconcileable doubtless, and afford another instance of the necessity for full particulars to accompany tan-analyses.

19. Eucalyptus Gunnii, *Hooker, fil. var.* [For particulars as to Natural Order &c., see *E. Gunnii* (Delegate variety).]

Vernacular Name (of this variety)—" Red Gum." Timber considered by most people in the neighbourhood to be the very best for standing under ground, and therefore preferred to any other for posts and piles, and especially for house-blocks. It is also used for fencing, slabs, &c.

Locality whence this particular specimen was obtained—Bombala, N.S.W.

Geological Formation—Granite.

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—Height 80 to 100 feet, diameter 3 to 4 feet.

Collected 6th January, 1887. Analysed 13th to 23rd July, 1887.

There are several differences between the two varieties of *E. Gunnii* which have yielded the barks examined in this paper. The variety from Delegate occurs near creeks and swampy places, the trunk is apt to branch out at no great altitude from the ground, and the timber is universally condemned as entirely useless for technical purposes; it is soft, brittle, and lighter in colour than the variety from Bombala. The latter variety grows in higher and drier situations, has a pretty straight trunk; the timber is rather hard to cut, and of a reddish colour. There is great diversity of opinion as to the value of this timber; while some consider it one of the most durable timbers to stand in the ground, others consider it of no use. It may be that some of those people who consider it one of the best timbers to stand in the ground confuse it with the Red Gum *(E. rostrata)* of the coast country. The bark now under examination is less deeply fissured than that from Delegate, and the fibre is more curled and interlocked. Both barks possess the odour of essential oil,—a most unusual circumstance for Eucalypt barks. This bark gives a solution of a much deeper colour (reddish-brown), than does the variety from Delegate. Colour of residue, dark brown.

Extract.—Soluble in water at 100° C. 20·84 per cent.

Kino-tannic acid—11·35 per cent.

20. Acacia colletioides, *A. Cunn., var.*,* N.O. Leguminosæ, B. Fl. ii., 325. Figure, Dec. i., " Iconography of Australian Acacias," (Mueller).

Found in New South Wales, Victoria, South Australia, and recently, in Western Australia.

* This variety only differs from the normal form in the flower-heads not being strictly globular.

Vernacular Name—"Wait-a-while," (a low-spreading bush, which has been suggested as suitable for hedge planting. The vernacular name is a delicate allusion to the predicament of a traveller desirous of penetrating a belt of it.)

Locality whence this particular specimen was obtained—Ivanhoe, viâ Hay, N.S.W.

Part of the Tree Examined—Bark.

Particulars of the trees (shrubs) whence it was obtained—Height, a few feet; diameter 3 to 4 inches.

Collected 2nd October, 1886. Analysed 5th to 23rd July, 1887.

Bark from a very old tree. Yields abundance of a light-coloured fibre. The description of the bark of *A. rigens* will apply here, with the following differences. Average thickness of bark $\frac{1}{4}$ inch. Colour lighter and of a yellowish tint. Yields a brightish yellow powder admixed with a few brown particles. Affords a pale yellow-coloured solution. This circumstance, in the case of a Wattle would of course pronounce it obviously worthless for tanning purposes.

Extract.—Dissolves in water at 100° C. to the extent of 10·56 per cent.

Catechu-tannic acid—4·4 per cent.

21. Acacia rigens, *A. Cunn*, N.O. Leguminosæ, B. Fl. ii., 337. Figure, Dec. ii., of Baron Mueller's "Iconography of Australian Acacias."

Found in South Australia, Victoria and New South Wales, chiefly in arid country.

Vernacular Names—"Nealie" or "Needle-bush."

Locality whence this particular specimen was obtained—Ivanhoe, viâ Hay, N.S.W. Very plentiful in some places.

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—Height 12 to 15 feet, diameter 6 to 8 inches.

Collected 6th September, 1886. Analysed 5th to 20th July, 1887.

This bark is obviously from a very old tree, and consists almost entirely of fibre, the whole bark separating with the slightest effort into ribbons of coarse tying material. It is deeply fissured, and the prevailing colour of the outside is a dirty grey. The bark possesses so little coherence that an exact determination of its thickness would be extremely difficult; its average thickness may be set down at $\frac{1}{2}$ inch. When finely divided it has the appearance of chopped hay, interspersed with reddish-brown particles.

Extract.—Soluble in water at 100° C. to the extract of 19·05 per cent.

Catechu-tannic acid—6·26 per cent.

22. ACACIA VESTITA, *Ker.*, N.O. Leguminosæ, B. Fl. ii., 375.

Found in the Southern portion of New South Wales, and recently in Northern Victoria.

I know of no vernacular name for this Wattle.

Locality whence this particular specimen was obtained—Quiedong, near Bombala, N.S.W.

Geological Formation—Limestone.

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—Height 20 to 25 feet, diameter 10 to 18 inches.

Collected 9th April, 1887. Analysed 5th to 13th July, 1887.

Very similar in appearance to the well-known bark of *A. decurrens*, being only a little lighter in colour, and having the inner bark redder. Average thickness ¼ inch. Affords a flesh-coloured powder. Forms a solution of an exceedingly rich, deep red colour. The extract contains so great a quantity of colouring matter as to clog the filter-paper during the operation of filtering, making this one of the most tedious of Acacias to subject to that operation.

Extract.—Soluble in water at 100° C., 50·82 per cent.

Catechu-tannic acid—27·96 per cent.

23. ACACIA PENDULA, *A. Cunn.*, *var. glabrata*, *F.v.M.*, N. O. Leguminosæ, B Fl. ii., 383.

Found in New South Wales and Queensland.

Vernacular Name—"Yarran."

Locality whence this particular specimen was obtained—Ivanhoe, viâ Hay, N.S.W. Plentiful.

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—Height 10 to 15 feet, diameter 3 to 4 inches.

Collected 25th Sept., 1886. Analysed 5th to 23rd July, 1887.

A moderately deeply fissured bark from rather an old tree. Contains abundance of a poor fibre. Colour dark grey. Average thickness ⅓ inch. Does not form a self-coloured powder as it is composed of nearly all tints from yellow to dark brown.

Extract.—Dissolves to the extent of 17·91 per cent in water at 100° C.

Catechu-tannic acid 7·15 per cent.

24. Acacia binervata, *DC.*, N.O. Leguminosæ, B. Fl. ii., 390.
Found in New South Wales and Queensland.
Vernacular Name—"Black Wattle."
Locality whence this particular specimen was obtained—Cambewarra, (between Moss Vale and Shoalhaven) N.S.W.
Geological Formation—Sandstone.
Part of the Tree Examined—Bark.
Particulars of the trees whence it was obtained—Height 25 to 30 feet, diameter 1 foot.
Collected 10th August, 1886. Analysed 12th to 23rd July, 1887.

Colour of bark dark brown to black, but apparently deepened in tint through a bush fire having affected it slightly at some remote period. Inner bark warm red-brown. Outer bark deeply fissured or flaky, (usually the latter, which makes it more or less pulverulent). Inner bark contains abundance of strong fibre. The bark becomes exceedingly hard when dry. Average thickness $\frac{1}{4}$ inch.

Extract.—Dissolves in water at 100° C. to the extent of 58·03 per cent.

Catechu-tannic acid—30·4 per cent.

Note.—"Bark not so rich as that of *A. decurrens.*" (W. Dovegrove, quoted by Baron Mueller). Nevertheless it is a most valuable bark, and presses *A. decurrens* hard for the premier position in point of yield of tannin.

25. Acacia longifolia, *Willd.*, N.O. Leguminosæ, B. Fl. ii., 397.
Found in all the Colonies except Western Australia.
Vernacular Name—"Golden Wattle."
Locality whence this particular specimen was obtained—Cambewarra, (between Moss Vale and Shoalhaven) N.S.W.
Geological Formation—Sandstone.
Part of the Tree Examined—Bark.
Particulars of the trees whence it was obtained—Height 12 to 15 feet, diameter 4 to 6 inches.
Collected 20th August, 1886. Analysed 13th to 23rd July, 1887.

Colour of bark varies from a dark grey (with light grey or whitish patches) to dirty brown or nearly black. Usually almost smooth, but those portions of the bark deepest in colour are generally more or less furrowed, though never deeply so. Thickness from one-sixteenth of an inch to one line. Full of fibre of an average tenacity (for Acacias). Inner bark warm brown.

Extract.—Dissolves in water at 100° C. to the extent of 30·35 per cent. Solution becomes turbid on cooling.

Catechu-tannic acid—18·93 per cent.

NOTES.—The only allusions to analyses of this bark that I can find are, "The bark of *A. longifolia* is only half as good as that of *A. decurrens.*" (Mueller.)

"It yields 12·67 per cent. of tannin." (Catalogue of Queensland Timbers, Colonial and Indian Exhibition, 1886).

The much-branching variety *Sophoræ* (=*A. Sophoræ*, Labill.) is frequently found on the coast and is very useful for binding sea sand. A convenient Sydney locality for good specimens is Lady Robinson's Beach.

26. ACACIA GLAUCESCENS, *Willd.*, N.O. Leguminosæ, B. Fl. ii., 406.
Found in New South Wales and Queensland, and recently in Victoria.
Vernacular Name—"Myall," (this name is of course shared by other species).
Locality whence this particular specimen was obtained—Quiedong, near Bombala, N.S.W.
Geological Formation—Limestone.
Part of the Tree Examined—Bark.
Particulars of the trees whence it was obtained—Height 20 to 25 feet, diameter 6 to 12 inches.
Collected 8th April, 1887. Analysed 5th to 23rd July, 1887.

A deeply fissured bark of a dark grey colour. Inner bark bright reddish-brown. Contains abundance of a light coloured tough bast, which would serve excellently as a coarse tying material for local use. Average thickness $\frac{1}{3}$ inch. Powder very like that of *A. rigens*, but a little brighter in colour (perhaps accounted for by its more recent collection).

Extract.—Soluble in water at 100° C. to the extent of 14·29 per cent.

Catechu-tannic acid—8·10 per cent.

27. ACACIA DEALBATA, *Link.*, B. Fl. ii., 415. *A. dealbata*, Link, Baron Mueller's Census, p. 47. *A. decurrens*, Willd., var. *dealbata*, F.v.M., Mueller's "Select Extra-tropical Plants," N.S.W. Edition.

Found in all the colonies except Western Australia. *A. dealbata* having recently been found in Queensland, it has approximately the same geographical range as *A. decurrens.* These two species are so closely allied that it is only within the last three or four years that Baron Mueller has conceded specific rank to *A. dealbata.* This similarity does not extend to the barks, in the learned Baron's opinion, for he says, (Select Extra-tropical Plants,) "The bark of this variety *(dealbata)* is much thinner and greatly inferior to the Black Wattle *(A. decurrens,* and var. *mollissima* presumably) in quality, yielding only about half the quantity of tanning principle." This can only allude to the higher percentages of tannin obtained by the Baron for *A. decurrens,* for as the result of perhaps 30 analyses of the barks of *A. dealbata* and *A. decurrens,* made by me, I find not such a great disparity between them. The matter can scarcely be settled until the barks of two trees of the two species similar in every respect, and treated in precisely the same manner shall have been analysed.

It may be convenient to give the following comparison of the barks (as far as they are represented in the Technological Museum), since their botanical affinities are so close :

A. decurrens	*A. dealbata.*
1. Smooth, or with very slight longitudinal flutings.	1. Furrowed, flaky, and rugged looking.
2. Thickness about half that of *A. dealbata.*	
	3. Yields a purplish extract to water, much more intense than that of *A. decurrens.* The residue is exceedingly like spent logwood in appearance.

These particulars must of course be compared in connection with the information given in this paper in regard to the tree whence the bark of *A. dealbata* was obtained, and in the paper for June in regard to *A. decurrens.*

Vernacular Name—"Silver Wattle."

Locality whence this particular specimen was obtained—Quiedong, near Bombala, N.S.W.

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—Height 20 to 30 feet, diameter 12 to 18 inches.

Collected 1st March, 1887. Analysed 5th to 23rd July, 1887.

A very rugged bark, both from longitudinal and transverse fissures. Colour dark grey to black. Inner bark tough and of a reddish-brown colour. Average thickness of bark barely $\frac{1}{4}$ inch. Yields a dark reddish-brown powder.

Extract.—Soluble in water at 100° C. to the extent of 29·86 per cent.

Catechu-tannic acid—21·22 per cent.

28. ACACIA DECURRENS, *Willd.**

Vernacular Name—"Green Wattle."

Locality whence this particular specimen was obtained—Ryde, Parramatta River, Sydney, N.S.W.

Geological Formation—Sandstone.

Part of the Tree Examined—Bark.

Particulars of the tree whence it was obtained—Height 15 feet, diameter 3 to 4 inches.

Collected 29th May, 1887. Analysed 5th to 18th July, 1887.

Extract.—Dissolves in water at 100° C. to the extent of 48·74 per cent.

In the report of the Board of Enquiry on Wattle Bark, appointed by the Victorian Government, (Melbourne, 1878) the following percentages of extract are given for *A. decurrens* bark grown in different localities :—29, 34, 40 and 45.

Catechu-tannic acid—

The bark now under examination yields 32·33 per cent., and is more than ordinarily uniform in quality.

Notes on A. decurrens.—The variety growing about Sydney is *A. decurrens* var. *normalis*, Benth. The Victorian and Tasmanian variety is *A. decurrens* var. *mollis*, Lindl., or *mollissima*, and corresponds to *A. mollissima*, Willd., vide B. Fl. ii., 415. In the *Flora Australiensis* these varieties (and others which occur) are merged in the one species *A. decurrens*. Baron Mueller does not alter this arrangement in his Census. The Baron experimented on the bark of the *mollissima* variety, ("Select Extra-tropical Plants," N.S.W. Edition, page 3) and obtained "from 30 to 54 per cent. of tannin in bark artificially dried." In my experiments the variety *normalis* has been used, but the two varieties are so closely allied botanically that it is not likely that any great difference will be found to exist in the barks. In the Catalogue of Queensland Woods at the Colonial and Indian Exhibition the percentage of tannin in a (presumably) Queensland grown bark of *A. decurrens* is given at 15·08, but no further particulars are given. But it is a well-known fact that the tannin in this species diminishes as the climate grows warmer and drier.

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* See p. 33, Proc. R. S. (N.S.W.) 1887, for particulars of natural order, locality &c., of this species. The bark now experimented upon differs from the former specimen in being blacker on the outside, of a lighter colour inside, and in being slightly thicker.

Since the above was written, I observe that Baron Mueller has promoted the *mollissima* variety of *A. decurrens* to the rank of a species. (*The Chemist and Druggist of Australasia*, May 2nd, 1887). Speaking of the typical *A. decurrens*, the Baron points out that (within Victoria territory) it is limited to North-eastern regions; that the branchlets from the decurrence of the leaf-stalks are still more angular than those of *A. mollissima* and *A. dealbata;* the leaflets are conspicuously longer, and the flowering-time is different from either of the two; moreover, the bark is considered for tanning purposes not quite so powerful as that of *A. mollissima.*

29. Fusanus acuminatus, *R. Br.*, B. Fl. vi., 215. Syn. *Santalum acuminatum*, A. DC., p. 64, Mueller's Census. N. O. Santalaceæ.

Found in all the colonies except Tasmania, chiefly in rather dry country.

Vernacular Name—"Quandong." The uses of the timber, fruit, and seeds are well known.

Locality whence this particular specimen was obtained—Ivanhoe, viâ Hay, N.S.W.

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—Height 10 to 12 feet, diameter 4 to 6 inches. Plentiful.

Collected 4th October, 1886. Analysed 5th to 23rd July, 1887.

Bark from almost smooth to moderately fissured, having the fissures as much as $\frac{1}{8}$ inch deep in some cases. Both outer and inner bark more or less flaky, and contain but little fibre. Colour of outer bark light or dark grey, of inner bark brown or warm red-brown. Average thickness of bark barely $\frac{1}{4}$ inch. Yields a reddish-brown powder, and an especially rich colour to water.

Extract.—Soluble in water at 100° C. to the extent of 39·46 per cent.

Tannic acid (closely allied to, if not absolutely identical with catechu-tannic acid)—18·84 per cent.

Qualitative Tests—Notes (First Supplement.)

1. In the list of re-agents for the qualitative tests I have substituted the *acetate* for the *sulphate* of *manganese* (12), and *ammonium nitromolybdate* for *hydrodisodic phosphate* (15), as I did not consider the precipitates with the latter re-agent sufficiently characteristic. I have added *Zinc acetate* (17) to the list of re-agents.

2. I have doubts as to the value of Ammonium sulphide as a re-agent for tans, and may reject it in future experiments. In addition, Manganese acetate, Chrome alum, Mercuric chloride, and Potassium ferro-cyanide give, in most cases, but poor reactions, while Tartar Emetic and Ammonio nitro-molybdate are not much better. Still, as most of these re-agents have been suggested by various authorities, I have up to the present followed suit.

3. The other re-agents yield precipitates more or less readily, many of which are characteristic.

4. I look upon the colour-reaction given by a drop of strong sulphuric acid (Column 10) as the most valuable, for practical purposes, of all. By the colours obtained affinities are indicated, and thus a rough classification of tans is at once feasible. The rich wattle-barks give rose-madder colours, and all give shades of colour proportionate in depth of tint (caused by *quantity* of colour) to the percentage of tannin. I showed the tile on which these colour reactions had been performed, to an assistant who had not been engaged with me upon tans, and who was perfectly ignorant of the percentages of tannin I had found in the species of Acacia referred to in this paper. Nevertheless, with but one slight mistake, he at once arranged the eight Acacia colours in the same order of tannin-yield, which by gravimetric processes I had proved them to occupy. I cannot but think that we have here a simple and excellent comparative method for the practical tanner.

5. The tans now under examination range themselves in three groups—*a. Acacia vestita, dealbata, binervata,* (the two former are very closely allied) *b. A. pendula, glaucescens. c. Eucalyptus hæmastoma, macrorrhyncha.*

6. The reactions yielded by *Acacia colletioides* are more or less unsatisfactory, owing to the exceptional poverty of the bark.

7. The extract of *Acacia rigens* contains a little mucilage, and to this circumstance, doubtless, some of the abnormal reactions of this species are owing.

8. The two varieties of *Eucalyptus Gunnii* bark show a marked difference in their behaviour with dilute ferric chloride.

9. Precipitates sometimes only form on standing. It is therefore necessary to allow a period of not less than two hours to elapse before completing the examination of a precipitate. In all cases, it is to be assumed that there is no change on standing, unless the contrary is stated.

10. The colour reactions have been given with much care and detail, as the description of these organic precipitates is frequently not unattended with difficulty.

Species.	1 Reaction.	2 Boiled with equal volume of Sulphuric Acid: a—in the cold.	b—on boiling.
14. ANGOPHORA intermedia, DC. (Kino.)	Faintly acid	Light yellow ochre ppt, which rises to the top on standing.	Ppt for most part dissolves, what remains is of a pure orange colour.
15. EUCALYPTUS macrorrhyncha, F.v.M. (Kino.)	Distinctly acid	Copious dark salmon ppt.	Ppt re-dissolves with the exception of small reddish particles which aggregate and form a scum; the liquid returns to the rich ruby colour of the original extract.
16. EUCALYPTUS hæmastoma, Smith. (Kino.)	do.	Ppt of an almost pure salmon colour.	Ditto
17. EUCALYPTUS rostrata, Schlecht. (Leaf-galls.)	do.	Light olive-brown ppt.	Ppt darkens and almost entirely dissolves.
18. EUCALYPTUS Gunnii, Hook., var. (Bark from Delegate.)	do.	Yellowish cloudiness, ppt forms on standing.	Ppt becomes more dense, of an orange-brown colour.
19. EUCALYPTUS Gunnii, Hook., var. (Bark from Bombala.)	do.	Reddish cloudiness, ppt forms on standing	Ditto
20. ACACIA colletioides, A. Cunn., var. (Bark.)	Faintly acid	Cloudiness, slight flocculent ppt on standing.	Becomes almost colourless.
21. ACACIA rigens, A. Cunn. (Bark.)	do.	Flocculent brown ppt	No change.
22. ACACIA vestita, Ker. (Bark.)	Distinctly acid	Light reddish-brown ppt.	Darkens but does not dissolve ppt.
23. ACACIA pendula, A. Cunn., var. glabrata, F.v.M. (Bark.)	do.	Yellowish cloudiness becoming a little more dense on standing.	No change other than that of darkening slightly.
24. ACACIA binervata, DC. (Bark.)	do.	Dirty salmon ppt.	Nearly dissolves, and what remains turns a rich reddish-brown colour.
25. ACACIA longifolia, Willd. (Bark.)	do.	Ppt of a light yellow ochre colour, dense sage-green gelatinous ppt on standing.	Partially dissolves, and what remains becomes denser and of a deeper green colour.
26. ACACIA glaucescens, Willd. (Bark.)	do.	A small quantity of a light brownish ochre ppt, which becomes more copious on standing.	No change except a little darkening.
27. ACACIA dealbata, Link. (Bark.)	do.	Same as *A. vestita*, but perhaps a shade lighter.	Same as *A. vestita*.
28. ACACIA decurrens, Willd. See p. 33 for reactions not noted here.			
29. FUSANUS acuminatus, R. Br. (Bark.)	do.	Turbidity, slight ochrey brown ppt on standing.	Ppt entirely dissolves forming a rich reddish-brown liquid.

3 Bromine Water.	4 Dilute Feric Chloride.	4 Add Ammonia.	5 Baric Hydrate.
Light orange-brown ppt, almost sufficiently light to be a drab.	Dark bluish-black ppt with an indigo tint.	Deep purplish-brown ppt.	Dirty greyish-brown ppt.
Dense orange ppt, bordering on an ochre tint, with streaks or coagulated masses of a yellow colour which rise to the top like scum.	Purplish black ppt.	Ppt redissolves, and a dark brownish-purple liquid is formed.	Exceedingly dense purplish ppt.
Ppt a little lighter than that of *E. macrorryncha.*	Almost pure purple ppt.	Ppt redissolves, and a rich purple liquid is formed.	Ditto. but a little darker in colour.
No change.	Greenish-black ppt.	Slight brownish-purple ppt.	Dense dark brown ppt
Faint cloudiness, which increases on standing.	Greenish-black ppt.	Copious ppt of a dark purple colour.	Orange-brown ppt.
Ditto	Purplish coloured liquid, with only a trace of ppt.	No ppt, colour of liquid brownish-purple.	Ditto, except a little duller in colour.
Cloudiness, slight flocculent ppt on standing.	Slight dirty brown ppt, which increases on standing.	Becomes almost clear	No change; light brownish ppt on standing.
Yellowish gelatinous ppt which coagulates on standing.	Dark brown ppt.	Very dark brown ppt	Rich reddish-brown ppt.
Dirty light-brown ppt	Purple ppt.	Very slight brownish purple ppt.	A very dark greyish purple ppt.
Yellowish flocculent ppt.	Olive green ppt.	Ditto	Very slight light brown ppt which increases on standing.
Ppt like that yielded by *Angophora intermedia*, but slightly darker.	Dark purplish-brown ppt.	Brownish-purple ppt	Dirty dark greyish-purple ppt.
Bright yellow (chrome yellow) ppt.	Purplish-grey ppt.	Dark brown ppt.	Light orange-brown ppt.
Slight ppt of a dirty white colour.	Dirty olive-brown ppt.	Light brown ppt.	Orange brown ppt, something like *A. pendula.*
Ppt much like that yielded by *A. pendula* only a little darker, it becomes much more dense on standing.	Same as *A. vestita.*	Dark purple brown ppt.	Same as *A. vestita.*
Light orange-brown ppt which becomes much more dense on standing.	Brownish-black ppt.	Ppt redissolves and a rich ruby coloured liquid formed.	Rich purplish-brown ppt.

QUALITATIVE TESTS, (Dilute Extract)—*continued.*

Species.	6 Ammonium Sulphide.	7 Potassic Dichromate.	8 Tartar Emetic.
14. ANGOPHORA intermedia, DC. (Kino.)	Turbidity.	Very dark-brown ppt	Very slight light-brown ppt
15. EUCALYPTUS macrorrhyncha, F.v.M. (Kino.)	No change.	A brown gelatinous mass with a slight yellowish tinge; the tube can be inverted without disturbing its contents.	Turbidity; a considerable purplish gelatinous ppt on standing
16. EUCALYPTUS hæmastoma, Smith. (Kino.)	ditto	ditto	ditto
17. EUCALYPTUS rostrata, Schlecht. (Leaf-galls.)	Turbidity	Slight orange-brown ppt	No change
18. EUCALYPTUS Gunnii, Hook., var. (Bark from Delegate.)	ditto	Very slight brownish ppt, which increases on standing	ditto
19. EUCALYPTUS Gunni, Hook., var. (Bark from Bombala.)	ditto	ditto	ditto
20. ACACIA colletioides, A. Cunn., var. (Bark.)	ditto	No change	ditto
21. ACACIA rigens, A. Cunn. (Bark.)	ditto	Cloudiness; slight brownish ppt on standing	No change other than separating into two layers, a brownish and a colourlesss one, the line of demarcation disappearing on standing
22. ACACIA vestita, Ker. (Bark.)	ditto	Chicory coloured ppt on standing	No change
23. ACACIA pendula, A. Cunn., var. glabrata, F.v.M. (Bark.)	ditto	Like *A. vestita*, but a little darker in colour	ditto
24. ACACIA binervata, DC. (Bark.)	ditto	Same as *A. vestita*	ditto
25. ACACIA longifolia, Willd. (Bark.)	ditto	Brown ppt	ditto
26. ACACIA glaucescens, Willd. (Bark.)	ditto	Very slight brownish ppt, which increases on standing	ditto
27. ACACIA dealbata, Link. (Bark.)	ditto	Same as *A. vestita*	ditto
28. ACACIA decurrens, Willd. See p. 33 for rèactions not noted here.			
29. FUSANUS acuminatus, R. Br. (Bark.)	No change	Purplish-brown ppt	ditto

QUALITATIVE TESTS, (Dilute Extract)—*continued.*

	9		10
Add Ammonic Chloride	Copper Sulpate.	Add Ammonia.	One drop of strong sulphuric acid to one drop of extract on a white glazed tile.
Ppt rendered paler in colour and more copious	Dirty ochre brown ppt	Dark brown ppt	Yellowish brown colour
Dense dirty salmon ppt	No change, dirty brown ppt on standing	Brownish-black ppt	Reddish-brown color
Ppt a shade darker than *E. macrorrhyncha*	ditto	ditto	ditto
Olive green ppt	Light olive-brown ppt on standing	Dark olive-brown ppt	Pure yellow colour
Slight turbidity; forms a yellowish ppt on standing	Turbidity; slight brownish ppt on standing	Light brown ppt	Light yellowish-brown colour
ditto	ditto	ditto	Light reddish-brown colour
No change	No change; slight light brown ppt on standing	No change	Slight brownish colour
Reddish-brown ppt	Dense brown ppt	Dark-brown ppt	Same as *E. Gunnii*, (Bombala)
Dark salmon ppt	Pure purple brown ppt	Purple brown ppt	Rose-madder colour, fading to a brown on standing
Very slight turbidity copious light brown on standing	Turbidity	No change	Slightly darker than *E. Gunnii* (Delegate)
Salmon coloured ppt	Light purplish-brown ppt	Same as *A. vestita*	Same as *A. vestita*
No change, copious flesh coloured ppt on standing	Dirty flesh-coloured ppt	Pure dark brown ppt	Brown colour
No change, orange-brown ppt on standing	No change; slight light-brown ppt on standing	Lightish-brown ppt	Same as *A. pendula*
Same as *A. vestita*	Same as *A. vestita*, but perhaps a shade lighter	Same as *A. vestita*	Same as *A. vestita*
No change, abundant bright reddish-brown ppt on standing	Turbidity	No change	Burnt Sienna colour

QUALITATIVE TESTS, (Dilute Extract)—*continued.*

Species.	11 Lead Nitrate.	12 Manganese Acetate.	13 Chrome Alum.
14. ANGOPHORA intermedia, DC. (Kino.)	Drab ppt	Dirty drab ppt	Turbidity; faint light brown colour on standing
15. EUCALYPTUS macrorrhyncha, F.v.M. (Kino.)	Light reddish brown ppt inclining to salmon	No change; slight dark brown gelatinous ppt on standing	No change; turbidity on standing
16. EUCALYPTUS hæmastoma, Smith. (Kino.)	ditto	ditto	ditto
17. EUCALYPTUS rostrata, Schlecht. (Leaf-galls.)	Light olive-brown ppt	Copious olive-brown ppt	Slight olive-brown ppt
18. EUCALYPTUS Gunnii, Hook., var. (Bark from Delegate.)	Slight light-brown ppt	Slight ppt of an ochrey brown colour	Turbidity; slight ppt on standing
19. EUCALYPTUS Gunnii, Hook., var. (Bark from Bombala.)	ditto	ditto	No change; turbidity on standing
20. ACACIA colletioides, A. Cunn., var. (Bark.)	Turbidity	No change; slight ppt on standing	ditto
21. ACACIA rigens, A. Cunn. (Bark.)	Orange brown ppt	No change; slight reddish-brown ppt on standing	Slight reddish-brown ppt
22. ACACIA vestita, Ker. (Bark.)	Very dark purplish-pink ppt	No change; slight pink-brown ppt on standing	Very slight purplish ppt
23. ACACIA pendula, A. Cunn., var. glabrata, F.v.M. (Bark.)	Ppt lighter in colour than *A. rigens*	No change; slight ppt on standing	No change
24. ACACIA binervata, DC. (Bark.)	Brownish-pink ppt	Same as *A. vestita*	Turbidity
25. ACACIA longifolia, Willd. (Bark.)	Same as *Angophora intermedia* but perhaps a shade lighter	No change; slight Sienna brown ppt on standing	No change; turbidity on standing
26. ACACIA glaucescens, Willd. (Bark.)	Brownish light-drab ppt	No change; slight brownish ppt on standing	No change
27. ACACIA dealbata, Link. (Bark.)	Same as *A. vestita*	Same as *A. vestita*	Same as *A. vestita*
28. ACACIA decurrens, Willd. See p. 33 for reactions not noted here.		No change; purplish ppt on standing	
29. FUSANUS acuminatus, R. Br. (Bark.)	Warm Sienna brown ppt	No change; slight reddish-brown ppt on standing	No change; turbidity on standing

QUALITATIVE TESTS, (Dilute Extract)—*continued.*

14 Mercuric Chloride.	15 Ammoniun Molybdate in Nitric Acid.	16 Potassium ferrocyanide	17 Zinc Acetate.
Abundant yellow ochre ppt	Darkens liquid	Slight whitish-brown ppt which increases on standing	Dense café au lait ppt
ditto	ditto	No change; slight purplish-brown ppt on standing	Dense purplish-grey gelatinous ppt
Abundant dark salmon ppt	ditto	ditto	ditto
No change	ditto	No change; liquid becomes turbid on standing	Olive-brown ppt
ditto	ditto	No change, orange ppt on standing	Slight yellowish-white ppt
ditto	ditto	Marked turbidity; slight purplish-white ppt on standing	Light brown ppt
Cloudiness	ditto	No change	Turbidity; yellowish flocculent ppt on standing
No change	ditto	No change other than the formation of two layers, a light and a darker one; on standing there forms a slight orange-brown ppt, uniformly distributed	Dark reddish-brown ppt, forming an upper layer in the test-tube
Turbidity	ditto	Slight turbidity; pure purplish-brown ppt on standing	Abundant light purple ppt
Slight turbidity	ditto	No change, cloudiness on standing	Same as *A. rigens*, but without the tendency to separate into layers
Turbidity	ditto	Slight turbidity; light purplish-brown ppt on standing	Ppt little lighter than that yielded by *A. vestita*
ditto	ditto	No change; dirty drab ppt on standing	Whitish-brown ppt
No change	ditto	No change; faint cloudiness on standing	Ppt a shade lighter than *A. pendula*
Turbidity	ditto	Same as *A. vestita*	Same as *A. vestita*
			Ppt a little darker in colour than that of *E. macrorrhyncha*
ditto	ditto	No change; faint cloudiness on standing	Turbidity; orange-red granular ppt on standing

Discussion.

In reply to Mr. W. A. Dixon, Mr. Maiden stated that the samples treated by him were dried at a temperature of 100° C., and that some had taken several days to dry and were weighed from a desiccator. The percentages of tannin obtained by him instead of being higher than the calculations of anybody else were actually lower in some cases. Baron Von Mueller for instance gave in one case 54 per cent., for *Acacia decurrens*, while he (Mr. Maiden) had not been able to get within 22 per cent. of that. Unless the barks are dried at a constant temperature it was impossible to get satisfactory results, they would give one result in June and a different one in August.

In answer to questions of Mr. J. T. Wilshire, Mr. Maiden said that Limestone was the only formation which was known for certain to yield barks weak in tannin. (2) That the *Acacia vestita* which is so rich in tannin is comparatively rare in well settled districts. It is so handsome a tree that it is generally cut down very ruthlessly, but exists in some quantity in parts of Gippsland. (3.) That there was no chance of the dyes obtainable from the Eucalypts and Acacias ever rivalling in quality or price the aniline dyes.

The President in presenting the thanks of the Society to Mr. Maiden for his paper, intimated that very little importance could be placed on the geological formations in regard to the properties of the trees growing upon them, except in certain localities. So much depended on the climate and the elevation. Certain trees found growing for instance at Sydney in the sand, and at an elevation of 3,000 feet perhaps the same trees would be found growing in a clay soil. A southern aspect seems however, the most essential for their thorough growth, and some derive more moisture from gullies sloping in a southerly direction. In Sydney alone, many varieties of the Wattle would grow admirably and pay well to do so, and it is important that by researches such as these we should know what varieties can be most profitably grown.

THE INFLUENCE OF BUSH FIRES ON THE DISTRIBUTION OF SPECIES.

By Rev. R. Collie, F.L.S.

[*Read before the Royal Society of N.S.W., August 3, 1887.*]

Some time ago it was my privilege to spend three weeks in a part of the country very seldom visited, either by the public, or scientific traveller, and presenting nearly the same appearance as it did to Robert Brown when he was collecting his specimens in the beginning of the century. The scrub which covered a great part of the country was very dense, composed chiefly of ti-trees, banksias, and a few dwarf gums. The soil was a loose sandy one, with a few rocks cropping through in different parts to the surface; but in another part it was boggy, and in winter formed a swamp. A small creek ran through the scrub, the banks of which were covered with ferns, and various kinds of mosses. Not far from the creek a few years ago a bush fire broke out, and assumed rather alarming dimensions, forcing its way through the scrub for the distance of nearly a mile, until its progress was stopped by a swamp. The widest part swept by the fire was nearly half a mile in width, but it narrowed towards the swamp to the width of a few yards. It was interesting to observe the contrast of the "flora" of the original scrub, and that of the ground cleared by the fire.

It so happened I was visiting in the district in the month of October, when the wild flowers are at their best, and I was very much interested in going over the ground again and again, and collecting the various species found there. I found that those bushes which formed the original scrub, (ti-tree, banksias, and dwarf gum), did not re-appear in the cleared ground as might have been expected. *Banksia ericifolia*, which was abundant in the original scrub gave place to *Banksia aemula*. Neither of the two ti-trees (*Leptospermun attenuatum* and *L. pauciflorum*) re-appeared, nor did any other species take their place. The same may be said with reference to the dwarf gum, (*Eucalyptus obtusiflora*). The cleared ground was well covered with a large number of species of wild flowers, not one of which was found in the original scrub; the seeds of which must have been carried a considerable distance by the wind, and scattered broad-cast over the ground fitted to receive them. Foremost (in appearance at least), were two species of grass-trees, (*Xanthorrhœa hastilis* and *X. minor*), a genus of plants peculiar to Australia, according to Bentham and Müeller.

The tall grass-tree *(X. hastilis)*, reached the height of nearly eight feet, and formed the most conspicuous object of the landscape. The smaller one *(X. minor)*, was about three feet in height, but not so numerous as the larger one. *Banksia aemula*, (one of the so-called native honey-suckles) represented *B. ericifolia*, but it was not numerously distributed, the specimens being few and far between. One or two specimens of *Banksia latifolia* with its large beautifully coloured leaf, were found in a damp piece of ground, a species not common in the neighbourhood of Sydney. It was the flowers however, which reaped the greatest advantage from the clearance made by the recent fire. Every square foot of ground was occupied by them, and I collected more than a hundred species during my three weeks visit. The beautiful Goodenias, with their bright yellow flowers, were growing side by side with the lovely blue Lobelias, and the pink Stylidias, interspersed with various species of Orchids, and other wild flowers. Of the Goodenias I collected five species, and probably there were more, *G. bellidifolia, ovata, hederacea, heterophylla*, and *paniculata.* According to Bentham and Müeller, the Goodenias are restricted to Australia. Growing freely among the Goodenias, and forming a beautiful contrast by their rich blue flowers, were the Lobelias. Of these I found three species, *L. dentata, L. anceps*, and *L. simplicicaulis.* Stylidæa, which are very abundant in Western Australia, have only a few representatives in New South Wales. Of these I found two : *Stylidium graminifolium*, and *S. laricifolium.* According to Bentham and Müeller this species is all but restricted to Australia, one or two species being found in New Zealand and a few in Central Asia. The genus Scaevola (which is largely a Western Australian one) has seven species in New South Wales. Of these I found one, *S. hispida ;* it is a herbaceous plant growing to the height of eighteen inches occasionally, with dark blue or purple flowers, It was very common, the soil suiting its requirements in every way. Side by side was another common blue flower, of lighter shade however, *Dampiera stricta ;* this genus is restricted to Australia, it was named after the celebrated navigator Dampier, who visited New Holland in the year 1688.

Of the Proteaceæ there were a goodly number. Petrophila was represented by *P. pulchella ;* Comespermum was represented by *C. longifolium*, and *C. ericifolium ;* Lamberta by *L. formosa ;* Lomatia by *L. longifolium*, and *L. silaifolia ;* Banksia by *B. aemula*, and *B. latifolia ;* Persoonia by *P. linearis*, and *P. lanceolata.* The genus Epacris was represented by six species, and that of the Orchideæ by fourteen species. There were a few species of lilies, sedges, and grasses, with two species of ferns, *Pteris aquilina, Davallia dubia*, in all one hundred and twenty one, the names of which are arranged according to the "Flora

Australiensis" of Bentham and Müeller. The doctrine of the "survival of the fittest" has been generally accepted by scientific men, but there are certain modifications which must be always taken into account.

The few species of scrub bushes already referred to in the early part of the paper had no difficulty in holding their own until the fire destroyed them, and then they disappear for a time at least, and a few of their nearest relatives took possession of the ground, along with a much feebler but more beautiful species of plants. The wild flowers in Australia had not much to contend with until the arrival of the white man. Then commenced a general destruction against forest trees, shrubs, and wild flowers, and this has continued down to the present day. Bush fires I have no doubt, were common enough when the Aborigines had possession of the country, and the effects then would be the same as they are now. When we read of a bush fire, we generally think of so many square miles of trees and shrubs destroyed, perhaps half a mile of fencing and a selector's barn burnt. We may visit the scene immediately after, and all that we see is scorched gum-trees, burnt shrubs, and the grass and wild flowers completely destroyed. If we should visit the district a few years later, the scene will be completely changed. The grass is richer and more abundant, the wild flowers more numerous, and new shrubs and trees have taken the place of those destroyed by the fire. Bush fires must have had a most important influence in the distribution of species in Australia. Many of them were of great extent; hundreds of square miles of country laid waste in one sense, and yet in another hundreds of square miles prepared for the perpetuation of humbler forms of plant life. We read of the influence of water in the distribution of species, of the influence of the wind, of the agency of birds, and many other operations at work fulfilling the same ends; but I am not aware that any one has called attention to what is going on before our eyes every summer in Australia, when at the expense of a certain number of forest trees, and scrub bushes, space is given for a hundred species of plants and flowers, which gladden our hearts as we walk abroad and make our lives all the happier because of their existence.

List of plants collected and arranged according to the "Flora Australiensis":—

DILLENIACEÆ.

Hibbertia stricta
,, fasciculata
,, dentata
,, virgata

VIOLARIEÆ.

Viola hederacea

DROSERACEÆ.

Drosera spathulata
,, binata

TREMANDREÆ.

Tetratheca juncea
,, ericifolia

RUTACEÆ.

Correa alba
Zieria Smithii
Boronia ledifolia
,, pinnata
,, serrulata
Eriostemon lanceolatus
,, buxifolius
Philotheca Australis

LINEÆ.

Linum marginale

GERANIACEÆ.

Geranium dissectum

STACKHOUSIEÆ.

Stackhousia spathulata
,, linariæfolia

LEGUMINOSÆ.

Oxylobium trilobatum
Gompholobium grandiflorum
,, pinnatum
Jacksonia scoparia
Daviesia genistifolia
Pultenæa daphnoides
,, hispidula
Dillwynia ericifolia
,, floribunda
Hovea linearis
Kennedya monophylla
,, rubicunda
Acacia falcata
,, linifolia
,, longifolia

HALORAGEÆ.

Haloragis teucrioides

MYRTACEÆ.

Darwinia fascicularis
Bæckia diosmifolia
,, virgata
Kunzea capitata
Callistemon lanceolatus
,, linearis
Melaleuca nodosa
Angophora cordifolia

UMBELLIFERÆ.

Actinotus Helianthi
,, minor

OLACINEÆ.

Olax stricta

PROTEACEÆ.

Petrophila pulchella
Conospermum longifolium
,, taxifolium
Persoonia lanceolata
,, pinifolia
Grevillea buxifolia
,, punicea
Hakea acicularis
Lomatia longifolia
Banksia aemula
,, latifolia

THYMELEÆ.

Pimelea linifolia

COMPOSITÆ.

Veronia cinerea
Cotula australis
Craspedia Richea
Lagenophora Billarderi
Cassinia longifolia
Helichrysum scorpioides
,, semipapposum
Gnaphalium Japonicum
Senecio australis

CAMPANULACEÆ.

Lobelia dentata
,, anceps
,, simplicicaulis
,, gracilis

STYLIDIEÆ.

Stylidium graminifolium
,, laricifolium

GOODENOVIEÆ.

Goodenia bellidifolia
,, ovata
,, paniculata
,, hederacea
,, heterophylla

Scaevola hispida.

Dampiera stricta.

LOGANIACEÆ.

Mitrasacme paludosa

SCROPHULARINEÆ.

Euphrasia speciosa

EPACRIDEÆ.

Styphelia tubiflora
,, viridis
Epacris longiflora
,, paludosa
,, obtusifolia
Woollsia pungens
Sprengelia incarnata

ORCHIDEÆ.

Thelymitra longifolia
,, ixioides
Calochilus campestris
Diuris maculata
,, sulphurea
Prasophyllum fuscum
,, elatum
Microtis porrifolia
Pterostylis curta
,, reflexa
Caleana major
Caladenia carnea
,, alba
Glossodia major

IRIDEÆ.

Patersonia sericea

AMARYLLIDEÆ.

Haemodorum planifolium

LILIACEÆ.

Smilax glycyphylla
Dianella lævis
,, cærulea
Burchardia umbellata
Sowerbya juncea

XYRIDEÆ.

Xyris gracilis

JUNCACEÆ.

Xanthorrhea hastilis
,, minor
Juncus communis

RESTACEÆ.

Restio dimorphus
,, australis

ERIOCAULEÆ.

Eriocaulon australe
Caustis flexuosa

GRAMINEÆ.

Panicum crus-galli
Anisopogon avenaceus

LYCOPODIACEÆ,

Selaginella uliginosa

FILICES.

Pteris aquilina
Davallia dubia

DISCUSSION.

The President stated that travelling very much throughout the Colony, he had often heard it remarked that bush fires did good in some districts and not in others. Owing to the absence of bush fires in some parts of the country, a dense scrub springs up over what is generally pretty clear ground, it being stated that the fires burning up the young shoots prevent this scrub from spreading at other times. It would be well to obtain statistics of the effects of fires in various districts, on high and low lands.

Mr. J. T. Wilshire said that pastoralists used fires as a means of preventing the growth of noxious weeds. Droughts would also have a great effect on the distribution of species of plants.

WEDNESDAY, AUGUST 3, 1887.

C. S. Wilkinson, F.G.S., President, in the Chair.

The minutes of the last meeting were read and confirmed.

The following gentlemen were duly elected ordinary members of the Society :—

Davey, Thomas Garby, M.E., Emmaville; N.S.W.
Faithfull, Robert L., M.D., L.R.C.P.; Sydney.
Huxtable, L. R., M.B., C.M.; Sydney.

Jones, George Mandor, M.R.C.S.E., L.R.C.P., *London;* North Annandale.

Kent, Harry Chambers, Bell's Chambers; Sydney.

Mitchell, J. Sutherland; Darling Point.

Pollock, James Arthur, B.E., *Roy. Univ. Irel.;* Sydney.

Ross, Andrew, M.L.A., M.D., *Univ. Glasgow;* Molong.

Schwarzbach, B., M. D., *Würzburg*, L. F. P. & S., *Glasgow;* Sydney.

Wood, W. E. Ramsden, M.D., M.R.C.P. & F.R.C,S., *Edin.* M.A., *Cantab.;* Stanmore.

The certificates of seven new candidates were read for the second time, and of one for the first time.

The President announced that the Council had dealt with the essays concerning "Original Researches" Series VI., in connection with which the following papers had been received, viz.:—No. 20—On the Silver ore deposits of New South Wales.—One paper. No. 21—Origin and mode of occurrence of gold-bearing veins and of the associated Minerals.—Seven papers. No. 22—Influence of the Australian climate in producing modifications of diseases.—One paper. No. 23—On the Infusoria peculiar to Australia.—Nil; and stated that with one exception they were not considered to have fulfilled the conditions laid down.

The successful essay had been written by Mr. Jonathan Seaver C.E., F.G.S., on "The origin and mode of occurrence of gold-bearing veins and of the associated minerals"; the medal and money prize would be awarded at the next General Monthly Meeting of the Society, when it was arranged that Mr. Seaver should read his paper.

The discussion upon the paper of Mr. H. G. McKinney, M.E., M.I.C.E., on "Notes on the Experience of other Countries in the Administration of their Water Supply," read at the last meeting was further postponed, the President stating that it was the wish of Mr. McKinney and other members of the Society, that the paper should be discussed when the writer was present.

The following papers were read:—1. "Notes on some Inclusions observed in a specimen of Queensland Opal" by Mr. D. A. Porter of Tamworth. The President said with regard to Mr. Porter's opinion that the silica composing the opal had been principally derived from the soil through the vegetable matter in which it is included; that he had no doubt that some of these inclusions may be due to that cause, as rushes for instance contain a great deal of silica, but he thought that in most cases the silica had been derived from the deposits in which it was imbeded.

2. "On some New South Wales Tan-substances," Part 2, by Mr. J. H. Maiden, F.R.G.S.

A discussion followed in which Messrs. W. A. Dixon, J. T. Wiltshire, and the Chairman took part.

3. "The Influence of Bush Fires in the Distribution of Species," by the Rev. R. Collie, F.L.S.

Some remarks were made by Mr. J. T. Wilshire and the Chairman.

Twenty two members were present.

The following donations received during the month of July, were laid upon the table and acknowledged :—

DONATIONS RECEIVED DURING THE MONTH OF JULY, 1887.

(The Names of the Donors are in *Italics.*)

TRANSACTIONS, JOURNALS, REPORTS, &c.

AMSTERDAM—"*Revue Coloniale Internationale,*" Tome IV., Nos. 5 and 6., May and June 1887. *The Editors.*

BERLIN—Königlich Preussische Akademie der Wissenschaften. Sitzungsberichte, No. 1 to 18, 6 Januar to 31 Mäsz, 1887. *The Academy.*

CAMBRIDGE (MASS.)—Museum of Comparative Zoölogy at Harvard College. Bulletin, Vol. XIII., No. 4. *The Museum.*

CHRISTIANIA—L' Association Geodesique Internationale, (Commission de la Norvége) Geodätische Arbeiten Heft V., 1887. Vandstandsobservationer, Heft IV., 1887. *The Commission.*

Videnskabs-selskabet, Forhandlinger Aar 1886. *The Academy.*

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HAMBURG—Vereins für naturwissenschaftliche Unterhaltung Verhandlungen, 1883 to 1885. ,,

LONDON—Meteorological Office. Hourly Readings, Part III., July to September, 1884, Official No. 70. Monthly Weather Report, Sept., Oct., Nov., 1886. Quarterly Weather Report, Parts II. and III., April to Septr. 1878 [New Series.] Weekly Weather Report, Vol. III., No. 53, and Appendices I., II. and III., [New Series.] Vol. IV., Nos. 1 to 11, 10 Jan. to 21 Mar., 1887, [New Series.] Report of the Meteorological Council to the Royal Society for the year ending 31 March, 1886. Report of the Third Meeting of the International Meteorological Committee held at Paris, September 1885. *The Meteorological Office.*

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"*Science*" Vol. IX., Nos. 226 to 229, June 3rd to 24th, 1887. *The Editors.*

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WELLINGTON, N.Z.—General Survey Office. The Eruption of Tarawera, New Zealand. By S. Percy Smith, F.R.G.S. *The Surveyor General.*

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MISCELLANEOUS.

(Names of Donors are in *Italics*.)

Hutchinson, Francis B., M.R.C.S.E., L.R.C.P., Edin.—Anniversary Address delivered by the President to the Members of the Wellington Philosophical Society at the opening meeting of the Session 1887-88. *The Author.*

Sprat, Thomas, D.D., late Lord Bishop of Rochester.—The History of the Royal Society of London, for the Improving of Natural Knowledge. The Fourth Edition, 4to, London, 1734. *Mrs. Helenus Scott.*

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"*The Publisher,*" No. 10, 18 July, 1887. *The Publishers, Sydney.*

A DISTRICT HOSPITAL: ITS CONSTRUCTION AND COST. WITH A DESCRIPTION OF A NEW METHOD OF CONSTRUCTING IRON BUILDINGS.

By J. ASHBURTON THOMPSON, M.D., Brux., San. Sci. Cert., Camb.
Chief Medical Inspector of the Board of Health of N.S.W.

[*Read before the Sanitary Section of the Royal Society, N.S.W., 12 July, 1887.*]

YOU are aware that among the multifarious functions of the Health Department is reckoned that of examining plans for proposed Country or District Hospitals in aid of which a subsidy of the public money is asked. The object of such supervision is, of course, to secure a reasonably wise and reasonably economical expenditure of the monies granted and subscribed. The intention is good, and it would be useful if means of practically effecting it were provided; but, for reasons into which I need not go, the power of the Department to cause alteration to be made in faulty schemes is but small. Now although fairly good plans are sometimes submitted, it is very seldom that any are met with so drawn as to show that the architect has practical knowledge of the requirements of hospital buildings; and occasionally egregious, and to the trained eye very singular errors, are unconsciously committed. Under these circumstances it has been considered whether a model plan could be put forward; but it appeared that the difficulty of suiting the tastes and requirements of various neighbourhoods was too great; moreover it is no part of the business of the Department mentioned to supply plans, for which indeed no means are at its command. Nevertheless it appeared that a carefully designed building, if its details were made known, might serve a useful purpose by showing what measurements, arrangement, ventilation and drainage, are unobjectionable, even if they might not be thought actually the best that could be devised; but in order to give this scheme practical force, it seemed to me necessary to be able to refer to an existing building, and not merely to a series of drawings. When therefore, about a year ago, Dr. Harman Tarrant, who at that time was a member of the Assembly for the Illawarra District, asked me to furnish a plan for a small hospital of 8 or 9 beds for the coast town of Kiama, I gladly took advantage of the opportunity. The building has been erected in accordance with my design, and has been occupied now for some months; photographs and a plan of it are before you; and it is this of which I propose to offer some description.

Construction and Material.—Communities proposing to erect hospital accommodation for their district seem unable to command large sums of money as a rule; apparently they can seldom gather much more than a couple of thousand pounds. And, generally speaking, they have a prejudice in favour of—but perhaps I should rather say, a preference for—bricks and stucco. But the cost of any building is proportionate to its cubic contents and the kind of material employed; it follows, therefore, that when the limit of cost is sharply defined one of three courses must be pursued. An attempt may be made to diminish the dimensions; but this course cannot be followed far, for dimensions which are large as compared with those of dwelling houses are necessary for hospitals. Then the number of beds may be reduced; but here again the downward limit is soon reached, for it is scarcely worth while to build a hospital of less than ten beds, and the administration sufficient for ten is (or should be) sufficient for 20. Thirdly, bricks and mortar and stucco may be discarded and some cheaper material chosen; whereby the largest number of beds and the amplest measurements may be had for the limited sum which I am led to name as the datum of the calculation. The last is the course I have chosen; and the material I select is corrugated iron. Now, there are three objections to this material. The first is a certain prejudice against it which I have found exists; a prejudice which I believe is partly due to the unscientific and inartistic treatment generally given to buildings constructed with it. But these are the north and west elevations of the Kiama Hospital; and I hope you will consider that the taste of the Architect, Mr. Charles A. Harding, of Wentworth Court, Sydney, has produced as agreeable a design in this simple material as need be. (Figs. 1 and 2.) Another objection is based on the score of durability. But I apprehend that a faithfully built structure of this kind may be trusted to endure for a generation—for 30 or 40 years at least; and, as far as I can understand, it is not considered certain that such a building would not last considerably longer. But a generation will do, surely. At the end of that time one of two things must have happened: either the town and district will have so increased that a large hospital on a new site and built necessarily of brick or stone, must be put up; or, if it should have remained nearly stationary, then the next generation must bear its own burden by providing a new building like the old one. One of these objections then is met by showing that it is, at least in my opinion, unfounded; the other appears to have no real weight. The third remains, and this is both sounder and more difficult to overcome; it is that the conducting properties of iron render it an unsuitable material for this climate, affording but insufficient protection against the heat of summer and the cold of winter alike. This has the greater force when it is understood that, in order to secure the greatest economy consistent with efficiency, the inner as well as the outer walls are made of iron; but I have met it, and met it successfully, by adopting the following method of construction. In the first place the wall-space and the roof-space are freely connected; this is done by means of a duct which continues the former around the wall-plate (Fig. 3). In the second place, the combined spaces mentioned are very carefully shut off from communication with the rooms of the building; the ventilation of the latter is quite independent of the roof space, instead of being, as usual, into it. In the ridge are placed large louvered lanterns, (Fig. 1.) which form exits for the air passing through the roof and wall-space; these louvres should admit of being closed, or nearly closed, when desired by a suitable arrangement of connecting rods accessible from the floor level outside. All round the building at the bottom, and below the iron of the walls, runs an opening eight inches high; this being divided into suitable lengths of about eight feet, is closed by a series of longitudinal doors. They have hooks to support them open; they should shut down on a strip of roofing felt, and should be closed with pressure fastenings.

Where the iron meets the frame of the doors at the bottom, the latter being sloped to run off water, a fillet (Fig. 3.) must be introduced; and the channel thus formed must be filled with cement in order that no space may be left by which air might travel up the corrugations of the iron, even when the doors are shut; and a similar expedient must be used around all door and window cases. At the top, the duct is let down square on to the top of the corrugations; and the sheets being tolerably true, it will there be sufficient to see that the painters in finishing the outside carefully putty up any small chink which may remain. Attention to secure the same quasi air-tightness should also be given to the bottom edge of the inner skin of iron. Four inch studding is used. By this arrangement two conditions are secured; in the summer, when doors and louvres are both open, the heat of the sun on the roof draws a current of air of considerable velocity between the two skins. This not merely abstracts heat from the interior of the building, but effectually prevents the transmission of heat from the outer to the inner skin; and the result, as practically seen at Kiama, is that the interior of such a building is, in hot weather, markedly cooler than buildings otherwise constructed and of more solid materials. Secondly, when, as in winter, the doors and louvres are closed, the inner skin of the building is surrounded by a layer of that excellent non-conductor, air, not less than four inches thick; and I have no apprehension that difficulty will be experienced in keeping such a building sufficiently warm. But on this point I cannot adduce the same degree of practical evidence as on the foregoing; for, through some incaution, the wood used was imperfectly seasoned, so that both the floors and windows present numerous and large cracks communicating with the outer air. Yet, although it is thus impossible to say to what temperature the interior might be raised, even with these serious drawbacks it is not too cold. This mode of constructing iron buildings I believe to be entirely new; its novelty consisting, not merely in the arrangement by which the whole surface is kept bathed in a rapidly moving current of air, but in the control to which the latter is made subject; so that the moving current may on occasion be converted into a nearly stagnant and non-conducting coat. I am much indebted to Mr. Harding the Architect, for working out the practical details and for successfully executing them; he having been supplied by me with a diagram of the arrangement, and some measurements only.

Having thus dealt with the material, and with the mode of construction as far as that is necessitated by the material, I proceed to give details of cost. The Kiama Hospital, just as it shows in the photographs, (Figs. 1, 2 and 4.) holding nine beds, and having, in addition, a detached ward for isolation, a dead-house, a windmill over the water-tank, and a water-service therefrom over the building; having moreover a suitable arrangement to dispose of the slop-water by irrigation; was built for £1,478, to which however, Architect's commission must be added. Farther, had the full original design been carried out, it would then have held 17 beds, and the cost would not have reached £300 more, or, say £1,750 The building as it stands is satisfactory. It has, indeed, been so highly approved by all who have visited it, that I have already had applications for details from other colonies. On examining it however, I perceive that some of the measurements of the administrative block are rather small. I have therefore re-drawn the plan, so that while the ward measurements and general arrangement of the building remain exactly the same, the dimensions of the administrative block are suitably enlarged. Moreover, by adopting a slightly different manner of lighting the smaller wards I have contrived to put five beds in the space occupied by four at Kiama, while the full-sized ward holds ten, instead of eight as originally projected. In every other respect the amended plan is exactly the same as that of the actually existing building; and the cost of carrying it out, reckoned as at Kiama and in the same state of the market (which was not exceptional)—and subject of course to any special difficulty and cost of foundations which some sites may involve, would be, for 21 beds £2,000, or for 11 beds £1,700. I will now ask you to regard the amended plan, (Fig. 5.) while I point out some of its special features; bearing in mind that the description applies equally to the existing hospital at Kiama in so far as the latter has been carried.

Site.—If the adjacent ground is higher than the hospital reserve and slopes towards it, such intercepting drains must be cut as will restrain surface water from flowing on to or near the building area. In addition, it will sometimes be found necessary to under drain the latter and a space around it; and this may be done by setting drain-tiles four feet below the surface, and in lines at such distances apart as the nature of the soil may require. Neither of these precautions was necessary at Kiama. The natural surface should be carefully cleared, and excavated six inches deep. It should be covered with a layer of coal-ash and a proportion of tar. Around all outside walls a space of four feet or more should be tar-paved, and carefully graded to a fall away from the building; the tar-paving had best extend to the whole of the court-yard between the two blocks, where it would fall to gullies in the middle line.

Construction.—This has already been described. The walls consist of a double skin of corrugated iron; and at Kiama the ceilings are of sheet iron. The appearance of the wards and rooms within will greatly depend on the taste displayed in colouring the walls. Sheet iron of the requisite guage for the ceilings cannot be got free from buckling, and cannot be made therefore to lie perfectly smooth or to make sufficiently neat joints. For this and for other reasons I think lath and plaster had better be substituted in future for the sheet iron ceilings used at Kiama. This modification also allows the ventilating openings to be somewhat reduced in size. Foundations should be of brick or stone; and a good damp-course should be built in above the ground-level and below the flooring joists.

The General Plan.—I have observed that the traditional front door in the middle of the principal elevation constitutes in such small hospitals as these a stumbling block; leading to waste of space, and the introduction of rooms for which uses have to be found. You will perceive that I have got rid of it. The entrance is at one end of the administrative block (Fig. 2), and gives, without intervening hall, upon a fairly large room which is destined to serve several purposes. It is intended to be the operating room; and therefore it has a good top light. But instead of a sky-light the windows may be made to run up to within six inches of the wall-plate; and this plan will doubtless be sometimes preferred. Then it is intended to serve as the dispensary; and a suitable press for this purpose should be regarded as a part of the building and provided for in the contract. Here also may be placed the hospital library, and the books of the institution; here, too the Board of Management may meet. And at this point I feel it necessary to break off for a moment, in order to point out that, if these arrangements do not seem all that can be desired, they are yet practically sufficient, and practically unobjectionable. A hospital of 21 beds is, after all, a very small place; and while the arrangements which, in larger institutions would be necessaries are here merely conveniences, the restriction of narrow means must not be lost sight of. When I come to speak of lavatories, much more forcible criticism of a similar kind may be offered. But again I should reply that the arrangement shown is not unhealthy, practically is sufficient for its purpose, and is as convenient as the money at command can provide. It would be very easy to furnish the two customary pavilions attached to each ward—the one for closets, the other for the lavatory, if money were no object. This entrance, then, gives on a large room intended for general business purposes. By it all patients enter; and as they must sometimes be carried, it is important that no steps should be necessary to reach it. For a similar reason the doorway should be four feet wide; and it may now be observed that all doors from, and including the entrance to the two wards on each side of the hall are of this width, while the passages measure six feet. The corners of the lavatories in the hospital block are cut off to make an easy turning for the stretcher-bearers; and the whole floor of both blocks should, for this and for another reason to be mentioned in its place, be on one level. This general room has two doors of exit; one by which the verandah is reached, and therefrom the wards, and another which leads to a special operation ward. When the latter is in use this door should be locked; access being then had to it from the central passage. Adjoining it is a room large enough to lodge two nurses; and then comes the central passage alluded to, four feet wide, leading on one side to the verandah opposite the middle of the ward-block; on the other to the ground at the back of the administrative block. On the other side of this passage, and opening from it are a room for one nurse or a servant, and a large store room; where, among other things, spare bedding may be kept. Next is the kitchen, wherein a recess is provided by cutting off a part of the store last mentioned, for the dresser; and this fitting should be regarded also as a part of the building A part of the verandah is enclosed at the end for a pantry. A close cooking range should be provided and it should have a hot water cistern attached, a tap from which should be led to the adjoining scullery. This is a somewhat larger apartment than might be expected; but it will have to serve for an ironing room, for example, and for some other purposes. It should be fitted with a wash-up sink, and a plate-rack over, and a convenient table or bench adjoining. In the floor under the sink should be a gully; and under the sink and bench should stand a bath on wheels, having a waste by which it may be emptied over the gully last mentioned. The hot-water tap spoken of above should be set at such a height and in such a position that the bath may be wheeled under it for filling. It may thence be passed to the ward in which it is required; and convenience in wheeling the bath is another reason for making all the floors on the same level. This scullery is in communication by a door with the kitchen; but it has another door at the back which issues under a covered way which runs along the laundry-shed. This should have a concrete floor with a suitably placed gully connected with the general drainage system; and it should be fitted with a copper and furnace, and with three washing troughs. These also should be considered part of the building. At the back of this shed again is the staff closet. In all of these rooms suitable battens for hanging purposes should be fixed in the course of building; especially the kitchen and scullery should have an ample supply, for hanging up utensils. Around the entrance room, and around the wards should be fixed a picture rail at a suitable distance below the ceiling; for some decoration is desirable, and it must not be forgotten that nails cannot be knocked into these walls.

I now turn to the ward-block. In the middle is a large room for the occupation of the Matron and her husband who should act as wardsman. It has French windows giving on the principal verandah; and it is guarded from being overlooked by patients on the verandah by a light barrier as shown. The room has two small casements overlooking the male and female wards respectively; and it contains a press to hold the ward linen. On each side of the entrance are the lavatories. Access to that for men is from the hall only; to that for the women, from their ward only. Both are fitted with wash-basins; and both have an appliance which I call a bath-tray. It consists merely of a tray with a sufficient combing and a waste; and it is intended to economise water in bathing, the patient having a bucket-full given him, and sponging himself from it. But at Kiama, these trays have a shower over them, and I think there is no objection to this. They should be enclosed by a curtain hung on rods. The total number of beds in this block being 20 is allotted as follows: 10 are placed in one large ward for males; a corresponding space on the opposite side is divided into two equal wards. Of these the nearer, having access from the central hall, holds five beds for women. The farther holds five beds for convalescent males—for patients, that is to say, able to some extent, to look after themselves. This ward has an entrance from the court-yard only; its inmates use the male lavatory in the middle; but it has its own closet attached. One fourth of the beds it will be seen are devoted to females, and I believe this proportion sufficient, except, of course, in large hospitals in cities. Such is the general arrangement of the building. I now mention some details under the heads Ward-space, Ventilation, Lighting, Drainage, and Water-supply.

Ward-space.—This I have taken as follows:—Floor-space, rather more than 96 feet; cubic space, rather more than 1,000 feet per bed. The wall-space in the large ward is nearly 9 feet; in the smaller wards it may be taken at about 11 feet; but the distribution of beds not being even over it, it must suffice to refer to the plan when I believe it will be found enough. The height of the wards (and of all rooms throughout the building) is 10 feet 6 inches. At first sight these measurements may be thought rather small; but it must be remembered, first that there is but a small number of patients in any ward; secondly that there will be no accumulation of serious surgical cases, nor any cases of the infectious fevers; and thirdly that the building is intended for the country.

Ventilation.—Considering the impermeability of the walls, I think the ventilation openings should have an area of, for outlets not less than one inch to every 22 feet of cubic contents; and for inlets, not less than one inch to every 21 cubic feet. These openings are not relatively proportionate, but the inlets as described will on the side of the building away from the wind act as outlets. These openings will be afforded for outlet purposes in the smaller wards by two tubes running from the ceiling through the roof-space each of 12 inches diameter; they should be capped above the ridge with a fixed exhaust cowl. I should prefer Boyle's, but Kershaw's or Stevens may be used, the latter being adopted at Kiama. The inlets should be disposed in two rows; one a little below the ceiling, the other a few inches above the floor. The former may consist of eight air-bricks, having each a nett opening of 24 inches; on the inside they should be guarded by a flap set at an angle like that of a Sherringham ventilator, but fixed; so as to deflect an entering current against the ceiling. The lower set should consist of air-bricks, each having a nett opening of about 12 inches, one of which should be set in the wall under the head of each bed. It is important to remember that air-bricks should be measured by the extent of nett opening they afford. Under the same head the warming apparatus must be mentioned; for this would be imperfect and even hurtful unless it were a means of ventilation as well. The apparatus I have selected as most suitable for the present building is the Calorigen; of which a few were imported at my instance by Messrs Maclean, Riggs & Co., some being subsequently used at Kiama. You are doubtless aware that this consists essentially of a slow combustion chamber for coal or coke through which winds a spiral duct communicating with the external air and with the ward; so that warmed fresh air is introduced by it. The fire draws its air for combustion from the ward. This is an excellent invention, very widely used; and although I believe that no form of stove designed for a similar purpose is equal to a Galton grate, yet this is so much simpler and is suitable for so many situations where the former cannot be fixed, that it seems to me to run it close. In the winter, if the Calorigen is proportioned to the size of the ward, all other ventilating inlets may be closed; but I do not recommend that they should be provided in this case with means of closing, since nurses and patients alike are prone to shut ventilators, if they have the means, when they should be open. The measurements just given are for the smaller wards: they should be doubled for the large one. It must not be supposed however that wards are the only rooms which require ventilation. Every room in the building should be provided with the same proportion of outlet ventilator; only the inlets, because the rooms are not continuously occupied, or because the doors must for the most part stand open, as in the kitchen for instance, may be reduced by one-half, or even more.

Lighting.—The proportion of glazed surface to cubic space which I have chosen is rather more than 1 square foot to every 60 cubic feet. It should not fall below this proportion; but it might exceed it without harm, except in elevated districts, where if it were greatly larger, some difficulty in keeping the rooms warm in winter might be felt. In the female ward it is necessary to introduce four high lights, measuring 4 feet by 3, of which the sill is 7 feet above the floor; it not being convenient to introduce more windows of ordinary construction than are shown. One of the windows in all the wards is a French light to give access to the verandah. All windows and transoms should be made in leaves or panels to open inwards from the bottom bar; they should not be centred so as to fall partly inwards and partly outwards. The latter plan prevents the adaptation of a good water-bar, which on the former may be made much more nearly continuous and more effective, not merely against rain but against drafts too.

Drainage.—All waste pipes, from the lavatory basins, slop-sinks, bath-trays, scullery, and the like should open on the outside of the building over yard gullies; while conveying the slop-water to the drain, they are thus cut off from connection with the latter. The only foul air they can introduce to the building, therefore, is that which may be drawn from the short length of piping between the sink and the gully; and in order to stop this, suitable S or P bends should be introduced. The gully over which the scullery waste discharges should be a grease-trap. The drain from the several gullies to the main outfall drain, as well as the latter should be very carefully graded, and set in cement; the joints should be gone over with the trowel internally so as to keep the interior smooth. They should be laid on such a foundation as will prevent sinking and consequent opening of the joints. After the branch drains have all come in to the main drain the apparatus known as an automatic flush tank should be introduced in the latter. Its capacity, whether for the full sized building or the part plan, may be about 25 gallons. This will secure several discharges during each day; the object of this apparatus being to reserve the slop-water until such an amount has accumulated as shall be sufficient to thoroughly flush the outfall drain, by causing it to run full bore and with a rapid stream, and yet not to reserve it long enough for putrefaction to set in. The main drain should run to a small plot of ground placed as far from the building as convenient; and should there discharge into a transverse trench leading from which several irrigation channels 6 or 8 feet apart have been cut. By a little management the stream may be conducted into one or other set of these furrows, by which it will be absorbed; and the intervening soil may be cultivated. In some situations it will doubtless be necessary to underdrain the area chosen for irrigation, and for this purpose the drain-tiles should be two feet deep. The effluent, if any one patch of the area be not over-worked will be bright and inoffensive, and may be conducted to the ward gutter. But, as a rule, this will be unnecessary; it being only essential to remember that the destruction of the organic matter in the slop-water is effected by the ground-air and near the surface, and that therefore the irrigation area must not be kept continually wet, but be so divided and of such an extent that one part may be rested while the other is at work. Unless this point is attended to, after a short time the soil will cease to destroy the organic matter; it will become sodden, and then offensive.

Water Supply.—The water must usually be caught on the roofs. It may be conducted to an underground tank; there is no objection to this method of storage, which even has advantages, provided the reservoir is made water-tight. But for this it is useless to trust to brick and cement work. Doubtless this can be made water-tight; but, as a matter of fact, it very seldom is so. No doubt also a sufficient thickness of puddle outside would serve; but it appears to me that asphalt affords the most suitable and the most effective means. We have here a company actively engaged in carrying out all kinds of work in this valuable material; and it would be well if it were more generally employed for the particular purpose I am now speaking of. There is no reason why the rain water should not pass through a filter before entering the tank. This should consist of a chamber divided by a septum extending from the top to within 3 or 4 inches of the bottom; empty on the supply side, but filled on the delivery side with layers of gravel, breeze, and sand, so that the water ascends through the filter bed. The size of such a tank is an important point. It will depend first on the daily amount per head allowed multiplied by the number of residents, and the rain fall of the district. I think 15 gallons per head per diem should be the minimum allowance; and the size of the reservoir will then depend upon the length of rainless intervals usually met with in the course of a year. The area of the roof measured along the eaves and expressed in square feet multiplied by one fourth the rainfall in inches will give the amount of rain-water likely to be actually collected from this source in gallons. At Kiama, as I have said, the water thus collected is raised by a windmill to an overhead tank, whence it is led to several parts of the building. But whenever this is done, the underground tank should be provided with a floating guage, and it should be the duty of the wardsman, supervised by some working member of the committeee to keep a record of the weekly amount used, so that in dry weather economy may be observed.

Closets.—It is necessary to add a word about the closets. These are pans, which should, of course be emptied every day, and which should be served after empting with some deodorant. They should be removable from the outside by a suitably placed door which is not shown in either of the plans, and the place for the pan should be so enclosed by a fillet that when pushed in with the most ordinary care it must occupy the right spot. On the male side, and in the staff closet, the seats must be hinged so that the pan may be used as a urinal; where a constant stream of water cannot be allowed to run, a urinal connected with the drains is inadvisable. The little lobby between the closets and the wards is ventilated by immoveable louvres on two sides; and it must not be forgotten notwithstanding its partial protection, that the ward-door to the closet is practically an external door; and must be carefully fitted accordingly. In this lobby, projecting from one of the walls is a recess, marked in the plan "louvred cupboard." This, which is 18 inches square, and which should be about 2 feet 6 inches high with two shelves in it, is intended to hold evacuations and the like which it may sometimes be necessary to reserve for inspection. On the other side of this lobby should be placed a slop-sink, not shown in the plan, with a water-tap over, at which bed-pans and other utensils may be washed.

It will, I hope, be understood that I do not presume to put forward this as a model design. To the best of my knowledge it is free from any highly objectionable faults, and I point to it as a proof that a district hospital building, well-adapted to its purpose, and with all the necessary structural adjuncts, can be built either for £1,700 or for £2,000 according as it accommodates 11 or 21 beds.

