REPORT

OF THE

TWELFTH MEETING

OF THE

BRITISH ASSOCIATION

FOR THE

ADVANCEMENT OF SCIENCE;

HELD AT MANCHESTER IN JUNE 1842.

LONDON:

JOHN MURRAY, ALBEMARLE STREET.

1843.

PRINTED BY RICHARD AND JOHN E. TAYLOR,
RED LION COURT, FLEET STREET.

CONTENTS.

ERRATUM.

Page 12, line 10 of Sections, *for* directed *read* vertical.

TO THE BINDER.

There are only Two Plates in this volume, which are numbered II and IV.

OBJECTS AND RULES

OF

THE ASSOCIATION.

OBJECTS.

The Association contemplates no interference with the ground occupied by other Institutions. Its objects are,—To give a stronger impulse and a more systematic direction to scientific inquiry,—to promote the intercourse of those who cultivate Science in different parts of the British Empire, with one another, and with foreign philosophers,—to obtain a more general attention to the objects of Science, and a removal of any disadvantages of a public kind which impede its progress.

RULES.

MEMBERS.

All Persons who have attended the first Meeting shall be entitled to become Members of the Association, upon subscribing an obligation to conform to its Rules.

The Fellows and Members of Chartered Literary and Philosophical Societies publishing Transactions, in the British Empire, shall be entitled, in like manner, to become Members of the Association.

The Officers and Members of the Councils, or Managing Committees, of Philosophical Institutions, shall be entitled, in like manner, to become Members of the Association.

All Members of a Philosophical Institution, recommended by its Council or Managing Committee, shall be entitled, in like manner, to become Members of the Association.

Persons not belonging to such Institutions shall be elected by the General Committee or Council, to become Members of the Association, subject to the approval of a General Meeting.

SUBSCRIPTIONS.

The amount of the Annual Subscription shall be One Pound, to be paid in advance upon admission; and the amount of the composition in lieu thereof, Five Pounds.

An admission fee of One Pound is required from all Members elected as Annual Subscribers, after the Meeting of 1839, in addition to their annual subscription of One Pound.

The volume of Reports of the Association will be distributed gratuitously to every Annual Subscriber who has actually paid the Annual Subscription for the year to which the volume relates, and to all those Life Members who shall have paid Two Pounds as a *Book Subscription.*

Subscriptions shall be received by the Treasurer or Secretaries.

If the Annual Subscription of any Member shall have been in arrear for two years, and shall not be paid on proper notice, he shall cease to be a Member.

MEETINGS.

The Association shall meet annually, for one week, or longer. The place of each Meeting shall be appointed by the General Committee at the previous Meeting; and the Arrangements for it shall be entrusted to the Officers of the Association.

GENERAL COMMITTEE.

The General Committee shall sit during the week of the Meeting, or longer, to transact the business of the Association. It shall consist of the following persons:—

1. Presidents and Officers for the present and preceding years, with authors of Reports in the Transactions of the Association.

2. Members who have communicated any Paper to a Philosophical Society, which has been printed in its Transactions, and which relates to such subjects as are taken into consideration at the Sectional Meetings of the Association.

3. Office-bearers for the time being, or Delegates, altogether not exceeding three in number, from any Philosophical Society publishing Transactions.

4. Office-bearers for the time being, or Delegates, not exceeding three, from Philosophical Institutions established in the place of Meeting, or in any place where the Association has formerly met.

5. Foreigners and other individuals whose assistance is desired, and who are specially nominated in writing for the Meeting of the year by the President and General Secretaries.

6. The Presidents, Vice-Presidents, and Secretaries of the Sections are *ex officio* members of the General Committee for the time being.

SECTIONAL COMMITTEES.

The General Committee shall appoint, at each Meeting, Committees, consisting severally of the Members most conversant with the several branches of Science, to advise together for the advancement thereof.

The Committees shall report what subjects of investigation they would particularly recommend to be prosecuted during the ensuing year, and brought under consideration at the next Meeting.

The Committees shall recommend Reports on the state and progress of particular Sciences, to be drawn up from time to time by competent persons, for the information of the Annual Meetings.

COMMITTEE OF RECOMMENDATIONS.

The General Committee shall appoint at each Meeting a Committee, which shall receive and consider the Recommendations of the Sectional Committees, and report to the General Committee the measures which they would advise to be adopted for the advancement of Science.

All Recommendations of Grants of Money, Requests for Special Researches, and Reports on Scientific Subjects, shall be submitted to the Committee of Recommendations, and not taken into consideration by the General Committee unless previously recommended by the Committee of Recommendations.

LOCAL COMMITTEES.

Local Committees shall be formed by the Officers of the Association to assist in making arrangements for the Meetings.

Local Committees shall have the power of adding to their numbers those Members of the Association whose assistance they may desire.

OFFICERS.

A President, two or more Vice-Presidents, one or more Secretaries, and a Treasurer, shall be annually appointed by the General Committee.

COUNCIL.

In the intervals of the Meetings, the affairs of the Association shall be managed by a Council appointed by the General Committee. The Council may also assemble for the despatch of business during the week of the Meeting.

PAPERS AND COMMUNICATIONS.

The Author of any paper or communication shall be at liberty to reserve his right of property therein.

ACCOUNTS.

The Accounts of the Association shall be audited annually, by Auditors appointed by the Meeting.

OFFICERS AND COUNCIL, 1842—43.

Trustees (permanent).—Francis Baily, Esq., F.R.S. Roderick Impey Murchison, Esq., F.R.S., Pres. G.S. John Taylor, Esq., F.R.S., Treas. G.S.

President.—The Lord Francis Egerton, M.P., F.G.S.

Vice-Presidents.—John Dalton, D.C.L., F.R.S., &c. The Hon. and Very Rev. Wm. Herbert, LL.D., F.L.S., Dean of Manchester. William Charles Henry, M.D., F.R.S. Sir Benjamin Heywood, Bart. The Rev. Professor A. Sedgwick, M.A., F.R.S., G.S., &c.

President Elect.—The Earl of Rosse.

Vice-Presidents Elect.—The Earl of Listowel. Visc. Adare, M.P., F.R.S. Sir W. R. Hamilton, R.I.A. Rev. T. R. Robinson, D.D.

General Secretaries.—Roderick Impey Murchison, Esq., F.R.S., Pres. G.S., London. Lieut.-Col. Sabine, F.R.S., Woolwich.

Assistant General Secretary.—John Phillips, Esq., F.R.S., York.

General Treasurer.—John Taylor, Esq., F.R.S., &c. 2 Duke Street, Adelphi, London.

Secretaries for the Cork Meeting in 1843.—John Stevelly, M.A., Prof. of Nat. Phil., Belfast. Rev. Jos. Carson, Fellow of Trin. Coll., Dublin. Wm. Keleher, Esq., Cork.

Treasurer to the Meeting in 1843.—James Roche, Esq., Cork.

Council.—Sir H. T. De la Beche. Sir David Brewster. Sir Thomas Brisbane. Rev. Dr. Buckland. Dr. Daubeny. Professor Forbes. Professor T. Graham. G. B. Greenough, Esq. W. J. Hamilton, Esq. Rev. W. V. Harcourt. Leonard Horner, Esq. Robert Hutton, Esq. Sir Charles Lemon, Bart. Rev. Professor Lloyd. The Marquis of Northampton. Rev. Dr. Peacock (Dean of Ely). Dr. Richardson. Sir John Robison. Dr. Roget. Rev. Professor Sedgwick. H. E. Strickland, Esq. Lieut.-Col. Sykes. Professor Wheatstone. Rev. William Whewell (Master of Trin. Coll., Cambridge). C. J. B. Williams, M.D. Rev. Professor Willis. James Yates, Esq.

Local Treasurers.—Dr. Daubeny, Oxford. C. C. Babington, Esq., Cambridge. Dr. Orpen, Dublin. Charles Forbes, Esq., Edinburgh and Glasgow. William Gray, jun., Esq., York. William Sanders, Esq., Bristol. Samuel Turner, Esq., Liverpool. Rev. John James Tayler, Manchester. James Russell, Esq., Birmingham. William Hutton, Esq., Newcastle-on-Tyne. Henry Woollcombe, Esq., Plymouth. James Roche, Esq., Cork.

Auditors.—William Yarrell, Esq. Robert Hutton, Esq. James Heywood, Esq.

I. Table showing the Places and Times of Meeting of the British Association, with Presidents, Vice-Presidents, and Local Secretaries, from its Commencement.

Presidents.	Vice-Presidents.	Local Secretaries.
The EARL FITZWILLIAM, D.C.L., F.R.S., F.G.S., &c. YORK, September 27, 1831.	Rev. W. Vernon Harcourt, M.A., F.R.S., F.G.S.	William Gray, jun., F.G.S. Professor Phillips, F.R.S., F.G.S.
The REV. W. BUCKLAND, D.D., F.R.S., F.G.S., &c. OXFORD, June 19, 1832.	Sir David Brewster, F.R.SS.L. & E., &c. Rev. W. Whewell, F.R.S., Pres. Geol. Soc.	Professor Daubeny, M.D., F.R.S., &c. Rev. Professor Powell, M.A., F.R.S., &c.
The REV. ADAM SEDGWICK, M.A., V.P.R.S., V.P.G.S. CAMBRIDGE, June 25, 1833.	G. B. Airy, F.R.S., Astronomer Royal, &c. John Dalton, D.C.L., F.R.S.	Rev. Professor Henslow, M.A., F.L.S., F.G.S. Rev. W. Whewell, F.R.S.
Sir T. MACDOUGAL BRISBANE, K.C.B., D.C.L., F.R.SS. L. & E. EDINBURGH, September 8, 1834.	Sir David Brewster, F.R.S., &c. Rev. T. R. Robinson, D.D.	Professor Forbes, F.R.S., L. & E., &c. Sir John Robison, Sec. R.S.E.
The REV. PROVOST LLOYD, LL.D. DUBLIN, August 10, 1835.	Viscount Oxmantown, F.R.S., F.R.A.S. Rev. W. Whewell, F.R.S., &c.	Sir W. R. Hamilton, Astron. Royal of Ireland, &c. Rev. Professor Lloyd, F.R.S.
The MARQUIS OF LANSDOWNE, D.C.L., F.R.S., &c. BRISTOL, August 22, 1836.	The Marquis of Northampton, F.R.S. Rev. W. D. Conybeare, F.R.S., F.G.S. J. C. Prichard, M.D., F.R.S.	Professor Daubeny, M.D., F.R.S., &c. V. F. Hovenden.
The EARL OF BURLINGTON, F.R.S., F.G.S., Chan. Univ. London. LIVERPOOL, September 11, 1837.	The Bishop of Norwich, P.L.S., F.G.S. John Dalton, D.C.L., F.R.S. Sir Philip Grey Egerton, Bart., F.R.S., F.G.S. Rev. W. Whewell, F.R.S.	Professor Traill, M.D. Wm. Wallace Currie, Esq. Joseph N. Walker, Pres. Royal Institution, Liverpool.
The DUKE OF NORTHUMBERLAND, F.R.S., F.G.S., &c. NEWCASTLE-ON-TYNE, August 20, 1838.	The Bishop of Durham, F.R.S., F.S.A. The Rev. W. Vernon Harcourt, F.R.S., &c. Prideaux John Selby, Esq., F.R.S.E.	John Adamson, F.L.S., &c. Wm. Hutton, F.G.S. Professor Johnston, M.A., F.R.S.
The REV. W. VERNON HARCOURT, M.A., F.R.S., &c. BIRMINGHAM, August 26, 1839.	The Marquis of Northampton The Earl of Dartmouth The Rev. T. R. Robinson, D.D. John Corrie, Esq., F.R.S. Very Rev. Principal Macfarlane	George Barker, Esq., F.R.S. Peyton Blakiston, M.D. Joseph Hodgson, Esq., F.R.S. Follett Osler, Esq.
The MOST NOBLE THE MARQUIS OF BREADALBANE. GLASGOW, September 17, 1840.	Major-General Lord Greenock, F.R.S.E. Sir David Brewster, F.R.S. Sir T. M. Brisbane, Bart., F.R.S.	Andrew Liddell, Esq. Rev. J. P. Nicol, LL.D. John Strang, Esq.
The REV. PROFESSOR WHEWELL, F.R.S., &c. PLYMOUTH, July 29, 1841.	The Earl of Mount Edgecumbe The Earl of Morley Lord Eliot, M.P. Sir C. Lemon, Bart. Sir T. D. Acland, Bart.	Wm. Snow Harris, Esq., F.R.S. Col. Hamilton Smith, F.L.S. Robert Were Fox, F.R.S. Richard Taylor, jun., Esq.
LORD FRANCIS EGERTON, F.G.S. MANCHESTER, June 23, 1842.	John Dalton, D.C.L., F.R.S. Hon. and Rev. W. Herbert, F.L.S., &c. W. C. Henry, M.D., F.R.S. Sir Benjamin Heywood, Bart. Rev. A. Sedgwick, M.A., F.R.S.	Peter Clare, Esq., F.R.A.S. W. Fleming, M.D. James Heywood, Esq., F.R.S.
The EARL OF ROSSE. CORK, August 1843.	Earl of Listowel Viscount Adare Sir W. R. Hamilton, Pres. R.I.A. Rev. T. R. Robinson, D.D.	Professor John Stevelly, M.A. Rev. Jos. Carson, F.T.C. Dublin. Wm. Keleher, Esq.

II. Table showing the Members of Council of the British Association from its Commencement, in addition to Presidents, Vice-Presidents, and Local Secretaries.

General Secretaries.	Rev. Wm. Vernon Harcourt, F.R.S., &c. ......1832—1836.
	Francis Baily, V.P. and Treas. R.S. ....1835.
	R. I. Murchison, F.R.S., F.G.S. ....1836—1842.
	Rev. G. Peacock, F.R.S., F.G.S.. &c. ....1837, 1838.
	Lieut.-Colonel Sabine, V.P.R.S. ....1839, 1842.
General Treasurer.	John Taylor, F.R.S., Treas. G.S., &c...........1832—1842.
Trustees (permanent).	Charles Babbage, F.R.SS.L. & E., &c. (Resigned.)
	R. I. Murchison, F.R.S., &c.
	John Taylor, F.R.S., &c.
	Francis Baily, F.R.S.
Assistant General Secretary.	Professor Phillips, F.R.S., &c. ....1832—1842.

Members of Council.

G. B. Airy, F.R.S., Astronomer Royal ......1834, 1835, 1841.
Neill Arnott, M.D. ....1838, 1839, 1840.
Francis Baily, V.P. and Treas. R.S. ....1837—1839.
Sir H. T. De la Beche, F.R.S...................1841, 1842.
George Bentham, F.L.S. ....1834, 1835.
Robert Brown, D.C.L., F.R.S...................1832, 1834, 1835, 1838—1841.
Sir David Brewster, F.R.S., &c. ....1832, 1841—1842.
Sir Thomas Brisbane. ....1842.
Sir M. I. Brunel, F.R.S., &c. ....1832.
Rev. Professor Buckland, D.D., F.R.S., &c. 1833, 1835, 1838—1842.
The Earl of Burlington ....1838, 1839.
Rev. T. Chalmers, D.D., Prof. of Divinity, Edinburgh ....1833.
Professor Clark, Cambridge.....................1838.
Professor Christie, F.R.S., &c. ....1833—1837.
William Clift, F.R.S., F.G.S. ....1832—1835.
J. C. Colquhoun, Esq. ....1840.
John Corrie, F.R.S., &c. ....1832.
Professor Daniell, F.R.S.........................1836, 1839.
Dr. Daubeny ....1838—1842.
J. E. Drinkwater ....1834, 1835.
Sir P. G. Egerton, Bart. ....1840, 1841.
The Earl Fitzwilliam, D.C.L., F.R.S., &c...1833.
Professor Forbes, F.R.SS. L. & E., &c ......1832, 1841, 1842.
Davies Gilbert, D.C.L., V.P.R.S., &c. ......1832.
Professor R. Graham, M.D., F.R.S.E. ......1837.
Professor Thomas Graham, F.R.S............1838, 1839—1842.
John Edward Gray, F.R.S., F.L.S., &c. ...1837—1839, 1840.
Professor Green, F.R.S., F.G.S. ....1832.
G. B. Greenough, F.R.S., F.G.S. ....1832—1839—1842.
Henry Hallam, F.R.S., F.S.A., &c. ....1836.
Rev. W. V. Harcourt, F.R.S. ....1842.
Sir William R. Hamilton, Astron. Royal of Ireland ....1832, 1833, 1836.
W. J. Hamilton, Sec. G.S. ....1840—1842.
Rev. Prof. Henslow, M.A., F.L.S., F.G.S. .1837.
Sir John F. W. Herschel, F.R.SS. L. & E. F.R.A.S., F.G.S., &c. ....1832.
Thomas Hodgkin, M.D. ....1833—1837, 1839, 1840.
Prof. Sir W. J. Hooker, LL.D., F.R.S., &c.1832.
Leonard Horner, F.R.S. ....1841, 1842.
Rev. F. W. Hope, M.A., F.L.S..............1837.
Robert Hutton, F.G.S., &c.......................1836, 1838, 1839—1842.
Professor R. Jameson, F.R.SS. L. & E.......1833.

Rev. Leonard Jenyns ....1838.
H. B. Jerrard, Esq. ....1840.
Dr. R. Lee ....1839.
Sir Charles Lemon, Bart. ....1838, 1839, 1842.
Rev. Dr. Lardner ....1838, 1839.
Professor Lindley, F.R.S., F.L.S., &c. ......1833, 1836.
Rev. Professor Lloyd, D.D. ....1832, 1833, 1841, 1842.
J. W. Lubbock, F.R.S., F.L.S., &c., Vice-
Chancellor of the University of London ...1833—1836, 1838, 1839.
Rev. Thomas Luby ....1832.
Charles Lyell, jun., F.R.S. ....1838, 1839, 1840.
William Sharp MacLeay, F.L.S. ....1837.
Professor Miller, F.G.S. ....1840.
Professor Moseley ....1839, 1840.
Patrick Neill, LL.D., F.R.S.E. ....1833.
The Marquis of Northampton, P.R.S. ....1840—1842.
Richard Owen, F.R.S., F.L.S. ....1836, 1838, 1839.
Rev. Geo. Peacock, D.D., M.A., F.R.S., &c.1832, 1834, 1835, 1839—1842.
E. Pendarves, Esq. ....1840.
Rev. Professor Powell, M.A., F.R.S., &c. ...1836, 1837, 1839, 1840.
J. C. Prichard, M.D., F.R.S., &c. ....1832.
George Rennie, F.R.S. ....1833—1835, 1839, 1841.
Sir John Rennie ....1838.
Dr. Richardson, F.R.S. ....1841, 1842.
Rev. Professor Ritchie, F.R.S. ....1833.
Rev. T. R. Robinson, D.D. ....1841.
Sir John Robison, Sec. R.S.E. ....1832, 1836, 1841, 1842.
P. M. Roget, M.D., Sec. R.S., F.G.S., &c....1834—1837, 1841, 1842.
Lieut.-Colonel Sabine ....1838.
Lord Sandon ....1840.
Rev. Professor Sedgwick, M.A., F.R.S. ......1842.
Rev. William Scoresby, B.D., F.R.SS. L. & E.1832.
H. E. Strickland, Esq., F.G.S. ....1840—1842.
Lieut.-Col. W. H. Sykes, F.R.S., F.L.S., &c.1837—1839, 1842.
H. Fox Talbot, Esq., F.R.S. ....1840.
Rev. J. J. Tayler, B.A., Manchester ....1832.
Professor Traill, M.D. ....1832, 1833.
N. A. Vigors, M.P., D.C.L., F.S.A., F.L.S...1832, 1836, 1840.
James Walker, Esq., P.S.C.E. ....1840.
Captain Washington, R.N. ....1838, 1839, 1840.
Professor Wheatstone ....1838—1842.
Rev.W.Whewell,F.R.S.,MasterofT.C.Camb.1838, 1839, 1842.
C. J. B. Williams, M.D. ....1842.
Rev. Prof. Willis, M.A., F.R.S. ....1842.
William Yarrell, F.L.S ....1833—1836.
James Yates, Esq., M.A., F.R.S. ....1842.

Secretaries to the Council. { Edward Turner, M.D., F.R.SS. L. & E. 1832—1836.
James Yates, F.R.S., F.L.S., F.G.S. 1831—1840. }

OFFICERS OF SECTIONAL COMMITTEES AT THE MANCHESTER MEETING.

SECTION A.—MATHEMATICAL AND PHYSICAL SCIENCE.

President.—The Very Rev. George Peacock, D.D., F.R.S., Dean of Ely.

Vice-Presidents.—Sir D. Brewster, K.H., F.R.S. Sir T. M. Brisbane, K.C.B., F.R.S. Rev. Professor Lloyd, F.R.S. Sir W. R. Hamilton.

Secretaries.—Professor Stevelly, M.A. Rev. W. Scoresby, F.R.S. Professor McCullagh, M.R.I.A.

SECTION B.—CHEMISTRY AND MINERALOGY.

President.—John Dalton, D.C.L., F.R.S.

Vice-Presidents.—Marquis of Northampton, F.R.S. Professor T. Graham, F.R.S. Rev. W. V. Harcourt, F.R.S. Michael Faraday, F.R.S. C. Henry, M.D., F.R.S.

Secretaries.—Dr. Lyon Playfair. Robert Hunt. John Graham.

SECTION C.—GEOLOGY AND PHYSICAL GEOGRAPHY.

President.—R. I. Murchison, F.R.S., &c., Pres. G.S.

Vice-Presidents.—Sir H. T. De la Beche, F.R.S., F.G.S. Rev. W. Buckland, D.D., F.R.S., F.G.S. Rev. A. Sedgwick, F.R.S., F.G.S. R. Griffith, F.R.S.

Secretaries.—H. E. Strickland, F.G.S. G. Lloyd, M.D., F.G.S. E. W. Binney, Sec. Manch. Geol. Soc. R. Hutton, F.G.S.

SECTION D.—ZOOLOGY AND BOTANY.

President.—The Hon. and Very Rev. Wm. Herbert, LL.D., F.L.S., Dean of Manchester.

Vice-Presidents.—John Richardson, M.D., F.R.S. John Moore, F.L.S. Sir William Jardine, Bart., F.R.S.E. The Bishop of Norwich, P.L.S.

Secretaries.—E. Lankester, M.D., F.L.S. R. Patterson. J. A. Turner.

SECTION E.—MEDICAL SCIENCE.

President.—Edward Holme, M.D., F.L.S.

Vice-Presidents.—Jas. Lomax Bardsley, M.D. C. B. Williams, M.D.

Secretaries.—Dr. Sargent, and Dr. Chaytor.

SECTION F.—STATISTICS.

President.—George William Wood, M.P., F.L.S.

Vice-Presidents.—Lieut.-Col. Sykes, F.R.S. Henry Hallam, F.R.S. Sir Charles Lemon, Bart., F.R.S. G. R. Porter.

Secretaries.—Rev. R. Luney, M.A. G. W. Ormerod, M.A. Wm. Cooke Taylor, LL.D.

SECTION G.—MECHANICAL SCIENCE.

President.—Rev. Professor Willis, M.A., F.R.S., &c. &c.

Vice-Presidents.—William Fairbairn, C.E. Eaton Hodgkinson, F.R.S. Sir M. I. Brunel, F.R.S. Sir John Robison, F.R.S.E., Pres. R.S.A.

Secretaries.—James Thomson, F.R.S.E., Civil Engineer. J. Scott Russell, M.A., F.R.S.E. I. F. Bateman, C.E. C. Vignoles, F.R.A.S.

CORRESPONDING MEMBERS.

Professor Agassiz, Neufchatel. M. Arago, Secretary of the Institute, Paris. A. D. Bache, Philadelphia. Professor Berzelius, Stockholm. Professor Bessel, Königsberg. Professor H. von Boguslawski, Breslau. Professor Braschmann, Moscow. Professor De la Rive, Geneva. Professor Dumas, Paris. Professor Ehrenberg, Berlin. Professor Encke, Berlin. Dr. A. Erman, Berlin. M. Frisiani, Astronomer, Milan. Baron Alexander von Humboldt, Berlin. M. Jacobi, St. Petersburgh. Professor Jacobi, Königsberg, Dr. Lamont, Munich. Professor Liebig, Giessen. Professor Link, Berlin. Professor Œrsted, Copenhagen. M. Otto, Breslau. Jean Plana, Astronomer Royal, Turin. M. Quetelet, Brussels. Professor C. Ritter, Berlin. Professor Schumacher, Altona. Professor Wartmann, Lausanne.

TREASURER'S ACCOUNT from

RECEIPTS.

	£	s.	d.	£	s.	d.
Balance in hand from last year's Account				367	3	11
Life Compositions from Members at Plymouth Meeting and since	358	0	0			
Annual Subscriptions ...Ditto.........Ditto...Ditto	773	1	0			
				1131	1	0
Compositions for Books (future publications)	563	2	0			
Moieties of £5 Compositions Refunded	50	0	0			
				513	2	0
Dividend on £6000 in 3 per cent. Consols, 6 months, to January 1842.				90	0	0
Proceeds of Sale of £500 3 per cent. Consols				452	1	0
Received on account of Sale of Reports, viz.						
1st vol., 2nd Edition	4	13	9			
2nd vol.	3	15	2			
3rd vol.	4	6	0			
4th vol.	5	1	9			
5th vol	5	12	0			
6th vol.	13	0	9			
7th vol.	21	9	0			
8th vol	30	6	7			
Lithographs	0	18	0			
				89	3	0
Received for Ladies' Tickets at Plymouth				261	0	0
				£2903	10	11

WILLIAM YARRELL,
ROBERT HUTTON,
JAMES HEYWOOD,
} AUDITORS.

24th July 1841 to the 23rd June 1842.

PAYMENTS.

			£ s. d.	£ s. d.
Sundry Disbursements by Treasurer and Local Treasurers, including the expenses of the Plymouth Meeting, Advertising, and Sundry Printing				321 15 5
Paid Balance of Account for printing, &c. Tenth Report			266 11 6	
Paid on account of Engraving for Eleventh Report			21 11 10	
				288 3 4
Salaries to Assistant Secretary, Accountant, &c....				305 0 0
Grants to Committees for Scientific purposes, viz.—for				
Dynamometric Instruments	1840	100 0 0		
Do.	1841	13 11 2		
			113 11 2	
Anopleura Britannica	1840		52 12 0	
Tides at Bristol	,,	50 0 0		
Do.	1841	9 8 0		
			59 8 0	
Action of Gases on Light	1840		30 14 7	
Roberts's Chronometers	,,		26 17 6	
Marine Zoology of Great Britain	,,		1 5 0	
British Fossil Mammalia	1841		100 0 0	
Statistics of Education	1840		20 0 0	
Marine Steam-vessel Engines	1838		28 0 0	
Reduction of Stars in Histoire Céleste	1841		59 0 0	
British Association Catalogue of Stars	,,		110 0 0	
Coloured Drawings of Railway Sections......	1840	11 10 0		
Do.	1841	150 0 0		
			161 10 0	
British Belemnites	,,		50 0 0	
Fossil Reptiles (Publication of Drawings and Report)	,,		210 0 0	
Forms of Vessels	1840	100 0 0		
Do.	1841	80 0 0		
			180 0 0	
Galvanic Experiments on Rocks	1838		5 8 6	
Meteorological Observations and Anemometers at Plymouth	1841		68 0 0	
Constant Indicator	,,		90 0 0	
Velocity and Force of Wind	,,		10 0 0	
Light on Germination of Seeds and Growth of Plants	,,		8 0 0	
Vital Statistics	,,		50 0 0	
Growth and Vitality of Seeds	,,		8 1 11	
Questions on the Races of Men	1840		7 9 0	
				1449 17 8
Balance in Bankers' hands			337 0 9	
Do. in Treasurer & Local Treasurers' hands			201 13 9	
				538 14 6
				£2903 10 11

The following Reports on the Progress and Desiderata of different branches of Science have been drawn up at the request of the Association, and printed in its Transactions.

1831-32.

On the progress of Astronomy during the present century, by G. B. Airy, M.A., Astronomer Royal.

On the state of our knowledge respecting Tides, by J. W. Lubbock, M.A., Vice-President of the Royal Society.

On the recent progress and present state of Meteorology, by James D. Forbes, F.R.S., Professor of Natural Philosophy, Edinburgh.

On the present state of our knowledge of the science of Radiant Heat, by the Rev. Baden Powell, M.A., F.R.S., Savilian Professor of Geometry, Oxford.

On Thermo-electricity, by the Rev. James Cumming, M.A., F.R.S., Professor of Chemistry, Cambridge.

On the recent progress of Optics, by Sir David Brewster, K.C.G., LL.D., F.R.S., &c.

On the recent progress and present state of Mineralogy, by the Rev. William Whewell, M.A., F.R.S.

On the progress, actual state, and ulterior prospects of Geology, by the Rev. William Conybeare, M.A., F.R.S., V.P.G.S., &c.

On the recent progress and present state of Chemical Science, by J. F. W. Johnston, A.M., Professor of Chemistry, Durham.

On the application of Philological and Physical researches to the History of the Human species, by J. C. Prichard, M.D., F.R.S., &c.

1833.

On the advances which have recently been made in certain branches of Analysis, by the Rev. G. Peacock, M.A., F.R.S., &c.

On the present state of the Analytical Theory of Hydrostatics and Hydrodynamics, by the Rev. John Challis, M.A., F.R.S., &c.

On the state of our knowledge of Hydraulics, considered as a branch of Engineering, by George Rennie, F.R.S., &c. (Parts I. and II.)

On the state of our knowledge respecting the Magnetism of the Earth, by S. H. Christie, M.A., F.R.S., Professor of Mathematics, Woolwich.

On the state of our knowledge of the Strength of Materials, by Peter Barlow, F.R.S.

On the state of our knowledge respecting Mineral Veins, by John Taylor, F.R.S., Treasurer G.S., &c.

On the Physiology of the Nervous System, by William Charles Henry, M.D.

On the recent progress of Physiological Botany, by John Lindley, F.R.S., Professor of Botany in the University of London.

1834.

On the Geology of North America, by H. D. Rogers, F.G.S.

On the philosophy of Contagion, by W. Henry, M.D., F.R.S.

On the state of Physiological Knowledge, by the Rev. Wm. Clark, M.D., F.G.S., Professor of Anatomy, Cambridge.

On the state and progress of Zoology, by the Rev. Leonard Jenyns, M.A., F.L.S., &c.

On the theories of Capillary Attraction, and of the Propagation of Sound as affected by the Development of Heat, by the Rev. John Challis, M.A., F.R.S., &c.

On the state of the science of Physical Optics, by the Rev. H. Lloyd, M.A., Professor of Natural Philosophy, Dublin.

1835.

On the state of our knowledge respecting the application of Mathematical and Dynamical principles to Magnetism, Electricity, Heat, &c., by the Rev. William Whewell, M.A., F.R.S.

On Hansteen's researches in Magnetism, by Captain Sabine, F.R.S.

On the state of Mathematical and Physical Science in Belgium, by M. Quetelet, Director of the Observatory, Brussels.

1836.

On the present state of our knowledge with respect to Mineral and Thermal Waters, by Charles Daubeny, M.D., F.R.S., M.R.I.A., &c., Professor of Chemistry and of Botany, Oxford.

On North American Zoology, by John Richardson, M.D., F.R.S., &c.

Supplementary Report on the Mathematical Theory of Fluids, by the Rev. J. Challis, Plumian Professor of Astronomy in the University of Cambridge.

1837.

On the variations of the Magnetic Intensity observed at different points of the Earth's surface, by Major Edward Sabine, R.A., F.R.S.

On the various modes of Printing for the use of the Blind, by the Rev. William Taylor, F.R.S.

On the present state of our knowledge in regard to Dimorphous Bodies, by Professor Johnston, F.R.S.

On the Statistics of the Four Collectorates of Dukhun, under the British Government, by Col. Sykes, F.R.S.

1838.

Appendix to Report on the variations of Magnetic Intensity, by Major Edward Sabine, R.A., F.R.S.

1839.

Report on the present state of our knowledge of Refractive Indices for the Standard Rays of the Solar Spectrum in different media, by the Rev. Baden Powell, M.A., F.R.S., F.G.S., F.R.Ast.S., Savilian Professor of Geometry, Oxford.

Report on the distribution of Pulmoniferous Mollusca in the British Isles, by Edward Forbes, M.W.S., For. Sec. B.S.

Report on British Fossil Reptiles, Part I., by Richard Owen, Esq., F.R.S., F.G.S., &c.

1840.

Report on the recent progress of discovery relative to Radiant Heat, supplementary to a former Report on the same subject inserted in the first volume of the Reports of the British Association for the Advancement of Science, by the Rev. Baden Powell, M.A., F.R.S., F.R.Ast.S., F.G.S., Savilian Professor of Geometry in the University of Oxford.

Supplementary Report on Meteorology, by James D. Forbes, Esq., F.R.S., Sec. R.S. Ed., Professor of Natural Philosophy in the University of Edinburgh.

1841.

Report on the conduction of Heat, by Professor Kelland, F.R.S., &c.

Report on the state of our knowledge of Fossil Reptiles, Part II., by Professor R. Owen, F.R.S.

1842.

Abstract of Professor Liebig's Report on Organic Chemistry applied to Physiology and Pathology, by Lyon Playfair, M.D.

Report on the Ichthyology of New Zealand, by John Richardson, M.D., F.R.S.

On the Fossil Fishes of the Old Red Sandstone, by Professor Agassiz.

Report on British Fossil Mammalia (Part I.), by Professor Owen.

The following Reports of Researches undertaken at the request of the Association have been published in its Transactions, viz.

1835.

On the comparative measurement of the Aberdeen Standard Scale, by Francis Baily, Treasurer R.S., &c.

On Impact upon Beams, by Eaton Hodgkinson.

Observations on the Direction and Intensity of the Terrestrial Magnetic Force in Ireland, by the Rev. H. Lloyd, Capt. Sabine, and Capt. J. C. Ross.

On the phænomena usually referred to the Radiation of Heat, by H. Hudson, M.D.

Experiments on Rain at different Elevations, by Wm. Gray, jun., and Professor Phillips (Reporter).

Hourly Observations of the Thermometer at Plymouth, by W. S. Harris.

On the Infra-orbital Cavities in Deers and Antelopes, by A. Jacob, M.D.

On the Effects of Acrid Poisons, by T. Hodgkin, M.D.

On the Motions and Sounds of the Heart, by the Dublin Sub-Committee.

On the Registration of Deaths, by the Edinburgh Sub-Committee.

1836.

Observations on the Direction and Intensity of the Terrestrial Magnetic Force in Scotland, by Major Edward Sabine, R.A., F.R.S., &c.

Comparative view of the more remarkable Plants which characterize the Neighbourhood of Dublin, the Neighbourhood of Edinburgh, and the South-west of Scotland, &c.; drawn up for the British Association by J. T. Mackay, M.R.I.A., A.L.S., &c.; assisted by Robert Graham, Esq., M.D., Professor of Botany in the University of Edinburgh.

Report of the London Sub-Committee of the Medical Section of the British Association on the Motions and Sounds of the Heart.

Report of the Dublin Committee on the Pathology of the Brain and Nervous System.

Account of the Recent Discussions of Observations of the Tides which have been obtained by means of the grant of money which was placed at the disposal of the Author for that purpose at the last meeting of the Association, by J. W. Lubbock, Esq.

Observations for determining the Refractive Indices for the Standard Rays of the Solar Spectrum in various media, by the Rev. Baden Powell, M.A., F.R.S., Savilian Professor of Geometry in the University of Oxford.

Provisional Report on the Communication between the Arteries and Absorbents, on the part of the London Committee, by Dr. Hodgkin.

Report of Experiments on Subterranean Temperature, under the direction of a Committee, consisting of Professor Forbes, Mr. W. S. Harris, Professor Powell, Lieut.-Colonel Sykes, and Professor Phillips (Reporter).

Inquiry into the validity of a method recently proposed by George B. Jerrard, Esq., for Transforming and Resolving Equations of Elevated Degrees; undertaken, at the request of the Association, by Professor Sir W. R. Hamilton.

1837.

Account of the Discussions of Observations of the Tides which have been obtained by means of the grant of money which was placed at the disposal of the Author for that purpose at the last Meeting of the Association, by J. W. Lubbock, Esq., F.R.S.

On the difference between the Composition of Cast Iron produced by the Cold and the Hot Blast, by Thomas Thomson, M.D., F.R.SS. L. & E., &c., Professor of Chemistry, Glasgow.

On the Determination of the Constant of Nutation by the Greenwich Observations, made as commanded by the British Association, by the Rev. T. R. Robinson, D.D.

On some Experiments on the Electricity of Metallic Veins, and the Temperature of Mines, by Robert Were Fox.

Provisional Report of the Committee of the Medical Section of the British Association, appointed to investigate the Composition of Secretions, and the Organs producing them.

Report from the Committee for inquiring into the Analysis of the Glands, &c. of the Human Body, by G. O. Rees, M.D., F.G.S.

Second Report of the London Sub-Committee of the Medical Section of the British Association, on the Motions and Sounds of the Heart.

Report from the Committee for making experiments on the Growth of Plants under Glass, and without any free communication with the outward air, on the plan of Mr. N. I. Ward of London.

Report of the Committee on Waves, appointed by the British Association at Bristol in 1836, and consisting of Sir John Robison, K.H., Secretary of the Royal Society of Edinburgh, and John Scott Russell, Esq., M.A., F.R.S. Edin. (Reporter).

On the Relative Strength and other mechanical Properties of Cast Iron obtained by Hot and Cold Blast, by Eaton Hodgkinson, Esq.

On the Strength and other Properties of Iron obtained from the Hot and Cold Blast, by W. Fairbairn, Esq.

1838.

Account of a Level Line, measured from the Bristol Channel to the English Channel, during the year 1837-38, by Mr. Bunt, under the Direction of a Committee of the British Association. Drawn up by the Rev. W. Whewell, F.R.S., one of the Committee.

A Memoir on the Magnetic Isoclinal and Isodynamic Lines in the British Islands, from Observations by Professors Humphrey Lloyd and John Phillips, Robert Were Fox, Esq., Captain James Clark Ross, R.N., and Major Edward Sabine, R.A., by Major Edward Sabine, R.A., F.R.S.

First Report on the Determination of the Mean Numerical Values of Railway Constants, by Dionysius Lardner, LL.D., F.R.S., &c.

First Report upon Experiments, instituted at the request of the British Association, upon the Action of Sea and River Water, whether clear or foul, and at various temperatures, upon Cast and Wrought Iron, by Robert Mallet, M.R.I.A., Ass. Ins. C.E.

Notice of Experiments in progress, at the desire of the British Association, on the Action of a Heat of 212° Fahr., when long continued, on Inorganic and Organic Substances, by Robert Mallet, M.R.I.A.

Experiments on the ultimate Transverse Strength of Cast Iron made at Arigna Works, Co. Leitrim, Ireland, at Messrs. Bramah and Robinson's, 29th May, 1837.

Provisional Reports, and Notices of Progress in Special Researches entrusted to Committees and Individuals.

1839.

Report on the application of the sum assigned for Tide Calculations to Mr. Whewell, in a Letter from T. G. Bunt, Esq., Bristol.

Notice of Determination of the Arc of Longitude between the Observatories of Armagh and Dublin, by the Rev. T. R. Robinson, D.D., &c.

Report of some Galvanic Experiments to determine the existence or non-existence of Electrical Currents among Stratified Rocks, particularly those of the Mountain Limestone formation, constituting the Lead Measures of Alston Moor, by H. L. Pattinson, Esq.

Report respecting the two series of Hourly Meteorological Observations kept in Scotland at the expense of the British Association, by Sir David Brewster, K.H., LL.D., F.R.SS. L. and E.

Report on the subject of a series of Resolutions adopted by the British Association at their Meeting in August 1838, at Newcastle.

Third Report on the Progress of the Hourly Meteorological Register at the Plymouth Dockyard, Devonport, by W. Snow Harris, Esq., F.R.S.

1840.

Report on Professor Whewell's Anemometer, now in operation at Plymouth, by W. Snow Harris, Esq., F.R.S., &c.

Report on the Motions and Sounds of the Heart, by the London Committee of the British Association for 1839–40.

An Account of Researches in Electro-Chemistry, by Professor Schönbein of Basle.

Second Report upon the Action of Air and Water, whether fresh or salt, clear or foul, and at various temperatures, upon Cast Iron, Wrought Iron, and Steel, by Robert Mallet, M.R.I.A., Ass. Ins. C.E.

Report on the Observations recorded during the Years 1837, 1838, 1839, and 1840, by the Self-registering Anemometer erected at the Philosophical Institution, Birmingham. By A. Follett Osler, Esq.

Report respecting the two series of Hourly Meteorological Observations kept at Inverness and Kingussie, at the Expense of the British Association, from Nov. 1st 1838, to Nov. 1st, 1839. By Sir David Brewster, K.H., F.R.S., &c.

Report on the Fauna of Ireland: Div. *Vertebrata.* Drawn up, at the request of the British Association, by William Thompson, Esq. (Vice-Pres. Nat. Hist. Society of Belfast), one of the Committee appointed for that purpose.

Report of Experiments on the Physiology of the Lungs and Air-tubes. By Charles J. B. Williams, M.D., F.R.S.

Report of the Committee appointed to try Experiments on the Preservation of Animal and Vegetable Substances. By the Rev. J. S. Henslow, F.L.S.

1841.

On the Tides of Leith, by the Rev. Professor Whewell, including a communication by D. Ross, Esq.

On the Tides of Bristol, by the Rev. Professor Whewell, including a communication by T. G. Bunt, Esq.

On Whewell's Anemometer, by W. S. Harris, Esq.

On the Nomenclature of Stars, by Sir John Herschel.

On the Registration of Earthquakes, by D. Milne, Esq.

On Varieties of the Human Race, by T. Hodgkin, M.D.

On Skeleton Maps for registering the geographical distribution of Animals or Plants, by — Brand, Esq.

On the Vegetative Power of Seeds, by H. E. Strickland, Esq.

On Acrid Poisons, by Dr. Roupell.

Supplementary Report on Waves, by J. S. Russell, Esq.

On the Forms of Ships, by J. S. Russell, Esq.

On the Progress of Magnetical and Meteorological Observations by Sir John Herschel.

On Railway Constants, by Dr. Lardner.

On Railway Constants, by E. Woods, Esq.

On the Constant Indicator, by the Rev. Professor Moseley.

1842.

Second Report of the Committee for registering Earthquakes, by David Milne, Esq.

On the Progress of simultaneous Magnetical and Meteorological Observations, by Sir John Herschel.

On the Preservation of Animal and Vegetable Substances, by C. C. Babington, F.L.S.

Reports of Committee on Railway Sections, by Charles Vignoles, F.R.S.

On the Growth and Vitality of Seeds, by H. E. Strickland, F.G.S.

On Zoological Nomenclature, by H. E. Strickland, F.G.S.

On the Form of Ships, by John Scott Russell, M.A.

On the Constant Indicator, by Professor Moseley.

On the Meteorological Observations made at Plymouth during the past year, by William Snow Harris, F.R.S.

On the Influence of Light on the Germination of Seeds and the Growth of Plants, by Robert Hunt.

On the Strength of Iron, by Wm. Fairbairn.

On Vital Statistics, by Colonel Sykes, and the Committee on that subject.

The following Reports and Continuations of Reports on the Progress and Desiderata of particular branches of Science, and on the results of Researches recommended by the General Committee, have been undertaken to be drawn up and presented to future Meetings of the Association. [Asterisks are prefixed to those Reports the request for which originated at the last Meeting.]

On Salts, by Professor Graham, F.R.S.

On the Differential and Integral Calculus, by the Rev. Professor Peacock, M.A., F.R.S., &c.

On the Geology of North America, by H. D. Rogers, F.G.S., Professor of Geology, Philadelphia.

On Vision, by Professor C. Wheatstone, F.R.S.

On Isomeric Bodies, by Professor Liebig.

On Organic Chemistry, by Professor Liebig.

On Inorganic Chemistry, by Professor Johnston, F.R.S.

On the Salmonidæ of Scotland, by Sir W. Jardine.

On the Habits of the Caprimulgidæ, by J. Gould, F.L.S.

On the state of Meteorology in the United States of North America, by A. Bache.

On the state of Chemistry as bearing on Geology, by Professor Johnston.

On the recent progress and present condition of Electro-Chemistry and Electro-Magnetism, by Professor De la Rive, of Gêneva.

On the state of our knowledge of the Zoology of New Zealand, by J. E. Gray, F.R.S.

On the resistance of the Atmosphere to Moving Bodies, by E. Hodgkinson, F.R.S.

On the progress of Astronomy during the present century (second Report), by the Astronomer Royal.

On the Theory of the Undulations of Fluid and Elastic Media, by Professor Kelland.

*On Photography and its Applications, and other Cognate Phenomena, by Fox Talbot, F.R.S.

*On Physical Optics (second Report), by the Rev. Professor Lloyd, F.R.S.

*On the Structure and Colours of Clouds, by a Committee consisting of Mr. Phillips, Professor Miller, Sir David Brewster, Professor Stevelly, Professor Daniell, Professor Forbes, and Mr. Luke Howard.

*On the Progress made by the German Meteorological Association (second Report), by Dr. Lamont of Munich.

*On the Analogy between Deposits of Peat and Beds of Coal, by the Rev. Dr. Fleming.

*On the Laws of Divisional Structure in Rocks, derivable from observation, by John Phillips, F.R.S.

*On the Structure and Uses of the Palpi of the Araneidea, by John Blackwell, F.L.S.

*On the present state of Knowledge of the Art of Smelting Iron, with a view of ascertaining what parts of the process may be susceptible of improvement, or may require the aid of scientific investigation; three Reports, from Mr. Anthony Hill for South Wales, Mr. Gibbon for the Midland Counties, and Professor Gordon for Scotland.

*On the consumption of Fuel and the prevention of Smoke, by Mr. Fairbairn, Mr. Houldsworth, Mr. Hodgkinson, and Mr. Buck.

Recommendation involving an application to Government adopted by the General Committee at the Twelfth Meeting.

That the President and Officers of the British Association, with the assistance of the Marquis of Northampton, the Dean of Ely, Sir John F. W. Herschel, and Francis Baily, Esq., be appointed a Committee to make application to Government to undertake the publication of the Catalogue of Stars in the *Histoire Céleste* of Lalande, and of Lacaille's Catalogue of the Stars in the Southern Hemisphere, which have been reduced and prepared for publication at the expense of the British Association; and that the President and Council of the Royal Society be requested to support this application. The Dean of Ely to be the Convener of this Committee. [To this Committee was also referred the consideration of the steps to be taken for securing a publication of the results obtained at the cost of the Association, by the Committee who have investigated the 'Forms of Ships.']

Recommendations of Researches in Science involving Grants of Money, adopted by the General Committee at the Twelfth Meeting.

MATHEMATICAL AND PHYSICAL SCIENCE.

ASTRONOMY.

That the Committee for the revision of the Nomenclature of Stars (consisting of Sir John Herschel, Rev. William Whewell, and Mr. Baily) be reappointed, with the sum of 32*l.*, the unexpended part of a former grant, at their disposal for the purpose.

That Mr. Baily and the Rev. Dr. Robinson be a Committee for completing the Reduction of the Stars requisite for the extension of the Royal Astronomical Society's Catalogue, with the sum of 25*l.* at their disposal for the purpose.

That the sum of 550*l.* be appropriated to the publication of the British Association Catalogue of Stars, conformably to a Report on the subject presented by the Committee.

TIDES.

That Sir John Robison and Mr. John Scott Russell be a Committee for making observations upon the anomalous Tides of the East coast of Scotland, and especially of the Frith of Forth, with the sum of 120*l.* at their disposal for the purpose.

METEOROLOGY.

That Sir David Brewster and Professor Forbes be a Committee for carrying on Hourly Observations of the Barometer, Thermometer, and Anemometer, for another year at Inverness, with the sum of 60*l.* at their disposal for the purpose.

That Sir David Brewster and Professor Forbes be a Committee for continuing for another year (if the Committee should think it advisable) the Hourly Meteorological Observations now making at Unst in Shetland, under the local superintendence of Dr. Edmonstone, with the sum of 35*l.* at their disposal for the purpose.

That Mr. Snow Harris be requested to continue, for an additional year, the Hourly Observations of the Barometer, Thermometer, and Hygrometer at Plymouth, with the sum of 50*l.* at his disposal for the purpose.

That Mr. Snow Harris, Mr. A. Follett Osler, the Rev. William Whewell, and Professor Stevelly, be a Committee for continuing, for an additional year, the observations of Whewell's Anemometer at Plymouth, with the sum of 10*l.* at the disposal of the Committee for the purpose.

That Mr. Snow Harris be requested to discuss the observations made with Osler's Anemometer, in connexion with the observations of other meteorological instruments, recorded at Plymouth, with the sum of 20*l.* at his disposal for the purpose.

That Sir John Herschel be requested to continue his superintendence of the Reduction of Meteorological Observations, with the 75*l.* (the balance of the former grant) at his disposal for the purpose.

That Mr. Snow Harris and Mr. A. Follett Osler be a Committee for making certain improvements in the Anemometers at Edinburgh and Plymouth, with the sum of 15*l.* at their disposal for the purpose.

That Professor Wheatstone, Professor Daniell, and Mr. Snow Harris, be a Committee for constructing a Self-recording Meteorological apparatus, to be employed in the building at Kew, recently placed by Her Majesty the Queen at the disposal of the British Association, with the sum of 50*l.* at their disposal for the purpose.

That the Treasurer be authorized to advance, in payment for certain instruments employed by Professor Forbes in researches requested by the Association, and for certain gratuities to persons employed in observing and reducing, a sum not exceeding 40*l.*

That the Committee formerly appointed (consisting of the Rev. Dr. Robinson, Colonel Sabine, Professor Wheatstone, the Rev. William Whewell, the Astronomer Royal, Sir John Herschel, and Sir John Lubbock) for conducting experiments, by captive Balloons, on the Physical Constitution of the Atmosphere, be re-appointed, with 250*l.* at their disposal for the purpose.

MAGNETICAL OBSERVATIONS.

That the Committee formerly appointed (consisting of Sir John Herschel, Professor Whewell, the Very Rev. Dr. Peacock, Professor Lloyd, and Colonel Sabine) for conducting the co-operation of the Association in the system of simultaneous Magnetical and Meteorological Observations be re-appointed, with the sum of 89*l.* 11*s.* 2*d.* (the residue of the former grant) at their disposal for the purpose.

LIGHT.

That Sir David Brewster be requested to continue his examination of the Action of different bodies upon the Spectrum, with the sum of 40*l.* at his disposal for the purpose.

KEW OBSERVATORY.

That the sum of 200*l.* be placed at the disposal of the Council for upholding the establishment in the Kew Observatory, lately placed by Her Majesty the Queen at the disposal of the British Association for the purposes of Scientific Investigation.

SCIENTIFIC MEMOIRS.

That the Committee formerly appointed to superintend the translation and publication of Foreign Scientific Memoirs (consisting of Colonel Sabine, Dr. R. Brown, Rev. Dr. Robinson, Sir John Herschel, Professor Wheatstone, Sir David Brewster, Professor Owen, Professor T. Graham, Professor Miller, Sir W. Jardine, and Professor R. Graham) be re-appointed, and that the sum of 50*l.* (part of the residue of the grant of last year) be placed at the disposal of the Committee for the purpose.

CHEMISTRY AND MINERALOGY.

That Professor T. Graham, Dr. C. J. B. Williams, Professor Owen, Dr. Prout, Dr. Hodgkin, and Professor Sharpey, be a Committee for making a series of researches on the Chemistry and Physiology of Respiration and Digestion, with the sum of 60*l.* at their disposal for the purpose.

That Dr. Lyon Playfair and Professor Bunsen of Marburg be a Committee for examining the gases evolved from Iron Furnaces (both hot and cold blast), more especially with a view to the œconomy of fuel, with the sum of 50*l.* at their disposal for the purpose.

That Dr. Kane, Dr. Schunck, and Dr. L. Playfair, be a Committee for examining into the Chemical History of the Substances of the Tannin family, with the sum of 10*l.* at their disposal for the purpose.

That Dr. Kane, Dr. Schunck, and Dr. L. Playfair, be a Committee for examining the Chemical History and Origin of the colouring materials used in the Arts, with the sum of 10*l.* at their disposal for the purpose.

That Mr. Robert Mallet be requested to make researches upon the amount of oxidation of the Rails of Railways, both in use and out of use, distinguishing and determining also the loss by abrasion, with the sum of 20*l.* at his disposal for the purpose.

That the Committee formerly appointed (consisting of Sir H. T. De la Beche, Mr. R. Hutton, Dr. Richardson, Mr. L. Horner, Colonel Sabine, and Professor Phillips), for promoting the publication of the drawings requisite to the illustration of the Report on Fossil Reptiles by Professor Owen, be re-appointed, with the sum of 40*l.* (the residue of the former grant) at their disposal for the purpose.

That the Committee formerly appointed (consisting of the President of the Royal Society, the Rev. Dr. Buckland, Mr. Murchison, Mr. John Taylor, Sir H. T. De la Beche, and Mr. C. Vignoles, with power to add to their number), for taking measures to obtain Coloured Drawings of Railway Sections before they are covered up, be requested to continue their labours; and that the sum of 200*l.* be placed at their disposal for the purpose.

That the Committee formerly appointed (consisting of Dr. Buckland, Mr. L. Horner, Mr. Wheatstone, Mr. Snow Harris, Lord Greenock, Mr. Milne, Professor Forbes, Mr. Pattison, Sir John Robison, Mr. T. J. Torrie, Major Portlock, Mr. Bryce) for registering the Shocks of Earthquakes in England, Scotland, and Ireland, and for making such Meteorological Observations as may appear to them desirable, be re-appointed; and that the sum of 100*l.* be placed at their disposal for the purpose.

That Mr. Binney be requested to make an excavation at the junction of the Lower New Red Sandstone with the Coal Strata at Collyhurst, near Manchester, with the sum of 10*l.* at his disposal for the purpose.

That Major Portlock be requested to continue his experiments on the Temperature of Mines in Ireland; and that the sum of 10*l.* be placed at his disposal for the purpose.

SECTION D.

That Mr. H. E. Strickland, Mr. C. Darwin, Professor Henslow, Rev. L. Jenyns, Mr. W. Ogilby, Mr. J. Phillips, Dr. Richardson, Mr. J. O. Westwood, Professor Owen, Mr. Broderip, be a Committee for printing and circulating their Report on Zoological Nomenclature, with the sum of 10*l.* at their disposal for the purpose.

That a Committee formerly appointed, consisting of Mr. H. E. Strickland, Professor Daubeny, Professor Henslow, and Professor Lindley, be requested to continue their Experiments on the Growth and Vitality of Seeds, with the sum of 16*l.* 14*s.* at their disposal for the purpose.

That Sir Charles Lemon and Mr. Jonathan Couch be a Committee for enabling Mr. Peach to continue his researches on the habits of the Marine Testacea, to institute a series of Experiments on their reproduction and Growth, and to draw up a Report on the result of his observations, with 10*l.* at their disposal for the purpose.

That a Committee formerly appointed, consisting of Mr. Babington and Mr. Garnons, be requested to continue the researches on the preservation of animal and vegetable substances; and that the sum of 6*l.*, formerly granted, be placed at their disposal for the purpose.

That a Committee formerly appointed, consisting of Dr. Richardson, Rev. Dr. Buckland, and Mr. R. Taylor, for defraying the necessary expenses attendant on the preparation of Professor Owen's Report on British Fossil Mammalia, be re-appointed, with the sum of 100*l.* (the unexpended balance of a former grant) at their disposal for the purpose.

That Sir W. Jardine, Mr. Selby, Mr. Yarrell, and Dr. Lankester, be a Committee for defraying the expense of illustrating undescribed species of Anopleura, Foreign as well as British, with the sum of 25*l.* at their disposal for the purpose.

That Mr. Edward Forbes be requested to draw up a Report on the Radiata and Mollusca of the Ægean and Red Sea, with special reference to the relation of the recent genera and species to those which have been hitherto supposed to occur only in a fossil state, with 100*l.* at his disposal for the purpose.

That a Committee formerly appointed, consisting of Mr. Gray, Mr. Forbes, Mr. Goodsir, Mr. Patterson, Mr. Thompson (of Belfast), Mr. Ball (of Dublin), Dr. Geo. Johnston, Mr. Smith (of Jordan Hill), Mr. Couch, Mr. Bartlett, Mr. H. Bellamy, Mr. Walker, Mr. Lyte, and Mr. Wallace of Douglas (Isle of Man), be requested to continue a series of researches with the dredge, with a view to the investigation of the Marine Zoology of Great Britain, the illustration of the Geographical Distribution of Marine Animals, and the more accurate determination of the Fossils of the Pleiocene Period; and that the sum of 50*l.* be placed at the disposal of the Committee for the purpose.

That Dr. Hodgkin, Dr. Prichard, Professor Owen, Dr. Hibbert Ware, Mr. J. E. Gray, Dr. Lankester, Dr. A. Smith, Mr. A. Strickland, and Mr. C. C. Babington, be a Committee for procuring information in regard to the varieties of the Human Race, with the sum of 5*l.* at their disposal for the purpose.

MEDICAL SCIENCE.

That Professor Sharpey and Mr. John Erichsen be a Committee for researches on Asphyxia, with the sum of 40*l.* at their disposal for the purpose.

That Dr. C. J. B. Williams and Mr. James Blake be a Committee for researches on the Physiological operation of medicinal agents, with the sum of 40*l.* at their disposal for the purpose.

STATISTICS.

That Col. Sykes, Viscount Sandon, Mr. G. R. Porter, Mr. J. Heywood, Dr. W. P. Alison, Mr. E. Chadwick, and Mr. G. W. Wood, be a Committee for continuing the Reports on Vital Statistics, with the sum of 150*l.* at their disposal for the purpose.

MECHANICAL SCIENCE.

That Sir John Robison and Mr. J. S. Russell be a Committee for completing the Experiments on the Forms of Ships, with the sum of 100*l.* at their disposal for the purpose.

That Sir John Robison and Mr. J. S. Russell be a Committee for reducing above 20,000 observations on the forms of ships, with the sum of 100*l.* at their disposal for the purpose.

That Professor Moseley, Mr. Enys, and Mr. Hodgkinson, be a Committee for procuring and defraying the expense of Morin's Instrument for measuring velocity, and for completing the trial of the Constant Indicator, with the sum of 100*l.* at their disposal for the purpose.

That Mr. Hodgkinson be requested to continue his Experiments on the Strength of Materials, with the sum of 100*l.* at his disposal for the purpose.

That Mr. Fairbairn, Mr. Buck, Mr. Hodgkinson, Mr. Nasmyth, Prof. Montagu Phillips, Mr. John Davis, Mr. R. Mallet, Mr. Lucas, and Mr. H. H. Watson, be a Committee for making Experiments to ascertain whether any and what changes take place in the internal constitution of metals when exposed to continual vibration and concussion, as in the case of axles of locomotive engines and other machinery, with the sum of 150*l.* at their disposal for the purpose.

That Mr. Anthony Hill, Mr Gibbon, and Professor Gordon, be a Committee for acquiring and employing the apparatus used by M. Bunsen in collecting the gases of Blast and other furnaces, for the use of those gentlemen appointed to prepare Reports on the Smelting of Iron.

GENERAL NOTICE.

Gentlemen engaged in scientific researches by desire of the British Association, are requested to observe that by a Resolution of the General Committee at the Manchester Meeting (1842), all Instruments, Papers, Drawings and other Property of the Association, are to be deposited in the Kew Observatory (lately placed by Her Majesty the Queen at the disposal of the Association), when not employed in carrying on Scientific Inquiries for the Association; and the Secretaries are instructed to adopt the necessary measures for carrying this resolution into effect.

Synopsis of Sums appropriated to Scientific Objects by the General Committee at the Manchester Meeting.

SECTION A.

	£	s.	d.
Nomenclature of Stars	32	0	0
British Association Catalogue of Stars { Reductions	25	0	0
British Association Catalogue of Stars { Publication of	550	0	0
Anomalous Tides, Frith of Forth	120	0	0
Hourly Meteorological Observations at Kingussie and Inverness	60	0	0
Meteorological Observations at Unst	35	0	0
Meteorological Observations at Plymouth	50	0	0
Whewell's Anemometer at Plymouth	10	0	0
Osler's Anemometer at Plymouth	20	0	0
Reduction of Meteorological Observations	75	0	0
Improvements in Anemometers	15	0	0
Meteorological Recorder at Kew	50	0	0
Meteorological Instruments and Gratuities	40	0	0
Experiments with Balloons	250	0	0
Magnetic Co-operation	89	11	0
Action of Gases on Light	40	0	0
Establishment at Kew	200	0	0
Scientific Memoirs	50	0	0
	£1711	11	0

SECTION B.

	£	s.	d.
Chemistry and Physiology of Digestion	60	0	0
Gases from Iron Furnaces	50	0	0
Chemical History of Tannin	10	0	0
Colouring Materials used in the Arts	10	0	0
Oxidation of Rails of Railways	20	0	0
	£150	0	0

SECTION C.

	£	s.	d.
Fossil Reptiles (Publication of Report)	40	0	0
Railway Sections	200	0	0
Earthquake Registration	100	0	0
Section of Lower New Red Sandstone	10	0	0
Subterranean Temperature in Ireland	10	0	0
	£360	0	0

SECTION D.

	£	s.	d.
Report on Zoological Nomenclature	10	0	0
Vegetative power of Seeds	16	14	0
Marine Testacea	10	0	0
Preservation of Animal and Vegetable Substances	6	0	0
British Fossil Mammalia	100	0	0
Undescribed Anopleura	25	0	0
Radiata and Mollusca of the Ægean and Red Seas	100	0	0
Marine Zoology	50	0	0
Races of Men	5	0	0
	£322	14	0

Section E.	£	s.	d.
Researches on Asphyxia	40	0	0
Medicinal Agents.	40	0	0
	£80	0	0

Section F.			
Vital Statistics	150	0	0

Section G.			
Forms of Vessels, additional Experiments	100	0	0
Forms of Vessels, Reduction of Observations	100	0	0
Morin's Instrument and Constant Indicator	100	0	0
Strength of Materials	100	0	0
Effect of Vibration and concussion on the internal structure of Metals	150	0	0
Bunsen's Apparatus	15	0	0
	£565	0	0

Total of Money Grants £3339 5 0

General Statement of Sums which have been paid on Account of Grants for Scientific Purposes.

	£	s.	d.	£	s.	d.
1834.						
Tide Discussions				20	0	0
1835.						
Tide Discussions	62	0	0			
British Fossil Ichthyology	105	0	0			
				167	0	0
1836.						
Tide Discussions	163	0	0			
British Fossil Ichthyology	105	0	0			
Thermometric Observations, &c.	50	0	0			
Experiments on long-continued Heat	17	1	0			
Rain Gauges	9	13	0			
Refraction Experiments	15	0	0			
Lunar Nutation	60	0	0			
Thermometers	15	6	0			
				435	0	0
1837.						
Tide Discussions	284	1	0			
Chemical Constants	24	13	6			
Lunar Nutation	70	0	0			
Observations on Waves	100	12	0			
Tides at Bristol	150	0	0			
Meteorology and Subterranean Temperature	89	5	0			
Vitrification Experiments	150	0	0			
Heart Experiments	8	4	6			
Barometric Observations	30	0	0			
Barometers	11	18	6			
				918	14	6

	£	s.	d.	£	s.	d.
1838.						
Tide Discussions	29	0	0			
British Fossil Fishes	100	0	0			
Meteorological Observations and Anemometer (construction)	100	0	0			
Cast Iron (strength of)	60	0	0			
Animal and Vegetable Substances (preservation of)	19	1	10			
Railway Constants	41	12	10			
Bristol Tides	50	0	0			
Growth of Plants	75	0	0			
Mud in Rivers	3	6	6			
Education Committee	50	0	0			
Heart Experiments	5	3	0			
Land and Sea Level	267	8	7			
Subterranean Temperature	8	6	0			
Steam-vessels	100	0	0			
Meteorological Committee	31	9	5			
Thermometers	16	4	0			
				956	12	2
1839.						
Fossil Ichthyology	110	0	0			
Meteorological Observations at Plymouth	63	10	0			
Mechanism of Waves	144	2	0			
Bristol Tides	35	18	6			
Meteorology and Subterranean Temperature	21	11	0			
Vitrification Experiments	9	4	7			
Cast Iron Experiments	100	0	0			
Railway Constants	28	7	2			
Land and Sea Level	274	1	4			
Steam-vessels' Engines	100	0	0			
Stars in Histoire Céleste	331	18	6			
Stars in La Caille	11	0	0			
Stars in R.A.S. Catalogue	6	16	6			
Animal Secretions	10	10	0			
Steam-engines in Cornwall	50	0	0			
Atmospheric Air	16	1	0			
Cast and Wrought Iron	40	0	0			
Heat on Organic Bodies	3	0	0			
Gases on Solar Spectrum	22	0	0			
Hourly Meteorological Observations, Inverness and Kingussie	49	7	8			
Fossil Reptiles	118	2	9			
Mining Statistics	50	0	0			
				1595	11	0
1840.						
Bristol Tides	100	0	0			
Subterranean Temperature	13	13	6			
Heart Experiments	18	19	0			
Lungs Experiments	8	13	0			
Tide Discussions	50	0	0			
Land and Sea Level	11	6	1			
Carried forward	202	11	7			

	£	s.	d.	£	s.	d.
Brought forward	202	11	7			
Stars (Histoire Céleste)	242	10	0			
Stars (La Caille)	4	15	0			
Stars (Catalogue)	264	0	0			
Atmospheric Air	15	15	0			
Water on Iron	10	0	0			
Heat on Organic Bodies	7	0	0			
Meteorological Observations	52	17	6			
Foreign Scientific Memoirs	112	1	6			
Working Population	100	0	0			
School Statistics	50	0	0			
Forms of Vessels	184	7	0			
Chemical and Electrical Phænomena	40	0	0			
Meteorological Observations at Plymouth	80	0	0			
Magnetical Observations	185	13	0			
				1546	16	4
1841.						
Observations on Waves	30	0	0			
Meteorology and Subterranean Temperature	8	8	0			
Actinometers	10	0	0			
Earthquake Shocks	17	7	0			
Acrid Poisons	6	0	0			
Veins and Absorbents	3	0	0			
Mud in Rivers	5	0	0			
Marine Zoology	15	12	8			
Skeleton Maps	20	0	0			
Mountain Barometers	6	18	6			
Stars (Histoire Céleste)	185	0	0			
Stars (La Caille)	79	5	0			
Stars (Nomenclature of)	17	19	6			
Stars (Catalogue of)	40	0	0			
Water on Iron	50	0	0			
Meteorological Observations at Inverness	20	0	0			
Meteorological Observations (reduction of)	25	0	0			
Fossil Reptiles	50	0	0			
Foreign Memoirs	62	0	6			
Railway Sections	38	1	0			
Forms of Vessels	193	12	0			
Meteorological Observations at Plymouth	55	0	0			
Magnetical Observations	61	18	8			
Fishes of the Old Red Sandstone	100	0	0			
Tides at Leith	50	0	0			
Anemometer at Edinburgh	69	1	10			
Tabulating Observations	9	6	3			
Races of Men	5	0	0			
Radiate Animals	2	0	0			
				1235	10	11
1842.						
Dynamometric Instruments	113	11	2			
Anopleura Britanniæ	52	12	0			
Tides at Bristol	59	8	0			
Gases on Light	30	14	7			
Carried forward	256	5	9			

	£	s.	d.	£	s.	d.
Brought forward	256	5	9			
Chronometers	26	17	6			
Marine Zoology	1	5	0			
British Fossil Mammalia	100	0	0			
Statistics of Education	20	0	0			
Marine Steam-vessels' Engines	28	0	0			
Stars (Histoire Céleste)	59	0	0			
Stars (British Association Catalogue of)	110	0	0			
Railway Sections	161	10	0			
British Belemnites	50	0	0			
Fossil Reptiles (publication of Report)	210	0	0			
Forms of Vessels	180	0	0			
Galvanic Experiments on Rocks	5	8	6			
Meteorological Experiments at Plymouth	68	0	0			
Constant Indicator and Dynamometric Instruments	90	0	0			
Force of Wind	10	0	0			
Light on Growth of Seeds	8	0	0			
Vital Statistics	50	0	0			
Vegetative Power of Seeds	8	1	11			
Questions on Human Race	7	9	0			
				1449	17	8

Extracts from Resolutions of the General Committee.

Committees and individuals, to whom grants of money for scientific purposes have been entrusted, are required to present to each following meeting of the Association a Report of the progress which has been made; with a statement of the sums which have been expended, and the balance which remains disposable on each grant.

Grants of pecuniary aid for scientific purposes from the funds of the Association expire at the ensuing meeting, unless it shall appear by a Report that the Recommendations have been acted on, or a continuation of them be ordered by the General Committee.

In each Committee, the Member first named is the person entitled to call on the Treasurer, John Taylor, Esq., 2 Duke Street, Adelphi, London, for such portion of the sum granted as may from time to time be required.

In grants of money to Committees, the Association does not contemplate the payment of personal expenses to the Members.

In all cases where additional grants of money are made for the continuation of Researches at the cost of the Association, the sum named shall be deemed to include as a part of the amount, the specified balance which may remain unpaid on the former grant for the same object.

On Thursday evening, June 23rd, at 8 P.M., the President, the Right Hon. Lord Francis Egerton, M.P., took the Chair in the Friends' Meeting House, Manchester, and delivered an Address (see page xxxi.).

On Monday evening, in the Theatre of the Athenæum, Mr. Vignoles explained the principles and construction of 'Atmospheric Railways,' and Sir M. I. Brunel described the 'Thames Tunnel.'

On Tuesday evening, in the same Room, Mr. Murchison stated the result of his recent Surveys of the Geology of Russia, in which he was accompanied by Count Keyserling and M. De Verneuil.

On Wednesday, at 8 P.M. the Concluding General Meeting of the Association took place in the Friends' Meeting House, when an account of the PROCEEDINGS OF THE GENERAL COMMITTEE was read by Colonel Sabine.

ADDRESS

BY

LORD FRANCIS EGERTON.

GENTLEMEN,—Some twelve years have now elapsed, since, by the exertions of individuals, most of whom are now present, the prototype of this meeting was held in the city of York; and so successful was that first experiment, that it has been annually repeated. The order and course of the proceedings of the body there constituted and arranged, has not, I apprehend, been strictly uniform, but I believe, on the whole, it has been usual, that on the occasion of its annual assemblage, those proceedings should be open to some observations incidental to the occasion, on the part of the President; and this preliminary duty I am anxious, to the utmost of the very limited means of my ability, to execute. In the earlier meetings of this Society, and on occasions when the office I now hold has been filled by men distinguished by scientific acquirement, it was, I believe, found possible and convenient for such Presidents to include in a preliminary discourse, a compressed but instructive statement of past proceedings and present objects. The punctual and complete observance of such a practice, indeed, could not be consistent with those arrangements which admit to the occasional honour of your Presidency, individuals, selected, like myself, not for any scientific pretensions, but from the accidents of local connexion with the place, rather than the objects of the assemblage. I apprehend that other reasons of equal urgency exist, calculated to make this custom one of partial observance. The operations of this Society have grown with its growth, and expanded with its strength; and I am happy to believe that it would be difficult for the most able and instructed of those with whose knowledge I am proud, for the moment, to find my own ignorance associated, now to compress into reasonable limits, and to reduce to terms adapted to a mixed audience, a satisfactory summary of scientific proceedings, past and contemplated, connected with the labours of this Society. If, indeed, I look to the proceedings of the last year's meeting at Plymouth, I find some warrant for this supposition. You met last year, indeed, under different auspices. I cannot forget—I wish for the moment you could—how your Chair was then filled and its duties discharged. Could you forget the fact, it were hardly to my interest to awaken your recollection to it, that such a man as Professor Whewell filled last year at Plymouth, an office which I now hold at Manchester. I do so for the purpose of remarking that he, more able, perhaps, than any man living in this country to give you a concise and brilliant summary of all that he and his fellow-labourers are doing, forbore in his discretion from that endeavour. If he, then, who is known in matters of science to have run

> "Through each mode of the lyre, and be master of all,"

abstained from that undertaking, I may now be excused, not for my own silence, which would require no apology, but for not calling on one of your other functionaries to supply my place for the purpose.

Slightly, indeed, before I sit down, I may presume to touch on one or two topics which I may consider immediately illustrative of the advantages of this Institution. In the first instance, however, allow me to indulge for a moment in the expression of feelings of congratulation on the subject of the particular locality which sees us here together. Guests and strangers will excuse me—inhabitants, I think, will sympathise with me, if, as a neighbour, and all but an inhabitant, I indulge in some avowal of complacency on this subject. It is not merely that to this spot from which I now address you, mechanical invention and skill have long been attracted as to one of their principal centres; nor that a neighbourhood so rich in mineral treasures bears its own recommendation to the followers of several important branches of natural science. These, with a host of other local reasons, might well justify the selection of Manchester as a place of scientific assemblage. It has, in my opinion, a claim of equal interest as the birth-place, and still the residence and scene of the labours of one whose name is uttered with respect wherever science is cultivated, who is here to-night to enjoy the honours due to a long career of persevering devotion to knowledge, and to receive, if he will condescend to do so, from myself, the expression of my own deep personal regret, that increase of years, which to him, up to this hour, has been but increase of wisdom, should have rendered him, in respect of mere bodily strength, unable to fill, on this occasion, an office which, in his case, would have received more honour than it could confer. I do regret that any cause should have prevented the present meeting, in his native town, from being associated with the name of Dalton as its President. The Council well know my views and wishes in this matter, and that, could my services have been available, I would gladly have served as a door-keeper in any house where the father of science in Manchester was enjoying his just pre-eminence.

It is no part, as I consider it, of my present office to discuss the reasons which have induced others to suppose that I might hold it, at least, without prejudice to the interests of the Society, or of this meeting. With those who originated its efforts, who conceived its formation, and who have tended it from its cradle in York to its present vigorous maturity in Manchester, I respectfully leave my apology. In addressing to you any remarks on the objects we are met to promote, I can only do so in one way, by endeavouring to convey to you the impressions of an unscientific man—the reasons which induce me, as such, to wish success to its operations, and to defer to the judgment of those who have thought I might be of service in my present position. All readers of German literature must have observed the frequent recurrence of a word which signifies the position from which an object is viewed by the spectator—the Standtpunkt, or place of standing, meaning the place from which an object is viewed by a spectator, the position of which must govern the accuracy and extent alike of his vision. My view of the vast temple of science which, raised by successive architects, is daily deriving new additions, is dim, and distant, and shadowy. Not even a proselyte of the gate, far less a Levite of the sanctuary, I cannot mould my lips to any Shibboleth of entrance; and though I fain would worship at a distance, the echo of the ritual falls too faintly on my ear to allow me to join in the service of the altar. The pile is a vast one; but who shall live to pronounce it complete? New edifices are daily arising round the central structure. Many a shaft remains to be polished, and many a capital to be elaborated into new forms of fitness and of beauty. The architects, I know, are at work.

I hear with you the clink of the trowel and the hammer. The builder is busy on the ground from which Bacon cleared the rubbish of centuries, and shaped the vast esplanade, the Moriah of philosophy, into a fit foundation for the subsequent erections of Newton and others. All this is going on,—I may and do congratulate you on the fact; but it is not for me to describe and particularize the progress of the labour. This will be done by the builders themselves in those sectional departments into which they have divided themselves. There the geologist will teach and learn the results of recent research and adventurous travel. Mr. Lyell is still, I believe, pursuing his investigations in the distant regions of the New World, but Mr. Murchison is returned rich with the results of his exploration of an interesting portion of the Old, and to tell you how highly and how justly such objects and such labours as his have been appreciated, how honourably to himself they have been assisted and promoted by the sovereign of those vast domains. With the political nature or extent of that sovereign's power we have here nothing to do. *Quid bellicosus Cantaber aut Scythus cogitet* is no subject for our thoughts or disquisitions; but his liberal appreciation of science, as evinced in the recent case of my friend Mr. Murchison, is worthy of our warmest acknowledgments; and I trust that those distinguished men among his subjects who have honoured us with their presence on this occasion, will bear back to him evidence of the fact, that the followers of science in England duly appreciate his conduct towards their countrymen. You will learn in those Sections through what new channels the electrical inquirer has directed the fluid which Franklin snatched from Heaven, into what shapes, and what service, the grasp of science has compelled the imponderable Proteus it is his mission to enslave to his bidding. The communication and the discussion of these past achievements, the suggestions of new methods and branches of inquiry which spring from such discussion, are among the main purposes of our meeting, and the volumes of this Society's Transactions bear ample witness to their accomplishment. We have, indeed, no longer to deal with conjecture in this respect; we have no longer an estimate to show, but an account, a profit, and a dividend. It was well for the originators of this Society to enter into calculations of prospective advantages, to foreshow that from personal intercourse and collision, light and heat would be elicited, that dormant energies might be excited in various parts of the country by the nomadic principle of this Society, that scientific operations which require simultaneous exertion on an extensive scale, might derive their necessary element of combination, and their necessary funds, from the voluntary association of men in this shape. All this it was reasonable to predict, and fortunately it is no less easy now to show that the prediction has been in all particulars of importance ratified by the result. It has been observed on more than one former occasion,—it was noticed on the last by my predecessor in the Chair, and at York in 1831,—that in the whole range of physical science Astronomy was the only one which had, generally speaking, derived direct assistance from governments, or even enjoyed what I may call the patronage of society at large. It was also remarked, with equal force and truth, that many other subjects are specially in need of that species of assistance which the power of the State, or the opulence of individuals, can afford to the otherwise solitary man of science. It has come, as you well know, within the scope of the operations of this Society to endeavour, in many instances, to meet and remedy this deficiency. To the science of the stars the first rank in the table of precedence may indeed be cheerfully conceded. Let it walk first in that dignity with which its very nature invests it, but let it not walk alone. The connexion, indeed, between that science and the State, between Greenwich and Downing Street, rests now upon the soundest principles of mutual advantage. It was not always thus that the astronomer found favour and footing in the councils of statesmen and the courts of princes. Time was when the strange delusions of judicial astrology reduced such men as Kepler to the level of Dr. Dee; and it is melancholy to think how much of such a life as Kepler's was wasted in casting the nativities of princes, and calculating the fortunes of their foolish and wicked enterprises. The sun of science has drunk these mists. The telescope of a Wellington was pointed, not like that of Wallenstein from his observatory in Egra on the heavenly host, but on the frowning masses of his country's foes. He knew but one, the Homeric omen, the defence of his country and the performance of his duty. Three centuries ago, a Mr. Airy might have been distracted from his intense and important labours at Greenwich, to mark what star was culminating at the birth of a royal infant. We do not now watch the configuration of the heavens on such events; but to that Providence which has shielded the mother, and under that Providence to the love and prayers of a loyal people we cheerfully confide the fate and fortunes of the infant hope of England: still, though such delusions are swept away, it is impossible that in this maritime country the protection of the State should not in the first instance be accorded to the science which directs her fleets. Even here, as you well know, the labours of this Society have not been wanting nor inefficient. Her advice has been followed, the contribution of her funds has been accepted. It is to the suggestion and the actual assistance of this Society that the country owes the reduction of observations now in progress under Mr. Airy; and were this the only practical result of which we had to boast, I might ask whether this were a mere trifling benefit conferred upon the nation which has accepted it at your hands. On this particular point, were it in the least degree doubtful, I might hereafter find an opportunity of appealing to Prof. Bessel, whose authority was specially quoted on a former occasion, and who will shortly be here in person to support it. Yes; and the railroad on Monday will convey in one of its carriages a most important freight. Adam Smith says, that of all luggage man is the most difficult to transport; fortunately the difficulty is not commensurate with the value of the article.

> "Weigh'd in the balance hero dust
> Is vile as vulgar clay."

Were it otherwise I doubt whether the workshop of my friends, Messrs. Sharp and Roberts, could construct an engine of power sufficient to draw here in safety a freight so illustrious as one which is shortly expected here by such conveyance. If ever accident is destined to happen on the Birmingham and Grand Junction rail-road, I hope it may be spared us on an occasion when two such companions as Herschel and Bessel are trusting their lives to its axles. May they convey to us in health and safety the illustrious stranger, the accuracy of whose observations, and the grasp of whose calculations have enabled him, if I am rightly informed, to pass the limits of our planetary system and the orbit of Uranus, to expatiate *extra flammantia mœnia mundi*, and to measure and report the parallax and the distance of bodies, which no contrivance of optics can bring sensibly nearer to our vision—and which remain on the mirrors of our most powerful telescopes, the same points of unextended light which they appeared to the Chaldean shepherd.

I have been speaking of matters for some time past in progress, and notorious to all who have taken an interest in your proceedings. They are gratifying as proofs that the impulse of this Society has been communicated and felt in high quarters. It is surely desirable that, under any form of government, the collective science of a country should be on the most amicable footing with the depositories of its power; free, indeed, from undue control and interference, not dangling in antechambers, nor wiping the dust from palace staircases, uncontaminated by the passions and influences with which statesmen have to deal, but enjoying its good will and favour, receiving and requiting with usury its assistance on fitting occasions, and organized in such a manner as to afford reference and advice on topics with respect to which they may be required. One more recent instance of the operations of this Society in this respect I may mention, in addition to those I have slightly enumerated. I do not refer in detail to other most important operations which owe their origin to this Society—the Magnetic Expedition now in progress; the extension of the Trigonometrical Survey on an expanded scale, suggested by you, and liberally adopted by the Board of Ordnance—these and many other similar matters are recorded in your Transactions; and to those Transactions, rather than to any defective catalogue of mine, I would refer those who may doubt the benefit of our labours. The most recent instance, however, I cannot omit; I mean the important accession to the means of this Society of a fixed position, a place for deposit, regulation, and comparison of instruments, and for many more purposes than I could name, perhaps even more than are yet contemplated, in the Observatory at Kew. This building was standing useless. The Council of the Association approached the throne with a petition that they might occupy it, and I am happy to say that the sceptre was gracefully held towards them; and I think this transaction a fair instance of that species of connexion between science and government, which I hope may always be cultivated in this country. I am informed that the purposes to which this building is readily and immediately applicable, are of an importance which none but men advanced in science can appreciate. You will hear further of them in the Committee of Recommendations.

With reference to the past transactions of the Society, it would be a presumption in me to enter upon any detail. I confess, however, that on looking over the printed Transactions of the year 1839, my eye was caught by a paragraph of the introduction to Prof. Owen's treatise on the fossil reptiles of Great Britain, in which he avows that but for the assistance of the Association he should have shrunk from the undertaking of that work. The context to this passage is a vast one. Those who wish to feel the entire force of the commentary it conveys, must follow it through the pages of subtle disquisition which succeed it. I ask you, learned and unlearned alike, to give but a glance at those pages. See how the greatest—am I wrong in calling him so?—of the British disciples of Cuvier walks among the shattered remnants of former worlds, with order and arrangement in his train. Mark how, page after page, and specimen after specimen, the dislocated vertebræ fall into their places,—how the giants of former days assume their due lineaments and proportions, some shorn of the undue dimensions ascribed to them on the first flush of discovery, others expanded into even greater bulk, all alike bearing the indelible mark of adaptation to the modes of their forgotten existence, and pregnant with the proofs of wisdom and omnipotence in their common Creator. This is a portion, at least, of the results of this Society. I select it for notice, because it deals with a subject which comes, partially at least, within the comprehension of those to whom algebraical formulæ or the hieroglyphics of mathematical science are a sealed letter.

Gentlemen, I have endeavoured by these remarks to convey to you the general reasons which induced me, an unscientific man, to wish this Society success, and to endeavour to assist that success by any means at my disposal.

I would ask leave, before I conclude, to further illustrate these views and feelings which are incidental to my own position, by reference to a scientific transaction of no very distant date. Some two years ago, as I have understood, an adventurous and scientific party, with Prof. Agassiz at its head, undertook the ascent of that Swiss mountain, whose name indicates that it had for ages been pronounced inaccessible to the foot of man. They applied, however, to physical difficulties in this case the energies and perseverance which have won them many triumphs over intellectual obstacles, and they succeeded. I doubt not that there were many who, from the chalet and the pasturage beneath, directed their glasses to those peaks of ice, and watched with intent and thrilling interest the progress of those adventurers. Perhaps among them were some who, by some trifling incursions into those awful regions, in pursuit perhaps of the artist's or the hunter's pastime, had learned to appreciate the dangers of the crevice, the toil of the ascent, cut step by step with the hatchet in the precipitous ice, and the general magnitude of the enterprise. Be assured, you climbers of the heights of science, and there are many of you here, that individuals so situated hail the progress they cannot share,—that they sympathize with your advance, lament when you are baffled; and that when you plant your flag on some hitherto virgin summit, their shout of applause would reach you from below,—if it could be conveyed to your organs by the pure and attenuated atmosphere it is yours, and yours alone, to breathe. Dwellers in the peopled valley as we are, absorbed by other cares, and I hope discharging other duties, breathers of a heavier and too often tainted atmosphere, we yet can look upwards. We watch and count your triumphs; and as you gain them, we gladly add your names to the list of those who have done honour to their country and service to their kind. For your labours have this privilege, that while their results become the common property of man, for that very reason, and because they confer that common benefit, they elevate the country in which they originate in the scale of nations, and gratify the most reasonable feelings of national pride, while they fulfil to the most unrestricted extent the obligations of our common humanity.

REPORTS

ON

THE STATE OF SCIENCE.

Report of the Committee, consisting of Sir J. Herschel, *the* Master of Trinity College, Cambridge, *the* Dean of Ely, *Dr.* Lloyd, *and Colonel* Sabine, *appointed to conduct the co-operation of the British Association in the system of Simultaneous Magnetical and Meteorological Observations.*

Your Committee have great pleasure in being enabled to continue their hitherto favourable report of the progress of the important operations which they have been delegated to watch over; and the extent of their operations being now vastly increased, by the addition of new foreign establishments observing upon the same concerted plan, and at the same hours,—by the adoption of a system of colonial and national magnetic Surveys, based upon and correlative with the fundamental determinations at the fixed magnetic centres,—and by the introduction of new instruments and processes of observation, affording great facilities for magnetic determinations to travellers both by land and sea,—it will be convenient, both for clearness and precision, if we subdivide this our report into several distinct sections, according to the subject matter of these and other heads. And as offering grounds of the warmest interest and most lively sympathy to a British audience, we shall commence with the

1. *Antarctic Expedition.*

Our last year's report brought down the account of the progress of the expedition to its departure from Hobart Town in November 1840. The published extracts from the dispatch of Captain Ross, dated April 7, 1841, containing the details of the brilliant success of the expedition in penetrating the formidable barrier of ice, which had baffled the efforts of the French and American navigators, (an achievement as daring as any which has illustrated the annals of British nautical prowess,) and of his discovery of the great volcanic and lofty continent of Victoria in the previously unexplored seas far to the southward of that barrier, must be too fresh in your recollection to need any recapitulation in this report. It is with the magnetic observations and results of the voyage only, that our immediate concern lies.

Landing on the Auckland Islands shortly after leaving Hobart Town, Captain Ross observed there the November term of 1840. Abandoning then, by reason of the ill success of his predecessors in that direction, his original intention of sailing across the isodynamic oval surrounding the point of maximum intensity, his adopted course led him between the two southern foci. And although his return to the northward was by a more westerly route, it seems probable that he was generally to the eastward of the present locality of the greatest intensity. The magnetic observations accumulated in this voyage, however, have only lately reached England. Their full import therefore cannot yet be known; but it is understood that intensities have been observed by Captain Ross in these regions exceeding $2\frac{1}{2}$ times the minimum observed by him near St. Helena; and that intensities of this high value prevail with little variation over a space extending from the 47th to the 77th degrees of latitude The intensity in lat. 76°, where the nearest approach was made to the magnetic pole, was found to be actually less than in 47°. The nearest approach to that interesting point, viz. the magnetic pole, was made in lat. 76° 12′, long. 164° east, the dip being between 88 and 89 degrees.

It was mentioned in our last Report that the publication of the magnetic observations of the expedition had, at the request of the Admiralty, been placed under the superintendence of Lieut. Col. Sabine. The first portion of this work has been published in the Phil. Trans. of the present year, containing the observations of intensity made at sea between England and Kerguelen Island. In this paper, the 3rd of a series of "Contributions to Terrestial Magnetism" which we owe to Col. Sabine's zeal and industry, the whole series of interesting observations made on board each of the ships with Fox's statical or deflecting magnetometer, are carefully analysed, projected, and reasoned on. The results are every way most satisfactory as regards the practicability of observing with precision at sea, in all sorts of weather; as a proof of which, it will be necessary only to mention, that out of 647 observations of this kind made between London and the Cape of Good Hope, on board the Erebus, one only was found so far irreconcileable with their general tenor as to be declared doubtful: while the observations taken on board both ships, when compared, exhibit a steady accordance which cannot be accidental, and may well be termed beautiful. From this examination it would appear (if earlier observations can be relied on) that the line of least intensity on successive meridians in the middle and eastern part of the Atlantic Ocean is travelling rapidly northward.

In addition to the sea observations, the expedition since our last Report has made absolute determinations and observed terms as follow:—

1840. Nov. .... Auckland Island.
1841. May and June .... Van Diemen Island.
—— July .... Sydney.
—— Aug., Sept., Oct., Nov. .... New Zealand.

The November term having been kept in the Bay of Islands, the expedition, according to the last letter received from Capt. Ross, dated Nov. 22, 1841, was to sail thence the day following to resume the exploration of the Antarctic regions. His intention, as stated in that letter, was to traverse the isodynamic oval surrounding the focus of greatest intensity, supposed to be in lat. 60°, long. 235° east, and steering thence directly south to the edge of the ice-pack, to make, on reaching it, for the point at which the first year's exploration of the coast of the new continent terminated, with intention to pursue the barrier, wherever its course may lead. The working out of this arduous undertaking may of course involve a winter spent within the antarctic circle. Should it be otherwise, we may expect shortly to hear of the arrival of the expedition at the Cape of Good Hope, or at the Falkland Islands *.

2. *British and Foreign Observatories.—Extension of the period for which the British Establishments have been granted by the British Government.*

All the British and Indian magnetic observatories, that at Aden excepted, as

* By letters received since the meeting of the British Association at Manchester, we laern that the Expedition arrived at the Falkland Islands in April of the present year, and was to sail again for the Antarctic Circle in October.

well as those Continental ones which can be regarded as intimately connected with and bearing part in the great operations in progress—are of course, and have long been, in full activity. The Russian Government has been pre-eminently active in the establishment of new observatories, and supported by the powerful protection of M. le Comte Cancrine, Minister of Finance, as well as aided by funds placed at his disposal for the purpose by Prince Mentchikoff and other Russian noblemen of distinction, the zealous and energetic director-general of the Russian observatories, M. Kupffer, has succeeded in procuring the establishment of magnetic observatories at Kasan, Barnaoul, Nertschinsk, and Catherinebourg, and in bringing them by his personal exertions into a state of efficient activity, as well as in obtaining the re-erection of the old and insufficient observatories of Tiflis and Nicolaijeff, and the prospect of a new foundation for the same purposes at Moscow, under the auspices of Count Strogonoff, curator of the university of that city.

This vast development of the original plan of operations, followed up as it has been by almost every European power, has of course not been accomplished, to say nothing of expenditure, without the lapse of much valuable *time*. The original term of observations granted by our own Government and the East India Company, was three years, which expire in the current year—just when in fact everything is come into full action, and the fruits of so much labour and expense are beginning to be regularly gathered in, on a scale commensurate to the exertions used. The necessary preparations, the instruction of officers, their conveyance to their points of destination, the building of observatories, the establishment and adjustment of instruments, were all works of time. The first year of the term was necessarily thus occupied, and in some cases a considerable portion of the second; so that in no case has anything like the three years of actual observation contemplated, been secured. Under these circumstances, and considering that a pause for the present, and resumption at some future time of the observations, would involve the breaking up of the whole system so auspiciously commenced, the dismantling and decay of the existing observatories, the fresh initial expense, delays, and difficulties of concerted organization in their re-establishment, it was considered advisable by the President and Council of the Royal Society that application should be made to Government on their part for the continuance of the observatories during another period of three years, to terminate with the end of the year 1845. At the same time it was officially intimated on the part of the Russian Government, that the Russian observatories should be kept on as long as the British; Baron Brunow at the same time stating, that so far from supposing the period thus asked for long, his communications led him to presume that it would be considered as the shortest time in which the objects contemplated were likely to be accomplished, and in which adequate returns could be made for the great exertions and outlay occasioned in the establishment of the observatories.

To these representations your Committee are happy to be enabled to report that an unhesitating assent on the part of the British Government has been given, and that in consequence the continuance of the general system for three additional years must be considered secure. Whatever may be the course of men's opinions as to the additional burdens recently imposed on the country, men of science may at least congratulate themselves that *their* quota of the general contribution will be devoted to objects which they cannot but heartily approve.

To this new period that which is on the point of elapsing must be considered (independent of the rich and valuable results it has yielded) as a preparation of incalculable value, since whatever modifications and improvements, under a revised system of instructions, it will be found necessary to introduce, will now be based on mature experience, and adopted with sound deliberation. Uniformity can now be insisted on in points which were necessarily at first open to peculiarities of local and individual practice. Hourly in place of two-hourly observations may possibly be found generally practicable. Instrumental corrections, and especially that for the temperature of the magnets, which has proved to be the most important of all, as well as the most difficult to ascertain, will have been accurately determined, and can henceforward be confidently applied.

But in regarding what has been done as preparatory to what is to follow, we are not to lose sight of its actual independent value. Were it only on account of its affording so vast a basis of comparison with the itinerant results of the antarctic expedition, it would have been inestimable. The demonstration it has afforded of the ubiquity over the whole globe of those singular disturbances to which the name of Magnetic Storms has been applied, could have been no otherwise obtained, and is in itself a physical result of the first importance. The data it has afforded for the revision of the Gaussian theory are numerous, and beyond all comparison more exact than any which had ever before been collected. In a word, were the series broken off at this point, though we must have grieved to find ourselves arrested in full career, we should still have found cause to regard the operation as conspicuously successful.

3. *Magnetic Surveys.*

Southern Africa.—Lieut. Clerk, R.A., who is noticed in the last Report as having been ordered by the Master-General of the Ordnance to join the magnetic observatory at the Cape of Good Hope, in anticipation of an application for this survey, arrived at the Cape in December, and has since taken part in the duties of the observatory as assistant to Capt. Wilmot. In the estimate which has been forwarded to the Treasury of the expenses of the magnetic establishments under the department of the Ordnance for the newly authorized period, Lieut. Clerk and one additional gunner are included in the strength of the Cape observatory, the survey having been made part of the duties of that establishment. It is proposed that the survey shall comprehend, in addition to the colony itself, as extensive a portion of the earth's surface in all directions from the observatory as time and circumstances will permit. Application has been made to the Admiralty (who have on all occasions shown the utmost readiness to promote magnetical inquiries,) to permit the sea portions of this survey to be carried into execution by occasional opportunities which the Admiral at the Cape station may be able to afford without prejudice to the public service in other respects, in Her Majesty's ships and vessels under his command. This will include the coasts of Africa on either side of the Cape. When this portion of the survey shall have been considerably advanced, we shall be better able to judge of the expediency of completing the circle by an excursion into the interior. With a view to this, inquiries have been set on foot at the Cape, and answers received from the colonial authorities in the commissariat and surveying departments, relative to the most desirable route, the strength of the party, time required, mode, and probable cost of transport and subsistence, &c. The Geographical Society have also furnished notices of high interest as to the points of geographical discovery (including the discovery of the Great Lake in the interior of South Africa, whose existence is considered certain, but which has never been visited by any European), which might be accomplished consistently with the objects of such survey.

North America.—Lieut. Lefroy, R.A., has been appointed successor to Lieut.

Riddell, in the principal direction of the observatory at Toronto, and of the survey there, which, as at the Cape of Good Hope, is made a part of the general duties of the establishment. Having been relieved at St. Helena by Lieut. Smyth, Lieut. Lefroy is now in England preparing instruments for the survey, and will proceed to America in a few weeks. Since Lieut. Riddell's return to England in January 1841, on account of health, the observatory at Toronto has been conducted in the most satisfactory manner by Lieut. Younghusband on the excellent system established there by Mr. Riddell. Extensive as is the field of research which now opens in that quarter of the globe, and arduous as will be the task of profiting duly by the opportunities likely to be afforded, the zeal, intelligence, and perseverance which have been already shown by Messrs. Lefroy and Younghusband, give the best assurance of the good performance of the further service entrusted to them. The Hudson's Bay Company, with its accustomed readiness to promote scientific inquiries of all kinds in their extensive territories, have most liberally undertaken to furnish conveyance in the summers of 1843, 1844, and 1845, over the countries to the north and west of Canada, extending to the shores of Hudson's Bay and to the Pacific Ocean, and have made the further offer of a passage in one of their annual ships from Hudson's Bay to England, so as to include in the survey the interesting magnetic region of Hudson's Bay and Straits.

The operations thus contemplated in the north will connect themselves with magnetic surveys actually in progress by several distinguished magneticians in the United States. Mr. Bache has during the last summer completed the systematic survey of Pennsylvania, commenced in the preceding year, including the three elements of Declination, Inclination, and Intensity. Professor Loomis has extended his series of observations of the Inclination over many parts (previously unvisited by him) of the States of Ohio, Indiana, Illinois, and Missouri. M. Nicollet has also observed in the same region, and Dr. Locke has added a contribution. These and other similar operations which we may expect in the United States, from the increasing interest which magnetism excites there, will connect the Northern British survey with the determinations of Captain Barnett, R.N., commanding H. M. S. Thunder, on the southern coasts of the United States and in the Gulf of Mexico. Captain Barnett is well provided with instruments both for sea and land observation, and has shown himself a zealous and careful observer.

4. *Observations made at Sea.*

It has already been stated in the last year's Report, that by the use of Mr. Fox's instrument the inclination or dip, and the magnetic intensity may be measured at sea, if not with absolutely the same precision as at land, yet with a precision quite as great as is requisite for every possible use to which observations at sea can be turned, that is to say, for the purpose of tracing out the isodynamic and other magnetic curves in the portion of the globe occupied by water; and the probable absence of local attractions and disturbances in open ocean, while it renders such curves more easily traceable, so it affords a ready method of checking each particular observation by reference to the chain of determinations of which it forms a part. To extend and facilitate the use of this valuable instrument, a set of instructions for its use has been drawn up by Col. Sabine, and printed by the Admiralty for general circulation. The use of this instrument has been adopted by Captain Blackwood in his surveying expedition to Torres Strait, and the same system of daily observation is practised with it, as in the Erebus and Terror; and the example it is to be hoped will be followed, not only in voyages designed expressly for purposes of survey and exploration, but in ships pursuing ordinary tracks, so as at length to furnish data for the construction of complete magnetic sea-charts, founded on observation alone, for these important elements, as well as for the declination.

For the formation of such charts, however, it is necessary to eliminate the influence of the ship's iron, an influence which the continually increasing quantity of iron on board of vessels renders an evil of great and increasing magnitude. Instructions for this purpose, as regards the declination, have also been issued by the same authority, founded on the experience obtained in our arctic expeditions, and embodied in rules which are substantially the same with those given by Col. Sabine in his paper in the Phil. Trans. on Compass Deviations on board the Isabella and Alexander in the arctic voyage of 1818, consisting in simultaneous sea and shore observations, and reciprocal bearings with the ship's head laid in succession round every point of the compass.

In reference to contributions made to our knowledge of the magnetic elements in various parts of the globe, it would be unjust to omit the mention of the valuable series of such determinations made by Captain Belcher, R.N., of H. M. S. Sulphur. These determinations, the first portion of which have been reduced by Col. Sabine, and published in the Phil. Trans. for 1841, have been continued by Captain Belcher at more than 20 stations in the islands and coasts of the Pacific and China Seas. The observations are arrived in England, and will shortly be reduced, forming altogether a very valuable contribution towards the data accumulating for the revision of the numerical elements of Gauss's Theory.

Still less pardonable would it be in this Report to omit signalizing the final publication during the last year of Professor Erman's magnetic results in his journey into Siberia and voyage round the world. It is true that these results are already in part interwoven with the numerical computations of M. Gauss's magnetic coefficients, and so constitute an integrant part, and a most important one, of that vast and laborious work. But this has been by the especial favour and liberality of that eminent traveller, in placing at the disposal of those engaged in theoretical researches, results to them invaluable, and which have actually proved most useful even without that final revision and laborious reduction which he has ultimately given to them. When we consider the vast extent of sea and land traversed by this indefatigable traveller, his long residence in the dismally cold and inhospitable regions of Siberia, the infinite labour of the observations themselves, and the care with which they have been made, we shall see reason to regard this work as one which must constitute an epoch in the history of magnetic science, both for the mass of information it contains and the personal devotion it indicates.