PROCEEDINGS OF THE SECTIONS.

(IN ABSTRACT.)

MICROSCOPICAL SECTION.

Preliminary Meeting held APRIL 18, 1887,

Mr. P. R. PEDLEY in the Chair.

VOTES of thanks were proposed and seconded to Mr. P. R. Pedley, the retiring Chairman, and Mr. F. B. Kyngdon the retiring Secretary. The following gentlemen were elected office-bearers for the ensuing session:—Chairman: Mr. F. B. Kyngdon. Secretary: Mr. P. J. Edmunds. Committee: Dr. Wright, Dr. Sinclair, Mr. G. D. Hirst, and Mr. S. Macdonnell. It was decided to continue to hold the meetings of the Section on the evenings of the second Monday in each month.

MAY 9, 1887.

Mr. F. B. KYNGDON in the Chair.

Mr. McDonnell exhibited a new form of live cell or zoophyte trough, made by Dunning. This cell, being only about a millimetre in depth, is useful for work with high power objectives.

Dr. Sinclair exhibited the following slides:—(1) A specimen of *Filaria Sanguinis hominis*, the supposed cause of Elephantiasis. (2) Stinging cells from the tentacle of the "Portuguese Man of War," *(Physalia Pelagica)*. (3) A specimen of Globigerina Ooze obtained from an Atlantic sounding of 422 fathoms. A discussion followed upon the first of these objects.

JUNE 13, 1887.

Mr. F. B. KYNGDON in the Chair.

Mr. Macdonnell presented Negretti and Zambra's new catalogue.

Mr. Whitelegge exhibited under the microscope 7 species of *Hydroid Zoophytes* obtained from Laminarian sea-weed cast upon Coogee and Bondi beaches after a gale.

Dr. Wright exhibited six very excellent photographs, showing great finish and fidelity, taken by Mr. Francis of Lavender Bay. They were microscopic enlargements of the male flea, the eye of a house-fly, and the tongues of the cricket, wasp, blow-fly, and bee, and were taken with Ross's objectives and a two candle power electric lamp.

Mr. Wiesener showed Leiss's new catalogue of the objectives and eye-pieces made from the new Schott glasses.

JULY 11, 1887.

Mr. F. B. Kyngdon in the Chair.

Dr. Wright exhibited the new four-guinea microscope of Beck, including two eye-pieces, two objectives, and iris diaphragm, and showed by its means three new slides of diatoms by Hinton, of London, and microscopic photographs of the planets.

Mr. Webb exhibited some of the so-called "ground nuts" from the Great Extended Gold Mine, Forest Reefs, near Orange.

AUGUST 8, 1887.

Dr. Wright presented to the Section four of the new bevelled-edge plate glass slides made by the Palmer Slide Company of Ohio, U.S.

Mr. Walker exhibited some fresh-water diatoms under one of Baker's travelling microscopes.

Mr. Wiesener exhibited one of Baker's new Histological Microscopes, with the differential-screw fine adjustment; also two simple dissecting microscopes made by himself, and intended for the use of amateurs.

ORIGIN AND MODE OF OCCURRENCE OF GOLD-BEARING VEINS AND OF THE ASSOCIATED MINERALS.

By Jonathan C. B. P. Seaver, C.E., F.G.S., &c.

[*Read before the Royal Society of N.S.W., 7 September, 1887.*]

The origin of metalliferous veins and lodes has given rise to many conjectures and theories from time immemorial, and great have been the differences of opinion held by scientific men of all ages as regards the question. In modern times, however, the large amount of information that has been collected, and is yet in course of collection, bearing on the different modes of occurrence of metals and minerals, their chemical and physical properties, and their geological and geographical positions, has placed certain theories regarding the origin of lodes and veins upon a more solid basis from which to reason, and has at the same time relegated others almost to oblivion.

In the following notes my remarks will be confined more particularly to auriferous veins and deposits, not that I believe they have peculiarities in their modes of occurrence distinct from all other metalliferous lodes, but because this essay is understood to be one on veins and deposits containing gold in such quantities as to be principally worked or prospected for that metal. I propose, moreover, to confine my description chiefly to the gold deposits of Australasia. I not only believe that most of the peculiar phenomena connected with the occurrence of gold-veins and other auriferous deposits may be better studied in that country than anywhere else, but also because a large amount of authentic information has been collected in Australasia regarding these deposits, and I have, personally, had considerable experience there in this class of mining, and so can speak in most cases with a certain amount of authority as to the actual phenomena connected with the mode of occurrence of gold and the associated minerals.

It has generally been conceded that by whatever means the veins have been filled, the process of opening the fissures, cavities, or crevices in which they exist has been to some extent independent thereof, and so these two branches of the subject ought to be considered separately, but it must be borne in mind that gold also occurs under conditions which cannot be classed as belonging to veins at all, being in fact impregnations through certain rocks.

As regards the origin of quartz veins and the minerals occurring in them, much has already been said by those who have advocated one or other of the theories of igneous injection, sublimation, lateral secretion, etc., to account for their forming, and perhaps it will be best to endeavour in these pages to see which of these may be most applicable to the phenomena observed in connection with the auriferous quartz veins of Australasia.

It is in Victoria that auriferous quartz mining has been carried on upon the largest scale in the colonies, and we find that the veins, or "reefs" as they are locally called (which name is synonymous with the term "ledge" used in America), may be sub-divided under two or three classes, which embrace most, if not all, of the special features of the gold veins in the colony.

No better idea can be given of the general distribution of auriferous quartz veins in Victoria than by quoting the following extract from Mr. Brough Smyth's "Gold Fields and Mineral Districts of Victoria":—"Whenever the surface of the schist rocks is touched,—whether exposed as at Castlemaine and Bendigo, or hidden under basalt, as at Ballaarat, or covered by tertiaries, as at Sebastian and Wahgunyah,—we find auriferous veins of quartz. The strata which they intersect are either altered or present a low degree of metamorphism. The veins vary in thickness from the sixteenth of an inch to 100 and 150 feet, and some,—as thin as the paper on which these words are printed,—intersect soft mudstone and sandstone containing palæozoic fossils, and in such a manner as almost to cut the fossils; but the delicate structure is not altered, nor are any of the interspaces filled with quartz.

"In some of the veins we find dense white milky quartz homogeneous and breaking with almost a hackly fracture; in others, brownish and yellowish quartz, laminated, and resembling jaspery quartz or hornstone, and showing a semi-conchoidal fracture where broken; again, we find veins of laminated quartz, with pyrites and other sulphides intercalcated, and pieces of blue slate included in the laminations of the quartz; and in many places quite crystalline quartz, containing crystals of galena, carbonate of copper, and iron pyrites, with free gold in the interstices of the crystals and intermixed with the sulphides and carbonates, and occasionally (not often) in the bases of the hexagonal crystals of quartz in moss-like aggregations; not only in the veins, but also in the casing of the veins does the gold occur in lumps, crystals, and small particles, with rugged edges; and in the soft mud-stones at Kamarooka, thin plates of gold lie in the planes of bedding of the rock."

But veins of auriferous quartz have also been found to exist in the granite and other igneous rocks of that Colony, and it has been shown that it is only where the sedimentary rocks have been intersected and disrupted by igneous ones that the veins of auriferous quartz exist to any extent in the former, proving beyond a doubt that the near vicinity of igneous rocks is conducive to the formation of quartz veins containing gold and other minerals. A description of some of the quartz veins of Victoria and of the other colonies of Australasia will give an idea of their different modes of occurrence, and supply reliable data to be considered in conjecturing as to the possible manner in which they were formed.

The quartz veins of Victoria may be divided into two great classes, viz. :—

1st. *True Lodes*, or those that have well-defined walls and continue on a certain strike and dip for a considerable distance, excepting in places where they are heaved by subsequent faults or slides, in which cases they are abruptly broken off, but may be picked up again in the direction in which the slide or fault has heaved or thrown them.

2nd. *Segregation Veins*, or those bearing evidence of being accumulations of quartz in irregular fissures, cracks, or cavities, or upon some natural planes—such as cleavage, bedding, or jointing in the rock. The latter veins comprise a very large portion of the auriferous quartz veins of the colony ; and it is a matter of opinion as to whether many seemingly true lodes are not of the same character, differing only in their more regular form.

Sometimes veins included under Class 1 (True Lodes) may bear evidence of being formed on a line of fault, and may be considered as true fissure lodes, while in other cases they coincide with natural planes of the country rock, such as those of bedding, or cleavage, etc., and an open question arises as to whether they should be considered as true lodes or segregations of ore that have accumulated on a natural plane in lode form. However, all the varieties of quartz veins in Victoria may be comprised under one or other of these two classes; the second class (Segregation Veins) embracing a great variety of deposits occurring under different conditions, as will be seen from the following description of some of the veins of the colony :—

Victorian Gold Mines.

The rocks that contain the gold veins and deposits of Victoria are sedimentary rocks, chiefly, if not wholly of upper and lower Silurian age. These are more or less altered, and while some contain fossils, others consist of chloritic micacous and granitoid schist and other metamorphic rocks, and intrusive and disruptive igneous rocks also occur in great variety. A common mode of occurrence under which the auriferous quartz veins of Victoria are found is that of true lodes, either coinciding with the bedding or other natural planes of the country rock, both in strike and dip, or intersecting the rocks perfectly independent of either, or, as in some cases, coinciding with the one and not with the other.

I will now proceed to give some characteristic examples of these different modes of occurrence under which true lodes, or those that have well defined walls and a certain general dip and bearing, are found to exist in the colony of Victoria. In doing so I will borrow largely from that excellent work on the peculiar characteristics of the Victorian quartz veins, viz., Brough Smyth's "Gold-fields and Mineral Districts of Victoria," but at the same time, as often as possible, make use of my own observations as regards some of the lodes of which I have an intimate knowledge, giving as many examples of quartz veins that have been examined by myself as this essay will allow of, without subjecting myself to be considered tedious.

Of true lodes that coincide both in strike and dip with natural planes in the containing country rock, the following from Brough Smyth's work already referred to, is a good example, showing as it does the lode in cross-section at different levels. (*Vide* Sketches of Main Lode of the Catherine Reef at *Clunes, Victoria*):—

Fig. 1.—Cross-section, between No. 2 and No. 3 levels.

Fig. 2.—Cross-section, 25 feet below last.

Fig. 3.—Cross-section, 25 feet below last.

As may be seen from these sections the lode varies in thickness, having, however, an average of about five feet, and the foot wall is very irregular, and has many spurs of quartz running into it. Upon the hanging wall-side of the lode is a vein of laminated quartz, varying from one to six inches in thickness, and upon this vein is a layer of sandstone, two feet thick which is overlain in turn by a 'flucan' about fifteen inches in thickness, and again by sandstone, which is supposed to be the real wall of the lode. The foot-wall is said to be slate, distinctly laminated parallel to the lode and its irregularities.

Of those lodes or quartz veins which do not seem to have been formed upon any natural planes of their containing rock, but which cut through the rock independent of such planes, there are many examples to be found among some of the richest quartz veins in the colony. Those shewn in section Fig. 5 and Fig. 6 are very good examples of this mode of occurrence, and in the course of this essay I shall speak of many others of a similar character that I have personally examined.

Fig. 5 is in Gippsland, at the Crooker River, and had a thickness of about eighteen inches, and for a depth of 80 feet gave an average yield of over two ounces and a half of gold to the ton.

Fig. 6 was also about eighteen inches thick, and yielded $1\frac{1}{4}$ ounces to the ton, being very rich in arsenical pyrites. It was in the same locality as Fig. 5.

Both these examples have been taken from Brough Smyth's work referred to, and have been chosen on account of their being good illustrations of this class of quartz vein.

The dyke lodes of Victoria are certainly a most peculiar class of auriferous deposit. They consist of dykes, or what appear to be dykes, of either a decomposed igneous rock or a sedimentary one which has been very much altered. In some cases they have much the appearance of decomposed diorite, whilst in others they are described as having a slaty cleavage. The auriferous portions, however, consist chiefly of narrow nearly horizontal veins of quartz, some of which intersect the dyke at right angles to its dip, while others lie nearly parallel with the walls, occurring in strings or lenticular bunches.

The horizontal veins are like thin floors of quartz, and some of these pass out of the dyke and for a short distance into the containing walls.

There can be little doubt that in many cases these belts of decomposed or partially decomposed rock are true dykes of igneous origin, in which the veins of quartz have been subsequently formed. They have often been proved to be very rich, but are seldom continuous to a great depth, being cut off in many cases by a hard undecomposed igneous rock, from which it appears probable that the dykes are offshoots. The Waverly dyke, of which I give a section (Fig. 7), and the Morning Star dyke (Fig. 8), are examples of this class of deposits.

The pipe veins are also a class worthy of particularizing as being a mode under which quartz veins are sometimes found in Victoria, and it may not be out of place to mention here that many of the quartz reefs both in that and other parts of the colonies, dip on their strike or bearing. Instances and examples of this will be given further on in treating of the New South Wales gold veins.

One of the most interesting districts in Victoria to the Engineering Mineralogist is that of St. Arnaud. This place contains a perfect net-work of quartz veins intersecting the strata at all angles, and occurring so close together and sometimes of such large dimensions that the question of how they were all formed, and what relation they may bear to each other, is a problem well worthy of consideration by the highest authority on such subjects.

I will mention a few of the principal of these veins that have been worked for their auriferous contents, and as I have for years been well acquainted with the locality, I can speak with a considerable amount of assurance as to the peculiarities of its auriferous deposits.

The Wilson Hill Reef is situated upon the hill that is close to the township of St. Arnaud. This hill is about 200 to 300 feet above the valley alongside. When first discovered the reef was of enormous dimensions on the surface, being nearly 100 feet wide, and it had thrown out on the western side of the hill rich alluvial surfacing by the denudation it had undergone in times past. For about 400 feet along its strike, which was about N. 36° W. with a dip to the westerly of about 75° from the perpendicular, it was a solid lode, but there seemed to be a break up into smaller veins, both to the northward and southward. It is most likely that it has made again and is identical with the Sebastopol Reef that is on the same strike, and has the same dip approximately, and which crops to the surface after crossing the lower country and reaching the higher land some miles to the northward from Wilson Hill.

This latter reef was also of as large dimensions, or nearly so, at the surface. The quartz of the Wilson Hill Reef was, for some distance from the surface, stained yellow, or sometimes of a greenish colour, and very much honeycombed with cavities, due, doubtless to the decomposition of iron pyrites and other sulphides. It was also very rich at the upper level, as much as ten to twelve ounces of free gold to the ton being obtained by ordinary treatment with comparatively primitive appliances; but when last I visited the mine, some four years ago, the lode had run into a pyritous one, having been worked down to some distance below the water level, and only about 3dwts. of free gold to the ton could be obtained from the quartz, the rest being now all in the undecomposed pyrites with which the stone was largely impregnated. Expensive machinery was just being erected to save the pyrites for transmission to places in Europe and elsewhere where such ore can be treated. All the quartz veins in this district become highly pyritous at low levels.

The Jerygaw Reef, another quartz vein in the same district is a nearly perpendicular lode, and yielded rich quartz at the surface; some of the specimens that I saw taken from it when first opened, and which were of a highly ferruginous character, were perfectly studded with gold, as thick as plums in a plum pudding, but it became poorer as it went down.

It is, however, being proved in this district that the rich shoots or ore-bearing portions of the quartz veins lie some distance below one another; and continued sinking will probably pass through a comparatively barren portion before reaching another ore-shoot similar to the one already cut near the surface, and that still further sinking will lead to other shoots being cut. As this is certainly the characteristic of numerous quartz veins in Australasia (as will be seen by other examples given) and also agrees with the law being established in all parts of the world with reference to metalliferous lodes in general, the same law is most likely to be equally applicable to the quartz veins in this district.

Other veins in this place yielded silver ores, such as chloro-bromides, &c., in conjunction with gold, and a large Stetefeldt furnace was erected some years ago, with a dry-crushing battery and other appliances, to treat such class of ores. Many other of the quartz veins in this locality might be described. One very peculiar deposit found, I may say, almost under my own eyes, was upon the top of a small rise, upon the side of which some pieces of gold of various sizes had been picked up.

Six hundred ounces of gold, mixed with broken quartz, was obtained in a sort of cleft in the rock some few feet wide at the top of the said rise, and although a shaft was sunk about 100 feet or so, no defined vein or lode was found, nor any more gold so far as I have heard. I might say that a large amount of gold was obtained from the district from the alluvial, evidently traceable in most cases to the denudation of reefs, or some particular reef; and also, in some of the auriferous veins, copper, silver, and lead ores, and many other minerals also occurred, but mostly in small quantities. I might add that the formation of the district just described is upper silurian, largely intersected by igneous rocks in the form of dykes and veins, and granite country lays to the east at a distance of about three miles from the Wilson Hill Reef

Perhaps no part of Victoria is more interesting in regard to the great peculiarity of its auriferous quartz veins than Sandhurst, and at the same time it is the centre of a most thriving mining district. The saddle reefs of Sandhurst are almost unique in their mode of occurrence. They appear to be irregular deposits of auriferous quartz, formed upon either two planes of the rock that intersect one another, such as bedding and jointing, or upon an anticlinal arch in the palæozoic strata.

The sketch plans illustrative of these veins (Figs. 11, 12, 14) show the manner in which they occur in the country rock, and as the sections are taken from the Garden Gully line of reef in Sandhurst, they show the actual manner in which one of the said saddle-reefs occurs in that line. It will be seen in this case the reefs form saddles of quartz in the arch of an anticlinal, and follow along the crown of the arch (in the same bedding plane most probably) either horizontally or with a greater or less dip. They occur one below the other, but each successive reef, as it is met with in sinking, is found to be either to one side or other of a vertical line passing through the one above it, their position being dependent upon the direction of the line normal to the anticlinal arches of the beds of the strata. The quartz is richest in gold near where the legs join the arch or crown of the saddles, and Fig. 13 gives an instance where a saddle-reef is formed upon two-cross planes of the strata, instead of an anticlinal arch.

There are many other peculiar modes of occurrence of quartz veins in this district and in other parts of the colony. The flat reefs of Pleasant Creek is another form under which quartz veins exist in Victoria, and Fig. 15 gives a cross-section of one of these flat reefs in that locality.

Many of the granites and other igneous rocks contain veins of auriferous quartz. A reef in gneissic granite at Omeo occurs as shewn in Figs. 16, 17, 18, and contains large quantities of very auriferous pyrites and some galena; both pyrites and gold being sometimes found impregnating the walls of the lode to such an extent as to pay the miners to crush a portion of the rock. This lode is crossed in its course by igneous dykes of quartz porphyry and diorite, and the quartz matrix of it seems to contain a large percentage of galena and silver as it approaches the dykes of quartz porphyry.

Gold is found in the same district impregnating granite in the form of small grains, and at Kamarooka it is found in thin plates in the laminations of slate. It has also been obtained from sandstone, and there is little doubt that all igneous rocks that are impregnated with iron pyrites have a greater or less quantity of gold in them, most particularly those of the diorite and granitic classes.

Gold Veins of Queensland.

Queensland is the colony of Australasia in which, next to Victoria, the working of auriferous veins has assumed the greatest proportions. Its gold reefs are well known for their richness and established payable character. Charters Towers, Gympie, Rockhampton, Herberton, and other fields are sites of quartz mining industry, and some of these places have peculiarities of their own as regards the modes of occurrence of their auriferous lodes and deposits.

The gold veins of Charters Towers are principally in granite, and one thing remarkable about them, mentioned by Mr. Jack, F.G.S., &c., the Government Geologist to the colony, is that they bear and dip in a manner that points to them as being formed around a common centre, towards which they mostly all underlay. This has been believed by Mr. Jack to have been caused by a sudden depression having taken place near the central point, and thus to have formed a system of fissures surrounding it that in most cases dip towards the centre. I give a plan of three reefs (Fig. 19) shewing their dip and strike, and also a cross section of the reefs after Mr. Jack's plan.

Fig. 20 is a cross-section of St. Patrick's lode, and it is largely impregnated with iron pyrites, which yielded as much as five ounces of gold to the ton of ore when first struck, but afterwards fell off to about two ounces; where decomposed in the upper levels it yielded about the same as the latter, viz., two ounces of gold to the ton of ore. This lode altered its underlay very much in one place, even curling upwards for some distance, as in Fig. 21.

Fig. 22, which is a cross-section of the Rainbow Reef shews the lode between the walls to consist of broken granite on the footwall, quartz without pyrites next, and quartz with pyrites on the hanging wall; both these lodes are evidently of the true fissure class, and interesting examples of such as gold veins. The mineralized or pyritous portion of the lodes are the richest in gold, and expensive machinery to treat pyritous ore exists on this field, and is continually being added to. Large quantities of comparatively poor pyritous tailings lie in heaps at the various crushing plants awaiting the day when improvements in the process of treatment will make them capable of being rendered remunerative.

The Gympie Reefing Field is noticeable for the fact that the lodes depend upon the character of different bands of rock they pass through for the extent to which they are auriferous.

Bands of black slate occur with diorite and other rocks, and it is when passing through this black slate that the lodes contain most gold; being comparatively poor in other parts. Four bands of this black slate are known to exist, and so dependent are the reefs on it that the miners first sink to cut the slate and then drive to where a reef passes through it, and start to work the lode at that place.

The Rockhampton lodes are of a very pyritous character in most instances, and perhaps the most remarkable gold mine in the whole of Australasia, and also in the world that has ever been found during modern times—is situated about eighteen miles from Rockhampton, and is known as the "Mount Morgan Gold Mine." Having visited it lately for the purpose of examining it and the surrounding country, I can describe it as follows:—

The country consists of altered sedimentary strata intersected by numerous dykes and intrusive masses of a variety of igneous rocks, of which syenite is the most prevalent. A sandstone, known as "Daintree's Desert Sandstone," at one time doubtless overspread the country, but has been almost entirely denuded, and only now remains, capping the higher ranges in the district where it forms steep escarpments of horizontally bedded rock.

In places narrow belts of highly altered slates and sandstones occur, which have been caught up in folds of the syenite, and are the last remnants of the sedimentary palæozoic rocks of the locality. They have been greatly altered, some of them being converted into quartzite, are highly charged with iron pyrites, and are intersected by numerous feldspathic dykes. One of these belts may be traced in a north easterly direction from a point immediately south of Mount Morgan, and is closely bounded to the south, east, and west by the syenite. In this belt a wide lode formation occurs, striking N. 30° E. (which is approximately the strike of the belt of rock enclosing it), and having all the appearance of a large dyke. It underlays to the east at an angle of 10° to 15° from the vertical, and has a banded structure parallel to its strike and underlay.

In Mount Morgan itself this lode consists in the higher levels of alternate bands of ironstone (limonite) and honeycombed or porous quartz (with much foreign matter), these bands having the same strike and underlay as the lode, and most probably changing in the lower levels into a dense quartz or numerous veins of quartz, through which a large quantity of iron pyrites is disseminated as minute crystals; veins wholly of iron pyrites may also exist below, that have decomposed on the surface in limonite iron ore. The entire width of these layers of ironstone and quartz with intervening bands of altered rock at Mt. Morgan is about 1500 feet, but those that constitute the main lode that is being worked comprise about two or three hundred feet in width. It appears that the narrow belt of altered strata in this place must have been fractured and opened into immense fissures or a number of parallel fissures which have been filled in with lode matter and probably afterwards undergone re-opening from time to time, and a re-filling with or re-depositing of the quartz and other minerals constituting the lode. Feldspathic dykes which have decomposed to kaolin are also found traversing the lode and parallel to the bands of ore in it.

The honeycomb quartz is doubtless the result of the decomposition of the pyrites, the resulting limonite having been dissolved out and probably redeposited with other matter in open fissures to form parts of the bands of ironstone described above. Every stage of the change can be illustrated by specimens from the mine, the quartz charged with minute crystals of pyrites giving place to a quartz in which crystals of pyrites yet exist, but which is cavernous in places, and this again passes insensibly into skeletons of silica the evident result of the complete extraction of the iron. The lode formation has been greatly denuded along the greater part of its course, the country being cut into deep gullies, and steep ridges which cross it at about right angles to its strike and head from the mountains capped with "desert sandstone," which bound the auriferous belt to the west.

Most of these gullies have been worked for alluvial deposits, and yielded rich returns many years ago, the gold which was obtained in them having doubtless been principally derived from the wearing away of this auriferous belt of country, some of the richest finds occurring just about where the line of the lode formation crossed the gullies worked.

Mount Morgan, standing as it does some five hundred feet above these gullies, is evidently a portion of the lode bearing formation that has not been so much denuded as the surrounding country, but on the same line and at a distance of four miles away a similar undenuded area is found which also carries gold but not so far as yet proved in the same quantities, and other smaller patches also exist.

The gold obtained from the Mt. Morgan mine is of a purer quality than any ever known to have been found before in nature, and the yields from the ore consisting of the ironstone and porous quartz is something enormous. The hill is being worked from the top like a quarry, and to the width of over two hundred feet, some of the ore giving as high as from 4 to 10 ounces of gold to the ton. Tunnels have also been put in to test lower levels.

The laminated layers of quartz in some parts of the workings have the appearance of having been cracked and fractured into minute irregular fissures, and these fissures filled in with silica from solution giving the quartz the appearance shewn in Fig. 24.

The process at present used to treat the ore is that of chlorination, the gold being of too fine a quality to save successfully by the ordinary methods of treating auriferous ores.

No metals are known to occur in the ore excepting the iron and gold, and a small quantity of manganese.

A sketch section across the Mount Morgan lode is given in Fig. 23.

Gold Veins of New South Wales.

The gold fields of New South Wales have in many places a great similarity to those of Victoria, but not in all, and there are certain distinctive features which are worth mentioning.

Whereas, the geological formations that contain the auriferous veins in Victoria are principally upper and lower silurian, those of New South Wales are chiefly, so far as has been determined, upper silurian and devonian, and as the carboniferous rocks of that colony immediately overlie these formations, and although denuded from the portions where the auriferous veins shew are still to be seen, *in situ* crowning many of the highest hills, and in some places covering up many of the valleys, and lying in isolated patches on their sides, it is quite evident that the same amount of denudation of the palæozoic rocks cannot have taken place in that colony, since the deposition of the carboniferous strata as in Victoria. This may be considered proved by the less extent of the alluvial leads in New South Wales, for although a certain amount of denudation of the reef bearing rocks is likely to have occurred prior to the laying down of the carboniferous strata, as seems to have been determined by the fact that some of the lower conglomerates of those measures have been proved to contain alluvial gold, still there is nothing to prove that such denudation has been nearly so extensive in New South Wales as in Victoria.

It would appear that the New South Wales quartz veins have not been worn away to as great an extent as those of Victoria, and that in many parts of the latter colony the entire mass of the upper silurian and devonian rocks have, with their contained quartz veins, been broken up and swept away, and have served to supply the truly rich and extensive alluvial leads that have been such a wonderful advantage to that colony.

A large portion of the carboniferous strata of New South Wales has undergone little or no alteration, but in some parts of the colony they seem to have been metamorphosed or altered to some extent, and to have been much contorted by the intrusion of igneous rocks, and in these places they have been found to contain auriferous quartz reefs or veins. There is, however, a doubt as to whether these altered strata are really carboniferous or whether they are not devonian beds.

I will now proceed to give a description of some of the principal gold veins in New South Wales, choosing those that are peculiarly characteristic of some mode of occurrence.

The alluvial field of Hargraves was the second gold field discovered in Australia, the Ophir being the first, and it is said to have been discovered by a blackfellow, an aboriginal of the colony, stating to those with him when taken to see the gold at Ophir, which is situated some miles away from Hargraves, that he knew where some of the same kind of stuff was, and he brought them to what is now known as Hargraves, and there shewed them on the surface a large lump of gold and quartz. This led to the working of the field, and a great amount of precious metal was obtained from a comparatively small area of ground.

But what chiefly concerns us in this place is the peculiar formation of the quartz veins that exist in it, the denudation of which has doubtless supplied the gold found in the alluvial.

The alluvial was obtained from a gully situated near the top of a high range, this gully being flanked on the one side by silurian or devonian slates and shale, and on the other by a sandstone formation, both strata being inclined at a very high angle.

Crossing this valley, but in an oblique direction, so as to cut through most of the alluvial field, is a quartz reef averaging in thickness from 8 to 10 feet in some places, and from 1 to 2 feet in others, the thickest part being on a small rise near the centre of of the field, and there the vein seems to consist of a large blow on the surface with possibly two legs or branches which divide as they go down. One of these legs dips easterly, and has been worked for some distance from the surface; it coincides with the dip and strike of the shales which are about 90° from the horizontal and north west respectively.

Cutting across the field in a direction more or less oblique to the main vein, are a number of flattish veins, and these are inclined at so small an angle from the horizontal, and are in some cases so near to each other that they actually lay under one another, so that a vertical shaft of some hundred feet deep might be expected to cut one after another as it went down.

Parallel to the main quartz vein or reef, and at varying distances from it and from each other, are small veins of quartz that coincide with the strata, and are thus parallel with one leg of the main reef. These veins are from one to two or three inches thick, and are heavily charged with arsenical pyrites. They strike the flattish veins as they go down, but do not cut them, although they are found again continuing downwards on the same course, immediately below the vein they strike, and continue thus until they strike another vein. It is where these small veins strike the flattish ones that the quartz in the flattish veins is richest,—the immediate point of junction being rich beyond all comparison with other portions of the deposit; as much as 700 ounces has been taken from immediately beneath one of these junctions, and so rich was the quartz in this place that the 700 ounces were taken from only a few feet along the vein and were all crushed out of the stone with an ordinary pestle and mortar by hand labour. It is not, however, always directly under the small vein that the extraordinarily rich quartz is formed, but in a space from about six to twelve inches to one side or the other of this vein (*vide* Figs. 27 and 28), and a shallow gutter, or sometimes a ridge, seems to run along the flattish quartz veins, and it is in this gutter, or on this ridge, that the highly auriferous quartz occurs and is generally easily detached from the other part of the flattish veins. The narrow vein is said to be barren, or nearly so, and highly charged with pyrites for about two or three feet above the flattish veins. Both the narrow vein and its containing wall are tinged green, the latter for about an inch, but this green tint shades gradually away from the vein inwards; arsenical pyrites occurs both in the narrow vein and its walls for about the same distance as the green tint, and in particularly large quantities for some distance above the flattish vein. Both the flattish veins (viz., those with a low angle of dip) and the narrow veins are heaved by a system of lodes that dip in an opposite direction to the former, and intersect them. These latter are of a loose barren character and of from a foot to three or four feet thick.

Sections across parts of the field shew the general mode of occurrence as described (*vide* Figs. 25 and 26). A somewhat similar phenomenon, I believe, exists at Ballaarat, in Victoria; the small vein being there known as the indicator vein, and is followed for its accompanying rich shoots of gold.

The flattish veins seem to have been formed upon joint planes of the country rock. The black places on diagram (Fig. 25) show the parts of the flat veins that are richest. All the quartz in this field is strongly charged with both sulphurous and arsenical pyrites, particularly arsenical, which exists in very perfect cubical crystals. Some of the alluvial gold was in very large pieces, as much as 100lbs. in weight of the precious metal having been obtained in one lump on more than one occasion. The piece of gold and quartz that the blackfellow found, and which led to the opening of the field, weighed over 100lbs., and most of this was gold. It is said to have been found lying near the outcrop of the main vein upon the small rise to the right in the diagram (Fig. 25).

The Hill End reefing field is situated some distance from Hargraves, and some extraordinarily rich patches of auriferous quartz have been obtained from the reefs in that place. A description of a portion of that field is thus given by Mr. E. Pitman, Associate Royal School of Mines, London, and now Chief Mining Surveyor of the colony of New South Wales:—

"Hawkin's Hill, which has become famous on account of the "enormous yield of gold obtained from its veins, is composed of "beds of the altered conglomerate above referred to, dipping to the "eastward. Thin layers of dark slate, with some chlorite slate, "occur at intervals in the conglomerate, and carry lenticular veins "of quartz, with pyrites and potash mica (muscovite). In some "places the mica was found to entirely replace the quartz, and "here the gold was found to be exceedingly rich. The veins are "about twelve in number, and nearly parallel. Their course is "nearly north and south, with a dip to the eastward, and they "occupy a width of from 80 to 120 feet in the aggregate."

The conglomerate Mr. Pitman describes as consisting of quartz and feldspar crystals in a blue silico-feldspathic matrix, with indistinct outlines of large pebbles of slate and sandstone.

At Adelong, also, there are found what are called "ore channels" by the miner. These are narrow belts occurring in the country rock, like large lodes, and consisting of a kind of chlorite schist. Quartz occurs in these places either as lenticular masses or more or less irregular veins, sometimes adhering to the walls of the channel or belt, and at others in some other part of it. The mines have been worked to a depth of 1050 feet. This mode of occurrence of quartz vein is very similar to that described by Mr. Pitman at Hill End, and it seems to be a characteristic mode of occurrence of auriferous lodes in different parts of the colony (*vide* Section of Three Ore Channels at Hill End, Fig. 29).

The following description by Mr. C. S. Wilkinson, F.G.S., F.L.S., Government Geologist for the Colony, of a mode of occurrence of quartz veins upon the Wentworth gold-field is most interesting. He says as follows:—

"The reefs occur at the junction of the serpentine and "hornblendic feldsite, the latter in places passing into diorite. "Along this line of junction is what the miners term the 'lode,' "which at the surface is a fissure, six feet or more in width, "extending in direction S. 50° E. (or nearly south-east and "north-west) for a distance of 50 chains. It is filled with a red "sandy ferruginous clay, containing hard siliceous accretions of "irregular shape, locally termed 'clinker.' This lode dips to the "north-east at an angle of about 65° though in some places it is "nearly vertical. The hornblendic feldsite forms the foot-wall and "serpentine the hanging wall. In the feldsite, at varying "distances along the lode, are quartz veins from a few inches to "six feet thick, coming in from the west and abutting against the "lode, which they appear to follow down and form irregular quartz "pipes or shoots dipping diagonally along the lode towards the "east. The veins have only been found to contain payable gold "where they occur in the lode and form the shoots."

Another lode that is interesting in its mode of occurrence is the Marshall McMahon reef, at Watson's Creek, near Murrumburrah, on the Southern Railway line, between Sydney and Melbourne, and about 230 miles from the former place. This vein is situated in granite, and was very rich in its upper levels, but has become so heavily charged with iron pyrites in its lower levels that the machinery necessary is of a very different kind to that used in the first instance, such machinery is, however, being now erected, and as the lode is one that holds out every reason to believe it to be continuous in depth, good results may therefore be expected in return for judiciously spent capital. This vein appears to belong to the true fissure lode class, and is a good example of such kind of vein. Fig. 9 is a section of a part of the vein below the water level, taken by the writer. This lode seems to have been faulted, but not heaved, and this characteristic may have much to do with the continuance or otherwise of the shoots of gold in it.

Gold veins occur in diorite and other igneous rocks in many places throughout the colony, and those in diorite are generally found to be very rich.

At the head of the Temora alluvial gold-field, which has been one of the richest ever found in the colony, is a rather low diorite hill which forms part of a large dyke or intrusive mass of that rock. This hill splits the upper part of the alluvial lead into two branches, and it is evident that the numerous reefs that intersect this hill have done much towards supplying the lead with its gold. Some of these veins are of a large size, and they all contain gold. So many reefs occur in this small hill that a 40-acre block of land on it contains the portion of seven of them.

The following sketch-plan (Fig. 31) shows the manner in which they intersect the hill at the surface, and the section (Fig. 30) is taken from one of the principal veins called the "Mother Shipton Reef." This reef has yielded in one part as much as 800 ounces from 2cwt. of quartz, and one piece of gold taken from the reef weighed 328 ounces. This magnificent specimen was sent to the Indian and Colonial Exhibition, and has since been presented to the Queen.

The quartz in this vein is tightly contained within the diorite walls and is largely charged with iron pyrites, as is also the walls of the lode for some distance from it. In the upper portion, near the surface, the walls close to the vein are much decomposed and completely filled with cubical cavities containing iron oxide from the decomposition of the pyrites. Both the croppings of this lode and the alluvial deposits close by contained a large quantity of gold, and the soft decomposed country along the junction of the diorite and the slate, which occurs close to the lode as shewn on plan, contained a number of narrow veins of quartz very rich in gold.

The lode has been heaved into the foot-wall three times in a depth of 100 feet, and some of the richest patches were obtained from near where the vein was broken by the heave or slide. The width of the lode is from a few inches to nearly two feet, having an average of about eighteen inches; in some parts the quartz is crystallized.

The South Australian Company's Reef varies in thickness from about two feet to ten or twelve or even more. It has yielded over half-an-ounce of gold to the ton of quartz on all that has been crushed, and is a very promising lode. It is also in diorite country, and has been heaved on its strike. The gold in this vein, particularly in some of the thickest parts, confines itself sometimes to about a foot or so of the quartz, either on the foot or hanging wall, but in the lower levels is more regularly distributed through the reef.

About eleven miles from Temora Gold Field, at a place called Sebastopol, is a quartz vein in talcose or micaceous schist, combined with chlorite schist. This lode has yielded some steady returns of a payable kind with ordinary appliances in years past, and is now about to be worked with more modern machinery so as to treat the pyrites contained in the stone. The following is a cross-section of this lode, and it is one of those lodes that coincides very closely with the bedding planes of the strata, both in strike and dip; for most of its course it varies very much in thickness, being as much as fourteen feet in some places and not more than two in others. It contains, besides gold, iron pyrites, and galena; cross-veins occur with it, and also parallel ones, all of which are auriferous. (A cross-section of "Morning Star" Reef, Sebastopol, is shown at Fig. 36).

The Junee reefs, near the same locality, are in granite or at the junction of slate and granite. Figs. 34 and 35 are cross sections of two of those quartz veins.

The Muttama Reefs, on the branch of the Southern railway line to a place called Gundagai, are in a rock that appears to be quartz diorite, and which is evidently a wide belt of that rock, bounded on each side by slate. A description of them will serve to show the fact of the gold occurring in oblique shoots that dip in certain directions common to the district or locality.

The formation of the district is, as has been said, a quartz diorite, bounded upon both sides by altered slates, both classes of rock carrying quartz veins. The hills, which are steep, have been denuded to some extent, and are intersected by creeks along which alluvial flats of greater or less richness occur.

The slates are probably of silurian age, and from the nature of the diorites it would appear that they are traversed by planes which dip to the west at an angle of about 45° in the same direction as the slates, and this gives a somewhat stratified appearance to them. At one place, near a reef called "The Doctor's," the diorite is hard near the surface but soft underneath, which also favours the supposition that the beds are stratified, as alternate hard and soft belts of tufuceous rock and diorite—as at the Thames in New Zealand—and the same belt of country, with somewhat similar characteristics, extends some miles to the southward, merging into serpentines, and proving gold-bearing throughout.

The veins in the diorite consist essentially of quartz, and in some cases they occur in the planes of the rock referred to, but cross-veins are also found upon fissures or joint planes intersecting the others at different angles. The quartz in the vein has a laminated appearance, and contains iron pyrites, galena, gold, and other minerals. The gold occurs in shoots which dip northward, the stone between these shoots being much poorer than that in them. Some of these shoots have been proved to be very rich, yielding as much as ten ounces to the ton of stone.

The veins of quartz vary from a few inches to three or four feet thick, and some of them dip on their strike (a peculiarity noticed before in Victorian gold-veins); they are formed both upon the planes spoken of as likely to be bedding, and also upon other planes that intersect these at various angles and are either due to joints or fractures.

The sections given (Fig. 31 and Fig. 32) are from two of the principal gold veins or reefs known as the "Muttama Reef" and the "New Year's Gift Reef," but as these two have approximately the same strike and dip in the same direction, as well as being nearly on a line with each other, although over a mile apart, they are most probably the same vein cutting across the country on a bearing of about N.S. with a general dip westward.

A most peculiar mode of occurrence is that of gold in serpentine in conjunction with asbestos. This is to be seen at Gundagai, some fifteen miles from Muttama, and is a continuation of the same belt of country just described. A vein of foliated serpentine exists in a diorite and serpentine formation, and between the leaves of this vein (for the lode readily splits into thin pieces or laminations) gold is found as thin gilding in patches sometimes as large as a five-shilling piece. I have split the leaves off with my knife quite easily and obtained the gold as described. Lumps of crystallized dolomite occur in the same vein, having the dog-tooth form of crystal, and veins of crystallized dolomite, carrying gold, intersect the serpentine wall in some parts.

A section of the foliated serpentine vein shows it to be divided into two parts differing in appearance from each other. Asbestos occurs near to this vein, and is said to have gold in it also.

Quartz veins also are found in the neighbourhood, and some of the gullies have been worked for alluvial gold with success.

Cross Section of Foliated Serpentine Vein (with pieces of crystallized dolomite) containing gold, is shown in Fig. 33.

At Solferino quartz veins occur that have been found to contain marvellously rich patches of auriferous quartz.

One of these I examined is in altered slate near its junction with a granite containing much black mica. It contains calcite as well as quartz, and in many places the calcite occupies the whole of the vein. Both the quartz and the calcite contain gold and iron pyrites with some galena, and often enclose portions of country rock. Some of the patches of auriferous vein-matter have given tons that yielded at the Sydney Mint as high as 600 ounces to the ton. Five tons of stone treated at that place gave over 2,600 ounces of gold. The lode, however, varies much in richness, the intervening quartz and other lode matter between the patches sometimes only equalling 5 dwt. to the ton. It also varies much in thickness from a few inches to about three feet, and it strikes across the bedding of the slate obliquely. The gold is chiefly in a free state, and the quartz has a bluish tint.

The Gold Veins of New Zealand.

The most important gold fields in this Colony are situated at Reefton and the Thames.

At Reefton, and within twelve miles radius from that town, a great number of reefs have been worked, some with good and others with unpayable results, and although the conditions have been somewhat similar throughout, the reefs themselves have varied a good deal both in size, productiveness, and distribution of the stone and gold. A sketch section Fig. 32a, across the field shows that several series of formations occur, in only one of which have reefs been hitherto discovered.

These gold bearing rocks, which are of lower carboniferous age, consist of fine grained silky slates, interstratified with sandstone and are folded into anticlinals and synclinals, the sides of which dip at angles of 60° and less from the horizontal, and they are traversed by dykes of diorite and reefs of quartz. The diorite, however, is seldom associated with the reefs themselves where worked, but the most productive country has been the slate band referred to.

Most of the reefs here are steep, underlying from 60° to vertical, and in one case at least, the Welcome Mine at Boatman's, not only does the gold occur in shoots, but the stone itself is found under the same conditions. This mine has been worked to a considerable extent, some 500 feet in depth, and the quartz is frequently three feet in width, but pinches out in every direction and then makes again, a series of blocks of quartz occurring, which although following the same line are almost disconnected from one another, and there have been times in the history of the mine when neither quartz or gold were to be seen in the levels. Notwithstanding this fact, there is distinct evidence to be found in the walls of the lodes, that movements have taken place, and consequently that they belong to the true fissure lodes.

At the Thames some most instructive reefs may be examined, including both true fissure lodes and others, which will be mentioned further on.

Amongst the first class I may mention the Queen of Beauty, Caledonian, and Alburnia Reefs, as affording fair types of those which are worked.

Of these the Queen of Beauty Reef stands nearly vertical, and has been worked to a depth of nearly 650 feet. The country rock consists of tufaceous sandstone, which varies in character from the surface to the 600 foot level, but at that point a breccia comes in which is found cropping out on the surface in Karaka Creek.

The reef changes its underlay from north-west to south-east, and is intersected three or four times in the shaft which has been sunk. The yields from this mine have been more uniform in character than those from any other mine on the field, but even here there have been richer and poorer parts of the stone.

After the breccia was met with, although there was still gold in the stone, it was not sufficiently rich to pay the expenses of raising and treatment.

The Caledonian Reef, on the other hand, underlays at an angle of about 45° and has been worked in three claims: the Manukau, Golden Crown, and Caledonian, as shewn in the plan, Fig. 34a, taken from the plans at the mine.

One continuous shoot of gold was followed from the surface to the 400 feet level, at which point it was cut off, close to the boundary of Tookey's claim, a change in the character of the country rock coming in there.

Through the Manukau and Golden Crown claims a hanging wall leader was traced following the shoot of gold, and this appears to have aided the country in increasing the productiveness of the shoot in the reef.

In the Caledonian the shoot was considerably enlarged, as shewn on the plan, and there is a very interesting feature in the reef itself in that Claim, for instead of being one reef only, as in the upper levels, it splits into three bands, which form a net-work of veins as in the following sketch, which separate and come together, and while the average course of the lode is N.N.E., it is when the branches strike more nearly north-east that the best stone is found.

The sketches Figs. 33a and 34a are taken from Mr. S. H. Cox, F.C.S., F.G.S., Report on the Gold Fields of the Cape Colville Peninsula.

In the Alburnia Claim the reefs are standing at a steeper angle than in the Caledonian, but are not so steep as the Queen of

Beauty reef, and the following sketch, taken from the same source, will show the distribution of the richest parts of the stone.

It will be seen in this claim again that the richer stone is confined to certain belts of rock, but at the same time certain junctions of lodes occur along which rich deposits of gold have been found.

South Australian Gold Veins.

South Australia, including the Northern Territory, comprises a very large tract of country, inasmuch as it extends right across the Continent of Australia from south to north, being bounded on the east by Victoria, New South Wales, and Queensland, and on the west by Western Australia. Gold veins exist in many places throughout this tract, and comprise many of the different modes of occurrence of such veins, but much of the country is but partly known and very little prospected as yet.

In the hills about Adelaide, the capital of the Colony, quartz veins carrying gold occur and some of them are being worked; they exist in sedimentary rocks possibly of lower silurian or pre-silurian age, in various metamorphic rocks such as mica schist, &c., and dykes of coarse granite and other igneous rocks intersect the country. The quartz veins are somewhat similar to those of Victoria and N. S. Wales, a large amount of iron pyrites occurring in many of them.

One of the most interesting districts in the colony is that of Waukaringa and Tetulpa, and as a reefing country I am sure it will yet become much noted.

The country consists in that part of large open plains, covered with salt-bush, and having barren-looking hills as ridges crossing them. Highly tilted and partly altered sedimentary rocks comprise the formation. The rocks are possibly early palæozoic, and they become more and more altered as you travel eastward until they pass into mica schists. Along the ridges and across the plains are to be seen numerous quartz reefs intersecting the strata and continuing on their course for miles.

The fact that very little alluvial covers the rock on the plains, and that it therefore shews in many places quite bare, enables the quartz veins to be easily followed on their strike across the country. These veins are auriferous, and some of them have been and are being worked. One of these, called the "Alma Reef," is a large vein, having two parallel veins that sometimes run quite close to it, only a foot or so being between them, and at other places diverge from it to some hundreds of feet.

The Alma Reef can be traced for about ten miles across the country; most of the way it runs along near the top of a hill and its sloping continuation as a low ridge. At one place, where worked, it has an underlay to the northward of about 30° from the horizontal, the strata dipping about 45° in the same direction. It carried most of its gold in the upper levels in a decomposed iron ore or gossan and in a ferruginous quartz of a very hard character. In the lower levels it ran into a solid highly pyritous ore. Other reefs in the same locality seem to be of a similar nature, while some of them contained a very large amount of galena and copper.

The thickness of the Alma lode was from about eighteen inches to four feet in the underlay shaft at the principal mine, but in other parts of its course it sometimes became even thinner than above, while in others it was over four feet thick; its underlay also decreased as it went easterly, the dip of the vein becoming greater from the horizontal. I have not, however, visited it for years, but I believe it is being worked at the present time.

At the Ulooloo old alluvial diggings some nice alluvial gold was obtained. Large iron-stone reefs occur, and one of the leads was richest where a lode of this sort crossed it. The formation of the strata at this place is very peculiar.

Of gold veins in other parts of the world, those of the United States hold the greatest prominence, and the "Comstock Lode" is certainly the most remarkable auriferous one in that country, and one of the most remarkable in the world. It is situated in the State of Nevada, and occurs upon the side of a diorite hill named Mount Davidson. It occupies for part of its course a line of contact between diorite and diabase rocks, but further north is contained wholly in diabase, and to the south it just touches metamorphic rock on one side while being bounded on the other by diabase. It has been traced for a distance of over four miles in a nearly due N. and S. direction, and it dips towards the East at an angle of about 45° and has a general thickness of from 20 to 60 feet. The fissure upon which it has formed is a line of fault. Its vein matter consists of country rock, clay, and quartz, all of which have been much crushed, probably due to the moving of the walls of the fissure on each other. A great heat commenced to prevail in the lower levels of the workings on this lode, which were over 3,000 feet in depth, and I understand that this has so much increased of late that the miners are unable to work for any length of time.

This lode has yielded enormous returns, over $300,000,000 worth of bullion having been taken from it up to 1st June, 1880, and of this $175,000,000 was silver and the remainder gold; $115,871,000 of this had been paid in dividends.

Some very interesting investigations connected with metalliferous lodes have been made at these mines, to some of which I shall refer further on in my dissertation on the origin of quartz veins and other auriferous lodes.

The Bassick Mine in Colorado, in the United States, is certainly one unequalled for its peculiarities in any other part of the world. It consists of a hill of trachyte and felspathic conglomerate about 200 feet above the surrounding country. In this hill is an irregular fissure, elliptical in horizontal section, and about 100 feet long by 20 feet wide; it has been followed for over 800 feet downwards. The ore in this fissure is composed of concentric layers surrounding individual worn and rounded boulders of country rock. These boulders are from the size of small pebbles to two feet in diameter, and the ore that surrounds them is in three or sometimes four layers. The first layer consists of sulphides of zinc, antimony, and lead, with about 60 ounces of silver, and from one to three ounces of gold to the ton. The next layer contains more lead, silver, and gold than the last,—frequently as much as 100 ounces of gold, and 150 to 200 ounces of silver per ton. The third layer consists of blend, with from 60 to 120 ounces of silver and 15 to 50 ounces of gold to the ton. The fourth layer, when it occurs, is formed of chalcopyrite (copper pyrites) and varies much.

Near the centre of the deposit the boulders are larger, and the layers of ore thicken and contain more of the precious metals; but the boulders gradually become smaller, and the layers of ore thinner and poorer, as the sides of the fissure are approached, until they merge into a pebbly conglomerate in a felspathic base and from thence into the country rock trachyte.

The interspaces between the boulders are filled with quartz and tetrahedrite (grey copper ore), and this quartz has the appearance of being deposited from solution in a gelatinous state. Graphite occurs in cavities between the boulders. This deposit is thought by some to have been the site of a geyser or mineral spring carrying minerals in solution in its waters.

The El Callao Gold Mine in Venezuelan Guiana, is one of the richest in the world. It is said to be in felstone, containing pyrites, the quartz of which the gangue consists, being white occasionally tinged with green. I have examined specimens from this mine, and they are very similar to some of the stone taken from the quartz veins in the Australasian Colonies. From 1871 to 1879 a total quantity of 67,362 tons of quartz is said to have been crushed from this mine for a return of 252,973 ounces of gold; and in 1880, 18,624 tons of quartz for 54,013 ounces of melted gold.

The gold of the Ural Mountains is contained in quartz veins in such rock as diorite and serpentine. Deposits of gold are found enclosed in the country rock. The quartz veins in that place are said by the late J. A. Phillips, F.R.S., to be especially interesting on account of the influence exercised upon them by the country rock. The crystalline schists are traversed in the locality by dykes of finely granular granite, and it is said to be only in the vicinity of these that the quartz veins are found to be productive. The granite near the auriferous veins is impregnated with iron pyrites, which has become partially converted into brown iron ore. The average yield of gold from these veins is about 8 dwts. to the ton. The gold is accompanied by galena, grey copper, and other minerals, including native silver and bismuth ochre.

An essay on the peculiarities of gold veins would not be complete without mentioning those of Transylvania in Hungary. The most remarkable of the auriferous deposits of that part are to be found at Voeroespatak, and they may also be classed amongst the most remarkable and interesting in the World, and some of them have been worked for a period said to date back to the time of the Roman Empire. A description of the principal workings in Voeroespatak is as follows :—A Mount called the Csetatye, composed of a decomposed igneous rock probably propylite, is surrounded by tertiary sandstones of Eocene age. In this Mount a large lode formation occurs consisting of a perfect network of veins. These veins are of the character of true fissure lodes, and they pass out of the igneous rock into the tertiary sandstone, and are prolific in both. The sandstone in the near vicinity of the Csetatye Mount is much silicified and interbedded with tufa strata and conglomerates. Upon the top of the Mount is a large excavation made probably in the time of the Romans, and immense cavernous workings exist underneath. The lode matter thus worked consisted of a network of veins containing gold both in them and in the intervening country rock. These veins are said to have been nearly vertical and irregularly columnar; they consisted of quartz, calcspar, and iron pyrites, and sometimes of diallogite, and contained gold in minute grains or in a crystallized state. Some of the diallogite veins are found at times perfectly permeated with crystalline gold, and when cut and polished have a beautiful appearance. Blende, tetrahedrite, and many other minerals are found associated with these veins, and the whole mountain is impregnated with metallic sulphides, chiefly iron pyrites.

The telluric veins (called locally "clifts") of this district are also remarkable as containing sylvanite, nagyagite, and other telluric minerals, with native gold, galena, blende, stibnite, pyrargyrite, and native silver, the principal gangue being quartz and diallogite. They are said to be richest in a slightly decomposed rock, but fall off in richness both when the rock becomes much decomposed or not decomposed at all. They exist principally in the igneous rock propylite, but segregation veins also occur in a granular limestone in the same locality. Offenbanya and Nagyag are the names of the principal places where the veins are worked in the district. A slight difference exists between the gangue of the lodes in these two places, but otherwise they are essentially the same.

In 1873 no less than 416 Mining Companies are said by J. S. Phillips to have been at work in the gold districts of Transylvania, giving employment to 8,369 miners; and in 1877 this region produced 27,870 ounces of gold, and 20,108 ounces of silver, besides other metals.

Many other parts of the world have auriferous veins, but I believe sufficient examples have been given in this essay to embrace all the different and most interesting modes of occurrence at present known. I will, therefore, now proceed to the most probable origin of these various lodes and deposits, and the manner in which they have been formed.

Before doing this, however, I must devote a few lines to a description of certain special modes of occurrence of gold which appear to bear somewhat closely upon the origin of the reefs. The deposits to which I allude are instances in which rocks have become impregnated with gold.

There are several remarkable instances of this mode of occurrence of the precious metal, and every year brings to light fresh evidence of certain rocks being charged to a greater or less extent with it.

It has been known for some years that the granites of the Timbarra Gold Field, New South Wales, contain a certain amount of free gold, more especially where the granite is in a decomposed state, and works have been started to sluice away the soft portions of the rock. It has, however, been proved by assay that in a number of places in the same district the undecomposed granite also carries gold to the extent of several pennyweights to the ton, and I have seen specimens from there in which free gold was visible in the rock (granite), sometimes in good sized specks. I may also mention the Yal Wal Gold Field, likewise in New South Wales, in which district the rock impregnated is a slate.

The lowest rock of the district is granite, which rises in the spur of the hill west of the Danjera Creek, and may be traced for many miles through the country; and resting upon this, and standing at angles from 45° to vertical, a series of schists, slates, quartzites, and breccia occur, striking north and south, and dipping east away from the line of elevation. It is only in the softer belts of sedimentary rock that payable gold has yet been obtained, and the characters of the different deposits are very curious. The ore deposits vary from a few inches to 100 feet in width, and gold has been obtained both in quartz veins, striking approximately north and south; in thin leaders which traverse the auriferous belts in all directions; and again in slates, which compose the entire mass of the ore channels in some parts of the ground. The claim, which is working on the widest of these channels, has saved £15,000 worth of gold since 1882, and the last 1,498 tons crushed yielded at the rate of $1\frac{1}{4}$ ounces to the ton.

In many cases the tufaceous rocks of the Thames (N.Z.) are impregnated with sufficient gold to make it worth while crushing them, and in the Waiotahi Mine especially the rock is frequently crushed for the gold it contains.

The gold-bearing character of the granite at Omeo, Victoria, has already been referred to. I would mention the fact that the late Rev. W. B. Clarke, F.R.S., was the first to call attention to this mode of occurrence of gold in his work entitled the "Southern Gold-fields."

Gold has also been found in lodes of antimony and bismuth, and also in veins of calcite; and it is known to exist in the Hawkesbury sandstones of New South Wales which are comparatively unaltered strata of Triassic age.

The Origin of Gold-bearing Veins.

In investigating the origin of gold-bearing veins or the manner in which they are most likely to have been formed, I think the foregoing notes have shewn that they have so much in common with other mineral lodes, as regards their actual physical peculiarities and the manner in which they occur in the rocks, that we may consider them to have been formed under very similar circumstances and are dependent to a great extent upon the same laws of nature for their modes of occurrence.

In seeking therefore to determine the most probable manner in which gold veins and other mineral lodes have been formed, it will be well first to mention some of the different theories that have been propounded on the subject, and after having briefly referred to the various arguments for and against each of these, to consider which, if any, have the best claim to be accepted as most applicable and best able to account for the various phenomena observed in connection with the occurrence of metalliferous lodes, and more particularly those in which gold is the most prominent metal. The various theories proposed may be classed under the following heads:

1. Igneous injection.
2. Sublimation.
3. Aqueous ascension.
4. Aqueous solution.
5. Lateral secretion.

6. Molecular aggregation.
7. Electrical currents.

The theory of igneous injection supposes that the quartz or other matrix of the veins or lodes together with the contained metals or minerals has been forced into fissures, cracks or cavities, caused in most cases by the same igneous force that injected the vein matter and that these having become solidified in the fissures, the lodes were thus formed. It therefore supposes the formation of veins and lodes to have taken place very rapidly and in close proximity to violent volcanic disturbance.

The sublimation theory considers that vein fissures were filled by the condensation of volatilized metals and minerals derived from some portion of the interior of the earth where intense heat prevailed.

The advocates of the *aqueous ascension theory* argue that the mineral waters containing the metals in solution have risen in fissures or cracks in the earth, and precipitated their contents upon the walls or sides of these fissures, (and in any cavities they could obtain access to) until they were almost or entirely filled with lode matter.

Those who support the *aqueous solution theory* believe that all the contents of mineral lodes were washed in from above.

Lateral secretion accounts for the formation of most veins and lodes by stating that the rock enclosing the lodes contains in itself nearly or all the constituents of the veins, and that these have gradually accumulated in the lodes in consequence of water dissolving various minerals and metals from the country rock, and then after filtering through the walls of the fissure redepositing all or some of them.

Molecular aggregation considers that the minerals and metals of the veins have collected together in a somewhat similar manner to that in which minerals collect together in the crystalline rocks, for instance like pegmatite in granite and the concentric layers in orbicular diorite.

Those who support the *electrical* hypothesis, say that both the formation of the fissures and the collection of the minerals in them could be produced by electrical action.

The advocates of each of these several theories have proved to a certain extent the possibility of veins of minerals being formed in accordance with their views, and interesting have been the experiments made to support their arguments. Magnetite for instance has been formed by sublimation in reverberatory furnaces as well as in volcanic fissures, and Daubrée succeeded with the aid of flourine in forming tin ore, oxide of titanium, and quartz by sublimation. Durocher passed gases and metallic vapours into heated glass tubes and obtained crystals of blende, iron pyrites, galena, sulphite of silver, sulphite of antimony, and sulphate of bismuth. Electricity is shewn to be capable of creating fissures and filling them with metals by an experiment made by Mr. R. W. Fox, who produced fissures in clay and filled them with metallic substances by means of electrical currents generated artificially.

Water under heat and pressure has been shewn to dissolve or decompose certain minerals and redeposit their constituents or some of them in other mineral forms.

Fissures are known such as the Steam Boat Springs, about fourteen miles from the Great Comstock Lode, that are in the actual process of being filled with a deposit from heated water and vapours. Veins of crystallized mineral have been found in cracks in the masonry in the bottom of a furnace, either through injection of the metals composing them in a molten state or by sublimation, and every one with any chemical knowledge knows how metallic compounds can be produced in the laboratory by precipitating metals from solution, and how these may be redissolved and deposited again in other mineral forms.

Many believe that lodes have been formed under all or most of the various conditions described, and that no particular one can be made to account for all the phenomena observed, and it is quite likely that such has been the case to a certain, but I believe only to a limited extent, and that most modes of occurrence can be accounted for by the theory of lateral secretion, combining with it the probability that the minerals have not in all cases been deposited at the very spot at which they entered the fissures, but may in some instances have been carried by circulating currents for some distance before being precipitated. This will allow the theory of ascending water holding metals in solution to be sometimes, but not necessarily always the one by which the metals or mineral matter have been conveyed and lodes formed.

As regards the auriferous lodes of Australasia and other parts of the World, they certainly do not in my opinion bear any sign of igneous injection, for not only does it seem impossible for such a complete ramification or network of quartz veins, as commonly occurs in rocks in our gold fields, to have been formed by the injection of molten matter, but deposits of quartz and ore are found completely separated from any other lode or vein, and show no inlet through which molten matter could have found its way. One would naturally also expect to see some evidence of intense heat in the baking or hardening of the sides of the fissures, as may be seen where sedimentary strata are in contact with igneous rocks, such as dykes of dolerite or other rocks of volcanic origin, which have been at one time in a highly heated state.

The *sublimation theory* is also met by somewhat similar difficulties, as to the way in which metals could reach such places as we often find them in, and we should moreover expect to find, were this theory correct, that all veins become richer in character the deeper they are worked. I need hardly say this is not universal in the history of our mines.

Having, however, done away with the igneous injection and sublimation theories, as regards the mode under which the greater number of mineral lodes have been formed, and having endeavoured to shew their entire inapplicability to the quartz veins of Australasia, I think before seeking to prove that lateral secretion or any other mode is best applicable to auriferous lodes, I should try to account in the most reasonable way for the forming of these fissures or openings in the rocks, that afterwards became filled with the materials of which the lodes consist, for as I have put injection aside, which considers the containing channels of the veins and lodes to have been formed for the most part about the same time as the injection of the molten vein matter, no other theory, unless it be that of molecular aggregation considers these channels were not already open to some extent before the deposition of the vein matter commenced.

As true fissure lodes may generally be seen to have been formed upon a fault in the country, the origin of such channels is at once apparent, and can be seen to have been caused by a violent rending of the rocks, making immense cracks in them, generally independent of all natural planes. These cracks may be opened either by tilting of the rock on both or either side, or through the walls sliding on one another, or by a separation of the walls to form a gaping fissure. In the second case the opening for the lode matter may be brought about in the manner shewn in diagram, the irregular line being the crack before it has opened to any extent, and the other diagram showing how it would appear after the walls had slid on each other in opposite directions, and it will be seen by this how veins formed in such a manner must be of irregular thickness. Fig. 10 also gives an illustration of how veins may be formed by the sliding of the walls of fissures on each other, caused by the depression of a portion of the country rock.

This disturbance of the rock, leading to such fissures being formed, may be due to one of two causes. 1st. A sinking of the strata in a certain place while another portion remained firm would lead to the formation of a system of cracks or fissures. 2nd. The intrusion of an igneous rock would act in a similar but more violent manner.

In both cases fissures would be formed, but in the former the action being possibly slower, the fractures would be most likely to follow natural planes in the country rock, and hence the instances in which we find systems of veins coinciding with and often crossing each other in the bedding and joint planes of the rock.

The folding of strata into anticlinals and synclinals may also lead to fractures somewhat similar to those which would be formed by bending a piece of iron or wood, and this may cause such cavities or fractures as those that contain the saddle reefs at Sandhurst in Victoria.

I have very little doubt that many fissures are increased in size by the circulation of subterranean waters, and are sometimes worn into irregular cavities and openings that are afterwards filled with ore, and it is also quite likely that such chambers and pockets as seem to have no inlet or outlet, may have been excavated by the action of solvent waters that carried away the minerals through the pores of the country rock, and the reason for believing this to be the explanation of such cavities will be seen further on when I treat of lateral secretion.

The theory that veins have been formed by a molecular substitution and aggregation of minerals like pegmatite veins in granite, must terminate with the fact that such veins have not smooth and regular boundaries like the wall of lodes, but gradually merge into the adjoining rock, large crystals of felspar often occurring, part in the vein and part in the granite.

The idea held by some that veins of quartz and lodes in general have been formed upon natural planes in the slightly open or fractured rock, and that the included mineral has by its expansion during crystallization forced open the cracks, and by repeated action of this sort quartz veins or other kinds of lodes of various dimensions have been formed, can only be held on the supposition that the lodes were formed very near the surface, and do not extend to any depth.

Experience has proved, however, that we have as yet no right to limit the depth at which lodes may be formed in any way whatever, as quartz veins and other lodes are worked for over 2,000 feet below the surface, and certainly extended at one time for thousands of feet above where the surface now exists, and have by being broken up, together with the containing rock, supplied immense alluvial leads, as in Victoria and elsewhere.

The faulting and heaving of lodes by others which have been subsequently formed shows that intense action has occurred, and to think that the expansion due to crystallization of silica or any other substance, could move a mass of rock even 2,000 feet thick cannot for a moment be entertained.

It is a noticeable fact that mineral lodes are in districts in which the strata have been broken through by the intrusion of igneous rocks or by other means, and that this is always the case.

FILLING OF VEINS.

Having adopted the theory of lateral secretion to account for the formation of most metalliferous lodes and of auriferous quartz veins in particular, let us consider what action must have taken place in nature to render such a theory comprehensible and legitimately entitled to be taken as the most feasible method of accounting for the various phenomena connected with lodes and veins, Lateral secretion supposes that the following actions may have taken place because they are in accordance with experiments and observed facts.

1. That water containing carbonic acid and other solvents is capable of dissolving all minerals and metals, and when the temperature is high this solvent action is greatly increased.

2. That such waters will retain these metals and minerals in solution until a change of condition causes the re-deposition of all or some of them, and it also affirms :—

3. That certain, non-metallic minerals have been proved to contain the metals we find in lodes and veins, and that these minerals frequently occur in the rocks which contain lodes or ore in close proximity to them.

4. That the metalliferous contents depend to a great extent upon the containing country rock, and that lodes and veins are generally richer in certain metals when they occur in or close to rocks that are largely composed of the minerals that contain such metals.

5. That water is capable of dissolving most if not all minerals to a greater or less extent, may be taken as proved, for all natural water contains some mineral in solution. It has also been ascertained by actual experiment that water will act upon certain rocks and clays when the conditions of pressure and temperature are varied so as to effect a re-arrangement of the elements to form fresh minerals, and the structure of the crystalline rocks of the granite type, affords evidence that they have been transmuted or changed from sedimentary rocks under the action of water at great depths below the surface where the temperature would be high and the pressure great.

6. That the mineral waters of our mines even at a low temperature contain metals in solution is most certain, as analyses have proved it to be the case, and that they deposit their metals combined as minerals is also known. Organic substances are frequently found silicified in our veins and alluvial leads and such minerals as marcasite and siderite formed.

It is also strongly worthy of notice that the quartz and other matrices of metalliferous veins, and the metals and minerals associated with them, are often found in the lodes in separate layers parallel to the walls of the lode or to each other, and having all the appearance of being deposited consecutively as from mineral waters.

or vapours carrying their constituents in solution. The laminated quartz veins and other auriferous lodes of Australasia give numerous instances of this phenomena, and not only does the quartz or other matrix have a laminated appearance, but the gold, iron pyrites, and associated minerals occur continually in seams parallel to the walls of the lode or vein, and between the layers of quartz are often found very thin leaves of a kind of slate (mostly chlorite slate). Flucans or slickensides sometimes exist between the lodes and their walls. Amongst other instances, given in this essay, of laminated lodes may be mentioned the Marshall McMahon Reef at Murrumburrah, New South Wales, the Mount Morgan lode in Queensland, the Catherine Reef at Clunes in Victoria, the St. Patrick and Rainbow Reefs at Charter's Towers, Queensland, and the Bassick lode in Colorado, United States; this last being a most remarkable instance of consecutive deposition of minerals, and if we depart from auriferous lodes to those worked chiefly for other metals or minerals the instances of laminated veins are innumerable.

In connection with this it will be well to refer to Mr. Wilkinson's experiments on the deposition of gold from solution in the presence of organic matter, and without quoting these experiments which may be seen detailed in Locke's book, entitled "Gold," attention should be called to the fact that they conclusively prove that gold can be precipitated from solution in the presence of organic matter by either pyrites, antimony, or several other minerals.

It is of course well known that gold is present in sea water in small quantities, and it must consequently be inferred that many of the subterranean streams of water also carry gold in solution.

Mr. Skey has stated that he obtained the same results as Mr. Wilkinson, even when no organic matter was present in the solution, and ascribed the action to the formation of a voltaic pair between the pyrites and gold. Both these gentlemen have applied their observations to account for nuggets in the alluvial deposits, but the information given appears to me of much greater value in accounting for the occurrence of gold in veins situated in the internal laboratory of the earth.

The Hot Springs of New Zealand which deposit silica as a sinter, and the Steam Boat Springs in America which are gradually filling up fissures with silica containing metals which are precipitated from heated water in course of circulation, are instances of what water can do in this respect.

That the contents of lodes and veins are influenced by the rocks containing them has not only been held by scientific men, but also recognised as an axiom by the practical miner in his prospecting and working of lodes and veins.

Certain formations and classes of rock are associated with certain metals, for instance, granite with tin, clay slate with copper, quartz porphyry with silver, and limestone with lead, and although such an arrangement has been shown to have many exceptions, these, only tend to prove the rule.

It is well known how the tin, copper, and lead lodes of Cornwall generally alter the leading metals when the formation changes, and we have ourselves seen how gold veins form no exception to such a rule, but not only generally occur with certain rocks, but also depend for their richness on the different belts of country they pass through,—the same lodes being always poor in one kind of rock and richer in another in the same district.

The Charters Towers reefs in Queensland, and others mentioned in this essay are instances of such influence being exerted by different rocks on lodes.

It may be considered as a fact that the rocks that are associated with auriferous lodes are principally those that contain magnesian minerals—such as hornblende, olivine, augite, and biotite,—all of which abound in those rocks that contain or are in close proximity to gold veins; and this is not only known to be the case in Australasia, but seems to be so elsewhere.

As to those minerals that are found in conjunction with gold in veins, iron pyrites is by far the most common, after which come galena, zinc blende, arsenical pyrites, and copper pyrites. None of these, however, hold such a prominent place as iron pyrites, in fact, most of the gold found in our veins is either in iron pyrites or was in it before the decomposition of the pyrites set it free.

Iron pyrites exist in many of our rocks to a great extent; granites and other rocks that are commonly associated with our mineral veins are often largely impregnated with it, and where gold is found disseminated through such rocks, it has doubtless been chiefly derived from the pyrites.

It will be clearly seen, therefore, how lateral secretion accounts for the formation of auriferous lodes.

That mineral waters have dissolved the metals contained in the rocks adjoining the lodes or close to them, and re-deposited the same in the veins, seems most feasible, and more in accordance with observed facts than any other theory that has been advanced. Of course, such deposits as dyke lodes or ore channels may be formed either by lateral secretion or igneous injection, so far as the main body of the lode is concerned, but the metalliferous parts of the lodes are generally veins of quartz or some other matrix, and these have been formed in the dyke or channels by the process of lateral secretion in every instance, whether the main body of lode was so or not. If metals are found as well in other portions of a dyke, they are of the nature of impregnations, and may either be contemporaneous with the rock itself, or afterwards deposited there by infiltration of mineral waters.

In the Comstock lode, not only has the country rock been proved to contain in its minerals all the matter found in the veins, but also the gold and silver are in the same proportion to each other in the rock as in the veins. The decomposed portions of the walls of the lode have not the same amount of gold and silver in them as the undecomposed, and sufficient decomposition of the walls is said to have taken place to account fully for as much matter as is found in the veins, by supposing such to have been derived from the decomposed parts.

The intimate association of iron pyrites with gold has been already referred to, and the fact that in the lower levels of our gold mines, the larger proportion of the gold occurs in this mineral has been shown. This will not appear so remarkable when we consider that nearly all metals are found as sulphides in the lower portions of metalliferous mines, in other words, in those parts that are least altered or decomposed, and appear to have retained to the greatest extent the original state in which they were first formed.

As to whether gold ever exists in a sulphide form in the pyrites is not known, although some experiments seem to imply that such is probable, but the sulphide of gold being a most unstable compound, renders it exceedingly difficult to determine whether it ever exists in nature in that state. It is certain, however that iron as a sulphide is the most usual associate of the precious metal, and therefore, if these two, iron pyrites and gold, are deposited from solution in the veins and lodes, they must be precipitated together by the same agent, or one is the precipitant of the other. Experiments in the laboratory have proved that sulphate and sulphide of iron will precipitate gold from a solution of chloride of gold. Quartz also may be produced by a heated solution of carbonic dioxide decomposing silicates and depositing the silica on cooling.