5. *Magnetic Disturbances.*

M. Gauss truly remarks, that "*It is one of the great results of British enterprise, that the existence of disturbances extending over the whole globe has been ascertained.*" As a physical fact deeply connected with the general causes of terrestrial magnetism, this is indeed a result of the first magnitude; and its consideration under all its circumstances, and especially as modified by distance and geographical locality, is eminently calculated to lead to speculations on those causes, and to theoretical views tending to connect these abrupt variations with the usual course of the magnetic phænomena. To disconnect, in the phænomena of the magnetic storms, what is local from what is general, and to trace individual shocks occurring in them from observatory to observatory, and from station to station, until they become so far enfeebled by the effects of distance from their origin as to be confounded and masked by the growing influence of other shocks whose point of action is nearer, is now one of the principal points to which attention must be directed. The great mass of the magnetic bars used for the regular determinations, and for observations of small and moderate disturbances, throws some obstacles in the way of this inquiry, when the changes of magnetic force are very sudden and irregular, which seems more likely to be prosecuted effectually by the use of very small bars capable of being instantly affected by short and sudden shocks. But however this may be, the occurrence of many and remarkable storms during the continuance of these observations, at the most distant localities, and with all their detail of circumstances, has given a very high degree of immediate interest to this branch of the inquiry, and occasioned a change in the contemplated order of publication of the reports. It has been considered advisable to collect together from all the returns the cases of remarkable disturbances observed, arrange them in chronological order, and publish them in volumes by themselves. Those of 1840 and 1841 will appear in the course of the summer. By pursuing this course it alone becomes practicable to mature such a plan of extra or storm observation (whether by the use of smaller needles or by other processes which will suggest themselves,) as can be fairly tried and effectually brought into action while the colonial observatories still subsist. Among those which will be included in this first publication, the great disturbance which took place on and about the 25th of September, 1841, though not the greatest in point of actual deviation which has occurred, is yet in many respects one of the most remarkable. It was observed at Greenwich and immediately made the subject of a circular communication addressed by the Astronomer Royal to his brother observers. Speedily accounts dropped in of the observation of the same disturbance at outlying stations, from Toronto, from St. Helena, from the Cape of Good Hope, nay, even from Trevandrum in Travancore. All these accounts arrived in time to be inserted in the Report of this Association for 1841, and it must surely be regarded as a signal proof of the efficiency of the arrangements made on all hands, that a phænomenon, casual in its nature so far as we yet see, and manifested by no external and visible premonitory symptoms, should have been thus seized upon by our observers in Europe, Asia, Africa and America, reported thence to England, reduced, printed and circulated in three months and a week after its occurrence. "*Tantum series juncturaque pollet*"!*

Anomalous magnetic movements of unusual magnitude take place on the average 3 or 4 times in the month, but apparently with greater frequency in some months than in others. The returns from the different stations show hitherto without exception that these disturbances are general, that is to say, that though the movements individually may not be, and in fact are not, always *simultaneous*, the observations of the same day never fail to exhibit unusual discordances at all the stations. Generally the disturbances are characterized by a diminution more or less of horizontal intensity, prevailing more or less for several hours together, everywhere, and mostly accompanied by a movement, also general, of the north end of the needle towards the west. By a memorandum of Lieut. Younghusband on the disturbance on the night of the 15th April 1842, which was so considerable that the range of the declination in little more than an hour extended over 2° 15′ in arc, it appears that with the 15-inch bars used in the observatory, which require 17^s for a vibration, a change of more than 50 divisions of the scale, or

* Dr. Lamont states that during the most intense part of this disturbance, (the whole of which was observed by him at Munich,) the movements exhibited no correspondence, taken seriatim, with those at Greenwich.

35 minutes of arc, occasionally takes place in the time required for the three vibrations which give the mean place entered in the tables.

Experience has somewhat diminished the value of the term observations as a *principal means of detecting disturbances*; especially since our observatories have adopted hourly observations, by which a departure from the normal state cannot continue long without notice; and thus the disturbance furnishes, of itself, at all the stations, a natural signal for extra and simultaneous observation. Besides our Colonial and East India observatories, the disturbances are watched with the greatest diligence at Prague, Munich, and Greenwich.

6. *New Magnetic Instruments and Modes of Observation.*

Transportable Magnetometer.—Among the most useful services that have been rendered to the magnetic cause in the year elapsed, has been the making this a thoroughly practical instrument, and the instructions which have been drawn up by Mr. Riddell for its use. These instructions are now in progress of printing. They are of the most distinct and practical kind, and contain the formulæ of correction and reduction with numerical examples from actual practice. This instrument and the instructions for its use, freely supplied to officers of the army and navy, will multiply absolute determinations, term observations, and disturbance observations far beyond what could ever be done by fixed observatories, and also in localities where such could not be established. Already have these improved instruments been supplied to the ships of Capt. Blackwood and Capt. Sulivan, the first proceeding to survey Torres Strait, and the latter the Falkland Islands, and the officers have been instructed in the use of the instruments at Woolwich. Another has been supplied to Mr. Lefroy, and will enable him to keep the terms in whatever part of America he may find himself on the days appointed. Others are preparing for Capt. Barnett and Capt. Grove, R.N., who are engaged in surveys at Bermuda and Malta, both being stationary for several months in the winter. From Capt. William Allen, R.N., of the Niger expedition, we have received the November and December terms, 1841, kept at Ascension, with the original German transportable magnetometer, as also the absolute determinations made with it in the same island.

Professor Lloyd's new Inclinometer.—The vertical element of the magnetic force is one of difficult determination with that precision which is required to become comparable with the determinations of its horizontal component, so as to afford a perfectly correct means of calculating the changes of the inclination and of the total intensity. The instrument hitherto used for the purpose, called by Prof. Lloyd the Balance Magnetometer, has been found scarcely adequate to its intended purpose. "Unexceptionable as its principle is in theory, the accuracy of its results has not been commensurate with that of the others. This inferiority is owing to the large influence which the unavoidable errors of workmanship necessarily have on the position of equilibrium of a magnet supported on a fixed axle." "The sources of error seem to be inherent in every direct process for determining the third element, and it is only by an *indirect* method that we can hope to evade them."* Such a method has accordingly been recently proposed and subjected to trial by Dr. Lloyd, by means of an instrument to which he has given the name of an Induction Inclinometer, the principle of which is the measurement of the intensity of the magnetism induced on a vertical bar of soft iron (which must be considered as due to the vertical magnetic component only) by the deviation it is capable of causing in a horizontal bar suspended near it. The details of

* Account of the Magnetical Observatory at Dublin, &c., by the Rev. H. Lloyd, D.D.

the construction and adjustments of this instrument are given in the work cited below.

Weber's Inductive Inclinometer.—Similar in respect of its general principle, but widely different in the mode of application of that principle, is a recent invention of M. Weber for the same purpose. The deflection of the horizontal magnet in this instrument is produced by the earth's magnetism, induced not on a vertical soft iron bar at rest, but on a ring, sphere, or plate of copper made to revolve about a vertical axis with a perfectly uniform and given velocity by clockwork. This ingenious instrument has not been tried in England, but is stated by M. Kupffer to perform very satisfactorily.

M. Lamont's Inclinometer.—A third and much less simple mode of accomplishing the same object of measuring the intensity of the earth's magnetism by its inductive power has been devised by M. Lamont. As in Dr. Lloyd's process, a bar of soft iron is used as the temporary magnet, but in other respects the application of the general principle is widely different. The bar so temporarily magnetized is made to act unequally on the two bars of an astatic magnetic couple, thereby tending to draw them aside from a given position in which they would otherwise be held by a fixed magnet of given power. This tendency however is destroyed by another magnet placed in a given position and distance. A series of reversals and changes of distance in the soft iron bar and the neutralizing magnet is then operated, which furnishes equations by which everything but the intensity sought and known quantities can be eliminated.

7. *Publication of Magnetic Observations, Descriptions of Observatories, &c.*

As it is not by any means the object of this Report to give a historical view of the progress of magnetic science generally, except in so far as the immediate purposes for which your Committee is constituted are concerned, and as bearing on the practical operations over which they are delegated by the Association to watch,—it must suffice under this head to notice very briefly the appearance of several works and memoirs, in which observations are recorded or discussed, instruments and observatories described, &c.

None of the returns of the regular observations at our stations are as yet printed; but, as has been noticed, those of the disturbances in 1840 and 1841 will appear in the course of the present year. In this respect however we are not more in arrear than our Russian coadjutors, the observations made in the whole extent of which empire under the superintendence of M. Kupffer, for the year 1839, have appeared in the course of 1841, forming the regular continuation of that noble collection, the "Annuaire Magnétique et Météorologique du Corps des Ingénieurs des Mines de Russie". Nor indeed does it seem practicable in works of this vast extent, and where the returns have to arrive from such distant quarters, to place a much less interval between the making and publication of the *ordinary* observations.

The year elapsed has also been marked by the publication of the first volume of the magnetic and meteorological observations made at Prague by M. Kreil, containing the observations from July 1, 1839 to July 1, 1840; a singular departure from the usual and far more convenient practice of packing together in the same volume the observations of each separate year. In this work the observations are not only registered, but very amply discussed and reduced, and the daily, monthly, and yearly march of the results investigated. The suspected influence of the moon on magnetic and meteorological phænomena is made a subject of especial discussion by M. Kreil.

M. Quetelet continues his praiseworthy labours in collecting and projecting meteorological observations on the solstitial and equinoxial term days.

These, and his observations of the magnetic terms with their graphical projections, continue to be regularly published by him in the Bulletins of the Royal Academy of Brussels.

Dr. Lloyd, Dr. Lamont, and Messrs. Lovering and Bond have respectively furnished descriptions of the magnetic observatories under their direction at Dublin, Munich, and at Harvard University, Cambridge, N. S. In the last-mentioned of these works (published in the Memoirs of the American Academy of Boston,) are also printed the term observations made in 1840 and the commencement of 1841 at that Institution, projected, and in the case of the term of Oct. 21, 1840, compared with the corresponding observations at Toronto (as regards the declination), and exhibiting (conformably to what has been found to obtain in stations not more distant from each other in Europe) a close and minute agreement in the march of the deviations, which on that occasion was very irregular.

Dr. Lamont's observations are characterized by the use of very small needles. Some anomalies appear to have been produced in their readings by circulating currents of air arising from inequality of temperature in their glass inclosures; but these he has succeeded in great measure in destroying. Indeed there seems no good reason why such needles should not be suspended in vacuo. Assuredly if very small needles could be used in place of large ones, (for those observations, that is to say, which do not depend on observed times of vibration, for to such they are quite inappropriate,) not only would the costliness of apparatus be much diminished, and its portability increased, but the temperature corrections would become more certain, by reason of the rapid distribution of heat through the whole extent of the needle, (neither would there probably be found much difficulty in keeping such needles constantly up to a definite state as to magnetic saturation) not to refer again to what has been already said of their applicability to a closer analysis of the shocks producing irregular disturbances.

Dr. Lloyd's paper may be advantageously referred to for a full account of the construction, adjustments and mathematical theory of all the magnetic instruments employed, and in this respect must be considered as a very useful and valuable contribution to the cause in hand.

Col. Sabine has reduced and discussed during the past year the observations of Capt. Belcher on the west coast of America and at Otaheite in the second series of his "Contributions to Terrestrial Magnetism" published in the Phil. Trans., 1841, and in his third series of such contributions has passed under examination the sea observations of intensity made on board the Erebus and Terror in the voyage from England to Kerguelen's Land.

Professor Loomis's observations of intensity and dip in several stations in the United States, made in the years 1838, 1839, 1840, have also appeared in the year elapsed.

The subject of the mutual action of permanent magnets, with a view to their best relative position in an observatory, has been resumed by Dr. Lloyd in a supplement to his former paper on that subject published by the Royal Irish Academy. Choosing among the incompatible conditions which a total destruction of the mutual actions of three magnets would require those of most importance to satisfy, he has been enabled to propose several arrangements adapted to specific purposes, which accomplish their object with great simplicity and convenience.

A considerable extent of correspondence has taken place on the important subjects of the best formula to be used and method to be adopted for determining the absolute intensity of a magnet by deflection observations, Mr.

Airy contending for the inadequacy of Gauss's formula, and proposing a different method, and Dr. Lloyd for its practical sufficiency. The subject must be considered as still under discussion, and the necessary revisal of the instructions for the new period will either cause both methods to be practised, or otherwise bring the point to a satisfactory issue. Opportunity will also be afforded for attention to many other valuable practical suggestions which have been offered as the result of experience already gained; such as Mr. Lamont's correction for change of magnetism in the deflecting bar in the same class of experiments, when in the meridian, and when perpendicular to it; as also Dr. Lloyd's determination of the ratio of the distances of the deflecting bar which shall give the smallest possible error in the resulting intensity corresponding to a given force of deflection, and his suggestion respecting the employment of the bifilar suspension for the purpose of magnifying small declination-changes, whether such changes require to be measured for ascertaining the temperature correction of a deflecting magnet, or simply for their own sake, at stations near the equator where they are habitually very small.

No expense beyond a charge of 10*l.* 8*s.* 10*d.* for observatory registers supplied to Mr. Boguslawski for the new period of three years, has been incurred, but your Committee pray a continuance of the remainder of their grant to meet such demands as may arise.

Signed on the part of the Committee, J. F. W. Herschel.

Annual Report of Professor Von Boguslawski, addressed to Colonel Sabine.

"My dear Sir, "Breslau, June 18, 1842.

"I have received with great pleasure, although much retarded, your esteemed communications of May 19th, 1841, and January 11th, 1842, as well as the highly interesting inclosures, but am still in expectation of the arrival of the *required forms*, as also of the new books for observations of this year, from 2 to 2 minutes. They will however arrive in time, because for this year past, extraordinary obstacles to the labours of the observatory have taken place, which however have now been happily removed. The only assistant who was associated with me was suffering under a complaint of the chest, which rendered him incapable of continued work. The labours thereby fallen to my share were increased by the death of Dr. Scholtz, Professor of Mathematics, part of whose lectures I was obliged to take upon me until his place was supplied again.

"Not without much exertion I have taken care, *that all the magnetic term observations were made complete*, and that everything was prepared to proceed presently to the absolute observations under more favourable circumstances, as also not to omit observations of perturbations out of terms.

"During the vacancies of the Easter holydays I have caused to be made for that purpose, not without difficulty, a deep blind (niche) within the old thick and strong wall of the tower, in order to get thereby sufficient room for observations of deviations of the declination needle also in the westerly direction. I place much confidence in the new assistant, who is to arrive by the 1st July, and live in hope that my request for a second assistant will be acceded to, so that the magnetic observations will be continued with redoubled zeal, and more time can then be given to the forming of the abstracts and registers for you.

"I beg to request of you the favour of communicating this to the Council of the British Association, and to present to them at the same time my most sincere and hearty thanks for the honour conferred upon me for naming me a corresponding member."

Report on the present state of the Ichthyology of New Zealand. By JOHN RICHARDSON, *M.D., F.R.S., &c., Inspector of Naval Hospitals, at Haslar.*

Now that New Zealand has become the adopted home of thousands of our countrymen, whose numbers are daily receiving fresh accessions, and whose efforts are primarily directed to the overthrow of the native forests with a view to their replacement by farm-houses, verdant pastures, rich crops of the cerealia, and the other accompaniments of a successful agriculture; we may expect that a corresponding change will follow in the distribution of animals. Some will become rare or perhaps entirely disappear, while others, casually or intentionally introduced, and finding appropriate food and protection, will increase, and people the land. It is of importance to zoology that the number, range and habits of the animals should be ascertained and recorded before the din and bustle of civilisation scare them from their native haunts; and it was with the view of facilitating the execution of such a task, that J. E. Gray, Esq. of the British Museum, and I undertook, on the recommendation of the general committee assembled at Plymouth, to draw up a report, of which the present paper is a part.

The islands of New Zealand crossing thirteen degrees of latitude, and possessing from their narrowness and their remoteness from continents, a purely maritime climate, are well situated for showing how far the distribution of animals is influenced by an increasing distance from the tropic, independent of other considerations. Several able zoologists have gone to reside in this the most remote of our colonies, and it is to them that we look for an accumulation of facts bearing on this question, before the unwearied assiduity and continual progress of the Anglo-Saxon race, and the ravages of the domestic beasts of prey which follow in their train, shall have compelled the various species to overpass the demarcations of their ancient ranges, which could have been but little disturbed by the operations of the thinly scattered aboriginal inhabitants. These observations apply more extensively to the birds than to the other vertebrata, for quadrupeds are very rare in New Zealand, Cook having observed only two, the dog and rat, and Polack, in his recently published popular account of the Colony, says that it nourishes no serpents or snakes of any description. Three individuals of the genus Pelamys were indeed thrown ashore on a piece of timber; but from the way in which the fact is mentioned, I suppose that they were destroyed by those who witnessed the descent. A large agama (*Hatteria*, Gray) is known to the settlers by the name of iguana, but it is now scarce, having been nearly extirpated by wild cats sprung from the introduced domestic race.

Mr. Gray with the assistance of his brother has prepared a list of the birds, and also drawn up one of the reptiles and invertebrata known to inhabit New Zealand; but he has lately received an accession of specimens which require time for examination, and has therefore found it expedient to defer his report to another year, that he may be able to present it in a more complete state. The fish have hitherto been more neglected than the other vertebrata or the mollusca, and had I designed to draw up an orological report, or to make extended observations on the peculiarities of organization exhibited by the fish which inhabit the seas of New Zealand, I must also have deferred this paper until materials accumulated; but my object is the much more humble though still useful one of furnishing the naturalists now at work on the ichthyology of those distant seas with a list of the known species and references to their figures and published descriptions.

It is to the accurate observers who accompanied Cook on his first and second voyages, that we are indebted for almost all that is known of the fish of New Zealand. They figured or described upwards of sixty-five species, to which nine have been added by Cuvier and Valenciennes in their admirable 'Histoire des Poissons,' and sixteen by other writers, making in all ninety. Even in this small list it is to be feared that in two or three instances the same species is mentioned more than once under different names.

From the great prolongation of the islands in a north and south direction, the deep indentations of their coast-lines, the different exposures of their bays, the variety of the beaches, the existence of sand-banks off their shores, their numerous rivers and interior lakes, we should expect to find them rich in fish, and in fact Polack says that few countries possess a greater abundance or variety of the finny tribes. There is no place in the northern hemisphere, situated in the same manner as New Zealand, so that it can be used as a standard of comparison; but the Mediterranean sea embraces similar parallels of latitude and it is known to nourish at least 230 species of acanthopterygii alone. The fish which frequent the shores of New Zealand are probably as numerous as those which visit the coasts of Italy and Sicily, and we may expect to find among them a greater variety of the wandering oceanic kinds. Lesson, in the zoological part of the account of the voyage of the Coquille, gives an eloquent sketch of the general distribution of fish in the Southern seas, which may be consulted with advantage; but much information is still required to complete this department of zoology. Seamen are so well acquainted with the general forms of the pelagic fish, that they have ceased to regard them as objects of curiosity, or to record their appearance; and we consequently lack observations on the precise ranges of the species. It is of the more local kinds, owing to their peculiar habits and strange shapes, that navigators on visiting a foreign coast form the bulk of their collections. Of these, some are strictly littoral in their haunts, and prey on the minute crustacea which deposit their spawn in such localities; others browse on sea-weed or on coral, and are not likely to traverse large districts of the ocean destitute of such productions. The *boleophthalmi* and some other *Gobioides* even ascend the beach, and like little lizards chase their insect prey through rocky crevices. The plectognathi seem to be peculiarly adapted for living in the surf of coasts exposed to all the fury of the ocean, and particularly among the coral barriers of the intertropical isles. Their powers of natation are small, aided though the caudal be by the approximation to it of the other two vertical fins, and they are apparently tossed about at the mercy of the waves. Some of them are protected by hard elastic cuirasses, strengthened by strong spines placed at the angles; others have their soft integuments studded by projecting flexible spines like those of the terrestrial hedge-hog or sea echinus; and they possess moreover the power of rendering themselves more buoyant by inflating the skin with air, or of steadying themselves by taking in water as ballast. Australian specimens of these fish abound in every museum.

The predominance of marsupial quadrupeds over the other Mammalia in Australia is the distinguishing feature of its zoology, and it would form a curious subject of inquiry, to ascertain whether there be anything analogous in the other divisions of the animal kingdom existing in that quarter of the world. Mr. Owen has shown that the marsupial structure is peculiarly adapted to the necessities of animals that are required to traverse large tracts of poor and barren country in search of food. Now an inhabitant of the waters must be in a condition somewhat similar to the kangaroos in the wastes of New Holland, when the element in which it is primarily organized to move and from which it draws its subsistence is occasionally deficient. Immediately without the tropics there is a zone of various width but nowhere passing the 34th parallel, within which little or no rain falls. We can trace this zone from Pitis and Lower California across the new world to the Atlantic. In the old world it includes the Sahara and lesser deserts of Northern Africa, Egypt, Arabia Deserta, and certain districts in Asia, being interrupted chiefly by the intrusion of lofty mountain chains. This arid belt is bounded by zones of periodic rains, which on the north side of it fall in the winter season, and on the south side in the summer only, the rains having a more uniform character in the latter district. Similar zones exist in the southern hemisphere, though they are less easily traced from the intervention of large tracts of ocean. We find them well characterised however both on the Pacific and Atlantic coasts of South America, again north of the colony of the Cape of Good Hope, and in the southern half of New Holland, where as at the Cape the rivers are for the most part mere chains of ponds. Some provision must be made for the preservation of fish inhabiting the ponds in such countries, in the dry season; and we observe, accordingly, that in Australia various *Cheironectes*, *Batrachi*, *Gobioides*, *Megalopes* and *Apodes* bury themselves in the mud as the water dries up, and like the lepidosiren of the Gambia remain in an inert state until the rain falls. In South America some siluroids, such as the Callichthys, also bury themselves in the mud, while the *Doras hancocki* when the water fails marches overland in dense bodies in quest of another river. The *Anabasideæ* have a peculiarity in the structure of the pharynx enabling them to retain a supply of water in seasons of drought, which has been compared by some authors to the water-bag of the camel, that ship of the desert. These fish are most abundant in the southern parts of Asia, a few range to the Indian archipelago, and the genus *Spirobranchus* peoples the rivers of the Cape of Good Hope. The Indian Anabas, a member of the family, is said to ascend palm-trees in quest of little pools of water to be found in the axils of the leaves. None of the group have as yet been detected in Australia, though the nature of the country would lead us to expect to find them there: but the rivers have been scarcely explored by the ichthyologist. As to New Zealand, its maritime, and consequently more humid climate, seems to render any peculiarity in the structure of the respiratory apparatus of its fresh-water fish less necessary. With regard to the marine fish the proportion of known species is as I have already said too small to enable us to draw any very precise conclusions; but we cannot fail in reckoning the known Australian fish (including those of New Zealand) to be struck with the unusual number which are furnished with simple pectoral rays, more or less divided from the rest of the fin. The cottoid family, in which this structure is predominant, is as numerous, if not more so, in the Australian seas, as in the corresponding latitudes of the northern hemisphere, and there are in addition many *Polynemi*, *Cheironemi*, *Aplodactyli*, *Cheilodactyli*, *Nemadactyli*, and *Latres*, all furnished with simple pectoral rays. Many Australian genera exist also in the seas of China. Of the Cyprinoids which are so very abundant in India, but one species is known to exist in Polynesia or Australia.

In the following list "Solander" refers to that naturalist's manuscript 'Pisces Australiæ,' containing his descriptions of the New Zealand fish obtained on Cook's first voyage. The term "Australia" as used by him relates solely to New Zealand, which was supposed until Cook circumnavigated it, to be part of a great southern continent. The figures of fish executed in the same voyage are quoted under the name of the artist "Parkinson". "G. Forster" indicates the drawings made on the second voyage, which are preserved with those of Parkinson, and Solander's manuscripts in the Banksian library. "J.R. Forster" refers to the description of the species in Schneider's edition of Bloch. Forster's manuscripts are kept at Berlin, and are said to be at present in the course of publication in an entire state. The 'Histoire des Poissons' is quoted under the initials of its authors, and reference is occasionally made to the 9th volume of the Annals of Natural History, in which I am now publishing "Contributions to Australian Ichthyology."

PERCOIDEÆ.

1. SERRANUS LEPIDOPTERUS (Rich. Annals, 9, p. 18.). The Butterfly-barber-fish. (*Perca lepidoptera* J. R. Forster MS. II. 58. apud Schn. *Epinephelus lepidopterus*, Bl. Schn. p. 302.)

This fish was discovered on Cook's second voyage, and has recently been detected by Dr. Lhotsky on the shores of Van Diemen's Land. It belongs to the group of *Serrani*, which is named "Les Barbiers" in the 'Histoire des Poissons,' and which is nearly equivalent to Bloch's genus *Anthias*. The works above quoted contain all that has been published respecting it.

2. POLYPRION CERNUUM (C. & V. 3. p. 24. t. 42.), Wreck-fish, Cherny or Jew-fish. (*Sciæna gadoides*, Solander, p. 38. Parkinson, 2. t. 74. *Perca prognathus*, et "Palo-tera," G. Forster, 2. t. 18. J. R. Forster, MS. iv. 19. *Epinephelus oxygeneios*, Bl. Schn. p. 301.)

Few of the finny tribes have a wider range than this curious fish, which is remarkable among the percoids for its considerable size, and the peculiar armature of its head. It is abundant in the Mediterranean, where the fishermen have long applied to it an epithet expressive of its worthlessness and consequent rejection as an article of food; and it has been taken on both sides of the Atlantic, from the coast of Cornwall to the Cape of Good Hope. Yet it seems to have been quite overlooked by European ichthyologists until the publication of M. Valenciennes' paper upon it in the eleventh volume of the 'Mémoires du Museum,' unless Duhamel intended to represent it in his 'Pêches,' pl. 6. (vide C. & V. 3., p. 23.). In the same year however as the publication of Duhamel's work, this fish was an object of interest to Solander, who was then with Cook, navigating the seas of New Zealand. His 'Pisces Australiæ' contain an extended description of a specimen taken off Motuaro, which embraces most of the peculiar characters of the genus. Parkinson's figure was executed at the same place, and most probably is a portrait of the same individual. On Cook's second voyage the species was seen by the Forsters at Queen Charlotte's Islands, near the 19th parallel of south latitude and 138th meridian, where it was known to the natives by the name of "Palo-tera". G. Forster's drawing of it is preserved in the Banksian library, and J. R. Forster's description may be found in Schneider's edition of Bloch.

3. CENTROPRISTES TRUTTA (C. & V. 2. p. 54.). (*Sciæna trutta*, G. Forster, 2. t. 210. *Perca trutta*, J. R. Forster, apud Bl. Schn. p. 542.)

This fish was procured by the Forsters in one of the coves of Queen Charlotte's Sound, and Schneider quoting from the manuscripts of J. R. Forster, informs us that it was named by the natives "Kahavai," and by the sailors "Salmon-peel," on account of its rich and delicate flavour. Cuvier adopted the species in the second volume of the 'Histoire des Poissons,' under the designation that it has in Schneider's edition of Bloch; but in the third volume of the 'Histoire des Poissons' he supposes that the species may prove to be the same with the *Centropristes? truttaceus* procured by Messieurs Quoy and Gaimard at Port Western. Several very closely resembling but distinct species appear to exist in the Australian seas. Two of them are named below, and Polack in his popular list of New Zealand fish mentions "Kahawai" or colourless Salmon, but gives us no clue by which to discover the species to which he alludes.

4. Centropristes mulloides. (*Sciæna mulloides*, Parkinson, 2. t. 68. *Sciæna mulloides*, β. (*sapidissima*), G. Forster, 2. t. 211.

This species was obtained by Parkinson at Hetrawai, and by the Forsters in Queen Charlotte's Sound.

5. Centropristes sapidissimus. (*Mulloides sapidissimus*, Solander, p. 22. Parkinson, 2. t. 67.)

Solander has given a pretty full description of this species in his 'Pisces Australiæ,' and mentions that it inhabits Tegadoo bay, and Tolaga, between the 38th and 39th parallels of latitude. Parkinson procured the specimen which he has figured at Opooragi. The drawings of these three, variously named *Centropristes*, being unfinished, we are not in a condition to point out their distinctive characters, neither is it quite certain that they are all specifically different from the New Holland *Centropristes truttaceus* (C. and V.), *C. georgianus** (C. and V.), and *C. salar* (Zool. Trans. 3. p. 78.). Some observations on their peculiarities may be found in the paper last quoted.

6. Aplodactylus meandratus (Rich. Zool. Trans. 3. p. 83.). (*Sciæna meandrata*, Parkinson, 2. t. 65. *Mæandrites*, Solander, p. 2.)

It was not until the year 1831 that the genus *Aplodactylus* was made known by Cuvier, on M. d'Orbigny bringing specimens of *punctatus* from Valparaiso. A second species, the *arctidens*, from Van Diemen's Land, is described in the third volume of the Zoological Transactions, now in the course of publication; and a third, not yet named, exists in the Museum of Fort Pitt. But as long ago as October 1769 Solander was in possession of a New Zealand species, which was taken off Cape Kidnappers, otherwise named Matamawi, in the forty-second parallel, and Parkinson made a drawing of it. This figure in conjunction with the extended description contained in the 'Pisces Australiæ' leaves us no reason for doubting the genus of the fish.

7. Percis colias (C. and V. 3. p. 273.). Coaly Percis. (*Labrus macrocephalus*, Solander, p. 27. Parkinson, 2. t. 57., *Gadus colias*, and New Zealand Colefish, G. Forster, 2. t. 181. J. R. Forster, MS. II. 36. apud Schn. *Encheliopus colias*, Bl. Schn. p. 54.)

This fish was discovered on Cook's first voyage off Owhooragi, and was named "Cole-fish" by the seamen. Parkinson's figure was done from a specimen which was taken at Motuaro. The Forsters afterwards found it on the same coast, and ascertained its native name to be "*nera-warre*." The painters and describers of this fish differ in the numbers of the fin rays, and we may conclude either that the species is variable or that two species have been confounded.

D. 5	20;	A. 12	Solander, Pisc. Austr.
5	20;	17	Parkinson, fig.
5	23;	20	G. Forster, fig.
5	25;	1 | 17.	J. R. Forster, apud Schn.

The two drawings however are very like one another, and there is no other marked discrepancy in the descriptions than the variation of the numbers of the rays.

8. Percis nicthemera (C. and V. 3. p. 274.).

Messieurs Lesson and Garnot brought this fish from the Bay of Islands, and

* *Arripis georgianus*, Jenyns, Zool. Beagle.

Cuvier says that he should be inclined to consider it as the same with J. R. Forster's *Gadus colias,* but for its very different numbers of rays, which are the same as in Parkinson's figure of *macrocephalus,* above quoted. It is possible that there may be a mistake or misquotation of the dorsal rays by Schneider, in which case the *nicthemera* would most probably have to be razed from our list of species. Solander mentions that the opercular bones of *macrocephalus* are the only scaly parts of the head, and this character is considered in the 'Histoire des Poissons' as a peculiarity of *nicthemera.* He also states that six or seven brown bands are faintly visible on the body of the living fish, the colours in other respects being those ascribed to *nicthemera.* The banded distribution of the darker tints is a prevailing one in the genus.

9. Uranoscopus maculatus (Forster). Bearded Star-gazer. (*Uranoscopus maculosus,* Solander, p. 21. *U. maculatus,* J. R. Forster apud Schneider. G. Forster, 2. t. 176. 177. *U. monopterygius,* Bl. Schn. p. 49. *U. cirrhosus,* C. and V. 3. p. 314. *U. forsteri* Idem, p. 318. *U. kouripoua,* Lesson, Voy. par M. Le Cap. Duperrey, pl. 18. *U. maculatus,* Rich. Annals, &c ix. p. 207.)

In the last-quoted paper reasons are assigned for considering the several names here quoted as synonyms of a single species, examples of which were procured at Tolaga bay on Cook's first voyage, in Queen Charlotte's Sound on his second voyage, and in the Bay of Islands by the naturalists of La Coquille. Lesson states that 'Kouripooa,' is the name given to it by the natives of New Zealand, while Forster says that they call it 'Bedee'.

10. Upeneus vlamingii (C. and V. 3. p. 452.). (*Labrus calophthalmus,* Solander, p. 35. Parkinson, 2. t. 46. *Up. vlamingii,* Annals, 9. p. 211.)

This fish came under the observation of Solander and Parkinson in Queen Charlotte's Sound. It exists likewise in the Indian ocean, Admiral Vlaming having left a figure of it which was copied by Renard. Specimens were also collected by Messrs. Quoy and Gaimard.

11. Upeneus porosus (C. and V. 3. p. 455.).

This Upeneus was detected by Peron in Van Diemen's Land, and by Lesson and Garnot in the rivers of New Zealand.

The following percoid-fish inhabit the seas of New Holland. *Apogon rex-mullorum* (C. and V.); *Ap. aprion* (Annals, ix.); *Serranus lepidopterus,* (Annals, ix.); *S. gilberti* (Annals, ix.); *S. merra* (C. and V.); *S. stellans* (Annals, ix.); *S. ura* (C. and V.); *S. crapao* (C. and V.); *Plectropoma dentex* (C. and V.); *Pl. serratum* (C. and V.); *Pl. nigro-rubrum* (C. and V.); *Mesoprion yapilli* (C. and V.); *M. carpo-notatus* (Annals, ix.); *M.? emeryii* (Icon. Pisc. fasc. i. t. 3. f. 2*); *Centropristes truttaceus* (C. and V.); *C. georgianus* (C. and V.); *C. scorpænoides* (C. and V.); *Grystes macquariensis* (C. and V.); *Cheironemus georgianus* (C. and V.); *Therapon servus* (C. and V.); *Th. theraps* (C. and V.); *Th. rubricatus* (Annals, ix.); *Pelates quadrilineatus* (C. and V.); *Helotes sexlineatus* (C. and V.); *H. octolineatus* (Jenyns, Zool. Beag.); *Sillago maculata* (C. and V.); *S. bassensis* (C. and V.); *S. punctata* (C. and V.); *S. burra* (Annals, ix.); *Beryx lineatus* (C. and V.); *Trachichthys australis* (C. and V.); *Aphritis urvillii* (C. and V.); *Uranoscopus lævis* (C. and V.); *Ur. maculatus* (Annals, ix.); *Polynemus plebeius* (C. and V.); *P. tetradactylus* (C. and V.); *Percis emeryana*† (Annals, ix. Icon. Pisc. 1. f. 1); *P. nebulosa* (C. and V.); *Upeneus porosus* (C. and V.).

* *Icones Piscium,* or Plates of Rare Fishes, by John Richardson, M.D., F.R.S., &c. London, 1842.

† This is *Dentex fasciatus* discovered by Solander on the coast of New Holland, May 24, 1770. It is also, perhaps, the variety of *Percis nebulosa,* noticed in C. and V. iii. p. 263.

COTTOIDEÆ.

12. TRIGLA PAPILIONACEA (Solander, p. 23.). The Kumu. (*Trigla papilionacea*, Parkinson, 2. t. 104. *Tr. kumu*, Lesson et Garnot, Coquille, pl. 19., C. and V., 4. p. 50. Jenyns, Zool. Beagle, p. 27.).

Parkinson and Solander saw this gurnard in Tolaga bay, at Opooragee, and on other parts of the coast of New Zealand. M. Lesson, and at a later period Mr. Darwin procured specimens of it in the Bay of Islands. Solander describes the colours of the recent fish more fully than any succeeding writer.

13. SCORPÆNA CARDINALIS (Solander, p. 28.); Parkinson, 2. t. 12. Annals, ix. p. 212.)

The 'Pisces Australiæ' contain a long description of this species. The habitat there assigned to it is Motuaro, but on Parkinson's drawing the more general one of Eaheenomauwee, or the northern island of New Zealand, is given. Much of Solander's description is quoted in the Annals of Natural History.

14. SCORPÆNA COTTOIDES (Forster apud Schneider.). (*Scorpæna cottoides*, G. Forster, 2. t. 190. *Synanceia papillosa*, Bl. Schn. p. 196.)

Forster's figure has a strong resemblance to the *Scorpæna ergastulorum* of Van Diemen's Land (Annals, ix.), but wants the black mark on the first dorsal fin. Cuvier compares it with the *cirrhosa* and *venosa* of the 'Histoire des Poissons.' Its New Zealand name is "enooheetara."

15. SCORPÆNA PLEBEIA (Solander, p. 21.). (Rich. Annals, ix. p. 214.)

Little is known of this species. Solander, who found it in Tolaga bay, described its colours merely, and there is no figure of it extant. It remains therefore for the local investigator of the Zoology of New Zealand, to compare it with the established species.

16. SCORPÆNA CRUENTA (Solander, p. 5. Annals, ix. p. 217.).

Neither have we any figure of this fish. It was procured off Cape Kidnappers, and has the black mark on the dorsal fin which is so conspicuous in the European *scrofa* and *ergastulorum* of Van Diemen's Land.

17. SEBASTES PERCOIDES. (*Scorpæna percoides*, Solander, p. 4. Parkinson, 2. t. 16. Annals, ix.)

This fish was obtained at Motuaro in Queen Charlotte's Sound on Cook's first voyage. Parkinson's unfinished drawing does not express the generic characters with precision, and Solander's description is confined to the tints of colour exhibited by the recent fish.

The following members of the cottoid family frequent the coasts of New Holland: *Scorpæna miles* (Zool. Tr. 3.); *Sc. jacksoniana* (Quoy et Gaim.); *Sc. burra* (Annals, ix. p. 215); *Sc. panda* (Annals, ix. p. 216); *Sc. ergastulorum* (Annals, ix. p. 217); *Platycephalus endrachtensis* (C. and V.); *Pl. fuscus* (C. and V.); *Pl. bassensis* (C. and V.); *Pl. lævigatus* (C. and V.); *Pl. inops* (Jenyns, Zool. Beagle); *Apistes australis* (C. and V.); *Apistes* ——? (Jenyns, Zool. Beagle); *Synanceia trachynis* (Annals, ix. p. 385).

SCIÆNOIDEÆ.

18. CHEILODACTYLUS CARPONEMUS (C. and V. p. 362.). (*Sciænoides abdominalis*, Parkinson, 2. t. 52. *Sparus carponemus*, G. Forster, 2. t. 206; *Cheilodactylus carponemus*, Zool. Trans. 3. p. 99.)

This species was obtained on Cook's first voyage at Matarruhow, and on the second in Dusky Bay. Quoy and Gaimard found it in King George's

Sound, New Holland, and it is a common and highly prized fish at Hobart Town.

19. Cheilodactylus macropterus. (*Sciæna and sciænoides abdominalis*, Solander, p. 11. and 27.; Parkinson, 2. t. 40.; *Sciæna macroptera*, G. Forster, 2. t. 206; J. R. Forster, MS. ii. 54. apud Schneider; *Cichla macroptera*, Bl. Schn. p. 342; *Cheil. macropterus*, Rich. Zool. Trans. 3. p. 101.)

In the 'Histoire des Poissons' this species is confounded with the preceding one, but it seems to be sufficiently distinct and to be characterized not only by a more conspicuous black mark above the shoulder, but also by a different number of rays, thus—

D. 17	26;	A. 3	14.	*macropt.*	Sol. and Schn.
17	31;	3	19.	*carponem.*	C. & V. and Rich.

The tip of the tenth ray of the pectoral passes the beginning of the anal, being proportionally longer than that of *carponemus*. Specimens were procured on Cook's first and second voyages off Cape Kidnappers, in Queen Charlotte's Sound and in Dusky Bay.

20. Latris? salmonea. (*Sciæna salmonea*, Parkinson, 2. t. 66; *Latris? salmonea*, Rich. Zool. Trans. 3. p. 114.)

The 'Pisces Australiæ' contains no account of this fish, which was procured in Totæranue Cove, Queen Charlotte's Sound, and Parkinson's figure is not complete enough to render the genus perfectly certain, though the general aspect is that of *Latris*.

21. Latris lineata. Yellow-tail. (*Sciæna lineata*, G. Forster, 2. t. 204; J. R. Forster, MS. ii. 52. apud Schneider; *Cichla lineata*, Bl. Schn. p. 342; *Latris lineata*, Rich. Zool. Trans. 3. p. 108.)

This inhabitant of the rocky narrows of Dusky Bay was discovered on Cook's second voyage, and immediately named by the sailors "Yellow-tail." It is very like the "Trumpeter" of Van Diemen's Land (*Latris hecateia*), and may possibly prove on examination to be the same, but the specimens of the Trumpeter which have been transmitted to this country do not show any yellow tints on the tail.

22. Latris ciliaris (Rich. Zool. Trans. 3. p. 115). (*Sciæna ciliaris*, G. Forster, 2. t. 205. and 2. t. 209.; J. R. Forster, MS. 2. 55. apud Bl. Schn. p. 311).

Two sketches of this fish were made on Cook's second voyage, one (205) in Dusky Bay, where it bears the native appellation of "moghee"; the other (209) in Queen Charlotte's Sound. Two ciliated tubercles placed above the eyes are peculiar to this species.

The characters of the genus *Latris* are detailed in the third volume of the Zoological Transactions, and a full description with an accurate figure is there given of the Trumpeter; Parkinson's and Forster's figures of the three New Zealand species have much of the general character of the genus, but do not clearly show the simplicity of the lower pectoral rays*.

The Sciænoid fish known to frequent the coasts of New Holland are *Eleginus bursinus* (C. and V.); *Scolopsis longulus* (Annals, ix. p. 389); *Cheilodactylus carponemus* (Zool. Tr. 3.); *Latris hecateia* (Zool. Tr.); *Nemadactylus concinnus* (Zool. Tr.); *Amphiprion melanostolus* (Annals, ix. p. 390); *Amph. rubro-cinctus* (Annals, ix. p. 391); *Pristipoma sexlineatum* (Q. and G.).

* And it may be proper to mention, that there is in the Museum of the College of Surgeons a fish, procured on one of Cook's voyages and presented to the Museum by Sir Joseph Banks, having a very close external resemblance to Latris, but with more dorsal spines than any species here enumerated, and the lower pectoral rays branched like the uppermost.

SPAROIDEÆ.

23. PAGRUS GUTTULATUS (C. and V. 6. p. 160.).

M. Lesson procured this fish in the mouth of one of the rivers of New Zealand, and Peron and Quoy and Gaimard found it on the coasts of New Holland.

24. PAGRUS MICROPTERUS (C. and V. 6. p. 163.).

The account of this species in the 'Histoire des Poissons' was drawn up from a specimen which was taken in the æstuary of the river Thames, New Zealand, by Mess. Quoy and Gaimard.

25. PAGRUS LATUS (Rich. Annals, ix. p. 392). (*Sciæna lata*, Solander, p. 25; *Sc. aurata*, G. Forster, 2. t. 208; J. R. Forster, apud Schn.; *Labrus auratus*, Bl. Schn. p. 266.)

Solander procured this fish between Owhooragi and Opooragi, and Forster found it on the second voyage in Queen Charlotte's Sound. The natives of the latter locality name it "ghoo-paree."

Pagrus guttulatus (C. and V.); *P. unicolor* (C. and V.); *Pentapus vitta* (C. and V.); *P. iris* (C. and V.); *Lethrinus cyanoxanthus* (Icon. Pisc. 4. f. 1); *L. cinnabarinus* (Id. 4. f. 2); and *Oblata tricuspidata* (C. and V.) are Sparoid forms which have been detected in the Australian seas.

We have the Mænoid *Gerres subfasciatus* (C. and V.), and *G. filamentosus* (C. and V.) from the same seas, which likewise produce the following. *Chætodontoideæ: Drepane punctata* (C. and V.), *Chelmon marginalis* (Annals), *Platax leschenaldi* (C. and V.), *Pl. orbicularis* (C. and V.), and *Scorpis georgianus* (C. and V.). No *Anabasideæ* have as yet been brought from New Holland.

SCOMBEROIDEÆ.

26. SCOMBER (SCOMBRUS) SOLANDRIS. (*Scomber scombrus*, Solander, p. 31; Richardson, Annals.)

Solander observed a mackerel in Queen Charlotte's Sound, which he thought was the well-known European species. He neither describes nor figures it, but merely mentions the number of its rays, and states that the ordinary size of the fish is greater than in Europe. It is probably the *Scomber loo* of the 'Histoire des Poissons.'

27. THYRSITES ATUN, *altivelis* (Rich. Zool. Tr. iii. p. 119). (*Scomber splendens*, Solander, p. 37; *Scomber dentex*, G. Forster, ii. t. 216; *Sc. dentatus*, J. R. Forster, MS. II. 58, apud Bl. Schn. p. 24.

Solander saw this fish in Murderer's Bay, and the Forsters found it in Queen Charlotte's Sound, and learnt that its native name was "maga." Solander's description is full and characteristic, and the figure corresponds pretty well with a specimen from Port Arthur, Van Diemen's Land, which is described in the 'Zoological Transactions.' An actual comparison of specimens is required to decide whether it be the same with the *Thyrsites atun* of the Cape of Good Hope, described in the 'Histoire des Poissons,' viii. p. 137, pl. ccxix.

28. GEMPYLUS SOLANDRIS (C. and V. viii. p. 216). (*Scomber macrophthalmus*, Solander, p. 40; Parkinson, ii. t. 91; *Gempylus solandris*, Annals, ix.)

The account of this inhabitant of the seas washing Eaheenomauwee, in the 'Histoire des Poissons,' rests upon Solander's description and Parkinson's figure. Some passages are quoted from Solander in the 'Annals of Natural History.'

Polack mentions Sword-fish in his list of the productions of New Zealand, but the latitude with which popular names are applied prevents us from forming any decided opinion as to the genus. He may have seen the *Histiophorus indicus*, which probably ranges southwards to New Zealand. The true sword-fish (*Xiphias gladius*) is confined as far as we know to the Atlantic. The same writer also includes "pilot-fish" in his list. He may perhaps mean the *Naucrates indicus* (C. and V. viii. p. 326).

29. Chorinemus forsteri (Rich. Annals, ix.). (*Scomber maculatus*, G. Forster, ii. t. 228; J. R. Forster, MS. II. 120, apud Schn.; *Sc. forsteri*, Bl. Schn. p. 26.

The Forsters found this fish in New Zealand, and a New Holland specimen is described in the 'Annals of Natural History.' It is named "milinjidnee" by the natives of Port Essington, and is very probably the same species with the *Chorinemus commersonianus* of the 'Histoire des Poissons,' viii. p. 370.

30. Trachurus Novæ Zelandiæ (C. and V. ix. p. 26).

This *trachurus* belongs to the group which has the lateral line armed by fewer than eighty shields, and differs little in external appearance from the common European *Caranx trachurus*, but there are peculiarities in the structure of its skeleton and viscera. It was brought from New Zealand and Amboyna by Quoy and Gaimard, and from Shark Bay, New Holland, by Lesson and Garnot.

31. Trachurus? clupeoides (Ann. ix.). (*Scomber clupeoides*, Solander, p. 31.)

Solander obtained this species in Dusky Bay. There is no figure of it, but his description points it out to be a *Caranx*, and most probably of the group of *Trachuri*.

32. Caranx lutescens (Annals, ix.). (*Scomber lutescens*, Solander, p. 38.)

Was procured in Queen Charlotte's Sound on the 30th of March, 1770.

33. Caranx sinus-obscuri (Annals, ix.). (*Scomber trachurus, varietas*, G. Forster, ii. t. 223. C. and V. ix. p. 20.)

This *Caranx*, discovered by the Forsters in Dusky Bay, is, like the preceding species, a member of the third of the three groups into which the "caranx proprement dit" are divided in the 'Histoire des Poissons,' x. p. 45.

34. Caranx platinoides (Annals, ix.). (*Scomber platinoides*, Solander, p. 13.)

An inhabitant of Tolaga Bay, but depending as a species on Solander's too brief description.

35. Caranx georgianus (Jenyns, Zool. Beagle, p. 71.). (*Scomber micans*, Solander, p. 27; Parkinson, 2. t. 89. *Caranx georgianus*, C. and V. ix. p. 85?)

Inhabits Opooragi, New Zealand, and Shark Bay, New Holland.

Polack mentions Dories as inhabiting the seas of New Zealand, but whether he alludes to the same species that is taken at Van Diemen's Land or not remains to be ascertained.

The Australian Scomberoids are *Scomber australasicus* (C. and V.), *Thynnus bicarinatus* (Q. and G.), *Thyrsites atun* (C. and V.), *Chorinemus forsteri* (Annals), *Cybium clupeoideum* (C. and V.), *Trachurus* —— ? (C. and V. ix. p. 20), *Trachurus declivis* (Jenyns), *Caranx clupeoides* (Annals), *Car. georgianus* (C. and V.), *Car. lessonii* (C. and V.), *Car. platinoides* (Annals), *Car.*

speciosus (C. and V.), *Psenes leucurus* (C. and V.), *Temnodon saltator* (C. and V.), *Seriola cultrata*, and *Capros australis* (Zool. Tr. iii.).

Siganoideæ.

36. Acanthurus triostegus (Bl. Schn.). (*Harpurus fasciatus*, Forster apud Schn.; *Teuthys australis*, Gray, King's Voy. to New Holl.; *Acanthurus triostegus*, C. and V. x. p. 137.)

An inhabitant of the seas of the Mauritius, New Zealand, New Holland and Polynesia.

Amphacanthus notostictus (Annals), *Amph. gymnoparcius* (Annals), *Amph. lunifrons* (C. and V.), *Amph. nebulosus* (C. and V.), *Amph. maculosus* (Q. and G.), *Acanthurus triostegus* (C. and V.), *Ac. grammoptilus* (Annals), are Australian Siganoideæ.

Mugiloideæ.

37. Mugil forsteri (C. and V. xi. p. 141). (*Mugil albula*? G. Forster, ii. t. 239; J. R. Forster apud Bl. Schneider, p. 120.)

Forster states that this mullet ascends the rivers of Dusky Bay in shoals in the month of April.

Polack says that mullet frequent the deep banks on the eastern coast of New Zealand, and are named "kanai" by the natives.

Mugil peronii (C. and V.), *M. acutus* (C. and V.), *M. argenteus* (Q. and G.), *Dajaus diemensis* (Zool. Tr.), *Atherina hepsetoides* (Annals), *Ath. pectoralis* (C. and V.), *Ath. presbyteroides* (Annals), *Ath. endrachtensis* (C. and V.), *Ath. nigrans* (Annals), and *Ath. jacksoniana* (C. and V.), are New Holland fish.

Gobioideæ.

Fish of this family abound in great variety in the seas of New Zealand and Australia, examples of most of the generic and sub-generic forms described in the 'Histoire des Poissons' having been brought by voyagers from that district of the ocean. The exposed haunts, singular habits and strange forms of many gobioid fishes subject them to easy capture, and we find accordingly that they form a considerable portion of the collections of the casual visitors of the shores which they inhabit.

38. Clinus littoreus (C. and V. xi. p. 389). (*Blennius littoreus*, G. Forster, ii. t. 184; J. R. Forster, MS. II. 42, apud Schn.; *Bl. quadridactylus*, Bl. Schn. p. 177.)

Named "kogop" by the inhabitants of Queen Charlotte's Sound, where the Forsters saw it on the 24th of October, 1774.

39. Acanthoclinus fuscus (Jenyns, Zool. Beagle, p. 93, pl. xviii. f. 2).

This form is peculiar to New Zealand. Mr. Darwin procured his specimens in the Bay of Islands. It is remarkable for the number of its anal spines. Mr. Jenyns remarks that the preceding species is probably another member of the genus, but this supposition is discountenanced by Forster's figure, which shows only nine anal rays.

40. Cristiceps australis (C. and V. xi. p. 102).

Peron discovered this fish in Van Diemen's Land, and Quoy and Gaimard afterwards found it in the river at Hobart Town, and drew the portrait of a specimen which measured seven inches. Another paragraph in the 'Histoire des Poissons' mentions that the last-named naturalists brought three very small examples of the species from New Zealand.

41. Tripterygion nigripenne (C. and V. xi. p. 413).

Lesson and Gamot, when they accompanied Duperrey, discovered this species in the rivers of New Zealand.

42. Tripterygion varium (C. and V. xi. p. 414). (*Blennius varius*, G. Forster, ii. t. 185; J. R. Forster, II. 43, apud Bl. Schn. p. 178.)

A finished drawing was made by G. Forster of a specimen of this fish, captured on the 9th of Nov. 1774, in Queen Charlotte's Sound. Its native name is "ke kogop."

43. Tripterygion forsteri (C. and V. xi. p. 415). (*Blennius tripinnis*, J. R. Forster, MS. II. 41, apud Bl. Schn. p. 174.)

This Tripterygion is also from New Zealand, notwithstanding the following passage in the 'Histoire des Poissons:'—"On ne nous dit pas où il avait été trouvé." But in Forster's 'Notes,' as quoted by Schneider, we find, under *Tripterygion fenestratum*, "*Habitat cum sequentibus circa insulam Novæ Zelandiæ, inter saxa ad ostia rivulorum aquæ dulcis, locis æstu mari irrigatis.*"

Now in Forster's manuscripts the species stand in the following order:—

MS. II. 39. *Tript. fenestratum.*	MS. II. 42. *Clinus littoreus.*
—— 40.	—— 43. *Tript. varium.*
—— 41. *Tript. forsteri* (*B. tripinnis*).	—— 44. *Scorpæna cottoides, &c.*

44. Tripterygion fenestratum (C. and V. xi. p. 410). (*Blennius fenestratus*, G. Forster, ii. t. 186; J. R. Forster, MS. II. 39, apud Bl. Schn. p. 173.)

G. Forster executed a figure of this species in Dusky Bay with more than usual care. It frequents the mouths of rivulets, and is named "he-tarooa" by the natives.

45. Tripterygion capito (Jenyns, Zool. Beagle, p. 94, pl. xix. f. 1.).

Mr. Darwin captured this little fish on tidal rocks in the Bay of Islands.

Several gobies and periophthalmi have been detected on the northern shores of New Holland, and in the islands of Torres Straits, but none exist in any of the collections that have hitherto been made in Van Diemen's Land and New Zealand.

46. Eleotris gobioides (C. and V. xii. p. 247). Jenyns, Zool. Beagle, p. 98.

Discovered by Quoy and Gaimard in the fresh waters on the north-east coast of New Zealand. Forster named another member of this family, which he found on the island of Tanna, *Blennius gobioides*. It is the *Salarias alticus* of the 'Histoire des Poissons.'

47. Eleotris radiata (C. and V. xii. p. 250).

Found by Quoy and Gaimard in the mouth of the river Thames, in February 1827.

48. Eleotris basalis (Gray, Zool. Misc. p. 73.).

Inhabits the river Thames.

49. Hemerocætes acanthorhynchus (C. and V. xii. p. 311). (*Callionymus acanthorhynchus*, G. Forster, ii. t. 175; J. R. Forster, II. 30, apud Schneider; *Call. monopterygius*, Bl. Schn. p. 41.)

No specimen of this curious fish having been seen since the time of Cook, our knowledge of it is entirely derived from the figure and description of the Forsters. It was thrown up after a storm in Queen Charlotte's Sound. The natives named it "kogo-hooee," probably from some fancied resemblance or connexion with *Eleotris nigra*, which is termed "kogo" in the Polynesian language. "Hoee-hoee" signifies poisonous or man-killer in the same tongue, and is the appellation given to the *Tetraodon hispidus* at Parietea. Since writing this passage, I have, through the kindness of Mr. Gray, seen a drawing by Dr. Dieffenbach of a *Hemerocœtes* from New Zealand, which may be the same species*. It appears to differ in some of the markings from Forster's figure, but I have not hitherto had an opportunity of comparing them accurately.

The following Australian Gobioids have been noticed by naturalists:—*Blennius tasmanius* (Zool. Tr. iii.); *Blennechis anolius* (C. and V.); *Salarias meleagris* (C. and V.); *S. forsteri* (C. and V.); *S. kingii* (C. and V.); *Clinus perspicillatus* (C. and V.); *Cl. despicillatus* (Zool. Tr. iii.); *Cristiceps australis* (C. and V.); *Eleotris trabeatus* (Annals); *Eleotris mogurnda* (Annals).

Batrachus diemensis (Le Sueur) and *Cheironectes politus* (Zool. Tr. iii.) are among the representatives of the Batrachoideæ on the coast of New Holland.

Labroideæ.

50. Labrus pœcilopleura (C. and V. xiii. p. 95).

Lesson and Garnot discovered this species at New Zealand, and ascertained its native name to be "parè-quiriquiri."

51. Julis? rubiginosus (Annals). (*Sparus rubiginosus*, Parkinson, ii. t. 38; Solander, p. 7.)

Solander discovered this fish off Cape Kidnappers. The species resembles *Julis decussatus*.

52. Julis notatus. (*Sparus notatus*, Solander, p. 16; Parkinson, ii. t. 37.)

This fish was found in Totæranue Cove and Tolaga Bay. It resembles *Julis decussatus* still more closely than the preceding species.

The 'Pisces Australiæ' contains accounts of the colours merely of *Sparus stellatus* and of a *Labroides asellinus*, but no drawing of them being extant, it is impossible now to say whether they ought to be referred to the Wrasse family or not. This point remains to be settled by the ichthyologists who may hereafter explore the bays in question. The two following species are nearly in the same predicament, though a description of their forms is to be found in Schneider's edition of Bloch.

53. Julis miles. (*Labrus coccineus*, J. R. Forster apud Schneider; *Labrus miles*, Bl. Schneider, p. 264.)

Forster's notes, as quoted by Schneider, inform us that this fish resembles *Labrus lunaris* of Linneus, meaning most probably thereby the *Julis blochii* which Cuvier distinguishes from the true *Julis lunaris*. All three have lunate caudal fins. The New Zealand fish was captured with the hook by the seamen, who named it the "soldier" on account of its red jacket.

54. Julis celidotus. (*Labrus celidotus*, J. R. Forster apud Schn.; Bl. Schneider, p. 265.)

Taken at the same place with the preceding fish.

The *Sparus prasiophthalmus* of Solander (p. 5) has six obscure bands, while *celidotus* has only three, and also a large black lateral mark over the anus not noticed as existing in *prasiophthalmus*. There being no description of the form

* Since the report was read I have had an opportunity, by the kindness of Mr. Owen, of examining a specimen of this rare fish, which was presented by Dr. Dieffenbach to the College of Surgeons. Forster's description has been misunderstood in some material parts. The species will be described in the appendix to Dr. Dieffenbach's account of New Zealand, which is now preparing for the press.

of the latter given, the genus of the fish must remain for the present uncertain, since in Solander's time the genus *Sparus* was made to include very various forms.

55. Odax pullus (C. and V. xiv. p. 304). (*Scarus pullus*, G. Forster, ii. t. 202; J. R. Forster, MS. IV. 17, apud Schneider, p. 208.)

Inhabiting Queen Charlotte's Sound, and known there by the name of "marraree."

56. Odax? vittatus (Annals, ix.). (*Coregonoides vittatus*, Solander, p. 1 and 39; *Callyodon coregonoides*, Parkinson, ii. t. 24.)

Two entries of this fish occur in the 'Pisces Australiæ,' the second being an account of the differences between the old and young. It was taken at Mataruhow.

The following Labroids have been taken in the Australian seas. *Labrus tetricus* (Zool. Tr.); *L. fucicola* (Zool. Tr.); *L. psittaculus* (Zool. Tr.); *L. laticlavius* (Zool. Tr.); *L. cyanodus* (Rich. ined); *L. iris* (Solander); *Tautoga melapterus* (C. and V.); *Cheilio lineatus* (C. and V.); *Julis lineolatus* (C. and V.); *J. auricularis* (C. and V.); *J. notatus* (*Sparus*, Solander); *J. dringii* (Rich. Icon. Pisc. 3. f. 1); *Odax pullus* (C. and V.); *Odax algensis* (Zool. Tr.); *Hoplegnathus conwayi* (Zool. Tr.).

Of the extensive family of *Siluroideæ*, of which nearly 300 species are described in the 'Histoire des Poissons,' not a single individual has been brought from New Zealand. Nor was it to be expected that many species should have been found there, since most of the family are inhabitants of fresh water and of the lower latitudes. In North America one species only is known to reach the 55th parallel, and the only European species is partially diffused over similar latitudes. The *plotosus ikapor* or *lineatus* (C. and V. xv. p. 412), a widely spread inhabitant of the Indian and Polynesian oceans, descends to the west coast of New Holland, and is the most southerly Siluroid which is known to us.

We have no Cyprinoid fish to enumerate among the productions of the fresh waters of New Zealand, though it is highly probable that some will hereafter be brought from thence. The *Leuciscus* (*Ptycholepis*) *salmoneus*, which is the *Mugil salmoneus* discovered by Forster at the island of Tanna, exists at Port Essington, New Holland. A specimen brought from thence by Mr. Gilbert has enabled me to ascertain that this fish is not an *Elops*, as Cuvier has said in his 'Règne Animal' (ii. p. 324). Solander notices briefly, in his 'Pisces Australiæ,' a *Mugil lavaretoides*, which is also referred to *Elops* in the 'Histoire des Poissons;' but the little that Solander says of the fish applies entirely to Mr. Gilbert's specimen of *salmoneus*, though his account is not particular enough to establish their specific identity; we may therefore quote Solander's New Zealand fish, with some doubt, as

57. Leuciscus? lavaretoides. (*Mugil lavaretoides*, Solander, p. 15.)

Esocidæ.

58. Galaxias alepidotus (Cuv. Reg. An. ii. p. 283). (*Esox alepidotus*, G. Forster, ii. t. 235; J. R. Forster, MS. II. 62, apud Schneider, p. 395.)

Taken with the hook in the lakes and rivulets which flow into Dusky Bay. The aborigines name it "he-para." Cook's sailors called it "rock-trout." Another species, most probably the *truttaceus* of Cuvier, inhabits the rivers of Van Diemen's Land, where it obtains the appellation of "the trout."

59. Galaxias fasciatus (Gray, Zool. Misc. p. 73.).

This species was discovered by Dr. Dieffenbach in the river Thames.

60. Mesites attenuatus (Jenyns, Zool. Beagle, p. 123, pl. xxiv. f. 5).

This fish was taken in the fresh waters of the Bay of Islands by Mr. Darwin. The genus *Mesites* seems to be very nearly allied to *Galaxias*, and this species in particular to be scarcely distinguishable from a young *Galaxias fasciatus*.

61. Saïris scombroides. (*Esox scombroides*, Solander, p. 40; *Esox saurus*, G. Forster, ii. t. 233; J. R. Forster, MS. II. 65, apud Bl. Schneider, p. 394.)

Solander first saw this very handsome fish in lat. 39½° S., long. 204¼° W., between New Zealand and New Holland. He describes it as having the most intense ultramarine or "garter-blue" on the back, and a silvery hue on the belly. Forster's description corresponds with Solander's, both agreeing in the colours, and in mentioning a blue network on the caudal fin, in the numbers of the dorsal and anal finlets, and in the upper jaw being only about two lines shorter than the lower one. They may therefore be considered as identical, or at least as very closely allied species. The specimen figured by G. Forster was captured on the 27th March, 1773, in Dusky Bay. The aborigines named it "he-eeya."

62. Hemiramphus marginatus (Cuv. Reg. An. ii. p. 286).

Polack includes "Flying Fish" in his enumeration of the animals of New Zealand. The *Exocœtus exiliens* and *volitans* inhabit both oceans, and both are mentioned by White in his 'Voyage to Botany Bay,' as existing in the seas of New Holland. We have no means of judging what the species are to which Polack alludes, unless the *Esox subpellucens* of Solander ('Pisces Australiæ,' p. 14) be an *Exocœtus*. The only particulars of form that he mentions are, that the upper jaw is longest; that there is a barbel beneath, and an appendix at the base of the pectoral. It cannot therefore be either of the common species, but is rather allied to the bearded ones of America, and will stand in our list as

63. Exocœtus? subpellucens.

An inhabitant of Tolaga Bay.

None of the voyagers, whom we have consulted, mention any of the Salmon family as peopling the waters of New Zealand. *Saurus* and *Aulopus* exist in the sea that washes the north-west coast of New Holland. *Vide* Icon. Pisc. f. 1.

Esox lewinii (Griff., Cuv. pl. 60) is from New Holland.

Clupeoideæ.

64. Clupea lata (Solander, p. 17).

Solander records the colours merely of this fish, and as there is no figure of it, the group of Clupeoideæ, to which it ought to be referred, must remain for the present undecided. It was procured in Tolaga Bay. The *Clupea setipinna* of Forster, discovered by him in the island of Tanna, is a *Megalops* which ranges southwards to the coast of New Holland.

Gadoideæ.

Polack mentions Cod-fish, bearing the native name of "wapuka," as inhabiting deep banks on the east coast of New Zealand. He also particularises Hake, Haddock and Polack as being frequently taken, though it is not likely that they correspond exactly with the European species, whose names the settlers have appropriated to them.

65. Lota baccha (Cuv. Reg. An. ii. p. 334). (*Gadus bacchus*, G. Forster, ii. t. 180; J. R. Forster, MS. II. 34, apud Bl. Schneider, p. 53, sub *Encheliopode*.)

This is probably the Haddock mentioned above, as it has a large black spot on the upper base of the pectorals. Solander obtained it in Murderer's Bay, and has recorded a pretty full account of its colours when fresh. George Forster's figure is coarsely executed, but in conjunction with J. R. Forster's notes, quoted by Schneider, it renders the species easily recognisable. Its native name, in Queen Charlotte's Sound, is "ehogoa."

70. LOTA RHACINA. (*Gadus rhacinus*, G. Forster, ii. t. 179; J. R. Forster, MS. iv. 16, apud Schn.; *Phycis rhacinus*, Bl. Schn. p. 56.)

This resembles the preceding species in form, but differs in colour and in the numbers of the fin-rays. It was also taken in Queen Charlotte's Sound, where it bears the appellation of "ahdoroo."

71. BROSMIUS VENUSTUS. (*Blennius venustus*, Parkinson, ii. t. 5.)

This is doubtless one of the Hakes mentioned by Polack. Parkinson's figure was executed from a specimen obtained in Totæranue, or Ship Cove. Solander gives no account of it, unless the brief notice of his *Blennius rubiginosus*, in p. 14 of the 'Pisces Australiæ,' ought to be referred to this species. As he mentions only a single dorsal, it is most likely a congeneric fish, and there is no great discrepancy in the colours so as to point unequivocally to a distinct species. He took it in Tolaga Bay.

We have already seen that the "Cole-fish" of the sailors is a *Percis*: whether the "Polack" of the settlers be another *Percis* or a true Gadoid fish we have no means of ascertaining.

The Lepidolepri, or Macrouri, which are considered by Cuvier to be nearly allied to the Gadoid family, but by the Prince of Canino to form a group of the Ganoid order, having much affinity with many fossil genera, exist in the depths of the Australian seas, and will probably be hereafter added to the list of New Zealand forms.

PLATESSOIDEÆ.

Polack says that the seas of New Zealand produce Flat-fish, which are named "pitiki" by the natives, and are intermediate between the large flounder and the sole.

72. RHOMBUS? SCAPHA. (*Pleuronectes scapha*, G. Forster, ii. t. 193; J. R. Forster, MS. II. 46, apud Bl. Schn. p. 163.)

An inhabitant of Queen Charlotte's Sound, named "mahoa" by the aborigines, and compared by Forster with the *Platessa limanda*. The eyes are on the left side.

73. RHOMBUS PLEBEIUS, Solander, p. 12.

Solander having noticed only the colours of this flat fish, without describing its form or dentition, we cannot refer it to its proper genus, but it is very probably a *Rhombus* brought from New Zealand by Dr. Dieffenbach, which agrees with the little that Solander says of the species. The eyes are on the right side. It was taken in Tolaga Bay, and, like the preceding one, measured a foot in length.

Mr. Jenyns notices a Platessa which was found by Mr. Darwin in King George's Sound, but does not name it. He says that it scarcely differs from the *Platessa orbignyana* of Bahia described by Valenciennes in the 'Voyage of Orbigny.' Another species from Port Arthur, Van Diemen's Land, is described in the 'Zoological Transactions,' vol. iii.

DISCOBOLI.

74. LEPADOGASTER PINNULATUS (Forster, MS. IV. 15, apud Bl. Schn. p. 199). (*Cyclopterus pinnulatus*, G. Forster, ii. t. 248.)

Three portraits of this fish, under different aspects, were made by George Forster from a specimen which was taken in Queen Charlotte's Sound on the

23rd of October, 1774. Its general appearance is very similar to the *Gobiesox marmoratus* of Chiloe, figured in the 'Zoology of the Beagle' by Mr. Jenyns, but it has a square pectoral disk with mammillated edges behind the triangular one of *Gobiesox*. The *L. pinnulatus* haunts stony beaches at the mouths of rivulets, and is named by the New Zealanders "moyèadoo."

75. Gobiesox littoreus (Cuv. Reg. An. ii. p. 345). (*Cyclopterus littoreus*, J. R. Forster, MS. II. 27, apud Bl. Schn. p. 199.)

An inhabitant of stony beaches.

At least two species of *Echeneis* exist in the Australian seas, and it is probable that the islands of New Zealand are within their range.

Anguilliformes.

76. Anguilla australis (Rich. Zool. p. 22.). (*Anguilla australis*, Jenyns, Zool. Beagle, p. 162.)

This Eel was sent to me from Port Arthur, Van Diemen's Land, by Deputy Assistant Commissary General Lempriere, and fully described in a paper read before the Zoological Society on the 9th of March, 1841. Mr. Darwin had previously found it in the Bay of Islands, New Zealand, and it has recently been described by Mr. Jenyns in the 'Zoology of the Beagle.'

77. Anguilla dieffenbachii (Gray, Zool. Misc.).

Discovered in New Zealand by the gentleman whose name it has received.

78. Ophidium blacodes (Forster). (*Ophidium blacodes*, G. Forster, ii. t. 174; Bl. Schneider, p. 285; Cuv. Reg. An. ii. p. 359.)

This fish is named "ekokh" by the inhabitants of New Zealand. Schneider, who describes it without making the usual reference to Forster's notes, informs us that it is voracious, torpid and sluggish, and lurks in stony places at the bottom of the sea, whence it may be easily extracted by an eel-spear. It is much prized by the natives as an article of food.

Anguilla australis (Zool. Proc.), *Gymnothorax wilsoni* (Schn.), *Gymn. scriptus* (Schneider), and *Machærium subducens* (Rich.), inhabit the waters of Australia.

Lophobranchi.

79. Hippocampus abdominalis (Lesson, Mém. de la Soc. Nat. IV. p. 411; Voy. du Duperrey, Zool. p. 125).

This species inhabits the creeks of the Bay of Islands, and is named "kiore" by the natives. We have received it also from Van Diemen's Land along with several other species. The *Hippocampus foliaceus* seems to range over the entire circuit of the coasts of New Holland.

Plectognathi.

The Australian seas are very rich in fish belonging to this order, and doubtless many of the same species frequent the coasts of New Zealand, though only a few have hitherto been brought from thence. The *Diodon nycthemerus* is abundant at Van Diemen's Land.

80. Tetraodon hamiltoni (Nob.).

This species was brought from New Zealand by J. M. Hamilton, Esq., Assistant Surgeon in the Royal Navy, and the specimen is now in the Museum of Haslar Hospital. It resembles the *Tetraodon fluviatilis* of Hamilton (Fishes of the Ganges, t. 30. f. 1). Van Diemen's Land produces another species of the same group, which is said to have poisoned several of the settlers.

The *Tetraodon sceleratus*, discovered by Forster in New Caledonia, descends to the west coast of Australia, where it attains a great size. It bears the reputation of being very poisonous. Another species is named at Otaheite "hoee-hoee" (kills men).

81. MONACANTHUS SCABER. (*Balistes scaber*, G. Forster, ii. t. 247; J. R. Forster, MS. II. 72, apud Bl. Schneider, p. 477.)

This is known at Queen Charlotte's Sound by the name of "baddeek." There is nothing either in the figure or description which disagrees with a species seen by Solander at Motuaro and off Cape Kidnappers, and entered twice in his 'Pisces Australiæ' under the names of *Balistes unicornu* (p. 9) and *Balistes scabrosus* (p. 35).

Diodon nicthemerus (Cuv.), *Balistes jacksonianus* (Q. and G.), *Monacanthus spinosissimus* (Q. and G.), *Mon. papillosus* (Cuv.), *Mon. megalourus* (Rich. ined.), *Aleuteres maculosus* (Rich.), *Aleuteres paragaudatus* (Rich.), *Al. ayraud* (Q. and G.), *Al. spilomelanurus* (Q. and G.), *Al. velutinus* (Jenyns), *Ostracion auritus* (Shaw), *Ostr. ornatus* (Gray), *Ostr. flavigaster* (Gray), *Ostr. spilogaster* (Zool. Proc.), *Ostr. lenticularis* (Zool. Proc.), are New Holland species.

CHIMÆRIDÆ.

82. CALLORHYNCHUS ANTARCTICUS (Lacep. l. xii.). (*Chimæra callorhynchus*, Solander, p. 18).

Solander observed this fish in Murderer's Bay on the 16th of January, 1770. His description extends merely to the colours of the recent fish. Its aboriginal name is "erkè-perkèpè;" its designation by the English settlers "elephant-fish." The species of *Callorhynchus* have not been rigidly compared with each other, but two certainly exist, if the size of pectoral fins be considered as a specific mark.

SCYLLIA.

83. SCYLLIUM? LIMA. (*Squalus lima*, Parkinson, i. t. 53; *Sq. Isabella*, Brousonnet, No. 1, Bl. Schneider, p. 127.)

Inhabits Eaheenomauwee.

CARCHARIÆ.

84. CARCHARIAS (PRIONODON) MELANOPTERUS (Müller und Henlè, Plagiostomen, p. 43.). (*Carcharias melanopterus*, Q. and G. Freyc. pl. 43. f. 1 and 2.)

Inhabits the Zealand and Australian seas.

SPINACES.

85. ACANTHIAS? MACULATUS. (*Squalus maculatus*, Parkinson, i. t. 52.)

Inhabits Eaheenomauwee.

SQUATINORAIÆ.

86. RHINOBATES (SYRRHINA) BANKSII (Müller und Henlè, pp. 123 and 192.) (*Raia rostrata*, Parkinson, i. t. 45.)

87. TRYGONORHINA FASCIATA (Müller und Henlè, Plagiostomen, p. 124.) (*Raia fasciata*, Parkinson, i. t. 47.)

RAIÆ.

88. RAIA NASUTA (Parkinson, i. t. 44.) (Müller und Henlè, Plagiostomen, p. 150.)

Inhabits Totæranue.

89. TRYGONOPTERA TESTACEA (Müller und Henlè, Plagiostomen, p. 174.) (*Raia testacea*, Parkinson, i. t. 146.)

MYLIOBATIDES.

90. MYLIOBATIS NIEUHOFII (Müller und Henlè, Plagiostomen, p. 177.) (*Raia macrocephala*, Parkinson, i. t. 48.)

The following *Plagiostomi* inhabit the Australian seas:—*Hemiscyllium malaianum* (M. und H.), *Crossorhinus barbatus* (M. und H.), *Carcharias* (*Prionodon*) *maoo* (M. und H.), *C.* (*Pr.*) *melanopterus* (M. und H.), *Hemiscyllium ocellatum* (M. und H.), *H. trispeculare* (Richardson), *Cestracion phillipi* (M. und H.), *Trygonorhina fasciata* (M. und H.), *Tæniura lymma* (M. und H.), *Narcine tasmaniensis* (Richardson).

CYCLOSTOMI.

91. HEPTATREMA DOMBEYI (Lacepede, i. 23). (*Petromyzon cirrhatus*, G. Forster, ii. t. 251; J. R. Forster, MS. II. 24, apud Schn. p. 532; Home, Phil. Tr. for 1815, p. 258.)

Discovered by the Forsters in Dusky Bay.

Report on the Progress of the Meteorological Observations at Plymouth. By W. SNOW HARRIS, *F.R.S., &c.*

SINCE I last had the honour of presenting to the Association the results of the discussion of the hourly meteorological observations, made and registered at H. M. Dock-yard at Devonport, three additional years have been nearly completed; and I shall be in a position at the close of the present year (1842) to revise and bring under one general view the results of the series, continued now hourly, without any material omission, since the year 1832, and which will hence complete for temperature ten years' observations. The vast mass of registered observations of the different instruments which the Association has entrusted to my care, have not been so far discussed and brought under an appropriate form, as to enable me, on the present occasion, to enter fully upon them; nor indeed is it desirable to do so before the observations of the present year are complete and can be included with the preceding years. The only notice, therefore, of the further progress of the meteorological register at Plymouth, which it is at present in my power to submit for the consideration of the Section, is a general discussion of five years' results of the barometer and of experiments on the wind made with Whewell's anemometer, and which I venture to hope the Association may deem not altogether unworthy its attention.

In the annexed table and accompanying chart (pl. iv.) will be found the mean hourly pressure for each of the years 1837, 1838, 1839, 1840 and 1841, together with the mean of these years deduced from 43,800 observations, at 75 feet above the level of the sea, and reduced to 32° of Fahrenheit's scale by Schumacher's tables, from the table referring to the expansion of the mercury without reference to the scale of measure, the instrument employed being of the peculiar construction already noticed in the Reports of the Association*, and to which that table is most perfectly applicable.

In laying down the graphical delineations given in this chart, the same method was resorted to as in my preceding Report three years since, viz.

* Reports of the British Association for 1833, p. 415.

the mean points were first marked off, and then a continuous line was passed through them by means of a flexible batten, so as to include the greatest number; the points of deviation from such a continuous and fair curve being marked by a star. Now, I have to call the attention of the Association to the surprising coincidence in the general character of all these lines, and the very few and small deviations which they present; a result which I cannot but deem somewhat remarkable, considering the frequent atmospheric disturbances to which we are liable in these latitudes. The observations themselves must have been most carefully made, otherwise such a constant result could not possibly have been arrived at; and I cannot but deem it my duty to impress on the Association, the propriety of preserving with great care the original manuscript of the observers and printing the whole series, as being calculated to advance the present state of meteorology. The meteorologist will have then at his command a series of hourly records obtained at considerable cost in money and time, of as unexceptionable a character as in the nature of the circumstances under which they have been made, and the present state of science, it is possible to obtain.

TABLE, containing the mean hourly pressures for each of the years 1837, 1838, 1839, 1840 and 1841, together with the mean of these years from 43,800 observations, at 75 feet above the mean level of the sea, reduced to 32° of Fahrenheit's scale.—The periods of maxima are denoted by the sign +, the minima by the sign —, and the mean by a *. See pl. iv.

	1837.	1838.	1839.	1840.	1841.	Mean of the 5 years.
A.M. 1.	29·8719 +	29·7565*	29·7768	29·8366	29·7173*	29·7918*
2.	29·8696	29·7547	29·7735*	29·8340*	29·7153	29·7894
3.	29·8626*	29·7518	29·7688	29·8294	29·7104	29·7846
4.	29·8608	29·7507	29·7670	29·8261 —	29·7086 —	29·7826 —
5.	29·8606 —	29·7507 —	29·7670 —	29·8271	29·7093	29·7829
6.	29·8619	29·7552	29·7710	29·8297	29·7121	29·7860
7.	29·8666	29·7585	29·7755	29·8331	29·7175	29·7902
8.	29·8706*	29·7615*	29·7772*	29·8364*	29·7217*	29·7935*
9.	29·8717	29·7637	29·7790	29·8400	29·7258	29·7960
10.	29·8732 +	29·7645 +	29·7807 +	29·8409 +	29·7294 +	29·7977 +
11.	29·8720	29·7627	29·7788	29·8395	29·7288	29·7964
12.	29·8663	29·7587*	29·7755	29·8361	29·7262	29·7926
P.M. 1.	29·8627*	29·7540	29·7705*	29·8310*	29·7217	29·7880*
2.	29·8580	29·7517	29·7670	29·8283	29·7184*	29·7847
3.	29·8567	29·7500	29·7657	29·8266	29·7167	29·7831
4.	29·8558 —	29·7475 —	29·7652 —	29·8262 —	29·7166 —	29·7823 —
5.	29·8597	29·7532	29·7685	29·8293	29·7181	29·7858
6.	29·8629	29·7557	29·7725	29·8334	29·7207	29·7890
7.	29·8679*	29·7610*	29·7770	29·8393*	29·7244*	29·7939*
8.	29·8740	29·7645	29·7798*	29·8441	29·7278	29·7980
9.	29·8779	29·7672	29·7832	29·8478	29·7303 +	29·8013
10.	29·8792 +	29·7665 +	29·7840 +	29·8482 +	29·7293	29·8014 +
11.	29·8790	29·7665	29·7822	29·8470	29·7276	29·8005
12.	29·8783	29·7639	29·7775	29·8438	29·7254	29·7978
Means ...	29·8675	29·7579	29·7743	29·8356	29·7208	29·7912

I have little further to observe on this table; the differences from the general results already deduced in my Report for 1839 not being considerable, the mean pressure of the five years corresponding with that already obtained. I may briefly remark that from the series of five years we find the line of mean pressure crossed between the hours 1 and 2, and 7 and 8 A.M., and again between 12 and 1, and 6 and 7 P.M. The hours of max. pressure are

10 A.M. and 10 P.M., being, with only one exception, a uniform result for the whole series.

The hours of minima are 4 A.M. and 4 P.M., being also a uniform result of the five years without any exception.

When we consider that the few deviations from a fairly continuous curvature, as laid down in the graphic delineation of the mean hourly march of the atmospheric pressure (pl. iv.), apply to the fourth place of decimals, we have fair ground for believing that by these observations we have really arrived at the general laws of the horary oscillation at Plymouth.

My Report for the year 1839 contains many general deductions from these observations; and Professor Airy, to whom they were submitted, seemed to think that at present little more could be effected by them. I cannot, however, but again remind the Association that 48,000 hourly observations on pressure and 87,600 hourly observations on temperature, of a very fair and perfect kind, made and discussed with great labour and at great cost to the Association, should not be lost sight of, and be allowed to exist only in the fragile form of a manuscript, but should be permanently secured and placed at the disposal of the scientific world generally. There are members of this Association so highly gifted with powers of physical research, that it would be by no means unreasonable to hope that, should their attention become directed to particular views of this branch of science, they would with such a mass of accredited observation at their command, find themselves in a position to contribute essentially to the future advance of meteorology.

My last Report on Whewell's anemometer contained an account of the general indications of the instrument for one year, and of the means I proposed to pursue with a view of giving its indications not only a relative but an absolute value. Although the tempestuous and unsettled weather which marked the close of the last meeting of the Association greatly impeded the experiments which I proposed to make, and the early period of our meeting this year has somewhat abridged the intermediate time, I have been to a great degree enabled to realize the view I entertained of the possibility of deducing, by actual experiment, the absolute velocity of the aërial current corresponding to certain indications of the instrument, so as not only to determine the mean direction of the wind for a given time, but the absolute mean rate at which it has moved.

It does not appear requisite at present to enter into a minute detail of the various experiments; it may perhaps be sufficient to state that the pressure and velocity of the wind were observed simultaneously with the anemometer, and the results tabulated and discussed. From these results the following deductions were arrived at.

1. When the pencil tracing the integral effect of the wind moved by the revolutions of the fly at the rate of 1 division of the scale of measure, or ·1 of an inch per hour; the current of air for the same time moved at a mean rate of 11 feet per second.

2. The space described by the pencil appeared to be proportional to the square of the velocity of the aërial current acting on the fly. Thus when the pencil described 4 divisions of the scale in an hour, the velocity, by a mean of many observations, amounted to 22 feet in a second.

When the velocity was 15 feet in a second, the pencil had described about two divisions of the scale in an hour, and so on.

Having then the velocity due to a given rate of indication per hour taken as unity, it is easy to find the velocity of the wind due to any other rate of indication, since we have only to multiply the square root of the given rate by the constant 11, the velocity per second corresponding to a space of 1 division of the scale. I have in this way endeavoured to arrive at something like an approximation to the velocity and direction of what I believe would amount to a trade-wind in the place of observation. The general type of the wind, as laid off on the principles suggested by Mr. Whewell, I have now the pleasure of exhibiting to the Section; and it will be seen that it furnishes a general resultant, directed from about S.S.W. to N.N.E., being from the southerly to the northerly points of the compass*.

In the annexed table will be found the mean velocity of the current for each successive month, taken without regard to direction, together with the mean velocity for the whole year; the period of observation being from April 1841 to April 1842.

TABLE showing the mean velocity of the wind by Whewell's Anemometer.

Month.	Velocity of wind in feet per second.	Month.	Velocity of wind in feet per second.
April	13·0	October......	15·29
May	11·6	November	14·96
June	10·9	December	12·54
July	9·0	January......	12·76
August	12·87	February	13·97
September....	15·42	March	14·63
Mean velocity 13·16 feet per second, or about 9 miles per hour.			

As I do not pretend to a degree of precision in these first results greater than is requisite to entitle them to consideration as useful and important approximations to a more refined inquiry, I have not thought it requisite to treat them more elaborately than their present state demands. If we diminish the mean velocity arrived at in this table, in the proportion of the whole length or trace of the wind described, to the general resultant, we shall have some general idea of the course and velocity of the aërial current, as deduced by this species of inquiry. Now the whole space described in this case is to the resultant as 2 : 1 nearly; we may therefore take the resulting velocity at about 4·5 miles an hour, and the general direction as N.N.E.

I shall be prepared to lay before the Section at our next meeting, typical delineations of the wind for 3 years, as deduced by this instrument, accompanied by more extended and corrected results than have been as yet arrived at. I hope what has been done is sufficient to show, that the instrument itself is capable, when well employed, of furnishing highly important results. It would necessarily have failed under the form in which it was first placed in my hands; but set up as stated in my Report for 1840, and constructed in a firm and solid way with little friction, I believe it highly calculated for meteorological observation. But whether we register by this or any other instrument the daily direction of the aërial currents, I feel persuaded that little advantage will ever be derived to meteorology, unless the observations be reduced to the form prescribed by Mr. Whewell, who has certainly taken the only correct view of the nature of such observations. Without deducing the integral effect of the wind, that is to say, a space proportional to that which a particle of air would pass over in a given time, taking into account the velocity of the wind and the time for which it blows, we can

* The mean velocity has been deduced by determining a value of V^2 for every 24 hours, a method which, although not mathematically exact, is still sufficiently approximative for our present purpose.

never hope to arrive at anything like a correct view of the great annual movement of our atmosphere.

In the preceding calculations it is to be understood that I have only been dealing with mean results, and not with particular ones, which would of course give velocities far surpassing anything exhibited in the preceding table.

I have now, in concluding this short notice of the progress and present state of the meteorological observations at Plymouth, merely to suggest to the Physical Committee of the Association, the propriety of either closing these observations after the completion of another year, or otherwise recommending the further continuance of the observations at the Dock-yard to the consideration of Her Majesty's government: a system and method of observation having been completely organized there, the inconvenience and expense to the naval department of the government would be too small to merit consideration. My own view is, that the ten years' observations which will be speedily complete, are sufficient for deducing the principal laws of temperature and pressure at this place; but that, inasmuch as similar observations are now being recorded through the instrumentality of the Association in various parts of the world, it would be so far desirable to have simultaneous observations made at Plymouth. I cannot but hope that the Physical Committee will give this matter serious consideration.

Plymouth, June 10, 1842.

Second Report of a Committee consisting of Mr. H. E. Strickland, *Prof.* Daubeny, *Prof.* Henslow, *and Prof.* Lindley, *appointed to make Experiments on the Growth and Vitality of Seeds.*

In order to carry out the objects of this Committee arrangements have been made for the formation at the Botanic Garden, Oxford, of a depôt of seeds to be preserved in various ways, and to be submitted, at successive periods, to experiment. The amount of labour required for the preservation of these seeds, the conduct of the experiments, and the tabulating their results, has necessitated the appointment of a curator at a small salary, whose report for the present year is annexed.

The expenses incident to these experiments have amounted to £9 15*s.* 11*d.* As a considerable number of jars and other materials for preserving seeds will be required for the further prosecution of the inquiry, the Committee respectfully recommend that the sum of £15 be this year granted for the purpose.

The Committee having now established a permanent place of deposit for seeds to be submitted to experiment, they wish particularly to request the contribution of specimens from persons who may be interested in this inquiry. Parcels of seeds of various species, both recent and of old dates, in quantities sufficient for a considerable number of experiments, and accompanied with remarks specifying the years in which they were collected, and the conditions under which they have been preserved, will be highly acceptable, as will also specimens of soils taken from excavations of various depths, and carefully protected from the access of extraneous matter, in order to ascertain the species of plants which may spontaneously vegetate in them. All communications on this subject to be sent to Prof. Daubeny, Botanic Garden, Oxford.

H. E. Strickland,
C. Daubeny.

Curator's Report.

In submitting to the British Association a statement of the progress made during the present year towards forming an extensive collection of seeds of at least one species of as many genera of plants as practicable, to be subjected to various modes of preservation, for the purpose of carrying on a series of experiments with the view of ascertaining the true limit of their vegetative durability, the curator begs to say, that he has, under the immediate superintendence of the Committee appointed to investigate the same, since October 1, 1841, received and collected seeds of 78 species of 60 genera, illustrating 25 natural families of plants, which are now preserved according to the mode decided on as that to be generally adopted; namely, in brown-paper parcels placed in earthen jars *with one aperture,* and covered with a stratum of fine sand.

Besides the mode just referred to as particularly determined on for general adoption, the curator has also put up some wheat and also seeds of *Lasthenia californica,* gathered in 1841, each in a mass in *porous earthen jars with two apertures,* which are covered with fine wire-gauze. A few seeds also of some of the same species as those preserved according to the prescribed mode are put up in *waxed cloth,* by way of comparison of methods of preservation.

The subjoined is a list of seeds, of which, with few exceptions, a sufficient quantity of each species has been obtained and already put up for experiments, if sown according to the scheme entered in the resolutions, up to the year 1909.

Of these seeds a portion has been purchased, and the remainder has been received from the London Horticultural Society, the Oxford Botanic Garden, and the Editor of the Gardener's Chronicle.

A certain number of seeds of each of the species entered in this list have this spring been sown, as directed, at the Oxford Botanic Garden, the Cambridge Botanic Garden, and also at the Garden of the London Horticultural Society at Chiswick, the result of which will be seen by reference to the following table:—

Name and Date when gathered.	No. of Seeds of each Species sown, 1842.	No. of Seeds of each Species which vegetated at			Time of vegetating. In days at		
		Oxford.	Cambridge.	Chiswick.	Oxford.	Cambridge.	Chiswick.
1834.							
Arabis lucida	500						
Hypericum Kalmianum	150						
Passiflora Herbertiana	125						
1835.							
Gilia capitata	500						
Gypsophila elegans	500	......	....	1	......	....	28
Polemonium gracile	125						
Hypecoum procumbens	50						
Potentilla nepalensis	300						
Horminum pyrenaicum	50						
Euphorbia Lathyris	25						
Berberis Aquifolium	20						
1836.							
Clematis erecta	50						
Hypecoum procumbens	50						

Name and Date when gathered.	No. of Seeds of each Species sown, 1842.	No. of Seeds of each Species which vegetated at Oxford.	Cambridge.	Chiswick.	Time of vegetating. In days at Oxford.	Cambridge.	Chiswick.
1836 (*continued*).							
Potentilla, sp. from Douglas	400						
Tacsonia pinnatistipula	50						
Turritis retrofracta	500						
Lupinus polyphyllus	100	......	....	1	......	....	28
Pentstemon diffusus	300						
——— pubescens	500						
——— pulchellus	250						
——— atropurpureus	250						
——— digitalis	300						
——— lævigatus	250						
——— gracilis	500						
——— procerus	400						
Eschscholtzia californica	200						
Mimulus moschatus	1000	......	....	3	......	....	60
Ononis angustifolia	100	......	1				
Coreopsis Atkinsoniana	300						
1837.							
Geum, sp.	500						
Allium fragrans	150						
Conium maculatum	150	1	1				
Clarkia elegans	500	......	....	1	......	....	60
Œnothera, sp. from Douglas	600						
Lupinus grandifolius	100						
Camassia esculenta	100						
Oxyura chrysanthemoides	75						
Godetia lepida	250	......	....	15	......	....	30
Calandrina grandiflora	200	2	....	37	......	....	21
Chryseis crocea	100	2	....	2	......	....	60
Delphinium flexuosum	200						
Lupinus lucidus	50						
——— rivularis	25	1					
Papaver orientale	500						
1841.							
Vicia sativa	50	43	41	45	......	11	14
Daucus Carota	100	38	57	60	......	11	21
Cannabis sativa	50	17	8	20	......	6	3
Pastinaca sativa	100	47	42	68	......	14	14
Brassica Rapa	300	178	158	147	......	5	3
Linum usitatissimum	150	142	125	130	......	6	3
Lepidium sativum	100	79	96	87	......	5	2
Polygonum Fagopyrum	50	18	13	30	......	15	14
Phalaris canariensis	100	55	70	69	......	9	14
Brassica Napus	150	90	160	90	......	5	3
Carum Carui	200						

Name and Date when gathered.	No. of Seeds of each Species sown, 1842.	No. of Seeds of each Species which vegetated at			Time of vegetating. In days at		
		Oxford.	Cambridge.	Chiswick.	Oxford.	Cambridge.	Chiswick.
1841 (*continued*).							
Petroselinum sativum	50	36	23	35	......	17	18
Trifolium ? repens	150	18	36	65	......	6	21
Lactuca sativa	50	5	5	43	......	8	3
Brassica oleracea	50	17	20	30	......	7	3
Pisum sativum	50	37	13	42	......	8	5
Faba vulgaris	25	25	23	23	......	10	14
Phaseolus multiflorus	25	24	22	21	......	9	10
Triticum æstivum	100	82	?	98	......	7	14
Hordeum vulgare	100	94	90	71	......	6	5
Avena sativa	100	90	?	90	......	7	14
Æthusa cynapioides	100	10	0	12	......		30
Antirrhinum majus	300	13	224	280	......	11	18
Calendula pluvialis	100	98	74	84	......	6	14
Collinsia heterophylla	300	125	176	21	......	9	30
Datura Stramonium	100	43	37	72	......	13	10
Gilia achillææfolia	200	21	94	10	......	7	14
Lasthenia californica	200	50	113	180	......	7	14
Ligusticum Levisticum	100	30	28	98	......	24	28
Pæonia, mixed vars.	100				......		
Verbascum Thapsus	500	?	?	430	......	19	28
? 1820.							
Gossypium sp.	2						

At Oxford, with the exception only of those seeds which are usually sown on a hotbed, the seeds here registered were sown this season (1842) on the 3rd of May, on a warm south border in the Botanic Garden.

The table shows that the three species of seeds gathered in 1834 and subjected to experiment in 1842, had entirely lost their vegetative power, as was the case with the eight species of the growth of 1835, the eighteen species of the growth of 1836, and also thirteen species of that of 1837, fifteen species having been sown. The whole under these dates were preserved according to the usual mode, viz. in stout brown paper: thus involving the necessity of procuring, if possible, new seeds of those species, during the current season, to be subjected to future experiments for the purpose of ascertaining the actual limit of their vegetative durability.

Although the above-registered seeds are all that can in conformity with the resolutions of the Committee be looked upon as constituting a portion of the experiments to which this report has strict reference, it may still be well to add that in the spring of 1841, having the same object in view which these experiments it is hoped will determine, many seeds of old dates were sown on a gentle hot-bed, principally in the Oxford Botanic Garden.

They were,—

I. Experimented on by Professor Daubeny, taken from Professor Morison's Herbarium at the Oxford Botanic Garden, bearing date, in many instances, of 1706. One hundred species were sown, but as it is supposed that they had been brushed with corrosive sublimate, this experiment is not of much value, and it is therefore not necessary to enumerate the species. A list of them is however preserved for reference.

II. Twenty-four species from Dr. Sibthorp's Collection at the Oxford Botanic Garden, dated about 1787, experimented on by Professor Daubeny. These seeds having been imperfectly preserved and injured by insects are not of much authority, and it is therefore needless to enumerate them.

III. The following species, from a very old Herbarium in Merton College Library, Oxford, given to the Committee by the Rev. J. Bigg, experimented on by Professor Daubeny.

Atropa belladonna.	Hedera helix.
Viburnum Opulus.	Aspidium Filix mas.

IV. One hundred seeds of *Wheat*, *Barley*, and *Lentils* respectively, from Egyptian catacombs, given to the Committee by the Trustees of the British Museum, experimented on by Professor Daubeny and H. E. Strickland, Esq.

V. Twelve seeds of *Maize*, brought from Peruvian graves by Mr. Cuming, given to the Committee by Dr. Robert Brown, experimented on by H. E. Strickland, Esq.

VI. Fourteen seeds of *Green Melon*, gathered in 1814, given to the Committee by Dr. Lindley, experimented on by H. E. Strickland, Esq., and Professor Daubeny.

In all these instances a purely negative result was obtained, no vegetation taking place in any of the cases.

The expenses incurred up to the present date (June 1842) are in detail as follows:—

	£	*s.*	*d.*
Printing Circulars	1	14	0
Books for registering Experiments	1	0	6
Jars and material for preserving Seeds	3	19	11
Sundries	0	11	6
Half-year's Salary, due April 1, 1842	2	10	0
Total	£9	15	11

Oxford, June 20, 1842. W. H. Baxter, *Curator.*

Report of the Committee on Railway Sections. By Charles Vignoles, *Esq., F.R.A.S., M.R.I.A., M. Inst. C.E., Professor of Civil Engineering, University College, London.*

A grant of 200*l.* from the Association was made at the Glasgow Meeting in 1840, on a joint application from the Geological and Mechanical Sections, towards obtaining profiles of the various railways in the United Kingdom, chiefly with a view (before the slopes of the excavations become soiled over and covered with vegetation) of putting on record the geological appearances and strata developed by the many vast openings made through the country by the operations of modern engineering.

At the Meeting in 1841, a renewal of the unappropriated balance of the first grant was made: the whole of this sum has however since been expended, and further liabilities have been incurred; and the results are now laid before the Sections which originated the subject, in the shape of numerous plans and sections of several of the railways, and of the enlarged parts of the profiles of the excavations only.

The Committee appointed by the Association have great pleasure in reporting, that in obtaining these documents they have been aided in the most effective and satisfactory manner by all the Railway Companies to whom they have applied, and also by their several officers; the engineers in particular having taken extreme pains and great interest in forwarding the views of the Association. When so many parties have thus zealously co-operated, it might be almost invidious to name one without specifying all; but in particularly mentioning Mr. Swanwick the engineer of the North Midland Railway, the Committee wish to do so for the purpose of remarking on the great care taken by that gentleman to mark upon the sections as his works went on, all the geological detail shown in the excavations of that railway which passes through so interesting a region. There has consequently been put into possession of the Committee a vast extent of most valuable records of the kind sought for, and which at the same time form a most striking example, well worthy of imitation, of the combination of engineering and geological information available for œconomic purposes.

The Committee were not at first able to organize a system of working the grant to their entire satisfaction, but after some experience they ascertained that, with the favorable disposition shown by all the Railway Companies, they might (without increasing the expense) by degrees and in no great time be able to form an interesting and valuable collection, not only of the sections of the excavations of the railways, but of the whole of the plans and sections of the lines, which, concentrated in a public depository and open to the inspection of all scientific and literary bodies and individuals, and to the public in general, under proper regulations, would be of high interest. In fact such documents were almost necessarily required as the mere indices whereby to identify the particular geological profiles; but so useful and important is such a collection likely to become, that it is not unreasonable to hope and believe that after another year's experience shall have matured the arrangements of the Committee, and perfected their proposed system of record, and brought down the expense to a certain and moderate rate per mile, the subject may be taken up by Her Majesty's Government, and made to form part of the great Geological Survey of the United Kingdom, conducted by Sir Henry De la Beche in connection with the Trigonometrical Survey now carrying on by Colonel Colby and the Officers of the Corps of Royal Engineers.

The Committee are therefore not without hope that the Geological Section will again apply to the General Committee for a further grant at the present meeting to enable them to complete the organization they have begun. The documents which the Committee have to submit are the following:—

1st. Plans and sections of the whole of the Midland Counties Railway from Rugby to Derby and Nottingham, about 68 miles.

Enlarged sections of the cuttings only of this railway, prepared to be filled in geologically. The chief characteristics of this district are the gypsum beds, commonly called plaster of Paris, and the water-setting lime, well known to engineers as the Barrow lime.

2nd. Plans and sections of the whole of the North Midland Railway from Derby to Leeds, about 72 miles. The geological detail, as furnished by Mr. Swanwick, is laid down on the working sections of the cuttings, but as it has been considered by the Committee that a uniform system should be observed, enlarged sections have been prepared, on which, as on the similar sections of the other lines, the strata should be delineated. It may be observed here, that these enlarged sections are laid down in the proportion of one inch to forty feet upon the natural scale, that is, the vertical and horizontal scales are alike, which is not always the case in ordinary geological sections, and very seldom so with the working sections for earth-work and similar engineering purposes.

This railway intersects the coal districts for many miles, and is replete with interesting subjects.

3rd. Plans and sections of the Manchester and Leeds Railway from Manchester to Normanton, about 50 miles.

These latter are not quite finished, but will be so before the close of the Meeting.

Enlarged sections of a considerable portion of the excavations only on this railway, filled up with the geological detail.

4th. Enlarged sections of the excavations only on the Glasgow, Paisley, and Greenock railway, about 15 miles, with the geological detail.

5th. Similar sections of the Manchester and Bolton Railway, about 11 miles, containing full details of the strata where the remarkable fossil trees were found, and of the trees also, models of which are in the Exhibition-room at the Royal Institution in Manchester. The liberality of this Company will afford several opportunities for the members of the Association to visit these trees, and the particular profile of the excavation where they were found will remain in the Geological Section, or in the Royal Institution, with the models.