Noting such facts as these, and then taking into consideration the intense heat, great pressure, aud other known and unknown agencies that must be at work in the internal laboratory of the earth, it seems that there are good grounds for believing in the strong probability of most of our metalliferous or mineral veins, and lodes, being deposited from mineral waters that obtain their contained metals and minerals from the country rock through which they percolate, by the strongly solvent powers they possess under certain conditions; conditions that are at present only partly guessed at and may never be fully understood practically, but always remain as theories, although based on strong circumstantial evidence.

RESULTS OF OBSERVATIONS OF COMETS VI. AND VII., 1886, AT WINDSOR, N.S.W.

By John Tebbutt, F.R.A.S., &c.

[*Read before the Royal Society of N.S.W., September 7, 1887.*]

In December, 1886, I communicated to the Royal Society my observations of Comets Fabry, Barnard, and Brooks, and they were duly published in the Society's Journal and Proceedings for that year. In addition to these comets two others were observed during the year, which have proved of unusual interest to astronomers. These are Comets VI. and VII., 1886.

Comet VI., 1886.

A telescopic comet was discovered by the indefatigable Pons on June 12, 1819, which turned out to be a remarkable one, inasmuch as it was shown by Professor Encke to be moving in an elliptic orbit with a period a little exceeding $5\frac{1}{2}$ years. Notwithstanding the shortness of the assigned period 39 years elapsed before the comet was again seen. On March 8, 1858, Dr. Winnecke at Bonn discovered a small comet which was at first regarded as a new one, but on calculating the elements of its orbit he made the further pleasing discovery that the object was identical with that detected by Pons in 1819. The comet was not seen at its next return to perihelion, but in the *Astronomische Nachrichten* of February 11, 1869, O. Linsser of Pulkowa published a sweeping ephemeris based on elements derived from the appearance of 1858. On April 9, he issued an extended ephemeris which enabled Dr. Winnecke to rediscover the comet on the date of publication. At this appearance it was well observed at several stations. In the above periodical for November 23, 1874, Dr. Oppolzer of Vienna, published the result of an investigation of the orbit from the series of observations in 1858 and 1869 and also an accurate ephemeris for January and February, 1875. In this investigation he carefully accounted for the perturbations of the comet's movements due to the action of the large planets Jupiter and Saturn. With the help of this ephemeris M. Borelly, at Marseilles, detected the comet on February 1, and the interesting visitor was again well observed. The errors of the ephemeris did not exceed sixteen seconds of time in right ascension and one minute in declination The comet itself was faint and diffused. It was not seen at the next return, but in the *Astronomische Nachrichten* of March 30, 1886, appeared an approximate ephemeris by Dr. Lamp, of the Royal Observatory at Kiel, calculated on three assumptions of the time of perihelion passage, namely, August 27, 31, and September 4, 1886. This ephemeris extended to the close of June, 1886, but the comet not having been discovered in consequence probably of its great distance from the sun and earth, another ephemeris was published by the same astronomer extending to the middle of September last. Meanwhile the comet's distance from the sun and earth was gradually diminishing. On August 25, I received from the Government Astronomer of Victoria, a copy of a Kiel telegram announcing that the comet had been detected at the Royal Observatory, Cape of Good Hope, on the 20th, when its R.A. and declination were 13h. 10m. 21s. 1° 8′ S. It was found at Melbourne on the 24th and at Windsor on the 25th. It was observed at Windsor with all possible accuracy till the close of October. The comet being too faint for observation in a bright field, and there being no means for observing with bright wires on a dark field I could not employ the filar micrometer. The accompanying table exhibits the resulting positions from August 25 to October 29. Those for August were determined with a square bar-micrometer on the Cooke 4½ inch equatorial. On September 1 a ring-micrometer, whose mean radius = 242·6″, was fitted to the recently mounted Grubb 8 inch equatorial, and with this instrument observations were continued till September 18, when the square bar-micrometer hitherto employed with the 4½ inch telescope was adapted to the large instrument. With this micrometer, whose adjustment and errors of form were carefully attended to, the remaining positions were obtained. The comet was at no time a good object for observation, and in consequence of either bright moonlight or haze, such was particularly the case on September 2, 7, 10, 11, 12, October 6, 7, 11, 25, and 29. On October 25, it approached so close to star No. 59 as to be observed with the greatest difficulty. On the whole I think the positions dependent on the square bar-micrometer will be found more satisfactory than those obtained with the ring. A brief description of the former micrometer will be found in the Introduction to the Results of my Observations of Comets Fabry, Barnard, and Brooks (No. 1) 1886, published in the last volume of the Society's Journal and Proceedings.

Comet VII., 1886.

At the close of September last, the Australian Observatories were notified of the discovery of a small comet on the 26th of that month by Mr. Finlay, the first assistant at the Royal Observatory, Cape of Good Hope, who was also the discoverer of Winnecke's Comet at its last appearance. The elements of its orbit were no sooner computed than they were found to bear a strong resemblance to those of the comet discovered by De Vico at the Roman College on August 22, 1844, and observed to the end of that year. The period assigned by Dr. Brunnow to this comet was 5·466 years, but the comet has not been seen since 1844, unless indeed Comet VII., 1886 is to be identified with it. There are, however, great doubts as to this identity, inasmuch as the period from the observations of the latter body is found to be much longer than that assigned to De Vico's Comet by Brunnow. The question of identity cannot be settled till the mean motion of the comet is determined with sufficient accuracy to permit the rigorous calculation of the perturbations during the interval between 1844 and 1886. According to a communication by Dr. Krueger in the *Astronomische Nachrichten* of April 15 last, the period of the Comet VII., 1886, is 2,433 days, whereas that assigned to DeVico's Comet by Brunnow is 1,994 days. It will thus be seen that irrespective of the question of identity, the Comet VII. is an exceedingly interesting one, in consequence of the shortness of its period. It was observed at Windsor by means of the square bar-micrometer on the Grubb 8 inch equatorial from October 8 to the end of the year, but it was throughout a very faint and difficult object. A table appended hereto contains the positions derived from these observations.

Reduction of the Star Places, &c.

In the determination of the mean places of the stars compared with the two comets I have availed myself of every authority in my Observatory library. In some few cases the comparison stars could not be identified; they will, therefore, have to be observed in the meridian in order to render them available for determining the comet places. I may here state that in working up the mean place of Star No. 15 compared with Winnecke's Comet on September 10, I found a considerable discrepancy between the results derived from the Catalogues of Lalande and Lamont, the only authorities available. I accordingly suspected a considerable proper motion of this star. As there was no well-determined star sufficiently near to it to be compared with it by means of the filar micrometer of my large equatorial, I sought the assistance of Mr. Lenehan, our Acting Government Astronomer, in determining its accurate position. He accordingly very kindly observed it for me with the 6 inch transit circle of the Sydney Observatory on the evenings of July 27, 28, 29, 30, last. The apparent places thus derived I have reduced by means of Peters' elements to the mean equinox and equator of 1886·0. The following comparison of this position with the positions derived by precession alone from the Catalogues of Lalande and Lamont will at once show a very considerable proper motion of this star in both co-ordinates.

Authority and Epoch.		*Mean R.A. 1886·0.*				*Mean N.P.D. 1886·0.*		
		h.	m.	s.		°	′	″
Lalande, 1800	...	14	25	1·06	...	105	6	33·4
Lamont, 1850	...	14	25	2·17	...	105	6	56·6
Lenehan, 1887	...	14	25	2·67	...	105	7	14·2

In conclusion I may state that the reduction of the star places and the calculation of the parallax factors have been effected in duplicate by different forms. For the parallax factors p and q denote respectively the parallax corrections of the comet in seconds of time and seconds of arc, and P the comet's equatorial horizontal parallax in seconds of arc.

Date.	Windsor Mean Time.	Comet—Star.		No. of Comps.	Concluded Apparent Places of Comet.		Parallax Factors.		Reductions of Star Places.		Comp. Star.
		△ R.A.	△ N.P.D.		R.A.	N.P.D.	Log. $\frac{p}{P}$	Log. $\frac{q}{P}$	R.A.	N.P.D.	
1886.	h. m. s.	m. s.	′ ″		h. m. s.	° ′ ″	+	+	s.	″	
Aug. 25	7 36 52	+9 26·57	−17 39·6	6	13 26 51·82	94 2 0·6	8·7070	9·7204	+0·87	+1·3	1
,, 25	7 36 52	+8 6·55	−17 16·4	6	...	...	8·7070	9·7204	+0·87	+1·2	2
,, 28	7 33 54	−3 30·39	− 9 16·3	9	13 37 58·72	95 58 49·5	8·7064	9·7088	+0·97	+0·6	3
,, 29	7 41 37	−2 52·10	+ 2 37·9	7	...	...	8·7134	9·7073	+0·98	+0·5	4
,, 29	7 41 37	−3 59·00	+ 2 25·7	7	13 41 47·91	96 38 53·6	8·7134	9·7073	+0·98	+0·4	5
Sept. 1	7 30 3	−4 52·50	...	4	13 53 27·82	...	8·7058	...	+1·03	+0·3	6
,, 1	7 30 3	−7 14·28	− 5 46·0	4	13 53 27·90	98 40 22·7	8·7058	9·6904	+1·04	+0·2	7
,, 2	7 22 57	+1 50·73	...	4	13 57 26·80	...	8·7000	...	+1·02	+0·6	8
,, 2	7 22 57	−8 25·15	− 4 3·5	4	...	...	8·7000	9·6823	+1·06	+0·1	9
,, 2	7 22 57	−9 2·38	− 0 23·7	4	13 57 27·70	99 21 24·5	8·7000	9·6823	+1·07	+0·1	10
,, 5	7 28 2	−2 54·38	− 4 31·3	8	14 9 47·67	101 27 37·6	8·7072	9·6690	+1·09	+0·3	11
,, 7	7 12 16	−3 19·87	+ 1 55·9	9	14 18 15·89	102 52 40·6	8·6929	9·6466	+1·12	+0·1	12
,, 8	7 10 1	+4 10·87	+ 1 58·8	8	14 22 36·35	103 35 46·8	8·6913	9·6382	+1·10	+0·4	13
,, 8	7 10 1	+3 22·91	+ 1 33·0	8	14 22 36·33	103 35 45·6	8·6913	9·6382	+1·11	+0·4	14
,, 10	7 13 28	+6 26·57	− 4 42·2	4	14 31 29·87	105 2 14·8	8·6968	9·6263	+1·13	+0·4	15
,, 10	7 13 28	+0 36·25	+ 1 34·3	4	...	...	8·6968	9·6263	+1·15	+0·2	16
,, 10	7 44 1	+0 42·29	...	3	...	...	8·7255	...	+1·15	+0·2	16
,, 10	7 44 1	−8 4·20	+ 4 28·9	3	14 31 37·64	105 3 11·3	8·7255	9·6518	+1·20	+0·2	17
,, 11	7 28 27	+2 15·25	+ 3 50·4	7	14 36 6·74	105 46 15·0	8·7130	9·6316	+1·16	+0·2	18
,, 11	7 28 27	+1 51·65	+ 3 20·3	7	14 36 7·49	105 46 12·7	8·7130	9·6316	+1·17	+0·2	19
,, 12	7 8 52	+2 29·78	+ 6 5·4	7	14 40 39·93	106 29 33·0	8·6932	9·6058	+1·18	+0·1	20
,, 12	7 8 52	+0 59·72	+ 6 35·3	7	...	...	8·6932	9·6058	+1·19	+0·1	21
,, 15	7 28 26	−4 47·14	− 0 27·5	8	...	...	8·7167	9·6003	+1·27	−0·3	22
,, 15	7 34 32	−4 52·29	...	5	...	...	8·7226	...	+1·27	−0·4	23
,, 16	7 26 15	−1 53·05	+ 0 44·1	10	14 59 56·45	109 25 17·2	8·7156	9·5891	+1·28	−0·3	24
,, 16	7 26 15	−5 47·88	...	10	14 59 56·87	...	8·7156	...	+1·30	−0·5	25
,, 17	7 14 43	+1 35·19	...	10	15 4 53·94	...	8·7039	...	+1·28	−0·2	26
,, 17	7 14 43	+1 9·65	+ 0 47·8	10	...	...	8·7039	9·5654	+1·28	−0·2	27
,, 18	7 26 27	−9 29·77	− 6 23·2	4	15 10 1·35	110 52 20·5	8·7176	9·5705	+1·36	−0·7	28
,, 20	7 25 51	+4 36·25	+ 9 4·6	5	15 20 26·95	112 18 28·3	8·7186	9·5485	+1·33	−0·3	29
,, 20	7 25 51	+2 52·09	− 0 33·2	5	15 20 25·98	112 18 27·4	8·7186	9·5485	+1·34	−0·3	30
,, 20	7 32 10	−2 10·51	+ 0 19·1	4	...	...	8·7251	9·5576	+1·36	−0·6	31
,, 21	7 15 17	−0 51·32	− 3 43·1	10	15 25 43·17	113 0 58·6	8·7073	9·5209	+1·38	−0·6	32
,, 22	7 20 35	+2 50·96	− 2 54·2	7	15 31 9·65	113 43 24·2	8·7141	9·5169	+1·38	−0·5	33
,, 22	7 20 35	+1 17·15	+ 6 28·9	7	15 31 9·58	113 43 22·7	8·7141	9·5169	+1·38	−0·6	34
,, 22	7 20 35	−1 17·10	+ 8 19·5	7	15 31 9·60	113 43 19·5	8·7141	9·5169	+1·40	−0·7	35
,, 23	7 20 19	+5 3·09	+ 8 29·8	5	15 36 40·40	114 25 13·4	8·7143	9·5035	+1·39	−0·6	36
,, 23	7 20 19	−2 23·77	+ 3 53·7	5	15 36 40·64	114 25 14·1	8·7143	9·5035	+1·42	−0·8	37
,, 24	7 24 5	+3 18·67	− 1 26·2	5	15 42 16·99	115 6 40·6	8·7192	9·4967	+1·42	−0·7	38
,, 24	7 24 5	−4 30·29	+ 7 37·9	5	15 42 17·21	115 6 44·9	8·7192	9·4967	+1·46	−1·0	39
,, 28	7 7 0	+0 12·53	+ 7 54·6	10	16 5 31·03	117 45 38·4	8·6971	9·3984	+1·52	−1·2	40
,, 28	7 27 43	+0 18·14	+ 8 23·5	3	16 5 36·64	117 46 7·3	8·7245	9·4454	+1·52	−1·2	40
,, 28	7 27 43	−5 38·56	+ 0 36·8	3	16 5 36·68	117 46 8·4	8·7245	9·4454	+1·55	−1·4	41
,, 30	7 18 16	−0 48·34	− 7 19·5	8	16 17 44·24	119 0 51·7	8·7121	9·3887	+1·57	−1·4	42
,, 30	7 18 16	−2 39·05	− 0 52·2	8	16 17 44·39	119 0 52·0	8·7121	9·3887	+1·58	−1·6	43
Oct. 1	7 32 2	+1 31·13	+ 0 37·3	4	16 24 0·75	119 37 22·5	8·7295	9·4055	+1·58	−1·5	44
,, 1	7 32 2	−0 32·46	− 1 0·7	4	16 24 0·85	119 37 20·9	8·7295	9·4055	+1·59	−1·6	45
,, 5	7 27 28	+0 6·56	+ 2 12·9	8	...	...	8·7205	9·3126	+1·68	−2·1	46
,, 5	7 27 28	−4 49·66	− 7 44·4	8	16 49 42·38	121 50 34·1	8·7205	9·3126	+1·70	−2·3	47
,, 6	7 41 23	+0 12·58	− 5 39·8	5	...	...	8·7378	9·3364	+1·70	−2·2	48
,, 6	7 42 12	+2 8·75	− 7 21·4	3	16 56 23·75	122 21 13·0	8·7388	9·3390	+1·69	−2·2	49
,, 7	8 19 0	−1 59·98	+ 2 9·9	15	...	...	8·7776	9·4325	+1·73	−2·5	50
,, 7	8 19 0	−3 5·90	+ 7 58·3	15	...	...	8·7776	9·4325	+1·73	−2·6	51
,, 11	8 33 5	+1 40·83	+ 0 46·8	13	...	...	8·7883	9·4115	+1·79	−3·1	52
,, 11	8 33 5	−0 50·18	+ 7 37·8	13	...	...	8·7883	9·4115	+1·80	−3·2	53
,, 21	8 47 16	+4 4·68	+ 5 17·5	14	18 40 31·77	126 54 51·5	8·7859	9·3033	+1·93	−5·0	54
,, 21	8 47 16	−2 18·26	− 1 37·6	14	18 40 31·71	126 54 52·2	8·7859	9·3033	+1·96	−5·2	55
,, 23	9 27 0	+3 25·89	−11 5·1	12	18 54 30·18	127 4 4·5	8·8157	9·4260	+1·96	−5·4	56
,, 23	9 27 0	+1 6·78	− 8 48·3	12	18 54 29·70	127 4 6·3	8·8157	9·4260	+1·97	−5·5	57
,, 23	10 0 30	−4 5·61	− 9 14·1	4	18 54 39·03	127 4 13·2	8·8338	9·5278	+1·99	−5·6	58
,, 25	8 26 59	+9 1·22	− 6 20·9	6	19 7 45·82	127 7 6·4	8·7486	9·1456	+1·95	−5·6	58
,, 25	8 26 59	−0 11·82	− 1 25·3	6	19 7 45·75	127 7 7·0	8·7486	9·1456	+1·99	−5·9	59
,, 25	8 26 59	−4 0·02	+ 1 15·4	6	19 7 46·17	127 7 5·1	8·7486	9·1456	+2·01	−6·0	60
,, 25	9 22 13	+0 4·45	− 1 22·0	8	19 8 2·02	127 7 10·3	8·8083	9·3891	+1·99	−5·9	59
,, 27	8 27 55	+9 19·18	− 1 22·5	10	19 21 5·33	127 4 27·1	8·7419	9·1229	+1·97	−6·1	60
,, 27	8 27 55	+0 15·01	− 8 32·1	10	...	...	8·7419	9·1229	+2·01	−6·3	61
,, 29	7 43 20	−0 47·22	+ 2 58·9	6	19 33 53·80	126 56 36·1	8·6503	8·7473	+2·02	−6·7	62

COMET VII., 1886, (Finlay.)

Date.	Windsor Mean Time.	Comet—Star.		No. of Comps.	Concluded Apparent Places of Comet.		Parallax Factors.		Reductions of Star Places.		Comp. Star.
		Δ R.A.	Δ N.P.D.		R.A.	N.P.D.	Log. $\frac{p}{\rho}$	Log. $\frac{q}{\rho}$	R.A.	N.P.D.	
1886.	h. m. s.	m. s.	′ ″		h. m. s.	° ′ ″	+	+	s.	″	
Oct. 8	8 0 48	+10 40·79	— 4 56·0	3	17 32 26·24	116 32 52·3	8·7015	9·4370	+1·70	— 5·2	1
,, 8	8 0 48	+4 44·87	— 6 37·0	3	17 32 26·42	116 32 52·6	8·7015	9·4370	+1·73	— 5·5	2
,, 22	8 7 58	—0 9·85	+ 0 2·2	14	18 17 25·55	116 32 57·8	8·7236	9·4730	+1·71	— 7·7	3
,, 22	8 7 58	—3 13·39	— 8 57·3	14	18 17 25·73	116 32 54·2	8·7236	9·4730	+1·72	— 7·8	4
,, 23	7 49 39	+3 21·14	— 2 12·2	7	18 20 56·52	116 30 43·3	8·7007	9·4366	+1·69	— 7·8	3
,, 23	7 49 39	—0 56 18	— 8 13·8	7	18 20 56·66	116 30 44·3	8·7007	9 4366	+1·71	— 7·9	5
,, 24	8 4 59	+2 42·30	—10 46·1	10	18 24 35·13	116 28 12·0	8·7206	9·4696	+1·70	— 7·9	5
,, 26	7 47 5	+2 8·45	— 0 40·7	12	18 31 53·78	116 21 55·7	8·6977	9·4358	+1·69	— 8·3	6
,, 28	7 58 34	—0 40·75	— 5 53·5	8	18 39 27·67	116 14 1·4	8·7130	9·4625	+1·70	— 8·7	7
Nov. 7	8 28 9	—9 9·61	+ 8 49·2	2	19 19 58·40	115 6 42·4	8·7402	9·5327	+1·73	—10·5	8
,, 7	8 28 9	—9 49·46	— 1 12·3	2	19 19 58·32	115 6 40·3	8·7402	9·5327	+1·74	—10·5	9
,, 8	7 34 11	—5 2·94	— 0 26·9	3	19 24 5·06	114 57 26·3	8·6718	9·4364	+1·72	—10·5	8
,, 8	7 34 11	—5 42·88	—10 26·2	3	19 24 4·88	114 57 26·4	8·6718	9·4364	+1·72	—10·5	9
,, 9	8 0 6	—0 38·79	—10 50·8	10	19 28 29·19	114 47 2·4	8·7075	9·4862	+1·70	—10·5	8
,, 9	8 0 6	—1 12·11	— 0 54·5	10	19 28 29·35	114 47 2·6	8·7075	9·4862	+1·70	—10·6	10
,, 12	7 54 58	—5 48·98	— 0 23·0	3	19 41 41·04	114 12 50·1	8·6971	9·4840	+1·73	—11·1	11
,, 12	7 54 58	—6 41·17	+ 0 44·4	3	19 41 40·48	114 12 48·8	8·6971	9·4840	+1·73	—11 2	12
,, 15	8 18 50	+3 42·85	— 5 5·6	7	19 55 18·32	113 32 48·1	8·7216	9·5311	+1·70	—11·4	13
,, 15	8 18 50	+3 4·14	— 5 42·9	7	19 55 18·55	113 32 45·9	8·7216	9·5311	+1·70	—11·4	14
,, 15	8 18 50	—1 58·42	+ 0 18·0	7	19 55 18·69	113 32 46·2	8·7216	9·5311	+1·72	—11·5	15
,, 16	8 15 15	+3 8·93	+ 1 58·4	6	19 59 53·19	113 18 12·0	8·7161	9·5277	+1·70	—11·6	16
,, 16	8 15 15	—2 42·81	+ 6 8·1	6	19 59 52·97	113 18 8 9	8·7161	9·5277	+1·72	—11·7	17
,, 16	8 15 15	—6 17·06	— 1 10·3	6	19 59 53·13	113 18 6·5	8·7161	9·5277	+1·74	—11·7	18
,, 22	8 5 25	—9 28·10	+ 0 6·6	3	20 28 8·83	111 36 2·9	8·6932	9·5296	+1·77	—12·6	19
,, 22	8 12 0	—2 49·99	— 7 40·3	4	20 28 10·44	111 35 58·8	8.7015	9·5390	+1·75	—12·5	20
,, 22	8 12 0	—5 40·84	— 1 2·5	4	20 28 10·53	111 35 48·8	8·7015	9·5390	+1·76	—12·5	21
,, 26	8 25 46	+1 56·23	+ 9 8·3	10	20 47 42·80	110 13 7 4	8·7091	9·5700	+1·75	—13·1	22
,, 27	8 18 51	—2 52·72	+ 9 28·9	10	20 52 38·34	109 50 43 5	8·6990	9 5647	+1·77	—13·2	23
,, 27	8 18 51	—3 39·47	+ 9 12·1	10	20 52 38·49	109 50 41·7	8·6990	9 5647	+1·78	—13·2	24
,, 29	8 34 4	+1 57·46	— 5 57·6	13	21 2 39·37	109 3 20·0	8·7115	9·5896	+1·77	—13·4	25
,, 29	8 34 4	+0 13·81	— 7 41·9	13	21 2 38·96	109 3 15·4	8·7115	9 5896	+1·78	—13·4	26
Dec. 1	8 22 6	+4 29·96	— 8 52·9	3	21 12 38·90	108 13 26·9	8·6936	9·5833	+1·78	—13·6	27
,, 15	8 59 33	+0 0·64	— 7 34·6	11	22 24 39·31	101 7 47·9	8·7021	9·6686	+1·96	—15·0	28
,, 15	8 59 33	—3 2·36	+ 1 38·0	11	22 24 38·94	101 7 50·4	8·7021	9·6686	+1·97	—15·0	29
,, 18	8 55 13	—2 51·37	— 9 16·6	4	...	...	8·6915	9·6782	+2·02	—15·1	30
,, 18	8 55 13	—14 16·60	— 6 2·0	4	22 40 8·02	99 23 8·5	8·6915	9·6782	+2·08	—14·9	31
,, 19	9 1 24	+8 10·60	— 6 48·0	6	22 45 16·99	98 47 25·0	8 6960	9·6850	+1·98	—15·3	32
,, 22	8 41 40	+3 58·93	—11 31·0	8	23 0 38·44	96 59 21·8	8·6676	9·6900	+2·06	—15·4	33
,, 27	8 40 55	+0 21·56	— 4 40·9	6	...	...	8·6569	9·7128	+2·17	—15·4	34
,, 27	8 40 55	—2 10·09	+ 1 51·4	6	...	...	8·6569	9·7128	+2·19	—15·4	35
,, 27	8 40 55	—3 33·24	— 8 46 8	6	...	...	8·6569	9·7128	+2·20	—15·3	36
,, 30	8 55 50	+4 35·02	— 3 52·3	4	23 41 8·39	92 5 14·3	8·6711	9·7274	+2·21	—15·5	37

Remarks on the Observations of Comet VII., 1886.

1886.

Oct. 8.—Comet hardly distinguishable, and observations mere guesses.

22.—Faint condensation. Last comparison difficult owing to close approach of comet to Star No. 3.

23.—Observations pretty good.

28.—Very slight condensation. Observations difficult owing to the comparison star crossing the square nearly at the same time as the comet.

Nov. 7—Considering the moon's presence the comet was brighter than expected. Slight condensation which could be pretty well observed. Clouds prevented further observations.

8.—Much baffled by clouds. Imperfect comparisons.

9.—A star of 9th mag. troublesome after 6th comparison. This star was observed for the comet in the last two comparisons, the latter being rendered invisible. I think the comet's centre passed slightly north of the star.

12.—Hazy sky and full moon. Observations not good.

15.—Marked condensation: good observations.

16.—Condensation not quite so distinct as on the 15th.

22.—Much baffled by clouds.

26.—Comet gradually condensed towards centre. During the earlier comparisons the comet was pretty close to a star of the 9th mag.

27.—Comet still slightly condensed, but notwithstanding a clear sky and an absent moon the comet was obviously considerably fainter.

29.—Sky beautifully clear.

Dec. 1.—Comet hardly distinguishable, owing to haze and moonlight, and distant only 2° or 3° from the moon.

15.—After a long period of cloudy weather comet bright̶er than expected. Slight condensation. Comet and Star No. 28 crossed the square so nearly together as to render the observations difficult.

18.—Central condensation. Observations pretty good, but comet fainter than on 15th. Pretty well seen in the finder whose aperture = $2\frac{1}{2}$ inches.

19.—Condensation still visible: comet still seen in the finder.

22.—Comet not so distinct as on the 19th; but still somewhat condensed. Sky hazy.

27.—Comet much fainter and more difficult to observe.

30.—Comet much diffused, but there was still a slight trace of condensation; very difficult to observe.

Adopted Mean Places for 1886·0 of the Stars compared with Comet VI., 1886.

No.	R.A.	N.P.D.	Authorities.
	h. m. s.	° ′ ″	
1	13 17 24·38	94 19 38·9	Cape Cat. (1850) 2383; Yarnall, 5535; Gr. 7 Yr. Cat. (1864) 1569; Glasgow, 3366; Gr. 9 Yr. Cat. (1872) 1223.
2	13 18 44	94 19	Anonymous, Star=8 mag.
3	13 41 28·14	96 8 5·2	Cape Cat. (1850) 2451; Yarnall, 5670; Schj. 4916 and 4917.
4	13 44 39	96 36	Anonymous=8½ mag.
5	13 45 45·93	96 36 27·5	Lamont (3), 1568; Schj. 4947.
6	13 58 19·29	98 42 34·5	Cape Cat. (1850) 2503; Yarnall, 5812.
7	14 0 41·14	98 46 8·5	Gr. Cat. (1850) 883; Cape Cat. (1850) 2511; 2nd Rad. Cat. 1355; Gr. 9 Yr. Cat. (1872) 1285.
8	13 55 35·05	99 23 19·6	Lamont (5), 1442.
9	14 5 52	99 25	Anonymous=8 mag.
10	14 6 29·01	99 21 48·1	Cape Cat. (1850) 2525; 2nd Rad. Cat. 1365; Gr. 9 Yr. Cat. (1864) 1639; Glasgow, 3521.
11	14 12 40·96	101 32 8·6	Schj. 5089.
12	14 21 34·64	102 50 44·6	Cape Cat. (1850) 2570; Rad. Obs. (1873) 729, and (1874) 800.
13	14 18 24·38	103 33 47·6	Yarnall, 5946.
14	14 19 12·31	103 34 12·2	Yarnall, 5955.
15	14 25 2·17	105 6 56·6	Lamont (5), 1570. Lalande's position differs considerably from Lamont's.
16	14 30 53	105 1	Anonymous=9½ mag.
17	14 39 40·64	104 58 42·2	Cape Cat. (1850) 2618; 2nd Rad. Cat. 1418; Yarnall, 6071; Gr. 7 Yr. Cat. (1864) 1677; Gr. 9 Yr. Cat. (1872) 1332; Rad. Obs. 1874, 810.
18	14 33 50·33	105 42 24·4	Lalande, 26702.
19	14 34 14·67	105 42 52·2	Lalande, 26706-7; Lamont (6), 264.
20	14 38 8·97	106 23 27·5	A. Oe., 13891.
21	14 39 39	106 23	Anonymous=9 mag.
22	14 59 50	108 41	Anonymous=8½ mag.
23	14 59 57	108 38	Anonymous=8½ mag.
24	15 1 48·22	109 24 33·4	A. Oe., 14280-1
25	15 5 43·45	109 21 33·9	Rad. Cat. (1845) 3329: A. Oe. 14348; Cape Cat. (1850) 2695; 2nd Rad. Cat. 1459; Yarnall, 6246; Gr. 7 Yr. Cat. (1864) 1710; Gr. 9 Yr. Cat. (1872) 1365, Stone, 8261; Rad. Obs. (1874) 832; (1882) 332; Cape Obs. (1880) 282; (1881) 438.
26	15 3 17·47	110 4 53·5	Lalande, 27567.
27	15 3 43	110 8	Anonymous =9 mag.
28	15 19 29·76	110 58 44·4	A. Oe., 14544-5; Wash. Mur. Cir., Z. 259, 8; Yarnall, 6342.
29	15 15 49·37	112 9 24·0	Wash. Mur. Cir., Z. 252, 22.
30	15 17 32·55	112 19 0·9	A. Oe., 14513; Wash. Mur. Cir. Z. 252, 24: Tacchini, 530; Yarnall, 6328. 2 secs. have been subtracted from the W. Mural Cir. Z. R.A.
31	15 22 37	112 18	Anonymous =9 mag.
32	15 26 33·11	113 4 42·3	A. Oe., 14643; Wash. Mural Cir. Z. 175, 11; 1 min. has been added to the R.A. of W. Mural Cir. Zone.
33	15 28 17·31	113 46 18·9	Wash. Mur. Cir. Z. 174, 14; Tacchini, 540.
34	15 29 51·05	113 36 54·4	Wash. Mur. Cir. Z. 174, 15; Tacchini, 542; 1′ has been added to W. Mur. Cir. Z. N.P.D.
35	15 32 25·30	113 35 0·7	A. Oe., 14728.
36	15 31 35·92	114 16 44·2	A. Oe., 14715; Wash. Merid. Tr. Z. 239, 25. The N.P.Ds. are discordant.
37	15 39 2·99	114 21 21·2	A. Oe., 14840; Cape Cat. (1850) 2831; 2nd Rad. Cat. 1515; Gr. 9 Yr. Cat. (1872) 1406; Stone, 8559.
38	15 38 56·90	115 8 7·5	A. Oe., 14838; Wash. Merid. Tr. Z. 166, 15; Wash. Mur. Cir. Z., 165, 62.
39	15 46 46·04	114 59 8·0	A. Oe., 14974-5; Wash. Merid. Tr. Z. 166, 18; Wash. Mur. Cir. Z. 165, 66; Tacchini, 563; Cape Cat. (1850) 2866; Yarnall, 6544; 2nd Rad. Cat. 1521; Gr. 7 Yr. Cat. (1864) 1780; Gr. 9 Yr. Cat. (1872) 1416; Armagh, 1852; Stone, 8628; Rad. Obs. (1882) 353. Wash. Mur. Cir. Z. R.A. and Wash. Merid. Tr. Z. N.P.D. rejected.
40	16 5 16·98	117 37 45·0	A. Oe., 15351; Cape Cat. 1850, 2957; Wash. Mur. Cir. Z. 29, 13; Yarnall, 6691; 2nd Rad. Cat. 1552; Stone, 8807; Rad. Obs. (1880) 351; Cape Obs. (1881) 468.
41	16 11 13·69	117 45 33·0	A. Oe. 15482; Cape Cat. (1850) 2992; Wash. Mur. Cir. Z. 29, 16; Yarnall, 6731; Rad. Obs. (1872) 777, (1874) 900, (1875) 694, (1876) 695; Stone, 8858.

Adopted Mean Places for 1886·0 of the Stars compared with Comet VI., 1886—*continued.*

No.	R.A.	N.P.D.	Authorities.
	h. m. s.	° ′ ″	
42	16 18 31·01	119 8 12·6	A. Oe., 15609-10-11; Cape Cat. (1850) 3022; Wash. Merid. Tr. Z. 117, 8; Wash. Merid. Cir. Z. 94, 22; Wash. Mur. Cir. Z. 263, 16; Yarnall, 6784; Rad. Obs. (1872) 786; Stone, 8931.
43	16 20 21·86	119 1 45·8	A. Oe., 15643-4-5; Cape Cat. (1850) 3030; Wash. Merid. Tr. Z. 117, 9; Wash. Merid. Cir. Z. 94, 25; Wash. Mur. Cir. Z. 263, 19; Yarnall, 6794; 2nd Rad. Cat. 1578; Stone, 8941; Wash. Merid. Tr. Z. R. A. rejected. There appears to be a systematic error of 1 s. in the R.A. of this Zone.
44	16 22 28·04	119 36 46·7	A. Oe., 15662; Wash. Merid. Tr. Z. 17, 86; Wash. Merid. Cir. Z. 97, 91; Wash. Mur. Cir. Z. 263, 20.
45	16 24 31·72	119 38 23·2	A. Oe., 15694; Wash. Merid. Tr. Z. 17, 88; Wash. Mur. Cir. Z. 263, 24; Yarnall, 6809. The authorities are very discordant.
46	16 49 34	121 48	Anonymous = 8 mag.
47	16 54 30·34	121 58 20·8	Cape Cat. (1850) 3178; Wash. Merid. Tr. Z. 30, 26; Yarnall, 7043; Stone, 9253; Rad. Obs. (1880) 370.
48	16 56 9	122 27	Anonymous = 9 mag.
49	16 54 13·31	122 28 36·6	Wash. Mur. Cir. Z. 25, 24.
50	17 5 13	122 49	Anonymous = 9 mag.
51	17 6 19	122 43	Anonymous = 8½ mag.
52	17 28 54	124 32	Anonymous = 9 mag.
53	17 31 25	124 25	Anonymous = 8½ mag.
54	18 36 25·16	126 49 39·0	Wash. Merid. Tr. Z. 56, 9; Stone, 10182.
55	18 42 48·01	126 56 35·0	Wash. Merid. Tr. Z. 56, 11.
56	18 51 2·33	127 15 15·0	Cape Cat. (1850) 3716; Wash. Merid. Tr. Z. 56, 13; Wash. Mur. Cir. Z. 48, 25; Melb. Cat. (1870) 961; Stone, 10309.
57	18 53 20·95	127 13 0·1	Wash. Merid. Tr. Z. 56, 14; Wash. Mur. Cir. Z. 48, 26; Yarnall, 8056; Stone, 10326.
58	18 58 42·65	127 13 32·9	Cape Cat. (1850) 3745; Wash. Merid. Tr. Z. 56, 18; Wash. Mur. Cir. Z. 48, 28; Yarnall, 8108; Melb. Obs. (1880) 302; Stone, 10373.
59	19 7 55·58	127 8 38·2	Wash. Merid. Tr. Z. 56, 19; Wash. Mur. Cir. Z. 48, 33; Yarnall, 8187; Stone, 10440.
60	19 11 44·18	127 5 55·7	Wash. Merid. Tr. Z. 56, 20; Wash. Mur. Cir. Z. 48, 34; Yarnall, 8223; Stone, 10459.
61	19 20 49	127 13	Anonymous = 9 mag.
62	19 34 39·00	126 53 43·9	Wash. Merid. Tr. Z. 56, 23; Cordoba Z. 22, 2; Yarnall, 8437: Stone, 10615. 1′ has been subtracted from the first authority for N.P.D.

Adopted Mean Places for 1886·0 of the Stars compared with Comet VII., 1886.

No.	R.A.	N.P.D.	Authorities.
	h. m. s.	° ′ ″	
1	17 21 43·75	116 37 53·5	A. Oe., 16820.
2	17 27 39·82	116 39 35·1	A. Oe., 16947-8-9; Wash. Merid. Tr. Z. 36, 57.
3	18 17 33·69	116 33 3·3	A. Oe., 18160; Wash. Mur. Cir. Z. 31, 76; Tacchini, 835; Yarnall, 7784.
4	18 20 37·40	116 41 59·3	A. Oe., 18229; Cape Cat. (1850) 3563: Wash. Merid. Tr. Z. 36, 103 and 178, 15; Wash. Mur. Cir. Z. 31, 77 and 176, 53; Yarnall, 7805; Rad. Obs. (1872) 919; Stone, 10044. 1 sec. has been added to the R.A. of Wash. Mur. Cir. Z. 31, 77.
5	18 21 51·13	116 39 6·0	A. Oe., 18262; Wash. Merid. Tr. Z. 36, 105; Wash. Mur. Cir. Z. 31, 78 and 176, 55; Cape Cat. (1850) 3572; Yarnall, 7815(1); Stone, 10060. The authorities are discordant.
6	18 29 43·64	116 22 44·7	A. Oe., 18434; Wash. Merid. Tr. Z. 178, 21; Wash. Mur. Cir. Z. 31, 81. The Wash. Merid. Tr. Z. N.P.D. is rejected.

Adopted Mean Places for 1886·0 of the Stars compared with Comet VII., 1886—*continued.*

No.	R.A.	N.P.D.	Authorities.
	h. m. s.	° ′ ″	
7	18 40 6·72	116 20 3·6	A. Oe., 18652; Wash. Merid. Tr. Z. 178, 26. The N.P.Ds. are very discordant.
8	19 29 6·28	114 58 3·7	A. Oe., 19743; Cape Cat. (1850) 3865; Wash. Mur. Cir. Z. 42, 62; Yarnall, 8377; Gr. 7 Yr. Cat. (1864) 2151; 2nd Rad. Cat. 1865; Stone, 10580; Rad. Obs. (1880) 426.
9	19 29 46·04	115 8 3·1	A. Oe., 19757; Gr. Cat. (1850) 1271; Cape Cat. (1850) 3867; Wash. Tr. Z. 173, 26; Wash. Mur. Cir. Z. 42, 63: Yarnall 8386; 2nd Rad. Cat. 1866; Gr. 7 Yr. Cat. (1864) 2152; Gr 9 Yr. Cat. (1872) 1790; Stone, 10584; Rad. Obs. (1873) 1121, (1875) 911, (1876) 925, (1880) 427, (1881) 416, (1882) 461. Wash. Merid. Cir. Z. R.A. rejected.
10	19 29 39·76	114 48 7·7	A. Oe., 19754-5.
11	19 47 28·29	114 13 24·2	A. Oe., 20054; Cape Cat. (1850) 3918; Wash. Merid. Cir. Z. 138, 26; Wash. Mur. Cir. Z. 170, 94; Yarnall, 8550; Cordoba Z. 1, 6; Stone, 10699. 1 sec. has been added to the Wash. Mur. Cir. Z. R.A.
12	19 48 19·92	114 12 15·6	A. Oe., 20063; Wash. Merid. Tr. Z. 57, 59; Wash. Merid. Cir. Z. 138, 27; Wash. Mur. Cir. Z. 170, 95; Tacchini, 937; Yarnall, 8556; Cordoba Z. 1, 7.
13	19 51 33·77	113 38 5·1	A. Oe., 20110; Wash. Merid. Tr. Z. 186, 25; Wash Merid. Cir. Z. 129, 112; Wash. Mur. Cir. Z. 195, 25; Cordoba Z. 1, 11. Authorities for 1850 very discordant.
14	19 52 12·71	113 38 40·2	A. Oe., 20125; Wash. Merid. Tr. Z. 186, 26; Wash. Merid. Cir. Z. 129, 113; Wash. Mur. Cir. Z. 195, 26; Cordoba Z. 1, 12. Authorities for 1850 very discordant.
15	19 57 15·39	113 32 39·7	Wash. Mur. Cir. Z. 195, 27; Cordoba Z. 1, 16.
16	19 56 42·56	113 16 25·2	A. Oe., 20178-9; Cordoba Z. 1, 15.
17	20 2 34·06	113 12 12·5	A. Oe., 20270; Cordoba Z. 1, 20.
18	20 6 8·45	113 19 28·5	A. Oe., 20311; Yarnall, 8726: Cordoba Z. 1, 24.
19	20 37 35·16	111 36 8·9	Wash. Merid. Tr. Z. 182, 65; Wash. Mur. Cir. Z. 181, 106.
20	20 30 58·68	111 43 51·6	A Oe., 20654; Wash. Mural Cir. Z. 181, 100; Yarnall, 8941.
21	20 33 49·61	111 37 3·8	A. Oe., 20716.
22	20 45 44·82	110 4 12·2	Lalande, 40257; Lamont (6), 1298; Rad. Obs. (1881) 459.
23	20 55 29·29	109 41 27·8	A. Oe., 21046; Yarnall, 9192.
24	20 56 16·18	109 41 42·8	Lalande, 40684; A. Oe., 21053; Yarnall, 9198. N.P.Ds. discordant.
25	21 0 40·14	109 9 31·0	Wash. Merid. Cir. Z. 141, 80; Wash. Mur. Cir. Z. 200, 65.
26	21 2 23·37	109 11 10·7	A. Oe., 21151; Lamont (6), 1350; Wash. Merid. Cir. Z. 141, 84. The last authority rejected for R.A.
27	21 8 7·16	108 22 33·4	Wash. Mur. Cir. Z. 204, 58.
28	22 24 36·71	101 15 37·5	Lalande, 43939-40; Rad. Cat. 1845, 5702; Gr. Cat. (1850) 1466; Cape Cat. (1850) 4505; Lamont (5), 3916; Yarnall, 9880; 2nd Rad. Cat. 2224; Gr. 7 Yr. Cat. 1864, 2573; Schj. 9207; Rad. Obs. (1873) 1398, (1874) 1444, (1875) 1123, (1876) 1091, (1880) 487; Stone, 11769; Cape Obs. (1880) 473, (1881) 630.
29	22 27 39·33	101 6 27·4	Schj., 9223.
30	22 42 57	99 33	Anonymous = 9½ mag.
31	22 54 22·54	99 29 25·4	Lalande, 44969; Cape Cat. (1850) 4607; Lamont (5), 4004; Yarnall, 10115; Schj., 9441; Glasgow, 6029; Armagh, 3106. Lamont, R.A. and Lalande N.P.D. rejected.
32	22 37 4·41	98 54 28·3	Cape Cat. (1850) 4550; Armagh, 3061. Armagh R.A. rejected.
33	22 56 37·45	97 11 8·2	Cape Cat. (1850) 4613; Yarnall. 10135.
34	23 25 39	93 59	Anonymous = 9 mag
35	23 28 11	93 53	Anonymous = 10 mag.
36	23 29 34	94 3	Anonymous = 9½ mag.
37	23 36 31·16	92 9 22·1	Lamont (1), 9285. Lalande's N.P.D. is very much less.

NOTE.—The Authority cited as "Tacchini" is the Catalogue in the Washburn Observatory Publications, Vol. III.

WEDNESDAY, SEPTEMBER 7, 1887.

CHARLES MOORE, F.L.S., &c., Vice-President in the Chair.

The minutes of the last meeting were read and confirmed.

The chairman announced the death of two Honorary Members of the Society since last meeting, viz:—Sir Julius von Haast, K.C.M.G., F.R.S., Christchurch, New Zealand, elected 1875; Professor L. G. De Koninck, M.D., Liége, Belgium, elected 1876.

Dr. Leibius moved the following resolutions, which were duly carried:

(1.) "That the members of the Royal Society of New South Wales desire to place on record their sense of the loss the Society has sustained in the death of Sir Julius von Haast, K.C.M.G., Ph.D., F.R.S., &c., for many years a most valued Honorary Member of the Society. And at the same time they desire to convey to his widow the expression of their deep sympathy with her in the irreparable loss she has sustained."

(2.) "That a similar letter of condolence be forwarded to the relatives of Professor De Koninck in response to their letter notifying his death."

The certificates of seven new candidates were read for the third time, of one for the second time, and of one for the first time.

The ballot for the election of the candidates whose certificates had been read for the third time was postponed to the next General Meeting in consequence of a quorum not being present.

In the absence of the author, Dr. Leibius read an abstract of a paper by Mr. John Tebbutt, F.R.A.S., entitled "Results of Observations of Comets VI. and VII., 1886, at Windsor, N.S.W.

A portion of a paper on "The origin and mode of occurrence of gold-bearing veins and of the associated minerals," for which the Society's medal and prize had been awarded, was read by Mr. Jonathan Seaver, C.E., F.G.S.

In consequence of the lateness of the hour, the remainder of the paper was postponed until the next meeting.

The medal and money prize of £25 were then presented to Mr. Seaver.

The Chairman referring to the smallness of the attendance at the meetings lately, thought it was partly due to the members not noticing the advertisement, and suggested that the Editors of the papers be requested to call attention to the advertisement in the news of the day.

About fifteen members were present.

The following donations received during the month of August, were laid upon the table and acknowledged :—

DONATIONS RECEIVED DURING THE MONTH OF AUGUST, 1887.

(The Names of the Donors are in *Italics.*)

TRANSACTIONS, JOURNALS, REPORTS, &c.

ADELAIDE—Report on the Progress and Condition of the Botanic Garden during the year 1886. *The Government Botanist.*

AMSTERDAM—"*Revue Coloniale Internationale,*" Tome V., No. 1, Juillet, 1887. *The Editors.*

BATAVIA—Koninklijke Natuurkundige Vereeniging in Nederlandsch-Indië, Natuurkundig Tijdschrift, Deel XLVI. Achtste Serie Deel VII. *The Society.*

BRUSSELS—Fédération de Sociétés d' Horticulture de Belgique. Bulletin, 1883-1884-1885. *The Federation.*

CALCUTTA—Asiatic Society of Bengal. Journal, Vol. LVI., Part I., No. 1, 1887. Proceedings, Nos. 2, 3, 4, 5, February to May, 1887. *The Society.*

CAMBORNE—Mining Association and Institute of Cornwall. Transactions, Vol I., Part 3. *The Association.*

CHARLOTTESVILLE, VA.—University of Virginia. "Annals of Mathematics," Vol. III., No. 3. *The Editor.*

CHRISTIANIA—The Norwegian North-Atlantic Expedition, 1876—1878. The North Ocean, Its Depths, Temperature and Circulation, by H. Mohn. Vols. XVIIIA. and XVIIIB. *The Editorial Committee.*

CINCINNATI—Society of Natural History. Journal, Vol. X., No. 2, July, 1887. *The Society.*

DRESDEN—K. Statistische Bureau des Ministeriums des Innern zu Dresden. Zeitschrift, XXXII, Jahrgang 1886, Heft 3 and 4. *The Bureau.*

DUBLIN—Royal Dublin Society. Scientific Proceedings, Vol. V., (N.S.) Parts 3, 4, 5, 6, 1886-7. Scientific Transactions, Vol. III., (Series 2) Parts 11, 12, 13, 1886-7. *The Society.*

EDINBURGH—Scottish Geographical Society. "*The Scottish Geographical Magazine,* Vol. III., No. 7, July, 1887. ,,

University. The Edinburgh University Calendar, 1887-8. *The University.*

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HARLEM—Société Hollandaise des Sciences à Harlem. Archives Néerlandaises des Sciences Exactes et Naturelles, Tome XXI., Liv. 5, 1887. ,,

HOBART—Royal Society of Tasmania. Abstract of Proceedings 14 June, 11 July, 1887. ,, JENA—Medicinish Naturwissenschaftliche Gesellschaft. Jenaische Zeitschrift für Naturwissenschaft, Band XX. N.F. Band XIII., Heft. 1, 2, 3, and 4, 1887. *The Society.*

LAUSANNE—Société Vaudoise des Sciences Naturelles. Bulletin, (3e Série) Vol. XXII., No. 95. ,,

LIÉGE—Société Liégeoise de Littérature Wallonne. Annuaire, 1887, 12me année. Bulletin, (2me Série) Tome IX. 1886. ,,

LONDON—Anthropological Institute of Great Britain and Ireland. Journal, Vol. XVI., No. 4, May, 1887. *The Institute.*

Meteorological Office. (Official No. 71.) Synchronous Weather Charts of the North Atlantic Ocean, Part I., from 1 August to 7 Nov. 1882; Part II., from 8 November, 1882 to 14 February, 1883. *The Meteorological Office.*

Pharmaceutical Society of Great Britain. Journal and Transactions, Third Series, Parts 203 and 204, May and June, 1887. *The Society.*

Royal Astronomical Society. Monthly Notices, Vol. XLVII., No. 7, May, 1887. ,,

Royal Geographical Society. Proceedings, (New Monthly Series), Vol. IX., No. 7, July, 1887. ,,

Royal Microscopical Society. Journal, Part 3, No. 58, June, 1887. ,,

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MELBOURNE—Field Naturalists' Club of Victoria. "*The Victorian Naturalist,*" Vol. IV., No. 4, August, 1887. *The Club.*

Mining Department. Victoria—Geology and Physical Geography, by Reginald A. F. Murray, 1887. *The Department.*

MONTREAL—Natural History Society of Montreal. "*The Canadian Record of Science,*" Vol. II., No. 7, 1887. *The Society.*

MULHOUSE—Société Industrielle de Mulhouse. Bulletin, Avril, Mai, Juin, 1887. ,,

NAPLES—Società Africana d' Italia. Bollettino, Anno VI., Fasc. V. and VI., Maggio-Giugno, 1887. ,,

Stazione Zoologica. Mittheilungen aus der Zoologischen Station zu Neapel, Band VII., Heft 2, 1887. *The Station.*

NEUCHATEL—Société des Sciences Naturelles de Neuchatel. Bulletin, Tome XV., 1886. *The Society.*

NEWCASTLE-UPON-TYNE—Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne. Transactions, Vol. IX., Part 1, 1887. ,,

North of England Institute of Mining and Mechanical Engineers. Transactions, Vol. XXXVI., Part 3, 1887. *The Institute.*

NEW YORK—American Geographical Society. Bulletin, Vol. XIX., No. 2, June 30, 1887. *The Society.*

NEW YORK—School of Mines, Columbia College. "*The School of Mines Quarterly,*" Vol. VIII., No. 4, July, 1887. *The School of Mines.*

"*Science*" Vol. X., Nos. 230 to 232, July 1st to 15th, 1887. *The Editors.*

PARIS—Académie des Sciences de l'Institut de France. Comptes Rendus, Tome CIV., Nos. 22 to 26, 31 Mai, to 27 Juin, 1887; Tome CV., No. 1, 4 Juillet, 1887. *The Institute.*

Société de Biologie. Comptes Rendus, (8e Série) Tome IV., Nos. 25 to 29, 1 to 29 Juillet, 1887. *The Society.*

Société de Géographie. Compte Rendu, Nos. 9, 10, 11, and 12, 1887. „

Société Entomologique de France. Bulletin, Nos. 1 to 13, 1887. „

Société Française de Minéralogie. Bulletin, Nos. 5 and 6, Mai-Juin, 1887. „

Société Française de Physique. Séances, Janvier-Avril, 1887. „

Société Géologique de France. Bulletin, 3e Série, Tome XV., No. 4, 1887. „

PHILADELPHIA—Franklin Institute. Journal, Vol. CXXIV., No. 739, July, 1887. *The Institute.*

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PISA—Società Toscana di Scienze Naturali. Processi Verbali, Vol. V., pp. 227 to 264, 1887. *The Society.*

RIO DE JANEIRO—Club de Engenharia. Revista Mensal, Anno I., Nos. 1, 2, 3, Jan.—Mar. 1887. *The Club.*

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ROME—Accademia Pontificia de 'Nuovi Lincei. Atti, Anno XL., Sessione IVa., Va., VIa., 27 Febbraio, 20 Marzo, 17 Aprile, 1887. *The Academy.*

Biblioteca Nazionale Centrale Vittorio Emanuele di Roma. Bollettino delle Opere Moderne Straniere, Vol. II., No. 1, 1887. *The Library.*

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The Minister of Public Instruction, Rome.

R. Comitato Geologico d' Italia. Bollettino, Vol. XVIII., 2a Serie, Vol. VIII., Nos. 3 and 4, 1887. *The Committee.*

SAINT ETIENNE—Société de l' Industrie Minérale. Comptes Rendus Mensuels, Avril, Mai, 1887. *The Society.*

SIENA—R. Accademia dei Fisiocritici in Siena. Bollettino della Sezione dei Cultori delle Scienze Mediche, Anno V., 1887, Fascicolo 3, 4. *The Academy.*

SYDNEY—Linnean Society of New South Wales. Proceedings, Second Series, Vol. II., Part 2, 1887. *The Society.*

SYDNEY—Observatory. Results of Meteorological Observations made in New South Wales during 1885. By H. C. Russell, B.A., F.R.S., &c. *The Acting Government Astronomer.*

Government Printing Office. The Statutes of New South Wales (Public and Private). Passed during the First and Second Sessions of 1887. *The Government Printer.*

TOKIO—Imperial University of Japan. Journal of the College of Science, Vol. I., Part 3, 1887. *The University.*

VIENNA—Anthropologische Gesellschaft in Wien. Mittheilungen, Band XVI., (Der neuen Folge Band VI.) Heft 3 and 4, 1886. *The Society.*

WASHINGTON—Comptroller of the Currency. Annual Report, December 4, 1886. *The Comptroller.*

Hydrographic Office. Notice to Mariners, Index for 1886. Nos. 7 to 22, 19 Feb. to 4 June, 1887. *Charts.*—Pilot Charts of the North Atlantic Ocean, March, April, May, June, 1887. No. 995, Great Circle Sailing Chart of the South Atlantic Ocean. No. 1025, Central America, West Coast of Nicaragua, Salinas Bay. No. 1027, Central America, West Coast of Costa Rica, Juanilla Bay. No. 1028, Ditto ditto, Murcielago Bay. No. 1029, Ditto, ditto, Potrero Grande Bay. 1033, Ditto, ditto, Ballena Bay (Gulf of Nicoya). No. 1036, Ditto, ditto, El Rincon Harbor (Gulf of Dulce). *The United States Hydrographer.*

MISCELLANEOUS.

(Names of Donors are in *Italics.*)

"*The Publisher,*" Nos. 8, 9, 10, 11, 1887. *The Publishers, Sydney.*

"*The Sydney Morning Herald,*" June, 1887, (Unbound). *The Hon. James Norton, M.L.C.*

"*The Illustrated Sydney News,*" Vol. XXIV., No. 8, August 15, 1887. *The Proprietors, Sydney.*

"*Trübner's American, European, and Oriental Literary Record,*" New Series, Vol. VIII., No. 2, April 30, 1887. *Messrs. Trübner & Co.*

PORT JACKSON SILT BEDS.

By Fred. B. Gipps, C.E.

[*Read before the Royal Society of N.S.W., October 5, 1887.*]

About the end of last July, under engagement with the late Harbour Tunnels Company, I undertook a series of borings across Sydney Harbour, between Fort Macquarie Point and the bottom of Beulah Street St. Leonards, and between Dawes Point and Milson's Point, for the purpose of ascertaining the character of what was supposed to be the rocky bottom on the lines of the proposed tunnels. These tunnels were designed to provide for both vehicular and railway traffic between Sydney and the North Shore, at a cost of £450,000. In view of the large capital required for this great engineering work, it was considered necessary to use the utmost precaution in acquiring an accurate knowledge of the depth of water and silt to the top of the rock, so that at least 30 feet of solid rock might be secured between the crown of the tunnels and the bottom of the harbour. For this purpose a large steam punt was moored on to a chain cable stretched across the harbour from point to point, so that it could be moved forward or backward as required. Divers were also engaged, in order to examine the rock thoroughly, that any fissures might be detected which previous soundings had not disclosed. Not anticipating any great depth of silt from the readings on the Government Chart, I was only provided at first with a sounding rod, made of different lengths of one inch gas piping, with a half inch steel bar sharply pointed, fixed on at the end. This was sufficiently stiff to jump through 44 feet of silt, but as this depth did not reach rock I was soon obliged to use a stronger rod. My next trial was made with two inch round and square bars of wrought iron jointed together in different lengths as required, and weighted near the top end with an iron rammer of 8 cwt. This rod was attached by chain to the derrick at the stern of the punt; its weight with the rammer was about 15 cwt., and the drop at each turn of the cog wheel just one foot. As the rod was not hollow, I was unable to obtain any true sections of the different silt beds, but the silt collected at each joint gave me a fair idea of their character at different depths.

The specimens before you, together with the abstract of borings and the annexed sections, will serve to convey to you the nature and relative depths of these beds. The bottom bed is composed chiefly of clay mixed with fine sand and mica. It crumbles very easy on pressure, and on rubbing with the hands leaves a dust stain on them. The next overlying bed is composed chiefly of greyish sand mixed with a few whole shells. On drying it becomes very heavy and sets like a cement, being very hard to break with the hand. The third bed is composed chiefly of broken shells mixed with sand ; it is of a bluish colour and breaks up much more easily than the previous formation. The ooze on the top of all, drys into fine clay and sand of a bluish colour, which has little cohesion.

The records of the borings between Fort Macquarie Point and Beulah Street, North Shore, show that the average depth of the whole channel is 67·1 feet, and of the silt 30·7 feet. The silt therefore fills ·45 or nearly a half of the channel. The greatest depth of water at low tide is 54 feet in the south shore channel, 44 feet in the centre, and 52 feet in the north shore channel. The greatest depth of silt at the above points is 57, 61, and 64 feet respectively. The records of the borings on the line between Dawes Point and Milson's Point give an average depth for the whole channel down to the bed rock of 65·52 feet, and an average depth of 18·86 feet for the silt beds, consequently ·29 of the channel has silted up. The greatest depth of water in the channel near the south shore is 74 feet, in the centre 51 feet, and near the north shore 57 feet. There is therefore a large excess of silt in the channel on the first line as compared with the last line, which is undoubtedly due to the accumulation from city drainage delivered by pipe at Fort Macquarie Point and to street drainage etc. from Circular Quay.

The history of these beds, could it be truly traced, would lead us through some of the most interesting epochs of the earth's existence. The bottom silt is apparently the sole relic of a very thick bed of alluvium, washed into the valley by the action of erosion on the softer rocks of the watershed for ages, which as the valley subsided was almost completely scoured out by tidal currents. The deposition of the grey heavy silt followed very slowly, and this was again succeeded by the dark coloured broken shell silt and ooze, which have evidently been deposited within quite recent periods since the tidal currents lost much of their scouring power.

As the age of the Hawkesbury sandstone and the accompanying shales which prevail over the whole watershed of Port Jackson have been pronounced by different scientists to belong to the Triassic age, it may be presumed that the same system of events has been at work during the life of that age in this country, which, according to Professor Dana, was the cause of the tilting, fractures, joints and ejections in Eastern North America. Whilst the preservation of its tilted beds, (for as far as I am aware, there are only very few and narrow limited indications of folding in the strata) free apparently from any deep seated faults but accompanied with numerous joints, shows, that the mechanical force which produced the tilting was gradual, the great thickness of its bed of fresh water origin measuring over 1000 feet deep, now rising only a few hundred feet above the sea level shows that a gradual subsidence has occured of considerable depth. Such a subsidence must have completely changed the appearance of the country, inducing by its great strain on the rocks below, dislocations in the earth's crust, as indicated at the present time by the deep chasms and precipitous gorges of the Hawkesbury River and Blue Mountains, also producing fractures of immense depth which have since been filled with ejections of molten trap. This eruption of igneous rock is especially denoted in Mount Prospect, which is at the northern extremity of the big Prospect dam, and in the belt of basalt extending for many miles along the top of the divide of the Parramatta and George's Rivers.

In this revolution of the natural features of the country there is reason to infer from an old river drift somewhat similar in its composition to the present gravel beds in the Nepean River near Penrith, disclosed in a deep cutting on the Western line five miles from Penrith, and 500 feet above the river level there, that the same differential movements, so perceptible in the neighbourhood of Liverpool and on the West Coast of Scotland have occurred here, extending through to the valley of the Darling River.

According to Mr. J. M. Reade, F.G.S., this differential movement is at the present time strikingly exemplified in the change of level taking place on the Baltic Coast. This scientist declares that whilst the Swedish Coast has been steadily rising, the Southern Coast has been as persistently falling. In 134 years the North of Sweden has risen 7 feet, the rate of elevation declining gradually to 1 foot at the Naze and zero at Bornholm which remains at the same level as in the middle of last century.

The appearance of Port Jackson at the close of the Triassic period must have somewhat resembled, though on a much more extensive scale, the gorge of the Nepean River near the junction of the Warragamba River, just before the valley widens out into the Camden flats, and the rolling country on each side of them.

Subsidence and erosion together have produced its present features. The character of the bottom stratum of silt, free apparently from marine mollusks and the presence of only a few whole ones in greyish silt above it, indicate that these silt beds were deposited as lacustrine and estuary formations. It is probable that the subsidence of Port Jackson and the Parramatta valley began at the close of the Triassic period. Since then climatic influences have assisted in scooping out its channel in the softer shales, wearing it down till it exposed the harder beds of sandstones.

The inner basin of the river being composed of softer rocks has widened by vertical and lateral denudation, whilst the outlet in the precipitous gorge formed by the hard sandstone cliffs of the Harbour Heads has gradually deepened but has increased very little in width. As the subsidence continued, the tidal currents began to operate and chiefly contributed to scouring the channel, leaving no covering on the rock near the shores and only a very shallow bank in the centre in comparison with previous deposits. At a certain period the erosion of the bottom ceased, either because it had reached "the base level of erosion," and from want of fall could not clear its bed, or because one of the hard ironstone bands, which frequently fill crevices in the sandstone on the lines of bedding, proved too tough for the scour of the tides or because of a change in the motion of the earth's crust from subsidence to upheaval. The first conjecture is the most reasonable because we find that by far the deepest bed of silt has been deposited after the scour on the bottom of the harbour has ceased to affect it, and it is largely composed of broken shells which have been partly contributed by littoral currents. The most important feature in the thickness or rising of these silt beds is the apparent tendency of the silt to fill in the channels on both shores of the harbour. This filling in took place much earlier in the centre and on the north shore than on the Sydney shore, and the reason of it is obvious. At first the tidal currents hugged each steep rocky shore deepening the channels and leaving a rise in the centre. This rise commenced at the entrance of the harbour between South Head and Middle Head at the rocks known as the Sow and Pigs, which are only a few feet below water at low tide.

The rocky crags or spurs connected with the Sow and Pigs and extending fully 600 yards down the harbour, inclining towards the north shore, offered a favourable catchment ground for the silt borne in or out by the tides, and gradually a bar was formed across to Middle Head. This reduced the force of the current along the north shore and induced the deep accumulation of silt shown by the borings. For a long period afterwards the force of the current running through the narrow deep channel on the south shore was sufficient to scour it, but gradually the equilibrium between the scour and deposit was destroyed and the channel choked which led to deposition of silt in the channel on that side. Whilst this bar according to the soundings on Captain Sydney's, R.N. Chart is 1300 yards wide in the centre, and 1000 yards on the north side, it is only 550 yards wide on the south shore. Judging by the narrow channel beyond the south end of the bar the accumulation of silt appears to be gaining ground on this side, so that in course of time the bar will be as wide on one side as the other. The actual extent and thickness of this silt formation and its rate of deposition in the channels can only be accurately guaged by periodical and careful investigations with the sounding line and boring rod. Though the soundings recorded on Captain Sydney's Chart show greater depths in some spots than the latest chart gives, yet as the soundings were not probably taken on exactly the same lines any comparison would be unreliable.

There is no doubt however as to the ooze being quite a recent deposit since the settlement of Sydney began, and that its presence evidences the loss to a certain degree of scouring action in the tidal currents. Therein lies the danger, for as the silt beds rise the power of the tidal currents for scouring it will diminish, and the volume of tidal water running up the Parramatta River will sensibly decrease. Thus whilst owing to the clearance and settlement of land all over the watershed of the harbour there will ever be increasing elements for silt deposit in its bed, the power of resistance from tidal currents will proportionately decrease. The cause and prevention of this silt formation it therefore a question of considerable importance. Its cause may be traced to different actions which are constantly at work, and as constantly increasing in force, such as city and suburban drainage, erosion of country within the watershed by heavy wind and rain storms, to the low rise and fall of the tide, and lastly to accumulation from littoral currents. There need be but little apprehension of any material addition to the silt beds from outside influences, such as littoral currents or the action of gales, because of the rocky precipitous character of the coast line and the great depth of water immediately beyond it. The great danger to be guarded against arises from inside influences, such as the erosion of the cleared country within the watershed of the Parramatta River and the drainage of Sydney and suburbs, which tend to fill in the river and harbour from Parramatta downwards, and so reduce the volume of water entering the harbour, and the range of tidal influences. Thus the action of scour on the bar will be continually weakened whilst the degree of silt accumulation during slack water will be proportionately increased.

In considering the measures to prevent these silt beds it is necessary to investigate; first, the quantity of silt being delivered into the harbour; second, the power that yet remains in the tidal currents to transport this silt; third, to what extent it can be prevented from entering the harbour; fourth, in what degree the volume and velocity of the tidal currents can be increased so as to preserve present channels. The quantity of silt delivered into the harbour cannot, without the most exact knowledge and minute examination of the country, be even approximately estimated, but it must be considerable. The approximate area of the watershed draining into the Parramatta River and Port Jackson is 188 square miles. The npper portion and most of the eastern flank of this watershed is formed of soft shales, whilst the steep spurs and broken precipitous ravines of the north and south shores and of the western flank are composed of hard Hawkesbury sandstone. The shale country is intersected by numerous small watercourses, harmless enough when with shallow tortuous channels they flowed at the foot of gentle slopes covered with dense underwood and forest trees, but now, worn into large clear channels in places over 20 feet wide and 6 feet deep, and receiving the immediate drainage of thousands of acres of cleared and settled land, they discharge immense bodies of silt into the river and harbour after every rain storm. A sample of this storm water taken by me from one of these channels between Ashfield and Croydon, and dried off, left a residue equal to 16 grains per gallon. The discharge of the stream was approximately 500,000 gallons per hour, so that it was actually delivering nearly $5\frac{1}{2}$ tons of matter in suspension every 12 hours into the river. The largest proportion of this matter would certainly have remained in suspension and been carried out to sea but the heavier portion, liable to settlement, would have added largely to the mud flats in the bay it entered and the river beyond. The power that yet remains to the tidal currents to transport this silt is also an unknown quantity, and must remain so until after careful investigation, but judging from the mud flats rising in the bays and lower portion of the Parramatta River, and the depth of ooze in the channels of the harbour there is good reason to fear that it is constantly decreasing.

The next question as to the extent that the silt and drainage can be prevented from entering the harbour can and should be dealt with at once. During low tide a large area of the bays above Darling Harbour are nothing but mud flats, which emit a most offensive stench far from conducive to the health of all living in their neighbourhood. By a judicious arrangement of fascine spurs or jetties, these bays might be converted from large cesspools into reservoirs or warping basins of great utility, not only for conserving water to supply the tidal current at low water but also for receiving the drainage of the country from the water courses alluded to, which together with the matter in suspension brought in by the tides, would assist in gradually reclaiming them. At the same time these flats, being rarely uncovered with water, would not be nearly so unpleasant to the suburbs around them, nor so prejudicial to the health of their residents. The fascine spurs should converge to small outlets, and should allow of $\frac{3}{4}$ tide to flow over them, thus they would retain water within their boundaries until the return of the tide.

By this means the alluvium from the erosion of the country and the drainage of the suburbs stretching 16 miles between Sydney and Granville would be provided with settling basins, and immense bodies of silt would be precluded from entering the harbour, whilst the period of slack water during which most of the silt is deposited would be reduced.

The fourth question as to the preservation of present channels is of equal importance with the previous one and largely depends on the satisfactory solution of it. It particularly necessitates a careful training of the tidal currents. No precautions will absolutely prevent drainage from entering the harbour, but if a plan could be devised to strengthen the force of the tidal currents so that they could transport it beyond danger of settlement inside it, the preservation of deep channels would be assured through all time. For this purpose it would be advisable to deepen and enlarge the channels in the bays above Darling Harbour and in the Parramatta River, as high up as the town of Parramatta so as to increase the depth and volume of low water, which would increase the velocity of the tidal currents, and enable them to carry off any ordinary drainage into them beyond reach of mischief. At the same time the South Channel on the bar should be deepened to 40 feet for a width of 200 yards. This latter enlargement, estimating its length at 600 yards and it its average depth at 5 yards, would require the removal of 600,000 cubic yards only. By such means the volume of tidal water entering the harbour would be increased, inducing stronger tidal currents, and thus establishing the equilibrium sought for, by which the action of deposit would be so evenly proportioned to that of scour, that the silt left by the slack water of one tide would be removed by the currents of the next tide. Here, for the present I leave my subject, feeling far from satisfied with the scant justice I have rendered it from want of more accurate information on several important particulars. The discussion it may provoke, may however make up for my shortcomings, and may render good service in the treatment of a question of such grave importance to our shipping interests.

APPENDIX I.

Abstract of boring records from Fort Macquarie Point to Beulah Street, North Shore, across Port Jackson reduced to low water mark.

No. of Boring.	Distance from Fort Macquarie Point in feet.	Depth of Water in feet.	Depth of Silt in feet.	Total Depth of Channel in feet.
1	100	22	6	28
2	150	36	10	46
3	250	52	7	59
4	350	54	23	77
5	400	51	49	100
6	500	40	57	97

APPENDIX I.—*continued.*

No. of Boring.	Distance from Fort Macquarie Point in feet.	Depth of Water in feet.	Depth of Silt in feet.	Total Depth of Channel in feet.
7	700	36	61	97
8	800	35	49	84
9	1000	43	48	91
10	1300	43	64	107
11	1400	46	60	106
12	1500	51	32	83
13	1550	46	12	58
14	1600	37	3	40
15	1700	0	0	to North Shore.

REMARKS. Square Feet.

The sectional area of the whole channel from low tide level to bed rock ... ... =113,900
The sectional area of the silt beds ... ... = 52,190
Consequently the silt beds fill ·45 of the channel.

APPENDIX II.

Abstract of boring records from Dawes Point to Milson's Point across Port Jackson, reduced to low water mark.

No. of Boring.	Distance from Dawes Point in feet.	Depth of Water in feet.	Depth of Silt in feet.	Total Depth of Channel in feet.
1	50	22	2	24
2	100	32	2	34
3	150	43	4	47
4	200	50	5	55
5	250	58	2	60
6	300	69	2	71
7	350	74	19	93
8	450	70	24	94
9	500	62	30	92
10	550	60	32	92
11	650	53	33	86
12	750	51	27	78
13	850	49	27	76
14	950	42	46	88
15	1100	42	28	70
16	1150	42	30	72
17	1250	50	32	82
18	1300	52	28	80
19	1400	57	23	80
20	1500	0	0	to Milson's Point

REMARKS. Square Feet.

The sectional area of the whole channel from low tide level to bed rock ... ... = 98,280
The sectional area of the silt beds ... ... = 28,290
The silt beds therefore fill ·29 of the whole channel.

SOME NEW SOUTH WALES TAN-SUBSTANCES.

PART III.

By J. H. MAIDEN, F.R.G.S., Curator of the Technological Museum, Sydney.

[*Read before the Royal Society of N.S.W., October 5, 1887.*]

NOTES—(Second Supplement).

1. In giving the colours of residues left after extracting with water, I have generally specified "moist residue," as the colour is usually more characteristic when the residue is in that state.

2. The word "ruby" is frequently a convenient one to employ in describing tan-extracts. I have used it to express the tint of the well-known glass used by photographers and for ornamental purposes.