6th. Similar enlarged sections of the cuttings only on the Hull and Selby Railway, about 20 miles, with the geological detail.

The whole of these enlarged geological sections were furnished by Mr. Wright; and others are stated to be preparing for the Committee, but they have not yet come to hand.

These records, according to the directions of the Association, will be deposited in the Museum of Œconomic Geology in London, where they may at all times hereafter be usefully referred to.

In conclusion the Committee cannot refrain from observing, that the documents thus collected are equally important and interesting to the philosopher, to the geologist, and to the engineer. To the theoretical investigator they present the curious and varying features of the crust of this portion of the globe; to the practical engineer they offer a memorial of the experience of the profession, whence many a serviceable lesson for future operations may be learned, whereby difficulties and expense may be hereafter avoided and diminished, and from which valuable information may be derived for the appliance of materials in constructions (it being one of the greatest arts of the engineer to avail himself of the most immediate natural resources which he has to displace in one instance, and to apply them usefully in another, when in juxtaposition). On the other hand, the minute variations of the strata and soil, thus accurately delineated, and referred to well-defined altitudes above the general level of the sea, become of the very highest interest to the geologist, and no less so to the mining engineer; more especially on the lines of railway intersecting the coal and mineral districts, where in so many instances labour, directed by science and sustained by commercial enterprise, has laid bare in deep chasms the secrets of nature, and the stores whence this country has derived so many advantages; and drawn from our mines of coal and rude metallic ores, that abundant wealth and prosperity which the more splendid productions of Potosi and of Mexico have failed to bestow on their possessors.

Report of the Committee for the Preservation of Animal and Vegetable Substances.

In making a report for the Committee for the preservation of Animal and Vegetable Substances, consisting of the Rev. W. L. P. Garnons and myself, I only propose to state the results, and terminate the series of experiments commenced by the former Committee appointed at the Liverpool Meeting in 1837, as we consider them to have been now continued for a sufficient time to supply us with very considerable negative evidence upon the preserving powers of the different materials taken separately. Upon receiving notice of our appointment, we determined that as no report upon these experiments had been printed by the Association, it would be advisable to defer the commencement of any new ones until after we had had an opportunity of giving a short statement concerning those already in progress, but hope in the autumn of the present year to commence a new series, in which it is proposed that vegetable substances should occupy a more prominent place.

The experiments to which this report refers were commenced in June 1838, having thus continued for four years, and were made by placing in small glass jars (5 inches by 2) solutions in water of the different substances unmixed, but tried in three proportions, namely, (1) a saturated solution, (2) a solution diluted with an equal quantity of water, and (3) with a double quantity. The following are lists of them, arranged according to their value as preservatives of animal substances.

1. Good Preservatives.

Subcarbonate of potash.
Naphtha employed in the proportion of 1 part to 7 of water.

2. Moderately good, but the specimens rather too soft.

Sulphate of magnesia.
Arseniate of potash.

3. Moderately good when examined in 1840, but the specimens now decomposed.

Alum.
Muriate of ammonia.
Muriate of magnesia.
Nitre.
Sulphate of zinc.
Bicarbonate of potash.
Arsenious acid.

4. Quite useless for the purpose of Preservation.

Sulphate of iron.
Sulphate of copper.
Sulphate of soda.
Sulphate of potash.
Carbonate of ammonia.
Nitrate of barites.
Nitrate of ammonia.
Nitrate of strontian.
Nitrate of soda.
Muriate of barytes.
Muriate of lime.
Phosphate of soda.
Chloride of potash.
Oxalic acid.
Rough pyroligneous acid.

A few drops of kreosote in water is a good preservative, but stains the specimens brown.

Corrosive sublimate preserves perfectly, but hardens the substances too much.

Concentrated acetic acid decomposes the skin, bones, and cellular membrane, but leaves the muscles untouched.

The vegetable specimens are well preserved in oxalic acid, concentrated acetic acid, naphtha and kreosote; moderately well in muriate of ammonia, nitrate of ammonia, and corrosive sublimate: none of the others appear to have succeeded, nor indeed is the colour of the vegetables well preserved in any case, and on the whole the experiments with them are far from satisfactory.

CHARLES C. BABINGTON.

Abstract of Professor Liebig's Report on "Organic Chemistry applied to Physiology and Pathology. By Lyon Playfair, *M.D.*

The first part of Professor Liebig's Report consists in the examination of the processes employed in the nutrition and reproduction of various parts of the animal œconomy.

In vegetables, as well as in animals, we recognise the existence of a force in a state of rest. It is the primary cause of growth or increase in mass of the body in which it resides. By the action of external influences, such as the presence of air and moisture, its condition of static equilibrium is disturbed; and entering into a state of motion or activity, it occupies itself in the production of forms, which, though occasionally bounded by right lines, are yet widely distinct from geometrical forms. This force has received the appellation of *vital force*, or *vitality*.

Vitality, though residing equally in the animal and vegetable kingdoms, produces its effects by widely different instruments. Plants subsist entirely upon matter belonging to inorganic nature. Atmospheric air, the source whence they derive their nutriment, is ranked with minerals by the most distinguished mineralogists. All substances, before they can form food for plants, must be resolved into inorganic matter.

But animals, on the other hand, require highly organised atoms for nutriment; they can only subsist upon parts of an organism. They possess within themselves a vegetative life, as plants do, by means of which they increase in size, without consciousness on their part; but they are distinguished from vegetables by their faculties of locomotion and sensation—faculties acting through a nervous apparatus. The true vegetative life of animals is in no way dependent upon this apparatus; for it proceeds where the nerves of voluntary motion and sensation are destroyed, and the most energetic volition is incapable of exerting any influence on the contractions of the heart, on the motion of the intestines, or on the processes of secretion.

All parts of the animal body are produced from the fluid circulating within its organism, by virtue of vitality, which resides in every organ. A destruction of the animal body is constantly proceeding; every motion, every manifestation of force, is the result of the transformation of the structure, or of its substance; every conception, every mental affection, is followed by changes in the chemical nature of the secreted fluids; every thought, every sensation, is accompanied by a change in the composition of the substance of the brain.

It is to supply the waste thus produced, that food is necessary. Food is either applied in the increase of the mass of a structure (i. e. *in nutrition*), or it is applied in the replacement of a structure wasted (i. e. *in reproduction*).

The primary condition for the existence of life is the reception and assimilation of food. But there is another condition equally important—the continual absorption of oxygen from the atmosphere.

All vital activity results from the mutual action of the oxygen of the atmosphere and the elements of the food. All changes in matter proceeding in the body are essentially chemical, although they are not unfrequently increased or diminished in intensity by the vital force. The influence of poisons and remedial agents on the animal œconomy, proves that the chemical combinations and decompositions proceeding therein, and which manifest themselves in the phænomena of vitality, may be influenced by bodies possessing a well-defined chemical action. Vitality is the ruling agent by which the chemical powers are made to subserve its purposes, but the acting forces are chemical. It is from this view, and from no other, that we ought to view vitality. Wonders surround us on all sides: the formation of a crystal is not less incomprehensible than that of a leaf or of a muscle; the production of vermilion, from the union of sulphur and mercury, is as much an enigma as the production of an eye from the substance of the blood.

According to Lavoisier, an adult man takes into his system every year 827 lbs. of oxygen, and yet he does not increase in weight. What then becomes of the enormous quantity of oxygen introduced in the course of a year into the human system? The carbon and hydrogen of certain parts of the body have entered into combination with the oxygen introduced through the lungs and through the skin, and have been given out in the form of carbonic acid and the vapour of water. At every moment, with every expiration, parts of the body are thus removed, and are emitted into the atmosphere.

No part of the oxygen inspired is again expired as such. Now it is found that an adult inspires 32½ ounces of oxygen daily; this will convert the carbon of 24 lbs. of blood into carbonic acid. He must therefore take as much nutriment as will supply the daily loss. And in fact it is found that he does so; for the average amount of carbon in the daily food of an adult man, taking moderate exercise, is 14 ounces, which require 37 ounces of oxygen for their conversion into carbonic acid.

But it is obvious, as the inspired oxygen can be removed only by its conversion into carbonic acid and water, that the amount of food necessary for the support of the animal body must be in direct ratio to the quantity of oxygen taken into the system. Thus a child, in whom the organs of respiration are naturally in a state of great activity, requires food more frequently, and in greater proportion to its bulk, than an adult, and is also less patient of hunger. A bird deprived of food dies on the third day; whilst a serpent, which inspires a mere trace of oxygen, can live without food for three months. The number of respirations is less in a state of rest than in exercise, and the amount of food necessary in both conditions must vary also.

An excess of food is incompatible with a deficiency in respired oxygen, that is, with deficient exercise; just as violent exercise (which implies an increased supply of food) is incompatible with weak digestive organs.

The capacity of the chest in an animal is a constant quantity; we therefore inspire the same *volume* of air, either at the pole or at the equator, But the *weight* of the air, and consequently of the oxygen, varies with the temperature. Thus an adult man takes into the system daily 46,000 cubic inches of oxygen, which, if the temperature be 77°, weigh 32½ oz.; but when the temperature sinks down to the freezing point (32°), it will weigh 35 oz. Thus an adult in our climate in winter may inhale 35 oz. of oxygen; in Sicily he would inspire only 28½ oz.; and if in Sweden, 36 oz. It is obvious also, that in an equal number of respirations we consume more oxygen at the level of the sea than on a mountain. The quantity of oxygen inspired, and carbonic acid expired, must therefore vary with the height of the barometer. Hence we expire more carbon in cold weather when the barometer is high, than we do in warm weather; and we must consume more or less carbon in our food in the same proportion. In our own climate, the difference between summer and winter in the carbon expired and therefore necessary for food, is as much as ⅛.

Even when we consume equal weights of food, an infinitely wise Creator has so adjusted it as to meet the exigencies of climate. Thus the fruit, on which the inhabitants of the south delight to feed, contains only 12 per cent. of carbon; whilst the bacon and train-oil enjoyed by the inhabitants of the arctic regions, contain from 66 to 80 per cent. of the same element.

Now the mutual action between the elements of food and the oxygen of the air is THE SOURCE OF ANIMAL HEAT.

All living creatures whose existence depends on the absorption of oxygen, possess within themselves a source of heat independent of the medium in which they exist. This heat, in the Professor's opinion, is wholly due to the combustion of the carbon and hydrogen contained in the food which they consume. Animal heat exists only in those parts of the body through which arterial blood, (and with it oxygen in solution) circulates; hair, wool, or feathers do not possess an elevated temperature. The carbon and hydrogen of food, in being converted by oxygen into carbonic acid and water, must give out as much heat as if they were burned in the open air. The only difference is, that this heat is spread over unequal spaces of time; but the actual amount is always the same.

As animal heat depends upon respired oxygen, it will vary according to the activity of the respiratory apparatus of the animal. Thus the temperature of the body of a child is 102°, whilst that of an adult is 99½°. That of birds is higher than that of quadrupeds, or than that of fishes or amphibia, whose proper temperature is 3° higher than the medium in which they live. All animals, strictly speaking, are warm-blooded; but in those only which possess lungs, is their temperature quite independent of the surrounding medium. The temperature of the human body is the same in the torrid as in the frigid zone. But as the body may be considered in the light of a heated vessel, which cools with an accelerated rapidity, the colder the surrounding medium, it is obvious that the fuel necessary to maintain its heat must vary in different climates. Thus less food is necessary in Palermo, where the temperature of the air is that of the human body, than in the polar regions, where it is about 90° lower.

It has formerly been stated that the quantity of oxygen respired in the colder regions of the earth is greater than that inhaled in the tropics; and by a more abundant supply of food, a greater generation of heat must ensue.

The human body may be aptly compared to the furnace of a laboratory destined to effect certain operations. It signifies nothing what intermediate forms the food or fuel of the furnace may assume; it is finally converted into carbonic acid and water. But in order to sustain a fixed temperature in the furnace, we must vary the quantity of fuel, according to the external temperature, that is, according to the supply of oxygen.

In the animal body the food is the fuel, and by a proper supply of oxygen, we obtain the heat given out during its combustion. In winter, when we take exercise in a cold atmosphere, we respire a greater amount of oxygen, which implies a more abundant supply of carbon in the food; and by taking this food, we form the most efficient protection against the cold. A starving man is soon frozen to death; and every one knows that the animals of prey of the arctic regions are far more voracious than those of the torrid zone.

Our clothing is merely an equivalent for food, and the more warmly we are clothed, the less food we require. Were we to go destitute of clothes, like certain savage tribes, or if in hunting or fishing we were exposed to the same degree of cold as the Samoyedes, we could with ease consume 10 lbs. of flesh, and perhaps a dozen tallow-candles to the bargain, as warmly-clad travellers have related with astonishment of these people. Then could we take the same quantity of brandy or blubber of fish without bad effects, and learn to appreciate the delicacy of train-oil.

We thus perceive an explanation of the apparently anomalous habits of different nations. The maccaroni of the Italian and the train-oil of the Greenlander and the Russian are not adventitious freaks of taste, but necessary articles, fitted to administer to their comfort in the climates in which they have been born. In cold regions, the food must contain a greater quantity of carbon, or, in other words, be more combustible.

The Englishman in Jamaica perceives with regret the disappearance of his appetite, which in England had been a constant recurring source of enjoyment. By the use of aromatics he creates an artificial appetite, and eats as much food as he did at home. But he thus unfits himself for the climate in which he is placed; for sufficient oxygen does not enter his system to combine with the carbon contained in the food, and the heat of the climate prevents him from taking exercise to increase the number of his respirations: the carbon of the food is therefore forced into other channels, and disease results.

England, on the other hand, sends her dyspeptic patients to southern climates. In our own land, their impaired digestive organs are unable to fit the food for that state in which it best unites with the oxygen of the air, which therefore acts on the organs of respiration themselves, thus producing pulmonary complaints. But when they are removed to warmer climates they absorb less oxygen and take less food, and the diseased organs of digestion have sufficient powers to place the diminished amount of food in equilibrium with the respired oxygen.

Just as we would expect from these views, in our own climate hepatic diseases, or diseases arising from an excess of carbon, are more prevalent in summer; and in winter pulmonic diseases, or those arising from an excess of oxygen.

The cooling of the body, by whatever means it may be produced, implies a greater demand for food. Violent exercise, loud and long-continued speaking, the crying of infants, moist air, all exert an appreciable influence on the amount of food which is taken.

The whole process of respiration appears most clearly developed in the case of a man exposed to starvation.

32½ oz. of oxygen enter into his system daily, which never again escape, except in combination with parts of his body. Currie mentions the case of an individual who was unable to swallow, and whose body lost 100 lbs. in weight in one month; and Martell, in the Transactions of the Linnean Society, recounts the case of a fat pig, overwhelmed in a slip of earth, which lived for 160 days without food, and had diminished in weight during that time 120 lbs. The history of the hybernating animals and of those which acquire a periodical accumulation of fat, proves that the oxygen of the air readily combines with the carbonaceous matters; whilst in their winter sleep they may be considered in the light of a lamp slowly burning, the oil or fat for which has been stored up in sufficient quantity to sustain the combustion, that is, the animal heat; for nutrition, properly so called, does not proceed in these animals during winter. The more fat then an animal contains, the longer will it be able to exist without food, for that will be consumed before the oxygen of the air acts upon the other parts of the body.

From all this it will be seen, that in Liebig's view respiration is the falling weight, the bent spring which keeps the clock in motion; the inspirations and expirations are the strokes of the pendulum which regulate it. In our ordinary time-pieces we know with mathematical accuracy the effect produced on their rate of going, by changes in the length of the pendulum, or in the external temperature. Few, however, have a clear conception of the effect of air and temperature on the health of the human body; and yet the research necessary for keeping it in the normal state is not more difficult than in the case of a clock.

No one can deny that the nerves have considerable influence in the respiratory process, and some have even gone so far as to suppose that they are capable of generating heat. When the *pons Varolii* is cut through in a dog, or when a sudden blow is inflicted on the back of the head, the dog continues to respire, perhaps more quickly than before, but its body cools as rapidly as if sudden death had occurred. Exactly similar effects ensue on the cutting of the spinal cord, or the *par vagum*. These experiments have been supposed to prove that animal heat is due to nervous influence, and not to combustion; but this singular view has arisen from the erroneous conception that the combustion proceeds in the blood itself. Nothing could be more erroneous. As will afterwards be shown, the compounds which are consumed by the oxygen of the air are produced by the viscera, and these being paralyzed in the experiments alluded to, are unable to furnish compounds for combustion, so that the heat disappears.

Others, on the contrary, have ascribed animal heat to the contraction of the muscles, just as heat is evolved when caoutchouc is allowed to contract from a state of extension. Some have gone so far as to ascribe part of the heat to the mechanical motions of the body, as if these motions could exist without an expenditure of force consumed in producing them. Let us inquire in what manner this heat is produced.

We kindle a fire under the boiler of a steam-engine and generate steam, which steam may be applied to a machine destined for producing friction. By this friction heat is disengaged, but it is quite impossible that the heat thus obtained can ever be greater than that employed to heat the boiler. We employ a galvanic current to produce heat; but the amount of heat obtained is never greater than we might have by the combustion of the zinc used in producing the current.

The contraction of muscles produces heat; but the force necessary for the contraction has manifested itself through the organs of motion, in which it has been excited by chemical changes. The *ultimate* cause of the heat produced is therefore to be found in these chemical changes.

Professor Liebig then proceeds to prove that the heat evolved by the combustion of carbon in the body is sufficient to account for all the phænomena of animal heat. He shows that the 14 oz. of carbon which are daily converted into carbonic acid in an adult, disengage no less than 197·477° of heat; a quantity which would convert 24 lbs. of water, at the temperature of the body, into vapour. And if we assume that the quantity of water vaporized through the skin and lungs amounts to 3 lbs., then we have still 146.380° of heat to sustain the temperature of the body. And when we take into calculation the heat evolved by the hydrogen of the food, and the small specific heat possessed by the organs generally, no doubt can be entertained that the heat evolved in the process of combustion, to which the food is subjected in the body, is amply sufficient to explain the constant temperature of the body.

From what has preceded, it is obvious that the amount of carbon consumed in food ought to depend on the climate, density of air, and occupation of the individual. A man will require less carbon when pursuing a sedentary occupation, than when he is engaged in active exercise.

Professor Liebig having thus discussed the source of animal heat, proceeds next to consider what are the ingredients in the food which may be properly considered to be nutritious. Physiologists conceive that the various organs in the body have originally been formed from blood; if this be admitted, it is obvious that those substances only can be considered as nutritious which are susceptible of being transformed into blood.

When blood is allowed to stand it coagulates and separates into a watery fluid called serum, and into the clot, which consists principally of fibrin.

These two bodies contain in all seven elements, amongst which sulphur, phosphorus and nitrogen are found; they contain also the earth of bones. The serum holds in solution common salt and other salts of potash and soda, of which the acids are carbonic, phosphoric, and sulphuric acids. Serum when heated coagulates into a white mass called albumen. This substance, along with fibrine, constitutes the globules of blood, along with a red colouring matter in which iron is a constituent.

Analysis has shown the singular result, that fibrine and albumen are perfectly identical in chemical composition. The arrangement of their particles is different, as the variation in their forms proves, and their composition in 100 parts is exactly the same. They may be mutually converted into each other. In the process of nutrition both may be converted into muscular fibre, and that in return into blood.

All organized parts of the body, *i. e.* parts possessed of a decided shape, contain nitrogen. The principal ingredients of blood contain 17 per cent. of nitrogen, and there is no part of an active organ which contains less than 17 per cent. of this element.

The nutritive process is simplest in the case of the carnivora. This class of animals lives on the blood and flesh of the graminivora; but this blood and flesh is identical with their own. The nutriment of carnivora is derived originally from blood, and on the entrance of the nutriment into their system it is again converted into blood. With the exception of hair, horn, hoof and feathers, every part of a graminivorous animal is susceptible of assimilation. In a chemical sense, therefore, it may be considered that a carnivorous animal in taking food feeds upon itself, for its nutriment is identical in composition with its own tissues.

But at first sight the nutritive process of graminivorous animals seems altogether different; their digestive apparatus is less simple, and their food contains very little nitrogen. From what constituents of vegetables is their blood produced?

All vegetables contain nitrogenized compounds, and the most ordinary experience shows us, that the greater the quantity of these compounds which are in the food, the less is the quantity of food required for the purposes of nutrition. The nitrogenized compounds of vegetables are called vegetable fibrine, vegetable albumen, and vegetable casein. Vegetable fibrine is familiarly known as gluten; vegetable albumen is obtained from decoctions of the juice of nutritious vegetables, such as cauliflowers, asparagus and mangel-wurzel; vegetable casein is principally found in leguminous seeds, such as peas, beans, and lentils.

These three compounds are the only nitrogenized bodies which form food for graminivorous animals, for all others existing in plants are rejected from the system.

Now analysis has led to the interesting result that they are exactly of the same composition in 100 parts; and, what is still more extraordinary, that *they are absolutely identical with the chief constituents of the blood*—animal fibrine and animal albumen. By identity, be it remarked, we do not imply similarity, but absolute identity even, as far as their inorganic constituents are concerned.

How beautifully simple, then, by the aid of these discoveries, does nutrition appear! Those vegetable constituents which are used by animals to form blood, contain the essential ingredients of blood ready formed. In point of fact, then, *vegetables* produce in their organism the blood of *all animals*; for the carnivora, in consuming the blood and flesh of the graminivora, consume, strictly speaking, the vegetable principles which have served for the nourishment of the latter. In this sense, we may say that the animal organism gives to blood only its form; and further, that it is incapable of forming blood out of other compounds which do not contain the chief ingredients of that fluid. Liebig does not, indeed, maintain that other compounds may not be transformed in the body, for we know that they are; but that they cannot form the blood, the starting-point of the series.

Animal and vegetable life are therefore closely connected; for the *first* substance capable of affording nutriment to animals is the *last* product of the creative energy of vegetables. The seemingly miraculous, in the nutritive power of vegetables, disappears in a great degree; for the production of the constituents of blood cannot appear more surprising than the occurrence of the fat of beef and mutton in cocoa beans, of human fat in olive oil, of the principal ingredient of butter in palm oil, and of horse fat and train-oil in certain oily seeds.

Whilst considerations such as these have led Liebig to these conclusions regarding the increase of mass in animals, he has still to account for the use of the substances in food, which are destitute of nitrogen, but which we know are absolutely necessary to animal life. Such substances are starch, sugar, gum and pectine. In all of these substances we find a great excess of carbon, with oxygen and hydrogen in the same proportion as in water. They therefore add an excess of carbon to the nitrogenized constituents of food, and they cannot possibly be employed in the production of blood, because the nitrogenized compounds contained in the food already contain exactly the amount of carbon which is required for the production of fibrine and albumen. Liebig enters into proofs to show that very little of the excess of this carbon is ever expelled from the system either in the form of solid or liquid compounds. It must therefore be expelled in the gaseous state. In short, by a train of admirable reasoning, he arrives at the interesting conclusion, that they are solely expended in the production of animal heat, being converted by the oxygen of the air into carbonic acid and water. The food of carnivorous animals does not contain non-azotized matters, so that the carbon and hydrogen necessary for the production of animal heat are furnished in them from the waste of their tissues. The transformed matters of the organs are obviously unfit for the further nourishment of the body, that is, for the increase or reproduction of the mass. They pass through the absorbent and lymphatic vessels into the veins, and their accumulation in these would soon put a stop to the nutritive process, were it not that the blood has to pass through a filtering apparatus, as it were, before reaching the heart. The venous blood, before returning to the heart, is made to pass through the liver and the kidneys, which separate from it all substances incapable of contributing to nutrition. The new compounds containing the nitrogen of the transformed organs, being utterly incapable of further application in the system, are expelled from the body.

Those, again, which contain the carbon of the transformed tissues, are collected in the gall-bladder as bile, a compound of soda, which being mixible with water in every proportion, passes into the duodenum and mixes with chyme. All the soda of the bile, and ninety-nine-hundredths of the carbonaceous matter which it contains, retain the capacity of resorption by the absorbents of the small and large intestines—a capacity which has been proved by direct experiment.

The globules of the blood, which in themselves can be shown to take no share in the nutritive process, serve to transport the oxygen, which they give up in their passage through the capillary vessels. Here the current of oxygen meets with the carbonaceous substances of the transformed tissues, and converts their carbon into carbonic acid, their hydrogen into water.

Every portion of these substances which escapes this process of oxidation, is sent back into the circulation in the form of bile, which by degrees completely disappears.

This view of Liebig's, of the use of bile, is highly ingenious and important. In the young of carnivorous animals, the circulation and the respiration are more rapid; but an infinitely wise Providence has furnished in the butter of the milk of the mother a highly carbonaceous substance, by which the loss of the organized tissues by the action of the oxygen of the air is prevented. In the young of carnivorous birds milk is not required, because the absence of all motion is an obvious cause of a diminished waste in the organs.

It is obvious also, that in the system of the graminivora, whose food contains relatively so small a proportion of the constituents of the blood, the process of metamorphosis in existing tissues, and consequently their restoration or reproduction, must go on far less rapidly than in the carnivora. Were this not the case, a vegetation a thousand times more luxuriant would not suffice for their sustenance. Sugar, gum and starch, which form so large a proportion of their food, would then be no longer necessary to support life in these animals, because in that case the products of waste, or metamorphosis of the organized tissues, would contain enough of carbon to support the respiratory process.

Man, when confined to animal food, requires sources of nutriment more widely extended than the lion and tiger, because when he has an opportunity he kills without eating. This is the reason that a nation of savage hunters cannot multiply themselves beyond a certain extent; but when civilization reaches them, and they become herbivorous as well as carnivorous, the population rapidly increases. When exercise is denied to graminivorous and omnivorous animals, this is tantamount to a deficient supply of oxygen. The carbon of the food not meeting with sufficient oxygen to consume it, it passes into other compounds containing a large excess of carbon and deficiency of oxygen, or, in other words, *fat* is produced. It is thus that the sedentary ladies of oriental countries acquire so much *embonpoint*, and stall-fed animals so much fat. That fat does arise in some such way as Liebig describes is obvious; for the herbs and roots consumed by the cow contain no butter; in the hay or other fodder of oxen no beef-suet exists; no hog's-lard can be found in the potato refuse given to swine; and the food of geese or fowls contain no goose-fat or capon-fat. The fat must be formed in the organism, and for this purpose oxygen must be separated from the carbonaceous constituents of food. Liebig is led to the startling conclusion, that fat is altogether an abnormal and unnatural production, arising from the adaptation of nature to circumstances, and not of circumstances to nature, altogether resulting from a disproportion of carbon in the food to that of the oxygen respired by the lungs or absorbed by the skin. Wild animals in a state of nature do not contain fat. The Bedouin or the Arab of the desert, who shows with pride to the traveller his lean, muscular, sinewy limbs, is altogether free from fat. And the Professor points out the diseases arising from this cause, and furnishes some valuable hints to therapeutics.

From all that has preceded, we may sum up the nutritious elements of food as follows. The ingredients adapted for the formation of the blood, and which the Professor calls the *plastic elements of nutrition*, are as follows:—

Vegetable fibrine.
Vegetable albumen.
Vegetable casein.
Animal flesh.
Animal blood.

The other ingredients of food being fitted to sustain the temperature of the body, he calls the elements of respiration. They are,

Fat.	Sugar of milk.
Starch.	Pectine.
Gum.	Bassorine.
Cane-sugar.	Wine.
Grape-sugar.	Beer.
	Spirits.

Having been led to give at such length an account of Professor Liebig's *general principles* of nutrition, we must dismiss with a mere announcement the details of which the second part of his work consist. In this he examines the chemical processes engaged in the production of bile, of urea, uric acid and its compounds, as well as of cerebral and nervous substance. The conclusions to which he has arrived on these subjects are of the most intense interest, and have surprised their author as much as they must his reader. In fact, we dare not venture to make an abstract of them, without entering into the calculations with which they are accompanied, lest their beautiful harmony with known operations would incline the reader to think that they are the creations of a brilliant imagination, instead of being (as they are) the results of sober calculation.

His explanatory remarks on digestion are highly beautiful, and we cannot pass them without referring to the singular function which he ascribes to saliva.

In the action of gastric juice on the food, no other element participates except the oxygen of the atmosphere and the elements of water. During the mastication of food the fluid saliva is secreted into the mouth. This fluid possesses the remarkable property of enclosing air in the shape of froth, in a far higher degree even than soap-suds. This air, by means of the saliva, accompanies the food into the stomach, and there its oxygen enters into combination with the constituents of the food, whilst its nitrogen is again given out through the lungs or skin. This, then, accounts for the fact discovered by physiologists, that pure nitrogen is given out by the lungs and skin. The greater the resistance of the food, that is, the longer digestion continues, the greater is the quantity of saliva, and consequently of air, which enters the stomach. Rumination, in certain graminivorous animals, has plainly for one object a renewed and repeated introduction of oxygen; for a mere mechanical division of the food only shortens the time required for solution. Of course, the Professor does not mean to infer that this is the only mode by which oxygen enters the stomach; it does so also by the property possessed by all animal tissues of being permeable to air.

The Professor, in treating of the formation of bile, shows the very interesting result, that if the formula of the compounds existing in urine and those of the bile be added together, we obtain the precise formula of the blood; as was indeed to be expected from his view, that the nitrogenous matters go principally to the former fluid, the carbonaceous matters to the latter. He enters largely into the hitherto mysterious transformations of bile into choleic acid, taurine, &c.; and as a consequence of this examination he obtains the remarkable result, that if the elements of proteine and starch (oxygen and water being also present) undergo transformation together and mutually affect each other, we obtain, as the products of this metamorphosis, urea, choleic acid, ammonia and carbonic acid, and besides these no products whatever! This is full of significance with regard to the processes which we actually know to proceed in the animal œconomy.

Following out the subject still further, he accounts very happily for the formation of calculi; a subject upon which, for obvious reasons, we cannot enter. In fact, in this second part of his report, all the most interesting transformations of the food of the various organs and tissues of the body are discussed with his usual success. Whilst examining the action of organic remedial agents on the animal œconomy, he touches upon the use of tea and coffee as an article of food; and as this is a subject of very general interest, we will briefly state his opinions.

It is well known that recent chemical research has proved the fact, which the boldest imagination dared not have ventured to conceive, that the active principles of tea and coffee, viz. theine and caffeine, are absolutely one and the same body, being perfectly identical in every respect. The presence of this in two vegetables belonging to different natural families, and derived from different quarters of the globe, proves that the action of tea and coffee on the system must be the same. Some cause there must be to explain how the practice of taking them has become a necessary of life to whole nations. Now caffeine (theine) is a highly nitrogenized body. Bile, it is well known, contains an essential nitrogenized ingredient, *taurine.* Now Professor Liebig considers that caffeine goes to the production of this taurine; and by calculating the formulas of both, he shows, that if nine atoms of water and nine atoms of oxygen be added to the formula of caffeine, *we obtain the formula of two atoms of taurine.* Two and eight-tenths of a grain of caffeine is sufficient to form the taurine contained in one ounce of bile; and if we admit that the infusion of tea consumed contained no more than one-tenth of a grain of caffeine, still if it contribute in point of fact to the formation of bile, the action even of such a quantity cannot be looked upon as nullity.

Neither can it be denied, that in case of using an excess of non-azotized food, or deficiency of motion, which is required to cause the change of matter in the tissues, and thus to yield the nitrogenized matter of the bile; that in such a condition the state of health may be benefited by the use of tea or coffee, by which may be furnished the nitrogenized product produced in the healthy state of the body, and essential to the production of an important element of respiration. It is only in a chemical sense that these remarks are intended to show, that such compounds as caffeine or theine, asparagine and theobromine, are better adapted to this purpose than all other vegetable principles.

The American Indian, with his present habits of living solely on flesh, could not with any comfort use tea as an article of food, for his tissues waste with such rapidity, that, on the contrary, he has to take something to retard this waste. And it is worthy of remark, that he has discovered in tobacco smoke a means of retarding the change of matter in the tissues of his body, and thereby of making hunger more endurable; and that he cannot withstand the captivation of brandy, which, acting as an element of respiration, puts a stop to the change of matter by performing the function which properly belongs to the products of the metamorphosed tissues. With the Indian savages, brandy administers to their feelings of comfort, which tea in their cases would not do.

The third part of Professor Liebig's report treats of the recondite laws of the phænomena of motion. His observations on these fully bear out the high character of the other parts of the report; but as they require more detail in order to be understood, we can better afford to shorten our abstract by merely referring to the report itself.

The Professor concludes his valuable communication by two chapters, one on the Theory of Disease, the other on the Theory of Respiration. With a very few words on these subjects, we will close this abstract.

The whole life of animals consists of a conflict between chemical forces and the vital power. In the normal state of the body of an adult both stand in equilibrium; that is, there is an equilibrium between the manifestations of the causes of waste and the causes of supply. Every mechanical or chemical agency which disturbs the restoration of this equilibrium is *a cause of disease. Disease occurs* when the resistance offered by the vital force is weaker than the acting cause of disturbance.

Death is that condition in which chemical or mechanical powers gain the ascendency, and all resistance on the part of the vital force ceases. This resistance never entirely departs from living tissues during life. Every abnormal condition of supply or waste may be called disease.

But it is evident that one and the same cause of disease, that is, of disturbance, will have different effects according to the period of life. A cause of disease added to the cause of waste, may in old age annihilate the resistance of the vital power, or, in other words, occasion death; while in the adult state it may produce only a disproportion between supply and waste, and in infancy only an abstract state of health, *i.e.* an *equilibrium* between supply and waste.

Now from what has preceded, it is obvious that a deficiency of resistance in a living part to the cause of waste is in fact a deficiency of resistance to the action of the oxygen of the atmosphere. Professor Liebig has shown, in that part of the report which I have omitted, that the phænomena of motion are dependent upon the change of matter; consequently, if by a diseased transformation of living tissues a greater amount of force be generated than is necessary for the production of the normal motions, it is seen in an acceleration of the involuntary motions, as well as in a higher temperature of the diseased part.

This condition is called FEVER.

And when a great excess of force is produced by change of matter, the force, since it can only be consumed by motion, extends itself to the apparatus of voluntary motion.

This state is called a FEBRILE PAROXYS.

Should there be any products formed during disease, which the organs in their immediate vicinity cannot employ in their own vital functions, eremacausis will ensue, which may be communicated to other parts of the body. The physician sometimes removes those diseased conditions by exciting an artificial diseased state in their vicinity, such as by blisters or by setons. In this case he throws a less important part of the body into a state in which it more readily yields to the oxygen, and therefore removes the causes of waste from the diseased organ. When this cause of waste is reduced, the resistance or vital force increases, and renovates the part removed by oxygen.

In cases of a different kind, where artificial external disturbance produces no effect, the physician adopts other indirect methods to exalt the resistance offered by the vital force. He diminishes the number of blood-carriers (the globules), and by this means the cause of change. He excludes from the food all matter capable of conversion into blood, and gives chiefly or entirely non-azotized food, which supports the respiratory process.

In regard to the nature of the vital force, it is plain that it must be connected with other physical forces, for its manifestations are similar; it is devoid of consciousness or volition, and is, as we know, subject to the action of a blister.

Perhaps we cannot give a better notion of the Professor's theory than by comparing the human body to a self-regulating steam-engine.

Every one knows that the tube which conveys the steam to the cylinder, where the piston-rod is to be raised, contains a stop-cock of a peculiar construction, through which the steam must pass. By an arrangement connected with the regulating-wheel, this stop-cock opens when the wheel moves slower, and shuts when it moves more rapidly than is necessary to produce a uniform motion. When it opens, more force (steam) is admitted, and the motion of the machine is accelerated. When the stop-cock shuts, the steam is more or less cut off, the force in the cylinder diminishes, the tension of the steam or force increases, and is preserved for subsequent use. The force, that is, the tension of the vapour, is produced by the change of matter by the combustion of coals. The force increases with the temperature of the fire-place. There are in these engines other arrangements, all intended for regulation. When the force augments beyond a certain point, the channels for the admission of air close themselves, combustion is diminished, and less force generated; but when the engine goes slower more steam is admitted to the cylinder, its tension decreases, the air-passages are opened, and the cause of the disengagement of heat, that is, of the production of force, increases. Another arrangement supplies the fire-place incessantly with coals, in proportion as they are wanted.

The body, in regard to the production of heat and of force (in Liebig's view), acts just like one of those machines. With the lowering of the external temperature, the respiration becomes deeper and more frequent; oxygen is supplied in greater quantity and of greater density; the change of matter is increased; and more food must be supplied if the temperature of the body is to remain unchanged.

It has been proved that iron is *not* necessary to the colouring matter of the blood, but that it forms an essential constituent of blood-globules. These globules, it is well known, take no part in nutrition. Liebig proves that iron is contained in a state of protoxide in venous, and in the state of sesquioxide in arterial blood. The latter very readily yields its oxygen to organic matter, the former becomes very readily oxidized; but the sesquioxide, in yielding its oxygen to organic tissues, produces carbonic acid, which (according to well-known facts) protoxide of iron readily absorbs. The globules of blood darken when exposed to carbonic acid gas, but become florid when exposed to oxygen, whilst all the carbonic acid is again evolved. Therefore, the organic compound of iron which exists in venous blood, recovers in the lungs the oxygen which it had lost, and liberates its carbonic acid. Professor Liebig conceives that the iron is therefore the great means of conveying to the lungs the carbonic acid formed in the system; and he has made a calculation of how much the iron contained in the body could thus actually convey, and the result of the calculation shows that twice as much carbonic acid could thus be conveyed as actually is expelled daily from the system.

In conclusion, I entreat that this abstract may not be regarded as doing justice to Professor Liebig. It is difficult indeed to abstract from a work in which every sentence contains some new views, if possible, more interesting and more important than those preceding. And when the very unfavourable circumstances under which this abstract was prepared are considered, I am sure that justice will be done to my learned friend by consulting the report itself.

In the opinion of all, Liebig may be considered a benefactor to his species, for the interesting discoveries in agriculture published by him in the first part of this report. And having in that pointed out means by which the food of the human race may be increased, in the work now before us he follows up the chain in its continuation, and shows how that food may best be adapted to the nutrition of man. Surely there are no two subjects more fitted than these for the contemplation of the philosopher; and by the consummate sagacity with which Liebig has applied to their elucidation the powers of his mind, we are compelled to admit that there is no living philosopher to whom the Chemical Section could have more appropriately entrusted their investigation.

Report on the British Fossil Mammalia. By Richard Owen, *Esq., F.R.S.*

Part I. *Unguiculata and Cetacea.*

By many recent valuable works there may be evidently discerned in the labours of the Naturalists of the present day a tendency to the acquisition of complete and precise knowledge of the animals and plants of particular countries and localities. The birds of Europe, the freshwater fishes of the same continent, the vertebrated animals of Italy, those of the northern regions of America, the fishes of Scandinavia, have had respectively their historians in a Gould, an Agassiz, a Bonaparte, a Richardson, and a Nillson; and, not to mention many other faunæ and floræ of foreign countries, the series of excellent zoological works, published by Mr. Van Voorst, have included able surveys by our most eminent Naturalists of the existing species of different classes of animals of Great Britain.

The British Association has favorably promoted the acquisition of analogous knowledge of the extinct animals of these islands, and the result of such investigations in regard to one class, encourages their application to other departments of primæval zoology.

How marvellous is the contrast, for example, which the catalogue of the British Fossil Reptiles presents in regard to the number, diversity, bulk, and outward forms of its subjects, with that of the existing species! In this comparison Prof. Bell's instructive volume on British Reptiles seems to form but a small appendix to that which treats of the extinct forms; to so small a group of diminutive species have the cold-blooded air-breathing animals dwindled down in our portion of the earth's surface.

The contrast promises to be, though not so striking, still very great, between the catalogues of the extinct and existing British Mammalia; and in undertaking, at the request of the Association, the present survey of the British Fossil Quadrupeds and Whales, the number and variety of these have made it requisite to divide the subject, and prolong the researches which it demands into another year.

It is proposed in this Report to record the fossil remains of extinct British Mammalia; first, according to their zoological relations, following them in the descending order; and, secondly, to enumerate them according to the strata, and in the same order.

The present division of the Report includes the *Quadrumana, Cheiroptera, Insectivora, Carnivora, Rodentia, Marsupialia,* and *Cetacea.*

This simple enumeration makes known the remarkable fact, that two orders of Mammalia, one of which has totally disappeared from the continents of the old world of the geographer, and the other is hardly recognized as European, have once possessed representatives in the land which now forms the island of Great Britain. So that whilst the Zoologist, enumerating the existing mammals of this island, finds the nearest approach to man in the diminutive bats, the palæontologist, by the extinct forms, can ascend another step, and commence his catalogue with a species of the quadrumanous order.

Order Quadrumana.

Genus *Macacus*.

The existence of this genus during the earlier tertiary epochs was established by the discovery, in sand, beneath a stratum of blue clay, at Kyson near Woodbridge, Suffolk, of a fragment of a lower jaw, including the socket of the last molar, with that highly characteristic tooth entire and in place, and the anterior part of the base of the coronoid process. This fossil was determined by me in August 1839*; it was of a dark colour and brittle from the loss of its original animal matter, but less absorbent than the cave fossils usually are. The crown of the tooth presents five tubercles, the four anterior ones being arranged in two transverse pairs, the fifth forming the posterior heel or talon. This conformation of the crown of the last molar of the lower jaw, is characteristic, as is well known, of two families of catarrhine or old-world monkeys,—the *Semnopithecidæ*, including *Semnopithecus* and *Colobus*, and the *Macacidæ* including *Macacus*, *Cynocephalus* and *Papio*. In the *Semnopithecidæ* the fifth tubercle or talon is large but simple. In most of the *Macacidæ* it presents two cusps, the outer one being much larger than the inner one. This character is well marked in the fossil, and reduces it to the lower group, or *Macacidæ*; in which, after a close comparison with several recent species, it appears to me to come nearest to the true *Macaci*. But the fossil exhibits the following differences from the recent *Macaci* :—the whole tooth is rather narrower in proportion to its length; the transverse ridge at the anterior part of the tooth crossing the base of the two anterior tubercles is a little more prominent, and passes more obliquely from the outer to the inner side; the second transverse ridge uniting the first pair of tubercles, rises nearer to their summits; the portion of the jaw is more compressed than the corresponding part of the jaw in the recent *Macaci*; the internal wall of the socket of the tooth is flatter and much thinner; the ridge on the outer side of the alveolus, which forms the commencement of the anterior margin of the coronoid process, begins closer to the tooth. These characters are sufficiently important and well-marked to establish the specific distinctions of the Macacque to which the portion of the jaw belongs, and are the more valuable as corroborating the evidence already adduced in proof that the fragment in question is a true fossil of the Eocene stratum in which it was discovered†.

A second specimen of the fossil *Macacus* consists of the crown and one fang of the second molar, left side, lower jaw; or the tooth which corresponds with the second 'bicuspis' in human anatomy; it was discovered in the same stratum and locality as the preceding. The crown presents four tubercles arranged in two transverse pairs, the anterior pair being the most distinctly developed, and rising the highest; there is also a very small ridge at the anterior, and another at the posterior side of the crown; the latter is placed between and connects together the two posterior tubercles. The fangs are two, strong and divergent; the anterior one has been broken off. The grinding surface of the tooth presents two depressions, a small one in front of the anterior pair of tubercles, and a larger one between the two pairs of tubercles. The tooth has evidently belonged to an old individual, for the tubercles are worn, and the posterior concavity is smoothed and deepened by attrition. It differs from the corresponding tooth of a recent *Macacus*

* See Magazine of Natural History, 1839, p. 444.

† A newspaper critic, when this discovery was first announced, suggested that the supposed fossil might be nothing more than the remains of some monkey belonging to a travelling menagerie, which had died and been cast out in the progress through Suffolk.

of the same size in having a slight ridge along the base of the anterior part of the crown, and in being a little narrower from side to side, and the same characters distinguish the posterior molar of the fossil *Macacus* above described. As, moreover, the present fossil molar bears exactly the same proportion to the above-mentioned fossil posterior molar, which obtains in the corresponding teeth of the recent *Macaci*, I have no doubt that the two fossil teeth belong to the same species of extinct *Macacus*.

The evidence on which this ancient British monkey has been recognized, is of the same nature as that which has proved the existence of another and higher organized Quadrumane, in a contemporary formation in the South of France. During the life-time of Cuvier no fossil referable to the quadrumanous order had been discovered in any part of the world. Such remains have, however, been subsequently determined not only from tertiary strata in England and France, but also from tertiary beds in the East Indies and South America; four different genera of apes and monkeys being now known to have co-existed with the stranger Mammalia of the tertiary periods which have become extinct.

Order Cheiroptera.

The most common situations in which the fossil bones of the bat-tribe have been met with are the bone-caves, in some of which, as in the cavern at Köstritz, they occur mixed with the bones of existing as well as extinct animals, and may have been introduced at a recent period. I shall not, therefore, here notice the remains of existing species of bats found in the superficial stalactites of caves, and which appear also to have been accidentally and recently introduced, like the remains of the human species, into caves containing the true fossil bones of extinct animals.

In the cavern called Kent's Hole, near Torbay, Devon, fragments of the skeleton of a bat have been found so associated with the remains of the extinct animals as to claim a like antiquity. A ramus of the lower jaw presents two large cuspidated molars in place, the socket of a third, those of two small premolars, and a canine, from which I am disposed to refer these fossils to the genus *Rhinolophus*, typified by the horse-shoe bat of the present fauna.

A species of small insectivore, referable only, as it appears to me, to the bat-tribe, has left indications of its presence during the remote tertiary periods in which the *Macacus*, already described, existed. These indications consist of two molar teeth, apparently the last and penultimate of the right side of the lower jaw.

One of these small grinders (penultimate or antepenultimate grinder) has the crown composed of four triangular prisms, placed in two transverse rows, with an angle turned outwards, and a side or flat surface inwards, the summits being sharp-pointed. The exterior prisms are the largest; the crown swells out abruptly above the fangs, defending them as it were by an overhanging ridge. There is a small transverse eminence or talon at the anterior part of the crown; and a very small tubercle is placed between the bases of the two external prisms. The second molar differs from the preceding in having the two posterior prisms suppressed, and replaced by a flattened triangular surface. The anterior prisms are present, and their apices project far beyond the level of the posterior surface. There is a small ridge at the anterior part of the tooth. These teeth agree more nearly with the antepenultimate and last molars of the larger insectivorous bats, than with any other teeth with which I have as yet compared them; they differ chiefly in the presence of the small tubercle at the basal interspace of the exterior prisms; a difference which M. de Blainville regards as ground for doubting the legitimacy of their approximation to the Cheiropterous order at all*. Since, however, an anatomist so familiar by his recent researches with all the modifications of the teeth of the Mammalia has been unable to refer the fossil molars in question to any of the terrestrial or aquatic genera of *Insectivora*, but has given my figures of these molars a place in the plate illustrating the ancient *Vespertiliones* in his 'Osteography,' I deduce from that fact additional confidence in my original determination. It is to the grinders of a tropical species of *Molossus*, in the collection of Mr. Cuming, that the present British fossils make the nearest approach.

Order Insectivora.

Genus *Talpa*.

Moles have been introduced into the retreats of owls and other birds of prey, and these remains have been detected in the earth at the bottom of caves, as in that at Paviland†, but these cannot be regarded as true fossils.

The almost entire skeleton, figured as a Saurian in the 'Geology of Bacton,' by Mr. Green, unquestionably belongs to the genus *Talpa*, as I have ascertained by examination of the characteristic humeri, which in the figure alluded to are placed so as to correspond with the coracoid and pelvic bones of Saurians. This mole's skeleton was discovered in a lacustrine deposit consisting of a greenish kind of mud intermixed with sand, underlying a stratum of bluish mud, with patches of brown clay, itself covered by the hard ferruginous crag and the superficial till.

The associated skeleton‡ of a quadruped, combining a dentition like that of the ruminants, with, apparently, a divided metacarpus and metatarsus, as in the *Anoplotherium gracile*, would indicate this formation to belong to the older tertiary series; but of this I shall be enabled to speak with more certainty, after a personal examination of the fossil and strata previous to the preparation of that part of the present report which will treat of the herbivorous Mammalia.

Genus *Sorex*.

Fossil remains of shrew-mice have been found in the bone-cave at Kent's Hole §; in the collections of bones in the raised beaches near Plymouth, and in other recent formations: they offer no evidence of species distinct from those now existing in Great Britain.

Genus *Amphitherium*.

The mammalian fossils which have excited most interest, and been the subject of closest examination and warmest discussion, are the small jaws from the oolitic calcareous slate at Stonesfield near Oxford, first indicated as evidence of the mammalian class by Dr. Buckland, in his celebrated paper on the *Megalosaurus*, published in 1823 in the 'Transactions of the Geological Society of London,' vol. i. 2nd series, p. 399; and there referred, on the authority of Cuvier, to the genus *Didelphys*.

A statement of so much importance as that of the existence of the remains of a terrestrial mammal in a secondary formation, much lower than the chalk, excited, as might be expected, much scepticism and close inquiry, first, in regard to the geological relations of the alleged oolitic stratum, and next as to the zoological affinities of the fossils.

* Osteographie des Cheiroptères, p. 93, pl. xv. fig. ix.

† Reliquiæ Diluvianæ, p. 93.

‡ Green's Geology of Bacton, plate ii, pp. 13–18.

§ As they have likewise been found in the cave at Köstritz, and in the bone-caves of Belgium.

The first exception to any generalization which has assumed the character of a law, is always admitted with difficulty, and by the strict or mechanical systematists with reluctance. The geological arguments by which M. Prevost endeavoured to invalidate the conclusions of Dr. Buckland, were soon and satisfactorily refuted by Dr. Fitton; and the question as to the real age of the rock containing the bones in question has not since been agitated. The attempts to remove the supposed anomaly by interpreting the appearances in the fossils as indications of a cold-blooded species, have been more frequent and persevering; and they assumed the character of so systematic a refutation of the Cuvierian view, in the memoirs communicated by M. de Blainville to the French Academy in the year 1838, that a close and thorough re-examination of the fossils in question became imperatively called for, in order that the doubts cast upon their mammalian nature might be tested. For this purpose the original fossil jaw described by Dr. Buckland, and those subsequently obtained from the Stonesfield slate and preserved in the Oxford Museum, were submitted to my inspection. I carefully examined the specimen described by Mr. Broderip and presented by him to the British Museum, and likewise that which is preserved in the Museum of the Philosophical Society at York. The results of these examinations were communicated to the Geological Society, and have been published with new and more exact figures of the fossils in the 6th vol., 2nd series, of the Transactions of the Society.