3. The tannic acids contained in the barks and kinos of Eucalypts and in the barks of Acacias, have been frequently examined, and, owing to slight specific differences, have been designated kino-tannic acid and catechu-tannic acid respectively. Some of the tannic acids yielded by other genera referred to in these papers have differences more or less marked, but at present I am not inclined to take upon myself the responsibility of adding to the already abundant and complex nomenclature of tannins.

4. Following a list of tan-substances given by C. T. Davis, "The manufacture of Leather," he makes the following judicious remarks :—"Only a relatively small number of the many tanning materials enumerated are used for tanning on a large scale. The cause of this may be found partly in the conservative bias of the tanners, and partly in the imperfect knowledge of the action of the various tanning materials upon the skin-tissue. It requires extensive study to become thoroughly conversant with the effects exerted by the various tannins, and the extractive resinous substances accompanying them, on the skin-tissue." To these I may make the important addition, that a tanner is not to be expected to take a fresh tan-substance into serious consideration, unless he has some means of knowing the probable extent to which it may become available for his use. Many circumstances may affect a trade in any of the tan-substances alluded to in this series of papers, and I express the hope that the members of this Society (particularly the country ones), will kindly favour me, as opportunities occur, with particulars as to the quantities available in different districts, and probable cost on the spot and in Sydney.

5. As a sample of the ignorance which prevails in Europe in regard to some of our raw products, the following from a standard work, is worth quoting :—"Dans les colonies anglaises, on trouve dans la Nouvelles-Galles du Sud, les écorces de l' *Urtica gigas* ou grande urticaire, du *Brachychiton luridum* ou sycomore, du *Melaleuca uncinata* ou arbre à thé. Dans la Tasmanie et à Queensland, les écorces d' *Acacia melanoxylon*. Dans l' Australie du Sud, les mêmes écorces, et, en autre, celle de l' *Ecualyptus*."—*Dictionnaire des arts et manufactures* (Laboulaye) Art. "Tan."—Of these barks, *Urtica gigas* and *Brachychiton luridum* are used only for fibre, while the bark of *Melaleuca uncinata* is useless for any purpose, the leaves only being used to a small extent, and then for yielding oil. *Acacia melanoxylon* is not found in Queensland at all. And why South Australia in particular should be credited with the use of Eucalyptus bark I do not know. This is the sum total of the information concerning our tan-substances in the principal technological dictionary in the French language. And references to the subject in books published in England are frequently not much better. It seems strange that the matter should have been so neglected.

30. Elæocarpus grandis, *F.v.M.*, N.O. Tiliaceæ, B. Fl. i., 281.

Found in Northern New South Wales and Queensland.

Vernacular Names—"Blue Fig," "Brisbane Quandong," (owing to the blue fruits being eaten by children and aboriginals). By the latter it is frequently called "Calhun" or "Cullangun." The tree from which this bark was obtained was cultivated in Sydney.

Part of the Tree Examined—Bark of the large limbs, removed in pruning the tree.

Particulars of the trees whence it was obtained—Height 20 feet, diameter 15 inches.

Collected 20th July, 1887. Analysed 12th to 28th September 1887.

Bark smoothish, but with very small fissures. Of a greenish-black appearance. Epidermis readily separable, possessing in its under surface the light colour and general appearance common in Tiliaceous plants. Abundance of chlorophyll underneath the epidermis. Inner bark fibrous and light yellow. Average thickness of bark $\frac{3}{16}$ inch. Colour of powder that of white pepper, but rather more yellow.

A piece of bark stripped off the tree was immediately put in the water-bath, with the following result :

Weight green	... ...	50·007 grm.
Weight dry...	... ...	19·045
	Loss	30·962

∴ Loss in drying = 61·913 per cent.

Extract.—Yields 21·566 per cent. to water at 100° C. Colour of solution, yellowish-brown of the tint of low-grade olive oil. Darkens on boiling. Has the smell of sweet-wort. The mucilage in solution clogs the filter-paper to a great extent. The filtrate deposits flocculent matter which dries of a deep bronze colour. The mucilage renders the filter-paper quite stiff, cementing the folds firmly. Color of moist residue, light dirty brown with very light woody particles intermixed.

Tannic acid—10·28 per cent.

There are nine Australian species of *Elæocarpus*, four of which are natives of New South Wales, two being found close to Sydney. Fifty species of this genus are spoken of in the the "Genera Plantarum" of Bentham and Hooker, and the two New Zealand species have been examined by Skey for tannin, with the following results :—*Elæocarpus dentatus*, Vahl. (= *E. Hinau*, A. Cunn.) the Hinau or Whinau or Pokaka of the Maoris, gave 21·8 per of tannin. *Elæocarpus hookerianus*, Raoul., called Pokaka (or Pokako, Bokako or Bocarro) and Hinau, and in addition Mahi-mahi, yielded 9·8 per cent. of tannin.

The following particulars on species of *Elæocarpus* in general are suggestive :—The bitter and resinous bark of *Elæocarpus* is renowned as a tonic; one species in Java is used as an anthelmintic. Their acidulous sugary fruit is eatable, being used largely by the natives of India in curries, and pickled. The kernels of several species, (including *E. grandis*) which are elegantly marked, are made by the Indians into necklaces and bracelets. They are often set in gold, and very ornamental.

31 and 32. Rhus rhodanthema, *F.v.M.*, N.O. Anacardiaceæ, B. Fl. i., 489.

Found in New South Wales and Queensland.

Vernacular Name—" Deep Yellow-wood." The wood of *R. Cotinus* is known as young or Zante Fustic. It produces a rich yellow colour, which property is shared to some extent by the wood of the species now under examination. There are about 120 species of *Rhus*, according to the "Genera Plantarum" of Bentham and Hooker. They are chiefly confined to the Cape and other extra-tropical regions.

The tree from which these leaves and this bark were taken was cultivated in Sydney. Thy were obtained in the usual operation of pruning the tree in the winter. The bark was taken from large limbs thus removed

Particulars of the trees whence it was obtained—Height 30 feet, diameter 20 inches.

Collected 20th July, 1887. Analysed: Leaves, 19th August to 8th September, 1887; Bark, 12th to 22nd September, 1887.

31. Bark.—Moderately smooth. Outer bark containing innumerable small and shallow fissures; the surface abundantly marked with small reddish-brown scars, disposed transversely, and about a line long. Outer bark dark grey to black, peeling off in flakes. Colour of inner bark reddish, and containing poor fibre. Average thickness of bark $\frac{1}{4}$ inch. From the cut ends a brownish viscid resin exudes, forming an inferior lacquer.* Colour of bark when powdered, brown with a shade of red. Intermediate in colour between the barks of *B. integrifolia* and *B. serrata.*

The day this bark was gathered it was put in the water-bath. By the 2nd August its weight was found to be constant. The following was the result:

Weight green	... ...	53·149 gms.
Weight dry	... ...	22·369 ,,
	Loss	30·78

∴ Loss of moisture on drying = 57·912 per cent.

Extract.—It yields 44·79 per cent. to water at 100° C. Colour of solution rich ruby; of moist residue Vandyke brown.

Tannic acid—23·15 per cent.; a percentage shewing this to be worthy of attention as a bark, irrespective of the use of the leaves.

The following particulars in regard to the barks &c. of other species of *Rhus* (not Australian) will be interesting:—

Rhus Cotinus (Fustic or Venetian Sumach)—Bark aromatic and astringent; used as a febrifuge, and in tanning. The fruit is eaten by the Turks. This tree, however, is chiefly valuable as a dye.

Rhus toxicodendron.—From the bark of this tree exudes a milky volatile, very acrid juice, the touch of which, or even an exhalation of it, frequently brings on violent erysipelas. See Proc. R. S., Tasmania, 1886, for an account of the severe injury which some

* The barks of several Asiatic species yield lacquers, especially *R. vernicifera*, so much used for the purpose in Japan. See the exhaustive "Report of Her Majesty's Acting Consul at Hakodate, on the Lacquer industry of Japan." (British Consular Reports, Japan, No. 2, 1882.)

gardeners in Hobart sustained while in the act of removing one of these trees.

Rhus glabrum.—The bark is considered a febrifuge, and is also employed as a mordant for red colours.

32. LEAVES.—The follow description, (so far as pertains to the leaves) is taken from the "Flora Australiensis":—"A tree of 70 to 80 feet,* quite glabrous except little tufts of hairs along the midrib of the leaflets underneath. Leaves pinnate, the common petiole terete; leaflets usually 7 or 9, oblong, obtusely acuminate, mostly 2 to 2½ inches long, entire, shortly petiolulate, the pinnate veins prominent underneath." I would supplement this description, at least as far as the particular tree from which my specimens were taken, as follows:—Leaves impari-pinnate, with usually five pairs of leaflets, which frequently are not strictly opposite, and therefore may perhaps better be described as alternately pinnate. Leaflets usually 2½ to 3 inches long.

These leaves were ground moderately fine in a small coffee mill. In the case of ordinary Sumach the desideratum is to produce a very fine powder, which of course facilitates the preparation of extract, and also makes the Sumach more homogeneous.

Extract.—They yield 32·2 per cent. to water at 100° C. Colour of solution yellowish-brown (with an olive shade), not to be distinguished in colour from that yielded by ordinary sumach. It remains clear on filtering. Colour of moist residue dark olive-brown.

Tannic acid†—16·91 per cent. An exceedingly satisfactory result, especially when it is borne in mind that sumach-yielding trees are never stripped in winter. Moreover this was by no means a young and perfectly vigorous tree, for its leaves were rather discoloured, and many of the branchlets infested with a coccus. This tree is entitled at least to rank with the North American Sumachs, and it now remains with some enterprising agriculturalist to prove whether or not it may be a formidable rival to those of Southern Europe.

For purpose of comparison, I have analysed a sample of ordinary commercial Sumach, as purchased in Sydney (August 1887) and probably obtained from *R. Coriaria.* I find that it contains 24·05 per cent. of Tannic acid, and Extract 50·36 per cent., the solution being of a yellowish-brown with shade of olive, and the moist residue olive-brown. The filtrate from this sumach deposited a dark flocculent precipitate on cooling; the leaves of *Rhus*

* It will be observed that *R. rhodanthema* grows to a far larger size than the species of *Rhus* at present cultivated for Sumach.

† Usually considered as identical with gallo-tannic acid.

rhodanthema gave a clear solution under the same circumstances. Analysed 22nd to 29th September 1887.

For comparison, the following particulars (chiefly in regard to leaves) of other species of *Rhus* will be found useful: *

Rhus Coriaria, Linn., (European, Sicilian or Tanning Sumach, called also "Varnish Tree.") The acid fruit is used in Turkey as a condiment. This is the principal Sumach, and is used for tanning light coloured leathers, chiefly morocco and pocket book leather. One and a-half pounds of sumach is required to convert one pound skin into leather—(Anthon). It is also used in dying and calico-printing. By keeping, the tannic acid of sumach is converted into secondary products, owing to a spontaneous fermentation.

		Tannic Acid. Per cent.	Authority.
Sicilian	... ...	16·2	(Davy.)
,,	First Quality	16·5	Wagner, quoted in Watts' Dict.
,,	Second ,,	13·0	Wagner, quoted in Watts' Dict.
,,	... ...	24·27	(Dept. of Agric. U.S.A.

The following analyses of Sicilian Sumach collected at different dates were made by Prof. N. Macagno, Director of the Agricultural Station of Palermo, Sicily.

	Tannic acid in leaves. Upper.	Lower.	Average.
June 10, 1879	24·93	17·45	21·19
,, 16, ,, ...	24·92	16·11	20·51
,, 27, ,, ...	25·82	15·27	20·54
July, 14, ,, ...	24·75	10·81	17·78
,, 29, ,, ...	23·80	9·44	16·62
August 11 ,, ...	21·91	8·77	15·34

These results show that leaves of sumach of the upper extremities of the stalk are always richer in tannic acid than those of the base. Yet in the interest of cultivators, the collection of the crop should be delayed as long as possible, because the diminution of tannin in the leaves will be abundantly compensated for by the quantity of the product.

Rhus glabra, Linn. (Smooth or White Sumach) and *R. canadense* are used largely in the United States, nearly all the morocco manufacturers mixing it with an equal quantity of Sicilian sumach to form the tanning liquor, which is forced through the goat-skins by hydrostatic pressure (Davis).

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* To colonists who may seriously consider the question of cultivating indigenous and other species of *Rhus* for Sumach, the "Report on the Cultivation of Sumac in Sicily and its preparation for market in Europe and the United States," (Department of Agriculture, Special Report No. 26), Washington, 1880, 32 pp. 8 plates, will be found invaluable. From this source much of the following information has been obtained.

R. glabra grows 2 to 12 feet high, and is considered the most valuable of the American species. It extends from Canada to Georgia and Louisiana. (Torrey and Asa Gray.)

Tannic Acid.

	Per cent.	Authority.
Winchester Va. U.S.A.	23·56	Dept. of Agric. U.S.A.
Georgetown DC. U.S.A.	16·50	,,

Rhus copallina, Linn. (Dwarf or Black Sumach) North America. Grows 1 to 7 feet high. Convenient for cultivation under some circumstances, on account of its small size. It ranks next in value to *R. glabra* of the American species.

Tannic Acid.

	Per cent.	Authority.
Winchester, Va. U.S.A.	16·99	Dept. of Agric. U.S.A.

Rhus Cotinus, Linn. (Venetian Sumach or Smoke Tree). Besides the use in Europe, in the Himalaya the twigs are used for basket making, and the bark and leaves for tanning. *Tannic acid*—Virginia, U.S.A., 24·08 per cent.

Rhus typhina, Linn. (Staghorn Sumach). Flowers and fruits used to sharpen vinegar, hence its name of "Vinegar Tree." Grows 10 to 30 feet high. Extends from Canada to South Carolina and Louisiana. (Flora N. Amer., Torrey & Gray.)

Tannic Acid.

	Per cent.	Authority.
Georgetown DC. U.S.A.	16·18	Dept. of Agric. U.S.A.

Rhus pentaphylla (Tezera Sumach). Used by the Arabs of Algeria for making morocco leather.

Rhus toxicodendron (Poison Sumach or Poison Oak or Ivy of North America). An extract prepared from the leaves is used in some cutaneous disorders.

Full particulars (which are more or less applicable to all the species) in regard to the culture and harvesting of Sumach will be found in the Special Report of the Department of Agriculture, (U.S.A.) alluded to above. The European species have hitherto failed in those parts of the United States were attempts have been made to acclimatise them, owing to the severity of the winters, but in the more genial climate of New South Wales this difficulty would not obtain. Rich soil is not a *sine quâ non*; in fact it is perhaps a drawback. "To grow Sumach to perfection requires a soil of only medium fertility; it is found that a very luxuriant growth is produced at the expense of the tanning principle; an exposure to sun on a southern slope is also favourable to an increase of tannin."* Another authority states that sumach flourishes best in arid country. In Italy the limestone soils are considered especially suitable; the American varieties appear to be well suited to sandy and clay soils as well. "The culture to be given the plant is somewhat similar to that required by Indian Corn (Maize)."

The value of sumach is greatly diminished according to the proportion of colouring matter it contains. With the view of roughly estimating the comparative quantity in different samples, the chemist of the Department of Agriculture (Report loc. cit.) adopted the following method. Of each substance to be tested he took about 5 grammes, extracted with boiling water, and made the filtrate up to 150 cc. To 50 cc of this solution he added 10 cc of solution of gelatine (1 in 100)† and noted the colours of the precipitates, as follows:—

Winchester, Va.,	mixed,	collected in	June	gave a nearly white precipitate
,,	,,	,,	July	gave a decidedly yellowish-white precipitate.
,,	*R. copallina*,	,,	August	gave a dirty yellow precipitate
,,	*R. glabra*	,,	,,	gave a very dirty white ,,
Fredericksburg,	mixed,	,,	,,	gave a dirty yellow ,,
Sicilian		,,	,,	gave a yellowish-white ,,

It is therefore advised that for the purpose of tanning white and delicately-coloured leathers, the collection should be made in June; while for tanning dark-coloured leathers, and for dying and calico printing in dark colours, where the slightly yellow colour will have no injurious effect, the collection be made in July. It appears that for all purposes, the sumach collected after the 1st of August is inferior in quality.

I have applied the same test to the leaves of *Rhus rhodanthema* and the Sydney purchased Sumach referred to in this paper, with the following results:—

Rhus rhodanthema—Almost the same tint as that yielded by Sumach, but a little dirty.

Sumach—Very light buff, almost cream-coloured.

NOTE.—The above colours are those obtained during the first few seconds. On standing, the Sumach precipitate also becomes of a dirty tint, tending to approach that of *R. rhodanthema*, which at the same time slightly darkens. Considering all the circumstances

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* Report of the Department of Agriculture for 1881, Washington. Yet at p. 7 of the Special Report on Sumach above alluded to, occurs the passage:—"In cultivation of the plant, on account of its power to withstand dryness, the soil usually chosen is poor and light; but a much larger crop of leaves can be secured from strong, rich, deep soils, and it is generally admitted that the product in the latter case is also better."

† The report gives 1 in 10, evidently a misprint, as gelatine does not dissolve in such a small proportion of water.

connected with the sample of *R. rhodanthema*, as already detailed, this colour-test is most encouraging. And even if colonists are not enterprising enough at present to cultivate this New South Wales Sumach tree as a tan-material, they will certainly carefully collect the valuable leaves of such trees as already are to be found in the Northern Districts whenever one is felled for the sake of its ornamental timber, and take measures for judiciously pruning those which self-interest will warn them not to destroy.

33. ACACIA HOMALOPHYLLA, *A. Cunn.*, N.O. Leguminosæ, B. Fl. ii., 383.

Found in New South Wales and Queensland, chiefly well in the interior.

Vernacular Name—" Narrow-leaved Yarran."

Locality whence this particular specimen was obtained—Ivanhoe, viâ Hay.

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—Height 10 to 15 feet, diameter 3 to 4 inches.

Collected 4th September, 1886. Analysed 19th August to 1st September, 1887.

Bark from an oldish tree ; full of a poor fibre ; the bark can be easily stripped into flakes with the fingers. Prevailing colour of outer bark dirty grey, the inner bark of rather a bright yellow, which turns light brown on exposure. The outer bark is rather deeply fissured and friable. Average thickness $\frac{3}{8}''$. When powdered its general appearance is light brown, but it contains particles of yellowish-brown and dark brown.

Extract.—It yields 21·51 per cent. to water at 100° C. Colour of solution rich reddish-brown ; of moist residue, Vandyke brown.

Catechu-tannic acid—9·06 per cent.

34. ACACIA OSWALDI, *F.v.M.*, N.O. Leguminosæ, B. Fl. ii., 384.

Found in all the Colonies except Tasmania.

Vernacular Name—" Miljee."

Locality whence this particular specimen was obtained—Ivanhoe, viâ Hay.

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—Height 6 to 8 feet, diameter 4 to 5 inches.

Collected 6th September, 1886. Analysed 19th August to 1st September, 1887.

A small bushy tree. Timber exceedingly hard and tough, and possessing a very disagreeable smell when fresh or green. Used by the natives in the manufacture of short weapons such as clubs. Leaves eaten by stock. Bark from an oldish tree. In appearance it much resembles that from *A. homalophylla*, but the following differences may be pointed out. Thickness ½ inch. Outer bark darker and inner bark lighter. Colour of powder, light reddish-brown.

Extract.—Yields 20·7 per cent. to water at 100° C., affording a ruby-coloured solution. Colour of moist residue Vandyke brown.

Catechu-tannic acid—9·72 per cent.

35 and 36. Acacia longifolia, *Willd.* See page 90, Proc. R.S. (N.S.W.) 1887, for botanical particulars of this Wattle. Figured Curtis' Botanic Magazine t. 1828 and var. *Sophoræ* t. 28 of Brown's "Forest Flora of South Australia."

Mr. W. Adam informs me that Sydney fishermen often tan their sails and nets with the bark of *Acacia longifolia*, and are well pleased with it, the articles being pliable after use; others use Ironbark (*Eucalyptus siderophloia* and *leucoxylon*) but the sails &c. are then stiff and hard.

35. Locality whence this particular specimen was obtained—On the banks of a small creek a few yards to the West of Oatley's platform, Illawarra Railway Line.

Geological Formation—Sandstone.

Part of the Tree Examined—Bark.

Particulars of the tree (sapling) whence it was obtained—Height 15 feet, diameter 4 inches.

Collected 23rd July, 1887. Analysed 12th to 30th September 1887.

The wood of this tree was injured to some extent by the ravages of a coleopterous insect. Two days after stripping the bark was dried on a water-bath with the following result:

Weight green	17·694
Weight dry	9 377
Loss	8·317

∴ loss on drying = 47·005 say 47 per cent.

Compared with the *A. longifolia* bark referred to in my previous paper (page 90) the general appearance of this bark is much the same outside, though at places slightly darker. The inner bark is lighter and more yellowish, and being from a younger tree the thickness is much less, i.e., only about $\frac{1}{20}$ of an inch. It is more fibrous than the bark from Ryde referred to in the present paper.

Extract.—Yields 24·91 per cent. to water at 100° C. Solution of an intense orange-brown colour. Becomes slightly turbid on cooling. Colour of moist residue sienna brown.

Catechu-tannic acid—15·34 per cent.

36. Locality whence this particular specimen was obtained—On the banks of a creek between Ryde and South Ryde Railway Stations, Great Northern Line, to the east of the line.

Geological Formation—Sandstone.

Part of the Tree Examined—Bark.

Particulars of the trees (saplings) whence it was obtained—Height 5 to 10 feet, diameter 1 to $1\frac{1}{2}$ inch.

Collected 30th July, 1887. Analysed 12th to 29th September 1887.

The saplings were healthy. Two days after stripping the bark was dried on the water-bath with the following result:

Weight green	... ...	34·822
Weight dry	... ...	14·702
	Loss	20·120

∴ loss on drying = 57·779 per cent.

In general appearance the bark of these saplings is much lighter than the bark examined at page 90. It is of a grey tint; also the inner bark is more yellow than that from Oatley's. Thickness up to $\frac{1}{16}$ inch.

Extract.—Yields 23·53 per cent. to water at 100° C. Colour pale brown; very turbid whether in the cold or on boiling, owing to the presence of much mucilage. Colour of moist residue sienna brown of a lighter tint than that of the bark from Oatley's.

Catechu-tannic acid—15·99 per cent.

37. Eucalyptus stellulata, *Sieber*, N.O. Myrtaceæ, B. Fl. iii., 200 Figure Dec. 6 "Eucalyptographia" (Mueller).

Found in New South Wales and Queensland.

Vernacular Name—"Sally or Black Gum."

Locality whence this particular specimen was obtained—Bombala.

Geological Formation—Limestone.

Part of Tree Examined—Kino.

Particulars of the trees whence it was obtained—Height 30 to 50 feet, diameter 2 feet.

Collected 17th and 18th February, 1887. Analysed 12th to 21st September, 1887.

This tree yields excellent fire-wood; otherwise it is considered of little use. It does not often attain a height of more than 12 feet at Nangutta. It yields kino in considerable quantity. The kino is in pieces intermediate in size between that yielded by *E. amygdalina* var. and *E. piperita* var. (referred to in this paper) but presenting no marked differences from those kinos. It is hard to powder, being very tough. The colour of its powder is near Venetian Red.

Extract.—Yields 99·22 per cent. to water at 100° C. Solution of a moderately intense ruby colour. Residue, a black resinous substance intermixed with woody fibre of a brown colour.

Kino-tannic acid—62·96 per cent.

38. EUCALYPTUS AMYGDALINA,* var. *Labill.*, N.O. Myrtaceæ, B. Fl. iii., 202. Figure Decade "Eucalyptographia" (Mueller).

Found in Victoria and New South Wales (range not co-extensive with that of the normal species).

Vernacular Name—"Peppermint."

Locality whence this particular specimen was obtained—Bombala.

Geological Formation—Limestone.

Part of the Tree Examined—Kino.

Particulars of the trees whence it was obtained—Height 60 to 80 feet, diameter 3 feet.

Collected 14th to 16th February, 1887. Analysed 12th to 26th September, 1887.

Of all shades of ruby or garnet, clear, more friable than the kino of *E. piperita*, but forming a less bright powder. Colour of powder light Indian red. Dr. Wiesner *loc. cit. (E. maculata)* speaks of this kino becoming turbid from solution in water. I cannot confirm this observation.

Extract.—Yields 96.06 per cent. to water at 100° C. Solution of about the same colour, and nearly as intense as *E. piperita.* Residue consists of a black resinous substance intermixed with woody fibre of a brown colour.

Kino-tannic acid—58·41 per cent.

39. EUCALYPTUS PIPERITA, *Smith*, var., N.O. Myrtaceæ, B. Fl. iii., 207. Figure Dec. 3, "Eucalyptographia," (Mueller).

Found in Eastern Victoria and New South Wales.

* See p. 36, Proc. R.S., N.S.W., 1887.

Vernacular Names—"Messmate," "Narrow or Almond-leaved Stringybark."

Locality whence this particular specimen was obtained—Brooman, Clyde River.

Geological Formation—Granite.

Part of the Tree Examined—Kino.

Particulars of the trees whence it was obtained—Height 100 to 120 feet, diameter 2 to 3 feet.

Collected 14th and 15th September, 1886. Analysed 12th to 22nd September, 1887.

This tree much resembles *E. obliqua* (the ordinary Stringybark), but the leaves of the former are narrower, the bark rougher and not so fibrous as that of *E. obliqua*; it is also much richer in kino. This substance is used by some of the local settlers in the manufacture of ink, the process simply consisting in boiling it in an iron vessel; the liquid is also used for staining leather black. This kino is obtained in pieces larger than is usual in the case of clear kinos, some of the pieces being as large as a walnut. It is of rather a dark colour, and rather hard and tough, but breaking down into garnet-coloured fragments. Has a very bright fracture.

Extract.—Yields 99·75 per cent. to water at 100° C. Colour of liquid bright garnet or ruby. Residue same as *E. stellulata*, but with a very small amount of woody fibre.

Kino-tannic acid—62·12 per cent.

40. * Eucalyptus siderophloia, *Benth.*, N.O. Myrtaceæ, B. Fl. iii., 220. Figure Decade 4, "Eucalyptographia," (Mueller)

Found from Southern New South Wales to Southern Queensland.

Vernacular Name—"Ironbark."

Locality whence this particular specimen was obtained—Cambewarra.

Geological Formation—Sandstone.

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—A sapling about 6 inches in diameter.

Collected 21st August, 1886. Analysed 12th to 22nd September, 1887.

It will be interesting to compare this analysis with that of the *E. siderophloia* bark described above (page 39). "Botany Bay Kino," was chiefly obtained from this species, hence the name *A. resinifera*, A. Cunn. (non Smith). This tree yields the chief portion of Ironbark timber in New South Wales. This bark

* See page 39, Proc. R.S. (N.S.W.) 1887.

differs from that described in June last, in containing but traces of kino visible to the eye, and consisting of the whole thickness of the bark. The complete difference will be apparent from the following description of the bark now under examination. It reminds me very strongly of virgin cork, more so, in fact, than any other specimen of Eucalyptus bark I have examined up to the present time. It is deeply fissured, light (though not quite so light as cork-bark), and these particular specimens certainly might be used as floats for fishermen's nets. It is very soft and elastic, can easily be indented and even torn away by the finger-nail. In a word it is simply inferior cork. Its outer surface has nothing of the hardness characteristic of Ironbarks, though it possesses their rugged, furrowed appearance. Prevailing colour light grey. The corky portion is readily detachable, and about an inch in thickness. The inner bark is of very uniform thickness (about $\frac{3}{16}$ inch), is hard and compact, and contains abundance of fibre of good quality (for Eucalypts). Colour light reddish-brown; of whole of bark ground up, pure light brown.

Extract.—Yields 14·2 per cent. to water at 100° C. Colour of solution of a deep orange colour, inclining to brown. Becomes turbid when fairly concentrated. Colour of moist residue, different shades of brown.

Kino-tannic acid—6·702 per cent.

41. Eucalyptus viminalis, *Labill.*, var. N.O. Myrtaceæ, B. Fl. iii., 239. Figure Dec. 10, "Eucalyptographia" (Mueller), and tab. 32 of Brown's "Forest Flora of South Australia."

Found in South Australia, Victoria, Tasmania and New South Wales.

Vernacular Name—"Ribbony Gum or Manna Gum."

Locality whence this particular specimen was obtained—Quiedong, near Bombala.

Geological Formation—Limestone.

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—Height 60 to 80 feet, diameter 2 to 3 feet.

Collected 6th April, 1887. Analysed 19th August to 29th September, 1887.

The wood of this species is used locally for a variety of purposes including rails and wheelwright's work, but the heartwood is considered of no use, so that about a foot of the centre generally has to be left as useless. Bark smoothish and light coloured, the thin reddish-brown, very smooth, outer bark having entirely peeled off in those specimens submitted to analysis. Prevailing colour of outer surface of inner bark yellowish-green to yellowish. It has a structure which may be described as "wavy," this appearance being evident both on the outside and on the inside. The wavy lines are very narrow, and the distance between each crest up to about $\frac{3}{4}$ inch. This structure causes the bark to break in pieces having a wavy fracture. Thickness varies from $\frac{1}{4}$ to $\frac{7}{8}$ inch in the samples examined. Colour of powder rather darker than *E. Stuartiana*. The smell of the powdered bark is very pleasant, owing to the presence of a little essential oil.

Extract.—Yields 18·65 per cent. to water at 100° C. The solution is of a ruby colour, but not quite so bright as that of *E. maculata* bark. It contains a trace of essential oil.* Colour of moist residue light yellowish-brown.

Kino-tannic acid—7·504 per cent.

In Decade 2 of the "Eucalyptographia" as a foot note to *E. longifolia*, Baron Mueller gives the per centage of tannic acid of *E. viminalis* bark (smooth) at 4·88, and from a "young tree" 5·97.

42. Eucalyptus Stuartiana, *F.v.M.*, N.O. Myrtaceæ, B. Fl. iii., 243. Figure Decade 4 "Eucalyptographia" (Mueller).

Found in South Australia, Victoria, Tasmania and New South Wales.

Vernacular Name—"Apple-tree," (the leaves being supposed to have the odour of apples).

Locality whence these particular specimens were obtained—Quiedong, near Bombala.

Geological Formation—Limestone.

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—Height 60 to 80 feet, diameter 2 to 4 feet.

Collected 7th April, 1887. Analysed 19th August to 8th September, 1887.

Prevailing colour of outside bark light grey with whitish patches. The outer portion can be readily torn away with the finger nail, exposing a yellowish colour. This soft outer bark contains numerous shallow longitudinal fissures, the distance between which is $\frac{1}{4}$ inch on the average. Parts of it are also inclined to be scaly. Inner bark tough, and full of short, inlocked fibre. Colour light brown. Powder something like grass-seed in general appearance; full of fibre.

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* Both this and the following bark (*E. Stuartiana*) are mounted on boards covered with white paper, and have remained in this position for some months. The presence of essential oil in both of them has evidenced itself by slightly staining the paper.

Extract.—Yields 15·39 to water at 100° C. Solution of a pale orange-brown colour, slightly aromatic through the presence in it of a trace of essential oil. Colour of moist residue pale dirty brown.

Kino-tannic acid—5·25 per cent. It yielded 4·6 per cent. to Mueller and Hoffmann.

43. * EUCALYPTUS CORYMBOSA, *Smith*, N.O. Myrtaceæ, B. Fl. iii., 256. Figure Decade 5, "Eucalyptographia," (Mueller).
Found from New South Wales to Northern Australia.
Vernacular Name—"Bloodwood."
Locality whence this particular specimen was obtained—Cambewarra.
Geological Formation—Sandstone.
Part of the Tree Examined—Bark.
Particulars of the trees whence it was obtained—Height 80 to 100 feet, diameter 3 to 4 feet.
Collected 28th August, 1886. Analysed 19th August to 1st September, 1887.

A crumbling deeply fissured bark, prevailing colour ash grey where undisturbed, but as the bark is so friable this weathered appearance is removed on the slightest handling, exposing a red-brown colour. Besides being crumbly, the bark peels off in large flakes, averaging ½ inch thick. The inner bark lighter, and full of short fibre. Total thickness of bark averages 1 inch. Powder of a very light reddish-brown, and very homogeneous.

Extract.—Yields 12·16 per cent. to water at 100° C. Colour of solution light reddish-brown, of moist residue, brown.

Kino-tannic acid—5·85 per cent. In the "Eucalyptographia" Baron Mueller records 2·7 per cent. as the percentage of tannic acid in a specimen of this bark.

44 and 45. EUCALYPTUS MACULATA, *Hook.*, N.O. Myrtaceæ, B. Fl. iii., 258. Figure Dec. 3, "Eucalyptographia,"(Mueller)
Found from Port Jackson northwards to Central Queensland.
Vernacular Name—"Spotted Gum."
Locality whence this particular specimen was obtained—Cambewarra.
Geological Formation—Sandstone.
Part of the Tree Examined—Bark and Kino.

* See page 41 for analysis of the kino of this tree.

Particulars of the trees whence they were obtained—Height 100 to 120 feet, diameter 3 to 4 feet.

Collected 10th August, 1886. Analysed: Bark, 19th August to 29th September, 1887; Kino, 12th to 29th September, 1887.

44. Bark.—This characteristic and well-known bark is somewhat similar in appearance to that of *E. viminalis, var.* The thin smooth, outer bark is dark purplish-brown to chocolate. When this peels off in patches (by the operation producing the spotted appearance), the fresh surface is bright yellow, which weathers into light greys of all tints. The inner bark is of a dark reddish-brown, in some instances, yellowish, brown in others, and full of poor fibre. Average thickness of bark $\frac{5}{8}$ inch. Colour of powder same as that of *E. corymbosa* bark, with a yellowish tint added.

Extract.—Yields 20·865 per cent. to water at 100° C. Solution of a rich ruby colour. Colour of moist residue light reddish-brown.

Kino-tannic acid—9·74 per cent.

45. Kino.—This is probably the most interesting of all the Eucalyptus Kinos, and I hope to be able to present a full chemical examination of it on a subsequent occasion. It has a comparatively low melting-point, the lowest, I believe, of our kinos. The melting point is scarcely higher, if at all, than that of commercial aloes. One of the most friable of all kinos, perhaps ranking only second to *E. corymbosa* in this respect. This friability is assisted by its porous nature, some of it being nearly as porous as pumice, and distinctly vesicular to the eye. It is of a yellowish-brown (to liver) colour, and dull in appearance, except at fresh fractures. When quite fresh it is of a reddish-brown colour, with rather a bright fracture. The sample now under examination yielded a powder of a colour rather darker than yellow ochre. It tends to aggregate.

Extract.—This kino yields 93·13 per cent. to water at 100° C. Mr. Staiger, in the Catalogue of Queensland Timbers at the Colonial and Indian Exhibition, 1886, says, "This kino is soluble in boiling water to the extent of 60 per cent."

It yields 81·9 per cent. to water at 60° F., and is excessively tedious to dissolve at this low temperature. It leaves a dark resinous residue. A paper on this kino by E. Norton Grimwade, will be found in the "Pharmaceutical Journal" of the 26th June, 1886:—"The kino operated upon contained much foreign matter, such as bark, quartz, &c. The best solvent proved to be rectified spirit, which dissolved about 80·85 of the crude gum. By the action of cold water about 18·9 per cent. was dissolved. Warm water was found to extract a slightly higher percentage, but the solution became turbid on cooling." This differs from Mr. Staiger's

60 per cent., but as *E. maculata* is an abundant and easily diagnosed Eucalypt, and the kino is very characteristic, there is no reason to suppose that there is any mistake in the nomenclature, and the discrepancy (making allowance for the great impurity of Mr. Grimwade's specimens), can only be owing to the different ages, and consequent weather exposures of the kinos operated upon. This affords another instance of the incomparability of different analyses of kino with the particulars as to age &c. omitted.

It dissolves in rectified spirit at 60° F. to the extent of 88·56 per cent. (Cf Mr. Grimwade's figures *supra*).

Action of Water at 100° C.—As soon as the water added to the kino is warmed, turbidity commences, the suspended matter being in considerable quantity, and of a yellow-ochre to brown colour. It yields an orange-brown filtrate which, as it cools, deposits a sediment of a yellow-ochrey colour, that is to say, of about the same colour as that of the originally suspended matter. This second sediment is redissolved as the solution is again heated. The odour of the aqueous solution of this kino (naturally more evident in the case of the hot water), is very marked, and, as far as I know, quite characteristic amongst Eucalyptus kinos. Nevertheless it is so peculiar as to be difficult of description, and half a dozen people would probably liken it to half a dozen different things. I am inclined to liken it to decomposing apples or perhaps pears, while another description which may appeal to some is the smell of a not perfectly fresh wine-cask. Mr. Grimwade likens this aromatic odour to styrol, and Dr. Wiesner pronounces it "vinous," in the following passage* :—"*E. citriodora*, Hook. * * * * Smells like Bordeaux wine, yellow colour, turbid on cooling. Porous lumps with greenish lustre, like Socrotine aloes, mixed with bark. *E. maculata*, Hook., exactly like the last."

E. citriodora is now only considered a variety of *E. maculata*. Dr. Wiesner's description should be compared with mine (*supra*). I will add that my sample is certainly unlike Socrotine aloes of good quality, but is very like specimens of Natal aloes (*Aloe capensis* var. *hepatica*). Colour of moist residue dark dirty brown. It is principally composed of woody fibre in a fine state of division with a few small pieces of wood or chips.

Action of Water at 60° F.—The colour of the solution at first is bright yellow, like picric acid, but gets browner as the process of solution goes on,—a rich dark sherry-coloured liquid being eventually formed. The liquid remains perfectly clear. The moist residue agglomerates into flattened pieces of a roundish shape, and is very much like Mosaic gold in appearance.

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* Zeitschr. d. allg. Oest. Apotheker-Vereines, quoted in "Pharmaceutical Journal," [3] ii., 102.

Action of Rectified Spirit at 60° F. It enters into solution readily, forming a dark sherry-coloured liquid. Colour of residue yellowish to brown, and consisting entirely of woody fibre in a fine state of division.

Kino-tannic acid—44·55 per cent. Mr. Staiger *(loc. cit.)* gives the percentage in his sample at 34·97. Mr. Grimwade *(loc. cit.)* gives the percentage in his sample at 10, "of tannin closely allied, if not identical with querco-tannic acid."

46 and 47. Eremophila longifolia, *F.v.M.*, N.O. Myoporineæ, B. Fl. v., 23. Figured, Tab. 13 of Baron Mueller's "Myoporinous Plants of Australia," and t. 18 of Brown's "Forest Flora of South Australia."

Found in all the Colonies except Tasmania,

Vernacular Name—"Emu Bush." (Other species of *Eremophila* also go by this name owing to Emus feeding on the fruits or seeds).

Locality whence this particular specimen was obtained—Ivanhoe, viâ Hay.

Parts of the Tree Examined—Bark and Leaves.

Particulars of the trees whence they were obtained—Height 10 to 15 feet; diameter 6 to 8 inches.

Collected : Bark, 4th October, 1886 ; Leaves, 19th November, 1886. Analysed : Bark, 19th August to 1st September, 1887 ; Leaves, 12th to 22nd September, 1887.

46. Bark.—A very prominently and irregularly fissured bark, prevailing colour of outside grey to brown. Very similar in appearance, except that the fissures are not so deep, to the bark of the Cork Oak. Inner bark light brown, and containing no fibre. Average thickness barely ½ inch. Forms an impalpable powder, owing to the absence of fibre, and of a yellowish-brown colour.

Extract.—Yields 19·11 per cent. to water at 100° C. Solution of an intensely dark brown colour. Colour of moist residue, dark dirty brown.

Tannic acid.—5·107 per cent.

47. Leaves.—The aboriginals in the interior use the bruised leaves of this and some other species of *Eremophila* for tanning the skins of the male wallaby in order to make water-bottles.

The following description of the leaves of this species, which applies in every respect to my specimens, is taken from the "Flora Australiensis":—"The young shoots minutely hoary tomentose, the older foliage nearly glabrous and often drying black. Leaves scattered, linear or almost linear-lanceolate, obtuse or tapering into a recurved point, rather thick but flat, 2 to 4 or even 5 inches long, contracted into a short petiole." They yield a bronze-green powder.

Extract.—Yields 42·92 per cent. to water at 100° C. Colour of solution light orange-brown, and slightly fluorescent. Becomes turbid when moderately concentrated. Colour of moist residue dark bronze-green inclining to brown.

Tannic acid—9·705 per cent.

48. POLYGONUM PLEBEJUM, *R. Br.*, N.O. Polygonaceæ, B. Fl. v., 267.
Found in all the colonies except Western Australia and Tasmania. It is not, however, endemic in Australia, as it is to be found in Tropical Asia and Africa.
Locality whence this particular specimen was obtained—Quiedong, near Delegate.
Geological Formation—Limestone.
Whole plant examined *except the root.* It was for the most part in fruit.
Collected 7th April, 1887. Analysed 19th August to 29th September, 1887.

The following description of *P. plebejum* is taken from the "Flora Australiensis," and will be useful to refer to here:—"A much-branched prostrate annual, rarely about 1 foot long, glabrous or the branches slightly hoary. Leaves linear, narrow-oblong or slightly spathulate, rarely above ½″ long. Stipules short, silvery, and ragged at the edges. Flowers very small, in clusters of 2 to 5 in the axils of most of the leaves. Fruiting perianth under 1 line long, the segments green, with a narrow white edge. Nuts triangular, very smooth and shining."

This genus contains 150 species according to the "Genera Plantarum" of Bentham and Hooker. Of these 11 are found in Australia, and some of these are endemic.

I chose *P. plebejum* for the purposes of the present examination because I had a most convenient opportunity of obtaining a quantity of it, but various species are common in swampy country throughout the Colony, and it is very probable that at an early date I may report on the tanning power of those species found about Sydney.

Most books which refer to Tan-substances take cognizance of species of *Polygonum*, which are more or less astringent. Perhaps the best known species is *P. Bistorta*, Linn., figured in Bentley and Trimen's "Medicinal Plants," which has a very astringent root sold by herbalists and others in Europe, under the name of Bistort and Snakeweed root. After suitable preparation the roots of this and some other species are used as food in some countries, on account of the starch they contain, and it is quite possible that the hungry Australian aboriginal may have put the species which are found in this part of the world to the same use, though I have never seen it recorded.

The leaves of *P. tinctorium* yield a kind of indigo in France, while the Chinese produce a blue dye from several species.

But up to the present it appears that *P. amphibium* is most used as a tan-substance. H. R. Procter in his admirable "Text-book of Tanning," and the "Year-book of facts in Science and Art, 1876," both draw attention to it. It is an annual, abundant in the Missouri Valley, United States, and can be mown and stacked like hay. It is largely used in the Chicago tanneries, and is said to give a leather which is tougher, more durable, of finer texture, and capable of higher polish, than that tanned with Oak bark. The process is said to be the same.

Consideration of these facts shows us that our native species of *Polygonum* are well worthy of examination. *P. plebejum*, for instance, occurs plentifully along rivers, creeks, and moist localities and in most places it could be mowed down. In handling the plant during the operation of drying it irritates to sneezing, though only slightly. The irritation was increased during the operation of grinding the dried plant for the purpose of these experiments.

Extract.—28·11 per cent. to water at 100° C., yielding a solution of a light reddish-brown, very similar to that yielded by *Eucalyptus corymbosa* bark, though not so bright in colour. Colour of moist residue dirty dark brown, interspersed with a few light particles.

Tannic acid—11·19 per cent.

It will be interesting to compare with this result the following analyses of two of the species of *Polygonum* referred to above. I am unable to find the names of the chemists who made the analyses, nor are the particulars as explicit in all cases as I could wish, but I quote my sources of information :

	Tannin.	
Polygonum Bistorta :		
(Roots presumably)	17·1	per cent.
"Spring,"	21·1	,,
"From botanic garden,"	17·0	,,
"Leaves in the fall,"	4·2	,,
"Waste of roots,"	16·0	,,
Polygonun sp.		
"Fall Polygonum from the Marsh," ...	20·0	,,
Summer ditto ditto	26·4	,,

C. T. Davis, "The Manufacture of Leather."

Polygonum amphibium :	Tannin.	
Leaves	18	per cent.
H. R. Procter, "Text-book of Tanning."		
? Leaves	11½	"
"Gardener's Chronicle."		

49 GREVILLEA STRIATA, *R. Br.*, N.O. Proteaceæ, B. Fl. v., 462.

Found in all the Colonies except Victoria and Tasmania.

Vernacular Name—"Beefwood"

Locality whence this particular specimen was obtained—"Near the Darling," not far from Wilcannia.

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—Height up to 40 feet, diameter 12 to 15 inches.

Collected 14th October, 1886. Analysed, 19th August to 2nd September, 1887.

The timber of this tree is beautifully marked, hence its local name. Bark very rugged-looking, very similar in appearance to an "Ironbark," but softer. Prevailing colour dark grey ; inner bark warm reddish-brown, and pitted, having the characteristic appearance of Proteaceous barks. Average thickness ½ inch. General appearance of powder dark reddish-brown with particles of light fibre disseminated through it.

Extract.—Yields 22·02 per cent. to water at 100° C. Solution of a very intense ruby colour. Colour of moist residue dark purplish-brown, inclining to Vandyke-brown.

Tannic acid—17·84 per cent.

50. HAKEA LEUCOPTERA, *R. Br.*, N.O. Proteaceæ, B. Fl. v., 515.

Found in South Australia, Victoria, New South Wales and Queensland.

Vernacular Names—"Needle or Pin-bush."

Locality whence this particular specimen was obtained—Ivanhoe, viâ Hay.

Part of the Tree Examined—Bark.

Particulars of the trees whence it was obtained—Height 15 to 20 feet, diameter 8 to 10 inches.

Collected 4th September, 1886. Analysed 19th August to 4th October, 1887.

Prevailing colour of bark dark grey. Fissured to a moderate depth. Distance between the ridges ¼ inch to 1 inch. Full of fibre through its total thickness. The individual fibres have a very regular wavy appearance, and when stripped in layers have the appearance of net-work. It has the usual Proteaceous appearance on the inner surface of the bark, which is of a light colour. Total thickness averages $\frac{3}{8}$ inch. Colour of powder reddish-brown, with abundance of light coloured fibre.

Extract.—Yields 14·95 per cent. to water at 100° C. Colour of solution light reddish-brown; of moist residue, like that of *Grevillea striata*, but less red.

Tannic acid, 10·99 per cent.

51. Banksia integrifolia, *Linn.* f., N.O. Proteaceæ, B. Fl. v., 554. Figure Curtis' Botanic Magazine, t. 2770.

Found in Victoria, New South Wales and Queensland.

Vernacular Name—"Coast Honeysuckle."

Locality whence this specimen was obtained—200 yards to the north-west of South Ryde Railway Platform, Great Northern Railway.

Geological Formation—Sandstone.

Part of the Tree Examined—Bark.

Particulars of the tree whence it was obtained—Height 35 feet; diameter 1 foot.

Collected 20th July, 1887. Analysed 30th July to 28th September, 1887.

A fissured bark. Colour light grey to dark grey and even nearly black. It reminds one strongly of the bark of the Cork Oak, except in thickness, which averages $\frac{1}{2}$ inch. Inner bark of pale colour, and having a surface which may be compared to that of a rasp, with the exception that the teeth, which are set with exceeding regularity, are longitudinal, and not transverse. Each tooth is lenticular, dentate on its upper surface, about a line long, and separated from its neighbour by a distance equal to its own greatest thickness, *i.e.*, about $\frac{1}{32}$ of an inch. Colour of powder light-brown, with little or none of the reddish tint of *B. serrata*.

This bark, preserved as much as possible from drying in the meantime, was put in the water-bath two days after collection. Following is the result:—

Weight green	... ...	43·606 grms.
Weight dry	... ...	20·805 „
	Loss	22·801

= 52·3 per cent. of moisture.

Extract.—Yields 14·2 per cent. to water at 100° C. Colour of solution deep orange-brown; of moist residue pure brown.

Tannic acid, 10·825 per cent.

52. BANKSIA SERRATA, *Linn.* f., N. O. Proteaceæ, B. Fl. v., 556. Figure Curtis' Botanic Magazine, t. 2671.

Found in Tasmania, Victoria, New South Wales and Queensland.

Vernacular Names—"Beefwood," "Honeysuckle."

Locality whence this particular specimen was obtained—A quarter of a mile to the west of Oatley's Platform, Illawarra Line.

Geological Formation—Sandstone.

Part of the Tree Examined—Bark.

Particulars of the tree whence it was obtained—Height 20 feet, (but of most irregular shape) ; diameter 10 inches.

Collected 23rd July, 1887. Analysed 12th to 30th September, 1887.

Outer surface of bark a mass of tubercles, with an average diameter of $\frac{3}{8}$ inch each. The tubercles show a greater or less tendency to shell in concentric layers. Outer surface dark grey. This bark when cut had all the appearance of fresh beef, in fact the fresh bark far more deserves the epithet of "beef" than the wood, which usually receives it. The rich red sap of the bark poured out at every stroke of the tomahawk, splashing freely. Even now when dried it has a reddish colour. Average thickness $\frac{3}{4}$ inch. Colour of powder reddish-brown.

Two days after collection this bark was put in the water-bath :

Weight green	... ...	65·789 grms.
Weight dry at 100° C.	...	26·668 ,,
	Loss	39·121

Showing loss of moisture on drying of 59·46 per cent.

Extract.—Yields 27·38 per cent. to water at 100° C. Colour of solution rich ruby ; of moist residue Sienna-brown. (Of the same tint as *A. longifolia*, Oakley's).

Tannic acid, 23·25 per cent.

Baron Mueller gives the result of an analysis of this bark at 10·8 per cent. of tannin. In the absence of any particulars as to the tree which yielded the bark referred to by Baron Mueller, I am unable to offer any explanation with regard to the apparent lack of agreement between the analyses. With regard to my specimen, however, I would point out that it was cut at a season most favourable for a high yield of tannin, and (which was also doubtless the case in Baron Mueller's specimen), I repeated the analysis three times on as many separate pieces of bark, with closely agreeing results.

53. Casuarina glauca, *Sieb.*, N.O. Casuarineæ, B. Fl. vi., 196.
Found in South Australia, Victoria, New South Wales and Queensland.
Vernacular Names—" Belar, Belah, Billa or Bull Oak."
Locality whence this particular specimen was obtained—Ivanhoe, viâ Hay.
Part of Tree Examined—Bark.
Particulars of the tree whence it was obtained—Height 40 to 50 feet; diameter 12 to 15 inches.
Collected 25th September, 1886. Analysed 19th August to 4th October, 1887.

A very common tree, in the interior. Timber exceedingly hard but brittle. Much used for fencing posts. Bark with innumerable longitudinal fissures and transverse cracks, which give the outer surface a flaky or sub-tubercular appearance. Prevailing colour light grey, with darker patches. Inner bark light brown, and containing fibre of low quality. A compact bark; total thickness $\frac{3}{16}$ inch. Colour of powder dirty brown, with an admixture of light and dark particles.

Extract.—Yields 17·2 per cent to water at 100° C. Solution of a colour which may be described as ruby, with a tinge of brown. Colour of moist residue Vandyke brown.

Tannic acid—11·58 per cent.

54. Exocarpus cupressiformis, *Labill.*, N.O. Santalaceæ, B. Fl. vi., 229.
Found in all the Colonies.
Vernacular Name—" Native Cherry."
Locality whence this particular specimen was obtained—A quarter of a mile to the east of Ryde Railway Station, Great Northern Line.
Geological Formation—Sandstone.
Part of Tree Examined—Bark.
Particulars of the shrub whence it was obtained—Height 10 feet; diameter $1\frac{1}{2}$ inch.
Collected 30th July, 1887. Analysed 12th to 28th September 1887.

This shrub was not a good specimen, being stunted and having a good many galls on it. I did not like to sacrifice a better tree as there were but few in the neighbourhood. The tree however, is a very common one, and the analysis of the bark of this sapling shows that it is worthy of further attention. In passing I may mention that in the neighbourhood of Delegate it grows to the unusual diameter of two feet. Colour of bark grey to black, but chiefly the latter. Innumerable small fissures give the bark of this tree (a very small one of its kind) a suberose appearance. Inner bark light coloured and containing but little fibre. Total thickness 1 line. Colour when powdered dirty brown.

Two days after stripping it was put in the water-bath with the following result :

Weight green	... ...	31·779 grms.
Weight dry	... ...	16·181 ,,
	Loss	15·598

∴ loss of weight in drying = 49·082 per cent.

Extract.—Yields 29·99 per cent. to water at 100° C. Colour of solution orange-brown, not absolutely clear and bright ; of moist residue Vandyke brown in general appearance. It is composed of a mixture of very dark drown and light brown particles.

Tannic acid—15·752 per cent.

Qualitative Tests—Notes—(Second Supplement).

1. Cobalt acetate has been substituted for Ammonium sulphide. The unsatisfactory nature of the reactions yielded by the latter has been already alluded to.

2. The solutions of leaves (*Rhus*, *Eremophila* and *Polygonum*) yield a green filtrate with ammonio-sulphate of copper (column 9).

3. The precipitates yielded by *E. amygdalina* kino are usually darker than those yielded by *E. stellulata* and *E. piperita* under the same circumstances.

4. The following statement has been made, and has been copied into several English and American works:—"The tannin of *Banksia serrata* imparts a beautiful violet-blue colour to solutions of ferric salts." I cannot confirm this observation. The violet tint is of the most transient nature, and the colour is more brown than anything else. See column (4) in schedule. When the ferric-chloride is moderately concentrated a pure brown *precipitate* is the result. Precipitates form in most cases with this re-agent unless it be dilute.

5. Ammonium nitro-molybdate darkens the liquid in every case, producing various shades of olive greens and olive-browns, chiefly the former. In the case of three of the kinos *E. stellulata*, *E. amygdalina*, and *E. piperita*, there is in addition an exceedingly abundant gelatinous precipitate, which sets to a firm jelly on standing, so that the test-tube can be inverted without any danger of loss of its contents. This is more particularly marked with *E. piperita*.

QUALITATIVE TESTS, (Dilute Extract).

Species.	1 Reaction.	2 Boiled with equal volume of Sulphuric Acid: (1 in 5) *a*—in the cold.	*b*—on boiling.
30. ELÆOCARPUS grandis, *F.v.M.* (Bark.)	Faintly acid.	No change.	No change.
31. RHUS rhodanthema, *F.v.M.* (Bark.)	Decidedly acid	Salmon coloured ppt. which increases on standing.	Almost entirely redissolves.
32. RHUS rhodanthema, *F.v.M.* (Leaves.)	Faintly acid.	No change; turbidity on standing.	No change.
33. ACACIA homalophylla, *A. Cunn.* (Bark.)	ditto.	No change; reddish-brown ppt. on standing.	Almost entirely redissolves.
34. ACACIA Oswaldi, *F.v.M.* (Bark.)	ditto.	Ditto; but less copious	Precipitate does not redissolve.
37. EUCALYPTUS stellulata, *Sieb.* (Kino.)	Decidedly acid	Turbidity; copious salmon coloured ppt. on standing.	Ditto; but rises to the top in coagulated lumps.
38. EUCALYPTUS amygdalina, *Labill.* var. (Kino.)	ditto.	Ditto.	Ditto.
39. EUCALYPTUS piperita, *Smith*, var. (Kino.)	ditto.	Ditto; but more flocculent.	Ppt. coagulates into one large lump which almost redissolves on further boiling.
40. EUCALYPTUS siderophloia, *Benth.* (Bark.)	Neutral.	Flesh-coloured ppt.	Precipitate does not redissolve.
41. EUCALYPTUS viminalis, *Labill.*, var. (Bark.)	Faintly acid.	No change; slight brownish ppt. on standing.	Ditto.
42. EUCALYPTUS Stuartiana, *F.v.M.* (Bark.)	ditto.	Ditto.	Ditto.
43. EUCALYPTUS corymbosa, *Smith* (Bark.)	ditto.	No change; turbidity on standing.	Ditto.
44. EUCALYPTUS maculata, *Hook.* (Bark.)	Decidedly acid	Turbidity; reddish-brown ppt. on standing.	Ditto.
45. EUCALYPTUS maculata, *Hook.* (Kino.)	Faintly acid.	No change; slight pale yellow ppt. on standing.	Entirely redissolves.
46. EREMOPHILA longifolia, *F.v.M.* (Bark.)	ditto.	Turbidity; slight pale brown ppt. on standing.	Almost redissolves.
47. EREMOPHILA longifolia, *F.v.M.* (Leaves.)	Decidedly acid	No change.	Precipitate entirely redissolves.
48. POLYGONUM plebejum, *R. Br.* (Whole plant except root.)	ditto.	Faint light ppt.	Precipitate does not redissolve.
49. GREVILLEA striata, *R. Br.* (Bark.)	Faintly acid.	No change; orange-coloured ppt. on standing.	Ditto.
50. HAKEA leucoptera, *R. Br.* (Bark.)	ditto.	Turbidity; pale flocculent ppt. on standing.	Ppt. almost entirely redissolves.
51. BANKSIA integrifolia, *Linn. f.* (Bark.)	ditto.	Reddish-brown ppt.	Precipitate does not redissolve.
52. BANKSIA serrata, *Linn. f.* (Bark.)	ditto.	Ditto; but in far larger quantity.	Ditto.
53. CASUARINA glauca, *Sieb.* (Bark.)	ditto.	No change; slight ppt. on standing.	Ppt. redissolves.
54. EXCOCARPUS cupressiformis, *Labill.* (Bark.)	ditto.	Salmon-coloured ppt.	Precipitate does not redissolve.
	For 35 and 36	*(A. longifolia)* see p. 90.	

QUALITATIVE TESTS, (Dilute Extract)—*continued.*

3	4		5
Bromine Water.	Dilute Ferric Chloride.	Add Ammonia.	Baric Hydrate.
No change.	Slight indigo-blue ppt.	Dark olive-brown colour.	Olive-brown ppt.
Orange-brown ppt.	Purplish-brown colour	Deep garnet colour.	Dark purplish-grey precipitate.
Slight yellow ppt.	Slight light blue ppt.	Light olive-brown colour.	Yellow precipitate.
Yellowish-brown ppt.	Brown colour.	Deep garnet colour.	Dark purple-brown precipitate.
Slight yellowish ppt.	Bluish-grey colour.	Light olive-brown colour.	Brown precipitate.
Light salmon-coloured precipitate.	Purple colour.	Very deep garnet colour.	Dense purple ppt.
Like *E. stellulata*, but a little darker.	Purplish-brown colour	Ditto.	Ditto.
Dense salmon-coloured precipitate.	Purple colour.	Ditto.	Ditto.
Yellow precipitate.	Slight dark bluish ppt.	Dark brown ppt.	Brown precipitate.
Slight yellow ppt.	Dark olive-green colour.	Light olive-brown colour.	Reddish-brown ppt.
Very slight orange-coloured ppt.	Olive-brown colour.	Ditto.	Brown precipitate.
Like *E. Stuartiana.*	Light purplish colour.	Ditto.	Ditto.
Orange-brown ppt.	Dark purplish-brown colour.	Deep garnet colour.	Dark reddish-brown precipitate.
No change.	Dark bluish - green colour.	Ditto.	Yellow ochre coloured precipitate.
No change.	Olive green colour.	Olive-brown colour.	Dark brown ppt. in small quantity.
Light brown ppt.	Dark purplish-brown colour.	Deep garnet colour.	Dark olive-green ppt.
Slight yellow ppt.	Dark olive-green colour.	Orange-brown colour.	Orange-brown ppt.
Ditto.	Orange-brown ppt.	Very slight dark brown precipitate.	Dark purple-brown ppt.
Like *Grevillea striata.*	Bluish-grey colour.	Orange-brown colour.	Light brown ppt.
Slight pale yellowish precipitate.	Purplish-brown colour.	Ditto.	Very dark brown ppt.
Pale yellow ppt.	Ditto.	Deep garnet colour.	Ditto; but more dense
Slight yellowish ppt.	Light brown colour.	Orange-brown colour.	Purple-brown ppt.
Orange-coloured ppt.	Purplish-brown colour.	Deep orange-brown colour.	Ditto.

QUALITATIVE TESTS, (Dilute Extract)—*continued.*

Species	6 Cobalt Acetate.	7 Potassic Dichromate.	8 Tartar Emetic.
30. Elæocarpus grandis, *F.v.M.* (Bark.)	Dirty brown precipitate.	No change.	No change.
31. Rhus rhodanthema, *F.v.M.* (Bark.)	Dark salmon precipitate.	Brown precipitate.	Slight orange-brown precipitate.
32. Rhus rhodanthema, *F.v.M.* (Leaves.)	Dirty brown precipitate.	No change; darkens on standing.	No change.
33. Acacia homalophylla, *A. Cunn.* (Bark.)	Reddish-brown precipitate.	Ditto.	No change.
34. Acacia Oswaldi, *F.v.M.* (Bark.)	Ditto.	No change.	No change.
37. Eucalyptus stellulata, *Sieb.* (Kino.)	Dark salmon precipitate.	Dark purplish-grey precipitate.	Slight purplish ppt.
38. Eucalyptus amygdalina, *Labill.* var. (Kino.)	Much darker than last, almost purplish-grey.	Ditto.	Ditto.
39. Eucalyptus piperita, *Smith*, var. (Kino.)	Like *E. stellulata.*	Ditto.	Ditto.
40. Eucalyptus siderophloia, *Benth.* (Bark.)	Dark reddish-brown ppt.	Turbidity; slight reddish-brown ppt. on standing.	Turbidity.
41. Eucalyptus viminalis, *Labill.*, var. (Bark.)	Dark brown precipitate.	No change.	No change.
42. Eucalyptus Stuartiana, *F.v.M.* (Bark.)	Ditto.	No change.	No change.
43. Eucalyptus corymbosa, *Smith* (Bark.)	A light brown precipitate.	No change; turbidity on standing.	No change.
44. Eucalyptus maculata, *Hook.* (Bark.)	Dark reddish-brown ppt.	Turbidity; slight reddish-brown ppt. on standing.	No change.
45. Eucalyptus maculata, *Hook,* (Kino.)	Dark brownish drab ppt.	Dark brown ppt.	No change.
46. Eremophila longifolia, *F.v.M.* (Bark.)	Very dark brown ppt.	No change.	No change.
47. Eremophila longifolia, *F.v.M.* (Leaves.)	Dark olive-brown ppt.	Turbidity; darkens liquid on standing.	No change.
48. Polygonum plebejum, *R. Br.* (Whole plant except root.)	Light brown precipitate.	No change.	No change.
49. Grevillea striata, *R. Br.* (Bark.)	Dark purplish-brown ppt.	No change; turbidity on standing.	No change.
50. Hakea leucoptera, *R. Br.* (Bark.)	Purplish-grey precipitate.	Turbidity.	Slight turbidity.
51. Banksia integrifolia, *Linn. f.* (Bark.)	Dark reddish-brown ppt.	No change.	No change.
52. Banksia serrata, *Linn. f.* (Bark.)	Very dark purplish-grey precipitate.	Turbidity.	No change.
53. Casuarina glauca, *Sieb.* (Bark.)	Purplish-brown precipitate.	Turbidity.	No change.
54. Excocarpus cupressiformis, *Labill.* (Bark.)	Very light purplish-brown ppt.	Turbidity.	No change.

QUALITATIVE TESTS, (Dilute Extract)—*continued.*

	9		10 One drop of strong sulphuric acid to one drop of extract on a white glazed tile.
Add Ammonic Chloride	Copper Sulpate.	Add Ammonia.	
Pale dirty yellow ppt.	Dark olive-brown ppt.	Dark olive-brown ppt. in aboundance.	Yellowish colour.
Salmon coloured ppt.	Dark purplish-grey precipitate.	Vandyke-brown ppt.	Light brown colour.
Yellow ppt.	Light olive-green ppt.	Dark brown ppt.	Bright yellow colour.
Russet-brown ppt.	Brown precipitate.	No change.	Light brown colour.
Whitish-brown ppt.	Ditto.	No change.	Ditto, but less intense.
Abundant purplish-grey precipitate.	Purplish-grey ppt.	Abundant Vandyke-brown precipitate.	Purplish-brown colour
Ditto.	Ditto.	Ditto.	Ditto.
Ditto.	Ditto.	Ditto.	Ditto.
Ditto; but in smaller quantity.	Brown precipitate, with a faint purplish tint.	Umber-brown ppt.	Light brown colour.
Orange-brown ppt.	Brown precipitate.	Light brown ppt.	Yellow ochre colour.
No change; orange-brown precipitate on standing.	Olive-brown ppt.	Ditto.	Ditto; but in smaller quantity.
Ditto; but in very slight quantity.	Dark brown ppt.	Ditto.	Very slight brownish colour.
Orange-brown ppt.	Ditto.	Vandyke-brown ppt.	Slight brownish colour
Yellow precipitate of an olive tint.	Olive-brown ppt.	Very deep olive-brown precipitate (almost bronze-green).	No change.
Turbidity.	Brown precipitate.	Redissolves.	Hardly any change.
Brown ppt.	Dark brown ppt.	Olive-green ppt.	Yellow colour.
Light olive-brown ppt.	Light brown ppt.	Dark brown ppt.	Bright yellow colour.
Very slight reddish-brown precipitate.	Flesh-coloured ppt.	Purplish-brown ppt.	Light reddish-brown colour.
Slight flesh-coloured precipitate.	Dark brown ppt.	No change.	Ditto.
Reddish-brown ppt.	Dark reddish-brown precipitate inclining to Sienna.	Vandyke-brown ppt.	Ditto.
Ditto.	Dark brown ppt.	Ditto.	Ditto; but more intense.
Light orange-brown precipitate.	Sienna precipitate.	Purplish-brown ppt.	Light brown colour.
Ditto.	Dark brown ppt.	No change.	Ditto.

QUALITATIVE TESTS, (Dilute Extract)—*continued.*

Species.	11 Lead Nitrate.	12 Manganese Acetate.	13 Chrome Alum.
30. ELÆOCARPUS grandis, *F.v.M.* (Bark.)	Dirty yellow precipitate.	No change; whitish-brown precipitate on standing.	No change.
31. RHUS rhodanthema, *F.v.M.* (Bark.)	Light reddish-brown ppt.	No change; light purplish-grey ppt. on standing.	Turbidity.
32. RHUS rhodanthema, *F.v.M.* (Leaves.)	Light yellow precipitate.	No change; turbidity on standing.	No change.
33. ACACIA homalophylla, *A. Cunn.* (Bark.)	Reddish-brown precipitate.	No change.	Ditto.
34. ACACIA Oswaldi, *F.v.M.* (Bark.)	Ditto; but in far less quantity.	Ditto.	Ditto.
37. EUCALYPTUS stellulata, *Sieb.* (Kino.)	Dark salmon precipitate.	Ditto.	Ditto.
38. EUCALYPTUS amygdalina, *Labill.* var. (Kino.)	Purplish-grey precipitate.	Ditto.	Ditto.
39. EUCALYPTUS piperita, *Smith*, var. (Kino.)	Dark salmon precipitate.	Ditto.	Ditto.
40. EUCALYPTUS siderophloia, *Benth.* (Bark.)	Reddish-brown precipitate.	Turbidity on standing; light brown ppt with a purplish tint.	Slight reddish-brown precipitate.
41. EUCALYPTUS viminalis, *Labill.*, var. (Bark.)	Light reddish-brown ppt.	No change; turbidity on standing.	Very slight ppt. of same colour.
42. EUCALYPTUS Stuartians, *F.v.M.* (Bark.)	Ditto.	No change; slight brownish precipitate on standing.	No change.
43. EUCALYPTUS corymbosa, *Smith* (Bark.)	No change; slight flocc: ppt on standing.	No change; slight whitish precipitate on standing.	Ditto.
44. EUCALYPTUS maculata, *Hook.* (Bark.)	Light reddish-brown ppt.	Same as *E. siderophloia.*	Turbidity; on standing slight reddish-brown ppt.
45. EUCALYPTUS maculata, *Hook.* (Kino.)	Dirty yellow precipitate.	No change; yellowish precipitate on standing.	No change.
46. EREMOPHILA longifolia. *F.v.M.* (Bark.)	Whitish-brown precipitate.	No change.	Ditto.
47. EREMOPHILA longifolia, *F.v.M.* (Leaves.)	Light olive-brown ppt.	No change.	No change.
48. POLYGONUM plebejum, *R. Br.* (Whole plant except root.)	Ditto.	Ditto.	Ditto.
49. GREVILLEA striata, *R. Br.* (Bark.)	Orange-brown precipitate.	Ditto.	Ditto.
50 HAKEA leucoptera, *R. Br.* (Bark.)	Flesh-coloured precipitate.	Ditto.	Ditto.
51. BANKSIA integrifolia, *Linn. f.* (Bark.)	Pale reddish-brown ppt.	Ditto; light reddish-brown precipitate on standing.	Very slight light reddish-brown ppt.
52. BANKSIA serrata, *Linn. f.* (Bark.)	Ditto; but in much greater quantity.	Ditto.	Ditto.
53. CASUARINA glauca, *Sieb.* (Bark.)	Orange-brown precipitate.	Ditto.	Ditto.
54. EXCOCARPUS cupressiformis, *Labill.* (Bark.)	Ditto.	Turbidity.	Ditto.

QUALITATIVE TESTS, (Dilute Extract)—*continued.*

14 Mercuric Chloride.	15 Ammoniun Molybdate in Nitric Acid.	16 Potassium ferrocyanide	17 Zinc Acetate.
No change.	Darkens the liquid.	No change.	Light olive-brown ppt.
Pale salmon ppt.	Ditto.	Ditto; light reddish-brown precipitate on standing.	Purplish-grey ppt.
No change.	Ditto.	No change.	Yellow precipitate.
Ditto.	Ditto.	Ditto.	Reddish-brown ppt.
Ditto.	Ditto.	Ditto.	Pale brown ppt.
Salmon precipitate.	Ditto; very dark olive-brown ppt. on standing. [See Notes.]	Ditto.	Purplish-grey ppt.
Ditto.	Ditto.	Ditto; turbidity on standing.	Ditto.
Ditto.	Ditto.	No change.	Ditto.
Turbidity.	Ditto; slight brownish ppt. on standing.	Ditto; slight purplish precipitate on standing.	Light brown ppt.
No change.	Darkens liquid.	No change.	Reddish-brown ppt.
Ditto.	Ditto.	Ditto.	Pale olive-brown ppt. in small quantity.
Ditto.	Ditto.	Ditto.	Whitish-brown ppt. in small quantity.
Ditto.	Ditto.	Ditto; turbidity on standing.	Brown precipitate.
Ditto.	Ditto.	No change.	Yellowish-drab ppt.
Ditto.	Ditto.	Ditto.	Very dark brown ppt.
No change; turbidity on standing.	Darkens liquid.	No change.	Dark olive-brown ppt.
Ditto.	Ditto.	Ditto.	Light olive-brown ppt.
Ditto.	Ditto.	Ditto.	Light purplish-brown precipitate.
Turbidity.	Ditto.	Ditto.	Light brown ppt.
No change; very slight pale brown ppt. on standing.	Ditto.	Ditto.	Reddish-brown ppt.
Ditto.	Ditto; fairly copious dark olive-brown ppt. on standing.	Ditto.	Dark purplish-grey precipitate.
Ditto.	Darkens liquid.	Ditto.	Reddish-brown ppt.
Turbidity; pale brown precipitate on standing.	Ditto.	Ditto; Sienna ppt. on standing.	Light reddish-brown precipitate.

It will not be out of place to give a few extracts from the Report of the expert appointed by the Society of Arts to examine Australian leather and tanning materials at the Colonial and Indian Exhibition of last year :- "The best of which (Australian and New Zealand leather) is now almost as bright as, and competes very closely with, good English tannages. The grain, however, is rather brittle, and the leather difficult to work, and has consequently to be used almost exclusively for common nailed work. Most of the exhibits are badly fleshed. * * * * In these colonies also myrabolans and valonia have been freely used, and when judiciously employed in a certain proportion with the mimosa bark, considerably improve the quality of the leather, and make it of better colour and firmer, and consequently more marketable and more valuable. It should be here remarked that mimosa bark always gives the leather tanned with it a more or less pinkish or reddish colour, which for the English market should be got rid of as much as possible. The use of some other material mixed with the bark, such as bright myrabolans, helps much to counteract this colour. The leather of Australia and New Zealand is not so solid as that of Canada. On the other hand, it is, however, much more "cleanly fleshed," "lighter weighing," more pliable, and more easily sewn, and therefore more adaptable for some purposes. * * * * One very noticeable feature about the Australian tannages is the strongly marked difference between the sole leather produced in the colonies of Victoria and New South Wales : that of Victoria being in every case much more cleanly fleshed, of brighter colour, and especially better finished than that tanned in New South Wales (tanned chiefly in or around Sydney); the Sydney leather is always more fleshy, of darker colour, more roughly finished, and only suitable for a common class of work. * * * * Some Australian tanners have experimented by using cheap extracts, the effect on the leather being very deleterious, as it spoils the colour, which is now the first and most important consideration for the English market. Others have very freely used glucose, in order to add weight to the leather. This is very detrimental, offering no advantages to the tanner, as he loses in price considerably more than he gains in weight." Flaying and branding are also taken cognizance of in the Report.