By a very singular coincidence the mammalian fossils from the Stonesfield slate, hitherto determined, are all portions of the lower jaw; whether belonging to individuals of different species, or of different genera, or even, as appears by examination of new specimens acquired since the publication of my memoir of 1838, of different orders of Mammalia.

The first fossil was referred originally to the genus *Didelphys*, from the resemblance of the grinders to those of the opossums; but Cuvier expressly states that they exceeded in number the molar series in that or any other known carnivorous genus of mammal. M. Agassiz, originally regarding this fossil as insufficient to determine the nature of the animal to which it belonged, subsequently proposed, nevertheless, a generic name, *Amphigonus*, for that animal, expressive of its supposed ambiguous nature. M. de Blainville, likewise, though participating in the incertitude or doubt which M. Agassiz had cast upon the original determination of the Stonesfield fossil, had as little hesitation in suggesting a name for the new genus which it seemed to indicate, whatever might subsequently prove to be its characters or affinities; and it is remarkable that the Greek compound '*Amphitherium*,' should imply by its terminal element a relation to the class Mammalia, which the two memoirs read to the French Academy by its inventor were designed to disprove.

M. Valenciennes, in his reply to M. de Blainville, arriving at the conclusion that the fossil jaw described and figured by M. Prevost and Dr. Buckland not only belonged to a mammalian but likewise to a marsupial animal, proposed for it a third generic name, indicative of these presumed affinities, viz. *Thylacotherium*.

The arguments of M. Valenciennes were opposed in a second detailed memoir by M. de Blainville, who concluded by stating that he felt himself compelled to pause, at least until fresh evidence was produced, in the conviction that the portions of fossil jaws found at Stonesfield, certainly did not belong to a marsupial—probably not to a mammalian genus, either insectivorous or amphibious—that, on the contrary, it was most likely the animal had been oviparous, and that, had not M. Agassiz decidedly given his opinion against the fossils in question belonging to fishes, he would rather have been led to suppose that they might have been the remains of an animal of that class.

With respect to the term 'amphibious,' in M. de Blainville's conclusion, this has reference to a later opinion expressed by M. Agassiz*, who, admitting the Stonesfield fossils to be certainly those of mammals, rejects them from the marsupial and insectivorous orders, observing that " each separate tooth resembles the greater part of those of seals, near which group (amphibious Carnivora) the animal to which the jaws belonged should form a distinct genus. In fact," adds M. Agassiz, " the aspect of these fossil fragments is so peculiar, that it draws our attention towards aquatic animals rather than away from them."

A mammiferous animal, not larger than the water-shrew, may manifest aquatic habits, but can hardly be supposed to have been piscivorous, or to have been endowed with instincts and an organisation like those of the seals; at all events it must be admitted, in the absence of any evidence of the locomotive extremities, that such an affinity can only be matter of mere conjecture; which a close examination of the dental and maxillary characters will show to have little probability.

The fossil first discovered by Professor Buckland, and figured by the Professor, by M. Prevost and myself, is the left ramus of a lower jaw wanting the anterior extremity, containing ten of the molar teeth more or less broken, and measuring ten lines in length.

This specimen, however, plainly exhibits,—first, a convex articular condyle; secondly, an indubitable and well-defined impression of what was once a broad, thin, high, and slightly recurved triangular coronoid process, rising immediately anterior to the condyle, having its basis extended over the whole of the interspace between the condyle and the commencement of the molar series, and having a vertical diameter equal to that of the horizontal ramus of the jaw itself; thirdly, the angle of the jaw continued to nearly the same extent below the condyle as the coronoid process reaches above it, and with its apex continued backwards in the form of a process; fourthly, the parts above described forming one continuous portion with the horizontal ramus of the jaw, which is not compounded of three or four distinct pieces. As respects this last statement, it is to be observed that an inferior marginal groove has been considered as evidence of the composite structure of the jaw under consideration; but there is no other mark that could be interpreted as an indication of this reptilian structure, whilst a similar groove characterizes the lower jaw of the marsupial *Myrmecobius* and *Wombat*, and of some large species of *Sorex*.

M. de Blainville was led to suppose that there was no trace of a convex condyle, but that in its place there existed an articular fissure, somewhat as in the jaws of fishes; that the teeth, instead of being imbedded in sockets, had their fangs confluent with, or anchylosed to, the substance of the jaws; and that the jaw itself presented evident traces of a composite structure.

The point, therefore, which first demanded the closest attention, was the actual condition, in the Stonesfield fossils, of the articular or condyloid process, in regard to which they give the same evidence. In the jaw examined by Cuvier, in the second specimen of the same species examined by M. Valenciennes, and in the lower jaw of another genus described and figured by Mr. Broderip, a prominent convex articular condyle is more or less distinctly revealed; it is most entire and unequivocal in Mr. Broderip's specimen which

* Neue Jahrbuch Mineral. und Geol. von Leonhard und Bronn, 1835, iii. p. 185.

I shall subsequently describe. What M. de Blainville has mistaken for an articular fissure, "une sorte d'échancrure, articulaire un peu comme dans les poissons," must be the entering angle or notch, either above or below the true articular condyle.

The angle of the jaw in the original fossil is produced backwards in the form of a process, as in the insectivorous and in all the carnivorous Mammalia, with the exception of the seals; but it could not be determined in that specimen whether this process was likewise bent inwards in the way which so strikingly characterizes the Marsupialia. A very complete half-lower jaw from Stonesfield, obtained since my paper was printed in the Geological Transactions, determines this question in the negative; and at the same time, therefore, turns the scale of evidence in favour of the affinities of the present ancient mammal to the placental insectivora.

Before, however, describing this fossil, I shall proceed to offer a few observations on the second specimen of *Amphitherium* figured in my paper in the Geological Transactions; and on the evidence which it affords of the affinities of this most interesting genus.

In this specimen the whole of the exposed surface of the lower jaw, with the exception of the coronoid, articular and angular processes, is entire; the smooth surface near the anterior extremity of the jaw is in bold relief, and slopes away at nearly a right angle from the rougher articular surface of the elongated symphysis. It may be supposed that this symphysial surface, which at once determines the side of the jaw, might be obscured in the plaster cast studied by M. de Blainville, but there is no possibility of mistaking it in the fossil itself; it is long and narrow, and is continued forwards in the same line with the gently convex inferior margin of the jaw, which thus tapers gradually to a pointed anterior extremity, precisely as in the jaws of the *Didelphys* as well as in other *Insectivora*, both of the marsupial and placental series. Its lower margin presents a small but pretty deep notch, which possesses every appearance of a natural structure, and a corresponding but shallower notch is present in the same part of the jaw of the *Myrmecobius*. In the relative length of the symphysis, as in its form and position, the jaw of the *Amphitherium* corresponds with that of the *Didelphys*, *Myrmecobius* and *Gymnurus*. A greater proportion of the convex articular condyle is preserved in this than in the foregoing specimen, and it projects backward to a greater extent. The precise contour of the coronoid process is not so neatly defined in this as in the first specimen of *Amphitherium*, but sufficient remains to show that it had the same height and width.

The exposed surface of the coronoid process is slightly convex. The surface of the ascending ramus of the jaw is entire above the angle, whence we may conclude that if the process from the latter part had been continued directly backwards, it would also have been entire; but the extremity of the angular process is broken off, proving it to have originally inclined inwards or towards the observer: as, however, the greater part of the angle is entire, it could not have been inflected to the same extent as in the *Didelphys*, *Dasyurus*, or the *Phascolotherium* next to be described. A groove is extended from the lower end of the articular condyle forward to the orifice of the canal for the dental artery, where it divides; the upper branch terminates in the dental orifice, the lower and larger division is continued forward near the lower margin of the jaw, and is gradually filled up half way towards the symphysis: this smooth vascular groove has no resemblance to an articular fissure. There is a broader and shorter groove in the corresponding part of the jaw of the *Myrmecobius*; and a narrower groove in that of the Wombat. The alveolar wall of the posterior grinders makes a convex projection, characteristic of the inner surface of the ramus of the lower jaw. The posterior grinder in the present jaw is fortunately more complete than in the first example, and shows a small, middle, internal cusp, with part of a large external cusp, both projecting from the crown of the tooth in nearly the same transverse line. The enamel covering the internal cusp, which is vertically fractured, is beautifully distinct from the ivory, and considerably thicker in proportion to the size of the tooth than is the enamel or its analogue in the teeth of any species of reptile, recent or fossil. The six molars anterior to the one in place, are broken off close to the sockets; both the fifth and fourth false molars are entire: the anterior cusp presents the same superior size as in the first specimen. The thick external enamel, and the silky, iridescent lustre of the compact ivory, are beautifully shown in these teeth. The third and second grinders are more fractured than in the first specimen, but sufficient remains to show that they possess the same form and relative size; but the most interesting evidence as regards the teeth, which the present jaw affords, is the existence of the sockets of not less than seven teeth, anterior to those above described. Of these sockets the four anterior ones are small and simple, like those of the mole, being more equal in their size and interspaces than in the *Didelphys*. The fifth socket contained a small premolar with double fangs, and so likewise did the sixth and seventh sockets. Thus the two false molars, with perfect crowns in the present specimen, are the eighth and ninth teeth, counting backwards, or the fourth and fifth of their class, viz. premolares or false molars. This fossil, therefore, gives evidence that the dental formula of the *Amphitherium* must have included thirty-two teeth in the lower jaw (sixteen on each side); that these, instead of presenting an uniform, compressed, tricuspid structure and being all of one kind, were divided into three series as regards their form: five, if not six, of the posterior teeth are quinque-cuspidate, and must be regarded as *molares veri*. Some of the *molares spurii* are tricuspid and some bicuspid, as in the opossums; but these are six, if not seven in number. Anterior to the molars are four simple teeth, of which the fourth may be regarded as the representative of the canine, and the anterior three as incisors. Thus the *Amphitherium* differs considerably from the genus *Didelphys* in the number of its teeth. Indeed at the time when Cuvier wrote respecting it, believing it to have had ten molars, no mammiferous ferine quadruped was known to possess a greater number of these teeth than the Chrysochlore, which has nine molars on each side of the upper jaw, and eight molars on each side of the lower jaw. The Chrysochlore, however, is not the only mammal in which the molars exceed the number usually found in the unguiculate Mammalia. The marsupial genus, *Myrmecobius*, has nine molars on each side of the lower jaw, besides one small canine and three conical incisors.

The teeth of *Amphitherium*, moreover, differ from those of *Didelphys* not only in number but also in size, being relatively smaller. The teeth of *Myrmecobius*, besides their approximation in number to those of *Amphitherium*, resemble them in their small relative size more than do those of *Didelphys*, but they are still smaller than in *Amphitherium*, which in this respect, as well as in the structure of the teeth, appears to hold an intermediate position between *Didelphys* and *Myrmecobius*. The *Didelphys Prevostii* being evidently, as Cuvier states, a distinct genus from *Didelphys* properly so called, a distinct generic name was no doubt desirable for it, and the term *Amphitherium* fulfils all the requisite conditions. In my memoir of 1838 I ventured to observe in reference to the new name proposed by M. Valenciennes, that it would have been more prudent to have chosen one less descriptive than *Thylacotherium*, since the affinities of the fossil insectivore to the marsupial order were indicated only with a certain degree of probability, and required further evidence before the desired demonstration could be attained. But the determination of the particular *order* of mammals to which the fossils in question belonged, was a matter of very inferior importance to the discovery of the *class* of vertebrate animals in which it ought to rank. In reference to this point the evidence afforded by the two jaws above described, decisively proves, in my opinion, that they belong to a true, warm-blooded, mammiferous species, referrible also to the higher or unguiculate division of the class Mammalia, and to an insectivorous genus; with a probability of the marsupial character of such genus.

The probability entertained in 1838, and supported by the degree of resemblance between *Amphitherium* and *Myrmecobius* in the number and form of the molar series of teeth, has since been diminished, if not destroyed, by the discovery of the right ramus of a lower jaw, presenting its external surface to the observer, and in which the angular process is shown not to have extended inwards. This jaw, now in the possession of Prof. Buckland, contains the whole series of twelve molar teeth, the last six being quinque-cuspidate; the six anterior ones uni-cuspidate, with one or two small basal accessory cusps; one small canine and three small incisors; altogether amounting to sixteen teeth on each side of the lower jaw, as indicated by the sockets of the second specimen above described. The convex condyle, the broad and high coronoid process, the projecting angle, the varied kinds and double-rooted implantation of the teeth, all unequivocally displayed in this fossil, establish the conclusions which I had deduced from the foregoing fossils, of the existence of a small insectivorous mammal during the oolitic epoch; and turn the scale in favour of the placental affinities of this ancient insectivore, for which, therefore, I shall retain the generic name *Amphitherium*, in preference to the later one of *Thylacotherium*, proposed by M. Valenciennes. Other fossils, also portions of the lower jaw, establish the existence of small Mammalia in the oolitic slate of Stonesfield; but they present more decided characters of the marsupial order, and will be, therefore, noticed after a survey of the fossils belonging to the larger placental Carnivora.

Ursidæ.

In regard to the larger extinct carnivorous quadrupeds, the remains of which are dispersed in the superficial drift or diluvial gravel, but are more especially accumulated in caves, it has been proved, chiefly by the researches of Dr. Buckland, that England differs very remarkably from the rest of Europe in the small number of its ancient bears as compared with the hyænas; the proportionate numbers of *Ursus spelæus* and *Hyæna spelæa* being reversed in the island and on the continent. How far this difference may be taken as an indication of some geographical separation having existed at the remote period of these beasts of prey, analogous to that which now divides us from the continent, may be worthy of closer inquiry; but the facts in regard to the Carnivora in question are indisputable.

I shall first indicate the chief localities of Ursine remains in this country, and then enter upon the question of their specific characters and relations.

The tusk of a bear, equalling in size that of the *Ursus spelæus*, has been discovered in the celebrated hyæna-cave at Kirkdale in Yorkshire. The solitary character of this specimen is made more remarkable by the fact of the incalculable numbers of hyænas' teeth which have been discovered in the same cavern. The size of the *Ursus spelæus* must be regarded as one of its striking and remarkable characters, but if this character were not associated with modifications of the osseous and dental structures, it might only indicate that the brown bear of Europe was a degenerate descendant of the same species, as M. de Blainville has recently endeavoured to show. The difficulties which oppose themselves to the view of the specific identity of the great cave bear and the existing European bears, I shall point out after noticing other localities in which the *Ursus spelæus* of Cuvier have been found in this country.

In the cave at Paviland, in the lofty limestone cliff facing the sea on the coast of Glamorganshire, the following parts of a large species of bear are enumerated by Dr. Buckland:—Many molar teeth, two canines; the symphysial end of two lower jaws, exhibiting the sockets of the incisor teeth and of the canines; the latter are more than three inches deep; a humerus nearly entire; many vertebræ, two ossa calcis; metacarpal and metatarsal bones.

At Oreston, on the coast of Devonshire, several caverns or cavernous fissures were discovered during the quarrying of the limestone rock for the construction of the breakwater at Plymouth. The first of these, described in the Philosophical Transactions for 1817, contained the bones of a species of *Rhinoceros*; in the second, a smaller cavern distant one hundred and twenty yards from the former, and described in the Philosophical Transactions for 1821, were found, associated with the tooth of a rhinoceros and parts of a deer, some teeth and bones of a large species of *Ursus*.

The fossils referable to the bear here discovered, include a canine tooth, left side, lower jaw; a canine tooth, left side, upper jaw; the penultimate grinder, right side, upper jaw; the penultimate grinder, left side, lower jaw; a portion of the sacrum; portions of two tibiæ; a portion of the ulna; a portion of the femur.

The richest cave-depository of the fossil bones of bears hitherto found in England is that called Kent's Hole, near Torquay. The natural history, with a special account of the organic riches of this cave, will be given in the second volume of the 'Reliquiæ Diluvianæ,' which Dr. Buckland is now preparing for the press. It is to the assiduous researches of the late Rev. Mr. Mac Enery that the discovery of the various and interesting fossils of this cave is principally due, and some of the rarest and most valuable of this gentleman's collection have been lately acquired by the British Museum. Among the Ursine fossils meriting especial notice, are portions of the skull and teeth of the *Ursus spelæus*, some of the latter equalling in size the largest specimens from the German caverns.

The anterior portion of a lower jaw, including the anchylosed symphysis, with two enormous canines, is likewise remarkable from the circumstance of its retaining a small and simple-fanged premolar in the interspace or diastema between the canines and the double-fanged molars.

A second interesting fossil is a large proportion of the lower jaw, including the symphysis and the whole dental series of each ramus; the sockets of two small simple-fanged premolars are visible in the diastema above described; one close to the canine, the other, less completely preserved, near the first double-fanged molar.

Amongst the bones of the trunk and extremities there occur remarkable examples of diseased action; a lumbar vertebra, for example, presents extensive exostosis from the under part and sides of the body; the distal extremity of the radius exhibits an oblique fracture of that bone, in the attempt to heal which a new and irregular ossific mass has been deposited on the surface of the bone. Several bones and teeth of the Bear from Kent's Hole exhibit very decided marks of having been gnawed, most probably by a hyæna. One of the fragments of the lower jaw of a young Bear shows the same interesting transitional state of dentition as has been discovered in fossils from the continental bear-caves.

The drift or diluvial deposits in several localities of England have yielded remains of large carnivorous quadrupeds, and among these of the Bear.

In the valley of the Thames this deposit affords considerable quantities of brick-earth, and in working this material at Grays in Essex, and also at Whitstable, remains of a large species of *Ursus* have been discovered.

An entire skull and portions of the upper and lower jaws of a bear have been discovered in Manea Fen, Cambridgeshire, five feet below the surface. The skull forms part of the collection of Professor Sedgwick: the portions of the jaws are in the possession of Sir P. de M. Grey Egerton, Bart.

These, though belonging to a genus extinct in Great Britain, can scarcely be considered as fossil bones, and they are included in the present report, rather as satisfactory objects of comparison with the remains of Bears from the caverns and drift formations.

I proceed now to inquire into the relations which the Bears, formerly inhabitants of this island, have to the existing species in Europe or other parts of the world;—an inquiry which the recent doubts published by M. de Blainville as to the real nature of the specific differences pointed out by Cuvier between the Cave Bears (*Ursus spelæus*, *U. priscus*, &c.) and the existing species render more necessary.

For this purpose I have critically compared most of our British fossils with specimens from the German caverns, in the museums of this country, and with the skeletons of the largest existing species, as the *Ursus ferox*, *U. maritimus*, *arctos*, &c.

Cranium.—John Hunter, who first instituted an anatomical comparison between the Cave Bears and those of the present period, selected the great Polar Bear for this purpose, as being the largest existing species with which he was acquainted. Hunter, however, restricts himself to pointing out the difference in the proportion of length to breadth in the skull of an old White Bear and in that of the great Cave Bear: the individual skulls which he compared are still preserved in juxtaposition in the Museum of the College of Surgeons, as they were left by Hunter when removed by death from this the latest field of his extensive and various researches.

This difference in the proportions of the skull, though one of the most striking between the fossil and recent species of Bears, is not the only one. The last molar tooth of the upper jaw in the White Bear has a smaller antero-posterior diameter, and a narrower posterior termination. The interspace between the antepenultimate molar and the canine tooth presents the remains of two sockets, one near the molar, the other near the canine, which in young full-grown Polar Bears contain small and simple-fanged premolars. The youngest specimens of Cave Bear which I have seen, exhibit no trace of either of these small premolars, or of their sockets: they doubtless existed in the fœtus, but normally were very soon lost; the exceptions are extremely few in which their traces are visible in the jaws of full-grown Cave Bears. The posterior palatal foramina are situated opposite the middle of the last molar tooth in all the skulls of the White Bear examined by me, but opposite the interspace between the penultimate and last molars in the skulls of the Cave Bear. The zygomatic arches are wider and shorter, and the base of the zygomatic process behind the glenoid cavity is more horizontal in the White Bear than in the Cave Bear. The Grisly Bear (*Ursus ferox*),—a larger species than the White Bear, and unknown to Hunter,—agrees with the Cave Bear in the great proportional size of the last molar tooth, but the interspace between the antepenultimate grinder and the canine is relatively less than in either the Cave Bear (*U. spelæus*) or White Bear (*U. maritimus*), and it contains two small and simple premolars in specimens, which from the worn state of the molar teeth have belonged to older individuals than those to which the skulls of the Cave Bear have belonged, which present no trace of premolars.

The lower jaw of the *Ursus spelæus* differs from that of the *Ursus ferox* in the greater breadth of the posterior molar as compared with its length, and in the greater convexity of the inferior contour of the ramus of the jaw, in which latter circumstance it differs, though in a somewhat less degree, from the Black Bear of Europe (*Ursus arctos*).

The lower jaw of the Grisly Bear, in differing by the larger size of its molar teeth, especially of the last molar from the Polar Bear, in the same degree differs less from the *Ursus spelæus*.

The Ursine remains from the Paviland Cavern, and some of those from Kent's Hole, are unquestionably identical with the *Ursus spelæus*.

To this species, also, I should refer, on account of the size of the canines and the extent of the diastema between these and the large molars, the anterior part of the lower jaw from Kent's Hole; notwithstanding the presence of a small simple-fanged premolar in that diastema: since a few exceptional instances have occurred of the persistence of these teeth in lower jaws of the *Ursus spelæus* from the German and Belgian caverns.

The fossil humerus from Kent's Hole likewise manifests all the characters of that of the *Ursus spelæus*; characters which appear to me to be as well marked as those which can be pointed out as distinguishing the same bones in any other two species of one genus.

Cuvier, as is well known, conceived that he had met with two very distinct forms of the humerus, belonging to equally gigantic extinct species of Cave Bears.

" On trouve deux sortes d'humérus, tous deux appartenant à des ours, et cependant fort différens l'un de l'autre, John Hunter les a déjà représentés (Phil. Trans. 1794, pl. xx.); mais depuis on n'a insisté dans aucun ouvrage sur leur différence. La deuxième sorte d'humérus de ces cavernes, pl. xxv. fig. 4, 5, 6, et 7, m'est comme par un échantillon bien entier que notre Muséum possède, par la gravure de Hunter, et par le dessin que je dois à feu Adrien Camper d'une portion qui en comprenoit les trois quarts inférieurs. Elle diffère éminemment de la précédente par un trou percé au dessus du condyle interne pour le passage de l'artère cubitale. (*Voy. a*, fig. 4 et 5)."—*Ossemens Fossiles*, 4to. 1823, tom. iv. p. 362.

Whatever may be deemed the value of the character of the perforation of the inner condyle, I can affirm that it derives no accession from the other differences manifested by the figure in Hunter's memoir, which Cuvier supposed to be of a fossil Bear; that figure having been, in fact, taken from the humerus of an old Polar Bear, inserted in the plate (pl. xx. Phil. Trans. 1794.), and placed above the figure of the fossil humerus in order to illustrate the differences between the recent and fossil species. The bone of the Polar Bear was placed by Hunter in the same drawer with two humeri of the Cave Bear from Gailenreuth, which it exceeds in size, and which are the identical specimens alluded to in the following passage of Hunter's Memoir:—" These are two ossa humeri rather of less size than those of the recent White Bear." Hunter does not allude to any other differences, probably intending these to be illustrated by the figures. These, in fact, show that the humerus of the White Bear is broader at both extremities, and thicker in proportion to its length. The supinator ridge forms an angle instead of being continued downwards in a gentle convex curve; the internal condyle is much thicker and stronger, where it bounds the olecranal cavity, and it extends inwards to a greater distance from the articular surface; the deltoidal ridge reaches lower down in the White Bear; the antero-posterior diameter of the proximal third part of the bone of the White Bear exceeds in a marked degree that of the extinct species.

The decease of Hunter took place before the printing of his observations on the fossil cave-bones, and the individual to whom the task of superintending the printing was entrusted, described both the figures of the humeri in the Plate, as belonging to the fossil species. Cuvier, who did not perceive the resemblance of the upper figure to the humerus of the White Bear, and who therefore did not recognise the mistake, avails himself of it to illustrate his opinions respecting the specific distinction of his *Ursi spelæus et Arctoideus*.

Cuvier, in fact, possessed a humerus of one of the great Cave Bears, the internal condyle of which was perforated, as in the feline tribe, whilst other humeri were imperforate, and corresponded with the lower figure in Hunter's plate. But the perforated fossil humerus figured by Cuvier differs from that of the White Bear in the shorter deltoid ridge, the narrower proximal and distal extremities, the convex outline of the supinator ridge, and the inferior production of the inner condyle; in short in all those characters by which the imperforate fossil humerus has been shown above to differ from that of the White Bear. Not any of the three fossil humeri in the Hunterian Collection have the perforation of the internal condyle; and amongst the extremely numerous humeri that have since been obtained from the bone-caves of Germany, not any have been found to present the perforation which Cuvier regards as the specific character of this bone in the *Ursus spelæus*; it is most probably therefore, as Professor de Blainville conjectures, an accidental anomaly. But the differential characters which both the imperforate and perforate humeri of the great Cave Bear present, when compared with those of any recent species, cannot be reconciled by the hypothesis that these are merely degenerated descendants of the *Ursus spelæus*.

The humerus from Kent's Hole presents all the characters of that of the *Ursus spelæus* above described.

Ulna.—The ulna of the Cave Bear (*Ursus spelæus*), compared with one of the same length from the Polar Bear, is less straight, being more convex towards the radius; is thicker, particularly at the anterior part of the shaft; the ridge on the outside of the distal end of the bone is more produced; the styloid process is more pointed; and the concavity on the inner side of the proximal articular surface is deeper.

The ulna from Kent's Hole agrees with that of the *Ursus spelæus* from the German caves.

The difference between the femur of the *Ursus spelæus* and the femur of *Ursus arctos* or *ferox*, is analogous to that which has been pointed out in the humeri; the femur of the Grisly Bear being broader in proportion to its length, especially at its two extremities: it is owing to this breadth that the lesser trochanter is thrown wholly to the posterior surface of the bone, the inner margin being continued beyond it, whilst in the Cave Bear the lesser trochanter, though on the posterior surface of the bone, projects a little beyond the inner margin. At the distal end of the bone the tuberosity above the internal condyle, corresponding with that in the humerus, is larger and more prominent in the Grisly than in the Cave Bear; the same difference in the position of the lesser trochanter is presented by the White Bear as compared with the Cave Bear, and the extremities of the bone are relatively broader.

I have not been able to detect any other well-marked modification of form in the remaining bones of the extremities of the *Ursus spelæus*, but the coincidence of such appreciable modifications in the femur, ulna, humerus, with those in the form and proportions of the head, and in the form and the relative size of certain teeth, seem to offer as good grounds for the specific distinction of the *Ursus spelæus* as for that of the *Ursus maritimus*, or any other existing species proposed by Pallas and Cuvier, and admitted by the best modern zoologists.

The question which the Palæontologist ought to propose to himself in his first survey of the fossils of any particular district, is the value of the distinctive characters which such remains may present, as compared with those which distinguish species, according to the zoological systems and principles of the time being. For if he disregard or suppress such differential characters in the fossils, because the limits of variation by the influence of time and surrounding circumstances may not be determined, he rejects one of the valuable means whereby the ultimate resolution of such higher and more general questions in zoology may be effected.

To refuse to recognise such differences as have been pointed out in the skeleton of the great Cave Bear, because they may be possibly or hypothetically accounted for by degeneration of the specific type, and thereupon to record the fossil species as the primæval *Ursus arctos*, seems a voluntary abandonment of the most valuable instrument in all ulterior inquiries.

Observation has well determined the extent of modification which the skull of a carnivorous species may undergo according to age, to sex, to the free or the constrained exercise of its destructive weapons; and the relative size of the intermuscular crests, the relative strength of the zygomatic arches and the proportions of the canines to the other teeth are well known to vary within certain limits.

But in the *Ursus spelæus* we have to account for the greater relative size and complexity of certain molar teeth; for the more extended diastemata, accompanying more lengthened jaws; for a premature loss of certain teeth and their sockets, without any predominating development of neighbouring canines to account for it; for narrower zygomata, with longer and higher parietal crests; for large frontal sinuses impressing a striking and readily recognisable feature upon the skull.

It has been endeavoured to explain the last-cited modification, by asserting that the primæval Bears had their frontal sinuses more developed in virtue of their respiring a fresher, drier, and more invigorating atmosphere than their less fortunate and degenerated descendants*. But we may question whether the flat-headed *Ursus ferox* has a less exposed locality or breathes a more humid and impure atmosphere on the rocky mountains of North America, than did the old Cave Bears of the German and British forests; and we may more than doubt that the cold and bracing sea-breezes inhaled by the still flatter-headed Polar Bear, should be less efficient in expanding the sinuses along the respiratory tract, than the musty air of the sepulchral retreats in which the Cave Bears slept.

Existing species of Bears, reckoned distinct by modern zoologists, do in fact differ in the relative convexity of their forehead, and the flat-headed species, as the Polar and American Bears, are unquestionably not those which habitually respire the least pure and invigorating air. Instead of speculating

* "L'intensité même de l'acte respiratoire dans les lieux plus découverts, ou l'air est plus vif, plus sec, plus frais, développe tous les sinus qui se trouvent sur le trajêt de l'air, et, des-lors, les frontaux sont dans ce cas aussi bien que tous ceux qui entourent les fosses nasales; des-lors aussi, par l'écartement des deux lames de l'os, le gonflement des fosses frontales, indépendantes et separées par un sillon."—De Blainville, *Osteogr.*, p. 36.

on the atmosphere as a physical cause of the inflation of the bony cells, it would be more profitable, if it were possible, to trace the relationship between the different degrees of development which the frontal sinuses may present in different species of Bears, and their peculiar habits and modes of life. We may thus, I think, see the reason why, in the piscivorous species of the Polar ice, the receptacles of air in the bones of the head are least developed, viz. to offer least resistance to its progress through the water when diving after its prey.

The opposite extreme in the condition of the frontal sinuses of the *Ursus spelæus*, may have had some corresponding relation to the habits of that gigantic extinct species.

From the great proportional size and more complicated tubercular surface of the posterior molar teeth, especially in the upper jaw, and from the greater complication on the crown of the smallest persistent molar in the lower jaw, one might be led to suppose that the *Ursus spelæus* fed more on vegetables than the Grisly Bear does.

If this were the case, one might infer from the slight traces of abrasion in the teeth of full-grown specimens, that the vegetable food, in whatever proportion it entered into their diet, was of a soft nature, as berries, or tender twigs or sprouts. The size and strength of the *Ursus spelæus* would, however, enable it to cope with the large Ruminants and ordinary Pachyderms, its contemporaries in ancient Britain and on the Continent, and to successfully defend itself against the large Lion or Tiger, whose remains have been found in the same caverns.

I proceed next to speak of other species of *Ursus*, of which the fossil remains have been found in the caves and superficial deposits in this country.

A large proportion of a lower jaw, with the incisors, canines, and the entire series of molar teeth on both sides, from Kent's Hole, corresponds with the jaw of the *Ursus priscus*, Goldfuss. The size is much inferior to that of the *Ursus spelæus*; while the worn surface of the teeth proves the animal to have been mature, and probably aged.

The socket of the first fangless small premolar is immediately behind the canine, and a trace of the socket of a similar premolar is visible near the first double-fanged molar. The interspace containing the simple sockets of the two small premolars is relatively longer than in the Brown Bear or White Bear. The last true molar is relatively smaller than in the *Ursus spelæus*.

The Oreston Ursine fossils appear to me to be referable also to the *Ursus priscus*.

The most remarkable fossils of the Ursine family which have been found in this country, are those of the *Ursus cultridens*, or at least of a species closely allied to that from Auvergne and the Val d'Arno; the singularly compressed and serrated canines of which suggested to Cuvier the specific name above quoted. The evidence of this species, since made the type of a distinct sub-genus under the names of *Machairodus* and *Stenodon*, which British localities have afforded, consists of detached canine teeth found in Kent's Hole. These are larger and broader in proportion to their thickness, and have shorter fangs than the Auvergne tooth figured in the 'Osteography' of M. de Blainville.

The crown of one of the canines of the *Ursus cultridens*, from Kent's Hole, measures $2\frac{1}{2}$ inches; the fang of a second canine, with the apex of the canine worn down, is $2\frac{1}{3}$ inches in length; the breadth of the base of the crown is 1 inch 2 lines; its thickness half an inch.

The oldest fossil referable to the genus *Ursus* which I have yet seen, is the crown of a molar tooth, found associated with remains of a large species of

Felis in the red crag, below the so-called mammaliferous crag near Woodbridge, Suffolk; the Ursine fossil in qnestion is the antepenultimate grinder of the right side, upper jaw; it is smaller than the corresponding tooth in the *Ursus spelæus.*

The most recent remains of the Bear which can claim to be included in the present Report, are those already mentioned, which have been discovered about five feet below the surface in the Manea Fen, Cambridgeshire.

Sir Philip Egerton possesses a fine example of the right superior maxillary and intermaxillary bone of the Bear from this locality.

The jaw nearly equals in size that of the *Ursus spelæus,* but differs in the much shorter interspace between the canine and the third molar tooth, counting from behind forwards; likewise in having this interspace occupied by two small and simple-fanged false molars. The crown of the penultimate grinder is broader in proportion to its length or antero-posterior diameter. The difference in regard to the presence of the two first false molars must be allowed due weight, since the present Fen Bear has its grinders much worn, whilst the Cave Bear, with which it is compared, is a younger but full-grown specimen, with the tubercles of the grinding teeth entire, and the last molar tooth of the Fen Bear has a narrower posterior termination than in the Cave Bear. The Fen Bear differs also from the *Ursus priscus,* which retains the two first false molars, by their being in contact, which results from the narrower interspace between the canine and the third false molar, which interspace is relatively as wide in the *Ursus priscus* as in the *Ursus spelæus*; and a great proportion of this interspace divides the first from the second false molar in the *Ursus priscus.* This likewise cannot be a difference dependent on age or sex, for the jaw of the Fen Bear here described belonged to an individual absolutely larger than the *Ursus priscus,* with which it is compared; and, judging from the size of the canine incisor teeth, the Fen Bear was probably an old male. The grinding surface of the molars prove it to have been a much older individual than the *Ursus priscus* with which it is compared, and to have attained that age when no difference could be expected to take place in the length of the interspaces of any of the teeth. In all the characters in which the upper jaw of the Fen Bear differs from that of the two species of Cave Bear with which it has been compared, it agrees with the *Ursus arctos,* especially the Black, or Norwegian variety.

In the museum of Prof. Sedgwick at Cambridge there is an entire cranium of the same species of Bear from the Manea Fen, which enables us to extend the comparison of this ancient British species with those still existing in Europe. In regard to which it may be observed that the cranium of the Manea Fen Bear in its less convex forehead, and the length of the sagittal crest, which commences at a greater distance, in front of the occiput, resembles the black variety of *Ursus arctos* more than it does the Brown Bear.

As it may serve to further elucidate the characters of the Cave Bears (*Ursi spelæus et priscus*), as well as those of the *Ursus arctos,* of which I regard the specimens under consideration to be a variety, I shall add a few observations arising out of the comparison of the lower jaw of the Fen Bear. The specimen, which is in the collection of Sir Philip Egerton, consists of the left ramus of the lower jaw, from Manea Fen, Cambridgeshire. It equals in length the largest specimen of the lower jaw of the *Ursus spelæus,* but differs from that species in the more simple form of the last spurious molar, or the fourth grinder counting from behind forwards; for, whereas the Cave Bear has two distinct cusps developed upon that tooth, in the present species there is only one cusp, as in the Black, Brown and White Bears. The Bear of the Fen also differs from the *Ursus spelæus* in the shorter interspace between the last-described molar and the canine, even when compared with the lower jaw of a Cave Bear absolutely shorter. The preceding interspace in the Fen Bear contains the sockets of two small spurious molars, each with a simple fang, but there is no trace of these in the Cave Bear, save in very rare exceptions; and this difference cannot be the effect of age, because the lower jaw of the Fen Bear, which has the grinders moderately worn by mastication, is here compared with the jaw of a young and small *Ursus spelæus,* in which the tubercles of the grinding teeth are all entire. The Fen Bear resembles the *Ursus priscus* in so far as the latter retains the first false molar, but differs in possessing the second, which is wanting in a younger specimen of the *Ursus priscus*; it differs also in the greater extent of the interspace between the canine and the third false molar; and, more importantly, in the form of that tooth, which in the *Ursus priscus* presents a second cusp on the inner side, and a little behind the first, which is wholly wanting in the Fen Bear. The ramus of the jaw is deeper, and the slope of the symphysis is more gradual. In all the particulars in which the Fen Bear differs from the two extinct species above cited, from the caverns, it agrees with the existing Black Bears of Europe, from which it does not appear to differ in any well-marked specific character. The Grisly Bear of North America agrees with the Cave Bear in the absence of the first two false molars and in the more complicated crown of the third false molar of the lower jaw.

Subgenus *Meles.*

Fossil remains of the Badger (*Meles vulgaris*) have not been discovered in British strata more ancient than the diluvium. They offer no characters distinguishable from those of the existing species: the comparison supporting this conclusion has been made on the right branch of the lower jaw, with the entire series of teeth, of the fossil Badger, from Kent's Hole, Torquay.

Remains of the Badger have been found fossil in the cave at Berry Head, Devon.

Genus *Putorius.*

Remains of a species of Weasel, not to be distinguished from the bones of the *Putorius vulgaris,* have been obtained from the bone-cave at Kirkdale, and from Kent's Hole, near Torquay. The collection of the late Mr. Mac Enery contained a nearly entire skull, having all the characters of that of the common Weasel, but evidently a contemporary with the Cave Bears and Hyænas, now extinct.

Remains of a somewhat larger species of *Putorius,* probably *Put. Ermineus,* have been discovered in the bone-cave at Berry Head.

A cranium stained red and absorbent from the loss of animal matter, of the size and conformation of that of the *Putorius Furo,* was obtained, with other fossils, from one of the raised beaches at Plymouth.

Genus *Canis.*

Amongst the fossils referable to the Wolf (*Canis lupus*) which have been discovered, associated with those of the Hyæna and Bear in most of the bone-caves of England, as at Kirkdale, at Paviland, at Oreston, in Kent's Hole, in the Mendip caverns, &c., the most remarkable is an almost entire skull, discovered in Kent's Hole. This does not exceed in size the skull of a fine male Arctic Wolf, but the penultimate molar is a little larger, and the lower border of the jaw rather more convex.

Remains of a smaller species of *Canis,* not distinguishable from those of the Fox (*Canis vulpes*), have been found in Kirkdale (a calcaneum and many teeth); at Oreston (teeth and bones of the extremities); and in Kent's Hole (an entire left ramus of the lower jaw, with other less perfect and instructive specimens).

Genus *Hyæna*.

In regard to the extinct British species of the genus *Hyæna*, little remains to be added to the accurate and graphic history of these Ossivora contained in the 'Reliquiæ Diluvianæ' of Dr. Buckland.

Besides the cave at Kirkland, in which the abundance of Hyænas' teeth and bones is so extraordinary, the remains of the same species of Hyæna have been found in the caverns at Oreston, at Paviland, at Kent's Hole, and in the Mendips.

The ancient British Hyæna resembles more closely the *Hyæna crocuta* of South Africa than the *Hyæna vulgaris* of North Africa and Asia Minor: it differs however from the Cape Hyæna in the smaller interspace between the occipital condyle and the mastoid process; and in the greater relative depth of the posterior plate of the glenoid cavity for the lower jaw. In the spotted Hyæna the anterior and internal tubercle of the penultimate molar (upper jaw) is relatively larger, and the small posterior molar is a little further removed from the penultimate one. The posterior ridge of the second molar tooth of the lower jaw is relatively broader in the fossil than in the recent Hyæna; the first molar lower jaw is also relatively larger, especially in its posterior division, and it is nearer the canine in the fossil Hyæna. The numbers of the *Hyæna spelæa* in England may be conceived, when the remains of not fewer than from 200 to 300 have been discovered in a single cavern, as that at Kirby Moorside.

Fossil Hyænas have been shown by Dr. Buckland to be found in this country, as on the Continent, in situations of two kinds, viz. caverns and drift, or the so-called diluvial gravel. In the latter formation they were first discovered in England in the year 1822, at Lawford near Rugby, associated with bones of the Mammoth, Rhinoceros, *Equus, Bos*, &c. The integrity of the Hyæna's under-jaw from this locality presents a remarkable contrast with the uniformly fractured condition of the bones from the caverns, and the explanation of, and deductions from, this difference, given by the author of the 'Reliquiæ Diluvianæ,' are replete with interest.

Genus *Felis*.

The remains of a feline animal surpassing in size the largest existing Lion or Tiger, have been found in the bone-caves of the Mendip Hills, in those at Oreston, at Kirby Moorside, and in Kent's Hole. Of this remarkable species, to which the name of *Felis spelæa* has been given, most of the characteristic bones have been discovered in the caves at Gailenreuth, proving its true feline structure and its large relative size.

The metacarpal bone of a large Felis from the Hyæna-cave at Kirby Moorside does not exceed in size the corresponding bones of the Tiger: it might have belonged to a young individual of the *Felis spelæa*. In a collection of fossil teeth from the red crag of Newbourne near Woodbridge, the genus *Felis* is represented by a posterior molar, belonging to the left side of the lower jaw of a species equal in size to the Leopard. This tooth presented the same mineral condition, and had been subject to the same mechanical attrition as the fossil teeth of an extinct Shark (*Carcharias megalodon*) found along with it.

The lower jaw of a species of *Felis* about the size of the Wild Cat (*Felis catus*) has been found in Kent's Hole.

Genus *Lutra*.

Of this genus I have determined characteristic remains of a species about the size of the common Otter, in the so-called mammaliferous crag at Southwold, and near Aldeburg, Suffolk.

Order Cetacea.

Most of the remains of this order of Mammalia, have been, in Great Britain found in gravel-beds adjacent to estuaries or large rivers, in marine drift or diluvium, and in the subjacent clay-beds: but although these depositories are the most superficial, and belong to the most recent period in geology, the situation of the cetaceous fossils generally indicate a gain of dry land from the sea. Thus the skeleton of a Balænoptera, 72 feet in length, found imbedded in clay on the banks of the Forth, was more than twenty feet above the reach of the highest tide. Several bones of a whale, discovered at Dumore Rock, Stirlingshire, in brick-earth, were nearly forty feet above the present level of the sea. The vertebræ of a whale, discovered by Mr. Richardson in the yellow marl or brick-earth of Herne Bay, in Kent, were situated ten feet above the occasional reach of the sea on that coast. A large vertebra of *Balæna mysticetus* was discovered fifteen feet below the surface, in gravel, by the workmen employed in digging the foundation for the new Temple Church. The teeth of a Cachalot have been discovered by Mr. Brown in the diluvium of Essex. Part of the tusk of a Narwhal (*Monodon*) has been discovered in the London clay; presenting the usual condition of the fossils from that old tertiary stratum.

The most completely petrified remains of this order are a series of anchylosed cervical vertebræ of a large *Delphinus* in the museum of Prof. Sedgwick. Their fossilized condition indicates a higher antiquity than the Cetacean fossils above noticed: they were discovered in Cambridgeshire, but the stratum and locality were unfortunately unknown.

No specimens of herbivorous Cetacea have hitherto been discovered in British strata.

Order Rodentia.

The British fossil remains of species of this order hitherto detected are referable to the genera *Castor* (Beaver), *Arvicola* (Water-vole, Field-vole), *Mus* (Rat and Mouse), and *Lepus* (Hare and Rabbit); which have been found in superficial drift, bogs and fens, (*Castor*), in bone-caves, in the brick-earth deposits, in the mammaliferous crag, and in the subjacent red crag. The ancient Rodents from the last two tertiary formations belong to the genus *Arvicola*. The fossils of the Beaver above noticed agree with the species of the Danube. Besides these, the remains of the great *Castor Trogontherium* have been found in the submarine forest at Bacton.

Order Marsupialia.

Genus *Didelphys*?

In the eocene sand, underlying the London clay, at Kyson near Woodbridge, Sussex, a small portion of jaw, with a spurious molar tooth, has been found. This fossil has been referred to the Opossum (*Didelphys*), but the evidence which it afforded is, in my opinion, insufficient to support that conclusion. There is no tooth so little characteristic, or upon which a determination of the genus could be less safely founded, than one of the spurious molars of the smaller carnivorous and omnivorous *Feræ* and *Marsupialia*. A large, laterally compressed, sharp-pointed middle cone or cusp with a small posterior, and sometimes also a small anterior talon, more or less distinctly developed, is the form common to these teeth in many of the genera of the above orders. It is on this account, and because the tooth of the fossil in question differs in the shape of the middle and size of the accessory cusps from that of any known species of *Didelphys*, that I regard its reference to that genus as premature, and the affinities of the species to which it belongs as needing further evidence before they can be determined beyond the reach of doubt. Mr. Charlesworth, by whom the present fossil was first described and figured, has accurately specified the differences above alluded to in the shape of the crown of the tooth as compared with the false molars of the true Opossums: they are seen in the more equilateral or symmetrical shape of the middle cusp, the greater development of the posterior talon, and the presence of the anterior talon at the base of the middle cusp: the grounds on which his determination of the fossil was founded are not stated.

The crowns of the spurious molars of the placental *Feræ*, which present the same general form as the fossil, are thicker from side to side in proportion to their breadth; the spurious molars of the *Dasyurus*, *Thylacinus*, and *Phascogale*, differ in like manner from the fossil. It is in the marsupial genera *Didelphys* and *Perameles* that the false molars present the same laterally compressed shape as in the fossil. Now besides the perfect tooth, the fossil includes the empty sockets of two other teeth; and the relative position of these sockets places the *Perameles* out of the pale of comparison. On the hypothesis that the present fossil represents a species of *Didelphys*, the tooth *in situ* unquestionably corresponds with the second or middle false molar, right side, lower jaw. This is proved by the size and position of the anterior alveolus.

Had the tooth *in situ* been the one immediately preceding the true molars, the socket anterior to it should have been at least of equal size and in juxtaposition to the one containing the tooth. The anterior socket, however, is little more than half the size of the one in which the tooth is lodged; it is also separated from that socket by an interspace equal to that which separates the first from the second false molar in the *Didelphys Virginiana*. This is well shown in the inside view. In the placental Mammalia, in which the first small false molar is similarly separated by a diastema from the second, the first false molar has only a single fang. In the present fossil, the empty socket of the first false molar proves that the tooth had two fangs, as in the marsupial *Feræ* and *Insectivora*. There is nothing in the size or form of the socket, posterior to the implanted tooth of the fossil, to forbid the supposition that it contained a false molar, resembling the one in place; had it been the socket of a true molar, then the fossil could not have belonged to *Didelphys*, or to any other known marsupial genus, because no known marsupial animal, which presents the posterior false molar of a similar form and in like juxtaposition with the true molars as the tooth in the present fossil (on the supposition that it immediately preceded the true molars), has the next false molar so small as it must have been in the fossil on that supposition.

Upon the whole, the conclusion that the present eocene tertiary fossil is marsupial is the most probable one, but the evidence is insufficient to demonstrate its truth. Cuvier, however, might have failed to convince contemporary naturalists that the corresponding formation in France contained the remains of a *Didelphys*, unless he had had the good fortune to demonstrate the marsupial bones in their natural connections with the pelvis.

Genus *Phascolotherium*.

With regard to the fossil on which the genus *Phascolotherium* is founded, the maxillary evidence is more complete. Two rami of lower jaws, one containing the whole dental series, have been discovered in the oolitic slate at

Stonesfield, associated with the *Amphitherium* described in a preceding section of the Report.

In the Geological Transactions, vol. vi., second series, p. 58, will be found the description and figures of the most complete of these fossils, and the observations in proof of the marsupial affinities of the *Phascolotherium*. It has four true molars, and three, or, at most, four false molars—one canine and three incisors in each ramus of the lower jaw. In the proportionate size of the molars, especially the small size of the hindmost tooth, the *Phascolotherium* resembles the *Myrmecobius* more than the Opossum or Dasyure, but it more resembles the *Thylacine* in the shape of the grinding teeth. It likewise agrees with the *Thylacine* in the low position of the condyle, and in the longitudinal extent of the inwardly inflected angle of the jaw. The close approximation of the *Phascolotherium* to marsupial genera, now confined to New South Wales and Van Diemen's Land, leads us to reflect upon the interesting correspondence between other organic remains of the British oolite and the existing forms now confined to the Australian continent and neighbouring seas. Here, for example, the *Cestracion* swims which has given the key to the nature of the "palates" from the oolite, now known as teeth of congeneric gigantic forms of cartilaginous fishes. Living *Trigoniæ* and *Terebratulæ* abound in the Australian seas, and afford food to the *Cestracion*, as their extinct analogues probably did to the *Acrodi*, *Psammodi*, &c. of the oolitic period. Araucariæ and cycadeous plants flourish on the Australian continent, where marsupial quadrupeds abound, and thus appear to complete a picture of an ancient condition of the earth's surface, which has been superseded in our hemisphere by other strata and a higher type of mammiferous organization.

Addendum to Report on British Fossil Mammalia, Part I.

Since the printing of the first part of the above Report, I have, in the course of an investigation of the mammalian fossils of Essex and Norfolk, examined the skeleton "combining a dentition like that of the ruminants, with, apparently, a divided metacarpus and metatarsus," and alluded to at p. 57, in reference to the stratum containing the remains of a mole.

The bones placed in the position of the metacarpus and metatarsus, and so described in Mr. Green's work*, do not belong to the same animal as the jaws and the rest of the skeleton: one of the so-called metatarsals is the tibia of a quadruped about the size of a hare, the other is a shorter bone, with a wide medullary cavity, like the shaft of a femur. The two metacarpals are the un-united divisions of the metatarsal, or cannon-bone, of a very young or fœtal ruminant. A portion of the vertebra dentata, and the distal epiphysis of the right radius of the animal to which the chief part of the skeleton belongs, are placed in the position of the tarsal bones; the distal end of the right femur is placed above the tarsus as the distal end of the left tibia: in short, the parts of the skeleton in question have been artificially and arbitrarily fixed in the position in which they are represented in the plate in Mr. Green's work, and in the drawing originally submitted to me.

The portion of the skull, jaws and teeth, vertebræ, pelvis, scapula, humerus, radius and ulna, femur and tibia, are parts of the same individual, which is a ruminant closely resembling the Roe-deer (*Cervus capreolus*), probably female, arrived at full size, as the dentition proves, but immature, as the state of the epiphyses shows. The bones have lost much of their animal matter, and are of a brown colour.

* Geol. of Bacton, p. 18.

Researches on the Influence of Light on the Germination of Seeds and the Growth of Plants. By Mr. ROBERT HUNT, *Secretary to the Royal Cornwall Polytechnic Society.*

THE British Association having committed to my care this interesting inquiry, to which I had the satisfaction of first drawing attention, I feel it is incumbent on me to furnish to the present meeting some account of the results of my researches, as far as I have proceeded with them. I wish it to be particularly understood, that this communication does not pretend to contain anything, which can fairly be looked upon as pointing to any definite laws, or which can support any theoretical view of the influence of solar light on vegetation. As it was not possible to commence my observations, in series, until January, the short time which has elapsed has not permitted of my varying the conditions under which my experiments have been tried. Had I been enabled to do so, I should in all probability have had it in my power to explain with some approach to correctness, the causes which have operated in the production of some of the effects described, but on which I am scarcely enabled to speculate in the present state of the inquiry. I simply record the facts as they stand, trusting they will prove the singular importance of the subject, which promises to lead us to a clear view of many of the most mysterious functions of plants, to explain some of the most interesting phænomena of vegetable life, and beyond this, to develope properties in light which have not yet been discovered.

Before I proceed to the principal subject of this paper, it is necessary I should particularly describe the arrangements with which I have operated.

Six boxes have been so prepared, that air was freely admitted to the plants within them, without permitting the passage of any light, except that which passed through the coloured glasses with which they were covered.

These glasses permitted the permeation of the rays of light in the following order.

1. A RUBY GLASS, *coloured with Oxide of Gold.*—This glass permits the permeation of the ordinary red, and the extreme red rays only.

2. A BROWN RED GLASS.—The extreme red ray appears shortened; the ordinary red ray, and the orange ray pass freely, above which the spectrum is sharply cut off.

3. ORANGE GLASS.—The spectrum is shortened by the cutting off of the violet, indigo, and a considerable portion of the blue rays. The green ray is nearly absorbed in the yellow, which is considerably elongated. The whole of the least refrangible portion of the spectrum permeates this glass freely.

4. YELLOW GLASS, *somewhat Opalescent.*—This glass shortens the spectrum by cutting off the extreme red ray, and the whole of the most refrangible rays beyond the blue ray.

5. COBALT BLUE GLASS.—The spectrum obtained under this glass is perfect from the extreme limits of the most refrangible rays down to the yellow, which is wanting. The green ray is diminished, forming merely a well-defined line between the blue and the yellow rays. The orange and red rays are partially interrupted.

6. DEEP GREEN GLASS.—The spectrum is cut off below the orange and above the blue rays. Although the space on which the most luminous portion of the spectrum falls appears as large as when it is not subjected to the absorptive influence of the glass, there is a great deficiency of light, and on close examination with a powerful lens, a dark line is seen to occupy the space usually marked by the green ray.

A case has also been prepared containing five flat vessels filled with different coloured fluids. Much delay has been occasioned in the observations with these, owing to the difficulty of securing the contents in the glass cells from leakage and evaporation; the sun, the alkalies, and the acids acting on the cements used to secure them. At length I have procured some very flat flint glass bottles, which answer extremely well; in these the fluids are about an inch thick, and observe the following order in their absorptive actions:—

A. Red. *Solution of Carmine in Supersulphate of Ammonia.*—This gives a spectrum nearly in all respects similar to that given by the ruby glass (1); all the rays above a line drawn through the centre of the space occupied by the orange being cut off.

B. Yellow. *A saturated Solution of Bichromate of Potash.*—This beautifully transparent solution admits the permeation of the red and yellow rays, which are extended over the space occupied by the orange ray in the unabsorbed spectrum. The green rays are scarcely evident.

From the absorptive powers of the sulphurets of lime and potash in solution, I was very desirous of using them, but they were found to be so liable to decomposition when exposed to the sun's rays as to be quite useless for my purposes, sulphuretted hydrogen being liberated in such quantities as to burst the bottles with great violence.

C. Green. *Muriate of Iron and Copper.*—This medium is remarkably transparent; the blue, green, yellow and orange rays pass freely, all the others being absorbed.

D. Blue. *Cupro-sulphate of Ammonia.*—This fluid obliterates all the rays below the green ray, those above it permeating it freely.

E. White.—This is merely water rendered acid by nitric acid, for the purpose of securing its continued transparency. It should be noted that spaces in the cases have been left open to the full influence of the light, that a fair comparison might be made between those plants growing under ordinary circumstances, and the others under the dissevered rays.

It will be seen from the above that the following combinations of rays have been obtained to operate with.

1 and A. The calorific rays, so called, well-insulated.

2. A smaller portion of these rays mixed with a small amount of those having peculiar illuminating powers.

3. The central portion of the solar spectrum well-defined, and all the rays of least refrangibility, thus combining the luminous and calorific rays, so called.

4. The luminous rays mixed with a small portion of those having a calorific influence.

5. The most refrangible rays with a considerable portion of the least so; thus combining the two extremes of chemical action, and affording a good example of the influence of the calorific blended with the chemical spectrum.

6. Some portion of those rays having much illuminating power, with those in which the chemical influence is the weakest under ordinary circumstances. [Some information given me with great kindness by Sir John Herschel shows that this is not a correct expression of the case, as he has discovered some preparations on which these rays act with the greatest intensity.]

B. The luminous rays in a tolerably unmixed state.

C. The luminous rays combined with the least actively chemical ones, as in 6; but in this case the luminous rays exert their whole influence.

D. The most refrangible or chemical rays well-insulated.

E. White light.

Although I have adopted the terms usually employed to designate the divisions of the spectrum, yet it is necessary to bear in mind that these terms are not absolutely correct; Sir John Herschel has shown that the calorific and the luminous spectra are co-extensive with the chemical one; and my own observations have proved that every ray of the prismatic spectrum exerts a decided chemical action, the relative intensities changing with the material upon which it is made to act.

These are matters of the first importance when the peculiar influences of light are to be studied, and it will be apparent from some of the results which I have already obtained, that they demand the most rigorous investigation. When we look on a spectrum which has been subjected to the influence of some absorptive medium, we must not conclude, from the coloured rays which we *see*, that we have cut off all other influences than those which are supposed to belong to those particular colours. Although a blue glass or fluid may appear to absorb all the rays except the most refrangible ones, which have usually been considered as the least calorific of the solar rays; yet it is certain that some principle has permeated the glass or fluid which has a very decided and thermic influence, and so with regard to media of other colours.

The relative temperatures indicated by good thermometers placed behind the glasses and fluid cells, which I have used, will place this in a clear light; the thermometers were carefully compared with a very excellent standard one at the Polytechnic Hall, Falmouth. The following results present a fair average series, and distinctly mark the relative degrees in which these media are permeable by the heating rays:—

GLASSES.

Colour.	Rays not absorbed.	Temperature.
1. Ruby.	Ordinary red, and the extreme red.	87°
2. Red.	Ordinary red, and orange, portion of extreme red.	83°
3. Orange.	Little blue, green, yellow, orange, red, and extreme red.	104°
4. Yellow.	Red, orange, green, and blue.	88°
5. Blue.	Violet, indigo, blue, little green, and some red.	94°
6. Green.	Orange, yellow, green, and blue.	74°

FLUIDS.

A. Red.	Ordinary and extreme red.	78°
B. Yellow.	Ordinary red, and yellow.	80°
C. Green.	Blue, green, yellow, orange.	69°
D. Blue.	Green, blue, indigo, and violet.	73°
E. White.	Green, blue, indigo, and violet.	89°

It will be found that these results are in strict accordance with those obtained by Sir John Herschel. An interesting account of the thermic spectrum, and the manner of obtaining it, will be found in a valuable Memoir, Philosophical Transactions, Part 1 for 1840, page 51. I contemplate a series of similar experiments on light, subjected to the analysing plates or fluids, considering it highly probable that the various *Thermographs* formed may indicate the condition of the calorific rays in a clearer manner than we can expect by the thermometer.

There are some other points on which it is desirable to obtain conclusive experimental evidence, particularly with regard to the absorption or otherwise of the luminous spectrum, by the media through which it passes.

The results obtained with the arrangements I have described are, up to the present time, as follows:—

Bulbous and tuberous rooted flowers (tulips and ranunculuses) were planted in pots, and placed in boxes under the glasses 1, 2, 3, 4, 5, 6.

The first appearance of germination took place with the tulips under the orange glass (3), which was followed in three days by those under the red glass (2), then by those under the ruby glass (1), and next by those under the influence of the yellow (4), blue (5), and green glasses (6). The roots under the orange glass developed the cotyledons a week earlier than those under the yellow, blue, and green glasses. But that the ranunculuses observed the same relative order in germinating, I should have suspected that some peculiarity in the bulbs had influenced the result, although these had been selected with the most scrupulous care, At first the greatest progress was made by the tulips under the yellow (4) and orange glasses (3); but the leaves under each of these were by no means healthy, particularly under the yellow glass (4), which had a singularly delicate appearance, being of a very light green, and covered with a most delicate white bloom.

The leaf-stalks of the tulips shot up remarkably long, and were in both cases white; at length an exceedingly small flower-bud appeared on the plant under the orange glass (3), which perished almost as soon as it appeared, and the death of the plant immediately followed. The tulips under the yellow glass (4) never showed any buds, and their vitality soon failed them. The condition of the ranunculuses was in most respects similar to that of the tulips; they exhibited the same exuberant length of stalk but the leaves were of a more healthful appearance. These plants, however, never showed any flower-buds, and they died nearly about the same time with the tulips.

It may be proper to mention that the garden-pots in which these roots were planted, were filled with a mixture of fine earth, sand, and well-rotted manure from a hot-bed. A few days after their exposure, those under the orange and yellow glasses threw up several fungi, and continued for some days to do so, which was not the case with any of the others.

Under the ruby (1) and red glasses (2), the tulips shot up a *single lobe*, which maintained a little life for three or four weeks, but never rose more than two inches above the soil. There was a marked redness upon this stunted formation, which I often fancied was in some respects characteristic of the kind of medium under which they were placed. The tuberous roots perished in the soil; sufficient moisture and warmth had called into action the latent principle of germination, but being unable to maintain it against the destructive influence of the light, they rotted.

Beneath the green glass (6) the plants grew all of them, slowly but tolerably strong. They were, however, marked by a more extraordinary length of stem than those before mentioned; some of the stems of the ranunculuses being above ten inches in length, having a small leaf at the end not more than two-thirds of an inch in diameter. These plants all show flower-buds, but none of them could be made to flower, notwithstanding the greatest care and attention was bestowed upon them; the effort of throwing up the buds appeared to exhaust their powers, and the whole of these plants soon died.

The results under the blue glass (5) were very different; the roots germinated, I think, a little less quickly than they did in the open ground, forming compact and healthy plants, developing their flower-buds strongly. Most unfortunately the wind on a tempestuous night overturned this box and scattered its contents, preventing of course the formation of the perfect flowers, which but for this accident there can be no doubt would have ensued.

Numerous experiments have been tried with the seeds of mignonette, many varieties of the flowering pea, the common parsley, and cresses; with all of them the results have been similar to those already described. The seeds have germinated, in general, the most rapidly under the red glass (2), and next under the ruby, blue, and orange glasses (1, 3, and 5). Except under the blue glass, these plants have all been marked by the extraordinary length to which the stems of the cotyledons have grown, and the *entire absence of the plumula.* No true leaves forming, the cotyledons soon perish, and the plant dies. Under the green glass (6) the process of germination has been exceedingly slow, and the plants, particularly the cresses and mignonette, have speedily died.

Under the blue glass (5) alone has the process gone on healthfully to the end, and although I have found a few instances of a perfect plant under the yellow glass (4), it has not on any occasion yet endured to the formation of a flower; excepting the plants under the yellow and blue glasses (4 and 5), all have been more or less etiolated.

The most remarkable phænomenon remains to be noticed; under all ordinary circumstances plants bend *towards the light,* whereas those growing under the red glass (2) have invariably *bent from it.*

The experiments with the light analysed by the *fluid media,* have been in every respect confirmatory of the results I originally obtained, which were published more than two years since in the Philosophical Magazine. Germination has been in *nearly all* cases prevented by the absorptive powers of yellow and red fluids (A and B). I say in nearly all cases, as I have within the last few weeks, since the sun has shone with more than usual fervour, noticed a few symptoms of weak germination under the yellow fluid (B). It will be seen by reference to my paper above referred to, that I suspected the difference in the results obtained by Professor Draper and myself, arose from some peculiar difference between the condition of the rays of the sun in Virginia and in England. The above fact confirms me in this opinion. The absorptive powers of the atmosphere I have no doubt are constantly changing, not merely with regard to its influence on the solar beam, but varying as it regards particular rays; and I think it will be found that the condition of the prismatic spectrum is not on all occasions the same. I believe Sir David Brewster has proved this to be the case; I am not, however, acquainted with the facts.

Under the green medium (C) the cotyledons only have been formed, and these have all been etiolated.

A very large wooden case was perforated with four small holes, two within a few inches of each other, on either side of the front of the box, one pair being about three feet from the other. These holes were covered with coloured glasses, red (2), yellow (3), blue (5), green (6); thus arranged it was turned over on the ground, several potatoes having been planted close to the back of the box, at the greatest possible distance from the holes through which alone light was admitted.

The red and yellow glasses were at one end, and the blue and green at the other.

After some weeks, when examined, it was found that the shoots from the potatoes, and the weeds which had sprung up from the ground, had, all of them, in the most marked manner, run towards the yellow glass, through which the greatest quantity of the luminous rays passed. This, I think, proves that the luminous spectrum has two distinct influences on the plant; or otherwise, that its action is modified by some peculiar functions of the plant itself.

I submit these few results, incomplete as they are, to the attention of the Association without any further remark. I do not consider that my experiments have as yet proceeded far enough to warrant my taking up the time of the Meeting with any opinion I may have formed. I hope the result of another year will place the matter in a clearer light, and remove many of the apparent contradictions which at present exist. I have planned many new experiments, and every Member of the Association must be aware that these experiments require much time, and often to be repeated. We have to deal with a subtile agent, and the few results which I have already obtained, convince me of the existence of some secret principle in light, which I hope to render evident to the senses by its operations, although it may not itself be sensible to the human eye.

Falmouth, June 20, 1842.

Report on the Fossil Fishes of the Devonian System or Old Red Sandstone. By Louis Agassiz*, *Professor of Nat. Hist. at Neufchatel.*

Having been requested by the British Association for the Advancement of Science to draw up a report on the Fossil Fishes of the Old Red Sandstone, I think it my duty, in the first place, to mention the favourable circumstances which have allowed me to undertake this labour, and under what auspices I have been able to accomplish a part of the important task confided to me.

It would be very difficult for me to give at present an idea of the limited extent of the knowledge possessed a few years back of the fossils of a formation very little known at that time, and which, nevertheless, is found at the present day to extend over a considerable portion of the surface of Europe. But if the rapid progress of discoveries in this field renders the appreciation of their limits almost impossible, I must nevertheless acknowledge, above all, that it is to the persevering researches and indefatigable zeal of English geologists that science is indebted for the knowledge of one of the most curious faunas, I might even say one of the strangest, that has hitherto engaged the attention of palæontologists. When I visited Scotland for the first time, in 1834, Dr. Fleming and Messrs. Sedgwick and Murchison were the only persons who had signalized fossil fishes in the old red; the first having described various scales from Clashbinnie, which he considered allied to the sturgeons; while Messrs. Sedgwick and Murchison, assisted by Cuvier, Valenciennes, and Pentland, published the description of two new genera of fossil fish from Caithness. The total number of species then determined amounted only to four, and only one of these had been figured. I have already mentioned in various parts of my 'Recherches sur les Poissons Fossiles,' the numerous communications which were made to me at that time on the subject, principally by Mr. Murchison, Mr. Lyell, and Dr. Traill, who enabled me to increase the number of genera to ten, and that of the species to seventeen, previous to the appearance of Mr. Murchison's great work on the Silurian system. Such was the impetus given to the study of the ancient rocks by the publication of this important work, that on visiting Scotland again in 1840, during the meeting of the British Association at Glasgow, I had occasion to examine, in consequence of communications which were made to me, nearly double the number of genera, and treble the number of species of fossil fishes, which had all been recently discovered, and had not yet been described. In one of the meetings of the Geological Section, I was, nevertheless, able to draw the attention of geologists and palæontologists to some of the most curious types I had just examined the characters of, forms agreeing so little with all we knew previously in regard to fossils, that it was impossible to determine at first sight even the class to which they belong. Never shall I forget the impression which the sight of these creatures, provided with appendages resembling wings, produced upon me, when I had assured myself that they belonged to the class of fishes. It was an entirely new type which was about to figure for the first time since it had ceased to exist in the series of beings,—again to form a link which nothing of all that had been revealed up to the time, with regard to extinct creations, would have led us even to suspect the existence of; showing forcibly that observation alone can lead us to the recognition of the laws of development of organized beings, and how much we should guard against all those systems of transformation of species which the imagination invents with as much facility as reason refutes them. The merit of the discovery of these curious fossils is chiefly due to Mr. H. Miller, and I had only to fix their characters, and their relations to the fossil fishes already known, for all their importance to be appreciated. I believe that the minute and comparative study of the type which I have called *Pterichthys*, and of the not less curious genus discovered at Caithness by Messrs. Murchison and Sedgwick, and to which I have applied the name *Coccosteus*, will open to comparative palæontology a field not less fruitful than was the first announcement, now nearly a quarter of a century ago, of the Ichthyosauri and Plesiosauri. How many interesting relations of organization have we not a right to expect to discover in analysing the solid remains of animals which have been regarded by the most able naturalists successively as Tortoises, Fishes, Crustacea, and even Coleoptera! Mr. Miller has already made known, in a separate publication, a portion of the palæontological treasures contained in the old red sandstone of the neighbourhood of Cromarty. The difficulties, almost insurmountable, which have occurred in determining fossils, varying so much from those already known as these two genera, have necessarily required on my part numerous and repeated comparisons, and a minute study of the smallest fragments preserved in all the collections of Scotland, to which I should have been unable to apply myself, notwithstanding the facilities afforded me for this examination by all the persons possessing any of these fossils, had it not been for the assistance which the British Association has kindly afforded me.

Among the recent contributions which have so considerably increased our knowledge of the fossil fishes of the Devonian system, I must place in the first rank what has been accomplished by Lady Gordon Cumming in order to illustrate this ancient fauna. Not satisfied with collecting and distributing among geologists with unequalled liberality the numerous specimens of these remains, which she had collected in a quarry worked on purpose, she studied them with care, placed aside the most perfect specimens, and painted them with a precision of detail and an artistic talent to which very few naturalists have been able to attain. These drawings, indeed, and those of her daughter, who constantly assisted her in her studies, will form one of the principal ornaments of my 'Monograph.' On the point of presenting this selection to the public, it is painful to me to think that this noble lady will no more be able herself to receive from geologists the tribute of gratitude which she so justly deserved. May this record, planted upon her grave, remind her estimable companion that the willingness with which she assisted her parent has contributed to raise for her a lasting monument in the scientific world.

Dr. Malcolmson has likewise deserved well of the geology of the old red sandstone by the memoir which has been recently inserted in the Transactions of the Geological Society of London. Endeavouring to characterize this formation with the greatest possible precision, he had caused to be made beautiful drawings of a very large number of fragments of fish which occur in it; their fragmentary state, however, did not allow of my determining them with sufficient accuracy previous to the printing of his memoir for the palæontological portion to be published at the same time. These drawings, however, will not be lost to science; perhaps the larger portion are already published. Alexander Robinson has also devoted himself with much success to the investigation of the fossil fishes of the old red: he even forwarded to me some very rare ones, with a book of drawings executed in a superior style, representing those contained in the Museum of Elgin and in several private collections. The collections of Lord Enniskillen and of Sir P. Egerton have likewise furnished very beautiful specimens from the old red sandstone of the North of Scotland; and these gentlemen have had the great kindness to cause Mr. Dinkel to draw for me all those which it appeared desirable to publish. Dr. Traill and Mr. Strickland again have increased the number of known species, already so considerable, from the schists of the Orkney Islands, which appear to be an inexhaustible deposit.

While the North of Scotland thus furnished treasures hitherto unknown, Professor Jameson and Mr. Anderson were collecting in the counties of the South the species contained in the upper strata of this formation, which are not less curious nor less well-preserved, and of which several have been figured very fairly by Mr. Anderson in his interesting Memoir on the Geology of Fifeshire.

Thanks to the distant excursions of Mr. Murchison, I need not confine my report on the fishes of the Devonian system to the species found in the British Islands, but I am able to compare them with those which that indefatigable geŏlogist has brought with him from Russia, and which exhibit the most perfect identity with those of Scotland. On the continent, MM. Omalius d'Halloy and Hoeninghausen have likewise found some scaly-plates of fishes from this formation. My Report would be imperfect were I not to notice the doubts which have long since been entertained with regard to these large scaly plates of the old red sandstone, which have been cast at various times into the most different classes of the animal kingdom, and even of the vegetable kingdom, and which are at present solved in a satisfactory manner. They must be referred to the Crustacea, of which Dr. Buckland and myself were convinced at the meeting at Glasgow.

At present I will offer some general considerations on the characters and the geological distribution of the species of fossil fishes which are found in the various strata of the Devonian system, reserving the descriptive details for the special part of my 'Monograph.'

On this occasion I cannot refrain from making a general observation on the method to be followed in determining these fossils. There was a period, already remote from us, when the most superficial approximations between the organic fragments buried in the strata of the surface of our globe and the species at present living at its surface sufficed for the investigations of the time. Cuvier was the first who applied to these determinations the necessary precision, establishing them on satisfactory comparison one with the other and with the living species: and the results, therefore, at which he arrived, have undergone no modification with time. Unfortunately, the method employed by Cuvier is not yet very generally followed; numerous works on fossils might be mentioned whose authors have never studied the recent animals which might have some analogy with the fossils they describe, trusting to the general results obtained by their predecessors, or else establishing their analogies from the comparison of simple figures. Moreover, now that a new and efficacious means of determining accurately the structure of fossil remains has come into use, it is less possible than ever to admit into the sanctuary of science results which have not been submitted to the test of the most severe criticism. It suffices, in fact, to look at the brilliant results obtained by Mr. Owen from the structure of the teeth, to be convinced that in future no palæontologist will be able to avoid microscopical researches, if he wishes to arrive at a profound knowledge of the beings of which he has undertaken to reconstruct the forms and the organization, even in its most minute particularities. If, however, such detailed researches are indispensable to establish general results, which sooner or later become public property, it is not less important that they be expressed in the most simple and correct manner, to render them intelligible to the largest number.

One of the first observations to make on the ichthyological fauna of the old red sandstone is, that it is wholly peculiar to this formation; its numerous species differ alike from those of the Silurian system and from those of the carboniferous strata; the greater portion of the genera even of the Devonian system are restricted to the duration of this geological system, and of this number are those containing most species, such as the genera *Pterichthys*, *Coccosteus*, *Cephalaspis*, *Osteolepis*, *Dipterus*, *Glyptolepis*, *Platygnathus*, *Dendrodus*, *Diplacanthus*, *Cheiracanthus*, and *Cheirolepis*. Among the genera which have representatives in the Silurian rocks or in the carboniferous series, such as the genera *Onchus*, *Ctenacanthus*, *Ctenoptychius*, *Ptychacanthus*, *Acanthodes*, *Diplopterus*, and *Holoptychius*, I am not acquainted with a single one of which the species are identical in these different formations; but, on the contrary, each formation in which they are represented has its peculiar ones. This result agrees admirably with those which I have already obtained for the other strata of the series of rocks of which the crust of our globe is composed, as well in my researches on fossil fishes as also in those on the fossil Echinodermata and Mollusca. And if my conclusions with regard to this latter class of animals were frequently not in harmony with those of the greater number of conchologists, I have at least the satisfaction of finding at present M. d'Orbigny arrive at the same results from the study of other families and of other formations than those I examined. This difference in the results which I had obtained arises, without doubt, from my having applied, in determining the fossil remains of the Mollusca, the same principles of criticism which have always guided me in the determination of the fossil Vertebrata.

It is now a truth which I consider as proved, that the "*ensemble*" of organized beings was renewed not only in the interval of each of the great geological divisions which we have agreed to term formations, but also at the time of the deposition of each particular member of all the formations; for example, I think that I can prove that in the oolitic formation, at least within the limits of the Swiss Jura, the organic contents of the lias, those of the oolitic group properly so called, those of the Oxfordian group, and those of the Portlandian group, as they occur in Switzerland, are as different from each other as the fossils of the lias from those of the Keuper, or those of the Portlandian beds from those of the Neocomian formation. I also believe very little in the genetic descent of living species from those of the various tertiary layers which have been regarded as identical, but which, in my opinion, are specifically distinct. I cannot admit the idea of the transformation of species from one formation to another. In advancing these general notions, I do not wish to offer them as inductions drawn from the study of any particular class of animals (of the fishes for instance), and applied to other classes, but as the results of direct observation of very considerable collections of fossils of different formations, and belonging to different classes of animals, in the investigation of which I have been specially engaged for many years, in order to assure myself whether the conclusions which I had drawn from the tribe of fishes were applicable to this class only, or whether the same relation existed in the other remains of the animal kingdom.

Another fact results in the most evident manner from the simple inspection of the specimens of these fossils which have hitherto been collected, viz. that the very large majority of the species are of middle and even of small size. I dwell on this circumstance because it has afforded me an opportunity of rectifying an exaggeration which has been pretty generally adopted, and which consists in representing the species of ages anterior to our own as being generally larger than those now existing. The idea of a gigantic size has become, so to say, the necessary reflection of a tableau of fossils of all the geological epochs, and nevertheless such a manner of viewing the question is quite out of the pale of truth. In fact, if it seems strange to us to find in the diluvial strata of Europe, and even of the northern portion of this continent, fossil fragments of Pachydermata very similar to those now existing in the tropical regions, and differing very much from those which inhabit these countries at present, it would nevertheless be an exaggeration to represent those fossils as vastly superior in size to the animals of the same families and even of the same genera which live in our days; and even as regards the species of Pachydermata of the lower tertiary rocks, it is necessary to admit that those of our time, taking all into consideration, are evidently larger than the former. I do not pretend on this account to deny the fact of the existence in certain fossil families of types much larger in size than those of the present day, I only intend to state that these proportions have been exaggerated, and that this disposition to exaggeration has occasioned a neglect of the study of the remote relations of these types between each other, and with those which have preceded and those which have followed them—relations which appear to me alone capable of solving this enigma. It is incontestable, for instance, that the reptiles of the oolitic rocks, the Ichthyosauri and the Megalosauri in particular, possessed dimensions to which no type of the reptiles of our time has been found to attain; but in comparing them with reptiles now existing, it must not be forgotten that these gigantic reptiles lived at a time when the Mammifera did not yet exist, or at least had not yet acquired the preponderance they now have; when the Cetacea and Pachydermata were as yet only projected in the plan of Nature; when the class of fishes and that of the reptiles reigned in sovereignty; and when, consequently, it is not surprising to see the Reptilia,—which, in separating from the Fishes after the carboniferous formations, are examples of a real progress in this series of the Vertebrata,—prepare a new progress, a movement towards the class of the Mammifera and that of the Birds by the introduction of the type of the Ichthyosauri, which announces in some measure the Cetacea; of the type Megalosaurus, which might be considered in relation with the Pachydermata; and of the bird-like type of the Pterodactyli. For my part, therefore, I cannot regard simply as ordinary reptiles those types precursory of analogous types which are met with at a later period in other classes; I am rather inclined to view them as types prophetic of the more recent ages; and hence it is necessary to apply to their study a different measure from that which should be employed when the object is to fix the degree of analogy existing between contemporary types. I might apply these same considerations to other families, and carry them even further, if I had not already observed elsewhere that among the fossil fishes the family of the Sauroids, of which the carboniferous series contain such remarkable fragments, might be viewed as announcing, by its ambiguous characters, the introduction of the reptiles, at a period when this class was not yet represented on the earth. Nor is it here the place to examine, under this point of view, the invertebrated animals, the study of which has likewise led me to very curious considerations; I will confine myself solely to the mentioning, in relation to the fishes of the old red sandstone, that the small size of the great majority of the species, compared with those of more recent periods, is a fact agreeing with what is observed relatively to the first development of the greater part of the classes of the animal kingdom. The genera of fish of the old red sandstone, the species of which are of middle or small size, are the following:—*Pterichthys*, *Cephalaspis*, *Osteolepis*, *Dipterus*, *Glyptolepis*, *Acanthodes*, *Diplacanthus*, *Cheiracanthus*, and *Cheirolepis*; and I mean by species of middle or of small size in the class of fish, such as do not exceed the length of one or two feet. The genera *Diplopterus*, *Coccosteus*, and the four Placoidian genera of this formation, contained species certainly larger, but which nevertheless appear to me not to have exceeded two or three feet in length. The genera *Holoptychius*, *Dendrodus*, and *Platygnathus*, alone contained species of larger size; but I doubt if any one of them has attained the dimensions of our Sharks and our Sword-fish, and much less those of the large Tunny.

The close relation which appears to exist between the size of animals and their organization, is evident in nearly all the families of the animal kingdom; to be convinced of this, it suffices to pass in review a small collection only of animals.

Nothing is more striking in a museum arranged systematically, than the conformity in size of species of the same family, where the extremes of the differences are generally circumscribed within very narrow limits. How little do the Quadrumana differ in reality one from the other in size; what uniformity in this respect in their *ensemble*, among the Cheiroptera, the Insectivora, the Rodents, the Ruminants; among the birds of prey, the Granivora, the Chelonians, the Anourous Batrachians; among Insects, taken as a whole, compared with other classes; among Infusoria, &c. &c. The same relations equally exist between the families of Fishes; and the diversity in size which I have just noticed, among the species of different genera of this formation, is indeed the first indication of the diversity of the types to which they belong. I will point out, in the first place, four genera of the Placoidian order, the genera *Ctenacanthus*, *Onchus*, *Ctenoptychius* and *Ptychacanthus*, which are provided with spinous rays to the dorsal fins, resembling the gigantic Ichthyodorulites of the carboniferous and jurassic formations, but differing in their less considerable size; they are distinguished among themselves by the forms and the ornaments of their rays. In the order of Ganoid fishes, the genera *Acanthodes*, *Diplacanthus*, *Cheiracanthus*, and *Cheirolepis*, present themselves at first sight as a separate group; for although covered, like the others, with enamelled scales, these are so small that they impart to the skin the appearance of shagreen. The manner in which the fins are sustained by spinous rays, or the absence of these rays, and the position of the fins themselves, have served as characters in the establishing of these genera. The genera *Pterichthys*, *Coccosteus*, and *Cephalaspis*, form a second group exceedingly curious: the considerable development of the head, its size, the large plates which cover it, and which likewise extend over the greater portion of the trunk, and the moveable appendages in the form of a wing, placed on the side of the head, give to them the most remarkable appearance. It is these peculiarities, indeed, which caused the class to which these genera belong for a long time to be misunderstood. The large bony and granulated plates of *Coccosteus* led to their being considered as belonging to *Trionyx*; and it will be a sufficient excuse for this error to call to recollection that the greatest anatomist of our age had sanctioned this approximation.

The form of the disc of the head of the *Cephalaspides*, which has the appearance of a large crescent, and their more numerous but very elevated scales, resembling the transverse articulations of the body, explain how it was possible to see in these fishes Trilobites of a particular genus. Lastly, the winged appendages of the sides of the head of *Pterichthys*, as moveable as fins, have easily given rise to the variety of opinions concerning the true affinities of these singular creatures, and has caused them to be taken at one time for gigantic Coleoptera, at another for Crustacea or small marine Tortoises; so little do the types of the classes appear fixed in certain respects at those remote times. Another singularity of these genera is the association to the bony plates of the head of a vertebral appendage, which is far from having acquired the same solidity, but appears, on the contrary, to have remained fibro-cartilaginous during the whole life of the animal, resembling in this respect the skeleton of the Sturgeon.

It would be difficult to find among recent fishes types presenting any direct analogy with the genera *Pterichthys*, *Coccosteus*, and *Cephalaspis*; it is only from afar that they can be compared to some abnormal genera of our epoch. Thus the Sturgeons, (and especially *Loricaria* and *Callichthys*), offer but a slight analogy with the *Cephalaspis* in their shielded head, and in the bony plates of their flanks; the bony shields ornamented with sculptures and regular granulations, which protect the head of the *Triglæ*, of the *Peristediones*, and of the *Dactylopteri*, in a slight degree call to mind what is seen in the genus *Coccosteus*, without however the analogy being perfect; the structure of the throat and the remainder of the skeleton are very different; and lastly, I find it impossible directly to compare those moveable appendages of the sides of the head of *Pterichthys* to anything observable in fishes of the present period. Perhaps they have some relation with the moveable sub-orbitals of the *Acanthopsis* of the family of the Cyprinoids; perhaps they might likewise be compared to the prolongations of the præoperculum of certain *Triglæ*, and in particular of the genus *Cephalacanthus*; but I have found it impossible as yet to determine precisely with what bone of the head these extraordinary appendages must be considered parallel. As to the less solid nature of the vertebral column of these fishes, they have it in common with the greater part of the species of the older rocks. The analogy which they offer on the one hand in form with the dorsal cord of the embryo of fishes, together with the inferior position of their mouth, which is equally met with in the embryos, and, on the other hand, the distant resemblance of these fishes to certain types of reptiles, present the most curious assemblage of characters that can possibly be conceived.

A third group of fishes belonging to this formation comprises those genera whose vertical fins are double on the back and under the tail, and which approach very near to the caudal. These are the genera *Dipterus*, *Osteolepis*, *Diplopterus*, and *Glyptolepis*, which differ from one another by the form of their scales and their dentition.

And lastly, it seems to me necessary to regard as a fourth group of this order the genera which are characterized by large conical teeth situated on the margin of the jaws, between which are alternately smaller, and indeed very small ones in form of a brush; such are the genera *Holoptychius* and *Platygnathus*, and the genus recently established by Mr. Owen under the name of *Dendrodus*, and respecting which this learned anatomist has given some exceedingly interesting microscopical details. These were evidently the *Pirates* of their day; but it would be difficult to determine precisely their size, for the very simple reason that nowhere have any portions of their body of any considerable size been discovered assembled together.

What we possess of them is nothing more than some detached scales, isolated teeth, and some broken bony plates.

This primitive diversity of the ichthyoid types of a formation so ancient as the old red sandstone, is, in my opinion, one of the facts the most contradictory to the theory of the successive transformation of species, and of the descent of organized beings now living from a small number of primitive forms.

In support of these general observations I add the synoptical table of all the species of this formation which I have to the present time been able to determine, and of which the detailed descriptions will be found in my 'Monograph.'

Synoptical Table of the Fossil Fishes of the Old Red Sandstone, or Devonian System.

PLACOIDIANS.

Onchus arcuatus, *Ag.*—Wales.
... semistriatus, *Ag.*—Wales.
Ctenacanthus ornatus, *Ag.*—Sapey and Abergavenny.
Ctenoptychius priscus, *Ag.*—Scotland.
Ptychacanthus dubius, *Ag.*—Abergavenny.
2 genera yet undetermined.—Babrodery and Elgin.

GANOIDIANS.

1st Group.

Acanthodes pusillus, *Ag.*—Gordon Castle.
Diplacanthus striatus, *Ag.*—Cromarty.
... striatulus, *Ag.* — Lethen Bar.
... longispinus, *Ag.*—Lethen Bar and Cromarty.
... crassispinus, *Ag.* — Caithness.
Cheiracanthus Murchisonii, *Ag.*—Gamrie.
... minor, *Ag.*—Stromness.
... microlepidotus, *Ag.*—Lethen Bar.
Cheirolepis Cummingiæ, *Ag.* — Lethen Bar and Cromarty.
... Traillii, *Ag.*—Pomona.
... Uragus, *Ag.*—Gamrie.

2nd Group.

Pterichthys Milleri, *Ag.*—Cromarty.
... productus, *Ag.*—Lethen Bar.
... latus, *Ag.*—Lethen Bar.
... cornutus, *Ag.*—Lethen Bar.
... testudinarius, *Ag.* — Cromarty.
... oblongus, *Ag.* — Cromarty and Gamrie.
... cancriformis, *Ag.*—Orkney.
Pterichthys hydrophilus, *Ag.* — Dura Den.
Coccosteus oblongus, *Ag.*—Lethen Bar.
... latus, *Ag.* — Caithness and Orkney.
... cuspidatus, *Ag.* — Cromarty and Gamrie.
Cephalaspis Lyellii, *Ag.*—Glammis.
... rostratus, *Ag.*—Whitbach.
... Lewisii, *Ag.*—Whitbach.
... Lloydii, *Ag.*—Shropshire.

3rd Group.

Osteolepis macrolepidotus, *Ag.*—Caithness and Cromarty.
... microlepidotus, *Ag.*—Caithness.
... major, *Ag.*—Lethen Bar.
... arenatus, *Ag.*—Gamrie.
Dipterus macrolepidotus, *Cuv.*—Caithness and Wales.
And several varieties of this species.
Diplopterus macrocephalus, *Ag.*—Lethen Bar.
... borealis, *Ag.*—Caithness.
... affinis, *Ag.*—Gamrie.
Glyptolepis leptopterus, *Ag.* — Lethen Bar.
... elegans, *Ag.*—Gamrie.

4th Group.

Holoptychius nobilissimus, *Ag.*—Clashbennie.
... Flemingii, *Ag.*—Dura Den.
... giganteus, *Ag.*—Scotland.

Dendrodus biporcatus, *Owen.*	Cornstone in Murrayshire.
... sigmoideus, *Owen.*	
... incurvus, *Owen.*	
... latus, *Owen.*	
... compressus, *Owen.*	
... strigatus, *Owen.*	

Platygnathus paucidens, *Ag.* — Caithness.
... Jamesoni, *Ag.*—Dura Den.
... minor, *Ag.*—Dura Den.

It results from this table, that the Devonian system contains not less than fifty-five species of fossil fish belonging to twenty different genera; a number more than ten times that which was nominally known in the entire series of formations of the British Islands ten years ago. Who at that time would have believed that fifty-five species of vertebrated animals would have been discovered in one of the formations of the transition rocks?

Appendix to a Report on the Strength and other Properties of Cast Iron obtained from the Hot and Cold Blast. By William Fairbairn, *Esq.*

The experiments, of which the present is a notice, were entered upon in March 1837, and subsequently the British Association did me the honour to print them in their seventh volume of Transactions. They were intended to determine an important quality in the strength of materials, viz. the powers of crystalline bodies to sustain pressure for an indefinite period of time, and to ascertain whether cast iron, when subjected by a given weight to long-continued transverse strain, would, or would not, be subject to fracture.

It appears that former writers on the transverse strength of materials had come to the conclusion, that the bearing powers of cast iron were confined within the limits of that force which would produce a permanent set, and that it would be unsafe to load this material with more than about one-third of the weight necessary to break it. This assumption is, however, incorrect, as the experiments which follow will abundantly testify.

It would be superfluous to offer in this notice any observations on a different theory, as the recent experiments of Mr. Hodgkinson and myself fully prove* that cast iron takes a permanent set with a load considerably under one-sixth of the breaking weight.

From these experiments, it will be found that cast iron is more to be depended upon, and exhibits more tenacity in resisting heavy strains long continued, than is generally admitted, and its bearing powers have deserved a much higher reputation than has at any former period been given to them: indeed it is evident from the experiments, that a cast-iron bar is capable of resisting for a series of years a force equal to $\frac{7}{8}$ths, and sometimes $\frac{9}{10}$ths of the load that would break it.

In the application of this force, it must be observed, that the room in which the experiments were made, and which are now in progress, is not entirely free from vibration, being slightly affected by persons crossing the floor, particularly when two or more are walking at the same time.

The experiments already published on the "*Effects of Time*," embrace a period of fifteen months, from the 6th of March 1837 to the 23rd of June 1838. Up to that time the deflections of both hot and cold blast iron were carefully registered; and the present is a continuation of the same experiments, exhibiting the changes that have taken place for the last four years, and the effects which the permanent weights have produced upon the bars. It is satisfactory to observe that, during the whole time of the experiments, the bars (whether loaded with the lighter or heavier weights) exhibited little or no change beyond what may be traced to the variations of temperature. One of the bars was, however, found broken some time since, but whether from accident or the effects of continued strain I am unable to determine with certainty; I am inclined to believe that the former was the cause, as the corresponding bars still retain their position, indicating changes so exceedingly

* See Reports on the Strength and other Properties of Cast Iron in the seventh volume of the Transactions of the British Association, and the sixth volume of the Manchester Memoirs.

minute as to be scarcely perceptible, even when examined with our best instruments.

The following tables exhibit the progressive state of the bars from the 23rd of June 1838, up to April 19th of the present year.

TABLE I.

Table of deflections, as exhibited with permanent weights of 336 lbs., suspended from the centre of bars of cold and hot blast Coed-Talon iron, cast to be one inch square, and left to determine the effect produced on each bar after given intervals of time.

Distance between the supports 4 ft. 6 in.

EXPERIMENT I. Cold Blast Iron, No. 2. Breadth of Bar... 1·020 Depth of ditto ... 1·030			Date of Observation, 1838 to 1842.	Temperature at the time of Observation.	EXPERIMEMT 2. Hot Blast Iron, No. 2. Breadth of Bar... 1·020 Depth of ditto ... 1·040		
Weight in lbs.	Observed deflection in inches.	Deflection, load removed.			Weight in lbs.	Observed deflection in inches.	Deflection, load removed.
336	1·293		Feb. 7, 1839.	54°	336	1·524	
336	1·304		March 8, ...	35	336	1·532	
336	1·304		April 5, ..	38	336	1·531	
336	1·305		July 5, ...	72	336	1·533	
336	1·304		Aug. 15, ...	63	336	1·532	
336	1·303		Nov. 7, ...	50	336	1·531	
336	1·303		Dec. 9, ...	39	336	1·531	
336	1·305		Feb. 14, 1840.	50	336	1·531	
336	1·309		April 27, ...	63	336	1·519	
336	1·303		June 6, ...	61	336	1·520	
336	1·305		Aug. 3, ...	74	336	1·523	
336	1·305		Sept. 14, ...	55	336	1·613	
336	1·306		Nov. 22, 1841.	50	336	1·620	
336	1·308		April 19, 1842.	58	336	1·620	

Results in the preceding table and the previously published report, showing the progressive and increased ratio of deflections, from the 23rd of June 1838 to April 19th of the present year.

Weight on bar 336 lbs.

Cold Blast Iron. Deflection in inches.	Date of Observation.	Temp. Fahr.	Hot Blast Iron. Deflection in inches.	Remarks.
1·316	June 23, 1838.	78°	1·538	Previous to the time of taking the deflection in Nov. and April, the hot blast bar had been disturbed.
1·305	July 5, 1839.	72	1·533	
1·303	June 6, 1840.	61	1·520	
1·306	Nov. 22, 1841.	50	1·620 }	
1·308	April 19, 1842.	58	1·620 }	

If we examine the results of this table, it will be observedthat the deflection in the cold blast iron has not increased but rather decreased since June 1838, an anomaly not easily accounted for, unless from some error in writing down the figures 1·316, which—according to the progressive increase which has been going forward since the commencement of the experiments—should have been 1·306. On comparing the rate of increase of the deflection in this table with Table XII. in my former Report, it will be seen that the tendency downwards has been regular and progressive (with the above exception) up to the present date. In the hot blast iron it is also progressive, the increase of deflection in four years being ·082.

It will be observed, that the state of the atmosphere has considerable influence upon the bars, an increase of temperature producing a corresponding increase of deflection, and *vice versâ*.

Table II.

Table of deflections, as exhibited with permanent weights of 392 lbs., suspended from the centre of bars of cold and hot blast Coed-Talon iron, cast to be one inch square, and left to determine the effect produced on each bar after given intervals of time.

Distance between supports 4 ft. 6 in.

Experiment 1. Cold Blast Iron, No. 2. Depth of Bar ... 1·030 Breadth of ditto... 1·020			Date of Observation, 1838 to 1842.	Temperature at the time of Observation.	Experiment 2. Hot Blast Iron, No. 2. Depth of Bar ... 1·050 Breadth of ditto... 1·000		
Weight in lbs.	Observed deflection in inches.	Deflection, load removed.			Weight in lbs.	Observed deflection in inches.	Deflection, load removed.
392	1·815		Feb. 7, 1839.	54°	392	1·784	
392	1·822		March 8, ...	35	392	1·795	
392	1·822		April 5, ...	38	392	1·796	
392	1·824		July 5, ...	72	392	1·798	
392	1·824		Aug. 15, ...	63	392	1·797	
392	1·824		Nov. 7, ...	50	392	1·796	
392	1·823		Dec. 9, ...	39	392	1·796	
392	1·824		Feb. 14, 1840.	50	392	1·797	
392	1·818		April 27, ...	63	392	1·802	
392	1·825		June 6, ...	61	392	1·798	
392	1·826		Aug. 3, ...	74	392	1·801	
392	1·826		Sep. 14, ...	55	392	1·802	
392	1·829		Nov. 22, 1841.	50	392	1·804	
392	1·828		April 19, 1842.	58	392	1·812	

Results in the preceding table and the previous reports, showing the progressive and increased ratio of deflections, from the 23rd of June 1838 to April 29th of the present year.

Weight on bar 392 lbs.

Cold Blast iron. Deflection in inches.	Date of Observation.	Temp. Fahr.	Hot Blast Iron. Deflection in inches.	Ratio of Increase of Deflection.
1·824	June 23, 1838.	78°	1·803	
1·824	July 5, 1839.	72	1·798	
1·825	June 6, 1840.	61	1·798	
1·829	Nov. 22, 1841.	50	1·804	
1·828	April 19, 1842.	58	1·812	
·004	Increase......	......	·009	1000 : 2250

With a load of 392 lbs. we have a slow but steady increase of the deflections, being for four years only ·004 for the cold blast and ·009 for the hot blast, which shows a ratio of increase in the hot blast of 1000 : 2250. In other respects the bars continue to maintain their position with little or no variation.

TABLE III.

Table of deflections, as exhibited with permanent weights of 448 lbs., suspended from the centre of bars of cold and hot blast Coed-Talon iron, cast to be one inch square, and left to determine the effect produced on each bar after given intervals of time.

Distance between supports 4 ft. 6 in.

Experiment 2. Cold Blast Iron, No. 2. Depth of Bar ... 1·020 Breadth of ditto... 1·030			Date of Observation, 1838 to 1842.	Temperature at the time of Observation.	Experiment 3. Hot Blast Iron, No. 2.		
Weight in lbs.	Observed deflection in inches.	Deflection, load removed.			Weight in lbs.	Observed deflection in inches.	Deflection, load removed.
448	1·433		Feb. 7, 1839.	54°			
448	1·445		March 8, ...	35			
448	1·445		April 5, ...	38			
448	1·446		July 5, ...	72			
448	1·446		Aug. 15, ..	63			
448	1·445		Nov. 7, ..	50			
448	1·445		Dec. 9, ...	39			
448	1·446		Feb. 14, 1840.	50			
448	1·445		April 27, ...	63			
448	1·445		June 6, ...	61			
448	1·447		Aug. 3, ...	74			
448	1·447		Sept. 14, ...	55			
448	1·449		Nov. 22, 1841.	50			
448	1·449		April 19, 1842.	58			

Results in the preceding table and the previous reports, showing the progressive and increased ratio of deflections, from the 23rd of June 1838 to April 29th, 1842.

Weight on bar 448 lbs.

Cold Blast Iron. Deflection in inches.	Date of Observation.	Temp. Fahr.	Hot Blast Iron. Deflection in inches.	Remarks.
1·457	June 23, 1838.	78°		Another bar of cold blast iron broke after sustaining the weight of 448 lbs. for 37 days.
1·446	July 5, 1839.	72		
1·445	June 6, 1840.	61		
1·449	Nov. 22, 1841.	50		The hot blast bars broke at once with 448 lbs.
1·449	April 19, 1842.	58		
·008	Decrease.			

In these experiments the same anomaly is present as in Table I., namely, a decrease of ·008 in the deflections, which may be accounted for in the same way as before. These discrepancies are the more apparent, as the deflection in March 1838 was 1·439, in June of the same year it increased to 1·457, and in the February following it returned to 1·433; thus corresponding in some degree with the temperature of the room, which varied as the respective numbers 51°, 78° and 54°. In every other respect the bars have been tending to rupture, and since the deflections were taken one of them has broken.

Viewing the subject in all its bearings, it appears evident from these experiments, that *time* is an element which in a greater or less degree affects the security of materials when subjected to severe and long-continued pressure. It may at first sight appear that the cohesive powers and the resistance may be so nicely balanced as to neutralise each other, and in this state continue *ad infinitum*, provided there be no disturbing force to produce derangement of the parts, and thus destroy the equilibrium of the opposing forces. This cannot, however, be expected: in practice, disturbing causes often occur, and I think we may reasonably conclude that long-continued strain will tend to lessen the cohesive force which unites the particles of matter together, and will ultimately destroy that power of resistance which has for the last five years been so strongly exemplified in the above and previously printed experiments.

Report of the Committee appointed at the Meeting of the British Association held at Plymouth, in 1841, *for registering Shocks of Earthquakes in Great Britain. By* David Milne, *Esq., M.A., F.R.S.E.*

I. The Committee have continued to promote the object for which they were appointed, by sending additional instruments to Perthshire, where shocks of earthquake still continue to be felt. The following is a list of the shocks observed at Comrie since the date of the report given in last year to the Association.

In the following Table column 1 represents the day of the month, column 2 represents the total number of shocks felt during that day, column 3 represents the hour of the three strongest shocks, and column 4 represents the degree of severity of each shock, reckoning at 10 a shock which occurred on October 23, 1839.

1.	2.	3.	4.	3.	4.	3.	4.	Remarks.
1841.								
July 23	1	1 A.M.	2					
25	1	$4\frac{3}{4}$ P.M.	3	......	...	......	...	Instrument moved.
26	1	3 A.M.	...	......	...	......	...	Instrument moved.
30	12	8 A.M.	2	$2\frac{1}{2}$ P.M.	8	$3\frac{1}{2}$ P.M.	2	Instrument moved.
31	3	8 A.M.	2	......	1	......	1	
Aug. 1	2	......	1	......	1			
10	2	......	1	......	1			
12	1	10 A.M.						
30	1	......	1					
Sept. 8	2	3 A.M.	1					
9	1	$11\frac{3}{4}$ P.M.	5	......	...	......	...	Instrument moved.
10	3	$2\frac{1}{2}$ A.M.	3	$4\frac{1}{2}$ A.M.	1	$11\frac{1}{4}$ A.M.		
16	2	A.M.	1	$9\frac{1}{2}$ P.M.	1			
17	2	1 A.M.	1	$4\frac{1}{2}$ A.M.	1			
22	1	$11\frac{1}{2}$ P.M.	1					
23	1	$2\frac{1}{2}$ A.M.	1					
29	2	A.M.	1	$9\frac{1}{4}$ A.M.	1			
Oct. 5	1	A.M.	1					
23	1	12 A.M.	2					
Nov. 3	1	12 A.M.	1					
5	1	1 A.M.						
6	1	8 A.M.						
7	1	......	1					
8	1							
18	1	8 A.M.						
Dec. 3		$8\frac{1}{2}$ A.M.						
6	1	3 A.M.	1					
7	1	3 A.M.	1					
1842.								
Jan. 2	1	A.M.	1					
7	2	A.M.	1	A.M.	1			
Mar. 10	1	1 P.M.	1					
Apr. 21	1	3 P.M.	1					
22	2	$10\frac{1}{2}$ P.M.	1	11 P.M.	2			
June 1	1	12 A.M.	1					
2	1	1 A.M.	2					
8	2	$1\frac{1}{2}$ A.M.	...	$1\frac{3}{4}$ A.M.	...	......	...	Instrument moved.