Then follow reports on individual exhibits, which should be well taken to heart by the exhibitors. Tanning materials are again referred to :— * * * * "They (Australian and New Zealand) have an admirable tanning agent in the bark of acacia, mimosa, or wattle, as it is spoken of in the country. The leather produced by means of this bark is some of it of bright colour and high excellence, and large quantities are sent to this country, where it sells as readily as the production of our own tan-yards. The black wattle bark is the richest in tanning properties, and the best is that shipped from Adelaide, where the chopping, grinding, packing &c., is as well done as it is capable of being. * * * The manufacture of extract from both the wood and bark of the mimosa was mentioned by one of the representatives of the Australian Courts as having been commenced, and if successfully carried out, it might be the means of economising freight on such a long sea-voyage. Otherwise, tanners in this country are very well satisfied with the bark, whether chopped or ground, sent by the best known shippers, and the skilful combination of this most valuable tanning agent with English oak-bark, myrabolans and valonia has enabled experienced tanners to produce sole-leather little inferior to that made from pure oak-bark, in half the time, and at a material reduction of the cost of tanning compared with that of the old system."

This report states that the best wattle bark comes from Adelaide, and further that the preparation for market is excellent. The report singles out the name of one South Australian firm (I have introduced no names into this paper) for special commendation. That firm is the only one exhibiting wattle barks in the Technological Museum of Sydney. Some years ago I (on behalf of the Committee) invited the co-operation of colonial firms to supply samples of tanning materials for display in the Museum. All the New South Wales firms written to either refused, or ignored my application. This South Australian firm replied at once, and was most thankful for the opportunity of exhibiting. A visit to the Adelaide Exhibition at once convinces one of the value the South Australians place on tanning materials. The exhibits are all from private firms and are excellent; those from New South Wales are solely from two Government-endowed institutions. The lack of enterprise of some people of this colony in regard to showing the world what tan-materials we possess, and of nicely preparing them for market is pitiable, and the colony as a whole suffers. Wattle bark of the highest excellence can be abundantly grown in the coast districts of New South Wales; in fact the climate and soil are, on the whole, more suited to this kind of culture in New South Wales than in South Australia, but very few farmers seem to appreciate the value of wattles as a crop. In South Australia on the other hand, the cultivation is engaged in both by individuals and by companies. South Australia has taken the lead in this matter and everything indicates that she will maintain it. And yet honourable rivalry between the two colonies would be mutually beneficial; the quantity of bark would be increased and the price lowered for local use, while European markets would gladly absorb all the bark which the colonies might choose to send.

As regards the three other tan-substances more or less used in the Colonies,—sumach (already dealt with at some length), valonia and myrabolans, they can all be grown in the colony, but as far as I know, their cultivation has never been attempted.

The inferior position in regard to the manufacture of leather which this colony occupies as compared with Victoria, has already been alluded to.

WEDNESDAY, OCTOBER 5, 1887.

CHRISTOPHER ROLLESTON, C.M.G., Vice-President in the Chair.

The minutes of the last meeting were read and confirmed.

The Chairman referred to the loss the Society had sustained through the death of Mr. F. B. Miller of the Melbourne Mint, who had been a corresponding member for the last seven years.

The following gentlemen were duly elected ordinary members of the Society :—

- Armstrong, William Harvey ; Waverley.
- Blaxland, Ernest Gregory, M.R.C.S.E., L.R.C.P., *London ;* Prince Alfred Hospital, Sydney.
- Hamlet, W. M., F.C.S., Government Analyst ; Sydney.
- Lyden, Michael John, M.D., M.Ch., Q.U. *Ireland ;* Sydney.
- MacAllister, J. G., M.B., Ch. M. ; Prince Alfred Hospital, Sydney.
- Miles, George E., L.R.C.P.L., M.R.C.S.E. ; Glebe.
- Munro, W. J., M.B., Ch.M., M.R.C.S.E. ; Glebe.
- Seaver, Jonathan, F.G.S., M.L.A. ; Sydney.

The followiny letters were read, from Professor Michael Foster, M.A., M.D., F.R.S., acknowledging his election as an Honorary Member of the Society ; and from His Excellency the Governor conveying the thanks of Her Majesty The Queen, for the address presented by the Society :

"Cambridge, England, July 1, 1887.

My dear Sir,

Will you kindly convey to your President, Officers, and Members, my grateful thanks for the honour they have done me in electing me an Honorary Member of your Society, a distinction which I highly appreciate.

It is especially pleasing to me to be thus associated with a leading Scientific Society of our Colonies, because as you know I have greatly at heart the development of Science in the Colonies, I need hardly say that any services which it may be in my power to offer, are at the disposal of your Society.

Believe me, yours very truly,
M. FOSTER.

To Prof. A. Liversidge, F.R S., &c., Hon. Secretary,
Royal Society of New South Wales."

"Government House, Sydney, N.S.W.,
26 September, 1887.

Sir,

I am directed by His Excellency the Governor to inform you that the address to the Queen congratulating Her Majesty upon the 50th year of her reign, from the Royal Society of New South Wales has been duly received, and the Secretary of State has been commanded to convey to you Her Majesty's thanks for the loyal congratulation expressed in the address.

Her Majesty has been pleased to notice particularly the tasteful binding of the address.

I have the honour to be, Sir,
Your obedient servant,
E. W. WALLINGTON,
Priv. Sec.

The President of the Royal Society."

The conclusion of the paper upon "The origin and mode of occurrence of gold-bearing veins and of the associated minerals," by Mr. Jonathan Seaver, C.E., F.G.S., was, in the absence of the author, taken as read.

The following papers were read :—

1. "On some New South Wales Tan-substances," Part 3, by Mr. J. H. Maiden, F.R.G.S. The Chairman in conveying the thanks of the Society, expressed the hope that the result of Mr. Maiden's valuable exertions would be the means of exciting more interest in the commercial industries using tan-substances.

2. "On Port Jackson Silt-beds," by Mr. Fredk. B. Gipps, C.E. The thanks of the Society were accorded to Mr. Gipps for his valuable paper, the Chairman remarking that the facts brought before the Society by Mr. Gipps were astonishing to him, as he had no idea that such an enormous filling-up of the harbour had taken place and was still continuing. He thought the facts were such as to challenge further investigations by the Government or Harbour Trust.

Exhibit.

Prof. Threlfall exhibited several pieces of Physical apparatus recently constructed at the University :—a set of 40 Clark cells made acccording to Lord Rayleigh's directions ; these cells had been in operation for about a year and were quite as good as ever: the variation of the cells as compared with one taken as standard were of the order of ·0001 volt. A set of four hundred and fifty copper zinc couples slightly modified from a description of a similar apparatus by Prof. Rowland in the "Philosophical Magazine." A very high resistance galvanometer mounted in the way recommended by Gray, but found to be rather clumsy and not so good as the ordinary form. A cross bow and other apparatus for drawing out threads of quartz, glass, &c., in the way described recently by Mr. Vernon Boys. An ordinary Wheatstone Bridge Resistance box with some slight modification in the number of coils and mechanical arrangements.

Prof. Threlfall referred at some length to various theoretical points which had arisen in connection with the construction of these instruments.

Twenty members were present.

The following donations were laid upon the table and acknowledged :—

DONATIONS RECEIVED DURING THE MONTH OF SEPTEMBER, 1887.

(The Names of the Donors are in *Italics*.)

TRANSACTIONS, JOURNALS, REPORTS, &c.

AMSTERDAM—"*Revue Coloniale Internationale,*" Tome V., No. 2, Août, 1887. *The Editors.*

BRISBANE—Royal Society of Queensland. Proceedings, Vol. III., 1886. *The Society.*

CORDOBA—Academia Nacional de Ciencias. Boletin, Tome IX., Entregas 1 and 2 Junio, 1886. *The Academy.*

DUBLIN—Royal Irish Academy. Proceedings, Polite Literature and Antiquities, Ser. II., Vol. II., No. 7; Proceedings, Science, Ser. II., Vol. IV., No. 5; Transactions, Polite Literature and Antiquities, Vol. XXVII., Parts 6, 7, 8. Transactions, Science, Vol. XXVIII., Parts 21 to 25 incl. "Cunningham Memoirs," Nos. 2, 3, 4. ,,

FLORENCE—Società Africana d' Italia (Sezione Fiorentina). Bullettino, Vol. III., Fasc. 5 and 6, 22 Luglio, 1887. *The Society.*

GLASGOW—University. The Glasgow University Calendar, for the year 1887-88. *The University.*

HOBART—Royal Society of Tasmania. Register of Papers published in the Tasmanian Journal and the Papers and Proceedings of the Royal Society of Tasmania, from the year 1841 to 1885. Woods and Forests of Tasmania, Annual Report, 1886-7: including Report upon the Systematic Conservation of the Woods and Forests of Tasmania, by G. S. Perrin, F.L.S. *The Society.*

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LONDON—Geological Society. Quarterly Journal, Vol. XLIII., Part 3, No. 171, 1 August, 1887. *The Society.*

Linnean Society. Journal (Botany) Vol. XXII., No. 149, Vol. XXIV., No. 158. Journal (Zoology) Vol. XX., No. 117, Vol. XXI., No. 129. ,, LONDON—Royal Colonial Institute. Proceedings, Vol. XVIII., 1886-7. *The Institute.*

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MELBOURNE—Geological Society of Australasia. Transactions Vol. I., Part 2. *The Society.*

Mining Department. The Gold-Fields of Victoria—Reports of the Mining Registrars for the Quarter ended 30 June, 1887. *The Secretary for Mines.*

METZ—Vereins für Erdkunde. Jahresbericht, Vol. IX., für 1886. *The Society.*

NEW YORK—American Chemical Society. Journal, Vol. IX., Nos. 1 and 2, 1887. ,,

New York Microscopical Society. Journal, Vol. III., Nos. 1 and 2, 1887. ,,

"*Science*" Vol. X., Nos. 233 to 236, 22nd July to 12th August, 1887. *The Editors.*

PARIS—Académie des Sciences de l'Institut de France. Comptes Rendus, Tome CV., Nos. 2 and 3, 11 and 18 Juillet, 1887. *The Institute.*

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Société Géologique de France. Bulletin, 3e Série, Tome XV., No. 5, 1887. ,,

Société Zoologique de France. Bulletin, Tome XII., Nos. 2 to 4, 1887. ,,

PHILADELPHIA—Franklin Institute. Journal, Vol. CXXIV., No. 740, August, 1887. *The Institute.*

ROME—R. Comitato Geologico d' Italia. Bollettino, Vol. XVIII., 2a Serie, Vol. VIII., Nos. 5 and 6, 1887. *The Committee.*

Società Geografica Italiana. Bollettino, Serie II., Vol. XII., Fasc. 6, 7, 8, 1887. *The Society.*

ST. PETERSBURGH—Comité Géologique—Institut des Mines. Bulletins, Tome VI., Nos. 6 and 7, and Supplement 1887. Mémoirs, Tome IV., No. 1, 1887. *The Committee.*

ZAGREB (Agram)—Société Archéologique. Viestnik hrvatskoga Arkeologickoga Druztva, Godina IV., Br. 3, 1882; Godina IX., Br. 2 and 3, 1887. *The Society.*

MISCELLANEOUS.

(Names of Donors are in *Italics*.)

"*The Illustrated Sydney News,*" Vol. XXIV., No. 9, September 15th, 1887. *The Proprietors, Sydney.*

"*The Publisher,*" No. 12, 15 September, 1887. *The Publishers, Sydney.*

"*The Sydney Quarterly Magazine,*" Vol. IV., No. 3, September 1887. *The Publishers.*

Whitelegge, T.—Notes on some Australian Polyzoa. *The Author.*

SOILS AND SUBSOILS OF SYDNEY AND SUBURBS.

By J. B. Henson, C.E.

[*Read before the Sanitary Section of the Royal Society, N.S.W., 13 Sept., 1887.*]

The general health of a community is largely influenced by the condition of the soil upon which the population is located and also by the condition of the soil of the surrounding country. Soils by their influence upon health are generally referred to as being healthy or unhealthy. This classification is not based upon the character of the mineral constituents of the soil, nor is the percentage of organic matter or humus present a usual element in its determination. But the condition of the organic matter, mainly in respect to the extent to which oxidation has progressed, is of vital importance and it is the condition of the organic matter in the soil together with the amount of moisture present which determine the unhealthiness. There are soils which are not naturally very unhealthy, but which are of such a description as to become readily contaminated by any organic refuse which may be deposited on their surface. In the neighbourhood of dwellings such contamination is likely to prove progressive and accumulative and serious results may ensue.

Healthy soils are such as contain a minimum amount of organic matters and are free, porous, and well drained. The ventilation of the soil is essential to its preservation in a healthy condition. This in porous soils takes place naturally at every change in the atmospheric pressure, for concurrent with every change in the density of the super-incumbent air a movement of the air in the interstices and pores of the soil occurs. The entry of rain water into such a soil displaces the air and as the water drains off air re-enters. The æration of the soil promotes the oxidation of contained organic matter be it natural to the soil or derived from outside sources. Soils containing an undue proportion of decomposable organic matter, or which are dense, unventilated and wet, are unhealthy. Soils which exhibit a combination of these two unfavourable conditions are very unhealthy. Excess of moisture in the soil is injurious to the majority of cultivated plants and to the higher types of animal life particularly to man. Farmers know well that to raise good crops or to breed healthy stock they must avoid wet soils and it is quite certain that the land which an intelligent farmer would reject as too unhealthy for his purposes would be unfit for a dwelling site for man. Pure water and pure air are essential to the maintenance of a proper standard of health and the purity of each depends mainly upon the condition of the soil. Authorities charged with the duty of procuring a water supply for a centre of population have always to pay particular attention to the state of the soil on the proposed catchment area and such area rarely includes the site where the population to be supplied is located. It may therefore be said that the effect of unhealthy soils upon the health of the residents thereon is chiefly transmitted through the air. Gases evolved from decomposing organic matter render the ground air impure. The presence of an excess of moisture in the soil causes coldness and dampness, and the vapour constantly rising from the surface is the vehicle for the dissemination in the air of many deleterious matters and germs.

It is not necessary at this stage to make a general statement of the measures usually taken to remedy defects in the healthiness of soils. These will be particularly referred to when considering the soils of the urban and suburban districts of the metropolis to which your attention will now be directed.

The natural soils of the metropolitan area may be divided into four classes in two groups. The first group comprises soils formed in situ from the surface rocks. The two divisions of this group correspond to the two characteristic rocks of the area, viz: first the sandstones and second the clay shales. The second group comprises soils formed from drift and waterborne material, and the two divisions are first the drift sand beds, second the fluviatile deposits. The relation of these divisions to each other will be better understood after reference has been made to the geology of this section of the country. The geological formation of the area under review is sedimentary, consisting of massive horizontally bedded sandstone strata, surmounted with a partial capping of ferruginous clay shale beds. The physical features have been developed by erosive action, which has produced in the sandstone rugged and precipitous outlines, and in the clay shale areas gentle and regular undulations. The sandstone attains its greatest elevation northward and eastward of the city where it also is the prevailing rock. Going westward from the city the sandstone is less and less elevated, the clay shale capping which appears in isolated patches on the sandstone summits around the city becomes more extensive and increasing in area and thickness further west, the sandstone is at last totally obscured.

The clay shales and the sandstones form the surface strata of the whole area, except where they are obscured by drift sands in the vicinity of the coast, and by mud deposits along the courses of the Parramatta and Cook's rivers and their tributaries. On the sandstone areas, which as before stated, lie chiefly to the north and the east of the city, the soil is derived from the weathering of the sandstone and as may naturally be inferred consists largely of sand. On some of the summits however, there is an admixture of clay and ironstone—the relics of former clay shale beds which have been abraded and removed by æolian and pluvial action. The soil being sandy is porous, and lying on surfaces developed entirely by erosive action, is well drained. The area is elevated and the slopes are steep. Fissures are common in the sandstone rock. These intercept a portion of the surface water which subsequently appears lower down on the hill sides in the form of springs. These springs are not uncommon, and steps should be taken when they occur in the vicinity of dwelling houses to intercept the water by means of properly constructed channels and carry it clear of the foundations. As a rule there is no subsoil on the sandstone areas.

The clay shale beds which prevail as the surface strata westwards from the city present features totally different from those which characterize the sandstone area.

The agency which has scooped out the deep gorges and cut rugged outlines in the latter, has carved pleasant valleys and rolling hills in the more plastic material of the former. The surface of the clay shales usually gives no indication of the structure of the underlying strata. The ferruginous clay shales are easily disintegrated, hence the beds are never found outcropping at the surface. The disintegration of the shale is largely due to two causes, first the oxidation of the iron and subsequent segregation from its matrix in the presence of moisture, and second by the action of the roots of plants. The action of the roots has produced the greatest effect. Roots of trees and plants grow and penetrate to a great distance underground in search of nourishment and moisture, not only laterally but deep down into and below the subsoil. The small fibrous rootlets insinuate themselves into the finest cracks and growing larger, gradually and irresistibly force the sides apart. Tree roots have great powers of upheaval. Interesting examples of this are often seen on hard rocky land.

The amount of earth displaced by the roots of an ordinary large forest tree amounts to many cubic yards. When the tree or plant dies the roots decay and earth falls in, other trees and plants spring up around; they grow to maturity and die; and so on for ages. In this manner many a hard compact stratum becomes broken up and comminuted. The results of the long continued mechanical action of the roots, combined with the chemical change which has taken place in some of the constituents of the clay shale by the infiltration of air and moisture from the surface, may be seen in the sections exposed in the railway cuttings. A top layer of mould will be observed gradually merging into a yellowish and reddish semi-plastic clay containing flat stones; with increasing depth the clay becomes more compact and dense until by almost imperceptible gradations it passes into a laminated clay shale of a uniform dark slaty colour and texture. The mould is usually from six inches to a foot in thickness. The semi-plastic layer of clay varies from one or two feet, to over six feet in thickness. It is important to observe that the minimum depth of the clay occurs on the summits of the hills, whilst the maximum is found in the hollows. From the foregoing description it will be seen that on the clay shale areas a true subsoil is found which consists of clay. The mould or surface soil is porous, especially so on timbered areas. The clay subsoil, like all other clays, is not easily saturated, but when once well wetted is not so readily dried. The mould acts as a sponge and retains a large amount of rain water, giving the water gradually down to the clay. The clayey layers and the shale offer considerable obstruction to the passage of water, especially the latter, although large quantities of water are absorbed wherever roots have penetrated. The writer knows of the existence of several wells excavated to a depth of ten or twelve feet below the surface and are bottomed on to compact shale. The wells are situated within a few yards of a deep railway cutting, and, although unlined, retain water. The action of rainfall in augmenting the quantity of water in the wells unconnected by drain pipes from roofs, &c. has been observed. The augmentation being the entire result of soakage from the surrounding ground. After continuous rains the water soaked in freely and uniformly from the soil—from the subsoil and partially disintegrated shale the water came in small springs, a close examination of which usually revealed the site of a decayed rootlet. With a sufficiency of rainfall the wells became filled up with water. The rain ceasing, the level of the water descended somewhat rapidly at first and then very gradually, until at about four feet from the surface it became stationary. The soakage water which drains into freshly made excavations at a depth of from ten to twelve feet below the surface is usually brackish. The depth of unlined wells is therefore limited if the water is required for domestic purposes. The presence of the soluble saline matter at such a shallow depth is a striking proof of the lateral impermeability of the strata, more especially when the immense period of time is considered during which the surface has been exposed to atmospheric influences.

In a porous strata salts would have long ago been removed. The presence of natural basins on the surface of the clay shale areas is exceptional—none are known to the writer. This is a favourable feature. Artificial basins formed for domestic or industrial purposes are far from uncommon.

The drift sand beds occur over one extensive area to the south and south-east of the city and lie partly on the sandstones and partly on the clay shales. The sandstone bounds the sand beds on the east, the clay shales bound them on the west. There are numerous sandhills and ridges on the area, several of which attain a fair elevation. The greater portion of the surface however is fairly uniform, rising gradually from Botany Bay on the south towards the city on the north. The surface formation having been developed chiefly by æolian action, basins are numerous, and as they have no outlet on the surface, in rainy seasons become charged with water which gradually soaks away. The sand beds are charged with water, the level of which varies with the rainfall. They gradually thin out where they overlie the clay shales and as the surface of the shale beds inclines towards the south, the water which descends through the sand meeting the impervious shale is deflected in that direction. It is almost a certainty that no water is stagnant in the sandy substrata, but that there is a continual, although slow movement towards Botany Bay. In some level places, notably about Redfern, Waterloo, and Alexandria the motion of the subterranean water is probably so slight as to virtually render it equivalent to stagnation. On some of the low lying portions of the sand beds there are considerable accumulations of peaty material.

Along the shores of the Parramatta River, chiefly at the outlets of its numerous tributaries and at the heads of shallow bays, and also at the embouchure of Cook's River, mud flats occur, some of these are of considerable extent. They are all of them but slightly elevated above the tide level and are always in a wet condition. The mud consisting largely of washings from the land contains a high percentage of organic matter.

The foregoing descriptions of the four divisions of soils on the metropolitan area enable them to be classified according to their relative healthiness.

The soil of the sandstone areas is well drained and there are few natural organic impurities in it, therefore that area may be considered healthy.

The clay shale areas have a soil containing organic matter overlying a clayey subsoil, which is always in a moist or wet condition. The clay shale areas must necessarily be classed as relatively unhealthy ; but not all over in the same degree. That is to say, the summits and upper portions of the slopes are probably very little inferior to porous and well drained summit sandstone strata. The lower portions of the slopes and the valley bottoms which have not elevation to facilitate drainage are undoubtedly unhealthy. The fogs and mists which form on them after sun down on winter evenings are a certain indication of this. The air in the bottom of the valleys on a calm winter's evening is very cold and chilly, whilst on the upper parts of the slopes and on the summits the air is warm. The change in passing from the lower to the upper elevation at night time is frequently as marked as the passage from a cold to a warm room. Although the summits of the hills may be favourable to health as regards drainage, the influence of contiguous low wet ground in the valleys is a danger.

The drift sand beds present two extremes. The summits of the sand hills and ridges present all the conditions necessary for a healthy soil and subsoil, but the low lying flat areas being charged with water and also containing in places a considerable amount of peaty matter, present conditions quite the reverse.

The fluviatile deposits present all the conditions appertaining to an unhealthy area. They have one redeeming feature—the danger to health is so apparent that population avoids them.

The natural condition of the soils having been considered in relation to the health of residents it is now necessary to study the effects likely to be produced on the soil by the settlement of population thereon.

First in regard to the sandstone areas where porous soils prevail contamination of the soil by house refuse &c., will be in a large measure corrected by oxidation of the contaminating elements. Underground waters will be very liable to contamination, hence the necessity for underground tanks being rendered impervious.

Second, the clay shales areas. The contamination of the soil will be accumulative and progressive. The minimum effect will occur on the summits, the maximum will be felt in the low lying parts.

Third, the drift sand area. The effect on the high parts will be similar to that on the sandstone areas, whilst on the low lying saturated parts the contamination will be progressive and accumulative.

Fourth, the mud flats. Residence on these areas should not be allowed under any conditions or the result will ever be disastrous.

It will not do to close these remarks without some indication of the lines along which action should be taken to improve the condition of the unhealthy soils and subsoils. The most decided improvement will be effected by drainage. Wet and moist land particularly in the valley bottoms of the clay shale and drift sand areas should be dried and ærated by means of subsoil drains. Buildings should be prevented from encroaching on the main lines of drainage, which should always be bounded by reserves. There are several areas within the city boundaries where subsoil drainage would effect immense improvements. The contamination of the soil should be prevented by the systematic collection of all organic refuse and its destruction by fire, or equally well disposed of in some other way which will prevent pollution of the soil, over which population will settle in the future. Sewage farms are admissible for the utilization of sewage. The ground should, however, be carefully prepared so that the organic matters may be destroyed by the combined agencies of oxidation and assimilation by vegetable growths. Some of the municipal authorities located on the clay shale areas, compel residents to dispose of their liquid refuse by casting it on to the surface of their back premises with the idea, no doubt, of instituting sewage farms on a small scale. Unless the clayey subsoil be drained and the æration of the soil facilitated by frequent movements of the surface by digging it up, most disastrous results will follow.

The ground surface under all houses, particularly in the western suburbs where the clay shales prevail, should be covered with an impervious layer of concrete or tar pavement, and the space underneath the floor well ventilated.

The recent wet season has developed unpleasant revelations to many residents on low lying areas, especially in the western suburbs, which are causing them to agitate for relief. There is a general reliance upon the promised sewerage scheme for a remedy. This is a mistake, the proper duty of sewers is now seen to be restricted to the removal of sewage proper and not storm water. The remedy consists in the construction of stormwater drains, combined with subsoil drainage. The importance of separating sewage from rainfall is now being generally recognized by sanitary authorities.

QUARANTINE AND SMALL-POX.

By J. Ashburton Thompson, M.D. Brux., Dipl. Publ. Health, Camb.; Chief Medical Inspector of the Board of Health of N.S.W.

[*Read before the Sanitary Section of the Royal Society of N.S.W., 18 Oct., 1887.*]

I venture to ask your attention while I make some general remarks upon quarantine against small-pox. A tendency, at present perceptible, to rely upon that measure for more protection than it can possibly yield, gives occasion for them; but I do not propose now to say much, because, whatever my opinions may be worth, I have at all events made them known in various publications during the past five years.

I must remind you first that the subject is eminently technical in this sense; that it can be examined profitably only in the light of that practical experience which the records of civilized countries during the last three or four centuries afford. The promises of quarantine are fair and full, and at the first blush, or even after study, seem easy of performance; but tested by the event they are found pretentious, and a snare to those who trust them unreservedly. To demonstrate this from the source alluded to would be easy, but it could scarcely be done within reasonable space; it is moreover unnecessary, for the experience of our own country and of our own age suffices.

I will next quote the fourth resolution of the Australasian Sanitary Conference of Sydney, 1884, namely, "Vessels infected with small-pox are those which have borne a case of that disease during the voyage;" and I point out that the restrictions of ancient quarantine were thus excluded from applying to ships which merely hail from infected ports. The Delegates who deliberately and unanimously affirmed this proposition were (myself excepted) the principal medical officers of the seven Governments represented; and these gentlemen had for years been practically engaged in restraining the entrance of sea-borne disease by means of quarantine. It is a fair assumption that they knew at least as much of the subject of their deliberations as others know. Nevertheless it seems that now, in the face of some danger from Tasmania, more than one of the Governments then represented by their most experienced officers are unwilling to act on the conviction so clearly expressed by the latter, and actually have reverted to the practice of ancient quarantine by enforcing the law against all vessels hailing thence. Upon this point I do not propose to argue further. It is judged by implication in the course of the following remarks, and I do not think that anyone who takes the trouble to consider them seriously will then maintain that that reversion is wise, or at all likely to be useful.

Thirdly, as to the powers and limitations of quarantine I have defined both in the following phrase:—"The true function of Quarantine is not to prevent the entrance of contagion, but to lessen the entering number of sources of contagion." This proposition is indisputable in the face of experience; and quite recent events here can be adduced to prove it. As to the first part, the very case of the *Port Victor*, which you have just listened to, shows that occasionally circumstances must arise in which it is practically impossible to detect contagion until it has effected entrance, and is already active among the general population; while as for the second part, the experience of the current year alone in the cases of the *Preussen*, the *Chingtu*, and the *Tsinan*, prove that as far as it goes it is a most useful and an indispensable defence. But what quarantine can do must not be considered alone; it concerns, not individual, but national, interests; and the price to be paid in the doing must not be left unbalanced against the benefits purchased in exchange. Even the limited quarantine I have just defined cannot be maintained without entailing serious expenditure both on the country using it, and, what is not a widely different interest, on ship-owners; for persons on infected ships cannot be ascertained to be themselves free from disease by any examination which does not involve detention during a considerable period. Nevertheless, expensive as it is I would not willingly see the least relaxation in its severity, while our circumstances remain what they now are; for I believe it affords a fully equivalent measure of security. Herein, it may be observed, our practice differs from that of the English. But this should not sway us to give up our plan; there is a sound reason for it which consists in conditions which do not affect the English. This also I have formulated; the whole case is stated in the sentence, "Nations whose internal sanitation is imperfect cannot afford to refer the observation of suspects to the country at large."

The foregoing are general considerations; but in the present case of Tasmania there are some of a more special nature to be entertained. The very foundation of the labours of the Conference was frank recognition of the unity of Australasia in respect of infectious disease; recognition of the fact that, for all practical purposes, the infection of one territory must be taken to imply the infection of all. It was clearly seen and admitted, in short, that intercolonial quarantine is a farce long since played out; and it is on that very ground and no other that Tasmania has been invited to join in the scheme of federal quarantine outports from which so much is hoped, and which is in reality capable of conferring great benefits. That admission I am satisfied was wise; and I may give the reason in yet a third proposition, the truth of which is almost self evident :- "The degree of protection which quarantine affords is inversely as the ease of communication between the infected country and the country to be defended."

But what, then, is to be said of the attempt which has been made upon the first appearance of danger to enforce that ruinous delusion ancient quarantine, against an island which physically is a dependency of one of the Colonies making it ? Its sole justification would appear to be the possibility of effectually preventing all communication by means of it. But is this possible, even theoretically ? A fatal flaw appears at first sight. At all events quarantine cannot be enforced until the supposed necessity for it is known to exist, and that is not until a case of the disease feared has been discovered. How often is the first case discovered the first case that occurred ? Very seldom indeed, as we know well, and as has now happened again in Tasmania ; and so the infection might have already been exported before the stoppage of communication could be attempted. But Tasmania is a small island; if ever communication can be entirely stopped it should be easy in her case ; and yet what is the fact ? Why, that quarantine has been twice broken within the past few days—I speak only of known instances—and two persons at least have succeeded in landing from two separate vessels, even at Melbourne itself. It does not matter at all by what accident they came to land ; they succeeded, and without special effort or scheme, in evading the defence of quarantine, and were arrested on shore. Now, observe ; the question is not one concerning contraband of trade. A cargo may be occasionally run in spite of the most active coast-guard service, no doubt. But the loss to revenue is measurable ; it cannot exceed the capacity of the vessel ; and once in a way, I suppose, smugglers may be welcome to what they have cunningly snatched. But quarantine tries to deal with a body which possesses powers of self-multiplication ; so that the smallest boat that holds a man may as seriously threaten the importing country as the *Orizaba* or the *Ormuz.* But, it may be said, if quarantine cannot entirely prevent communication, at all events half a loaf is better than no bread ; and so it is—when you can get it. The implied statement would seem to be that the chance of importing disease increases proportionately with the number of persons escaping quarantine. This, obviously, is not true, unless all the inhabitants of the infected country are not only equally susceptible of disease but also have all been equally exposed to infection ; and this is never the case. But, farther, the element of human nature must not be left out of account, since the danger does not consist so much in numbers as in the state as to disease of individuals. In the present case, a man living in Hobart and under necessity to reach the mainland might very probably sail in the usual way, trusting to the supposed cleanness of that city to escape arrest, and so would fall under detention on arrival; but a man who lived in Launceston, knowing that he could not escape detention nor yet, perhaps, afford to suffer it, would be likely to seek some irregular means of transit. He could easily escape the quarantine officers; and he would be one of the very persons it is most desirable to exclude. This illustration is not fanciful or rhetorical, but on the contrary represents universal experience; and the opinion is warranted that the more urgent the danger from infection, and the more stringent the measures taken under ancient quarantine to exclude it, the greater in reality becomes the likelihood that the latter will be evaded and the disease introduced; while the more quarantine is relied upon to entirely exclude infection, the more are other and truer and better means of defence likely to be overlooked.

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I have hitherto spoken designedly, not of epidemic disease, but of contagion. To some casual local spread of contagious disease two conditions alone are necessary; viz., the presence of the specific contagium, and of personal and local susceptibility. Against epidemics of small-pox thus arising (I speak now of shore populations) our limited quarantine, or policy of isolation with vaccination, is doubtless a sufficient protection usually; that is to say, when the members of the quarantine service are themselves also rendered invulnerable by vaccination and re-vaccination. But to pandemic extensions of disease at all events, and probably therefore to any very wide and uncontrollable spread even in a particular city, a third condition is necessary. What this is, is not yet known; although it may fairly be supposed to consist in conditions which prolong the life of the contagion after it has parted from the animal body in which it has been propagated. But its existence may be inferred from the observation that whereas small-pox is endemic in many places yet it becomes formidable only from time to time. Now if such accessions of virulence were merely local, they might be accounted for by accumulation of susceptible persons, newly born for the most part since the last preceding outbreak, when the then susceptible either got immunity after suffering, or were killed off. But it is not in isolated spots that such accessions are observed as a rule; on the contrary, many widely separated places begin to suffer about the same time; and hence it must be concluded that a third, not local, condition is necessary to them. This being so, if we have hitherto escaped any serious epidemic of small-pox here, clearly that is because the third condition has never coincided with the other two. For we exhibit a full measure of personal susceptibility, since, as I calculate, there are at present in this city alone, at least 100,000 unvaccinated persons, reckoning those only who are under 20 years of age; while the specific contagium has been often introduced, and must continue to be introduced from time to time in the future, in spite of the greatest possible watchfulness at quarantine, and in spite of the arrest of all but a very few undiscoverable cases. The outbreak of 1881 seems to me a conspicuous example of the absence of the third condition, for although there were then in the city, I reckon, not less than 23,400 unvaccinated children under five years of age alone, and although the contagium remained alive and active for about eight months, yet no more than 154 persons are known to have suffered out of a population of about 228,000.

The outbreak occured in 1881; the district affected being the city and suburbs of Sydney. The aggregate population (Census, 1881) was 224,211; the specific population of the city only (holding 103,379 people) was 24,268. The natural and industrial conditions were markedly healthy and the people were prosperous (birth-rate, 39·1). The general sanitary condition was bad; the death-rate per 1000 living, from fever, cholera, and diarrhœa, and the true infantile mortality, both reckoned on an average of the 5 years 1876—80, were respectively 2·4 and 169·6. Also, vaccination although gratuitous was voluntary, and the amount done by practising physicians was admittedly insignificant; but of the latter no record has been kept.

Table showing the births, the deaths under 1 year, and from 1—5 years; the number of successful public vaccinations under 1 year and from 1—5 years, and the total number of successful public vaccinations at all ages; in the city and suburbs of Sydney, for each of the five years 1876—80:—

Year.	Births.	Deaths.		Vaccinations.		
		0—1	1—5	0—1	1—5	Total all ages.
1876	6368	1082	859	308	679	1217
1877	6645	1038	500	1079	2928	5236
1878	7158	1241	753	151	270	518
1879	7861	1206	595	222	328	649
1880	8354	1606	963	141	227	457

The Outbreak.—The first known case was discovered May 25, 1881; the last February 19, 1882; the mode of introduction remained undiscovered. The total number attacked was 154; the death-rate 25·9 per cent.

Method of Treatment:—Isolation and (voluntary) vaccination of all members of infected households.

In practice:—For the first three months the general administration was chaotic, and there were mistakes of diagnosis (see contemporary non-official records). From the Official Report issued in 1883 it appears that it was believed that many cases were concealed during the first six months, and were therefore not isolated; that in many other cases isolation was not perfectly maintained; and that the vaccination of quarantine officers was not thorough, since two caught the disease on duty.

Distribution of disease :—The total number of households known to have been infected was 88. Of these 74 per cent. were situated within the city, while 22 per cent. stood in boroughs continuous with it and but little less densely populated. The remainder (or 5 houses only) stood in boroughs rather more remote, and much less densely populated; in three of them the disease did not make its appearance until after the third month of the outbreak, although a large proportion of the inhabitants went backwards and forwards to town every day.

All these circumstances being considered together, it becomes clear that the contagium showed very little activity, and that almost all the cases must have been due to contact either with the sick themselves or with fomites; at all events its aërial diffusion was so slight as to be negligable. And, as a matter of recorded observation, of 103 cases which happened after September 2, when note of the source of infection first began to be taken, 70 per cent. were found to have been infected either by contact with the sick, or by fomites, or by close contiguity of the sick in an adjoining house—a large proportion to be thus traced in a crowded city. Lastly, although communication was easy and remained uninterrupted, there was no spread of the disease to other cities or to the country districts.

Smallpox would be a disease but little formidable if, under similar circumstances, it always showed itself as sluggish as it did on that occasion. Compare this with the case of the city of Montreal in the fall of 1885, where no less than 2,500 persons lay sick on a single day, and the total deaths amounted to more than 1,000. No one I think, can doubt that something more than mere neglect or breakdown of quarantine was there at work. I make these remarks because I no longer care to share in the administration of a scheme of defence against small-pox which I see is valued by the public far beyond its true worth, without stating my opinion, that, useful as it undoubtedly is, and necessary to be retained whatever additional steps we may take to defend ourselves, it is not to be reckoned upon to prevent the spread of a true epidemic. When the three conditions happen to coincide here, we shall suffer even as Montreal did, and as a thousand other cities have done; and it is scarcely doubtful that then the public will be prone to blame the administration of the Health Department of the Government. But I declare beforehand that that blame will be unmerited, unless the Department shall have connived at the neglect of what is the only true protection against small-pox; I mean vaccination. But successive Chiefs of that Department have again and again urged it; and, for the twentieth time I disclaim any such connivance, and I venture to do so not less for the profession of this city as a whole, than for myself individually. The Government, however, cannot enforce vaccination among the people, since it is believed (I know not how reasonably) that they will have none of it; but when the time of epidemic comes, as soon or late it must come, it will be the people who will suffer, and not the doctors or their families.

ON THE PRESENCE OF FUSEL OIL IN BEER.

By William M. Hamlet, F.C.S., Government Analyst.

[Read before the Royal Society of N.S.W., November 2, 1887.]

The beverages we know so well as fermented malt liquors are so complex in their composition and so liable to change and decay, that until the last few years very little was known of their exact nature and internal constitution, still everyone was supposed to know all along the difference between good and bad beer. From the time of Falstaff to the present day, the beer drinker has always been a trifle suspicious of his brewer, and ever ready to exclaim with that fat and valiant judge of good liquor—"You rogue, here's lime in this sack," and he generally experiences a most lively satisfaction in changing his "barley bree."

It would help us to clearer views on this subject if we consider what beer really is, or rather what it ought to be, and what are the chemical and biological processes involved in its manufacture. I may therefore at once define beer as an alcoholic beverage made from malt, hops, yeast and water.

As briefly as I can describe it, the process of brewing ordinary beer is as follows :—Malt is crushed between rollers and dissolved in, or extracted by water at a temperature which is more or less a secret with the individual brewer—generally from about 140 or 145° to 150° Fah., by this means an infusion of malt is made, the operation being known as that of mashing : the vessel in which it is produced being termed the mash tun, while the product is known as the wort. The water found most suitable for mashing is one containing very little or no organic matter and a somewhat large proportion of sulphate of lime, which makes what is called a *hard* water; for porter brewing, however a softer water is used. By using a hard water certain albuminous matters contained in the malt are prevented from coming into solution; that is, the albumenoids are rendered much less soluble.

The chief object of the brewer in mashing is to convert the starch present in the malt into a peculiar variety of sugar termed maltose : this change being effected by the presence of a body known as *diastase.* A very small amount of this diastase is sufficient to convert an unfermentable body like starch into maltose. One part will transform 10,000 parts of starch into maltose—a sugar which is directly fermentable.

The next step is to boil the wort in a separate vessel termed the copper, together with a certain quantity of hops. The object of adding the hops is to impart the well-known bitter flavour—to endow the beer with narcotic properties, and finally to act as a preservative agent and so enhance the keeping qualities of the beer.* After boiling, the worts are rapidly cooled down to a temperature, varying from 58° to 62° Fah.. and run into the fermenting "rounds" or "squares" Yeast is now added—or in the language of the brewer—fermentation is said to be "pitched" at a temperature varying with the locality, and the practice and ideas of the brewer.

Fermentation proceeds rapidly attended by a rise in temperature; and here comes one of the most critical parts of the process of brewing. It is after the worts have arrived at the fermenting tuns that the brewer's skill and experience comes in. I do not mean that any amount of skill in regulating the fermentation will ever remedy carelessness in mashing, because, if the wort is not perfectly sound on its arrival at the fermenting tuns, a perfect fermentation cannot be obtained; but only that, be they ever so satisfactory at this point, negligence or unskilfulness will be then even more fatal than at any other previous stage. Here it is that with a climate like that of Sydney, ice or artificial cooling machinery becomes absolutely essential for the production of good beer. Experience has shown, that fermentation should never exceed 70° to 72° Fah. When this temperature is exceeded no amount of after treatment or doctoring of the beer will ever remove its own inherent bad quality.†

What goes on in the act of fermentation will be better understood if we regard the wort merely as a sugar solution with some other albuminous bodies that may be more conveniently considered hereafter.

Alcoholic fermentation is the outcome of the life of a minute plant—a very lowly organism called the yeast cell or *Saccharomyces cerevisiæ.* The sugar solution is its arena, and ethylic alcohol is one of the products of its own life-decomposition, just as much as urea is one of the life-products of a man. As plants possess the faculty of changing the carbon dioxide of the atmosphere into starch, sugar, alkaloids and other products, so this little cryptogam lives upon the maltose of the brewer's wort changing it into alcohol and other compounds.

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* Hops are to the high fermentation brewer what ice is to the brewer of lager bier.

† Pasteur speaks of this as "a rigorous limit of fermentation temperature." "Etude sur la Biere," Paris 1876, p. 14.

The illustrious Pasteur found that 100 parts of cane sugar, first converted into the fermentable variety of sugar, will yield:—

Ethylic alcohol	48·40	per cent.
Carbon dioxide	46·60	„
Succinic acid	·67	„
Glycerine...	3·30	„
Cellulose fat &c.	1·20	„

Now it is just at this critical stage of fermentation that other higher alcohols may be produced. Pasteur, Schützenberger, and Berthelot all recognize the fact of the simultaneous evolution of the higher alcohols under varying, or under abnormal conditions. Schützenberger says*:—"We may ask whether these secondary products, [—*i. e.* fusel oil] which are relatively not very abundant, owe their origin to alcoholic fermentation properly so called, or to distinct concomitant fermentation having each a special ferment; or whether, in fact, it is better to attribute their appearance to special principles accompanying glucose in the natural saccharine juices. The actual state of science does not allow us as yet to answer these questions definitely."

Pasteur† mentions the production of butylic alcohol in irregular fermentation and its non-appearance in carefully conducted fermentation.

Before proceeding further it will be well to see what is the actual composition of properly brewed genuine beer, so far as it has been investigated by modern chemical research:—

Percentage composition of genuine beer.

Extract	Dextrin	from	2 to 5
	Albumenoids ...	„	·2 — ·4
	Maltose	„	1 — 3
	Lactic acid	„	·02 — ·05
	Succinic acid ...	„	·04 — 1
	Glycerine	„	·2 — ·25
	Colouring matter / Hop extract ...	„	1 — 1·2
	Ash (mineral matter)	„	·2 — ·27
	Total Extract	„	5 to 8
Alcohol (by weight)		„	$3\frac{1}{2}$ to 7
[Alcohol equivalent in Proof Spirit		„	$7\frac{3}{4}$ to $15\frac{1}{4}$]
Acetic acid		„	·02 —·04
Carbonic acid		„	·22 —·25

* Fermentation: Kegan, Paul, French & Co., London, 1883, p. 30.

† Etude sur la Bière, Paris 1878, p. 297.

The origin of the enquiry which forms the subject-title of this paper, arose during the ordinary routine work in the Government laboratory. For several years, the examination of beers was somewhat a rare occurrence, but in the year 1881 a Mr. Waters from Melbourne created no small excitement by stating that the beers made in Sydney contained vitriol, aloes, bluestone and infusion of tobacco juice. The result of this alarming statement induced Mr. Barney, Chief Inspector of Distilleries to send a number of spirituous liquors to my predecessor—Mr. Charles Watt—for analysis. It appears from the enquiry then made that the chief interest centered in the quality of the rum, whisky, and brandy, however later on, in the following year some eleven samples of Sydney beer were examined.

During the four years from 1882 to the end of 1886 a very large number of samples were examined in the Government laboratory. The general results showed that the statement of Mr. Waters were without foundation. The methods of analysis usually included the estimation of the percentage of alcohol, ash and extract together with some statement to the effect that none of the articles mentioned in the Licensing Act had been found. In fine, the worst that could be said of the beers was that sometimes traces of lead or copper were found.

Early in the present year the question of artificial bitters and hop substitutes engaged the attention of analysts in England, amongst whom my friends Dr. Muter and Mr. Otto Hehner were much interested in the subject. At the same time statements were frequently heard in Sydney to the effect that the brewers were in the habit of putting poisonous bitters into the beers instead of hops, and inasmuch as the police were constantly sending samples of beers and spirits for analysis, I wished to seek further satisfaction in the matter by carrying out a fuller and more extended investigation as to the nature of the bitter principle used in the manufacture of the local beer, with this object in view I requested that larger samples should be submitted for analysis. These were all specially examined for strychnine, picric acid, cocculus indicus, and tobacco, as well as for quassia, gentian, chiretta, &c. In the case of all the brewers, it should be said to their credit that no poisonous bitter of any kind could be discovered not even after a most laborious and lengthy research.

During the course of analysis it was observed that the proportion of dextrin was unusually large, while the amount of maltose and albumenoids were extremely small. This might of course be attributed to great attenuation in the process of fermentation. In the course of mashing with malt, the proportion of dextrin to maltose goes on in very nearly a fixed ratio up to 140° Fah., when the maltose diminishes rapidly and the dextrin increases very considerably. Therefore are we to account for the dextrin by high mashing heats? or would it not more likely be owing to the fact that large quantities of sugar are used in the brewing process? If this be so, why does the brewer use sugar, and if so what kind of sugar?

The object of the brewer in using sugar may be considered under two heads; firstly, his object is to reduce the proportion of the albumenoid matter in the wort; and secondly, to effect a saving in the price of malt, in other words, to use as little malt as possible, because barley is not grown here and has therefore to be imported; while sugar grows well as every body knows.

In the ordinary brewing process the reduction of albumenoids is mainly effected by the boiling of the wort after mashing; but it is also further considerably effected by the tannin of the hops, and by the employment of natural or else artificial waters, containing suitable saline bodies principally sulphate of lime, which renders some of the albumenoids insoluble.

Notwithstanding these various methods of reducing the albumenoids it is generally found by most brewers that a further reduction is necessary beyond what is attainable by these means. Now the addition of sugar effects this by the simple process of diluting the albumenous wort with a substance which is non-albumenous, but yet fermentable. These albumenous bodies, from a sanitary or dietetic point of view would prove of advantage to the beer consumer, inasmuch as these are flesh and tissue formers, being in fact the proteid matter from the grain. The reason why stout would be given to the invalid or the convalescent would be precisely on account of these albumenoids, which are studiously eliminated in the manufacture of Sydney beer. From the brewer's point of view, he would say they were decidedly objectionable, since they would prove food for the *yeast cell*, and for false or adventitious ferments. And still these albumenoids are essential for the healthy growth of the yeast, so that it is important that the brewer has a sufficient quantity in his worts for the yeast to live upon, as otherwise the *S. cerevisiæ* would starve and die. The main object of the brewer is to conduct his fermentation without the introduction of the false ferments so-called—the lactic, acetic, and butyric ferments. A beer so made and afterwards kept from their contamination, would keep sound for an indefinite length of time.

Now, as to the why and wherefore of the use of sugar. The beer betrays its origin by its taste, albeit the demand may be for sweet ales, or sweet 'running ales' as they are somtimes termed. the sweetness may not be due to cane sugar: certainly not, since the sugar has undergone a change. If sugar crystals are used in brewing Sydney beer, and there is internal evidence from the beer itself that such is the case, the brewer must first convert them into a fermentable variety of sugar ; the sugar must be inverted as it is more correctly termed. Cane sugar of itself is unfermentable. This inversion may be effected in four different ways :—

1. By malt extract in mashing at not too high a temperature.
2. By prolonged boiling with water.
3. By treatment with yeast and water.
4. By the action of sulphuric acid and after treatment with chalk.

The brewer is confronted with the question as to what sugar may be used, raw or refined crystals? If the former, other organisms besides the *S. cerevisiæ* would inevitably be introduced : this would be followed by a high and uncontrollable fermentation : with refined crystals the sugar we have seen, has to be inverted. Another question then arose, were these beers brewed at an abnormally high temperature? Remembering that an eminent authority on brewing, Dr. Charles Graham, had found that a high temperature in fermentation means not only a rapid attenuation of the wort, but an increased loss of alcohol by evaporation, together with an increase in the higher alcohols—the fusel oils ; reasoning upon this hypothesis the presence of fusel oil would therefore indicate to some extent the mode of manufacture of the beer. The question then resolved itself into this—does this beer contain fusel oil? Some difficulty then arose as to the process for finding out whether higher alcohols existed in beer. The methods in use which were applicable to liquids, such as brandy and whisky, failed when applied to beer. The method of fractional distillation was tried : the distillates from two litres of beer were placed in a flask fitted with a modified Hempel's column and the fractions collected separately, a current of steam being used to remove the last traces. As the boiling points of the different alcohols were not sufficiently marked from each other, the idea presented itself of converting the alcohols into their respective iodides, since the boiling points would be sufficiently removed from each other to enable a more complete separation to be effected.

However, these methods were afterwards abandoned, since it might be said that these higher alcohols might be generated in the act of distillation, an objection that I do not think carries much weight, as the alcohols are products of fermentation and are not likely to suffer changes in distillation. However, these methods were set aside for a process that would remove the higher alcohols from the beer itself, *without* distillation. The process I finally adopted—a modification of my own of Marquardt's—was based upon the fact that amylic alcohol is soluble in chloroform. I operated on a gallon of the beer in the following manner :—Some of the beer to be tested is placed in a capacious separator, together with 50 cb. c. of chloroform; after repeated shaking, the liquid is allowed to subside, and the beer poured off without disturbing the chloroform. More beer is added until half the gallon has been so treated, when a further 50 cb. c. of chloroform is added together with more of the beer until about 5 pints have been used; a third 50 cb. c. is taken, making altogether 150 cb. c. of chloroform with which the remainder of the beer is thoroughly agitated. By this time the whole of the fusel oil will have been extracted. The next step is to wash the chloroform with water to remove traces of valerol derivable from the hops, and also to remove ethylic alcohol that may have been taken up into solution. The solution is then placed in a strong glass vessel with 5 grams. of potassium di-chromate and 2 grams of concentrated sulphuric acid and oxidised under pressure for six hours at a temperature of 85° C. The oxidation having been completed, the liquid is now distilled, water added to the residue and the distillation continued. The distillate, which has a strong odour of valerianic acid is boiled for half an hour with some pure barium carbonate in a flask connected with an inverted Liebeg condenser. After this the chloroform is removed by distillation and the residue filtered. The filtrate is then evaporated to dryness in a platinum dish, weighed and dissolved in water with a few drops of nitric acid. The solution is divided into two equal parts. In one the barium is estimated: in the other the amount of barium chloride. The weight of the latter is deducted from the residue. The total amount of barium salt, minus that existing as chloride, gives the amount of barium as barium valerianate and from which the amount of amylic alcohol is readily found.

The chloroform and the rectified spirit used throughout this research was carefully tested by blank experiments for the presence of the higher alcohols. Care was taken that only pure chloroform was used.

Another method for the estimation of minute quantities of amylic alcohol, and indeed for all the higher alcohols is that of Traube,* who employs a method based on the fact that butylic and amylic alcohols depress the capillarimetric column in a small tube. This process has in my hands been found more suitable for brandies and white spirits than for beer.

During the first experiments in working out this process, a somewhat unlooked for result was obtained; one giving positive indications that genuine hops had been used in the brewing of all the samples of Sydney beer; thus corroborating the results I obtained by the methods of Duprè and Allen used in my search for spurious bitters and hop-substitutes.

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* Bulletin de la Societé chimique de Paris.

Hops contain about $7\frac{1}{2}$ parts in a thousand of an essential oil. This oil consists of a terpene isomeric with turpentine oil ($C_{10}H_{16}$) and a stearoptene termed valerol ($C_6H_{10}O$?): the first, being a very volatile etherial body, is entirely dissipated during the process of brewing and gives that pleasant aromatic odour often noticed in the brewery; the second consists of a mixture of the stearoptene valerol and resin. The valerol is easily oxidised by ordinary atmospheric oxidation into valeric acid, which may sometimes be observed in the peculiar cheesy smell of old hops.

Valerol being soluble in ether and in ethylic alcohol would therefore be found in the crude chloroform extract; hence the necessity for a prolonged washing with water to remove both the valerol as well as the ethylic alcohol before proceeding further with the process. If the impure and unwashed chloroform residue be oxidised the valerol would become oxidised into valeric acid along with the amylic alcohol. The presence of the hop oil of the hops may therefore be recognised if the chloroform residue be divided into two parts: one of which is thoroughly washed and oxidised by chromate. If oxidation yields valeric acid in the one case and none in the other, then it follows and, I think proves conclusively that hops have been used in brewing the beer.

The process, therefore has a double value and significance; namely, in determining first, whether the beer has been really flavoured with hops, and secondly if the higher alcohols are present.

To remove all doubt as to whether the fusel oil really existed in beer, I took two litres of beer and removed the whole of the ethylic alcohol by slow and careful evaporation; the liquid was made alkaline by sodium hydroxide treated with ether in a separator and the valerol thus removed. Acetic acid was then added to neutralise the soda and the chloroform process, as before described and carried out. The result was that barium valerianate was produced as before. This was dissolved in water with a few drops of nitric acid, the barium estimated as sulphate and the amount of fusel oil found and expressed in terms of amylic alcohol.

Four and a-half litres of beer (= 1 gallon) gave ·530 grain of barium sulphate, equal to ·4 grain of amylic alcohol per gallon.

One gallon of another sample gave on analysis ·324 grain of barium sulphate, equal to ·245 grain of amylic alcohol per gallon.

In another instance, one gallon of a beer gave 1·18 grain of barium sulphate equal to ·89 grain of amylic alcohol per gallon, this being the largest proportion found. The amount therefore of fusel oil ranged from $\frac{1}{4}$ grain to nearly 1 grain [·245 to ·89] per gallon.

Molecular weight of $C_5H_{11}HO = 88$
ditto $C_5H_9O_2H = 102$

Molecular weight of $(C_5 H_9 O_2)^2 Ba + 2 OH_2 = 375$

1 part of ditto $= \cdot 5_{44}$ $C_5 H_{11} HO$

1 part of $Ba SO_4$ = $\cdot 7553$ $C_5 H_{11} HO$

In the case of Marquardt's process for brandies and whiskies :

1 part of $(C_5 H_9 O_2)^2 Ba$ contains ·4513 Ba O

Whereas

1 part of $(C_2 H_5 O)_2 Ba$ contains ·674 Ba O

Fusel oil or fousel oil, Fr. *Huile de pommes de terre*, Ger. *fuselöl* derived from the Greek *φυω*, I produce, alluding to its *production* or generation in and during the act of distillation and not merely to its *eduction* or mere separation from a liquid in which it is already present. I may say that I have very strong grounds for saying that this is not so, and that fusel oil is not a mere creature of the distilling process ; but that it existed in the wash before distillation took place. However that may be, I will give a short description of what fusel oil is and would refer my hearers to the many published accounts of this liquid.

The compound known as fusel oil is a complex oily liquid possessing a powerful sickly odour, producing nausea, coughing, irritation and headache when inhaled, and having a biting fiery taste. It occurs in the residues, the faints,* of the distillation or rectification of all kinds of spirit, such as cane spirit, brandy, potato, rye, maize, and other grain spirit, from the marc of grapes and from the fermentation of sugar and glucose.

I desire it to be stated that I am not the first discoverer of fusel oil in beer, and that a paper appeared in the Comptes Rendus 96 [19] 1368—1370 by J. A. Le Bel, who shows that amylic alcohol† is a product of the fermentation of beer. It has also been shown in Germany that when impure saccharum was used in brewing, that fusel oil was developed. In the Rep. Anal. Chem. 5, 188, a case is cited where a brewer was fined for allowing fusel oil to appear in his beer, and where it is stated that the fusel oil "may under certain circumstances prove injurious to health."

Toxic action of fusel oil.

The administration of a quantity estimated at not more than ½ grain kills frogs. One minim sufficed to kill three blow flies. One minim killed a minnow. Two minims was found fatal to guinea pigs. Sixty grains of fusel oil was given to a dog. The effect was instantaneous, producing muscular paralysis of the hinder legs with drunkenness, giddiness and stupor. In a few minutes the animal was quite unable to stand on its legs and rolled about on

* Faints contain over 60 per cent. amylic alcohol.

† Named amylic alcohol by Cahours, from *amylum* starch.

the floor. In ten minutes the muscular tremors came on recurring with perfect regularity. In twenty minutes there was foaming at the mouth. In thirty minutes the muscular tremors came on in paroxysms, especially at each inspiration of the lungs, amounting to what Dr. Ashburton Thompson better described as a spasm. The tremors continued for some time. In three hours the dog was in a state of coma, the twitching going on all the while regularly. At this stage violent headache and nausea was experienced by myself and two other observers. The dog was seized with a most violent fit of vomiting about five hours after, and partially recovered in 24 hours from the time of administration.

In conclusion, these results may be summarised as follows :—

1. That traces of certain other alcohols besides ordinary ethylic alcohol exist in most of the beers brewed in Sydney.

2. That these may be derived either from the the temperature at which the fermentation is allowed to take place ; or from the excessive use of saccharum, glucose, or sugar crystals, or from both.

3. That the presence of even traces of fusel oil is quite undesirable and most probably injurious to health, since it is known that small quantities of fusel oil act as a poison on the animal system.

Discussion.

Mr. W. A. Dixon F.C.S., said that it seemed to him that too much attention had of late been given to minute analysis of foods. Since Mr. Hamlet's first report had been published he had given a good deal of attention to this matter and had himself carried out some experiments. From these, as far as he had gone, he concluded that the glycerine formed during fermentation was extracted by the chloroform, and in the process used by Mr. Hamlet this was oxidised to formic acid and determined as valerianic acid and hence as amylic alcohol. Mr. Hamlet appeared to have only examined beers manufactured in Sydney. He (Mr. Dixon) had examined beer brewed at home and found as much amylic alcohol as in any beer brewed here. It seemed to him that amylic alcohol was always produced more or less in fermentation ; and that its production was not well understood. It is only known that it is produced in largest quantity from roots, next from raw grain, and generally when the yeast was in bad condition, and the temperature high. He did not think the temperature of fermentation here was carried much higher than at home, not much beyond 76° or 78° F. at the outside. If much amylic alcohol was produced the beer would be very distasteful. What was essential at one time was not so at another, thus at one time beer was brewed without hops at all ; in the reign of Queen Elizabeth very stringent regulations were laid down against the use of hops in beer, but the use of hops has so grown that the use of beer without is now almost unknown. Beer was a complex liquid containing various ingredients which made it palateable, some of them affected the sense of taste and others the sense of smell, these were called sapors and odours and together flavor. The bitter of hops and the salt affected the taste, some people liked more of the latter some less, but the quantity present could scarcely produce thirst. The ingredients which affected the organs of smell were, the oil of hops and the small quantities of those higher alcohols which were present, and if these were left out the beer would be undrinkable. What Mr. Hamlet had said with regard to the water here being particularly soft, and therefore taking up a large quantity of albuminous matter, was perfectly correct, and the brewer got rid of that difficulty by the use of sugar, as otherwise the beer would never be bright. The waters used in the brewing of some of the English beers contained besides the sulphate of calcium mentioned, sulphate of potassium, and both these were absent in Sydney waters. British beers contained from 200 to 300 grains of inorganic matter per gallon, which was more than in Sydney beer. With regard to the intoxicating effects of amylic alcohol, he did not think much dependence would be placed upon experiments made on animals. The effect of experiments made on different men might be very different, and the difference might be still greater between experiments made upon a man and a dog. For example, give a glass of rum to a blackfellow and he would be hopelessly drunk, but on most white men it would have no effect one way or the other. Various people had given different accounts of the effects of amylic alcohol; some said that it was fifteen times as intoxicating as ordinary alcohol; others said three grains produced decided effects. He knew of a case in which a man took a jar of fusel oil, thinking it was brandy and took a mouthful of it; it made him drunk but he soon got over it. Even if beer contained one grain of fusel oil per gallon, he did not think that was sufficient to condemn it, but he had not found nearly as much. As a chemist he thought that too much importance was often attached to minute chemical analysis and in a general way he considered that what would pass his sense of taste and smell was good enough.

The Rev. S. Wilkinson said he had been enabled to make some observations of the evil effects of fusel oil. There was one part of this colony in which wine was very extensively produced and to his certain knowledge considerable quantities of very coarse sugar was used in fermentation in order to produce the wine; that he knew to be a fact, and it was a certainty from that fact that a considerable quantity of fusel oil is generated by fermentation to produce the wine he alluded to. But what was the result of it?

He had been talking to a very trustworthy man in the Police of that district, who had large experience of the men who had got drunk upon that wine, and his answer was, "Sir, they are not drunk, they are mad." He observed the difference between the men who got drunk on spirits and those who got drunk on the wine produced largely by the use of sugar, and these latter became perfectly mad with it. He was fully persuaded in his own mind, that the larger the quantity of fusel oil found in beer or elsewhere the more deleterious were the effects, and therefore he thought that the results arrived at by our Government Analyst after skilful examination were most important, and shewed that this oil was to be avoided by every possible means. He had not drunk any beer for a quarter of a century, but had observed the effects upon others. He was very pleased that Mr. Hamlet had not discovered any of those deleterious ingredients that are put in some of the beers in other countries, such as grains of paradise, cocculus indicus, copperas and other baneful metallic substances.

Mr. Smith said the point seemed to have been lost sight of as to the amount of amylic alcohol necessary to produce any toxic effects. The authorities of the present day give ·3 of a grain as the quantity required to produce toxic effects on the human system. Mr. Hamlet had shewn that colonial beer contained on an average ·05 grains to the gallon: therefore to get enough amylic alcohol to produce any poisonous symptoms a man must drink six gallons before it would produce any effect. It had been suggested that it might remain in the system over a period of time and eventually the amylic alcohol produced toxic effects upon the system. Delirium tremens had been attributed to fusel oil, but was in no way caused by it. Mr. Dixon had spoken about the analysis of foods: and had rather cried down the analysing of food substances. With all due deference to Mr. Dixon he thought the paper read that night proved that there was a use in analysing food substances. Again, Mr. Dixon had made the remark that anything which would pass his nose and palate he thought good enough to take. He (Mr. Smith) while in England studying chemistry, on one occasion had been appointed to go over one of the works where potted meats were largely manufactured. The course of inquiry was with reference to poisonous salts found in the meat, and this necessitated going through the whole process, and during the examination of the manufactory he certainly saw some things which had entirely prevented him for some years past from eating potted meats. The filthy way in which the meats were prepared would prevent many of the members here present from eating them again; it was only by analysis that we could find out and put a stop to unhealthy products being put on the market. Again from a medical point of view, there were many diseases which could not be found out either by nose or palate; there are various species of tape worm that cannot be found out by chemistry, but they can by microscopical examination.

Mr. W. A. Dixon wished to refer to the incident mentioned by Mr. Wilkinson where men had been reported to be mad by the policemen as the result of drinking certain wine. He (Mr. Dixon) wished to point out that the effect of fusel oil in those cases in which it had been administered had been to produce coma and not madness. A man would be reported dead drunk but would not be reported mad by the average policeman if the effect were due to fusel oil. As for potted meats they never passed his palate.

The Chairman said he was perfectly aware that many ingredients were put in foods although with no intent to cause injury; he was very glad to find that the samples of beer examined by Mr. Hamlet did not contain those injurious things which had been alleged. He certainly thought from what he knew of the brewers here, they would not put in deleterious things; he felt assured that it was not the brewers but the people through whose hands it passed afterwards who adulterated the beer. Chemical analysis was very valuable, and Mr. Hamlet's investigations proved that fusel oil was there, although not in large quantities; but can it be produced without fusel oil? (Mr. Hamlet:—Yes, it can). He was very pleased, and had been instructed by what he had heard that night and wished that more of their members would come forward with papers. Before sitting down he would mention a fact that just occurred to his mind through reference to hops, and it was this:—that nearly all plants twine from right to left, but the hop is an exception; it twines the reverse way and it was the only plant he knew that did so. He would tender on behalf of the Society a cordial vote of thanks to Mr. Hamlet for his paper.

Mr. Hamlet in acknowledging the vote of thanks, said that he considered that any one who had an interest in the State as a citizen, should do all he could to investigate such matters rightly. He did not bring forward his paper to "rob a poor man of his beer," as the popular saying goes, but he simply stated what he found to be the fact—that fusel oil was contained in beer. He concurred very much in what Mr. Dixon had stated about the residues in British beers being higher than that in Sydney beer. He did not think that adding salt had any great deleterious effect nor did he think the amount of common salt that Mr. Dixon referred to, had any great effect, having regard to the fact that most people took a considerable quantity of salt in twenty-four hours. It had been remarked that a man must take a large quantity of beer before the fusel oil takes any effect. That might be so, but it was no so much that, as the cumulative effect of amylic alcohol. If he were going to be dosed with minute doses for six months it would accumulate in his system much in the same way as small doses of lead. If you took small doses of lead it would not produce any immediate effect; but not being eliminated it would be stored up in the body and by and bye produce very alarming results, and it was quite possible that the toxic action of fusel oil would act much in the same way. The men about the streets were not to be compared with the ordinary drinker who takes an occasional glass; those poor creatures that we saw standing about the corners of the streets were imbibing it all day. They are members of the State, and we had, it was to be hoped, some degree of interest in mankind so as to enable them to get as pure an article as possible. Mr. Dixon had suggested that he should have tried experiments on men and not on animals; that had been a great difficulty with him. He should like very much to have experimented on human subjects, and he had hinted as much, but of course it was an impossibility. He only knew from these effects upon himself, that it was a very irritating disagreeable noxious liquid. With regard to the incident mentioned by Mr. Dixon of the man who took a gulp of fusel oil, he could only think it must have been largely diluted. The latest authorities on the subject, considered that 1 – 60th to 1 – 15th of a grain produced intoxicating results. The effect on animals was very distressing to see.

In reply to a question of Dr. Leibius, Mr. Hamlet said there were no recorded experiments of the cumulative effects of fusel oil, but it was inferred from the innate properties of fusel oil that it was so. Of course, he did not compare it with lead, but merely mentioned lead by way of illustration, and it would not be fair to compare it with lead.

WEDNESDAY, NOVEMBER 2, 1887.

Charles Moore, F.L.S., &c., Vice-President in the Chair.

The minutes of the last meeting were read and confirmed.

The certificate of one new candidate was read for the third time, and of two for the first time.

The ballot for the election of the candidate whose certificate had been read for the third time, was postponed to the next General Meeting in consequence of a quorum not being present.

The following letter was read from Lady Von Haast :—

180 Worcester Street, Christchurch, N.Z.

Lady Von Haast desires to express her heartfelt thanks to the members of the Royal Society of New South Wales for their high appreciation of the life and labours of her late husband, Sir Julius Von Haast, and also for their kind expression of deep sympathy with her in her great sorrow and irreparable loss.

Mr. William M. Hamlet, F.C.S., Government Analyst, read a paper on "The presence of fusel oil in beer"

A discussion ensued in which the following gentlemen took part, viz.: Mr. W. A. Dixon, Rev. S. Wilkinson, Mr. C. A. Smith, Dr. Leibius, and the Chairman.

The thanks of the Society were accorded to Mr. Hamlet for his valuable paper.

Eighteen members were present.

The following donations were laid upon the table and acknowledged :—

Donations Received during the Month of October, 1887.

(The Names of the Donors are in *Italics.*)

TRANSACTIONS, JOURNALS, REPORTS, &c.

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MISCELLANEOUS.

(Names of Donors are in *Italics.*)

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SOME NEW SOUTH WALES TAN-SUBSTANCES.

PART IV.—*Leaves only.*

By J. H. MAIDEN, F.R.G.S., Curator of the Technological Museum, Sydney.

[*Read before the Royal Society of N.S.W., December 7, 1887.*]

NOTES—(Third Supplement).

1. It has been quite an oversight on my part that I have omitted to state that all the determinations of tannic acid detailed by me in the present (1887) Journal of this Society, have been made by Fleck's process. The tannate of copper has in all cases been reduced to cupric oxide, and Eeler's factor (1·3061) has been employed to calculate the tannic acid. Fleck's acetate of copper and ammonium carbonate process has been frequently used by me during the last few years with very satisfactory results. Even Procter, who has subjected the various processes for the estimation of tannin, to as rigid a scrutiny as any chemist with whose writings I am acquainted, does not impugn the accuracy of the method, so far as I am aware. Being a gravimetric process it is tedious, but considerations of this nature have had no weight with

me in the present series of experiments. Nevertheless, as the improved process of Löwenthal is rapidly superseding all others (at least on the continent of Europe), I will probably use it exclusively in future, in any future experiments I may be permitted to bring under the notice of our Society.

2. I began by treating the leaves with benzene in an exhauster, similar in principle to that described by J. West-Knights (*Analyst* viii., 65), but comparative experiments between fresh leaves, and leaves thus treated, showed me that the oil present did not perceptibly affect the determinations of tannic acid by the process adopted.

3. There is likely to be greater differences between analyses of leaves than of barks, inasmuch as the life of a leaf is much less than the bark of a tree, and so all the stages from the state in which it consists almost entirely of cellular matter to that in which it contains its maximum of fibre, and (usually) minimum of active principles, are passed through in a comparatively short space of time.

4. The amount of tannin in some of the determinations may appear high, but it must be borne in mind that the moisture in leaves is comparatively great, and that these determinations have, as usual, been calculated on the leaves thoroughly dried at 100° C.

5. A convenient way of preparing the leaves for experiment is to put them on a board and cut them in small portions by *pressing* the sharp blade of a tomahawk over them. The fragments are then passed through a small mill.

6. The leaves and petioles *only* have been taken in each case, all other portions of the twigs having been removed.

7. The state of the leaves has been noted. Owing to the dampness of the weather, in some instances, the collector was not always successful in drying them in a satisfactory manner.

8. The measurements of the leaves have been determined in the following way. Twenty average leaves of each species have each been measured with a millimetre rule, the greatest length (including petiole), and breadth taken, and the mean calculated. Mr. G. S. Home, my assistant, has been kind enough to do this for me.

9. In each case I have attached a physical description of the leaf, the minute description of the Eucalypts being from the "Eucalyptographia" of Baron Mueller, while the less detailed descriptions of *Eucalyptus* and *Acacia* are from the "Flora Australiensis." In the "Eucalyptographia" the Baron takes cognizance of the (a) shape, (b) colour, (c) lateral veins, (d) circumferential vein—(the intermarginal vein of Bentham), (e) oil dots; and although these characteristics are of course not sufficient for a diagnosis of a species, yet they are valuable aids

and will be more thoroughly studied as Eucalyptus leaves increasingly enter into commerce. Where a leaf under examination presents a difference from the published description, that difference has been pointed out.

10. According to Watts' Dict: Chevreul discovered a yellow colouring matter in Sumach, which separates from a concentrated decoction on cooling, in small crystalline grains. I have been unsuccessful, up to the present, in tracing the original memoir, but the yellow colouring matter before you, has been deposited from Eucalyptus leaves in a similar manner to that of the yellow pigment of Chevreul obtained from Sumach. Of those species, I have up to the present examined, *E. maculata* contains a small quantity, but *E. macrorrhyncha* contains it in abundance. In boiling the leaves with a limited quantity of water, the greater part of the tannic acid is dissolved out, and but little colouring matter. Prolonged boiling with a second water extracts the colouring matter freely. This is but a preliminary note, for the substance is of such great interest, and, probably, of commercial importance, that I am subjecting it to careful examination from the point of view both of the chemist and colourist.

Tannic Acid in Leaves—Preliminary notes.

1. Allusions to the tannin of leaves (with the exceedingly important exception of Sumach) in text-books and the proceedings of societies, are of the rarest occurrence. I have therefore considered it convenient to present a few notes which I have come across, on the leaves of such plants as have been examined for tannic acid. It will be interesting to compare these results with those of the few New South Wales species referred to in the present paper. Leaves as a rule are solely valued as a manure, and hence the frequent determinations of the ash of them, *e.g.*, Gueymard (Comptes Rendus, lix., 989).

2. Tannin (Tannic acid) is found more constantly in cells presenting a low degree of vital activity, as those of the wood and bark; and that of early decaying excrescences, as galls: but still it is found in many leaves, as those of the tea-plant, and of the *Ericaceæ;* but here, perhaps, it only occurs in the bundles of vessels, or less actively vital cells of the leaf. (Princip. of Scientific Botany, Schleiden, 1849).

(A.) *Tannic Acid in Leaves not Australian.*

1. Although I cannot find it specifically stated that the leaves of any Indian Acacia are used in tanning, yet the astringent properties of the leaves of some species cause them to be used in medicine. The leaves of *A. arabica*, for instance, are used in India as an astringent and stimulant application to ulcers attended

with sanious discharge. They are also used in mucous discharges. Poultices made of the young tender leaves are usually employed by the native practitioners.

2. *Acacia Cebil*, Grisebach, (Leguminosæ), the red Cebil of the Argentine Republic, contains 6 – 7 per cent. in the leaves. Another variety, the white Cebil, contains 7 – 8 per cent. in the leaves.

3. In the Argentine Republic the leaves of *Acacia guarensis*, ? Grisebach, an Algarobillo, are used (as well as the bark and pods) for tanning. (F. Fol. *Moniteur industriel*, March 1879).

4. *Arbutus Unedo*, Linn., (Ericaceæ). The "Strawberry tree." Both the leaves and bark are used for tanning in Greece, while the bark alone is used for that purpose in Spain.

5. *Arctostaphylos Uva-ursi*, Wimm., (Ericaceæ), "Bearberry." The whole plant is used for tanning in Russia and Sweden, and the leaves also as an astringent in medicine, finding a place in the British Pharmacopœia. Meiphen found the leaves to contain no less than 36·4 per cent. of tannin.

6. *Comptonia asplenifolia*, Gaertn., (Myricaceæ), the "Sweet Fern" of the United States. Dr. McMurtrie found 9·42 per cent. of tannic acid in some leaves which were gathered at Boston, Mass.

7. *Coriaria myrtifolia*, Linn., (Coriariæ). These leaves are used for tanning in the South of France, but their principal use is in dyeing black. They form a very inferior Sumach.

8. *Cybistax antisyphilitica*, Mart., (Bignoniaceæ). (A plant with many synonyms). Its leaves called "Caroba leaves," are used in medicine. They contain ·439 per cent. of tannic acid according to Dr. Zaremba of Chicago. (Therap. Gazette, 1880, p. 34).

9. *Ephedra antisyphilitica*, C. A. Mey, (Gnetaceæ). Dr. McMurtrie found 11·9 per cent. of tannic acid in the leaves of this plant, which is found in the table-lands of Arizona and Utah.

10. *Osyris compressa*, DC., (Santalaceæ), 17 per cent. of tannin. This species is from the Cape of Good Hope, and a North Indian species is used as a substitute for tea. Although Riddell states that this plant came into use on account of the similarity in appearance of its leaves to those of the tea-plant, its astringency has doubtless confirmed its use.

11. *Polygonum amphibium*, Linn., (Polygonaceæ). The whole plant, from Nebraska, 11·6 per cent. of tannic acid. (McMurtrie) Dr. McMurtrie states—"The percentage of tannic acid found in these leaves is very much below that found by Professor Samuel Aughey of the University of Nebraska. The sample we examined had been collected over a year, and was the best we could obtain." This plant is common enough in Europe, and other species are more or less astringent.

12. *Quercus sp.* In 1768 Lavoisier used oak-leaves, but their general employment was restricted by their strength for tanning

varying with the period of the year, and the variety of the tree whence they where obtained, (Jour. Soc. Arts 1884). Leaves of different trees (oaks) exhibit considerable diversity in their yield of tannin. The tannin of the leaves is identical with the bark. Oser (Chem. Centr. 1875, 517) makes reference to the fact that the green leaves of the oak contain a considerable quantity of quercitanic acid, so that they would prove a good material for tanning purposes.

13. *Quercus tinctoria*, Willd., (Cupuliferæ). "Quercitron leaves." "Avec le quercitrin coexiste assez souvent le tannin, quelquefois l'acide gallique, matières qui ont avec lui ce caractère commun de donner une couleur brune avec les sels de fer. A côté du quercitrin ou en son absence, on trouve aussi la quercétine et la méline. (Bolley, Stein). Ces matières, quercitrin, tannin, acide gallique &c. . . . . . . ont une diffusion ou généralite d'existence très différente ; le quercitrin est le plus répandu ; le tannin l' est beaucoup moins ; l' acide gallique est rare." (Chatin et Filhol, Comptes Rendus lvii., 39). Pendant la coloration automnale des feuilles, les matières qui colorent les sels de fer disparaissent, et leur destruction a lieu dans l' ordre suivant : quercitrin, tannin, acide gallique. Cet ordre de destruction est le même que celui de leur diffusion, qui est sans doute celui de leur importance physiologique." *(loc. cit.)*

14. *Fagus sylvatica*, Linn., (Amentiferæ). Beech leaves. The leaves were gathered in ? England on the 26th of each month, except November 7th. They yielded tannic acid per cent. :— June, 1·164 ; July, 1·804 ; August, 2·395 ; September, 2·93 ; October, 2·802 ; November, 3·576. (Journ. Chem. Soc., xxviii., 1279). Beech leaves gave 20·8 per cent. of extract to Wanklyn.

15. *Spirea tomentosa*, Linn., (Rosaceæ) of New England, U.S.A. Called "Hardhack." The leaves and young shoots are rich in tannin, and once in three years the plant is mowed, cured, and sold to the tanners at prices which afford a fair profit for the use of the land. (Monthly Reports of Depart. of Agric., Washington, 1873, p. 35).

16. *Tea.*—Chinese Green (Hyson) 17·8 per cent. Chinese Black (Congou) 12·88 per cent. Java Green (Hyson) 17·56 per cent. Java Black (Congou) 14·8 per cent. (Mulder in Watts' Dict.) Hassall gives 18·69 per cent. for green tea and 15·24 per cent. for black. S. Jauke, using the copper acetate process, finds, taking 18 samples of black tea, the maximum to be 9·142 per cent., the minimum 6·922 per cent., and the mean 8·1. Of three samples of green tea 9·94 the maximum, 8·56 the minimum, and 9·57 the mean. Wigner gives the percentage of tannic acid in some astringent teas he examined at from 27·7 to 42·3. Hill (Analyst, 1881, p. 95 – 99) gives 14·8 per cent. as the average of 32 samples of black and green tea.

17. Stenhouse in Watts' Dict. i., 1075, gives the percentage of tannic acid in coffee-berries at 3 – 5, and states that it exists in combination with calcium and magnesium. "They also appear to contain a larger proportion of caffetannic acid than the beans; the proportion of matter extracted by water was 38·8 per cent."

18. *Ilex paraguayensis*, St. Hil. (Aquifoliaceæ). "Maté or Paraguay tea" contains "little more than 6 per cent. of tannic acid."

(B.) *Tannic Acid in Australian Leaves.*

1. Leaves of the following Australian plants have already been examined by me with respect to their tanning properties:—*Rhus rhodanthema*, F.v.M., page 185; *Eremophila longifolia*, F.v.M., page 199; *Polygonum plebejum*, R. Br., p. 200.

2. In addition to those noted under the species described in this paper, the following notes on tannic acid in leaves of Australian plants will be useful:—*Eucalyptus cosmophylla*, F.v.M.—"The ordinarily dry leaves gave 13 per cent. of tannin according to a solitary experiment; equal to nearly 15 per cent. in absolutely dry leaves." Decade 7 "Eucalyptographia," (Mueller).

3. *E. doratoxylon*, F.v.M., 7·01 per cent. in the dried leaves. (Dec. 4, "Eucalyptographia.")

4. "The leaves of *E. leucoxylon* have yielded us here from dry material 9½ per cent. of Eucalypto-tannin, whereas the dry foliage of *Acacia pycnantha* furnished as much as 15 – 16 per cent. of Mimosa-tannic acid, and therefore still more approaches in its richdom of tan-principle to the genuine Sumach-leaves of *Rhus coriaria*. Our experiments here showed that about four weeks were required to effect the tanning of cow-hides (which were used on this occasion) by simple immersion in the tan-liquor, as obtained by decoction, without any additions of other substances, whether leaves or bark were employed, except in the case of *E. Gunnii*, the tanning process with that species being completed in two weeks, and with *E. goniocalyx* in three weeks. The leather obtained from leaves of *E. leucoxylon* was grey-brown, hard and tough; that from the bark of *E. Gunnii*, light brown and rather flexible; that from bark of *E. viminalis*, *E. goniocalyx*, and *E. amygdalina* reddish-brown and tough; that from the bark of *E. macrorrhyncha* and *E. melliodora* darker still than that of the preceding three; that from the bark of *E. obliqua* red-brown in colour." (Dec. 7, "Eucalyptographia.")

5. It will here be convenient to present the results of the determinations of tan and extract in the present paper, in tabular form, in order of tanning power and quantity of extractive matter. Similar tables (compiled from my former papers read before the Society) are also given in regard to such barks as were obtained from the trees which yielded the leaves described in the present paper:—

TABLE I.—LEAVES.

No.	Species.	Percentage of Extract.
1	E. melliodora	49·8
2	E. hæmastoma	47·19
3	E. amygdalina (Bombala)	44·24
4	E. Stuartiana	42·74
5	E. stellulata	42·14
6	E. obliqua	41·13
7	E. Gunnii (Delegate)...	41·08
8	E. rostrata	40·8
9	E. Gunnii (Bombala)...	40·61
10	E. viminalis, var.	40·59
11	E. odorata, var.	40·19
12	E. macrorrhyncha	40·18
13	A. vestita	40·18
14	E. corymbosa	36·72
15	E. robusta	34·7
16	E. piperita, var.	34·08
17	E. Sieberiana	32·31
18	E. amygdalina (Nelligen)	32·13
19	A. glaucescens	30·96
20	E. polyanthemos	29·69
21	E. maculata	28·32
22	A. melanoxylon	23·22
23	E. siderophloia	22·93
24	A. longifolia	21·55

TABLE II.—LEAVES.

No.	Species.	Percentage of Tannic Acid.
1	E. corymbosa	18·377
2	E. obliqua	17·2
3	E. stellulata	16·62
4	E. Gunnii (Bombala)...	16·59
5	A. vestita	15·18
6	E. piperita, var.	12·59
7	E. robusta	12·069
8	E. hæmastoma	11·27
9	E. Stuartiana	10·158
10	E. macrorrhyncha	10·13
11	E. amygdalina (Bombala)	8·75
12	E. Gunnii (Delegate)	8·28
13	E. melliodora	7·89
14	E. odorata, var.	6·775
15	E. rostrata	6·62
16	E. siderophloia	5·95
17	E. maculata	5·263
18	E. viminalis	3·998
19	A. melanoxylon	3·382
20	A. glaucescens	2·874
21	E. sieberiana	2·389
22	A. longifolia	1·932
23	E. polyanthemos	1·881
24	E. amygdalina (Nelligen)	1·815

TABLE III.—BARKS.

No.	Species.	Percentage of Extract.
1	A. vestita	50·82
2	A. longifolia	30·35
3	E. stellulata	27·64
4	A. melanoxylon	20·63
5	E. maculata	20·865
6	E. Gunnii (Bombala)...	10·84
7	E. Gunnii (Delegate)	19·4
8	E. viminalis	18·65
9	E. Stuartiana	15·39
10	A. glaucescens...	14·29
11	E. siderophloia...	14·2
12	E. corymbosa	12·16

TABLE IV.—BARKS.

No.	Species.	Percentage of Tannic Acid.
1	A. vestita	27·96
2	A. longifolia	18·93
3	E. stellulata	12·86
4	E. Gunnii (Bombala)...	11·35
5	A. melanoxylon	11·12
6	E. maculata	9·74
7	E. Gunnii (Delegate)...	9·45
8	A. glaucescens...	8·10
9	E. viminalis	7·504
10	E. siderophloia...	6·702
11	E. corymbosa	5·85
12	E. Stuartiana	5·25

It will be observed that the percentage of tannic acid in the Eucalyptus leaves examined, varies between 1·815 and 18·377 per cent., and in Acacia leaves between 1·932 and 3·382 per cent., with the exceptional instance of *A. vestita*, (15·18 per cent.), which forms a notable exception to the general poverty of Acacia *leaves* as regards tannin. It has been previously noted that Baron Mueller and Mr. Rummel found between 15 and 16 per cent. of tannic acid in the leaves of *Acacia pycnantha*; these two Acacias therefore agree very closely in wealth of tanning power. But Wattle (Acacia) leaves are as a rule of no value to the tanner, and likewise many species of gum (Eucalyptus) leaves which, although richer, are still not of much value. Yet although in these researches I have scarcely crossed the threshold of the subject, I think I have shown that some leaves are worth conserving, and the intelligent farmer herein should receive an additional stimulus to acquire the names of the trees upon his property. The percentage of extract in the leaves of the Acacias examined varies between 21·55 and 40·18 per cent., and of Eucalypts between 22·93 and 49·8 per cent. In the barks (Tables 3 and 4) there is a fair agreement in numerical order between extracts and tans; in the case of the leaves (Tables 1 and 2), I fail to find any such relation. Also, in the barks the percentage of tannin is roughly about one-half that of the extract; no such proportion (or in fact *any* that I can detect), occurs in the case of the leaves.

6. Count Maillard de Marafy has suggested that the leaves of *E. globulus* can be utilized as a substitute for sumach ("L'Eucalyptus, nouvel emploi industriel). I have not access to the original memoir, but the following passage, not so full as could be desired, will be found, *Pharm. Journ.*, [3] iii., 43:—" Leaves of *E. globulus*, taken from a plantation near Alexandria, and pulverized like Sumach, when used upon cotton and wool in the same proportion as the best Sicilian Sumach, gave an intense black that left nothing to be desired." The process alluded to is the usual one with lime water and copperas (Sulphate of iron). Of course if the value of the leaves for producing a black dye in this way be proved, their value as a tan-substance is proved likewise. As the result of my experiments I am impressed with the general similarity of the behaviour of Eucalyptus leaves to Sumach. They are inferior in tanning power of course to the latter, but as they will doubtless yield light-coloured leather, and as they are so exceeding abundant, they should not be beneath the notice of an enterprising tanner to perform systematic experiments with them. At least *E. corymbosa*, *E. obliqua*, *E. stellulata*, and *E. Gunnii*, are worthy of attention on account of their high yield of tannin, and subsequent researches will doubtless augment the list. I have not yet analysed the leaves of *E. globulus*, but I must confess that although I commenced this paper not seriously thinking that the leaves of any Eucalypt were worthy to be ranked with Sumach, I have now come to the conclusion that the Comte de Marafy's remark was not an unjustifiable one.

7. I would throw out the suggestion that the residue left after the distillation of oil from Eucalyptus leaves might be used for tanning purposes.

55. Acacia vestita, *Ker*, N.O. Leguminosæ, B. Fl. ii., 375.

Found in Southern New South Wales and Northern Victoria.

Locality whence this particular specimen was obtained—Quiedong, near Bombala.

Geological Formation—Limestone.

Part of Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 20 to 30 feet, diameter 10 to 18 inches.

Collected 9th April, 1887. Analysed 11th to 17th November, 1887.

Phyllodia obliquely ovate elliptical, more or less recurved falcate, undulate, mostly about $\frac{1}{2}$ inch long, with a fine, but not pungent point, cuneate at the base, 1-nerved. (B. Fl.) Each phyllode is softly pubescent. The shrub from which these leaves (phyllodia) were taken, contained abundance of quarter-grown flower-buds. These leaves were scarcely discoloured in drying. Average length 15·45 mm., average breadth 5·4 mm. Colour of the powdered leaves, sage-green.

Extract.—They dissolve in water at 100° C. to the extent of 40·18 per cent., yielding a solution of a ruby colour (like *A. melanoxylon*). The extract clogs the filter, making the operation exceptionally difficult.* Colour of moist residue, light brown with a greenish tinge.

Catechu-tannic acid.—15·18 per cent.

56. Acacia melanoxylon, *R. Br.*, N.O. Leguminosæ, B. Fl. ii., 388. Figured Tab. 1659 Curtis' Bot. Mag.

Found in all the Colonies except Queensland and Western Australia.

Vernacular Names—"Blackwood." "Lightwood."

Locality whence this particular specimen was obtained—Monga, near Braidwood.

Geological Formation—Granite.

Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 40 to 60 feet, diameter 1 foot.

Collected 28th September, 1886. Analysed 11th to 17th November, 1887.

These leaves (phyllodia) have lost much of their original greenness in drying, their prevailing colour being brownish. The branchlets contain a few half-opened flower-buds.† Phyllodia falcate-oblong or almost lanceolate, 3 to 4 inches long, the common varieties $\frac{1}{2}$ to 1 inch broad, obtuse or rarely almost acute, much narrowed towards the base, coriaceous, with several longitudinal nerves and numerous anastomosing veins. (B. Fl.) Average

* A similar observation was made in regard to the bark of this species at p. 89.

† These were of course removed for the purpose of the experiments See p. 251.

length 94 mm., average breadth 4·75 mm. They form a powder of a dirty sage-green tint.

Extract.—They dissolve in water to the extent of 23·22 per cent., yielding a solution of a light ruby colour ; colour of moist residue light brown.

Catechu-tannic acid—3·382 per cent.

57. Acacia longifolia, *Willd.*, N.O. Leguminosæ, B. Fl. ii., 397. Figured in Part 6 Brown's "Forest Flora of S.A." and Tab. 1828 Curtis' Bot. Mag.

Found in all the Colonies except Western Australia.

Vernacular Name—"Golden Wattle."

Locality whence this particular specimen was obtained—Cambewarra.

Geological Formation—Sandstone.

Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 12 to 15 feet, diameter 4 to 6 inches.

Collected 20th August, 1886. Analysed 12th to 17th November, 1887.

Phyllodia from broadly oblong to oblong-lanceolate or linear, very obtuse or almost acuminate, usually narrowed towards the base, with 2 to 5 more or less prominent longitudinal nerves, and conspicuously or faintly reticulate between them, varying in length from 2 to 3 inches in some varieties, to 5 or 6 inches in others. (B. Fl.) This wattle was in flower when the leaves (phyllodia) were taken. Average length 159·25 mm., average breadth 9 mm. These leaves have lost much of their fresh appearance in drying. In powder they afford a sage-green tint rather darker than that of *A. melanoxylon.*

Extract.—They dissolve in water to the extent of 21·55 per cent., yielding a solution of a dark orange colour, and a moist residue of different shades of brown. The extract of these leaves is very difficult to filter.

Catechu-tannic acid—1·932 per cent.

58. Acacia glaucescens, *Willd.*, N.O. Leguminosæ, B. Fl. ii., 406.

Found in Victoria, New South Wales, and Queensland.

Vernacular Name—"Myall."

Locality whence these particular specimens were obtained—Quiedong, near Bombala.

Geological Formation—Limestone.

Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 20 to 25 feet, diameter 6 to 12 inches.

Collected 8th April, 1887. Analysed 12th to 21st November, 1887.

Phyllodia oblong-falcate or lanceolate, narrowed at both ends, mostly 4 to 6 inches long, $\frac{1}{2}$ to near 1 inch broad in the middle, coriaceous, striate, with numerous very fine nerves, 3 to 5 rather more prominent, the smaller ones occasionally anastomosing, and all free from the lower margin from the base. (B.Fl.) This wattle was in bud (flower) when collected. Average length 62.25 mm., average breadth 7.8 mm. The uncrushed foliage has a beautiful silvery appearance. It yields a powder of a dark pea-green colour.

Extract.—Yields 30.96 per cent. to water at 100°. Colour of extract light lemon, of moist residue light brown. Extract difficult to filter.

Catechu-tannic acid—2·874 per cent.

59. Eucalyptus stellulata, *Sieb.*, N.O. Myrtaceæ, B. Fl. iii., 200. Figure Dec. 6, "Eucalyptographia."

Found in Victoria and New South Wales.

Vernacular Name—"Sally" or "Black Gum."

Locality whence this particular specimen was obtained—Little River, near Braidwood.

Geological Formation—Granite.

Parts of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 40 to 60 feet, diameter 1 to 2 feet.

Collected 5th November,, 1886. Analysed 24th October to 28th November, 1887.

Leaves scattered, on rather short stalks, from oval- to narrow-lanceolar or rarely linear-lanceolar, of firm consistence, hardly inequilateral, not much elongated, shining and of equal colour on both sides ; primary *veins almost longitudinal*, mostly prominent, three of them arising almost jointly from near the acute base of the leaf, the circumferential vein removed from the edge ; oil-dots much concealed or quite obliterated. (Eucalyptographia).

Leaves elliptical, lanceolate, or the lower ones ovate, rarely much above 3 inches long, usually straight or nearly so, acuminate and much narrowed towards the base, the veins very oblique and anastomosing, a few of the principal ones prominent, starting from near the base, and almost parallel to the midrib. (B. Fl.)

In these specimens the leaves are more or less falcate, and the circumferential vein *close to* the edge. Average length 116·4 mm., average breadth 19·25 mm. These leaves were evidently collected damp, for they have not dried green. They yield a pale dirty-brown powder.

Extract.—Yield 42·14 per cent. to water at 100° C. Colour of extract ruby, of moist residue reddish-brown.

Kino-tannic acid—16·62 per cent.

60. Eucalyptus Sieberiana, *F.v.M.*, (*E. virgata*, Sieb., B. Fl. iii., 202). N.O. Myrtaceæ. Figure Dec. 2 "Eucalyptographia."

Found in all the Colonies except Queensland and Western Australia.

Vernacular Name—"Cabbage Gum."

Locality whence these particular specimens were obtained—Monga, near Braidwood.

Geological Formation—Granite.

Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 60 to 80 feet, diameter 1 to 2 feet.

Collected 28th September, 1887. Analysed 11th to 21st November, 1887.

Leaves scattered, sickle-shaped lanceolar, shining and nearly of equal colour on both sides, more or less transparently dotted; *their lateral veins more longitudinal than transverse and faint*, the intramarginal vein somewhat removed from the edge or evanescent. (Eucalyptographia).

Leaves lanceolate, usually narrow falcate and acuminate, 4 to 6 inches long or sometimes longer, thick and shining, with the veins more oblique than in *E. obliqua* . . . and often very indistinct. (B. Fl.)

The present are large coriaceous leaves more or less spotted through insect punctures and evidently from a well-matured tree. Average length 153·5 mm., average breadth 26·6 mm. Yield a pale green powder of a yellowish tint, containing a fair quantity of a fine fibre.

Extract.—They yield 32·31 per cent. to water at 100° C. Colour of extract lemon, and of moist residue dirty yellowish-brown.

Kino-tannic acid—2·389 per cent.

61. Eucalyptus amygdalina, *Labill.*, var., N.O. Myrtaceæ, B. Fl. iii., 202. Figure Dec. 5, "Eucalyptographia," and Tab. 3260, Curtis' Bot. Mag.

This particular variety is found in South-east Australia.

Vernacular Name—" Ribbon Gum."
Locality whence this particular specimen was obtained—Nelligen, Clyde River.
Geological Formation—Granite.
Part of the Tree Examined—Leaves.
Particulars of the trees whence they were obtained—Height 100 to 120 feet, diameter 2½ feet.
Collected 21st September, 1886. Analysed 24th October to 24th November, 1887.

Leaves on rather short stalks, scattered or rarely opposite, narrow- or sickle-shaped-lanceolar or very narrow, usually attenuated into an acute but oblique base, generally not of thick consistence, mostly of a saturated green and somewhat shining on both sides ; *lateral veins very thin, not much spreading*, nor closely approximated, the circumferential vein remote from the edge of the leaf ; *oil-dots very copious transparent.* (Eucalyptographia.)

Leaves from linear to broadly lanceolate, straight or falcate, mostly acuminate and 2 to 4 inches long, when narrow rather thin, when broad thicker, the veins few and oblique but often inconspicuous, the intra-marginal one at a distance from the edge, or rarely near to it. (B. Fl.)

These leaves are tapering linear, slightly falcate, very thin, and with very prominent midrid. Many of them are slightly spotted through insect punctures. Oil dots inconspicuous.

Average length 127·8 mm., average breadth 10·6 mm. They yield an olive-brown powder.

Extract.—Yield 32·13 per cent. to water at 100° C. Colour of extract dark lemon, of moist residue, brown.

Kino-tannic acid—1·815 per cent.

For a note on leather made from the leaves of the same species see p. 255.

The collector observed, " the leaves of this species ought to be rich in oil," before he knew the species. They are very fragrant yet. This species yields much of the " Eucalyptus globulus " oil of commerce ; the specific name *globulus* adherring to ninety-nine hundredths of the Eucalyptus oil sold, in defiance of botanical science.

62. Eucalyptus amygdalina, *Labill.*, var.
Vernacular Name—" Peppermint."
Locality whence this particular specimen was obtained—Bombala.
Geological Formation—Limestone.
Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 60 to 80 feet, diameter 3 feet.

Collected 14th February, 1887. Analysed 24th October to 24th November, 1887.

These leaves are as different from the previous variety as it is possible for Eucalyptus leaves to be. They are lanceolate to nearly ovate, are slightly inequilateral, and have very prominent oil-dots. The tree was in flower-bud when they were gathered. They are deliciously aromatic, more so than the previous variety, but they have been better dried than those leaves. Average length 90·25 mm., average breadth 26·6 mm. They yield a greenish powder containing a certain excess of yellow,—"quaker green."

Extract.—They yield 44·24 per cent. to water at 100° C. Colour of extract light yellow, slightly turbid, and of moist residue dark drab.

Kino-tannic acid—8·75 per cent.

63. EUCALYPTUS OBLIQUA, *L'Hérit.*, N.O. Myrtaceæ, B. Fl., iii., 204. Figured in Brown's "Forest Flora of S.A." (Part i.), Dec. 3, "Eucalyptographia,"

Found in South Australia, Tasmania, Victoria, and New South Wales.

Vernacular Name—"Stringybark."

Locality whence these particular specimens were obtained—Cambewarra.

Geological Formation—Sandstone.

Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 60 to 80 feet; diameter 2 feet.

Collected 30th August, 1886. Analysed 12th to 17th November, 1887.

Leaves scattered, sickle-shaped or sometimes oval-lanceolar, equally green and shining on both sides; their *lateral veins not very spreading*, rather prominent, the circumferential vein rather removed from the edge, oil-dots concealed. (Eucalyptographia.)

Leaves in the usual form mostly oval-lanceolate, falcate and very oblique at the base, more or less acuminate, 4 to 6 inches long, thick with very oblique distant anastomosing veins, the intramarginal one at some distance from the edge. (B. Fl.)

Average length 159 mm., average breadth 35 mm. They yield a powder of a sage-green tint.

Extract.—They yield 41·13 per cent. to water at 100° C. Colour of extract ruby, and of moist residue light yellowish brown.

Kino-tannic acid—17·2 per cent.

64. EUCALYPTUS MACRORRHYNCHA, *F. v. M.*, N.O. Myrtaceæ, B. Fl., iii., 207. Figured Dec. 1, "Eucalyptographia."
Found in New South Wales and Victoria.
Vernacular Name—"Stringybark."
Locality whence this particular specimen was obtained—Delegate.
Geological Formation—Mudstone (Silurian).
Part of the Tree Examined—Leaves.
Particulars of the trees whence they were obtained—Height 60 to 80 feet, diameter 2 to 3 feet.
Collected 12th May, 1887. Analysed 24th October to 28th November, 1887.

Leaves scattered, elongate or sickleshaped-lanceolar, rarely verging into an almost oval form, equally green on both sides, with very subtle much concealed oil-dots; their lateral veins moderately spreading, the intramarginal vein distinctly removed from the edge. (Eucalyptographia.)

Leaves mostly falcate, rather narrow and acuminate, 3 to 5 inches long, the lower ones broader, thick and coriaceous, the very oblique rather distant veins prominent. (B. Fl.)

Average length 91·8 mm., average breadth 35·5 mm. They yield a powder of a Brunswick green colour, On account of the large quantity of oil they contain they clog the mill a good deal.

Extract.—They yield 40·18 per cent. to water at 100° C. Colour of extract same as that of *E. amygdalina* (Nelligen), with yellow deposit on cooling; and of moist residue light olive-brown

Kino-tannic acid—10·13 per cent.

65. EUCALYPTUS PIPERITA, *Smith*, var., N.O. Myrtaceæ, B. Fl. iii., 207. Figured Dec. 3, "Eucalyptographia."
Found in Victoria and New South Wales.
Vernacular Names—"Messmate," "Narrow or Almond-leaved Stringybark."*
Locality whence these particular specimens were obtained—Brooman, Clyde River.
Geological Formation—Granite.
Part of the Tree Examined—Leaves.
Particulars of the trees whence they were obtained—Height 100 to 120 feet, diameter 2 to 3 feet.
Collected 14th September, 1886. Analysed 31st October to 24th November, 1887.

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* This tree much resembles *E. obliqua*, the ordinary Stringybark, but the leaves are narrower, the bark not so stringy; it is also much richer in kino.

Leaves scattered, sickle-shaped lanceolar, not very long, rather more shining above than below; their lateral *veins very subtle* and numerous, usually more erect than transverse, the circumferential vein somewhat removed from the margin of the leaf; oil-dots copious, more or less pellucid. (Eucalyptographia).

Leaves from ovate-lanceolate and very oblique to lanceolate and nearly straight, rarely above 1 inch long, rather thick and rigid, the veins very oblique, almost as in *E. obliqua*, but usually fine and less conspicuous, and more numerous, especially in the narrower leaves. (B. Fl.)

Average length 154·8 mm., average breadth 30·2 mm. Colour of powdered leaves, olive-brown with a slight tinge of blue.

Extract.—They yield 34·08 per cent. to water at 100° C. Colour of extract ruby, but lighter than *E. stellulata;* of moist residue, brown.

Kino-tannic acid—12·59 per cent.

66. Eucalyptus melliodora, *A. Cunn.*, N.O. Myrtaceæ, B. Fl., iii., 210. Figured in Dec. 3 "Eucalyptographia," also "Botanic Teachings" (Mueller).

Found in Victoria and New South Wales.

Vernacular Name—"Yellow Box."

Locality whence these particular specimens were obtained—Colombo, near Candelo.

Geological Formation—Granite.

Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 30 to 50 feet, diameter 2 feet.

Collected 23rd December, 1886. Analysed 24th October to 25th November, 1887.

Leaves narrow-lanceolar or somewhat sickle-shaped, sometimes verging into an oblong or oval form, not very long, mostly of a dull-green on both sides, seldom shining; their lateral veins neither very spreading nor very numerous nor unusually prominent, the marginal vein distinctly removed from the edge; oil-dots rather copious, but many concealed. (Eucalyptographia.)

Leaves lanceolate, usually narrow, acuminate and often falcate, mostly 3 to 4 inches long, rather thick, with very fine and rather numerous but oblique veins, the intramarginal one at a distance from the edge. (B. Fl.)

Average length 95·2 mm., average breadth 19·1 mm. Colour of powder dirty olive-green.

Extract.—They yield 49·8 per cent. to water at 100° C. Colour of extract dark orange, and of moist residue, light olive-brown.

Kino-tannic acid—7·89 per cent.

67. EUCALYPTUS HÆMASTOMA, *Smith*, N.O. Myrtaceæ, B. Fl. iii., 212. Figured Dec. 2, "Eucalyptographia."

Found in Tasmania, Victoria, New South Wales, and Queensland.

Vernacular Name—"Rough or small-leaved Stringybark."

Locality whence these particular specimens were obtained—Colombo, near Candelo.

Geological Formation—Granite.

Part of the tree examiued—Leaves.

Particulars of the trees whence they were obtained—Height 40 to 60 feet, diameter 2 feet.

Collected 23rd December, 1886. Analysed 24th October to 25th November, 1887.

Leaves sickle-shaped-lanceolar, occasionally much narrower or exceptionally also verging to a somewhat oval form, shining and of equal green on both sides; their lateral veins more longitudinal than transverse, the intramarginal vein somewhat removed from the edge. (Eucalyptographia).

Leaves usually oblique or falcate, lanceolate, about 4 to 6 inches long, thickly coriaceous, the veins very oblique not close and often anastomosing as in *E. obliqua*, the lower ones sometimes broader and more reticulate. (B. Fl.)

Average length 94·8 mm., average breadth 20 mm. Colour of the powdered leaves dark pea-green.

Extract.—They yield 47·19 per cent. to water at 100° C. Colour of extract light orange, of moist residue light brown of a bronze-green tint.

Kino-tannic acid—11·27 per cent.

68. EUCALYPTUS POLYANTHEMOS, *Schauer.*, N.O. Myrtaceæ, B. Fl iii., 213. Figured Dec. 3, "Eucalyptographia."

Found in Victoria and New South Wales.

Vernacular Name—"Box."

Locality whence these particular specimens were obtained—Quiedong, near Bombala.

Geological Formation—Limestone.

Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 60 to 80 feet, diameter 3 to 4 feet.

Collected 10th April, 1887. Analysed 24th October to 24th November, 1887.

Leaves on rather long stalks, *orbicular or broad ovate or roundish, of an almost ashy-hue or dull-greenish*, occasionally verging into an oval-lanceolar form; primary veins considerably spreading, the circumferential veins distinctly removed from the edge. (Eucalyptographia).

Leaves on rather long petioles, broadly ovate-orbicular or rhomboidal, obtuse or rarely shortly acuminate, mostly under 3 inches long, passing in older trees into ovate-lanceolate obtuse, and 3 inches long or more, rather rigid with fine diverging anastomosing veins, the intramarginal ones distant from the edge. (B. Fl.)

Average length 97·1 mm., average breadth 35·75 mm. Colour of powdered leaves, dark Brunswick green.

Extract.—They yield 29·69 per cent. to water at 100° C. Colour of extract, exceedingly pale lemon, of moist residue light olive-brown.

Kino-tannic acid—1·881 per cent.

69. Eucalyptus odorata, *Behr.*, var., N.O. Myrtaceæ, B Fl. iii., 215. Figured in Part 6 of Brown's "Forest Flora of S.A." Dec. 2, "Eucalyptographia" and "Plants Indigenous in Victoria" (Mueller).

Found in South Australia, Victoria, and New South Wales.
Vernacular Name—"White Box."
Locality whence these particular specimens were obtained—Wongrabell, near Eden.
Geological Formation—(?)
Part of the Tree Examined—Leaves.
Particulars of the trees whence they were obtained—Height 100 to 150 feet, diameter 6 to 8 feet.
Collected 5th February, 1887. Analysed 11th to 28th November, 1887.

Leaves narrow-lanceolar, rarely broad, often on comparatively short stalks, not much elongated, rather dull-green or somewhat shining, of equal colour on both sides; their veins mostly spreading at a very acute angle and not crowded, the two longitudinal veins somewhat removed from the edge. (Eucalyptographia.)

Leaves lanceolate, usually narrow, but sometimes broad, rarely above 4 inches long, rather rigid, the veins oblique, and sometimes very much so, and not close, the intramarginal one at some distance from the edge. (B. Fl.)

Average length 111·2 mm., average breadth 25·5 mm. Colour of powder bronze green.

Extract.—They yield 40·19 per cent. to water at 100° C. Colour of extract dark orange, of moist residue bronze-green.

Kino-tannic acid—6·775 per cent.

70. EUCALYPTUS SIDEROPHLOIA, *Benth.*, N.O. Myrtaceæ, B. iii., 220. Figured Dec. 4, "Eucalyptographia."
Found in New South Wales and Queensland.
Vernacular Name—"Ironbark."
Locality whence this particular specimen was obtained—Cambewarra.
Geological Formation—Sandstone.
Part of the Tree Examined—Leaves.
Particulars of the trees whence they were obtained—Saplings about 6 inches in diameter.
Collected 21st August, 1886. Analysed 11th to 17th November, 1887.

Leaves elongate or narrow-lanceolar, moderately or not much curved, often not very inequilateral, of almost equal colour on both sides; primary *veins numerous, subtle, and very spreading,* the circumferential vein near to the edge of the leaf; oil-dots much concealed. (Eucalyptographia.)

Leaves ovate-lanceolate or lanceolate, much acuminate, straight or more frequently falcate, about 3 to 6 inches long, often rather thick, with numerous fine diverging veins, the intramarginal one close to the edge. (B. Fl.)

Average length 117·6 mm. Average breadth 20·1 mm. Colour of powdered leaves olive-brown.

Extract.—They yield 22·93 per cent. to water at 100° C. Colour of extract orange, of moist residue pure brown.

Kino-tannic acid—5·95 per cent.

71. EUCALYPTUS ROBUSTA, *Smith*, N.O. Myrtaceæ, B. Fl. iii., 228. Figure Dec. 7, "Eucalyptographia."
Found in New South Wales and Queensland.
Vernacular Name—"Mahogany."
Locality whence this particular specimen was obtained—Brooman, Clyde River.
Geological Formation—Granite.
Part of the tree examined—Leaves.
Particulars of the trees whence they were obtained—Height 60 to 80 feet, diameter 1 foot 6 inches.
Collected 15th September, 1886. Analysed 11th to 28th November, 1887.

Leaves large, scattered, oval-lanceolar, pointed, of thick consistence, shining, *paler beneath, hardly or slightly inequilateral; veins copious, prominent, very spreading,* the circumferential vein rather close to the slightly recurved margin of the leaf; oil-dots much concealed or obliterated. (Eucalyptographia.)

Leaves ovate-lanceolate, nearly straight or the upper ones narrower and falcate, 4 to 6 inches long or sometimes more, with numerous fine but prominent parallel veins almost transverse, the intramarginal one very near or close to the edge. (B. Fl)

Average length 136·5 mm., average breadth 53·2 mm. Colour of the powdered leaves olive-brown with a slight tinge of blue.

Extract.—They yield 34·7 per cent. to water at 100° C. Colour of extract light ruby (with slight flocculent masses owing to presence of mucilage), of moist residue brown, with a slight yellowish tinge.

Kino-tannic acid—12·069 per cent.

72. EUCALYPTUS VIMINALIS, *Labill.*, N.O. Myrtaceæ, B. Fl. iii., 239. Figured in Part 7 of Brown's "Forest Flora of S.A." and Dec. 10, "Eucalyptographia."

Found in all the colonies except Queensland and Western Australia.

Vernacular Names—"Manna Gum," "Ribbony Gum."

Locality whence these particular specimens were obtained—Quiedong, near Bombala.

Geological Formation—Limestone.

Part of Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 60 to 80 feet, diameter 2 to 3 feet.

Collected 6th April, 1887. Analysed 24th October to 24th November, 1887.

Leaves elongate- or falcate-lanceolar, of equal colour on both sides; *lateral veins rather subtle, crowded, pinnately spreading,* the circumferential vein somewhat removed from the edge of leaf; oil-dots mostly concealed. (Eucalyptographia.)

Leaves lanceolate and more or less falcate and acuminate, 3 to 6 inches long, the veins rather regular, numerous and diverging, the intramarginal one near the edge. (B. Fl.)

Average length 143·5 mm., average breadth 29·75 mm. Colour of powdered leaves, dark Brunswick green.

Extract.—They yield 40·59 per cent. to water at 100° C. Colour of extract pale orange; of moist residue light bronze-green.

Kino-tannic acid—3·998 per cent.

Mueller and Rummel found 3·47 per cent. in leaves of this species.

For a note on leather made from these leaves, see p. 255.

73. Eucalyptus rostrata, *Schlecht.*, N.O. Myrtaceæ, B. Fl. iii., 242. Figured Dec. 4, "Eucalyptographia."

Found in all the Colonies except Tasmania.

Vernacular Name—"Red Gum."

Locality whence these particular specimens were obtained—Colombo, near Candelo.

Geological Formation—Granite.

Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 80 to 100 feet, diameter 2 to 4 feet.

Collected 27th June, 1887. Analysed 24th October to 24th November, 1887.

Leaves lanceolar-sickleshaped, of equal colour on both sides; lateral veins rather subtle, crowded, pinnate-spreading; the circumferential vein somewhat removed from the edge; oil-dots scanty or obscured. (Eucalyptographia.)

Leaves lanceolate, mostly falcate and acuminate, 3 to 6 inches long and even more, the lower ones sometimes ovate or ovate-lanceolate and straight, not thick, the veins rather regular, numerous and oblique, the intramarginal one not close to the edge, or in some desert specimens thick, with the veins much less conspicuous. (B. Fl.)

Average length 129 mm., average breadth 14·4 mm. Colour of powdered leaves, pea-green.

Extract.—They yield 40·8 per cent. to water at 100° C. Colour of extract lemon, of moist residue light ochre, inclining to brown.

Kino-tannic acid—6·62 per cent. "The fresh leaves" yielded Mueller and Rummel 4·68 per cent. of tannic acid. (Dec. 4, "Eucalyptographia.) My experiments were as usual, on leaves dried at 100° C. Making suitable allowance for moisture, the Baron's result and my own closely approximate.

74. Eucalyptus Stuartiana, *F. v M.*, N.O. Myrtaceæ, B. Fl., iii., 243. Figured Dec. 4, "Eucalyptographia."

Found in all the Colonies except Queensland and Western Australia.

Vernacular Name—"Apple-tree."

Locality whence these particular specimens were obtained—Quiedong, near Bombala.

Geological formation—Limestone.

Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 80 to 100 feet, diameter 3 to 4 feet.

Collected 7th April, 1887. Analysed 24th October to 28th November, 1887.

Leaves lanceolar sickle-shaped, shining and equally dark-green on both sides, copiously dotted, but the oil-glands often partly concealed; lateral veins very thin, considerably spreading, but neither crowded nor almost transverse, the circumferential vein distinctly removed from the edge. (Eucalyptographia.)

Leaves from broadly ovate-lanceolate to narrow lanceolate, mostly 3 to 6 inches long, much narrowed at the base, usually equal or nearly so, but sometimes oblique, thick, the nerves rather regular and diverging, but scarcely conspicuous. (B. Fl.)

Average length 158·2 mm., average breadth 22 mm. Colour of powdered leaves light Brunswick green.

Extract.—They yield 42·74 per cent. to water at 100° C. Colour of extract very pale lemon, almost as pale as *E. polyanthemos*, of moist residue dirty yellowish brown.

Kinó-tannic acid—10·158 per cent.

75. Eucalyptus Gunnii, *Hook., fil.*, var., N.O. Myrtaceæ, B. Fl., iii., 246. Figured in Brown's "Forest Flora of S.A.," Part 1, Dec. 4, "Eucalyptographia."

Found in South Australia, Tasmania, Victoria, and New South Wales.

Vernacular Name—"Red Gum."

Locality whence these particular specimens were obtained—Bombala.

Geological Formation—Granite.

Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 80 to 100 feet, diameter 3 to 4 feet.

Collected 6th January, 1887. Analysed 24th October to 28th November, 1887.

Leaves oval, or oblong, or elongate-lanceolar, or almost oval, acute at the base and apex, *not very inequilateral*, rigid, shining, and of equal and saturated green on both sides, their oil-dots concealed or hardly developed, their lateral veins slightly prominent, somewhat distant and moderately spreading, the circumferential vein distinctly removed from the edge of the leaf. (Eucalyptographia).

Leaves from ovate-lanceolate or elliptical and obtuse to lanceolate-acute, under 3 inches long, usually much narrowed at the base and rarely oblique, thick, with the veins not numerous and scarcely conspicuous. (B. Fl.)

Average length 117·2 m.m., average breadth 34 mm. Colour of dried leaves pale olive-green, inclining to sage.

Extract.—They yield 40·61 per cent. to water at 100° C. Colour of extract deep orange, of moist residue light brown.

Kino-tannic acid—16·59 per cent.

76. Eucalyptus Gunnii, *Hook.*, *f.*, var.

Vernacular Names—"Bastard Gum," "Flooded Gum."

Locality whence this particular specimen was obtained—Delegate.

Geological Formation—Mudstone (Silurian).

Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 60 to 80 feet, diameter 2 to 3 feet.

Collected 25th May, 1887. Analysed 24th October to 24th November, 1887.

Average length 119·8 mm., average breadth 68·4 mm. Colour of powdered leaves rather a bright green with a bluish tint.

Extract.—They yield 41·08 per cent. to water at 100° C. Colour of solution pale orange, of moist residue yellowish brown.

Kino-tannic acid—8·28 per cent.

77. Eucalyptus corymbosa, *Smith*, N.O. Myrtaceæ, B. Fl. iii., 256. Figured Dec. 5, "Eucalyptographia."

Found in New South Wales and Queensland.

Vernacular Name—"Bloodwood."

Locality whence these particular specimens were obtained—Cambewarra.

Geological Formation—Sandstone.

Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 80 to 100 feet, diameter 3 to 4 feet.

Collected 28th August, 1886. Analysed 11th to 21st November, 1887.

Leaves of firm consistence, ovate or elongate-lanceolar, slightly curved or somewhat sickle-shaped, *paler beneath, the lateral veins very numerous, subtle, almost transversely spreading*, the circumferential vein nearly contiguous to the edge, the oil-dots generally concealed or obliterated. (Eucalyptographia.)

Leaves ovate-lanceolate or lanceolate, acuminate, about 3 to 6 inches long, with numerous fine transverse parallel veins, often scarcely visible. (B. Fl.)

Average length 95·8 mm., average breadth 24·25 mm. Yield a greenish drab powder.

Extract.—They yield 36·72 per cent. to water at 100° C. Colour of solution orange, of moist residue light brown.

Kino-tannic acid—18·377 per cent.

78. Eucalyptus maculata, *Hook.*, N.O. Myrtaceæ, B. Fl. iii., 258. Figured Dec. 3, "Eucalyptographia."

Found in New South Wales and Queensland.

Vernacular Name—"Spotted Gum."

Locality whence these particular specimens were obtained—Cambewarra.

Geological Formation—Sandstone.

Part of the Tree Examined—Leaves.

Particulars of the trees whence they were obtained—Height 100 to 120 feet, diameter 3 to 4 feet.

Collected 10th August, 1886. Analysed 11th to 17th November, 1887.

Leaves elongate or narrow-lanceolar, often somewhat sickle-shaped, seldom more oval, of equal green on either side; their *lateral veins crowded, pinnate-spreading, prominent*, the circumferential vein very close or almost contiguous to the edge; oil-dots more or less concealed. (Eucalyptographia.)

Leaves ovate-lanceolate or lanceolate, straight or falcate, acuminate, mostly 4 to 6 inches long or even more, with numerous parallel but rather oblique veins . . . . rather coarse, the intramarginal one close to the edge. (B. Fl.)

Average length 165·2 mm., average breadth 38·8 mm. Colour of powdered leaves dull olive-brown.

Extract.—They yield 28·32 per cent. to water at 100° C. Colour of solution reddish-orange, of moist residue brown.

Kino-tannic acid—5·263 per cent.

Qualitative Tests—Notes—(Third Supplement).

1. After the present paper I do not propose to continue these voluminous schedules of qualitative tests of tan-substances. My object in presenting them has partly been to show that the reactions of the species of a genus often differ considerably amongst themselves, so that it is absurd, as is the case in some text-books, to give a reaction with "Mimosa bark," "Eucalyptus bark," as if it were quite generic. Characteristic re-actions will, however, continue to be noted.

2. *Column* 2*a*. *E. piperita* var., was the only one which gave a precipitate at once.

3. *Column* 4*a*. Where "no change" is stated, the only action of the Ferric chloride is to produce a slight purplish colour.

4. *Column* 4*b*. When Ammonia is added, the liquids in which no precipitate exist are turned brown in colour.

5. *Column* 5. Precipitates form at once in all cases. With *E. viminalis*, *E. polyanthemos*, and *E. Gunnii* (Delegate), the precipitate is but slight.

6. *Column* 6. A precipitate is given in all cases with the exception of *E. viminalis* and *A. longifolia*.

7. *Column* 8*a*. No immediate change in any case, *E. stellulata* and *E. haemastoma* excepted. Colours of precipitates taken on standing.

8. *Column* 8*b*. In this case also the precipitates were taken on standing, the only leaves giving precipitates at once being *A. vestita* and *E. amygdalina* (Bombala).

9. *Columns* 9*a and* 11. Precipitates were given at once; colours &c. were noted on standing.

Species—Leaves.	1 Reaction.	2 Boiled with equal volume of Sulphuric Acid: (1 in 5) a—in the cold.	b—on boiling.
55. ACACIA vestita, *Ker.*	Slightly acid.	Brown precipitate on standing.	Precipitate does not dissolve on boiling.
56. ACACIA melanoxylon, *R. Br.*	ditto.	Very slight brownish ppt. on standing.	Precipitate dissolves on boiling
57. ACACIA longifolia, *Willd.*	ditto.	Light brown ppt. on standing.	Precipitate does not dissolve on boiling.
58. ACACIA glaucescens, *Willd.*	Distinctly acid	Dark dirty salmon-coloured precipitate on standing.	Ditto.
59. EUCALYPTUS stellulata, *Sieb.*	Slightly acid.	Light brown ppt. on standing.	Precipitate dissolves on boiling
60. EUCALYPTUS sieberiana, *F.v.M.*	Distinctly acid	No change on standing	No change.
61. EUCALYPTUS amygdalina, *Labill.*, (Nelligen.)	Slightly acid.	Very slight light brownish precipitate on standing.	Precipitate does not dissolve on boiling
62. EUCALYPTUS amygdalina, *Labill.*, (Bombala.)	Distinctly acid	Ditto; but very slight on standing.	Ditto.
63. EUCALYPTUS obliqua, *L' Hérit.*	ditto.	Light brown ppt. on standing.	Ditto.
64. EUCALYPTUS macrorrhyncha, *F.v.M.*	Faintly acid.	No change on standing	No change.
65. EUCALYPTUS piperita, *Smith*, var.	Distinctly acid	Brown precipitate	Precipitate does not dissolve on boiling
66. EUCALYPTUS melliodora, *A. Cunn.*	Faintly acid.	Precipitate of a light dirty drab colour on standing.	Precipitate disappears on boiling
67. EUCALYPTUS haemastoma, *Smith*	Distinctly acid	Light dirty drab ppt. on standing.	Precipitate dissolves on boiling
68. EUCALYPTUS polyanthema, *Schauer*	ditto.	No change on standing	No change
69. EUCALYPTUS odorata, *Behr.*, var.	Faintly acid.	Very slight precipitate on standing	Precipitate does not dissolve on boiling
70. EUCALYPTUS siderophloia, *Benth.*	ditto.	Slight light brownish precipitate on standing	Ditto.
71. EUCALYPTUS robusta, *Smith*	Distinctly acid	Brown precipitate on standing	Ditto.
72. EUCALYPTUS viminalis, *Labill.*, var.	ditto.	No change on standing	No change
73. EUCALYPTUS rostrata, *Schlecht.*	ditto.	Ditto.	Ditto.
74. EUCALYPTUS Stuartiana, *F.v.M.*	ditto.	Ditto.	Ditto.
75. EUCALYPTUS Gunnii, *Hook., f.* (Bombala.)	Acidity very marked	Orange-brown ppt. in good quantity on standing	Precipitate does not dissolve on boiling
76. EUCALYPTUS Gunnii, *Hook., f.* (Delegate.)	Distinctly acid	Drab precipitate on standing	Ditto.
77. EUCALYPTUS corymbosa, *Smith*	Acidity very marked	Ditto	Ditto.
78. EUCALYPTUS maculata, *Hook., f.*	Faintly acid	Light brown ppt. on standing	Ditto.

3	4		5
Bromine Water.	Dilute Ferric Chloride.	Add Ammonia.	Baric Hydrate.
Orange-coloured ppt. (slight) on standing	Vandyke-brown ppt.	No change	Dark brown precipitate
Ditto; on standing	Very slight brown ppt. copious Vandyke-brown precipitate on standing	Ditto.	Reddish-brown ppt.
Ditto.	Very slight ppt. increases on standing; of a dark brown colour	Precipitate dissolves	Olive-brown ppt.
Very light orange-tinted precipitate on standing	Dark brown precipitate increases on standing.	Nearly all dissolves	Olive precipitate
Orange-coloured ppt.	Copious dark olive-brown ppt., same on standing	Becomes more copious; of a purplish-black	Dark brown precipitate
No change.	Precipitate of a very dark Vandyke-brown	Almost entirely dissolves	Orange-brown ppt.
Ditto.	Precipitate of a dark brown	Ditto.	Dark orange-brown precipitate
Ditto.	Very slight precipitate dark brown	No change	Light olive precipitate
Precipitate copious of a light orange colour	Slight precipitate	Purplish-brown ppt.	Light brown ppt.
Orange precipitate on standing	No change	No change	Ditto.
Precipitate copious of a light orange colour	Copious precipitate almost black	Turns ppt. purple	Copious reddish-brown precipitate
Precipitate very light orange tint, copious on standing	No change	No change	Reddish-brown ppt.
Lemon tint precipitate on standing	Slight precipitate	Ditto.	Very light olive-brown precipitate
Very slight precipitate on standing	Precipitate of a dark purplish colour	Ditto.	Light orange-brown precipitate
Precipitate very copious, of a light orange tint	No change	Ditto.	Reddish-brown ppt., copious
Slight precipitate, on standing orange tint	Copious precipitate, brownish-black	Ditto.	Orange coloured ppt.
Ditto.	Precipitate very slight	Precipitate increases of a purplish-brown colour	Dark brown ppt.
Precipitate orange colour	No change	No change	Very light precipitate of an orange-brown
No change.	Copious precipitate, dark purple	Ditto.	Orange precipitate
Very slight light ppt.	No change	Ditto.	Very light orange-brown precipitate
Precipitate light orange colour	Ditto.	Ditto.	Dark brown ppt.
Very light precipitate on standing	Ditto.	Ditto.	Light orange-brown precipitate
Slight light precipitate	Ditto.	Ditto.	Reddish-brown ppt.
No change.	Copious precipitate, Vandyke-brown	Ditto.	Dark reddish-brown precipitate

Species—Leaves.	6 Cobalt Acetate.	7 Potassic Dichromate.	8 Tartar Emetic.
55. ACACIA vestita, *Ker.*	Dark purplish-grey ppt.	Very slight brownish precipitate	No change.
56. ACACIA melanoxylon, *R. Br.*	Pure brown ppt	No change.	No change.
57. ACACIA longifolia, *Willd.*	Turbidity	Ditto.	Turbidity.
58. ACACIA glaucescens, *Willd.*	Brown ppt.	Ditto.	Turbidity.
59. EUCALYPTUS stellulata, *Sieb.*	Copious purplish-grey precipitate	Ppt. dark brown	Slight Indian-red ppt.
60. EUCALYPTUS sieberana, *F.v.M.*	Dark brown precipitate.	No change.	No change.
61. EUCALYPTUS amygdalina, *Labill.*, (Nelligen.)	Ditto.	Ditto.	No change.
62. EUCALYPTUS amygdalina, *Labill.*, (Bombala.)	Very light dirty olive-brown precipitate	Very slight brownish precipitate	Very slight dirty yellow precipitate.
63. EUCALYPTUS obliqua, *L' Hérit.*	Ppt. light purplish-brown	Copious pure brown precipitate	Dirty salmon coloured precipitate.
64. EUCALYPTUS macrorrhyncha, *F.v.M.*	Same as *E. obliqua*	No change.	No change.
65. EUCALYPTUS piperita, *Smith*, var.	Copious dark brown ppt.	Copious dark brown precipitate	Slight reddish-brown precipitate
66. EUCALYPTUS melliodora, *A. Cunn.*	Dark brown precipitate	No change.	No change.
67. EUCALYPTUS haemastoma, *Smith*	Brownish-grey precipitate	Precipitate very slight brownish	Yellowish precipitate
68. EUCALYPTUS polyanthema, *Schauer*	Brown ppt.	No change.	No change.
69. EUCALYPTUS odorata, *Behr.*, var.	Slight brown precipitate	No change.	No change.
70. EUCALYATUS siderophloia, *Benth.*	Olive-brown precipitate.	No change.	No change.
71. EUCALYPTUS robusta, *Smith*	Dark purplish-grey ppt.	Precipitate dark olive-brown	Slight reddish-brown precipitate
72. EUCALYPTUS viminalis, *Labill.*, var.	No precipitate	No change.	No change.
73. EUCALYPTUS rostrata, *Schlecht.*	Light olive-brown ppt.	No change.	No change.
74. EUCALYPTUS Stuartiana, *F.v.M.*	Ditto.	No change.	Slight yellowish ppt.
75. EUCALYPTUS Gunnii, *Hook.*, *f.* (Bombala.)	Ditto; but with a tinge of red	Precipitate very slight brownish	Slight reddish-brown precipitate
76. EUCALYPTUS Gunnii, *Hook. f.* (Delegate.)	Ditto.	No change.	Turbidity.
77. EUCALYPTUS corymbosa, *Smith*	Dark olive-precipitate.	Precipitate very slight brownish	No change.
78. EUCALYPTUS maculata, *Hook.*, *f.*	Very dark brown ppt.	No change.	No change.

	9		10
Add Ammonic Chloride	*a*—Copper Sulpate.	*b*—Add Ammonia.	One drop of strong sulphuric acid to one drop of extract on a white glazed tile.
Turbidity; light reddish-brown ppt.	Very light reddish-brown precipitate	Purple-brown ppt.	Yellowish brown colour
No change	Brown ppt.	Light brown ppt.	Slight reddish-brown colour.
Slight light reddish-brown ppt., a little lighter than that of *A. vestita*	Very light brown ppt.	Very slight brown ppt.	Ochre colour
Precipitate same as that of *A. longifolia*	Very light brown ppt.	Brown precipitate	Yellow colour.
Very dark salmon ppt. almost a light purple	Light purplish-brown precipitate	Very dark and copious purple-brown ppt.	Rose madder colour fading to brown on standing
No change	Dark olive-brown ppt.	Slight olive-brown ppt.	Yellow colour same as *A. glaucescens*
No change	Slight brown ppt.	Very slight brownish precipitate	Slight yellow ochre colour
Precipitate light olive-brown	Brown precipitate	Reddish-brown ppt.	Bright yellow colour.
Very light reddish-brown precipitate	Very dark purplish-grey precipitate	Brown precipitate	Orange-brown colour
Very slight dirty brown precipitate	Brown precipitate.	Ditto.	Very bright yellow colour
Reddish-brown ppt. in good quantity	Brown precipitate.	Ditto.	Light reddish brown colour
Very slight brownish precipitate	Light olive-brown ppt.	Very slight brown ppt.	Colour same as *E. piperita*, var.
Yellowish-drab ppt.	Greyish-brown ppt.	Brown precipitate	Slight yellow ochre colour
Very slight brownish precipitate	Slight brown ppt.	Very slight brown ppt.	Slight yellow ochre colour scarcely distinguishable
No change	Very dark olive-brown precipitate.	Precipitate dissolves	Light reddish-brown colour
Slight yellowish-brown precipitate	Dirty brown ppt.	Brown precipitate	Very slight light brown colour
Reddish-brown ppt.	Dark brown ppt. with a greyish tinge	Brown precipitate	Light reddish-brown colour
No change	Very slight light brown precipitate	Precipitate dissolves	Yellow colour
Dark drab ppt.	Dark dirty grey ppt.	Brown precipitate	Slight yellowish colour scarcely distinguishable
Dark drab ppt.	Brown precipitate	Ditto.	Same as *E. rostrata*
Light reddish-brown precipitate	Very light brown ppt.	Dark brown ppt.	Reddish-brown colour
Light reddish-brown precipitate	Ppt. darker and more dirty than that from Bombala	Brown precipitate	Very slight brownish colour
Light olive ppt.	Light brown ppt.	Brown precipitate	Yellow colour but slight
Light reddish-brown precipitate	Very dark brown ppt.	Light brown ppt.	Ochre yellow colour

Species—Leaves.	11 Lead Nitrate.	12 Manganese Acetate.	13 Chrome Alum.
55. ACACIA vestita, *Ker.*	Dark brown precipitate	Slight brown ppt. after standing	Purplish-brown ppt.
56. ACACIA melanoxylon, *R. Br.*	Dark brown ppt. same as *A. vestita*	No change.	Ditto.
57. ACACIA longifolia, *Willd.*	Very dark dirty grey ppt.	Slight light brown ppt. on standing	Ditto.
58. ACACIA glaucescens, *Willd.*	Light dirty grey ppt.	No change.	Dark grey precipitate
59. EUCALYPTUS stellulata, *Sieb.*	Very dark salmon ppt.	Purple-brown ppt. on standing	Purple-brown ppt.
60. EUCALYPTUS sieberiana, *F.v.M.*	Olive-brown precipitate	No change	No change
61. EUCALYPTUS amygdalina, *Labill.* (Nelligen.)	Olive-brown precipitate	No change	Turbidity
62. EUCALYPTUS amygdalina, *Labill.* (Bombala.)	Light yellowish drab ppt.	Light greyish bronze-green precipitate on standing	No change.
63. EUCALYPTUS obliqua, *L'Hérit.*	Light greyish-brown ppt.	Dark dirty salmon ppt. on standing	Precipitate dark dirty grey
64. EUCALYPTUS macrorrhyncha, *F.v.M.*	Yellowish-brown precipitate	No change; very slight yellowish-brown ppt. on standing	No change
65. EUCALYPTUS piperita, *Smith*, var.	Dark greyish-brown ppt. in good quantity	Light reddish-brown ppt. on standing	Precipitate very dark greyish-brown
66. EUCALYPTUS melliodora, *A. Cunn.*	Light orange-brown ppt.	No change; very slight brownish precipitate on standing	Ppt. slightly more brown than that of *E. piperita*, var.
67. EUCALYPTUS haemastoma, *Smith*	Light drab ppt.	Greenish-drab ppt. on standing	Dark dirty grey ppt.
68. EUCALYPTUS polyanthema, *Schauer*	Slight olive-precipitate	No change; very slight ppt. of a brownish-colour on standing	No change.
69. EUCALYPTUS odorata, *Behr.*, var.	Brown ppt.	No change.	No change.
70. EUCALYPTUS siderophloia, *Benth.*	Light olive-brown ppt.	Dirty grey precipitate on standing	Slight greyish-brown precipitate
71. EUCALYPTUS robusta, *Smith*	Brown ppt. with a slight greyish tinge	Brown precipitate on standing	Greyish-brown ppt.
72. EUCALYPTUS viminalis, *Labill.*, var.	Olive-brown precipitate	No change.	No change.
73. EUCALYPTUS rostrata, *Schlecht.*	Light dirty brown ppt.	Greyish-drab ppt. on standing	No change
74. EUCALYPTUS Stuartiana, *F.v.M.*	Dark brownish drab ppt.	Dirty grey precipitate on standing	No change
75. EUCALYPTUS Gunnii, *Hook., f.* (Bombala.)	Greyish-brown ppt. in good quantity	Light purple-brown precipitate on standing	Slight brownish ppt.
76. EUCALYPTUS Gunnii, *Hook. f.* (Delegate.)	Light olive-brown ppt.	Dark greenish-drab precipitate on standing	No change
77. EUCALYPTUS corymbosa, *Smith*	Olive ppt. in good quantity	Light bronze-green precipitate on standing	Greyish-brown ppt.
78. EUCALYPTUS maculata, *Hook., f.*	Dark reddish-brown ppt.	Reddish-brown ppt. on standing	Very slight brownish precipitate

14 Mercuric Chloride.	15 Ammonium Molybdate in Nitric Acid.	16 Gelatine.	17 Zinc Acetate.
Dirty greyish-drab ppt.	Darkens the liquid.	Deep orange-brown	Dark reddish-brown precipitate
No change.	Ditto.	Light orange-brown	Light reddish-brown precipitate.
Turbidity.	Ditto.	Dull orange	Brown precipitate.
Ditto.	Ditto.	Light lemon	Olive precipitate.
Brick-red precipitate	Ditto.	Reddish-brown	Light purple-brown precipitate.
No change	Ditto.	Dull lemon	Light olive-brown ppt.
Ditto.	Ditto.	Lemon	Slight olive-brown ppt.
Turbidity	Ditto.	Lemon, a little darker than that from Nelligen	Dirty olive precipitate
Ditto.	Ditto.	Orange-brown	Light brown ppt.
Ditto.	Ditto.	Lemon	Dark olive precipitate
No change	Ditto.	Light reddish-brown	Greenish-brown ppt.
Turbidity	Ditto.	Dull orange	Very light reddish-brown precipitate
Slight yellowish ppt.	Ditto.	Light orange	Light olive-brown ppt.
Turbidity	Ditto.	Light lemon	Slight dark olive ppt.
No change	Ditto.	Light reddish-brown, same as that of *E. piperita*, var.	Brown precipitate
Turbidity	Ditto.	Lemon	Olive-brown ppt.
Ditto.	Ditto.	Light orange-brown	Brown precipitate
No change	Ditto.	Lemon	Very slight brown ppt.
Turbidity	Ditto.	Lemon	Slight olive-brown ppt.
Ditto.	Ditto.	Light lemon	Light olive-brown ppt.
Slight greyish ppt.	Ditto.	Orange brown	Brown precipitate
Turbidity	Ditto.	Lemon	Light olive-brown ppt. same colour as *E. Stuartiana*
Ditto.	Ditto.	Dark lemon	Dark olive-brown ppt.
Ditto.	Ditto.	Dull orange	Slight reddish-brown precipitate

AUTOGRAPHIC INSTRUMENTS USED IN THE DEVELOPMENT OF FLYING-MACHINES.

By Lawrence Hargrave.

[*Read before the Royal Society of N.S.W., December 7, 1887.*]

The result obtained by Machine C described in June last, rendered the construction of a 48-band machine justifiable; the first one of this power met with continued disaster until the ninth trial when it became a total wreck. The second 48-band machine (Figs. 3 & 4) was more successful, and its work (Observations F & G) is comparable with C; A, and B, being considered obsolete types.

A small vertical plane is now attached over the after end of the strut, to counteract the effect of imperfections that have a tendency to make the machines turn to one side.*

H, J, and K are three very similar observations made with a square-bodied machine of large area (Fig. 5) after experimenting with the wing comparing apparatus (Fig. 6).

It was found necessary to invent a contrivance to test the work done by a number of elastic bands arranged with different purchases, to see if there was any great loss by friction as the cord passed over 4 or 8 sheaves, and to construct a more accurate curve of strains on the cord than that previously used. Fig. 1 shews a plan of the apparatus used and facsimiles of the diagrams taken. A solid model of the strut of the 48-band machine is screwed down on a table, with the india-rubbers, blocks, sheaves and cord used in the actual machine: the standing part of the cord, instead of being fastened to the tail end of the strut, is fastened to a barrel with a winch handle; the other end of the cord, instead of being secured to the winder is attached to a lever and spring balance, a glass pen on the end of the lever draws the diagram, the indicator drum being rotated by a small weight that descends as the india-rubbers are stretched towards the tail by turning the winch. The bands on each side of the strut are observed to be equally stretched.

It is thought that the space between the stretching and contracting curve partly represents the loss by friction of pulleys, and partly a quality of the india-rubber that prevents it giving

* Since rejected as useless.

out through the cord all the power required to stretch it, part being lost in heat (Prof. Marey. Animal Mechanism): the mean of all the curves, 14 stretching and 14 contracting, develops the datum curve (Fig. 2), used now for estimating the approximate foot-pounds of energy of the machines; it is considerably lower than the old curve, and shews that the strength of the strut sheaves and cord may be safely reduced.

Each $\frac{3}{4}$ inch the bands are stretched represents one foot of cord in the 48-band machine, or six inches in the 24-band machine, so that each small rectangle is a foot-pound of work for the large machine, and half a foot-pound for the smaller ones.

Serious errors in the amount of energy supposed to have been used in A, B and C observations were found, and a new table of comparison was made.

COMPARISON OF FLYING-MACHINES.

Observations made with	Total area in square inches.	Square inches per foot-pound.	Square inches per pound weight	Weight in pounds.	Pounds weight per foot-pound.	Pounds weight per sq. inch.	Foot-pounds of power used.	Foot-pounds per pound weight.	Foot-pounds per square inch.	Horizontal distance flown in ft.	Distance flown per foot-pound of power used.	Distance flown per lb. weight.	Distance flown per sq. in. area.	Centre of effort abaft the mean centre of gravity, in inches.
24-band ....A	1236	7·55	841	1·47	·0089	·0012	163·6	111·3	·13	120	·73	82	·09	5·5
24-band ....B	1381	7·02	1132	1·22	·0062	·0009	196·6	161·1	·13	170	·86	139	·12	9·6
24-band C	1177	4·79	997	1·18	·0048	·0010	245·9	208·4	·21	201	·82	170	·17	7·0
48-band .... { F	1606	4·33	873	1·84	·0050	·0011	370·8	201·5	·23	189	·51	103	·12	12·3
48-band .... { G	1551	4·55	843	1·84	·0054	·0012	340·9	185·3	·22	171	·50	93	·11	13·1
24-band .... { H	1986	10·28	1555	1·28	·0066	·0006	193·1	150·9	·097	192	·99	150	·097	13·9
24-band .... { J	1974	9·49	1542	1·28	·0061	·0006	208·0	162·5	·105	203	·98	158	·103	14·2
24-band .... { K	1974	9·06	1542	1·28	·0059	·0006	218·0	170·3	·110	209	·96	163	·106	14·2
48-band L	2130	4·53	1019	2·09	·0044	·0010	470·0	224·9	·221	270	·57	129	·127	14·6

The next instrument wanted was one to measure the comparative efficiency of various forms of wings, also the variation in thrust produced by lengthening the connecting rod, and the time occupied by one revolution of the crank-shaft to determine the approximate speed of the flying-machines, and lastly to find the best position of the midrib with regard to the leading edge of the wing membrane.

It was at first surmised that a descending weight would be equivalent to the contracting elastics, but after much trouble it was found that the speed acquired by 10lbs. falling $2\frac{1}{2}$ inches and being brought to a standstill in the next $2\frac{1}{2}$ inches produced a puzzling distortion of the diagram (Diag. 1), this led to an erroneous supposition that lead of winder would be advantageous.

India-rubber had then to be interposed between the weight and the winder, so that when the winder was in readiness to be released by the starting-bolt, the weight was just clear of the ground.

Diagram 2 shews the benefit derived from cutting off the membrane of the wing near the wing socket.

Diagram 3 shews the effect of altering the length of the connecting rod.

The pencil of the pendulum chronograph is adjusted so that it is just clear of the paper on the indicator drum when the bob is hanging vertically; a number of timed trials determine the mean period of the oscillations.

By connecting the chronograph and putting on the wing of C, which is identical with that used on the 48-band machine in Observations F & G, it is found that the crank shaft turns once in ·57 seconds, 10lbs. on the 5 inch winder being thought to be a fair average of the strain on the actual machine, this gives 11·6 miles per hour as a mean speed for the two successful flights of the 48-band machine (Observations F & G).

Diagram 4 shews the effect of altering the proportions but not the area of the wing—

A	is	9·22 ins.	×	9·22 ins.
B	,,	7 ,,	×	12·5 ,,
C	,,	5 ,,	×	17·5 ,,

and obviously C produces the most thrust.

Diagram 5 shews the effect of moving the midrib to the forward edge of the wing, bringing the torsional stress on the midrib into play, and a very marked improvement is perceptible.

Comparing the time of the revolution of the crank-shaft with the midrib on the forward edge of the wing, that is ·66 seconds, with the time of revolution of the old-fashioned wing, that is ·57 seconds, we find that the long and narrow wing with square tip offers most resistance, produces more thrust and flaps slower, shewing that the tip is the most effective part of the wing, and may be said to do nearly all the work.

As to the amount of thrust produced by the wing, it may be mentioned that when the wing is at half-stroke, it takes about 8 ozs. to draw the pencil as high up the diagram as the maximum pressure shewn in Diag. 2, the weight of course being hung where the indicator cord is attached to the midrib.

Observation L in the table of comparison was made with 48-band machine No. 5. It is thought that if we compare this observation with the mean of H, J, and K, the 63·3 per cent. extra weight is cheaply carried the 34·3 per cent. greater distance by the expenditure of 128 per cent. more energy, when it is considered that the area is only increased 7·7 per cent. The two perspective sketches with table attached together with what has previously been delineated in the Royal Society's Proceedings supply all necessary detail for the construction of similar machines; the point to be remembered being that any observation by which it is shown that a lighter machine of less area is propelled farther in a calm by the same power, will tend to advance this branch of Engineering.

WEDNESDAY, DECEMBER 7, 1887.

Christopher Rolleston, C.M.G., Vice-President in the Chair.

The minutes of the last meeting were read and confirmed.

The certificates of two new candidates were read for the second time, and of two for the first time.

The ballot for the election of the candidate whose certificate had been read for the third time, was postponed to the next General Meeting in consequence of a quorum not being present.

It was resolved that Messrs. H. O. Walker and John F. Mann be appointed Auditors for the present year.

The following papers were read :—

1. "On some New South Wales Tan-substances," Part 4, by Mr. J. H. Maiden, F.R.G.S.
2. "On Autographic Instruments used in the Development of Flying Machines," by Mr. Lawrence Hargrave.

Mr. H. C. Russell, B.A., F.R.S., Government Astronomer, exhibited a French vitrified photograph of a star cluster, and Mr. A. A. Common's photograph of nebula in "Orion ;" he remarked as follows :—"One of the most remarkable things to be seen at the conference of Astronomers in Paris, was the result already attained by those remarkable men the Brothers Henri, who have with their own hands made the telescope and taken the star photographs which are so remarkable. They do not however, by any means consider their work accomplished. A photograph on a gelatine film is a very perishable article ; under many conditions to which they are subject the film peals off the glass, and now Dr. Gould's great difficulty is to preserve the films of his valuable photos taken only a few years since. To avoid this fatal objection to stellar photos the Henri's have done and are still doing everything possible to make the photographs permanent. At the

Conference certain results were shown, which promise a solution of the difficulty, but in these, although there is little doubt that the photo is made as permanent as the glass itself, because the photo is actually melted on to the glass and made part of it, the heat necessary to do this is sufficient to melt the glass, and generally put it out of form, so that no satisfactory measures can be taken on such a plate. M. Henri acknowledged that this objection was fatal to the process in its present stage, but he said he was still experimenting and hoped to be able to burn in the photo without melting the glass. As a great favour one of these vitrified star photos was given to me to bring to Australia, and it is this that I have to shew you to night. The photo represents a part of the constellation Cassiopeia, in one of the richest parts of the milky way in the North. Assuming this plate to be on the same scale as all the other Paris photos, viz., 1 millemetre to 1 minute of arc, we have a part of the heavens measuring 132 minutes by 162 minutes, or about five square degrees, and on that the photograph shews 5,000 stars of all sizes. If the same cluster had been mapped out by the old method of measuring with the telescope and then plotting on to paper, it would have taken one observer working six hours every night 422 days to attain the same result. It is estimated that the star photos, including all to the 11th magnitude, will record the positions of one and a-half millions of stars in the same way as they are upon this plate, and that ultimately all these stars will be measured and catalogued in books. Taking as a moderate estimate half-an-hour for each star, that is to measure and catalogue it, one man would have to work at the rate of six hours a day for 417 years to get through the work. Of course, the work is not going to be done at this rate; but these facts obviously call for that united effort which it was the object of the Paris Astronomical Conference to secure.

"I have here another photograph shewing the nebulæ in Orion, which I am sure you will all be pleased to see, for it is no longer dependent upon the unknown peculiarities of the observer, whose eyes have, it may be, unknown peculiarities in their sensibility to light or to colour or faint differences of these; but we have here the actual record of the light itself upon known chemicals under known conditions, which can be repeated and varied at pleasure. This photo was taken by Mr. Common with his own 3ft. diameter reflector, and is a just reward for his unlimited perseverance and ability; perhaps one of the most hopeful things about it is that success so far has nerved Mr. Common's arm, and made him feel that *better results* still are possible with him, so that now every moment that can be spared from other engrossing occupations, is given to the grinding and polishing of a silver-on-glass mirror, five feet in diameter, which when completed—and it is fast approaching that condition, will be the most powerful telescope that has ever been made. With this he purposes to take photographs far finer than any which he has yet obtained, and I have not the least doubt, from what I have seen in Mr. Common's Observatory and Laboratory, that before very many months are over, we shall have some magnificent photos of nebulæ from his hands.

"I have here also a picture of a sun-spot, taken in M. Janssen's famous Observatory at Meudon in the suburbs of Paris. The original photograph of the sun was 7·78in. in diameter, and it was so perfect that it bore enlarging until the picture of the sun of which this spot picture is a part is 14 feet 9 inches in diameter. Here you can see portrayed all the features which the best telescope in the best atmosphere reveals. There is the dark central umbra, the lace-like margin, penumbra, the great flame-like masses of light poised as it were over the umbra, and round the whole the faculæ like a ring of light, and so perfect is the relation of all, that you seem to be looking into a hole when you look at this photograph of a sun-spot, just as you do when viewing one with a large telescope under the most favourable conditions, but you will have some measure of the difficulty of obtaining such pictures when I tell you that it stands alone, M. Janssen or any other astronomer has no second. Most of those who have tried hard to get such pictures say that the air must have been marvellously still and pure when it was taken. The actual diameter of the large spot was 19,300 miles, and the length of the whole group of spots was 53,000 miles.

"There is yet another feature shewn here, and it is one which few observers have seen as well, even with the best telescope, so much does the motion of the atmosphere tend to blur the finer details of the sun's surface. I refer to the so-called rice grains—little indistinct points of light more or less isolated by some darker matter, and yet giving a general appearance like a mass of boiled rice, in which the form of the grains could still be made out although much softened. It is very instructive to look closely at the picture; every here and there you come upon a darker place that looks exactly like the beginning of a spot, as if the rice grains were separating and so revealing a darker mass (the umbra) below, and at the outskirts of the spots, there can be no doubt that this is actually what is going on. These rice grains are floating clouds of light, incandescent masses, floating over the relative darkness, and easily separated by a great uprush of hydrogen or other matter from below. But here again to get a clear idea of the conditions, we must remember the actual size of these rice grains, and they measure from 300 to 450 miles in diameter, the majority being about 400 miles. M. Janssen, though old in years is full of vigour, and is now working hard to get an Observatory furnished in a style which he thinks commensurate with the work in hand. He has a large place, the old palace of Napoleon at Meudon, to work upon; and part of the ruined building—for it was a stronghold of the Prussians in the Franco-German war, stands upon a hill overlooking Paris. A truly magnificent site for an Observatory, round it are the various telescopes now in use; but in the grand old building is to be erected a refractor, with an object glass of 31½ inches, and a focal length of 40 feet, so arranged that the ordinary objective can at any moment be removed, and a photographic objective of 23½ inches diameter and 40 feet focus put in its place, and used for photographing the sun, moon and stars. These things are ordered, and M. Janssen waits impatiently like other astronomers until the mechanic makes what he wants."

Mr. Russell, who was warmly welcomed on this his first appearance at the Meetings of the Society since his return from the Conference of Astronomers at Paris, said that one of the difficulties about the photographs was to get the pictures perfectly round. The focus of an ordinary lens has a curved surface, and it is found that any expansion of the picture beyond one degree produces a distortion in the image of the stars in the corners of the photograph. The images indeed are oval and not circular.

In reply to a question of Mr. Hirst as to the time of exposure allowed for the sun photograph of M. Janssen, Mr. Russell stated that M. Janssen was very reticent, and it was a mark of great favour that he was allowed to see the photograph, a copy being afterwards presented to each Member of the Conference. He understood that the photograph was taken a number of years ago, and nothing to equal it had been since obtained. The time of exposure was probably not more than $\frac{1}{2000}$th part of a second.

Mr. Adair on behalf of Prof. Threlfall exhibited an arrangement which had been devised for the purpose of obtaining a nearly perfect astatic combination of magnets for galvanometer purposes. Since, for accuracy, it is necessary to magnetize the needles *in situ* on their suspension, and the distance between them is not very great compared with the dimension of the magnet used in the magnetization, the operation must be performed simultaneously on both needles, otherwise partial demagnetization of one of them will ensue. The apparatus consisted of two small electro magnets, provided with some obvious adjustments, and arranged so as to be as magnetically similar as possible. The conditions for this similarity were mentioned and the use of the instrument explained. Some fine quartz threads drawn by Mr. Boy's method were also exhibited.

Nineteen members were present.

The following donations were laid upon the table and acknowledged :—

Donations Received during the Month of November, 1887.

(The Names of the Donors are in *Italics.*)

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Brussels—Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique. Annuaire, 1886, 1887. Bulletins, 3me Série, Tome IX. to XIII., 1885 to 1887. Notices Biographiques et Bibliographiques, 1887. *The Academy.*

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Cambridge—Public Free Library. Thirty-second Annual Report, 1886-87. *The Library.*

Christiania—Die Internationale Polarforschung 1882-83, Beobachtungs-Ergebnisse der Norwegischen Polarstation Bossekop in Alten, herausgegeben von Aksel S. Steen, 1887. *The Editor.*

Cordoba—Academia Nacional de Ciencias. Boletin, Tome IX., Entrega 4a, Diciembre, 1886. *The Academy.*

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Hobart—Minister of Lands and Works. Report upon the Woods and Forests of Tasmania to 30 June, 1886; Ditto, ditto, 1886-7. Saw Mill Reservations: Report by Conservator of Forests, G. S. Perrin, F.L.S. *The Minister of Lands and Works.*

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MISCELLANEOUS.

(Names of Donors are in *Italics.*)

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"*The Publisher,*" Nos. 13 and 14, October 22, November 15, 1887. *The Publishers, Sydney.*

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PROCEEDINGS OF THE SECTIONS

(IN ABSTRACT.)

MICROSCOPICAL SECTION.

Meeting held SEPTEMBER 12, 1887.

Mr. F. B. KYNGDON in the Chair.

Mr. MACDONNELL exhibited under the microscope an unmounted specimen of *Flustra*, also a live specimen of *Chirodota*.

Dr. WRIGHT showed under Powell and Lealand's oil immersion $\frac{1}{12}$th a specimen of *Amphipleura Pellucida*, and demonstrated the remarkable fact, first discovered by Mr. Thomas Francis, of Lavender Bay, that on removing the cap of the eyepiece and putting on the analysing prism, in a certain position of the latter the lines were resolved in a far more distinct manner. The subject gave rise to considerable discussion.

The CHAIRMAN placed on the table the new rules of the Natural History Society.

Mr. W. H. H. LANE presented to the Section a test-slide, containing 22 diatoms mounted in regular order in balsam, by Peticolas of Richmond, U.S. The slide was accompanied by a list showing the names of the diatoms, and the number of striæ to the inch.

Meeting held OCTOBER 10, 1887.

Mr. F. B. KYNGDON in the Chair.

Dr. WRIGHT presented to the Section a bottle containing H. R. Spencer & Co's. new homogeneous immersion fluid, with full description of its manufacture.

Mr. MACDONNELL presented a slide of the wheel-plates of *Chirodota*, mounted in balsam.

Mr. WHITELEGGE exhibited living specimens of *Chara* and *Nitella*, showing very distinctly the protoplasmic circulation in the cells, and the antheridium and archegonium.

Mr. BRINDLEY exhibited some "Oriental Polish," consisting of pure diatoms, under the microscope.

Mr. RIGG exhibited several excellent slides, (chiefly petrological and bacteriological), by John Watson and Sons of London.

Mr. W. H. H. LANE presented three double-stained sections ($\frac{1}{5000}$th of an inch) of woody tissue.

Meeting held NOVEMBER 14, 1887.

Mr. F. B. Kyngdon, in the Chair.

Mr. Wiesener exhibited a new form of natural-history microscope and cabinet, suitable for young people.

Mr. Rigg exhibited several slides of bacteria, and some biological sections.

Mr. W. H. H. Lane exhibited two specimens of trichina, some in the muscle, the others dissected out. Also a slide of *Phylloxera Vastatrix.*

Dr. Morris exhibited the new apochromatic $\frac{1}{12}$ inch objective of Messrs. Powell and Lealand, of London. This lens was tried on the most difficult test-objects, and was considered one of the finest yet made. Attention was called to a slide of *Amphipleura Pellucida,* mounted by Dr. Morris in realgar eighteen months ago as being still in perfect preservation.

Meeting held DECEMBER 12, 1887.

Mr. F. B. Kyngdon in the Chair.

The Chairman brought before the meeting a request from Mr. Alex. Bruce, Government Inspector of Stock, asking for suggestions as to the use of the microscope in judging wool. A discussion followed, in which it was suggested that the microscope might be easily arranged for use in a general way, and would no doubt be of great service, especially if photographic enlargements were taken of the specimens; but Mr. Pedley pointed out the difficulty of obtaining reliable standard measurements of thickness and of the number of imbrications to the inch, by means of the micrometer, owing to the variability of individual fibres.

Mr. MacDonnell exhibited three dozen slides, (chiefly Entomological, and sections of wood) mounted by Mr. H. Sharp in balsam in an ingenious manner, so as to obviate pressure and distortion of the object, by pasting a rim of paper on the slide and thus leaving a space of any requisite thickness for the object. This process was invented by Mr. Sharp of Adelong, and the results were excellent.

Mr. Wiesener exhibited a small pocket microscope made by Anderson of London, which folded up into a box 5 x 2 x 1$\frac{1}{2}$ inches, and which possessed rackwork adjustment, stage, mirror and triplet lens equal to a $\frac{1}{4}$ inch objective.

MEDICAL SECTION.

A preliminary meeting was held on April 12th, 1887, and the following officers were elected:—Chairman: Dr. P. SYDNEY JONES. Committee: Prof. ANDERSON STUART, M.D., Dr. KNAGGS, Dr. CHAMBERS, Dr. CRAGO, WM. CHISHOLM, M.D., and Dr. E. FAIRFAX ROSS. Secretaries: A. MACCORMICK, M.D., EDWD. J. JENKINS, M.D.

The first ordinary general meeting was held May 20th, 1887, Dr. Sydney Jones in the Chair. Twenty members attended.

Dr. CRAGO read a paper on "a case of child with Coloboma of Iris" of the right eye, and absence of the eyeball in the left. The child exhibited had also "Imperforate anus, and recto-vaginal fistula."

Dr. JAMES GRAHAM read a paper on "Hæmophilia," and exhibited two patients with that disease.

Dr. SYDNEY JONES read a paper on so-called "Post-Hemiplegic chorea."

Exhibit by Dr. ROTH—Two kidneys and bladder with enlarged prostate.

Second Meeting, June 17th, 1887.

Dr. SYDNEY JONES in the Chair. Forty members present.

Dr. E. FAIRFAX ROSS read a paper on "Peripheral neuritis."

Dr. MACCORMICK exhibited a "scapula with sarcomatous growth" removed by him, also photograph of the patient after recovery.

Third Meeting, July 15, 1887.

Dr. SYDNEY JONES in the Chair. Twenty members present.

Dr. CRAGO read a paper on "Multiple Sarcomata."

Dr. MACCORMICK read a paper on "Radical cure of Hernia."

Dr. BLAXLAND read notes on a case of "cerebellar abscess, otitis, and Insanity."

Dr. BOWKER, junr., exhibited specimen of "cancer of the Pylorus."

Fourth Meeting, August 19, 1887.

Dr. SYDNEY JONES in the Chair. Twenty members present.

Dr. KNAGGS exhibited for Dr. ROTH a "Spirometer, and Dynamometer"

Exhibits by Dr. CHAMBERS—(1) Hairpin from urethra of girl. (2) New growth from the "Vulva." (3) Uterine Fibroid.

Dr. GARRETT exhibited two of his own fingers in a state of dry gangrene from accidental application of pure carbolic acid.

Fifth Meeting, September 16, 1887.

Dr. SYDNEY JONES in the Chair. Seventeen members present.

Mr. TWYNAM read a paper on "Amputation at the hip joint."

Dr. MACCULLOCH exhibited patient with peculiar curvature of the tibia.

Dr. MACCORMICK exhibited a foreign body removed from knee joint.

Dr. SYDNEY JONES exhibited a tumour from axilla.

Sixth Meeting, October 21, 1887.

Dr. SYDNEY JONES in the Chair. Twenty-six members present.

Dr. WM. CHISHOLM read notes of a case of "Gastrostomy," and exhibited the patient.

Dr. WAUGH, Parramatta, shewed a case of "Vicious union of Tibia."

Dr. WM. GOODE read notes on a case of "excision of rectum."

Dr. SYDNEY JONES read a paper on "Intestinal Obstruction," for Dr. Mander Jones, absent.

Dr. GOODE exhibited—(1) Strangulated femoral Hernia (2) Large fatty Tumour.

Last Meeting, November 18, 1887.

Dr. SYDNEY JONES in the Chair. Twenty-seven members present

Dr. WORRALL read a paper on "Remarkable case of Fæcal accumulation."

Dr. CHISHOLM exhibited a patient with "Hydatid Tumour of Right Lung," also a specimen of "Abscess in Frontal Lobe."

Dr. JENKINS read notes of a case of "Fibroid Polypus of the neck of Womb" and exhibited the specimen.

Dr. FOREMAN exhibited a cyst of the Broad Ligament.

Dr. ROSS exhibited specimens of two kidneys, one with renal calculus obstructing ureter—the other from same patient shewing "grave cirrhotic change."

Dr. SCHWARZBACH read a paper on the use of "corrosive sublimate" in eye-disease.

"*Remarks.*"—Seven meetings of the Medical Section were held during the Session of 1887, under the Presidency of Dr. P. Sydney Jones, and the abstract will show that the attendance of members was considerably above that of the previous year. Some of the papers excited great interest, and lively discussion, and there was no lack of material, and the exhibits living and dead were unusually attractive.

A. MACCOMICK, M.D., *(Edin.)*
EDWD. J. JENKINS, M.D., *(Oxon.)*

EXCHANGES AND PRESENTATIONS

MADE BY THE

ROYAL SOCIETY OF NEW SOUTH WALES,

1887.

The Journal and Proceedings of the Royal Society of N.S.W. for 1886, Vol. xx., has been distributed as follows :—

The publications for Europe were sent through Messrs. Trübner & Co., London; those for the United States of America and Canada to the care of Messrs. Wesley & Co., Agents for the Smithsonian Institution; the packages for French Societies and Institutions were forwarded through the Ministere de l'Instruction Publique des Beaux Arts et des Cultes; and in all other cases, not otherwise provided for, the parcels have been transmitted by book post.

The Smithsonian Institution, Washington, U.S.A., and Messrs. Trübner & Co., 57, Ludgate Hill, London, E.C., have kindly undertaken to receive and forward to Sydney all communications and parcels intended for the Royal Society of New South Wales.

Presentations to the Society are acknowledged by letter, and in the Society's Annual Volume.

* Exchanges of Publications have been received from the Societies and Institutions distinguished by an asterisk.

Argentine Republic.

1 CORDOBA ... ... *Academia Nacional de Ciencias.

Austria.

2 PRAGUE ... ... *Königlich böhmische Gesellschaft der Wissenschaften.
3 TRIESTE ... ... *Società Adriatica di Scienze Naturali.
4 VIENNA ... ... *Anthropologische Gesellschaft.
5 ,, ... *Kaiserliche Akademie der Wissenschaften.
6 ,, ... *K. K. Central-Anstalt für Meteorologie und Erdmagnetismus.
7 ,, ... *K. K. Geographische Gesellschaft.
8 ,, ... *K. K. Geologische Reichsanstalt.
9 ,, ... *K. K. Naturhistorische Hofmuseum.
10 ,, ... *K. K. Zoologisch-Botanische Gesellschaft.
11 ,, ... *Œsterreichische Gesellschaft für Meteorologie.

Belgium.

12 BRUSSELS ... ... *Académie Royale des Sciences, des Lettres, et des Beaux Arts.
13 ,, ... *Musée Royal D'Histoire Naturelle de Belgique.
14 ,, ... *Observatoire Royal de Bruxelles.
15 ,, ... *Société Royale Malacologique de Belgique.
16 LIEGE ... ... *Société Géologique de Belgique.
17 ,, ... *Société Royale des Sciences de Liége.
18 LUXEMBOURG ... *Institut Royale grand-ducal de Luxembourg.
19 MONS ... ... *Société des Sciences, des Arts et des Lettres du Hainaut.

Brazil.

20 Rio de Janeiro ... *L'Observatoire Impérial de Rio de Janeiro.

Denmark.

21 Copenhagen ... *Société Royale des Antiquaires du Nord.

France.

22 Bordeaux ... *Académie Nationale des Sciences, Belles-Lettres et Arts.
23 Caen ... ... *Académie Nationale des Sciences, Arts et Belles-Lettres.
24 Dijon ... ... *Académie des Sciences, Arts et Belles-Lettres.
25 Lille ... ... *Société Géologique du Nord.
26 Montpellier ... *Académie des Sciences et Lettres.
27 Paris ... ... *Académie des Sciences de l'Institut de France.
28 „ ... ... *Depôt des Cartes et Plans de la Marine.
29 „ ... ... Ecole Nationale des Mines.
30 „ ... ... Ecole Normale Supérieure.
31 „ ... ... *Ecole Polytechnique.
32 „ ... ... Editor "*Cosmos Les Mondes.*"
33 „ ... ... Editor "*Revue des Cours Scientifiques.*"
34 „ ... ... Faculté de Médecine de Paris.
35 „ ... ... *Faculté des Sciences de la Sorbonne.
36 „ ... ... Jardin des Plantes.
37 „ ... ... *L'Observatoire de Paris.
38 „ ... ... *Musée d'Histoire Naturelle.
39 „ ... ... *Ministère de l'Instruction Publique, des Beaux Arts, et des Cultes.
40 „ ... ... Société Botanique.
41 „ ... ... *Société d'Anatomie.
42 „ ... ... *Société d'Anthropologie de Paris.
43 „ ... ... *Société de Biologie.
44 „ ... ... Société de Chirurgie de Paris.
45 „ ... ... *Société d' Encouragement pour l' Industrie Nationale.
46 „ ... ... *Société de Géographie.
47 „ ... ... *Société Entomologique de France.
48 „ ... ... *Société Géologique de France.
49 „ ... ... Société Météorologique de France.
50 „ ... ... *Société Française de Minéralogie.
51 „ ... ... *Société Française de Physique.
52 „ ... ... *Société Philotechnique.
53 „ ... ... *Société Zoologique de France.
54 Saint Etienne .. *Société de l'Industrie Minérale.
55 Toulouse ... ... *Académie des Sciences Inscriptions et Belles-Lettres.

Germany.

56 Bremen ... ... *Naturwissenschaftlicher Verein zu Bremen.
57 Berlin ... ... Deutsche Chemische Gesellschaft.
58 „ ... ... *Königlich Preussische Akademie der Wissenschaften.
59 „ ... ... *Königl. Preuss. Meteorologisches Institut.
60 Bonn ... ... *Naturhistorischer Verein der Preussischen Rheinlande und Westphalens in Bonn.

61 Braunschweig ... *Verein für Naturwissenschaft zu Braunschweig.
62 Carlsruhe ... *Grossherzogliches Polytecknikum zu Carlsruhe.
63 ,, ... *Naturwissenschaftlicher Verein zu Carlsruhe.
64 Cassel ... ... *Verein für Naturkunde.
65 Chemnitz .. ... *Naturwissenschaftliche Gesellschaft zu Chemnitz
66 Dresden ... ... *Das Statistische Bureau des Ministeriums des Innern zu Dresden.
67 ,, ... *Königliches Mineralogisches Museum.
68 ,, ... *Offentliche Bibliothek.
69 ,, ... *Verein für Erdkunde zu Dresden.
70 Elberfeld .. *Naturwissenschaftlicher Verein in Elberfeld.
71 Frankfurt a/M .. *Senckenbergische Naturforschende Gesellschaft in Frankfurt a/M.
72 Freiberg (Saxony) Die Berg Akademie zu Freiberg.
73 ,, ... *Naturforschende Gesellschaft zu Freiberg.
74 Görlitz ... ... *Naturforschende Gesellschaft in Görlitz.
75 Göttingen ... *Königliche Gesellschaft der Wissenschaften in Göttingen.
76 Halle A.S. ... *Die Kaiserlich Deutsche Leopoldinisch—Carolinische Akademie der Naturforcher zu Halle A.S. (Prussia).
77 Hamburg ... ... *Die Geographische Gesellschaft in Hamburg.
78 ,, ... *Naturhistorisches Museum der freien Stadt Hamburg.
79 ,, ... *Verein für Naturwissenschaftliche Unterhaltung in Hamburg.
80 Heidelberg ... * Naturhistorisch Medicinischer Verein zu Heidelberg.
81 Jena ... ... *Medicinisch Naturwissenschaftliche Gesellschaft
82 Königsberg ... *Königliche Physikalisch-ökonomische Gesellschaft.
83 Leipzig (Saxony) *Königlich Sächsische Gesellschaft der Wissenschaften.
84 ,, ... *Vereins für Erdkunde.
85 Marburg ... ... *Gesellschaft zur Beförderung der gesammten Naturwissenschaften in Marburg.
86 ,, ... *The University.
87 Metz ... ... *Verein für Erdkunde zu Metz.
88 Mulhouse ... *Société Industrielle de Mulhouse.
89 Munchen ... ... *Königlich Baierische Akademie der Wissenschaften in München.
90 Stuttgart ... *Königliches Statistisches Landesamt.
91 ,, ... *Verein für Vaterländische Naturkunde in Württemberg.

Great Britain and the Colonies.

92 Birmingham ... *Birmingham and Midland Institute.
93 ,, ... *Birmingham Philosophical Society.
94 Bristol ... ... *Bristol Naturalists' Society.
95 Camborne ... *Mining Association and Institute of Cornwall.
96 Cambridge ... *Philosophical Society.
97 ,, ... *Public Free Library.
98 Cambridge ... Union Society.
99 ,, ... University Library.
100 Dudley ... ... Dudley and Midland Geological and Scientific Society and Field Club.

101	LEEDS ...	... *Conchological Society.
102	" ...	... *Philosophical and Literary Society.
103	" ...	... *Yorkshire College.
104	LIVERPOOL	... *Literary and Philosophical Society.
105	LONDON ...	... *Agent-General (two copies).
106	" ...	... *Anthropological Institute of Great Britain and Ireland.
107	" ...	... *British Museum (two copies).
108	" ...	... Chemical Society.
109	" ...	... Colonial Office, Downing Street.
110	" ...	... Editor "*Cassell's Encyclopædia*."
111	" ...	... Entomological Society.
112	" ...	... *Geological Society.
113	" ...	... Institute of Chemistry of Great Britain and Ireland.
114	" ...	... *Institution of Civil Engineers.
115	" ...	... *Institution of Naval Architects.
116	" ...	... *Iron and Steel Institute.
117	" ...	... Library, South Kensington Museum.
118	" ...	... *Linnean Society.
119	" ...	... London Institution.
120	" ...	... *Lords Commissioners of the Admiralty.
121	" ...	... *Lord Lindsay's Observatory.
122	" ...	... *Meteorological Office.
123	" ...	... *Mineralogical Society.
124	" ...	... Museum of Practical Geology.
125	" ...	... Patent Office Library.
126	" ...	... *Pharmaceutical Society of Great Britain.
127	" ...	... *Physical Society, South Kensington Museum.
128	" ...	... *Quekett Microscopical Club.
129	" ...	... *Royal Agricultural Society of England.
130	" ...	... *Royal Asiatic Society of Great Britain and Ireland
131	" ...	... *Royal Astronomical Society.
132	" ...	... *Royal College of Physicians.
133	" ...	... *Royal College of Surgeons.
134	" ...	... *Royal Colonial Institute.
135	" ...	... *Royal Geographical Society.
136	" ...	... *Royal Historical Society.
137	" ...	... *Royal Institution of Great Britain.
138	" ...	... *Royal Meteorological Society.
139	" ...	... *Royal Microscopical Society.
140	" ...	... Royal School of Mines.
141	" ...	... *Royal Society.
142	" ...	... Royal Society of Literature.
143	" ...	... *Royal United Service Institution.
144	" ...	... Society of Arts.
145	" ...	... University of London.
146	" ...	... War Office—(Intelligence Branch).
147	" ...	... *Zoological Society.
148	MANCHESTER	... *Geological Society.
149	"	... *Literary and Philosophical Society.
150	"	... *Owens College.
151	NEWCASTLE-UPON-TYNE...	*Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne.
152	"	... *North of England Institute of Mining and Mechanical Engineers.
153	"	... *Society of Chemical Industry.

154	Oxford	*Ashmolean Library.
155	"	*Bodleian Library.
156	"	*Radcliffe Library.
157	"	*Radcliffe Observatory.
158	Penzance ...	*Royal Geological Society of Cornwall.
159	Plymouth ...	*Plymouth Institution and Devon and Cornwall Natural History Society.
160	Windsor ...	The Queen's Library.

CAPE OF GOOD HOPE.

161	Cape Town ...	*South-African Philosophical Society.

DOMINION OF CANADA.

162	Halifax (Nova Scotia)	*Nova Scotia Institute of Natural Science.
163	Hamilton (Canada West)	*Hamilton Association.
164	Montreal ...	*Natural History Society of Montreal.
165	Ottawa	*Geological and Natural History Survey of Canada
166	"	*Royal Society of Canada.
167	"	The Ottawa Literary and Scientific Society.
168	Toronto	*Canadian Institute.
169	Winnipeg ...	*Manitoba Historical and Scientific Society.

INDIA.

170	Calcutta ...	*Asiatic Society of Bengal.
171	"	*Geological Survey of India.

IRELAND.

172	Dublin	*Royal Dublin Society.
173	"	*Royal Geological Society of Ireland.
174	"	*Royal Irish Academy.

MAURITIUS.

175	Port Louis ...	Royal Society of Arts and Sciences.
176	"	Société d'Acclimatation de l' Ile Maurice.

NEW SOUTH WALES.

177	Sydney	Australian Club.
178	"	*Australian Museum.
179	"	*Engineering Association of New South Wales.
180	"	*Free Public Library.
181	"	*Linnean Society of New South Wales.
182	"	*Mining Department.
183	"	*Observatory.
184	"	School of Arts.
185	"	*Technological Museum.
186	"	Union Club.
187	"	*University.

NEW ZEALAND.

188	Auckland ...	*Auckland Institute.
189	Christchurch ...	Philosophical Institute of Canterbury.
190	Dunedin... ...	Otago Institute.
191	Wellington ...	*Colonial Museum.
192	" ...	*New Zealand Institute.
193	" ...	Philosophical Society.

QUEENSLAND.

194 Brisbane ... *Acclimatization Society of Queensland.
195 „ ... ... *Royal Geographical Society of Australasia (Queensland Branch).
196 „ ... ... Parliamentary Library.
197 „ ... ... *Royal Society of Queensland.

SCOTLAND.

198 Aberdeen ... *Dun Echt Observatory, Earl of Crawford and Balcarres.
199 „ ... ... *University.
200 Edinburgh ... *Editor, *Encyclopædia Britannica,* Messrs. A. and C. Black.
201 „ ... ... *Edinburgh Geological Society.
202 „ ... ... *Royal Botanic Garden.
203 „ ... ... *Royal Observatory.
204 „ ... ... *Royal Physical Society.
205 „ ... ... *Royal Society.
206 „ ... ... *Scottish Geographical Society.
207 „ ... ... *University.
208 Glasgow ... *Geological Society of Glasgow.
209 „ ... ... *University.

SOUTH AUSTRALIA.

210 Adelaide ... *Government Botanist.
211 „ ... ... *Government Printer.
212 „ ... ... *Observatory.
213 „ ... ... *Royal Society of South Australia.
214 „ ... ... *Public Library, Museum and Art Gallery of South Australia.
215 „ ... ... *University.

STRAITS SETTLEMENTS.

216 Singapore ... *Royal Asiatic Society.

TASMANIA.

217 Hobart ... ... *Royal Society of Tasmania.

VICTORIA.

218 Ballaarat ... *School of Mines and Industries.
219 Melbourne ... Eclectic Association.
220 „ ... *Field Naturalists' Club of Victoria.
221 „ ... *Government Botanist.
222 „ ... *Government Statist,
223 „ ... *Mining Department.
224 „ ... *Observatory.
225 „ ... *Public Library.
226 „ ... *Registrar-General.
227 „ ... *Royal Society of Victoria.
228 „ ... *University.
229 „ ... *Victorian Institute of Surveyors.

Hayti.

230 Port-au-Prince Société de Sciences et de Géographie.

Hungary.

231	Bistritz (in Siebenbürgen)	*Direction der Gewerbeschule.
232	Zagreb (Agram)	*Société Archéologique.

Italy.

233	Bologna...	... *Accademia delle Scienze dell' Istituto di Bologna.
234	" ...	... Università di Bologna.
235	Florence	... *Società Entomologica Italiana.
236	" ...	... *Società Italiana di Antropologia e di Etnologia.
237	" ...	... *Società Africana d'Italia (Sezione Fiorentina.)
238	Genoa ...	... *Museo Civico di Storia Naturale.
239	Milan ...	... Reale Istituto Lombardo di Scienze Lettere ed Arti.
240	" ...	... Società Italiana di Scienze Naturali.
241	Modena ...	... *Académie Royale de Sciences, Lettres et Arts de Modène.
242	Naples ...	... *Società Africana d'Italia.
243	" ...	... *Società Reale di Napoli (Accademia delle Scienze fisiche e matematiche).
244	" ...	... *Stazione Zoologica (Dr. Dohrn).
245	Palermo ..	... *Accademia Palermitana di Scienze Lettere ed Arti.
246	" ...	... Reale Istituto Tecnico.
247	Pisa ...	... *Società Toscana di Scienze Naturali.
248	Rome ...	... *Accademia Pontificia de'Nuovi Lincei.
249	" ...	... *Biblioteca e Archivio Tecnico (Ministero dei Lavori Pubblico).
250	" ...	... Circolo Geografica d'Italia.
251	" ...	... Osservatorio del Astronomico Collegio Romano.
252	" ...	... *R. Accademia dei Lincei.
253	" ...	... *R. Comitato Geologico Italiano.
254	" ...	... *Società Geografica Italiana.
255	Siena ...	... *R. Accademia de Fisiocritici in Siena.
256	Turin ...	... Reale Accademia della Scienze.
257	" ...	... Regio Osservatorio della Regia Università.
258	Venice ...	... *Reale Istituto Veneto di Scienze, Lettere ed Arti

Japan.

259	Tokio ...	.. *Imperial University.
260	" ...	... *Seismological Society.
261	Yokohama	... *Asiatic Society of Japan.

Java.

262	Batavia ...	... *Kon. Natuurkundige Vereeniging in Nederl Indië.

Netherlands.

263	Amsterdam	... *Académie Royale des Sciences.
264	"	... *Association Coloniale Néerlandaise.
265	"	.. *Société Royale de Zoologie.
266	Harlem ...	... *Bibliothèque de Musée Teyler.
267	" ...	... *Société Hollandaise des Sciences.

Norway.

268	Bergen ...	... *Museum.
269	Christiania	... *Kongelige Norske Fredericks Universitet.
270	"	... *Videnskabs-Selskabet i Christiania.

Roumania.

271 Bucharest ... *Institutul Meteorologic al Romănieĭ.

Russia.

272 Helsingfors ... *Société des Sciences de Finlande.
273 Moscow ... ... *Société Impériale des Naturalistes.
274 „ ... ... *Société Impériale des Amis des Sciences Naturelles d'Anthropologie et d'Ethnographie à Moscow (Section d'Anthropologie).
275 St. Petersburgh *Academie Impériale des Sciences.
276 „ ... *Comité Géologique— Institut des Mines.

Spain.

277 Madrid ... ... Instituto geografico y Estadistico.

Sweden.

278 Stockholm ... *Kongliga Svenska Vetenskaps-Akademien.
279 „ ... *Kongliga Universitetet.

Switzerland.

280 Berne ... ... *Société de Géographie de Berne.
281 Geneva ... ... *Institut National Genèvois.
282 Lausanne ... *Société Vaudoise des Sciences Naturelles.
283 Neuchatel ... *Société des Sciences Naturelles.

United States of America.

284 Albany ... ... *New York State Library, Albany.
285 Annapolis (Md.) *Naval Academy.
286 Baltimore ... *Johns Hopkins University.
287 Beloit (Wis.) ... *Chief Geologist.
288 Boston ... ... *American Academy of Arts and Sciences.
289 „ ... ... *Boston Society of Natural History.
290 Brookville ... *Brookville Society of Natural History.
291 „ ... Indiana Academy of Science.
292 Buffalo ... ... *Buffalo Society of Natural Sciences.
293 Cambridge ... *Cambridge Entomological Club.
294 „ ... *Museum of Comparative Zoology, Harvard College
295 Chicago ... ... Academy of Sciences.
296 Cincinnati ... *Cincinnati Society of Natural History.
297 Coldwater ... Michigan Library Association.
298 Davenport (Iowa) *Academy of Natural Sciences.
299 Denver ... ... *Colorado Scientific Society.
300 Hoboken (N.J.) .. *Steven's Institute of Technology.
301 Iowa City (Iowa) *Director Iowa Weather Service.
302 Minneapolis *Minnesota Academy of Natural Sciences.
303 Newhaven (Conn.) *Connecticut Academy of Arts.
304 New York ... *American Chemical Society.
305 „ ... *American Geographical Society.
306 „ ... *Editors "*Science.*"
307 „ ... *New York Academy of Sciences.
308 „ ... *New York Microscopical Society.
309 „ ... *School of Mines, Columbia College.
310 Philadelphia ... *Academy of Natural Science.
311 „ ... *American Entomological Society.

312	Philadelphia ...	*American Philosophical Society.
313	,, ...	*Franklin Institute.
314	,, ...	*Second Geological Survey of Pennsylvania.
315	,, ...	*Zoological Society of Philadelphia.
316	Salem (Mass.) ...	*American Association for the Advancement of Science.
317	,, ...	*Essex Institute.
318	,, ...	*Peabody Academy of Sciences.
319	St. Louis ...	*Academy of Science.
320	San Francisco ..	*California Academy of Sciences.
321	,, ...	*California State Mining Bureau.
322	Washington ...	*American Medical Association.
323	,, ...	*Bureau of Education (Department of the Interior)
324	,, ...	*Bureau of Ethnology.
325	,, ...	*Chief of Engineers (War Department).
326	,, ...	*Chief Signal Officer (War Department).
327	,, ...	*Commissioner of Agriculture.
328	,, ...	*Director of the Mint (Treasury Department).
329	,, ...	*Library (Navy Department).
330	,, ...	*National Academy of Sciences.
331	,, ...	*Office of Indian Affairs (Department of the Interior).
332	,, ...	*Ordnance Department.
333	,, ...	*Philosophical Society.
334	,, ...	*Secretary (Department of the Interior).
335	,, ...	*Secretary (Treasury Department).
336	,, ...	*Smithsonian Institution.
337	,, ...	*Surgeon General (U.S. Army).
338	,, ...	*U. S. Coast and Geodetic Survey (Treasury Department).
339	,, ...	*U.S. Geological Survey.
340	,, ...	*U. S. National Museum (Department of the Interior).
341	,, ...	U.S. Patent Office.
342	,, ...	*War Department.

Number of Publications sent to	Great Britain	... ...	82
,, ,,	India and the Colonies	...	54
,, ,,	America	... ...	61
,, ,,	Europe	... ...	136
,, ,,	Asia, &c.	... ...	4
,, ,,	Editors of Periodicals	...	5
	Total	... ...	342

A. LIVERSIDGE...
F. B. KYNGDON... } Hon. Secretaries.
S. HERBERT COX

The Society's House, Sydney, 30th September, 1887.

INDEX.

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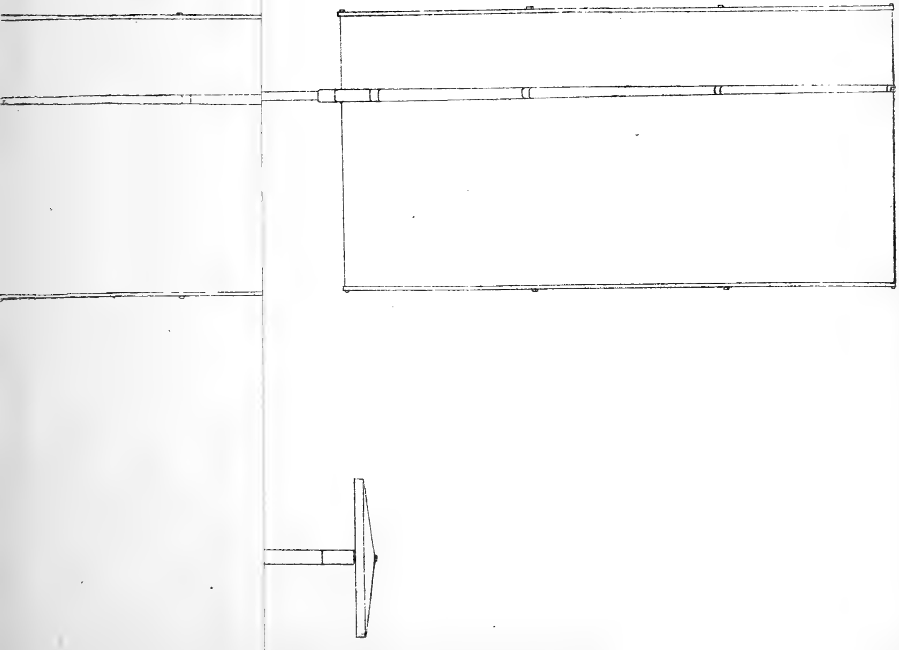
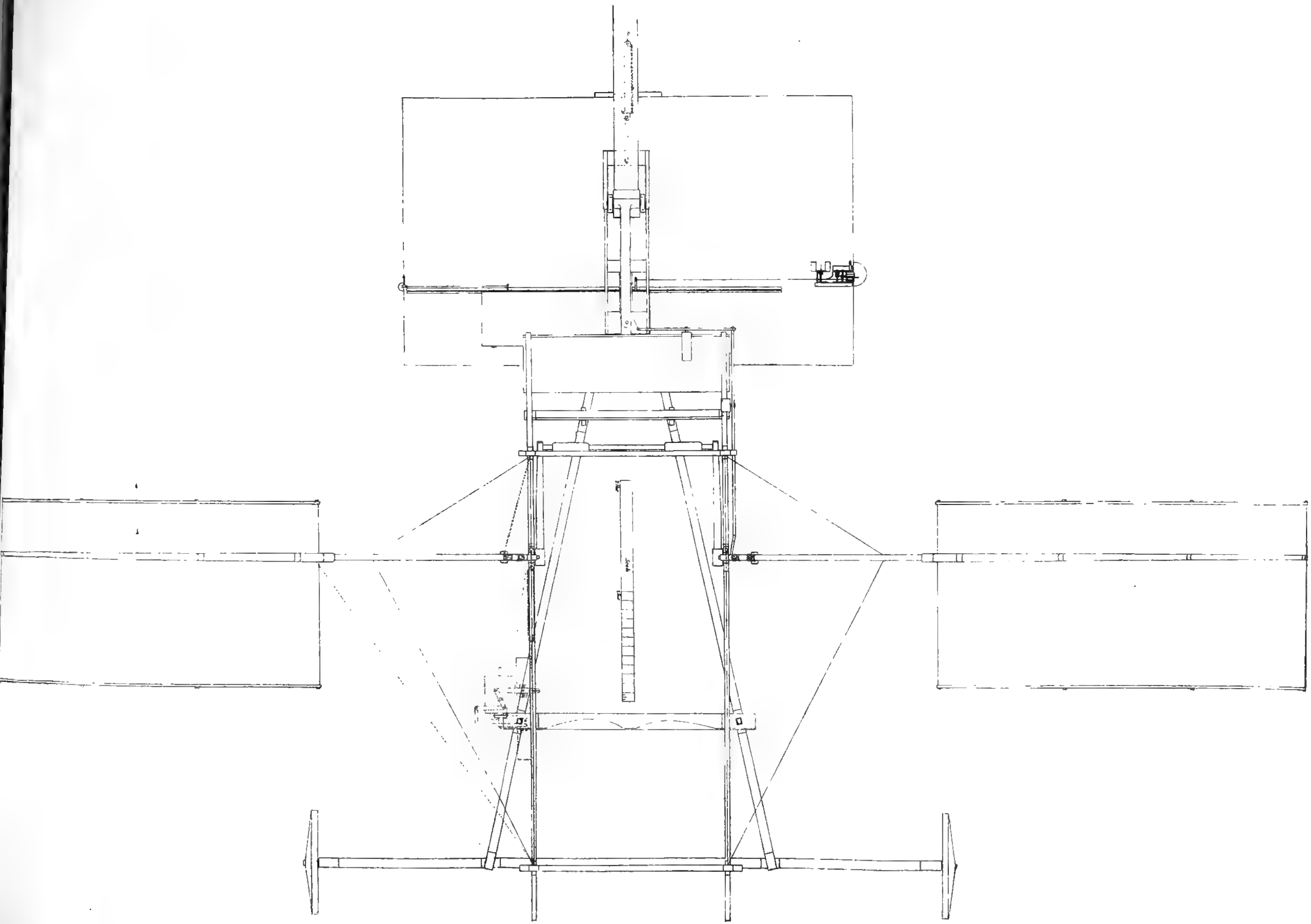
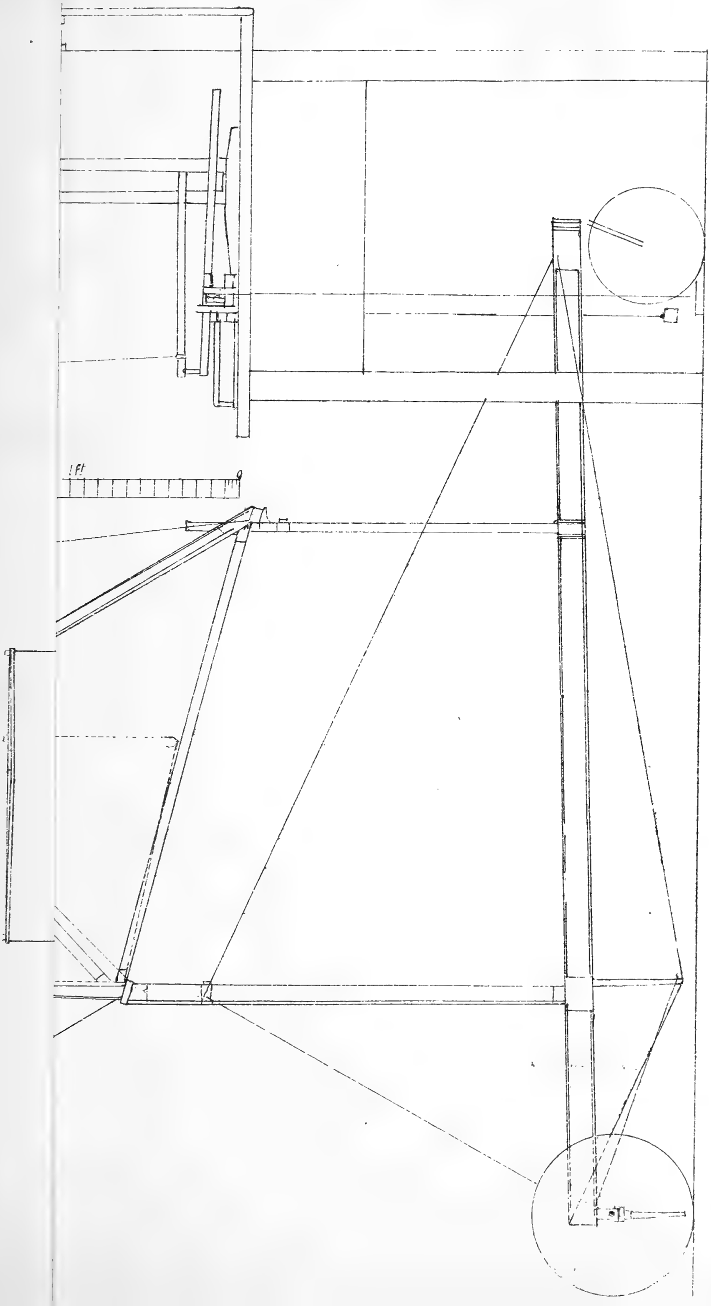
F. W. WHITE,
PRINTER, MARKET STREET,
SYDNEY.



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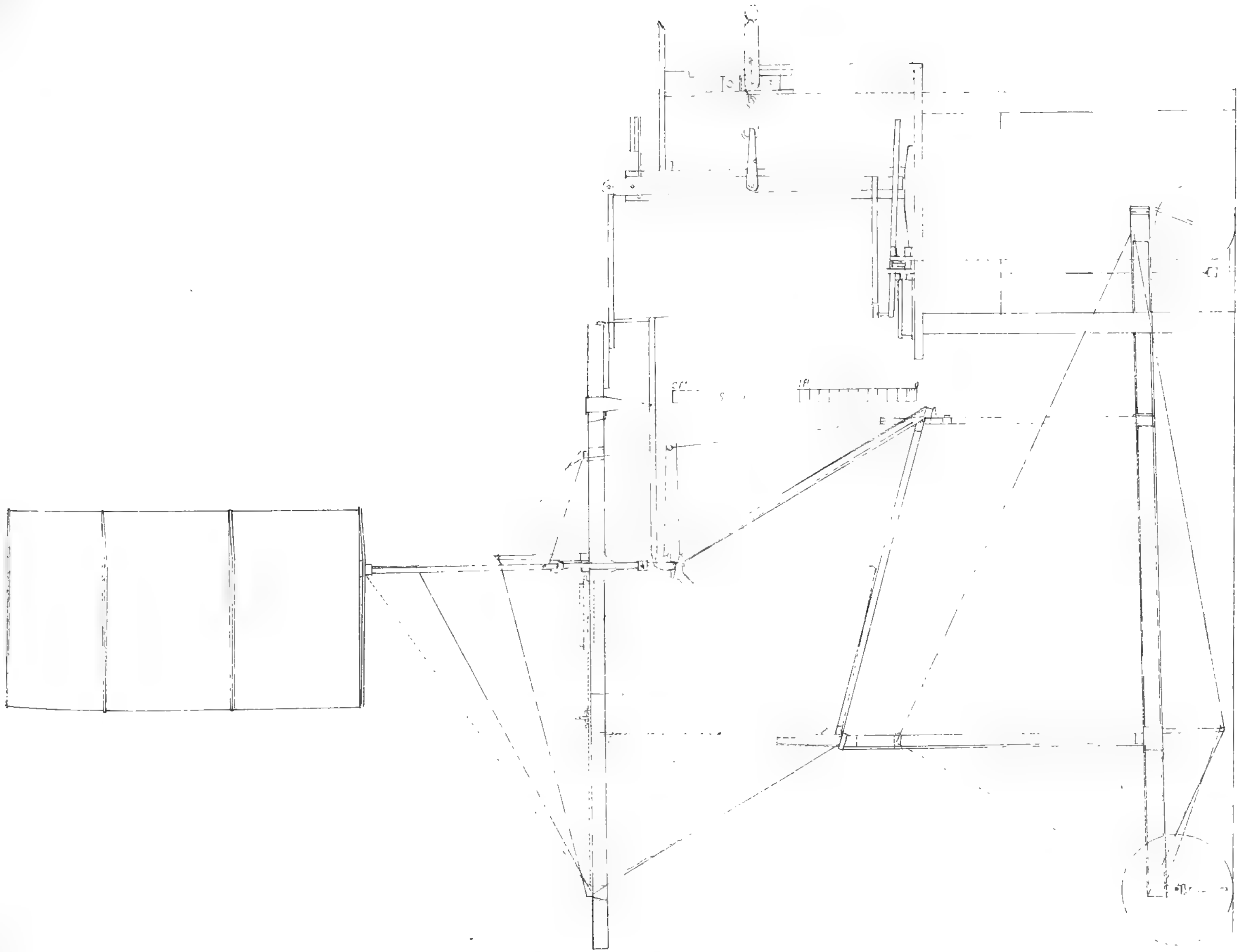
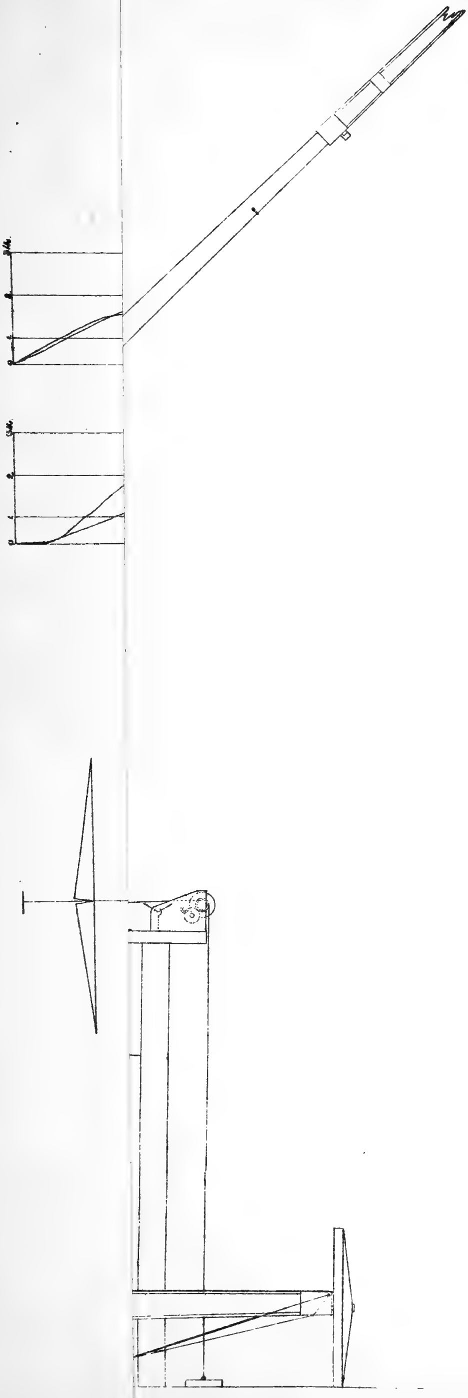
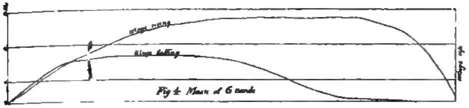





wings rising
Wings falling
Fig 4. Mean of 6 cards

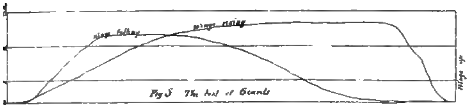
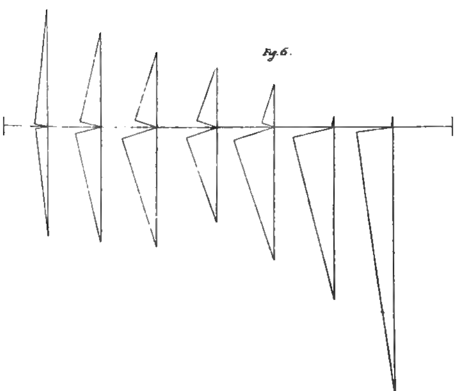
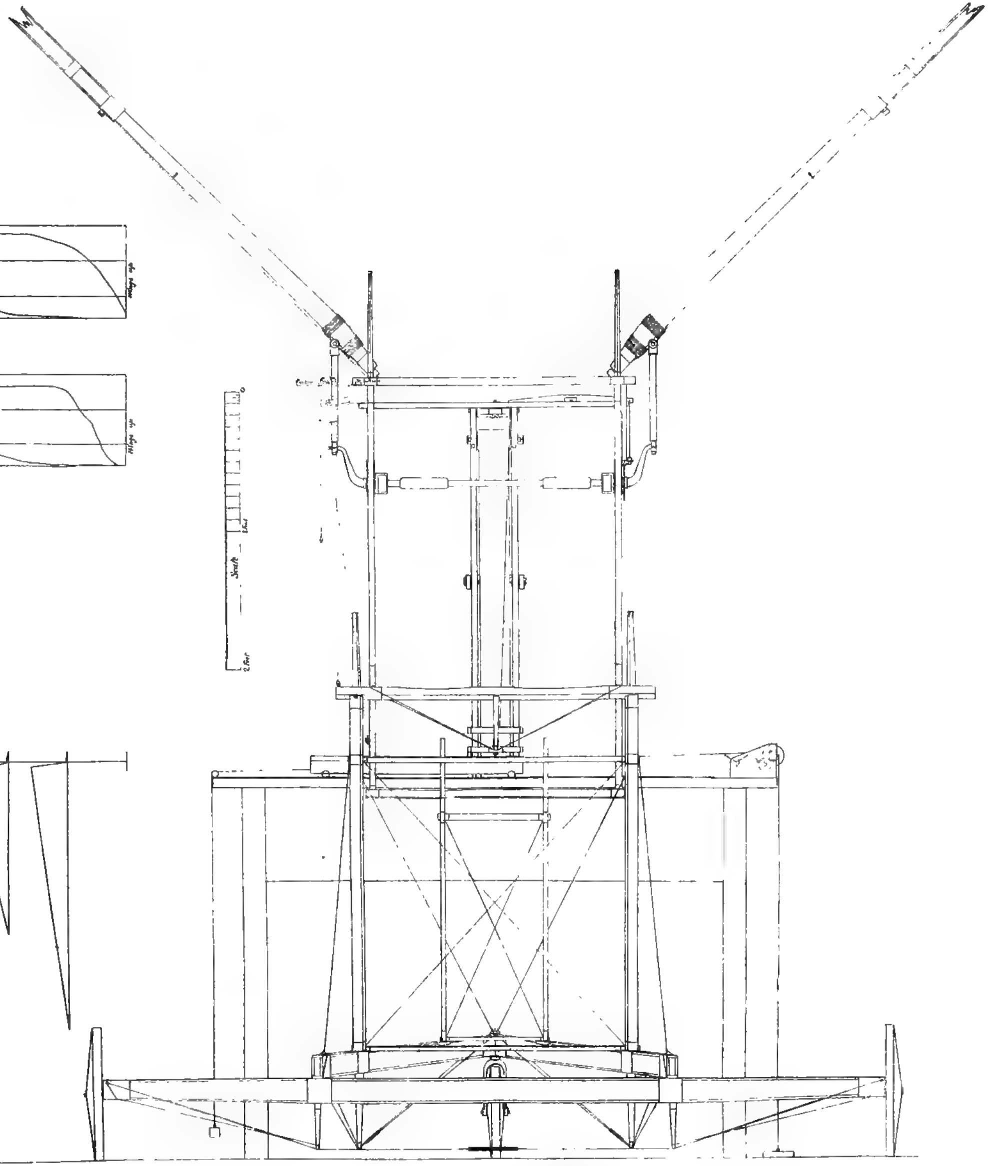

wings falling
wings rising
Fig 5 The last of 6 cards

Fig. 6.





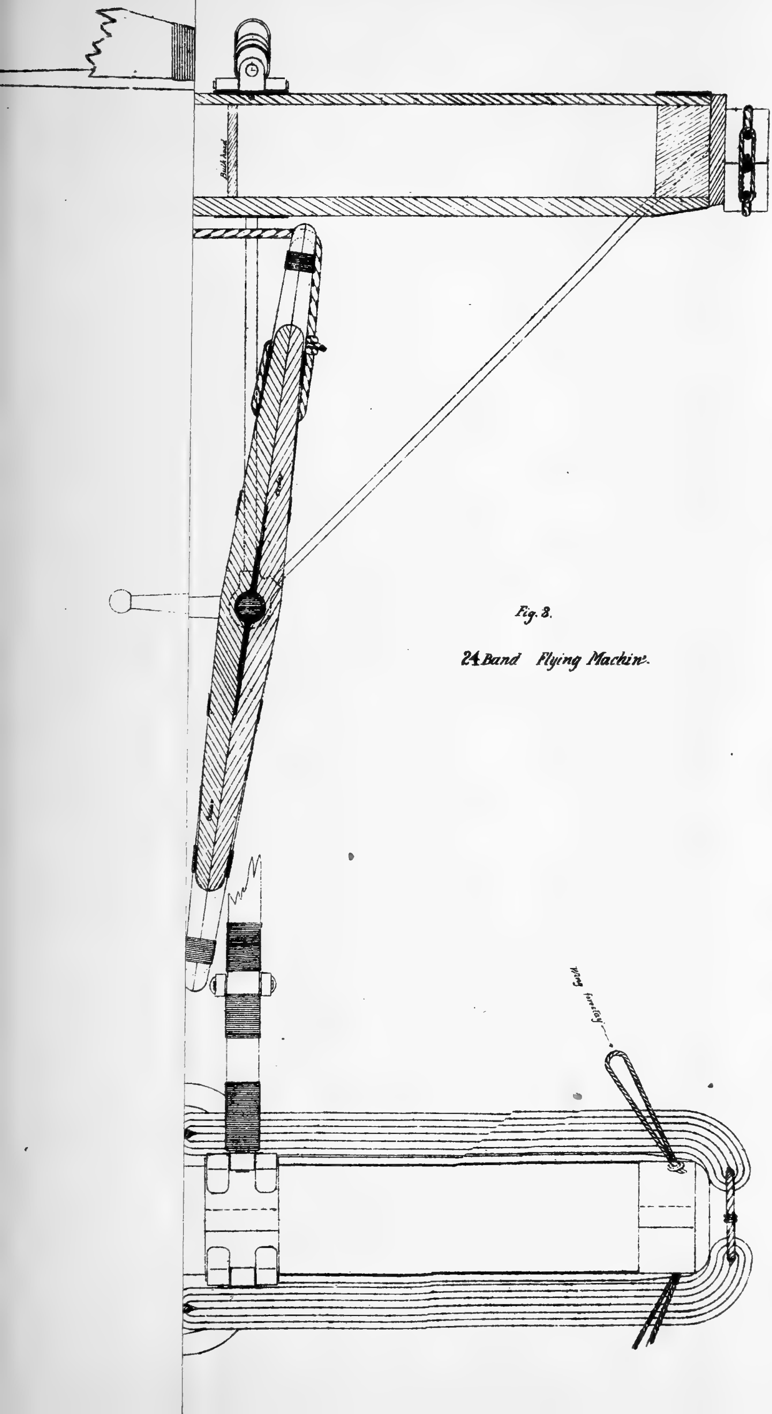


Fig. 3.

24 Band Flying Machine.

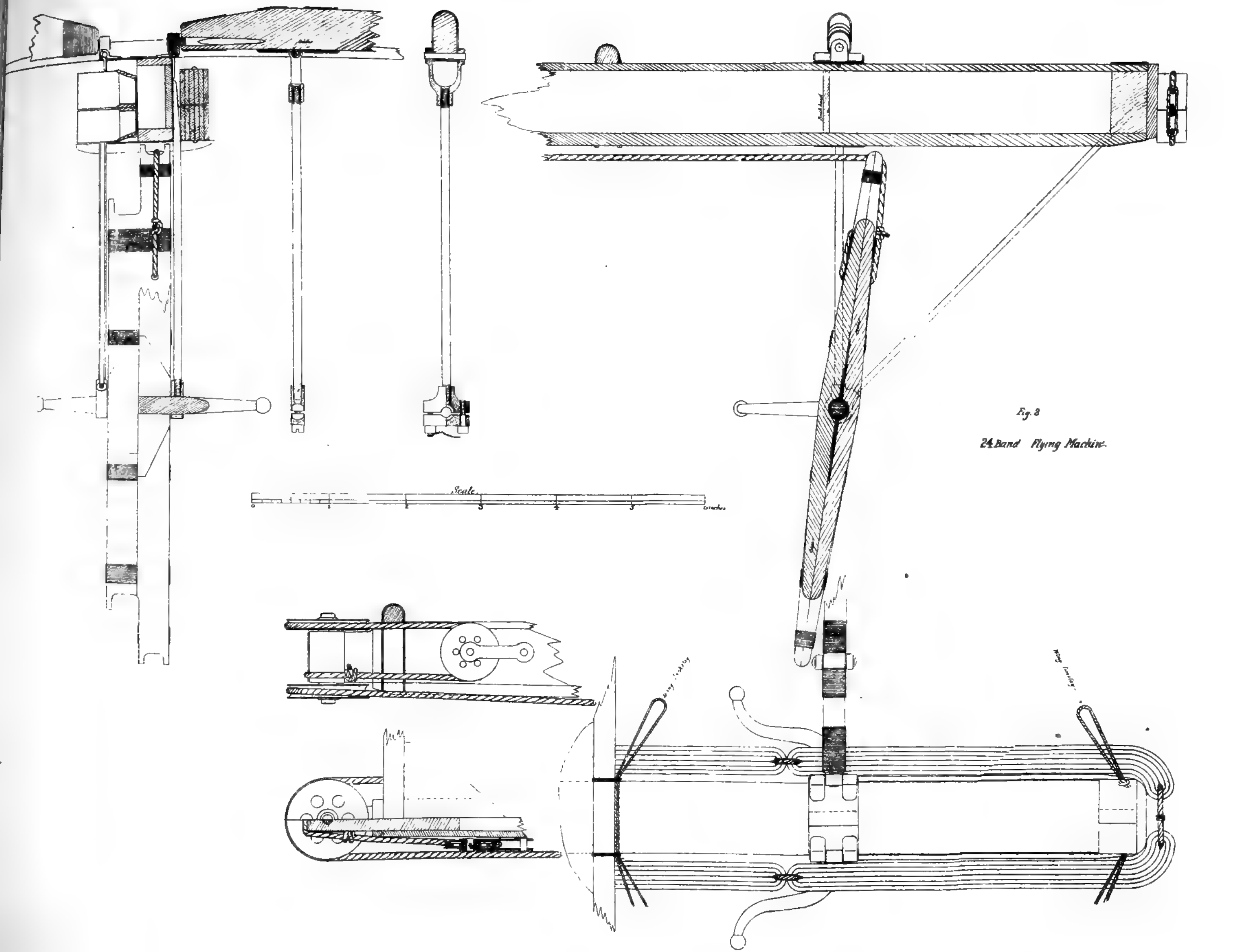
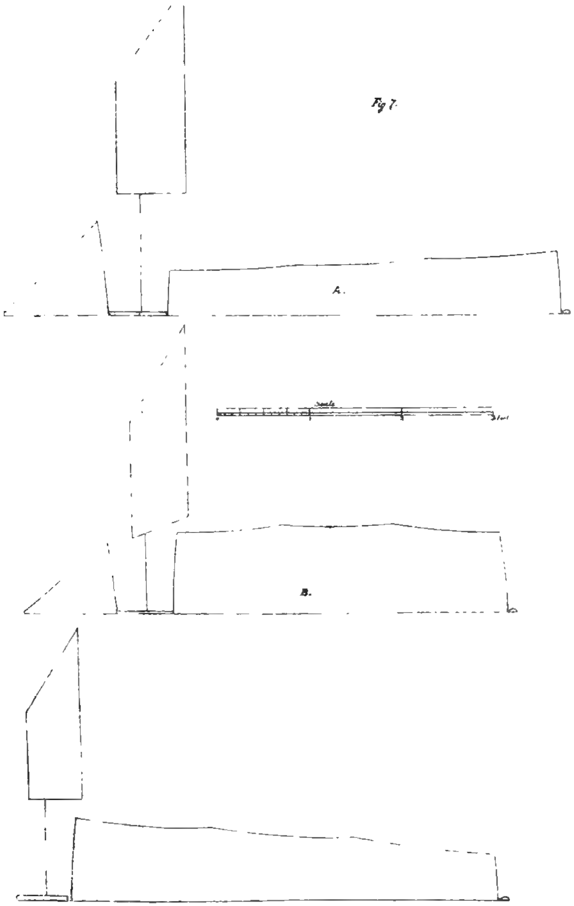


Fig. 3

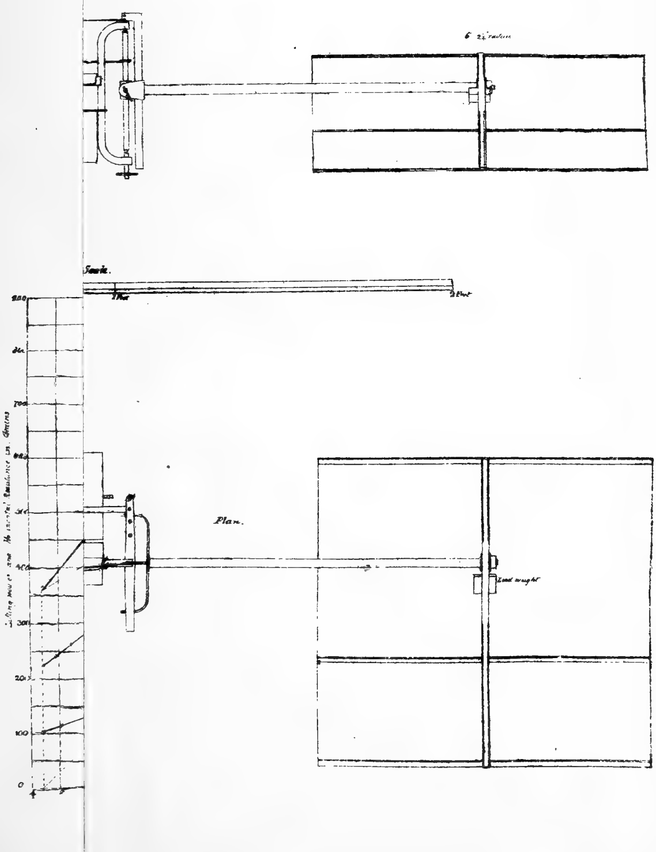
24 Band Flying Machine.

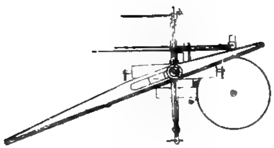
	A	B	C
square inches	378	311	242
	683	939	935
	175	131	—
	1236	1381	1177
pounds	1·47	1·22	1·18
oot-pounds	155·7	145·9	183·5
feet	120	170	201
ard end inches	33	32·8	26
	26	20·5	16
	29	26	22
	6	6·25	6,15,5, 4.
t	8	13·5	5, 19, 2,
	24	24	24
inches	30·6	28·5	31.
end of the flight	17·25	8	8

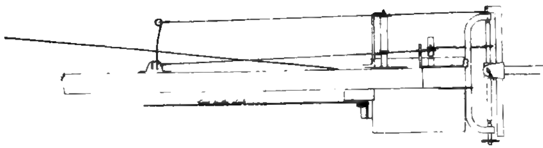


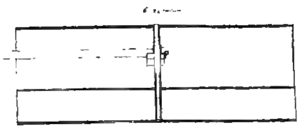
		A	B	C
Area of the wings	square inches	378	311	242
Area of the body		683	939	935
Area of the head		175	131	—
Total area		1236	1381	1177
Weight	ounces	1·47	1·32	1·18
Energy	foot-pounds	135·7	145·0	183·5
Horizontal flight	feet	120	170	201
Centre of effort from the forward end	inches	33	32·8	26
Centre of gravity unwound		26	20·5	16
wound up		29	26	22
Length of the winder		6	6·25	6·75, 3, 4
Revolutions of the shaft		8	13·5	3, 19, 2
Number of elastic bands		24	24	24
Each band stretched	inches	30·6	28·5	31
at the end of the flight		17·25	8	8

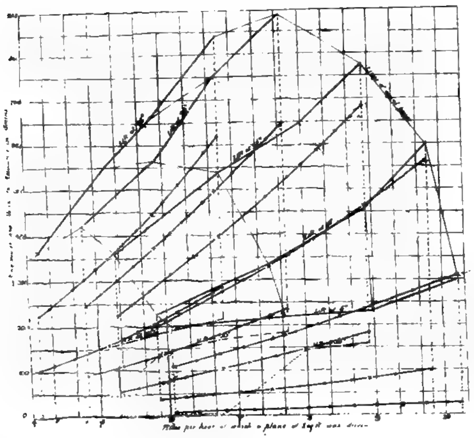
l Society, N.S.W., 1887. *Plate* 6. *Part I.*

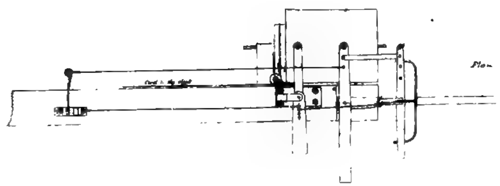












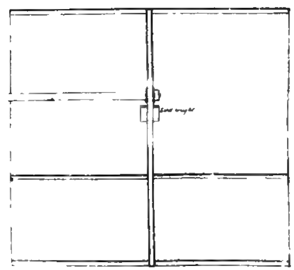


Fig 9

AUTOGRAPHIC TEST-RECORDER.

Autographic Apparatus used by Professor Kennedy.

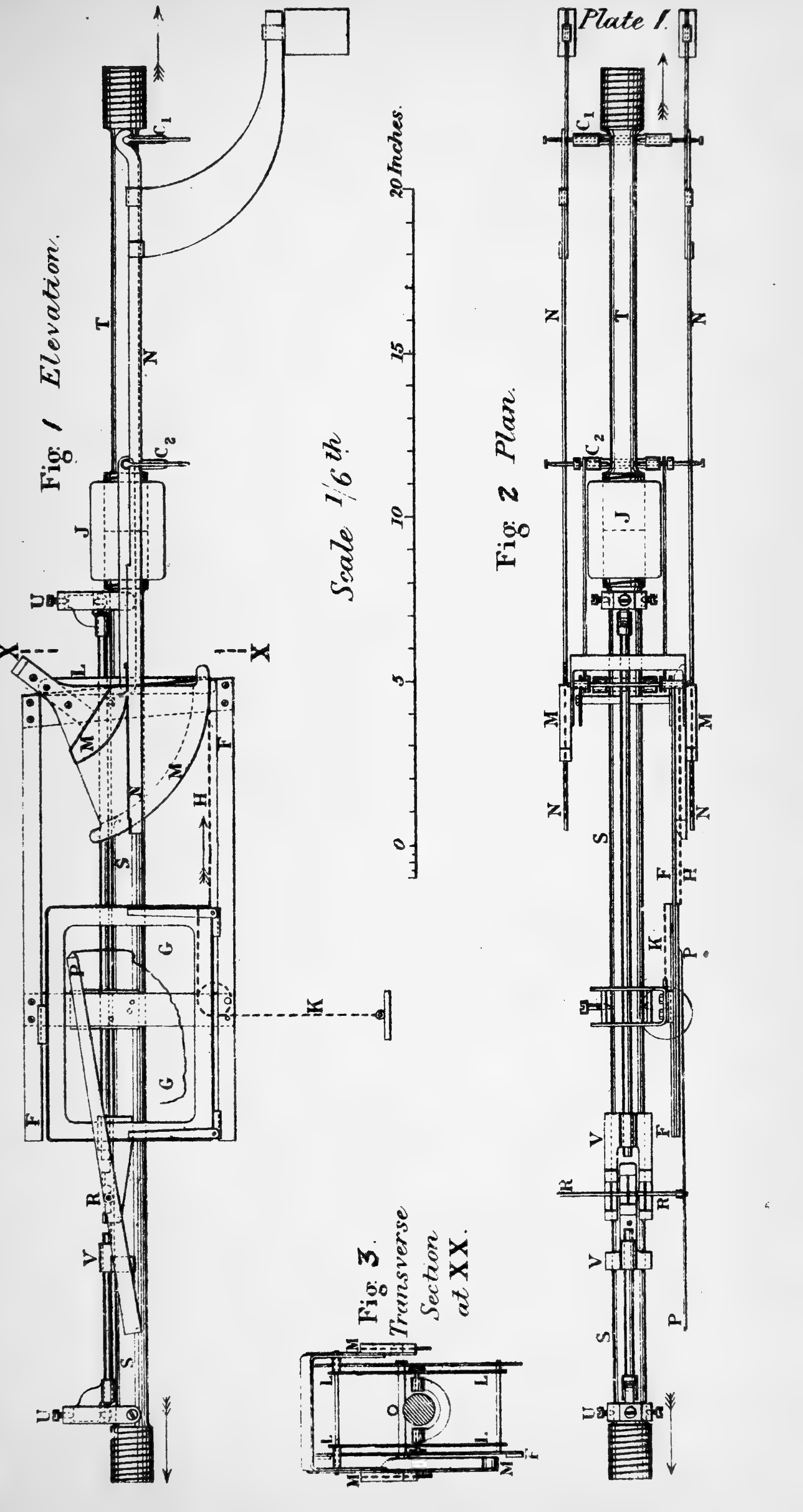
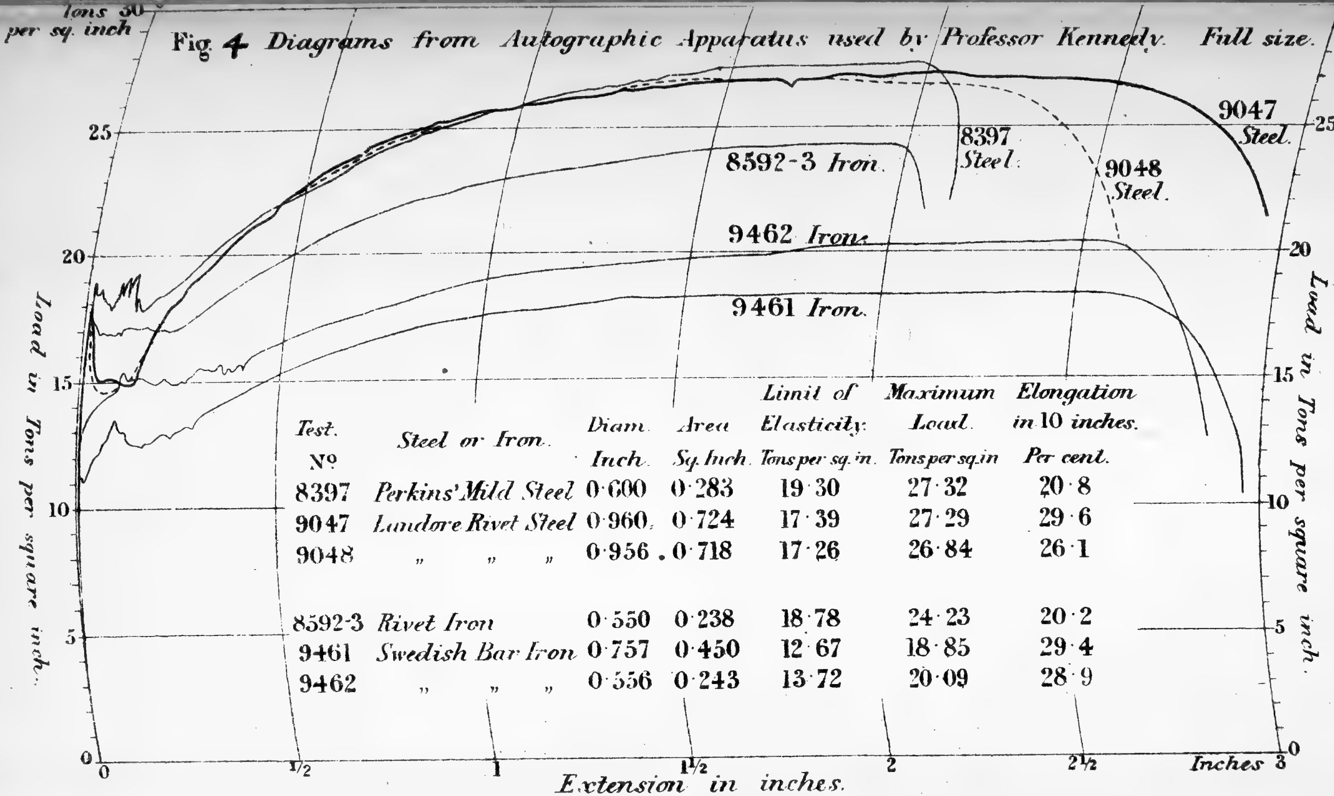


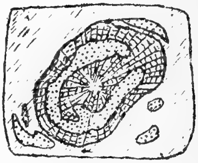
Fig. 4 Diagrams from Autographic Apparatus used by Professor Kennedy. Full size.



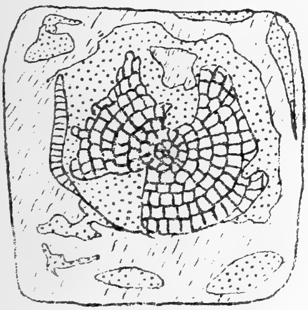
Test. Nº	Steel or Iron.	Diam. Inch.	Area Sq. Inch.	Limit of Elasticity. Tons per sq. in.	Maximum Load. Tons per sq. in.	Elongation in 10 inches. Per cent.
8397	Perkins' Mild Steel	0·600	0·283	19·30	27·32	20·8
9047	Landore Rivet Steel	0·960	0·724	17·39	27·29	29·6
9048	" " "	0·956	0·718	17·26	26·84	26·1
8592-3	Rivet Iron	0·550	0·238	18·78	24·23	20·2
9461	Swedish Bar Iron	0·757	0·450	12·67	18·85	29·4
9462	" " "	0·556	0·243	13·72	20·09	28·9

Figures of vegetable inclusions, observed in Queensland opal.

No. 1



No. 2



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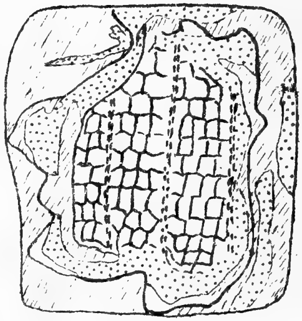


No. 4

Opal. Fossil wood.

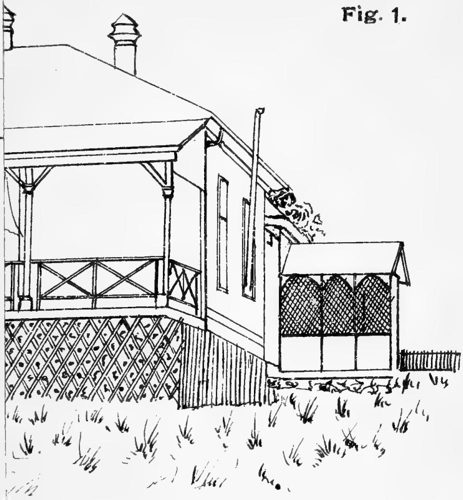


Fig. 1. North Front.

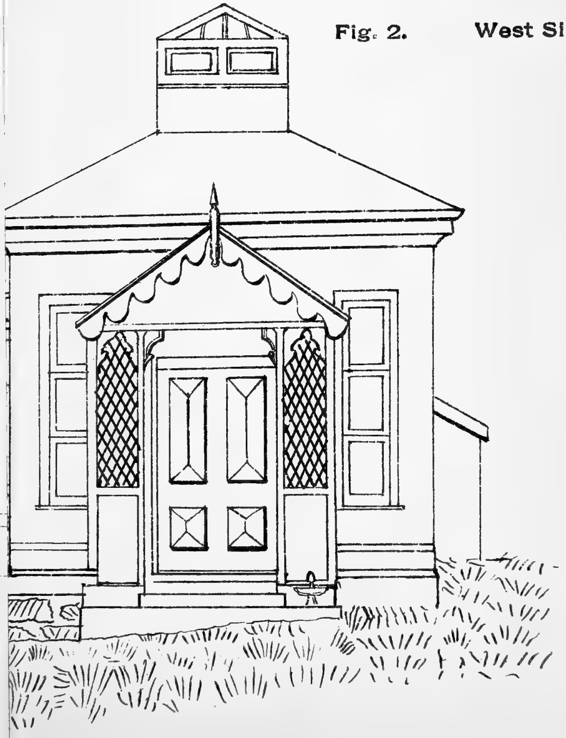


Fig. 2. West Side.

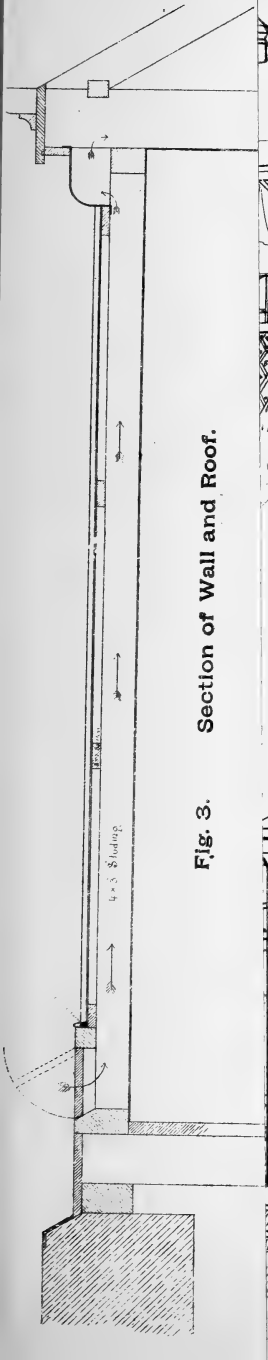


Fig. 3. Section of Wall and Roof.

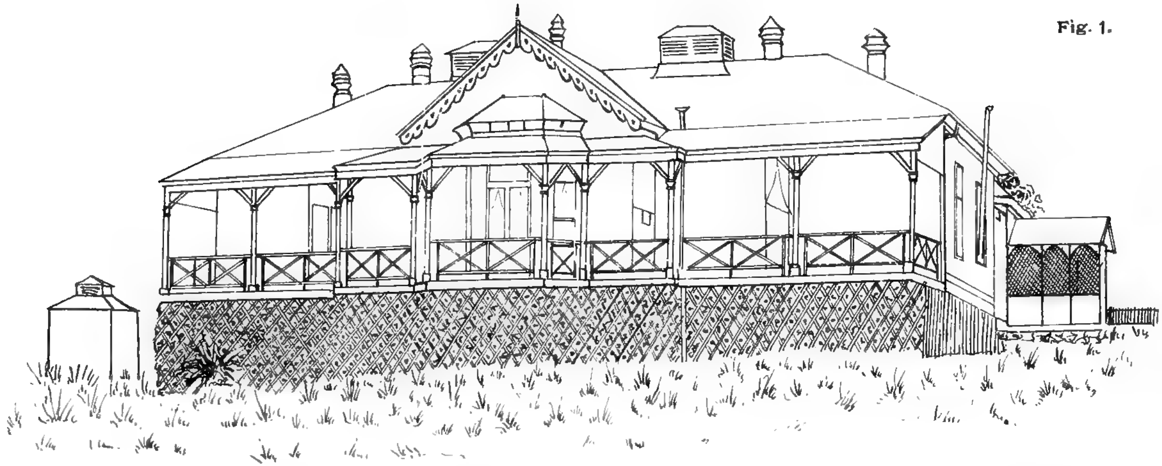


Fig. 1. North Front.

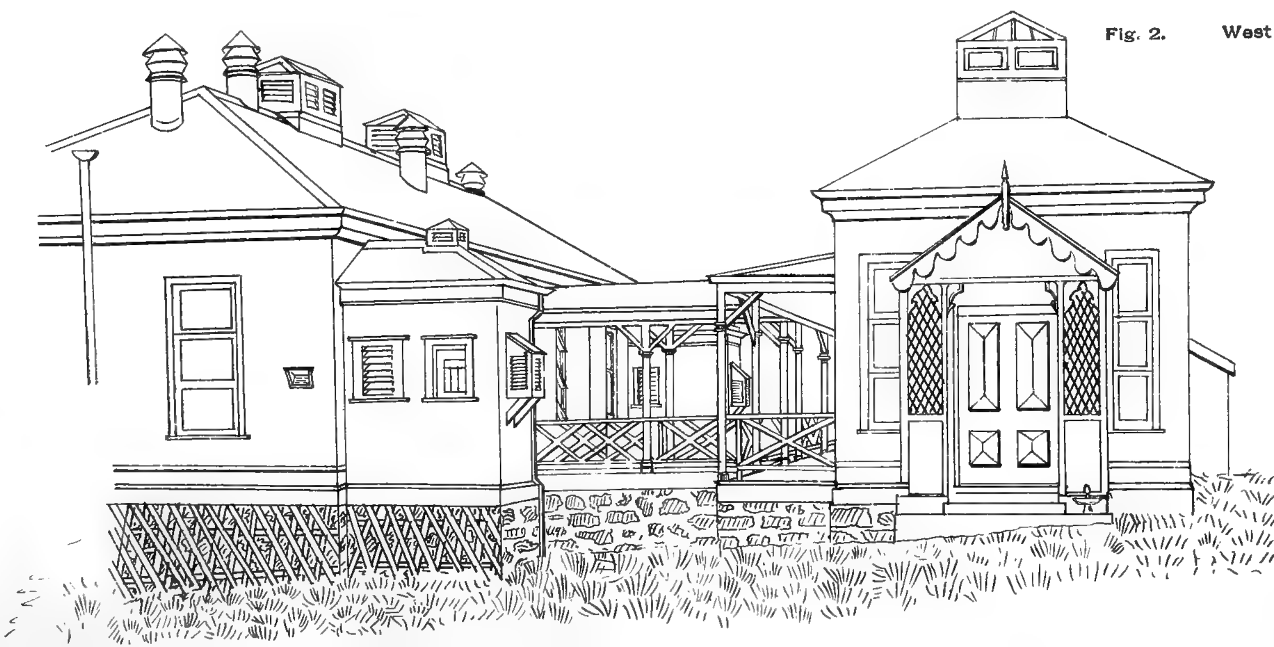


Fig. 2. West Side.

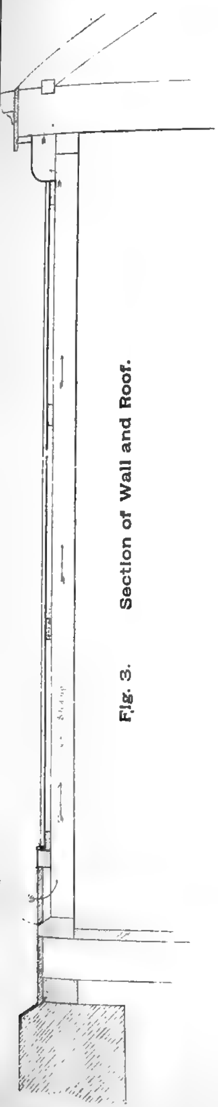
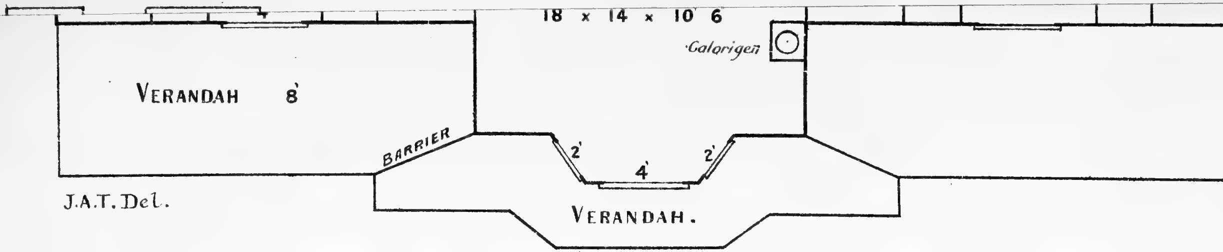


Fig. 3. Section of Wall and Roof.

Fig. 4.



Sketch Plan of the Kiama District Hospital.

— Designs and Descriptions by —

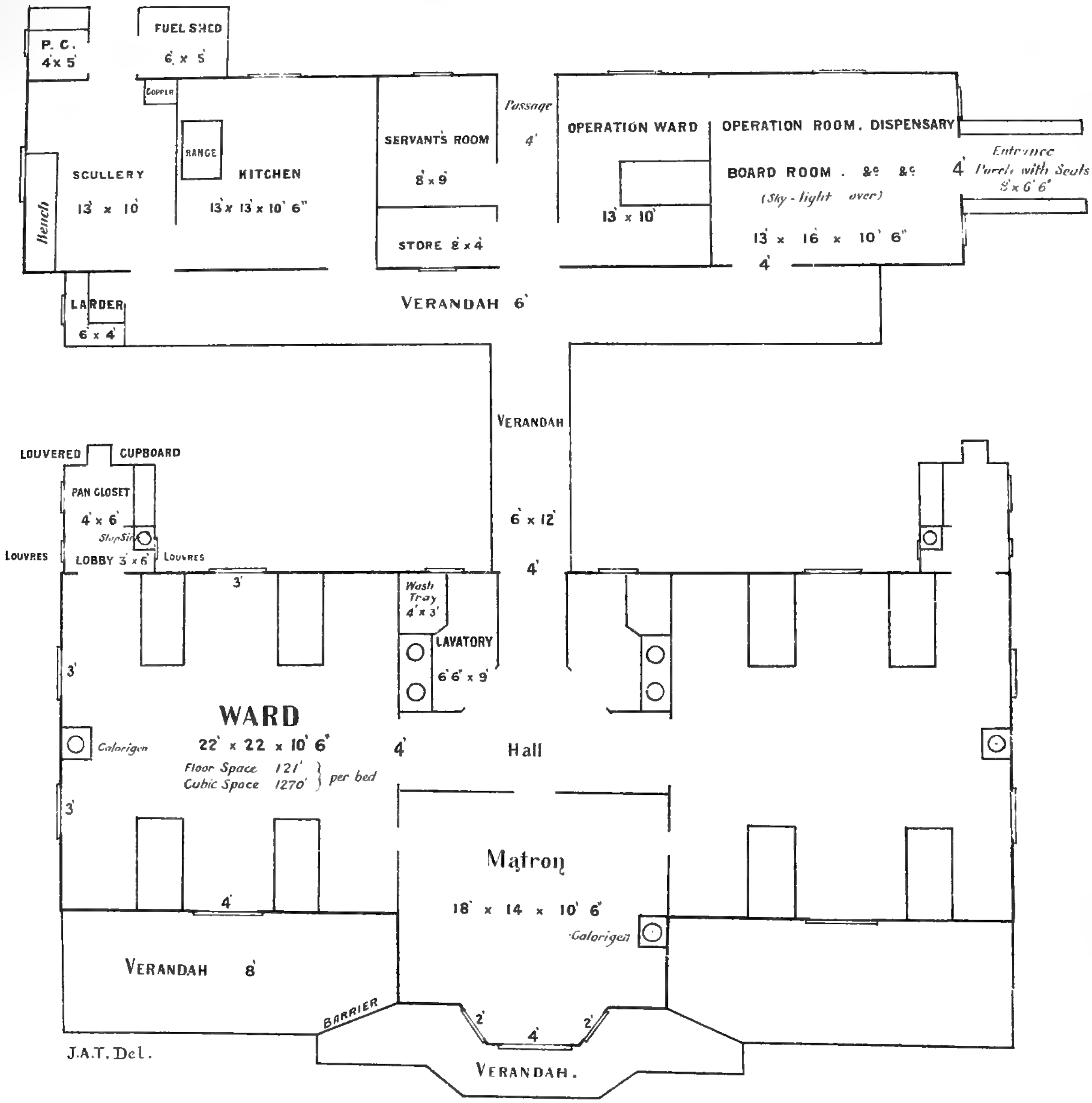
J. ASHBURTON THOMPSON, M.D.

— Architect —

Charles A. Harding . Esq[re]

— SYDNEY. —

Fig. 4.



Sketch Plan of the Kiama District Hospital.

Designs and Descriptions by

J. ASHBURTON THOMPSON, M.D.

Architect

Charles A. Harding. Esqre

SYDNEY.

Journal Royal Society, N.S.W., 1887. Plate 11. Part II.

HOSPITAL OF 11 OR 21 BEDS –

RON COST £2000

BY

N THOMPSON M.D.

– = '8 inch to the foot

hed ward for one bed, Deadhouse & Swag Rm.

h windmill and water fittings, not shown.

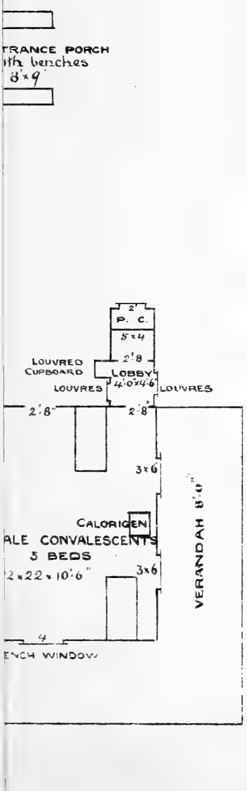


Fig. 5.

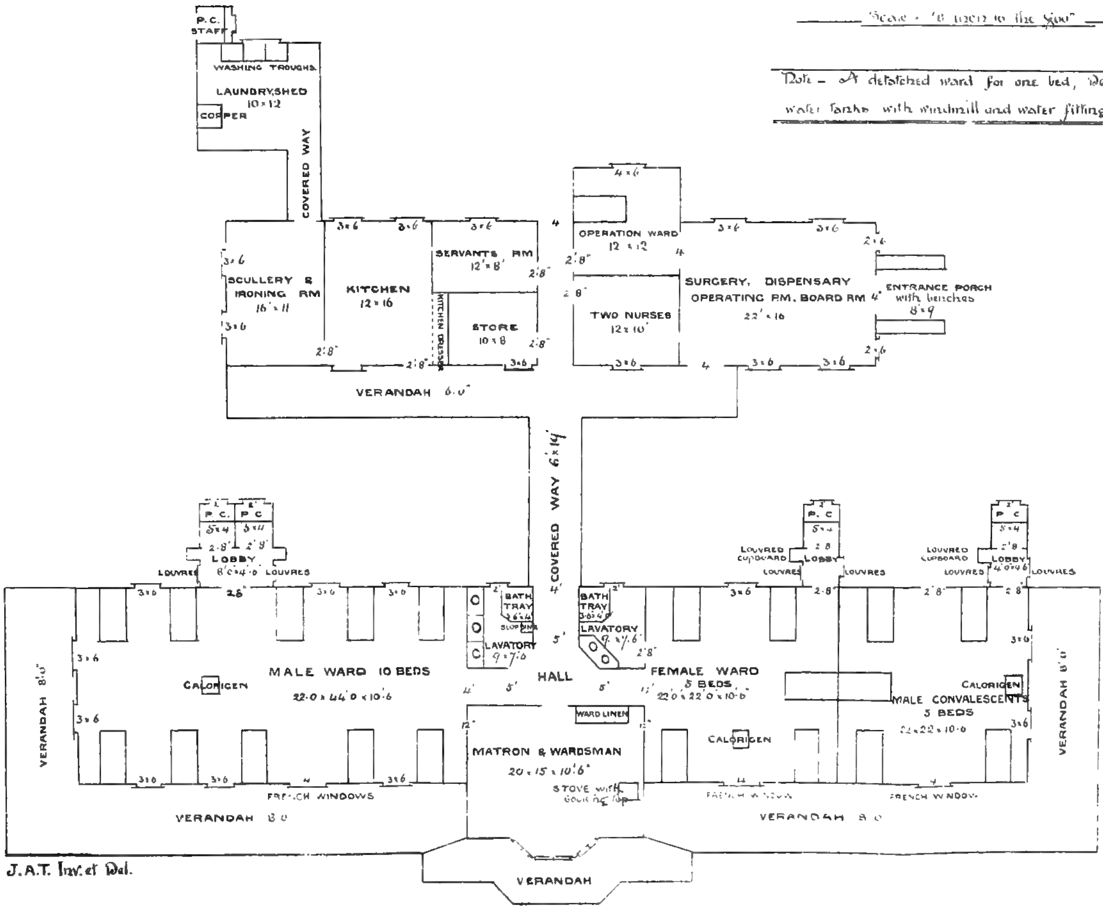
PLAN FOR A DISTRICT HOSPITAL OF 11 OR 21 BEDS

MATERIAL IRON COST £2000

BY

J. ASHBURTON THOMPSON M.D.

Note – A detatched ward for one bed, Deadhouse & Swag Rm water tanks with windmill and water fittings, not shown.



J.A.T. Inv. et Del.

Fig. 1.

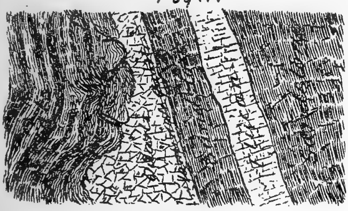


Fig 2

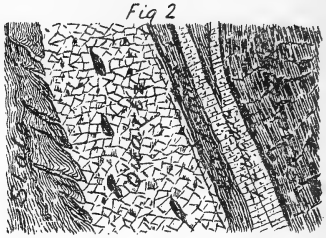


Fig 3

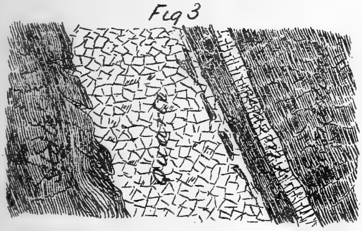


Fig 4

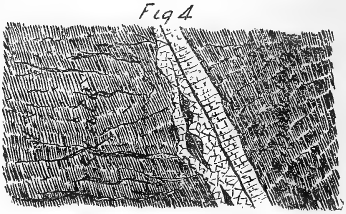
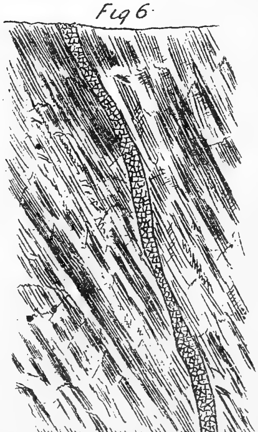


Fig 5

Fig 6.



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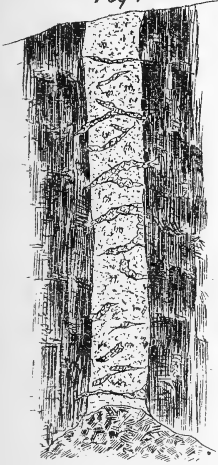

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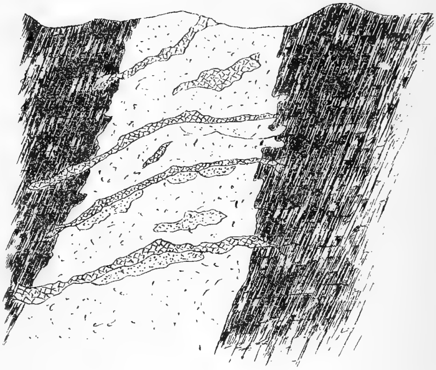


Fig. 9.

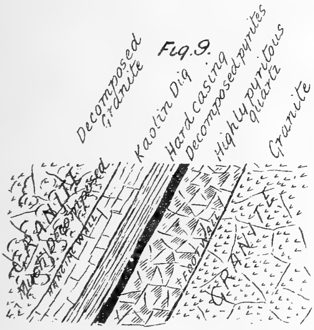


Fig 10.

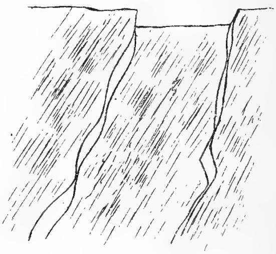


Fig A

Fig 11.

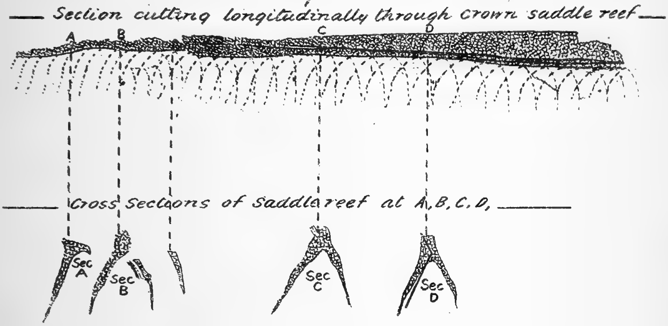


Fig 12.

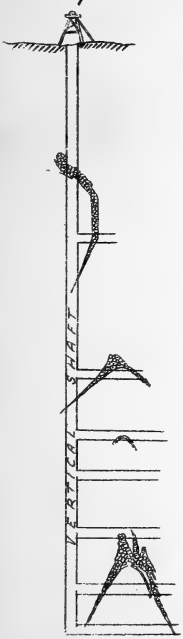


Fig 13.

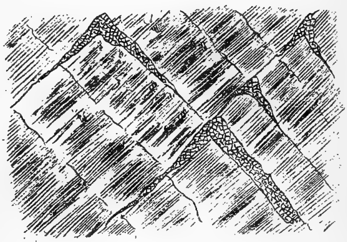


Fig 14.

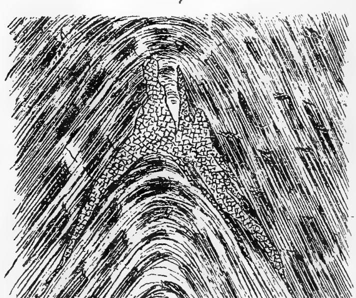
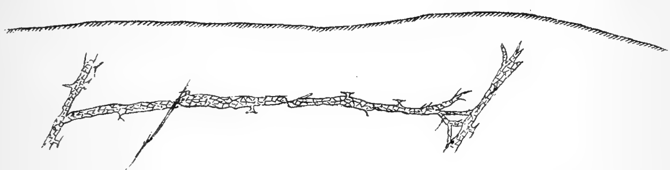


Fig.15.



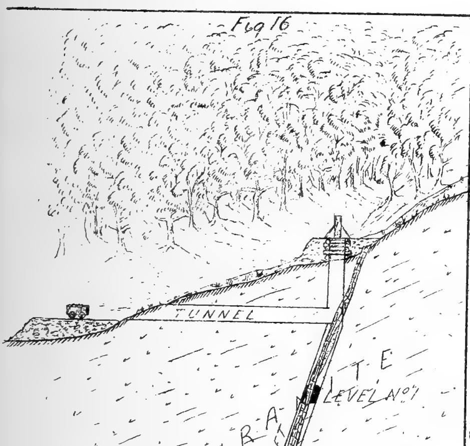


Fig 17.
HORISONTAL SECTION
OF LODE No3 LEVEL

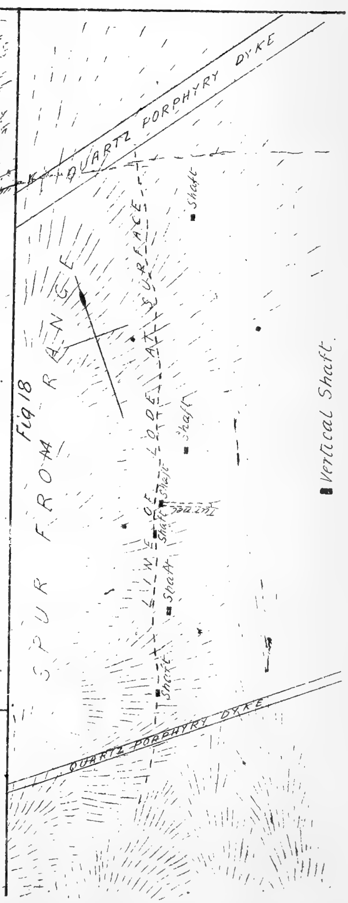


Fig 19

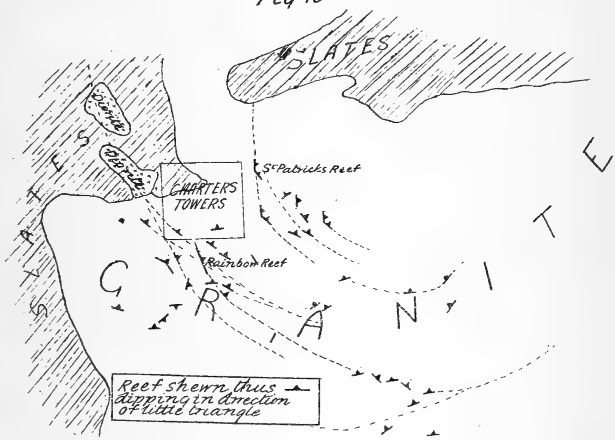


Fig.22.

Fig.20.

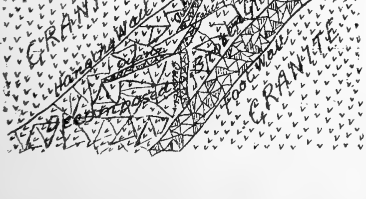
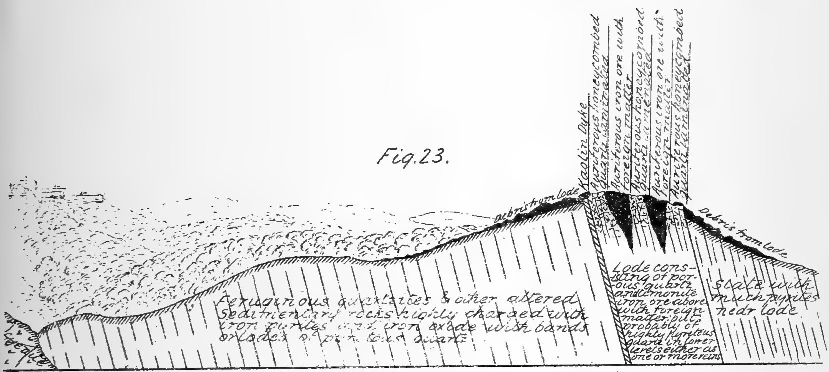


Fig.21.

Fig.23.



Section across Mount Morgan Lode Formation

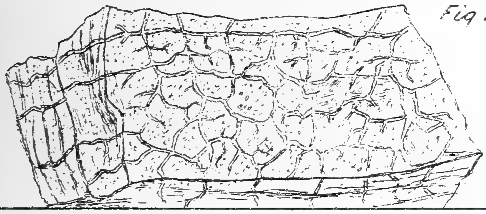
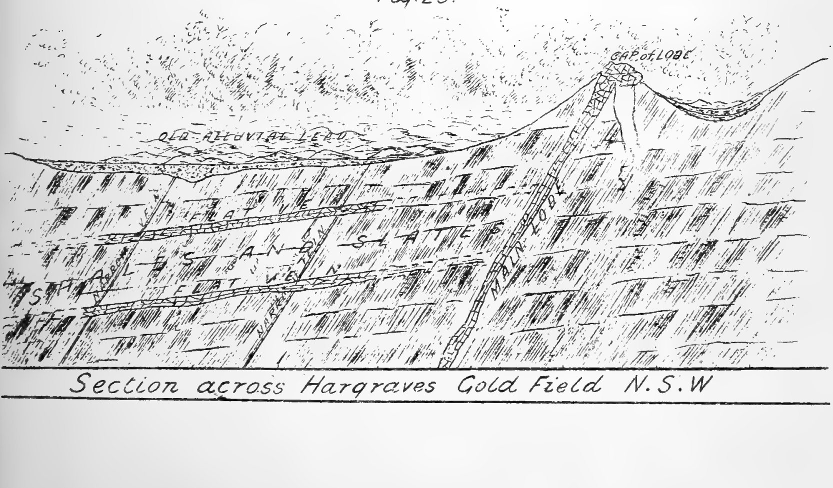


Fig 24

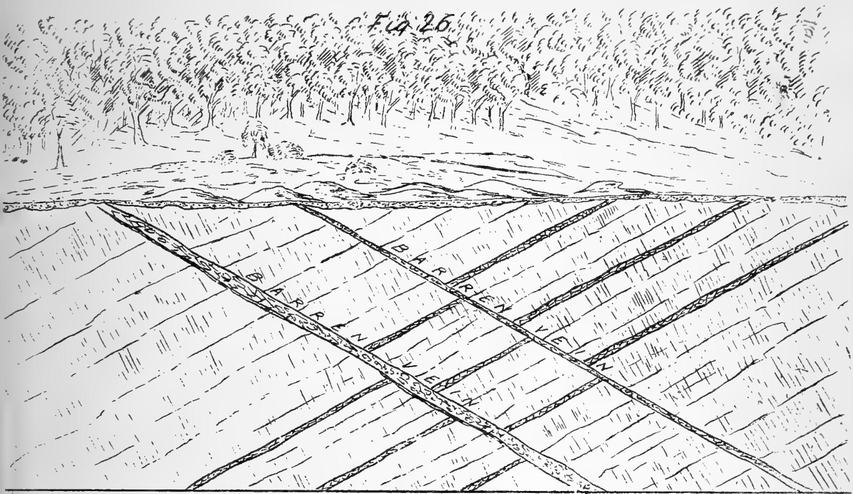
Appearance of laminated quartz in Mt Morgan lode having fractures filled in with silica from solution subsequently deposited to that of main body of Quartz

This quartz is very porous in upper levels of the mine

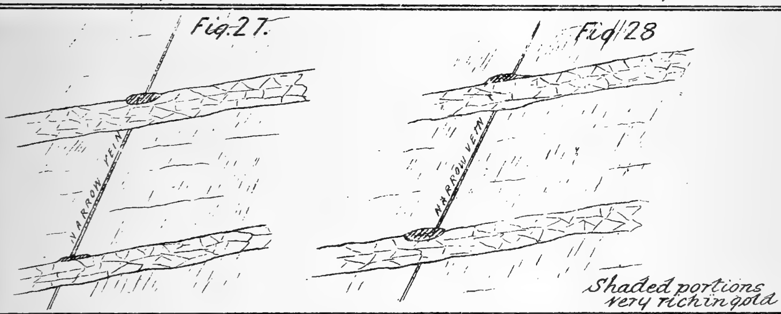
Fig.25.



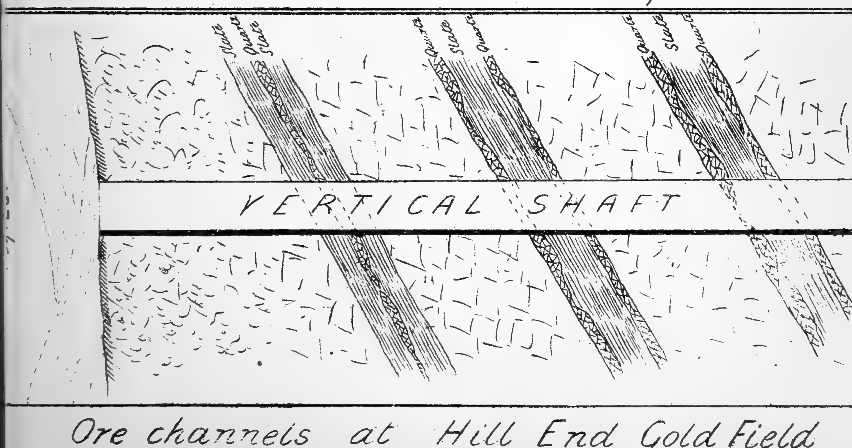
Section across Hargraves Gold Field N.S.W



Section parallel to narrow vein Hargraves

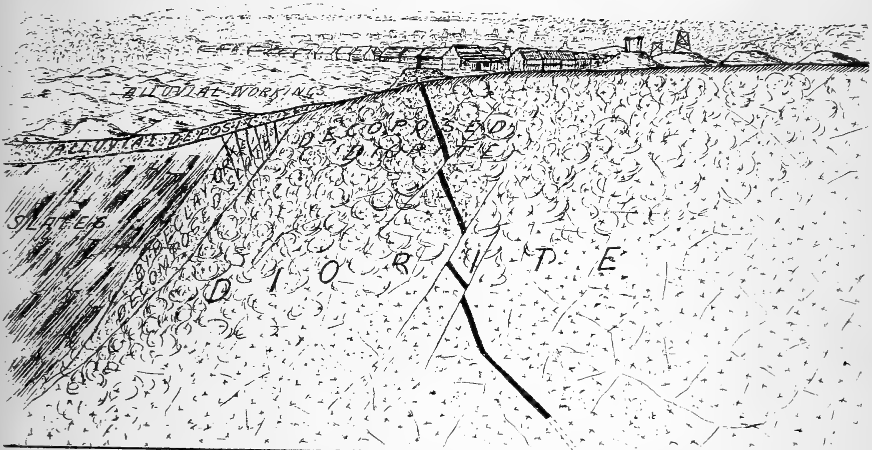


Section across narrow veins Hargraves.



Ore channels at Hill End Gold Field

Fig 30



Mother Shipton Reef at Temora N.S.W

Fig. 31. A

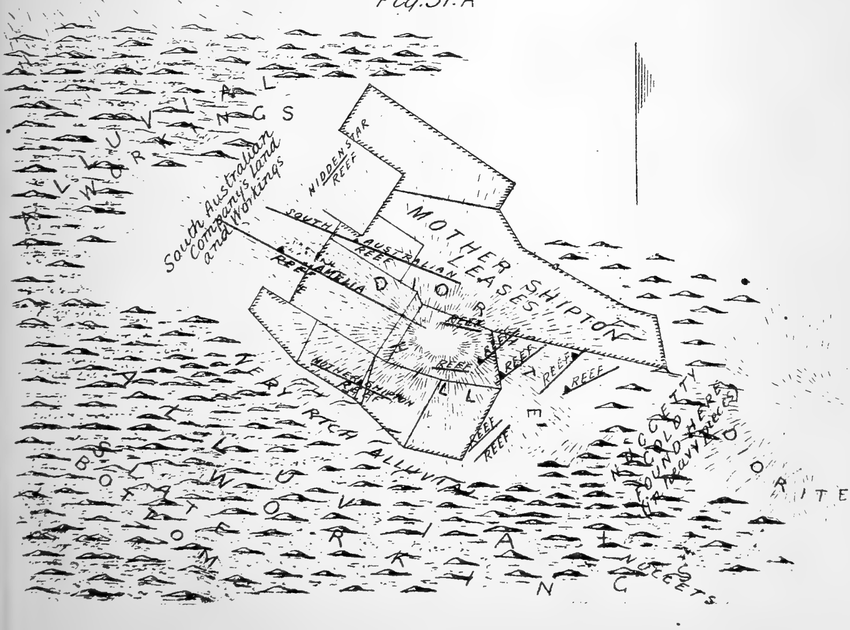


Fig 31

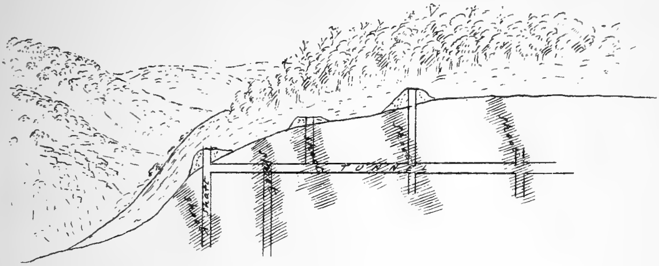


Fig 32

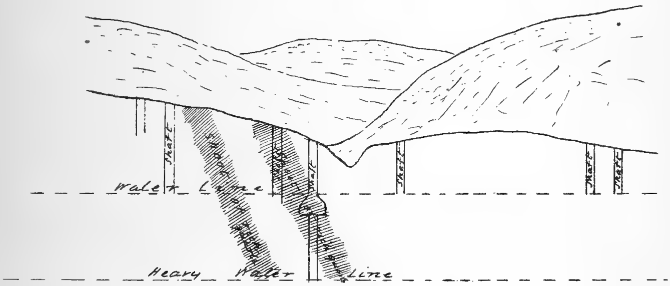


Fig 33

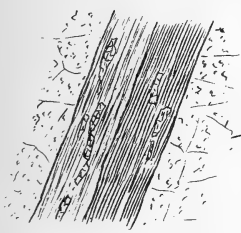


Fig 36

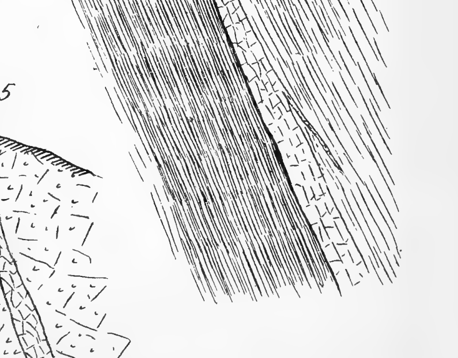


Fig 34

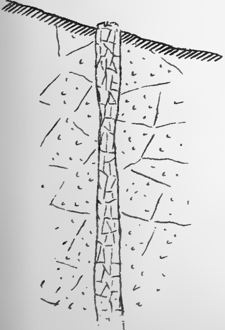


Fig 35

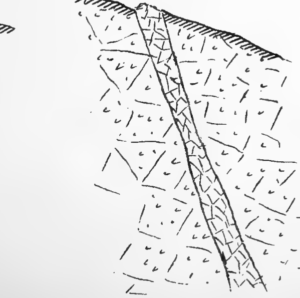


Fig 32.A.

Section across Reefton Gold Field

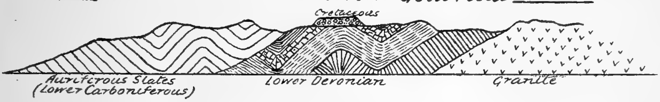


Fig 33.A.

CALEDONIAN MINE

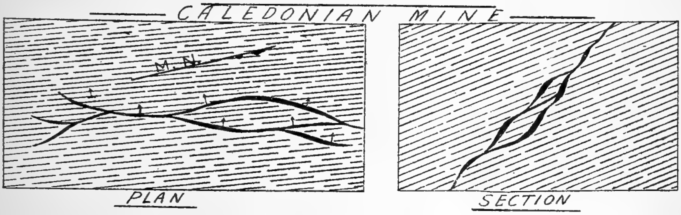


Fig 34.A.

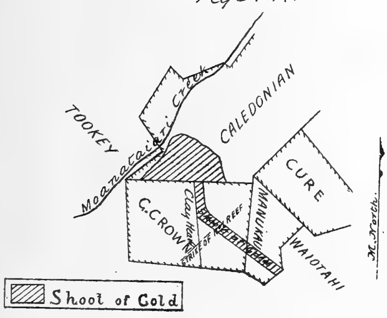
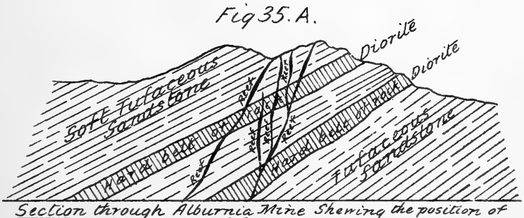
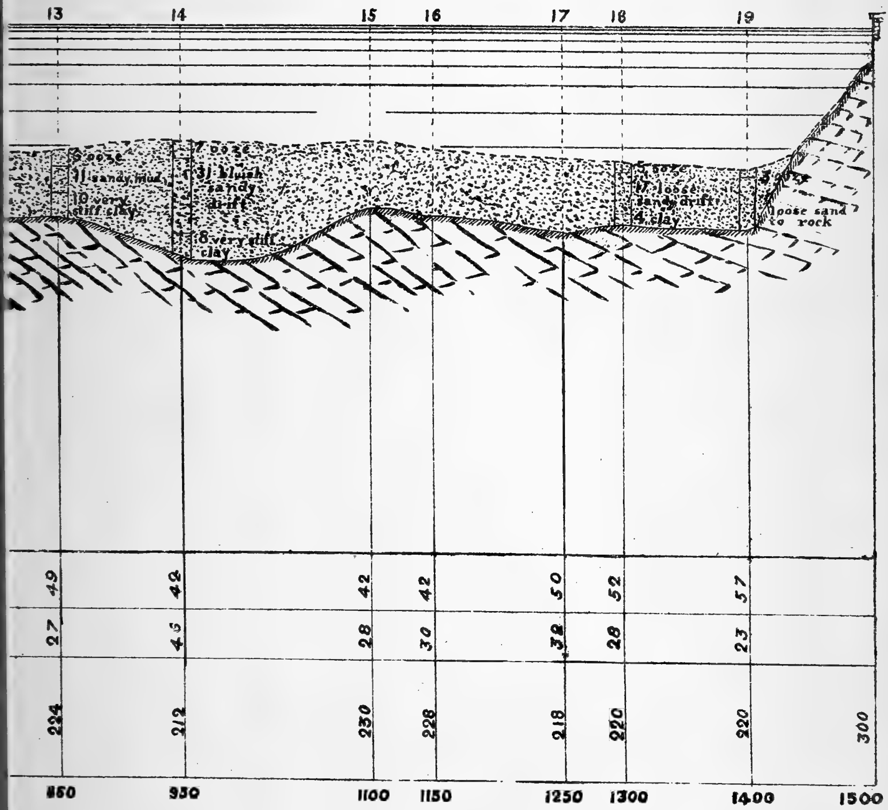


Fig 35.A.



Section through Alburnia Mine Shewing the position of hard belts of Country

to MILSONS POINT



BORINGS
for
HARBOR TUNNELS COMPANY

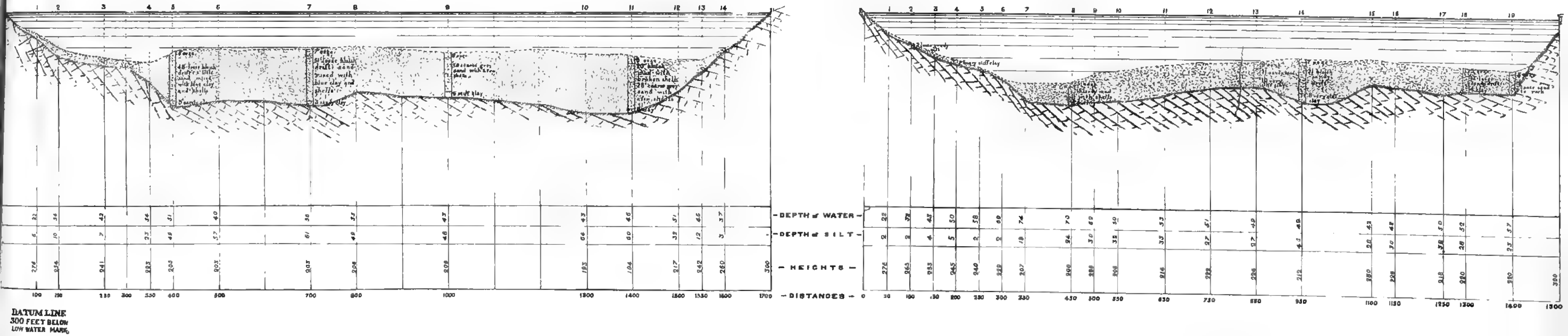
SCALES

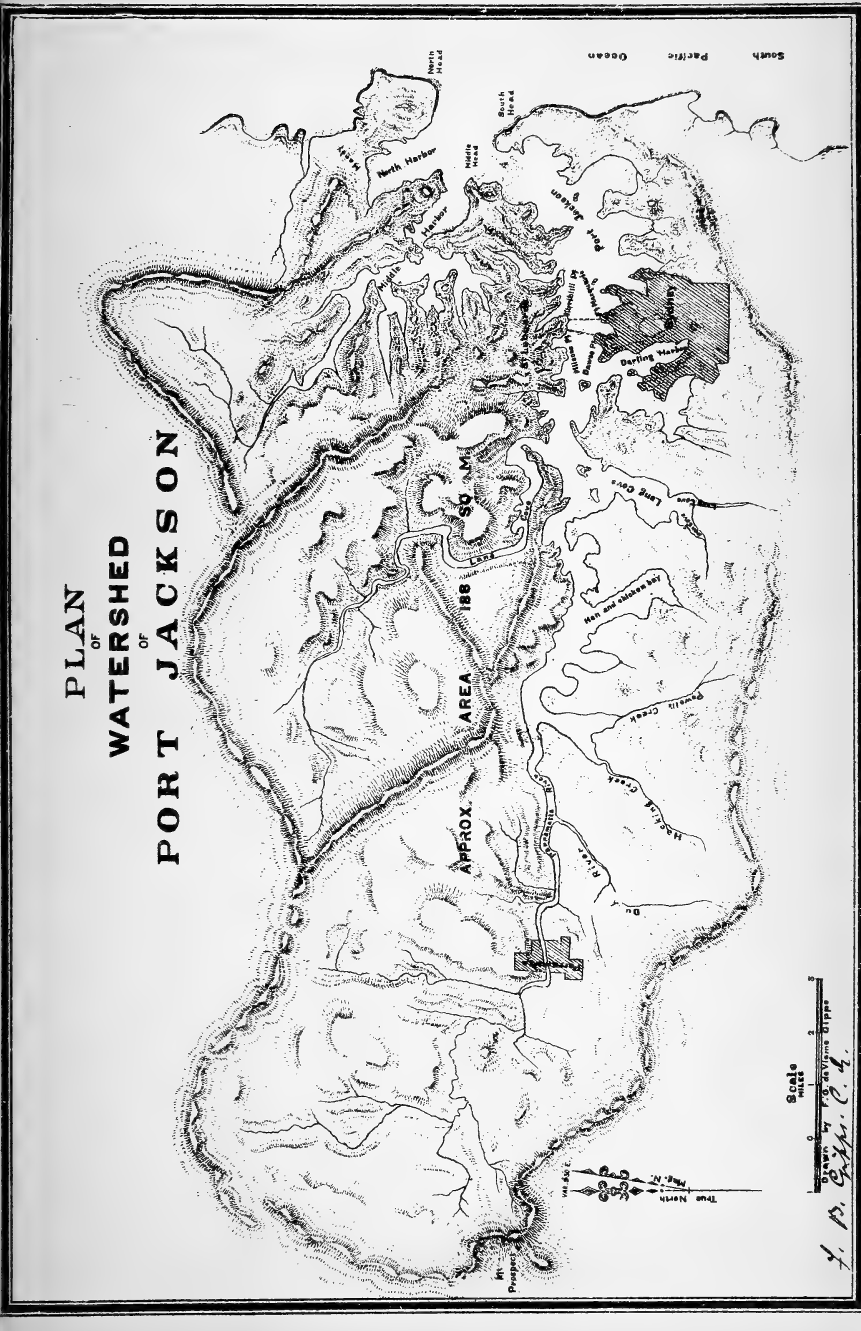
VERTICAL HORIZONTAL

J. B. Gipps C.E.

1. SECTION from FORT MACQUARIE to BEULAH S^t NORTH SHORE

2. SECTION from DAWES POINT to MILSONS POINT




PLAN OF WATERSHED OF PORT JACKSON
APPROX. AREA 188 SQ. M.
North Head
South Head
Middle Head
North Harbor
Middle Harbor
South Pacific Ocean
Port Jackson
Sydney
Darling Harbor
Lane Cove
Long Cove
Hen and chicken bay
Powells Creek
Haslams Creek
Parramatta River
Duck River
Prospect
Scale
True North
Mag. N.
Drawn by F. G. deVisme Dippe

S.W., 1887. Plate 25. Part III.

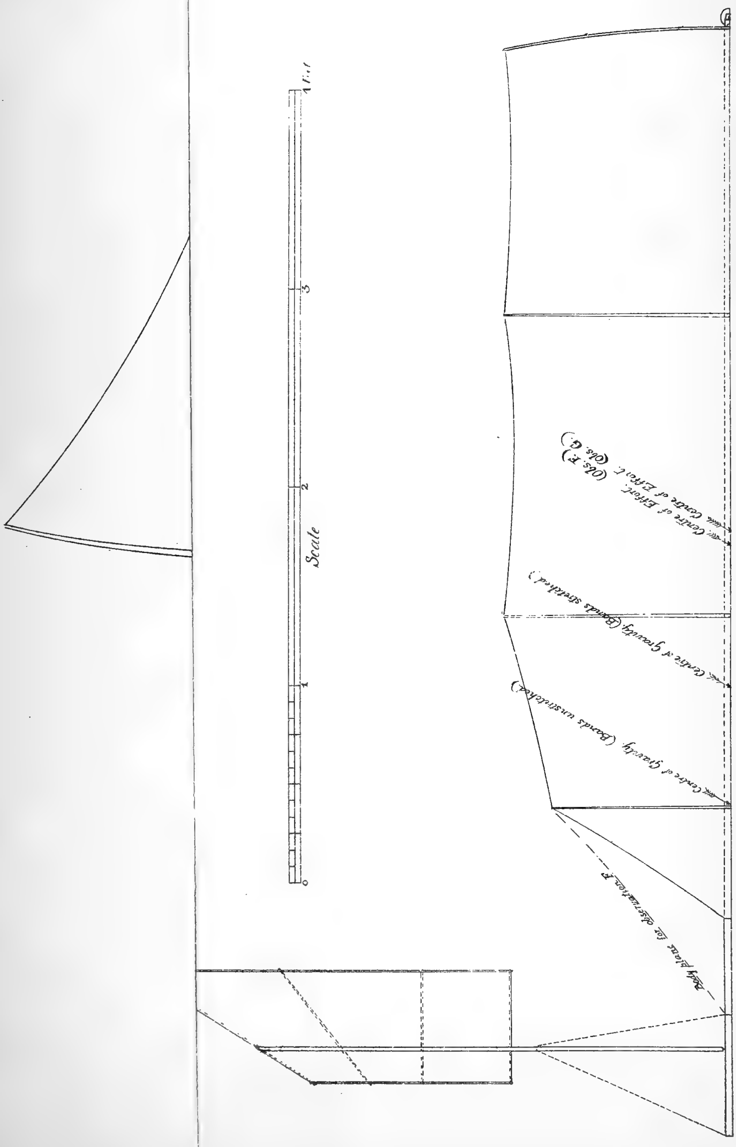
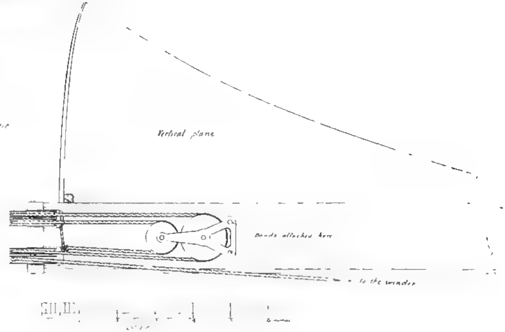


Fig. 3. Half plan of 48 band machine. Observations F&G.

Arrangement of the cord and blocks on the 48 band machine

Fig 4



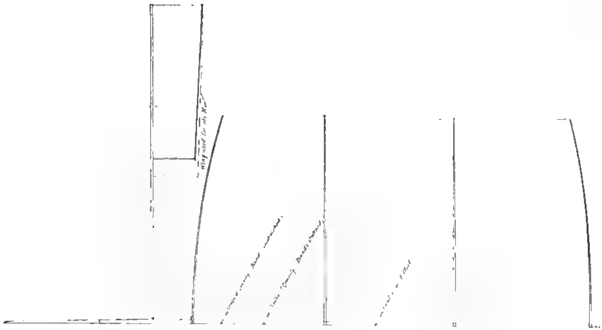


Fig 5 Half plan of 24 band machine

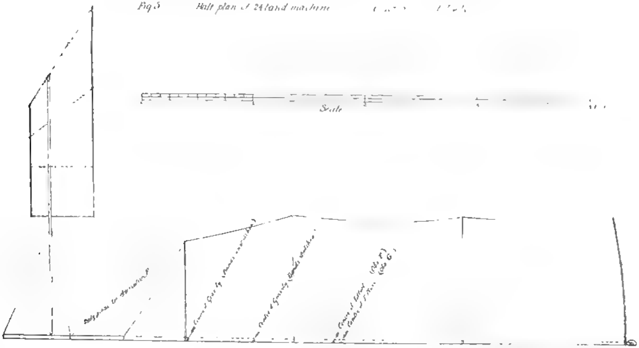
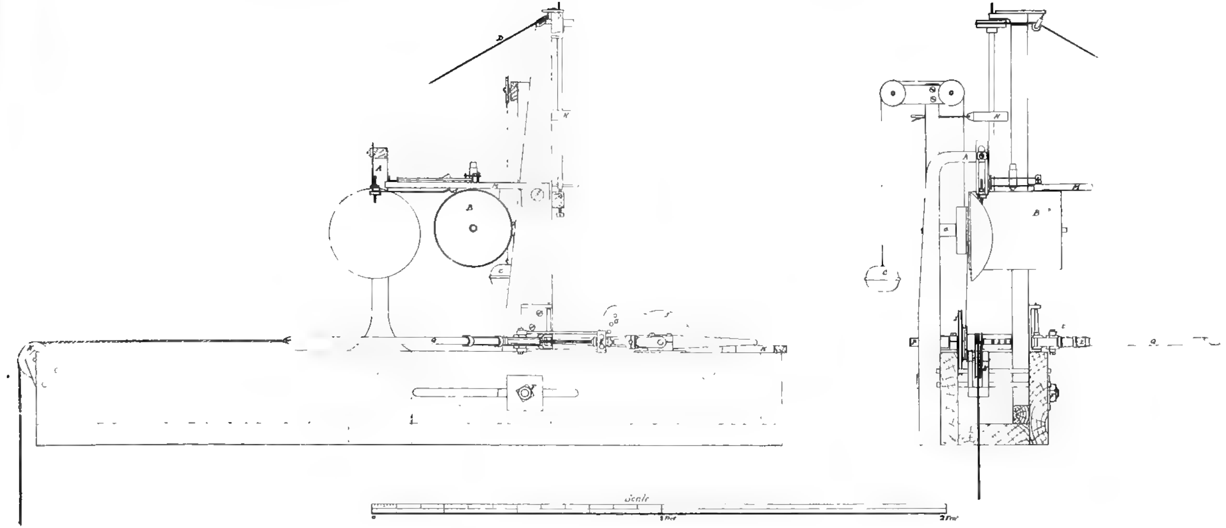


Fig.3. Half plan of 48 band machine Observations F&G

.6.

A. Chron
B. Ind
C. Ind
D. Cord
E. Adj
F. Nut,

Holes
Ind
Pull
Sta
Wedg
Arm
Fair
Bea
Har
Mia



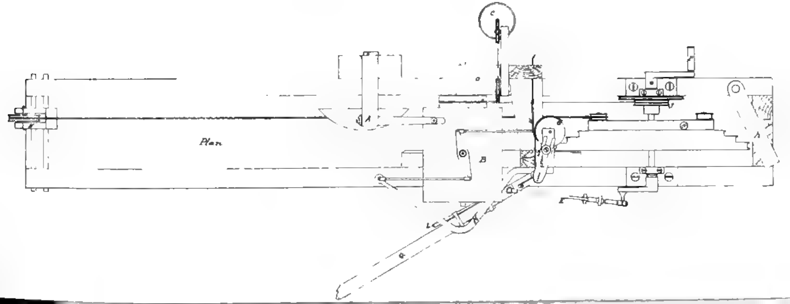
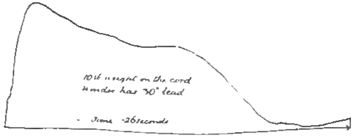


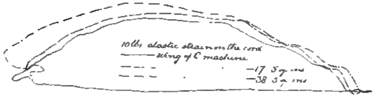
Fig. 6 — *Wing testing Machine*

- A Chronograph ½ oz pendulum 3½ lb bob
- B Indicator drum
- C Indicator drawing weight
- D Cord to the centre of effort of the wing
- E Adjustable connecting rod
- F Nut for altering the distance between the crank shaft and the wing socket
- G Holes for testing the effect of under lead
- H Indicator pencil spring
- J Pulleys to alter the length of the diagrams
- K Starting bolt
- L Wedge for changing wings
- M Arm to carry radius rod centre
- N Fair lead to elastics on 10 lb weight
- O Bracket to hold the axis of indicator drum
- P Handle to turn the machine when adjusting
- Q Midrib of wing

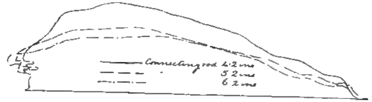
Diag 1



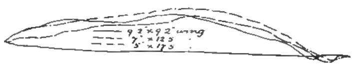
Diag 2



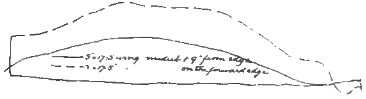
Diag 3



Diag 4



Diag 5



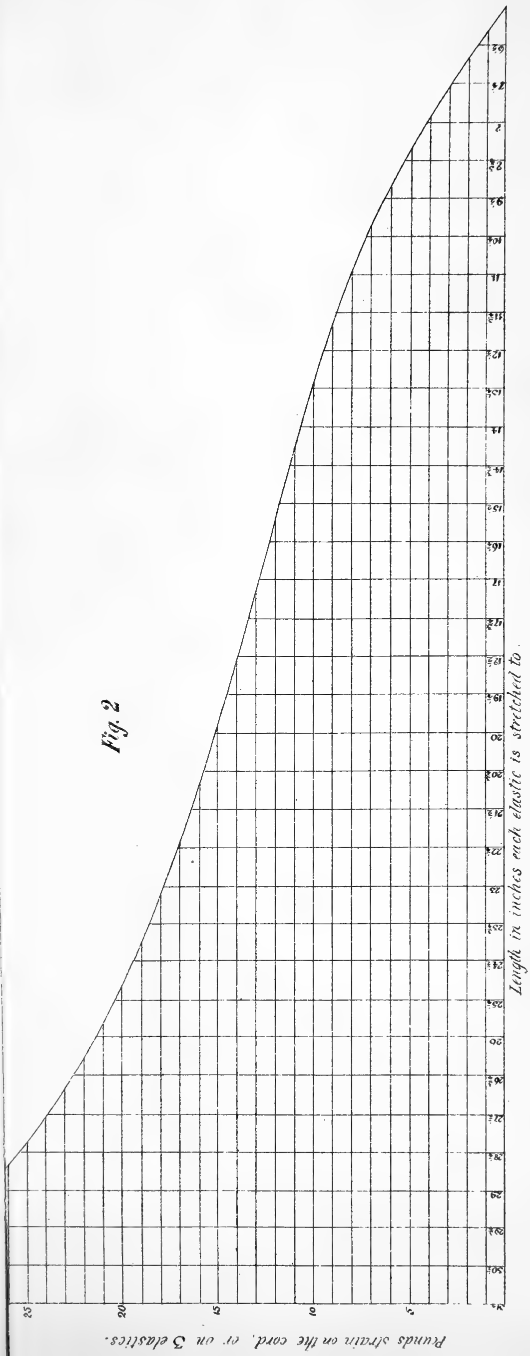
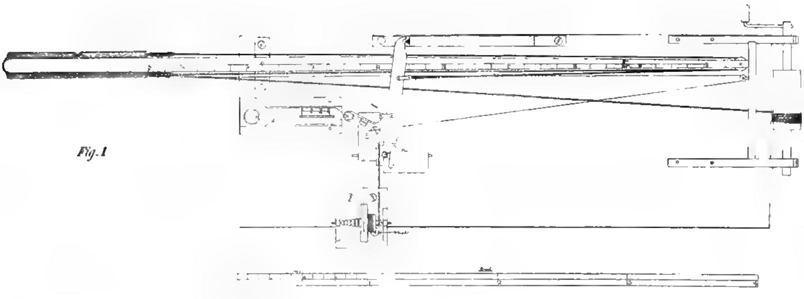


Fig. 2
Length in inches each elastic is stretched to
Pounds strain on the cord, or on 3 elastics.

Fig. 1



Apparatus for taking diagrams from stretched indiarubber bands

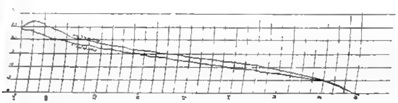
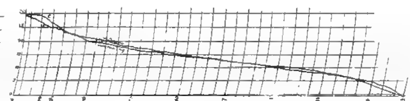


Diagram from 48 bands



24 bands

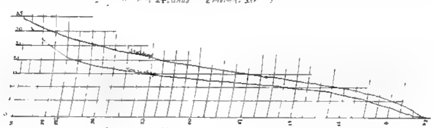
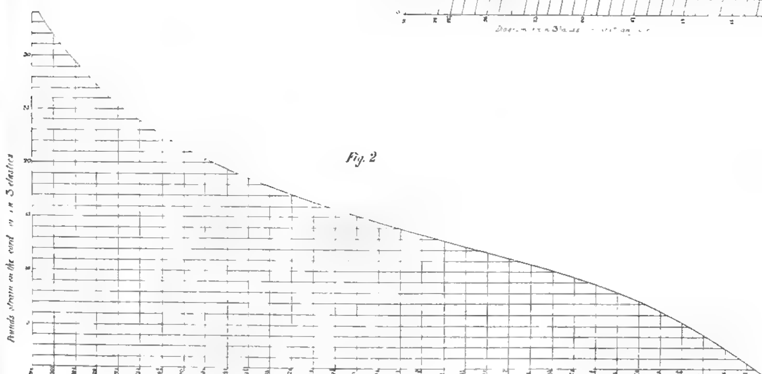
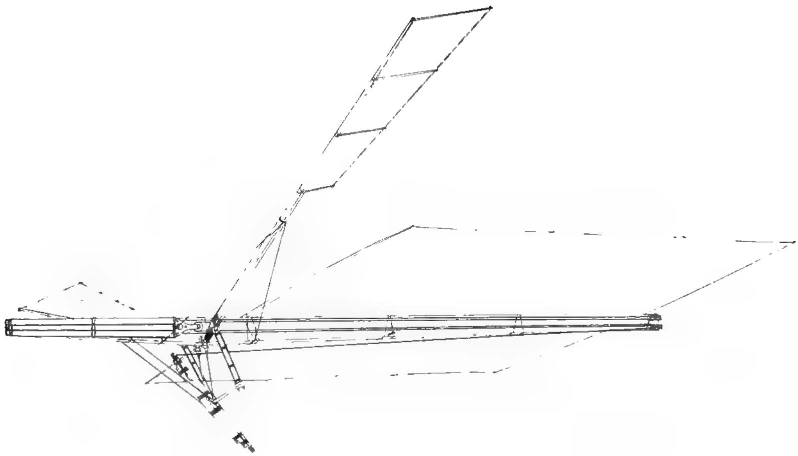


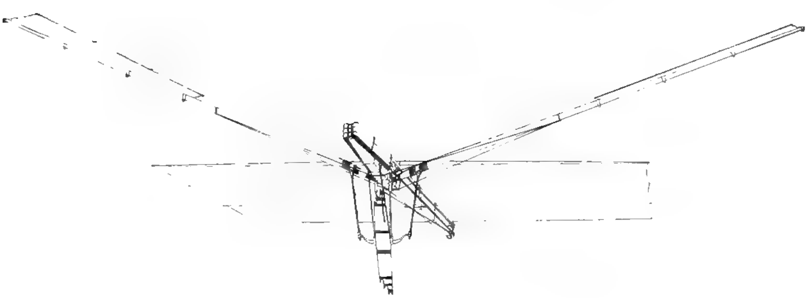
Diagram from 3 bands

Fig. 2



Length in inches each elastic is stretched to





EXPERIMENTAL MODEL OF A FLYING MACHINE.

Total weight of the model	33¼ ounces.
Weight of 48 vulcanised india-rubber bands	10 „
Area of the body plane	1914 square inches.
Area of the wings	216 „
Total area of paper surface	2130 „
Length of the three steps of the winder, respectively, 8, 9 and 10 inches.	
Cranks	1.72 inches.
Connecting Rods	5.23 „
Extreme length of the model	5 feet 7 inches.
Spread of the wings	6 feet 1 inch.
Each wing flaps in an arc of 107° 20′	

There are 470 foot pounds of energy stored in the model when the bands are stretched to the tail by winding the cord on the winder.

The model has flown 270 feet horizontally in a dead calm.

Sydney, N.S.W. LAWRENCE HARGRAVE.