It will be perceived that out of the 60 shocks above recorded, felt during the last eleven months, there were three occasions on which the instruments were moved. From this it is evident, that the instruments are not sufficiently sensitive to indicate the great proportion of the shocks now occurring, however well adapted they may be for registering those of a more violent character which occurred in 1839 and 1840.

II. Referring to the Report of last year (published in the last volume of the Transactions of the Association) for the nature and number of the instruments which were then at Comrie or its neighbourhood, the Committee will now mention what additional instruments have been sent there, and to whose charge they have been entrusted.

The additional instruments for indicating earthquake shocks are seven in number.

Four of these are on the principle of the watchmaker's noddy described in last year's Report.

Another instrument consists of four horizontal glass tubes, slightly turned up at each end, and filled with mercury. These tubes are laid down on the solid floor of a room, according to the different points of the compass; and it is expected that, when a shock takes place, the mercury will flow out of one or more of these tubes. If there is a horizontal movement of the earth's surface, say in a direction from W. to E., the mercury will flow out of the west end of the tube placed in that direction, and partially out of two other tubes. If there is no horizontal movement, but an inclination of the ground only, the mercury will flow out of the tube or tubes affected by the inclination, and probably in a larger measure from the ends of the tubes towards the dip. This instrument was made by Mr. Newman of London, under the directions of Professor Wheatstone and Mr. Milne.

The two remaining instruments are intended exclusively to indicate any vertical movements of the ground. They consist of a horizontal bar, fixed to a solid wall by means of a strong flat watch-spring, and loaded at the opposite end. If the wall suddenly rises or sinks, the loaded end of this horizontal rod remains, from its *vis inertia*, nearly at rest, and thus can move any light substance (as paper or a straw) brought against it by the vertical movement of the ground, and which light substance is so adjusted as to stick wherever the rod leaves it.

One of this last mentioned class of instruments, and the one formed with glass tubes, have been set at Comrie, in the upper story of a house occupied by Mr. Macfarlane, post-master there,—a very intelligent person, and most anxious to aid the Committee in their inquiries. He has kept an accurate register of all the shocks felt at Comrie during the last three years.

In regard to the instruments formed on the principle of the watchmaker's noddy, one of them has been placed at Crieff (six and a half miles east of Comrie), under the charge of the Rev. Mr. M'Alester. A second has been placed at St. Fillans (a small village five and a half miles west of Comrie) under the charge of the Rev. Mr. Logan. A third is placed at Invergeldie, about five miles north of Comrie, under charge of the farm-overseer there. A fourth instrument of this kind is about to be sent to Kinlochmoidant, near Strontian in Argyleshire, where shocks are occasionally felt. It is to be taken charge of there by Wm. Robertson, Esq., the proprietor of Kinlochmoidart. To the same place there is to be sent one of the horizontal bars intended to indicate vertical movements of the ground.

Besides the foregoing instruments, others of a meteorological character have been placed at Comrie, in order that the state of the atmosphere at the moment of the shocks, and the nature of the weather generally during their occurrence, may be as nearly as possible ascertained. These instruments consist of a barometer, double thermometer, and a rain-gauge. They are under the charge of Mr. Macfarlane of Comrie, by whom their indications are regularly registered.

III. The Committee will next notice any effects produced on the instruments, during the course of last year, by earthquake shocks. The instruments sent lately by the Committee have not yet been affected, having been but a short time at their respective stations. Those which have been affected, were the instruments sent last year.

1. On the 26th of July 1841 (as Mr. Macfarlane reports), a shock occurred, which is noticed in the register. The inverted pendulum set in the steeple of Comrie parish church was thrown about half an inch to the west, apparently indicating a horizontal movement of the ground as much towards the east. Another instrument, invented by Mr. Macfarlane himself, on the principle of the common pendulum, and kept at his own house, about 150 yards from the church, had vibrated in a direction due east and west. On this occasion an *upward* heave of the ground, to the extent of half an inch, was also indicated by two instruments, one of them being a horizontal bar, of the nature before described.

2. The next shock by which the instruments were affected, occurred on the 30th of July 1841. Mr. Macfarlane reports that the two inverted pendulums in his house vibrated to the extent of half an inch, and in a direction south and north, which is different from previous indications. At Tomperran (about a mile and a half east of Comrie), an instrument on the principle of the common pendulum vibrated east and west. The instruments for showing any vertical movement were but slightly affected.

Notwithstanding the slight nature of the effects of this shock on the instruments, Mr. Macfarlane reports that it was very severe, though not so violent as the one which occurred in October 1839. Reckoning this former one at 10, he says the shock of July 30, 1841, may be reckoned 8. He adds, that "it was distinctly *double*, the latter part, if anything, more violent than the first: the noise and shake awful, at least I felt them so in the house, and those out of doors gave the same account. It is difficult to account for the smallness of its effects on the instruments. Perhaps the vibrations of the ground, though violent, were short and frequent, and thereby interrupted the natural swing of the pendulums. I recollect some person, on the occurrence of one of the former severe earthquakes, describes his feelings as if on horseback, when the animal shook itself. Somewhat such were my impressions on the 30th, even before I had looked at the instruments. It is said here that there were twelve shocks that day. I felt nine myself; there was one about 8 A.M., pretty smart, and none else till the great one about $2\frac{1}{2}$ P.M. *Immediately* after it there were two or three slight shocks, and about an hour afterwards a loud one, &c. The weather was cold and inclined to stormy about the time of the severe shock, and for a day or two before and after."

In a subsequent letter, dated August 9, 1841, by which time Mr. Macfarlane had visited all the places in and near Comrie affected by the shock, he gives some details, which it may not be out of place here to notice. "A house at Garrickrow (about two miles west of Comrie) was so severely handled that three out of four chimney-tops will require to be rebuilt or repaired, and there is a rent in the west gable of the house. A man from Comrie, who happened to be working at the time on the hill behind, describes the shock as awful indeed; and he says the trees around him were so much agitated that he thought they would have been torn out of the roots, but he cannot remember exactly in what direction they waved, but thinks it was east and west. The wall of one of the houses of Ross (the neat suburb of our city) was rent, and the miller's house (you 'll recollect it), in spite of its numerous abutments, has had its rents much enlarged. This shock, I learn, has been felt as far east, at least, as Newburgh, about thirty-eight miles from Garrickrow; as far to the west as Dalmally, the distance of which I do not exactly know (but probably it may be about the same); as far north as Glenlion, thirty miles; and as far south as Alloa and Stirling, twenty to thirty miles.

"I have seen several of the shattered buildings; one of the chimney-tops in Duneira House is slightly rent; one in the stable behind very much; two of the gardeners' cottages behind that again considerably; one so much that it was taken down and rebuilding when I saw it. The directions in which the stones have been moved, seem to have been various. It is remarkable that neither the row of chimney-stacks on the hot-house wall, of the same construction with those of the gardener's cottage (octagonal), nor those of the gamekeeper's house, which is a little up the hill, have been injured. The gardener told me the foundation of all the buildings thereabout (except the last) was upon a gravelly soil, but how near the subjacent rock he could not guess. A person who happened to be on the hill or rising ground immediately to the west of Duneira House, told me as a proof of the shock having come even there from the west, that after the shock passed him he *heard* the rattle of the slates and of the buildings about Duneira; but this you will at once see was not evidence of the alleged fact. Another standing on the hill above, said that he thought he *saw* the disturbance of the woods pass eastward. This was near Comrie. Those in the wooden shed at the saw-mill near Duneira, saw the roof open for a moment; and when they rushed from the shed, they observed that the water in the mill-head was for a short time dammed backwards, and raised about four inches above its former level at that place; and from this, and other indications, they judged that the earth there was heaved directly upwards *about six inches.* There were traces of electricity in the clouds at the time, and other peculiarities in the appearance of the sky, but nothing amounting to the least hint, so far as I could judge, that we were to be so roughly handled. I recollect before of noticing the appearance of the sky as lurid and particularly sombre when we had quakings below, but I have frequently since seen the same, or even stronger marks of the same kind, and yet all pass peaceably off, and, on the other hand, earthquakes when the sky was clear and open. Even a course of previous wet weather, which, from its being hitherto an almost constant forerunner of the violent and frequent shocks, warranted the inference that they were somehow connected, does not seem to be a *sine qua non*; so that the remark of a sagacious old man, one well-known here as 'Deacon Reid,' will hold good, who long ago, in the first series of our earthquakes, had been paying particular attention to the phænomena, and being asked if he had made out whether they affected the weather or the weather them, replied that he had attended particularly to that point, and all that he could make of them was, that there was 'aye some kind o' weather when they happened.' I may here add, it was omitted in its proper place, that the only difference I could observe in the circumstances of the *shattered chimneys* about Duneira, was that they were all on walls or gables running south and north, while those untouched had the walls on which they stood east and west. Dykes were thrown down in many places."

With reference to the part of Mr. Macfarlane's letter last quoted, it may be proper to explain, that the spot from which the Perthshire shocks of earthquake appear to emanate, is situated about a mile north of Duneira, and therefore it is not difficult to understand why walls running north and south should chiefly or exclusively have been rent, whilst walls running east and west should have escaped. This explains the fact mentioned in Mr. Macfarlane's letter, that the hot-house wall and range of chimneys on it escaped injury, whilst the west gable of the house at Garrickrow (a quarter of a mile east of Duneira House) was rent.

Accounts have been received by a Member of the Committee, of the effects produced by the same shock in other parts of the country, which in so far as interesting, will be given in a treatise he is publishing on British earthquakes.

3. On the 9th of September 1841, another pretty severe shock was felt at Comrie, at about ten minutes before midnight. Mr. Macfarlane reports concerning it, "The next morning the Association's instruments indicated as follows:—

"The steeple one was inclined to south three-quarters of an inch. The Comrie House one inclined north half an inch.

"No damage, that I have heard of, has been done. The weather for the two preceding days was remarkably wet and close, much resembling that in which the shocks occurred in 1839; so much so was the sky, that the evening previous I was remarking to some folks here, that it looked very like an earthquake night. But I have more than once observed the same misty and lurid sky without any shock; so that, after all, the thing may be a mere coincidence."

The indications of the instruments, mentioned in Mr. Macfarlane's note, do not coincide with those produced by previous shocks, and are in themselves somewhat perplexing, if they are assumed to have been caused by one and the same shock. Comrie House is about half a mile due north from Comrie Church, and it is difficult to understand how Comrie Church could have moved three-quarters of an inch to the north, whilst at the same time Comrie House was moved half an inch to the south, unless on the supposition that the intermediate ground was lifted up to an extent which certainly would have been perceivable by the inhabitants.

But it will be seen from the register, that after the severe shock near midnight on the 9th of September, two other shocks occurred before the instruments were examined. It is very possible, therefore, that the indications registered were not the effects of only one shock.

4. On the 8th of June 1842, two shocks were felt at Comrie between one and two in the morning, by which the horizontal pendulum in Mr. Macfarlane's house (recently rent) was affected. It indicated a vertical upheave of the ground of fully a quarter of an inch.

From the foregoing details, it seems probable that the opinion entertained by those acquainted with the locality, that the particular spot from which the Perthshire shocks emanate on the earth's surface, is situated about one mile north-north-east of Duneira House, and about one mile and a half north-west of Comrie, may be correct. It is desirable therefore to have additional instruments placed at Duneira, and in the neighbourhood of it, with the view of approximating still nearer to the exact spot of discharge or emission. Two instruments have been lately sent to Duneira and St. Fillans, from which, if the shocks continue, some useful data may be expected.

Further, it is evidently desirable to have instruments greatly more sensitive than any which the Committee yet possess; and the Committee would be greatly obliged for any hints which may be given to them with that view. Some of the members of the Committee are now making experiments which promise well: and if the Committee be reappointed, with a renewal of the grant, they hope, even before the earthquaking season (autumn and winter) commences in Perthshire, to be prepared for a correct registration of most of the shocks.

IV. The Committee wish particularly to call the attention of the Association to the importance of carrying on meteorological observations at Comrie.

There seem strong grounds for the opinion entertained by many, that an intimate connection of some kind or other exists between earthquake shocks and the state of the weather, or rather those various agents which affect the weather. Some persons, indeed, maintain, that the shocks are nothing else than electrical discharges from the earth, and are preceded as well as followed by certain meteorological symptoms, which are capable of accurate registration. This view of the matter is, for the sake of the theory of earthquakes, deserving of being tested by meteorological observations: and such observations have accordingly been commenced at Comrie, by means of instruments, sent there in accordance with the recommendation contained in last year's Report, and understood to have been approved of and sanctioned by the Association. At present the barometer and thermometer are observed at Comrie only twice in the twenty-four hours. It would, however, be evidently desirable to have much more frequent observations, in order that the state of the atmosphere immediately before, as well as immediately after shocks, should be ascertained. The Committee understand that there are two places in Scotland, where, at the expense of the British Association, *hourly* observations of the barometer and thermometer are now made and registered. The importance of these observations to meteorology is unquestionable; and it is manifest that great additional value would be given to them were they carried on at Comrie, where they would become subservient to another branch of scientific research. In this view of the matter they are strongly supported by the Meteorological Committee of the Association, whose convener (Sir David Brewster) may be with propriety consulted on this subject.

The Committee have ascertained that proper persons can be found at Comrie, who, under the superintendence of Mr. Macfarlane, would observe the barometer and thermometer every hour in the twenty-four hours, at an expense of 40*l.* yearly; and the Committee express a hope that the Association will enable them to carry this plan into effect.

On this subject the Committee will only further observe, that they would be glad if some other meteorological instruments could be sent to Comrie. For an anemometer there is an excellent situation, viz. on the steeple of the parish church. It would be very desirable also to have some instrument capable of indicating the existence of any sudden changes in the electrical state of the earth or the atmosphere; and it is understood that the expense of these instruments is not great.

V. The Committee have not yet attempted the registration of earthquake shocks occurring in any other part of this country, except Scotland. Elsewhere the shocks are not so frequent, or so regular in their recurrence, as to warrant the establishment of instruments: at the same time there do appear to be some parts of the country much more subject to shocks than others. For example, the primary districts of Cornwall and Wales have pretty often experienced shocks; and if in the course of the following year any are repeated in these quarters, it may be right to send some instruments there.

VI. The Committee have finally to report, that the sum of 26*l.* 16*s.* have been expended by them in the prosecution of their inquiries.

Report of a Committee appointed at the Tenth Meeting of the Association for the Construction of a Constant Indicator for Steam-engines, and for the determination of the Velocity of the Piston of the Single-acting Engine at different periods of the Stroke. Members of the Committee:—EATON HODGKINSON, *Esq., F.R.S.*; J. ENYS, *Esq.*; *the Rev. Professor* MOSELEY, *M.A., F.R.S. (Reporter).*

IN the conclusion of their last report the Committee stated it to be their purpose, during the present year, to apply the indicator to some of those engines whose work is registered by other means, and to compare the result of the two registrations. It is to this comparison that their labours have accordingly been directed. Of the numerous engines whose duty is periodically recorded, none seemed to be so well adapted to their purpose as the Cornish engine at the East London Water-works. The long-continued and careful experiments of Mr. Wicksteed upon that engine*, have made the work performed by it better known probably than that of any other engine. The request of the Committee to be allowed to apply the indicator to it was at once and most liberally acceded to, and every facility was afforded to them during the progress of their experiments by the servants of the company.

Results of a Trial of the Constant Indicator upon the Cornish Engine at the East London Water-works.

The indicator was put to work on the 28th of January and continued its registration, without intermission, until the 25th of February. The numbers registered by the counter of the engine and by the indicator were taken by the engineer every morning and evening. These numbers are contained in the two first columns of the accompanying table.

Date.	Number registered by Counter.	Number registered by Indicator.	Number of strokes made by Engine between each two succeeding observations.	Number registered by Indicator between each two succeeding observations.	Mean registration made by Indicator at each stroke of Engine.
Jan. 28	07680006	000429·5			
,,	07685564	004613·2	5558	4183·7	·752
29	07691430	008945·4	5866	4332·2	·738
,,	07696378	012546·3	4948	3600·9	·728
30	07699548	014863·2	3170	2316·9	·730
31	07702161	016768·5	2613	1905·3	·729
,,	07707828	020946·3	5667	4177·8	·737
Feb. 1	07712075	024055·5	4247	3109·2	·732
,,	07717805	028317·6	5730	4262·1	·743
2	07722337	031693·3	4532	3375·7	·744
3	07738647	043776·4	16310	12083·1	·740
4	07742155	046378·6	3508	2602·2	·741
,,	07743790	047586·3	1635	1207·7	·738
5	07747184	050113·5	3394	2527·2	·744
,,	07750988	052917·2	3804	2803·7	·737
6	07756340	056982·4	5352	4065·2	·759
,,	07761966	061306·4	5626	4324·0	·768
7	07766741	064847·3	4775	3540·9	·741
,,	07768676	066285·3	1935	1438·0	·743
8	07775229	071142·6	6553	4857·3	·741
,,	07780816	075336·6	5587	4194·0	·750
9	07788825	081257·6	8009	5921·0	·739
,,	07792228	083786·5	3403	2528·9	·743
10	07798391	088419·4	6163	4632·9	·751
11	07801012	090405·6	2621	1986·2	·757
,,	07806022	094299·3	5010	3893·7	·777
12	07809569	096947·4	3547	2648·1	·746
,,	07814786	100910·5	5217	3963·1	·759
13	07819727	104619·4	4941	3708·9	·750

* Experimental Inquiry, &c., by Thomas Wicksteed, 1841. Weale.

TABLE (*Continued*).

Date.	Number registered by Counter.	Number registered by Indicator.	Number of strokes made by Engine between each two succeeding observations.	Number registered by Indicator between each two succeeding observations.	Mean registration made by Indicator at each stroke of Engine.
Feb. 14	07824891	108461·2	5164	3841·8	·743
„	07830561	112652·0	5670	4190·8	·739
15	07833566	114880·9	3005	2228·9	·741
16	07842556	121598·8	8990	6717·9	·747
17	07847210	125036·2	4654	3437·4	·738
„	07851371	128106·2	4161	3070·0	·737
18	07859783	134385·1	8412	6278·9	·746
„	07864386	137818·9*	4603	3433·8	·746
19	07868100	140562·2	3714	2743·3	·738
20	07876295	146683·2	8195	6121·0	·746
21	07880045	149499·9	3750	2816·7	·751
22	07887975	155454·2	7930	5954·3	·750
23	07896246	161731·7	8271	6277·5	·758
24	07904433	167890·7	8187	6159·0	·752
25	07912703	174144·9	8270	6254·2	·756

The difference of each two consecutive numbers taken from the counter shows the number of strokes made by the engine between the corresponding observations, and the difference of each two consecutive numbers taken from the indicator shows the number registered by the indicator whilst this number of strokes is made by the engine. These differences are given in the third and fourth columns of the table.

The number registered by the indicator whilst any number of strokes is made by the engine, being divided by that number of strokes, gives the mean registration of the indicator per stroke of the engine, between the periods of observation. The quotients obtained from this division, in respect to all the observations, are shown in the last column of the table.

Between the 28th of January and the 18th of February the engine made 179777 strokes, and the indicator registered the number 133955·6, being a mean registration of ·7451 per stroke of the engine.

Between the 28th of January and the 25th of February (being the whole time of the working of the indicator) the engine made 232617 strokes, and the indicator registered the number 173176·7, being a mean registration of ·7444 per stroke of the engine.

Now the general formula for determining the work of the engine from the number registered by the indicator, as demonstrated in the report made by

* On the 18th the cord got out of the pulley of the indicator, and it is not known how much was lost in the registration before the accident was discovered and the cord replaced; supposing, however, that throughout the 4603 strokes made by the engine between the two observations on the 18th, the registration had continued the same, ·746 per stroke, as between the two preceding observations, the number registered would have been 3433·8, which added to the previous registration, gives 137818·9 for the number which would have been shown by the indicator; the number actually shown was 137280·2: so that on this supposition the number lost by the indicator, whilst the cord was out of the pulley, was 538·7. This number is added as a correction to all the registrations of the indicator after the 18th. The numbers in the last column can only be affected by any error in it on the 18th and 19th; any such error must be inconsiderable.

the Committee to the British Association of Science at their last meeting, when reduced* by the substitution in it of the particular values assigned to the constants in these experiments, is as follows:—

$$U = 161{\cdot}4474\,N - {\cdot}09051\,L,$$

where N represents the number registered by the indicator during the period for which the work of the engine is to be determined, L the space in feet described by the piston of the engine during that time, and U the number of units of work (in lbs. one foot high) done by the steam upon each square inch of the piston of the engine during that time. The second term of the formula is exceedingly small as compared with the first, and is a correction for the influence of the friction of the indicator on the number registered by it.

The mean number registered by the indicator per stroke of the engine between the 28th of January and the 18th of February being ·7451; the mean work done by the steam (in lbs. one foot high) on each square inch of the piston per stroke during that time (according to the indicator) was, by the above formula,

$$161{\cdot}4474 \times {\cdot}7451 - 10 \times {\cdot}09051 = 119{\cdot}3883.$$

Also the mean stroke of the engine, during that time, was (by the measurement of the engineer) 9 ft. $10\frac{1}{2}$ in., or 9·875 ft., so that the *mean effective pressure* of the steam upon each square inch of the piston was, by the indicator,

$$\frac{119{\cdot}3883}{9{\cdot}875} = 12{\cdot}09 \text{ lbs.}\dagger$$

The whole number of units of work done upon each square inch of the piston, between the 28th of January and the 15th of February, was, by the indicator,

$$21{,}464{,}067{\cdot}1727.$$

This number multiplied by the number of square inches in the piston, which is 5019·5, gives the whole number of units of effective work done by the steam upon the piston of the engine during the time of the experiments, or the whole number of lbs. of water which would have been raised one foot high by the engine during that time, had it not been for friction and other prejudicial resistances. This number is

$$107{,}738{,}885{,}310{\cdot}4.$$

During this time $1226\frac{1}{4}$ cwt. of coals were consumed by the engine; whence

* The general formula as proved in the report is,

$$U = 1{\cdot}67052\left(\frac{m}{\lambda}\right)N - {\cdot}3017\left(1 - \frac{2}{p}\right)L,$$

where m represents the ratio of the space described by the piston of the engine to that described in the same time by the circumference of the pulley of the indicator; λ the additional deflexion of the springs, in inches, for each additional lb. in the strain upon them; p the number of times the engine expands.

Now (by the measurement of Price the engineer) the cord passing over the pulley of the indicator described $37\frac{1}{4}$ inches, whilst the piston of the engine made a stroke of 10 feet, so that $m = \frac{120}{37\frac{1}{4}} = 3{\cdot}2215$; also (by the experiment of Mr. Timme, Mr. Holtzapffel's draughtsman) the springs deflected exactly 3 inches under a strain of 90 lbs., so that $\lambda = \frac{3}{90} = \frac{1}{30}$, whence it follows that $1{\cdot}67052\left(\frac{m}{\lambda}\right) = 161{\cdot}4474$; also the steam was cut off at 3 ft. 6 in. $\therefore p = \frac{10}{3\frac{1}{2}} \therefore \frac{2}{p} = {\cdot}7 \therefore 1 - \frac{2}{p} = {\cdot}3 \therefore {\cdot}3017\left(1 - \frac{2}{p}\right) = {\cdot}09051.$

† This is the mean pressure of the steam *above* the vacuum resistance.

it follows, that by the indicator the duty done by the steam upon the piston for each cwt. of coals consumed, was

87,852,427·049*.

Comparison of the Results given by the Indicator with the Experiments of Mr. Wicksteed.

The effective work done by the steam per square inch of the piston per stroke of the engine, as determined by the experiments of Mr. Wicksteed (Experimental Inquiry, p. 22), was

$$129{\cdot}4 - 7{\cdot}30\dagger = 122{\cdot}1.$$

In Mr. Wicksteed's experiments the engine was assumed to make a mean stroke of 10 feet. At the time of the experiments with the indicator, the mean stroke of the piston was 9 ft. $10\frac{1}{2}$ in. (by the measurement of the engineer). The mean stroke being thus $1\frac{1}{2}$ in. short of its former length, the work done per stroke is to be diminished by the $\frac{1\frac{1}{2}}{120}$th part, or the $\frac{1}{80}$th part. This deduction being made, we obtain

Work per stroke per square inch by experiment 120·574;

$$\text{Mean pressure by experiment } \frac{120{\cdot}574}{9{\cdot}875} = 12{\cdot}21.$$

The duty done per cwt. of coals, consumed between the 28th of January and 15th of February, estimated by the water raised, was, by Mr. Wicksteed's calculation,

81·627,471.

On the whole, therefore, we have

lbs. one foot high per square inch per stroke by experiment	120·574
lbs. one foot high per square inch per stroke by indicator	119·388
Mean effective pressure of steam per sq. in. of piston by experiment	12·21 lbs.
Mean effective pressure of steam per sq. in. of piston by indicator	12·09 lbs.
Duty done at pumps with 1 cwt. of coals, as shown by water raised	81,627,471.
Duty done by steam on piston with 1 cwt. of coals, as shown by indicator	87,852,427.

Variations in the Registration.

The greatest variations from the mean registration per stroke, as shown by the table, occur on the 6th and the 11th of February. The latter differs from the mean by ·032, which is equivalent by the formula to 4·26 units of work.

These variations are due,—1st, to a variation in the length of the stroke, amounting to $2\frac{1}{2}$ in. at least, and giving a variation of the $\frac{2\frac{1}{2}}{120}$th part, or the $\frac{1}{48}$th in the work per stroke, which variation is equivalent to $\frac{122{\cdot}1}{48}$, or 2·543 units of work per square inch of the piston.

* The coals used were small coals of the worst quality, Mr. Wicksteed having, it is well known, adopted the excellent expedient of contracting with the coal-merchant, on the part of the company, to pay not according to the quantity or quality of the coals supplied, but according to the pounds of water which the engine is made to raise by them one foot high; i. e. to pay the coal-merchant so much per unit of work done by the coals. Had the best Welch coals (such as are used in Cornwall) been used on this occasion, the duty would have been 110 millions per cwt.

† The work expended per stroke on the vacuum resistance is here deducted to get the *effective* work, which is evidently that shown by the indicator.

2ndly. To the continual variation of the level of the water in the *well*, which variation amounts, according to the statement of the engineer, to 16 inches, and often continues for days together. The variation in the registration which results from this cause amounts to $1{\cdot}0274 \times 1\frac{1}{4} = 1{\cdot}2842$ unit of work per square inch of the piston.

The possible variation in the registration due to these two causes amounts, therefore,

	Units per square inch.
By variation in length of stroke, to	2·543
By variation in water-load, to	1·284
Total......	3·827

That further variation in the work of the engine which is due to a different state of the packing of the piston and a different supply of oil, it is of course impossible to estimate; but it is not too much to assign to it a possible variation of $\frac{4}{10}$ths of a unit of work per square inch of the piston per stroke. This small variation, added to that shown to be due to the length of the stroke and the water-load, accounts for the entire amount of the greatest variation in the daily registration of the indicator, as shown by the table.

If the friction of the indicator be neglected altogether, the work shown by it per stroke will be 120·2944, whilst the work by experiment is 120·574. The difference is on this supposition, therefore, only ·27, or about one quarter of a unit of work out of $120\frac{1}{2}$ units.

In respect to these results it is sufficient to say, that no others ever obtained by any of the instruments applied for a similar purpose have approached to them in the accuracy of their registration of the work, although that registration, which was by those instruments limited to a single stroke, has been by this extended continuously over 179,000 strokes; and that Mr. Wicksteed has expressed an opinion that the results given by the indicator are probably nearer to the true work of the engine than his own experimental results.

These experiments having sufficiently established the general accuracy of the instrument and its working qualities, as applied to single acting stationary engines, the Committee became desirous of trying it on the marine engine, and the directors of the Great Western steam-ship having kindly given their consent, it was fixed upon the engines of that vessel when about to proceed on her first voyage in the present year.

Unfortunately no trial could be obtained of the particular expedients adopted for this new application of the instrument until the vessel was actually upon her voyage, and the Committee regret to state that this costly experiment was rendered useless for their purpose by circumstances which would have been obviated had such a trial been possible, and which would have been wholly unimportant and soon remedied on shore. Of these the principal was the accidental unscrewing of one of the pistons from the extremity of the piston rod.

The knowledge which would be supplied by a series of registrations of such accuracy as those given by the indicator, as well in regard to the duty of marine engines as in respect to the general conditions of the resistance opposed under different velocities to the motion of a vessel of the dimensions of a steam-ship, is of vast importance practically and scientifically; it is therefore desirable to repeat this experiment under more favourable circumstances.

The attention of the Committee was directed by the Association, in the second place, to an application of the admirable chronometrical instrument suggested by M. Poncelet, and contrived and applied by M. Morin, to an admeasurement of the velocity of the piston of the steam-engine at different periods of the stroke. This velocity is dependent in engines working expansively upon the particular law, according to which the pressure of the steam varies as its volume expands; any such law being assumed, the velocity may be expressed by a mathematical formula in terms of that law and of other given elements of the question. The determination of it by experiment thus supplies a means (and apparently the best) of verifying the different formulæ which have been proposed to represent the true law of the expansion of steam.

M. Morin has himself kindly undertaken to superintend the construction of one of his instruments for the use of the Committee. It is in the hands of M. Breguet, and they hope to receive it early in November.

Nothing has hitherto approached to the admirable accuracy of the admeasurements stated to have been given by this instrument. It discriminates between spaces described in successive intervals of time, whose duration does not exceed the 10,000th part of a second, and *measures* them.

Report of a Committee on the Form of Ships. By JOHN SCOTT RUSSELL, *M.A.*

IT contained upwards of 20,000 observations, the result of careful experiments on the resistance to models of ships of more than a hundred different forms and sizes, and extending from small models of 30 inches long, to vessels of 25 feet, 60 feet, and 200 feet long, and above 1000 tons burden. These experiments were under the general superintendence of a Committee of the Association, consisting originally of Sir John Robison, Mr. Scott Russell, and Mr. Smith. Unfortunately, the ill-health of Mr. Smith's family had altogether deprived the Committee of his advice and assistance, but the observations were personally conducted by Mr. Scott Russell, who had to acknowledge the pleasure he had derived from conferring with his friend Sir John Robison, with whom he had frequent occasion to consult during the progress of the observations. The smaller experiments had been made in a reservoir in the ground attached to his (Mr. Russell's) residence, and the larger ones in the open sea. It was probable that these results, maturely digested, and illustrated by accurate drafts of the forms of the ships subjected to experiment, would be published in such completeness as might be practically serviceable to the naval constructor and mercantile ship-builder; and he would therefore confine the present Report to a general account of the objects contemplated in the experiments, and the method by which these designs had been carried out. Several series of experiments have already been made, both by scientific bodies and by public-spirited men, for the advancement of naval architecture. These had cost large sums of money, and consumed much valuable time and talent. To most of them it had been objected—unhappily not without reason—first, that they had not been conducted with an adequate knowledge of the wants of the constructor; secondly, that the forms of bodies submitted to experiment were by no means such as are used by the ship-builder; thirdly, that the scale on which these bodies were constructed was too small to claim for the results, as applied on a large scale, any considerable degree of confidence; fourthly, that it had not been established by what law the results of experiments on one scale of magnitude are to be transferred to a different scale, either greater or less; and, fifthly, that the apparatus formerly used was liable to errors which it was difficult to eliminate from the results. To obviate such objections was one great object in these experiments. Mr. Russell had contrived a new apparatus, which was so simple and convenient, that a uniform propelling force was obtained, by which vessels of any magnitude might be drawn by a uniform mechanical force along any given distance. The forms of the models employed were not confined to mathematical and arbitrary solids, but were those of such classes of ships as are either actually employed in navigation, or have been proposed for that purpose. Among these were some of the highest reputation. It was found that there were other circumstances besides the form of the vessel which affected the result; and that the form and dimensions of the channel were as important as those of the vessel in determining it. Experiments had been instituted on the largest as well as the smallest scale, to show the law of relation between different scales. These various modes of experiment were illustrated by reference to drawings and tables which were prepared for publication. As an illustration of the value of giving a proper FORM to ships, altogether independently of proportion or dimension, the following remarkable experiments were adduced:—Four vessels, of about twenty-five feet length, having all the same dimensions of breadth and depth, of the same capacity and weight, and of the same draft of water, were towed together at the same time, under the same circumstances and at the same velocity. Some writers on naval architecture have asserted that, in such circumstances, vessels would have precisely the same resistance. The forms of these four vessels were not, to an inexperienced eye, very dissimilar: they were all good sea boats, and each of them found its admirers to give its shape a preference over the others. These vessels, alike in all their principal dimensions, and weight, and area of midship section, and draft of water, differed so much in resistance, that the one had nearly double resistance to another: thus, at $7\frac{1}{8}$ miles an hour, the resistances were as follows:—

No. I. form	56·6	lbs. resistance.
No. II.	138·5	....
No. III.	102·7	....
No. IV.	90·2	....

All of these were good sea boats, and it was one of the most valuable of these results, that No. I., the form of least resistance, was found also the best sea boat, the easiest, and the driest. The whole of the observations, comprising more than 20,000, were in the course of preparation for publication, so that the whole body of the observations would be at the disposal of the Members of the Association. It had been the aim of the Committee to reduce the whole into the form most immediately conducive to the purposes of the naval constructor and mercantile ship-builder, and the drawings had been made on the scale and with the accuracy of the drafts of ships of the largest class.

Mr. Russell also explained a model showing the waves in a channel arising from the natural channel wave and the wave resulting from the form of the boat.

Report of a Committee appointed "to consider of the rules by which the Nomenclature of Zoology may be established on a uniform and permanent basis."

[*Minute of Council, Feb.* 11, 1842.

"Resolved,—That (with a view of securing early attention to the following important subject) a Committee consisting of Mr. C. Darwin, Prof. Henslow, Rev. L. Jenyns, Mr. W. Ogilby, Mr. J. Phillips, Dr. Richardson, Mr. H. E. Strickland (reporter), Mr. J. O. Westwood, be appointed, to consider of the rules by which the Nomenclature of Zoology may be established on a uniform and permanent basis; the report to be presented to the Zoological Section, and submitted to its Committee, at the Manchester Meeting.

Minute of the Committee of the Section of Zoology and Botany, June 29, 1842.

" Resolved,—That the Committee of the Section of Zoology and Botany have too little time during the Meeting of the Association to discuss a Report on Nomenclature, and therefore remit to the special Committee appointed to draw up the Report, to present it on their own responsibility."

THE Committee appointed by the Council of the British Association to carry out the above object, beg leave to report, that at the meetings which they held in London the following gentlemen were added to the Committee and assisted in its labours:—Messrs. W. J. Broderip, Prof. Owen, W. E. Shuckard, G. R. Waterhouse, and W. Yarrell. An outline of the proposed code of rules having been drawn up and printed, copies of it were sent to many eminent zoologists at home and abroad, who were requested to favour the Committee with their observations and comments. Many valuable suggestions were obtained from this source, by the aid of which the Committee were enabled to introduce several important modifications into the original plan. A few copies of the plan as amended were then printed for the use of the Committee, and the total cost of printing these two editions amounts to £4 10*s*.

As the probable success of this measure must greatly depend on its obtaining a rapid and extensive circulation among foreign as well as British zoologists, the Committee beg to recommend that a small sum (say £5 10*s*.) be appropriated for printing and distributing extra copies of this report in the form which it may finally assume in our Transactions.

The plan as amended has been further considered by the Committee during the present meeting at Manchester, and the Committee having thus given their best endeavours to maturing the plan, beg now to submit it to the approval of the British Association under the title of a

SERIES OF PROPOSITIONS FOR RENDERING THE NOMENCLATURE OF ZOOLOGY UNIFORM AND PERMANENT.

PREFACE.

All persons who are conversant with the present state of Zoology must be aware of the great detriment which the science sustains from the vagueness and uncertainty of its nomenclature. We do not here refer to those diversities of language which arise from the various methods of classification adopted by different authors, and which are unavoidable in the present state of our knowledge. So long as naturalists differ in the views which they are disposed to take of the natural affinities of animals there will always be diversities of classification, and the only way to arrive at the true system of nature is to allow perfect liberty to systematists in this respect. But the evil complained of is of a different character. It consists in this, that when naturalists *are* agreed as to the characters and limits of an individual group or species, they still disagree in the appellations by which they distinguish it. A genus is often designated by three or four, and a species by twice that number of precisely equivalent synonyms; and in the absence of any rule on the subject, the naturalist is wholly at a loss what nomenclature to adopt. The consequence is, that the so-called commonwealth of science is becoming daily divided into independent states, kept asunder by diversities of language as well as by geographical limits. If an English zoologist, for example, visits the museums and converses with the professors of France, he finds that their *scientific* language is almost as foreign to him as their *vernacular*. Almost every specimen which he examines is labeled by a title which is unknown to him, and he feels that nothing short of a continued residence in that country can make him conversant with her science. If he proceeds thence to Germany or Russia, he is again at a loss: bewildered everywhere amidst the confusion of nomenclature, he returns in despair to his own country and to the museums and books to which he is accustomed.

If these diversities of scientific language were as deeply rooted as the vernacular tongue of each country, it would of course be hopeless to think of remedying them; but happily this is not the case. The language of science is in the mouths of comparatively few, and these few, though scattered over distant lands, are in habits of frequent and friendly intercourse with each other. All that is wanted then is, that some plain and simple regulations, founded on justice and sound reason, should be drawn up by a competent body of persons, and then be extensively distributed throughout the zoological world.

The undivided attention of chemists, of astronomers, of anatomists, of mineralogists, has been of late years devoted to fixing their respective languages on a sound basis. Why, then, do zoologists hesitate in performing the same duty? at a time, too, when all acknowledge the evils of the present anarchical state of their science.

It is needless to inquire far into the causes of the present confusion of zoological nomenclature. It is in great measure the result of the same branch of science having been followed in distant countries by persons who were either unavoidably ignorant of each other's labours, or who neglected to inform themselves sufficiently of the state of the science in other regions. And when we remark the great obstacles which now exist to the circulation of books beyond the conventional limits of the states in which they happen to be published, it must be admitted that this ignorance of the writings of others, however unfortunate, is yet in great measure pardonable. But there is another source for this evil, which is far less excusable,—the practice of gratifying individual vanity by attempting on the most frivolous pretexts to cancel the terms established by original discoverers, and to substitute a new and unauthorized nomenclature in their place. One author lays down as a rule, that no specific names should be derived from geographical sources, and unhesitatingly proceeds to insert words of his own in all such cases; another declares war against names of exotic origin, foreign to the Greek and Latin; a third excommunicates all words which exceed a certain number of syllables; a fourth cancels all names which are complimentary of individuals, and so on, till universality and permanence, the two great essentials of scientific language, are utterly destroyed.

It is surely, then, an object well worthy the attention of the Zoological Section of the British Association for the Advancement of Science, to devise some means which may lessen the extent of this evil, if not wholly put an end to it. The best method of making the attempt seems to be, to entrust to a carefully selected committee the preparation of a series of rules, the adoption of which must be left to the sound sense of naturalists in general. By emanating from the British Association, it is hoped that the proposed rules will be invested with an authority which no individual zoologist, however eminent, could confer on them. The world of science is no longer a monarchy, obedient to the ordinances, however just, of an Aristotle or a Linnæus. She has now assumed the form of a republic, and although this revolution may have increased the vigour and zeal of her followers, yet it has destroyed much of her former order and regularity of government. The latter can only be restored by framing such laws as shall be based in reason and sanctioned by the approval of men of science; and it is to the preparation of these laws that the Zoological Section of the Association have been invited to give their aid.

In venturing to propose these rules for the guidance of all classes of zoologists in all countries, we disclaim any intention of dictating to men of science the course which they may see fit to pursue. It must of course be always at the option of authors to adhere to or depart from these principles, but we offer them to the candid consideration of zoologists, in the hope that they may lead to sufficient uniformity of method in future to rescue the science from becoming a mere chaos of words.

We now proceed to develope the details of our plan; and in order to make the reasons by which we are guided apparent to naturalists at large, it will be requisite to append to each proposition a short explanation of the circumstances which call for it.

Among the numerous rules for nomenclature which have been proposed by naturalists, there are many which, though excellent in themselves, it is not now desirable to enforce*. The cases in which those rules have been overlooked or departed from, are so numerous and of such long standing, that to carry these regulations into effect would undermine the edifice of zoological nomenclature. But while we do not adopt these propositions as authoritative laws, they may still be consulted with advantage in making such additions to the language of zoology as are required by the progress of the science. By adhering to sound principles of philology, we may avoid errors in future, even when it is too late to remedy the past, and the language of science will thus eventually assume an aspect of more classic purity than it now presents.

Our subject hence divides itself into two parts; the first consisting of *Rules* for the rectification of the present zoological nomenclature, and the second of *Recommendations* for the improvement of zoological nomenclature in future.

PART I.

RULES FOR RECTIFYING THE PRESENT NOMENCLATURE.

[*Limitation of the Plan to Systematic Nomenclature.*]

In proposing a measure for the establishment of a permanent and universal zoological nomenclature, it must be premised that we refer solely to the Latin or systematic language of zoology. We have nothing to do with vernacular appellations. One great cause of the neglect and corruption which prevails in the scientific nomenclature of zoology, has been the frequent and often exclusive use of vernacular names in lieu of the Latin binomial designations, which form the only legitimate language of systematic zoology. Let us then endeavour to render perfect the Latin or Linnæan method of nomenclature, which, being far removed from the scope of national vanities and modern antipathies, holds out the only hope of introducing into zoology that grand desideratum, an universal language.

[*Law of Priority the only effectual and just one.*]

It being admitted on all hands that words are only the conventional signs of ideas, it is evident that language can only attain its end effectually by being permanently established and generally recognized. This consideration ought, it would seem, to have checked those who are continually attempting to subvert the established language of zoology by substituting terms of their own coinage. But, forgetting the true nature of language, they persist in

* See especially the admirable code proposed in the 'Philosophia Botanica' of Linnæus. If zoologists had paid more attention to the principles of that code, the present attempt at reform would perhaps have been unnecessary.

confounding the *name* of a species or group with its *definition*; and because the former often falls short of the fullness of expression found in the latter, they cancel it without hesitation, and introduce some new term which appears to them more characteristic, but which is utterly unknown to the science, and is therefore devoid of all authority*. If these persons were to object to such names of men as *Long*, *Little*, *Armstrong*, *Golightly*, &c., in cases where they fail to apply to the individuals who bear them, or should complain of the names *Gough*, *Lawrence*, or *Harvey*, that they were devoid of meaning, and should hence propose to change them for more characteristic appellations, they would not act more unphilosophically or inconsiderately than they do in the case before us; for, in truth, it matters not in the least by what conventional sound we agree to designate an individual object, provided the sign to be employed be stamped with such an authority as will suffice to make it pass current. Now in zoology no one person can subsequently claim an authority equal to that possessed by the person who is the first to define a new genus or describe a new species; and hence it is that the name originally given, even though it may be inferior in point of elegance or expressiveness to those subsequently proposed, ought as a general principle to be permanently retained. To this consideration we ought to add the injustice of erasing the name originally selected by the person to whose labours we owe our first knowledge of the object; and we should reflect how much the permission of such a practice opens a door to obscure pretenders for dragging themselves into notice at the expense of original observers. Neither can an author be permitted to alter a name which he himself has once published, except in accordance with fixed and equitable laws. It is well observed by Decandolle, " L'auteur même qui a le premier établi un nom n'a pas plus qu'un autre le droit de le changer pour simple cause d'impropriété. La priorité en effet est un terme fixe, positif, qui n'admet rien, ni d'arbitraire, ni de partial."

For these reasons, we have no hesitation in adopting as our fundamental maxim, the " law of priority," viz.

§ 1. The name originally given by the founder of a group or the describer of a species should be permanently retained, to the exclusion of all subsequent synonyms (with the exceptions about to be noticed).

Having laid down this principle, we must next inquire into the limitations which are found necessary in carrying it into practice.

[*Not to extend to authors older than Linnæus.*]

As our subject matter is strictly confined to the *binomial system of nomenclature*, or that which indicates species by means of two Latin words, the one generic, the other specific, and as this invaluable method originated solely with Linnæus, it is clear that, as far as species are concerned, we ought not to attempt to carry back the principle of priority beyond the date of the 12th edition of the 'Systema Naturæ.' Previous to that period, naturalists were wont to indicate species not by a *name* comprised in one word, but by a *definition* which occupied a sentence, the extreme verbosity of which method was productive of great inconvenience. It is true that one word sometimes sufficed for the definition of a species, but these rare cases were only binomial by accident and not by principle, and ought not therefore in any instance to supersede the binomial designations imposed by Linnæus.

* Linnæus says on this subject, " Abstinendum ab hac innovatione quæ nunquam cessaret, quin indies aptiora detegerentur ad infinitum."

The same reasons apply also to generic names. Linnæus was the first to attach a definite value to genera, and to give them a systematic character by means of exact definitions; and therefore although the *names* used by previous authors may often be applied with propriety to modern genera, yet in such cases they acquire a new meaning, and should be quoted on the authority of the first person who used them in this secondary sense. It is true, that several of the old authors made occasional approaches to the Linnæan exactness of generic definition, but still these were but partial attempts; and it is certain that if in our rectification of the binomial nomenclature we once trace back our authorities into the obscurity which preceded the epoch of its foundation, we shall find no resting-place or fixed boundary for our researches. The nomenclature of Ray is chiefly derived from that of Gesner and Aldrovandus, and from these authors we might proceed backward to Ælian, Pliny, and Aristotle, till our zoological studies would be frittered away amid the refinements of classical learning*.

We therefore recommend the adoption of the following proposition:—

§ 2. The binomial nomenclature having originated with Linnæus, the law of priority, in respect of that nomenclature, is not to extend to the writings of antecedent authors.

[It should be here explained, that Brisson, who was a contemporary of Linnæus and acquainted with the 'Systema Naturæ,' defined and published certain genera of birds which are *additional* to those in the 12th edition of Linnæus's work, and which are therefore of perfectly good authority. But Brisson still adhered to the old mode of designating species by a sentence instead of a word, and therefore while we retain his defined genera, we do not extend the same indulgence to the titles of his species, even when the latter are accidentally binomial in form. For instance, the *Perdix rubra* of Brisson is the *Tetrao rufus* of Linnæus; therefore as we in this case retain the generic name of Brisson and the specific name of Linnæus, the correct title of the species would be *Perdix rufa*.]

[*Generic names not to be cancelled in subsequent subdivisions.*]

As the number of known species which form the groundwork of zoological science is always increasing, and our knowledge of their structure becomes more complete, fresh generalizations continually occur to the naturalist, and the number of genera and other groups requiring appellations is ever becoming more extensive. It thus becomes necessary to subdivide the contents of old groups and to make their definitions continually more restricted. In carrying out this process, it is an act of justice to the original author, that his generic name should never be lost sight of; and it is no less essential to the welfare of the science, that all which is sound in its nomenclature should remain unaltered amid the additions which are continually being made to it. On this ground we recommend the adoption of the following rule:—

§ 3. A generic name when once established should never be cancelled in any subsequent subdivision of the group, but retained in a restricted sense for one of the constituent portions.

[*Generic names to be retained for the typical portion of the old genus.*]

When a genus is subdivided into other genera, the original name should be retained for that portion of it which exhibits in the greatest degree its essential characters as at first defined. Authors frequently indicate this by selecting some one species as a fixed point of reference, which they term the

* "Quis longo ævo recepta vocabula commutaret hodie cum patrum?"—*Linnæus.*

"type of the genus." When they omit doing so, it may still in many cases be correctly inferred that the *first* species mentioned on their list, if found accurately to agree with their definition, was regarded by them as the type. A specific name or its synonyms will also often serve to point out the particular species which by implication must be regarded as the original type of a genus. In such cases we are justified in restoring the name of the old genus to its typical signification, even when later authors have done otherwise. We submit therefore that

§ 4. The generic name should always be retained for that portion of the original genus which was considered typical by the author.

Example.—The genus *Picumnus* was established by Temminck, and included two groups, one with four toes, the other with three, the *former* of which was regarded by the author as typical. Swainson, however, in raising these groups at a later period to the rank of genera, gave a new name, *Asthenurus*, to the *former* group, and retained *Picumnus* for the *latter*. In this case we have no choice but to restore the name *Picumnus*, Tem., to its correct sense, cancelling the name *Asthenurus*, Sw., and imposing a new name on the 3-toed group which Swainson had called *Picumnus*.

[*When no type is indicated, then the original name is to be kept for that subsequent subdivision which* first *received it.*]

Our next proposition seems to require no explanation :—

§ 5. When the evidence as to the original type of a genus is not perfectly clear and indisputable, then the person who first subdivides the genus may affix the original name to any portion of it at his discretion, and no later author has a right to transfer that name to any other part of the original genus.

[*A later name of the same extent as an earlier to be wholly cancelled.*]

When an author infringes the law of priority by giving a new name to a genus which has been properly defined and named already, the only penalty which can be attached to this act of negligence or injustice, is to expel the name so introduced from the pale of the science. It is not right then in such cases to restrict the meaning of the later name so that it may stand side by side with the earlier one, as has sometimes been done. For instance, the genus *Monaulus*, Vieill. 1816, is a precise equivalent to *Lophophorus*, Tem. 1813, both authors having adopted the same species as their type, and therefore when the latter genus came in the course of time to be divided into two, it was incorrect to give the condemned name *Monaulus* to one of the portions. To state this succinctly,

§ 6. When two authors define and name the same genus, *both making it exactly of the same extent*, the later name should be cancelled *in toto*, and not retained in a modified sense*.

This rule admits of the following exception :—

§ 7. Provided however, that if these authors select their respective types from different sections of the genus, and these sections be afterwards raised into genera, then both these names may be retained in a restricted sense for the new genera respectively.

Example.—The names *Œdemia* and *Melanetta* were originally co-exten-

* These discarded names may however be *tolerated*, if they have been afterwards proposed in a totally new sense, though we trust that in future no one will *knowingly* apply an old name, whether now adopted or not, to a new genus. (See proposition *q*, *infra*.)

sive synonyms, but their respective types were taken from different sections which are now raised into genera, distinguished by the above titles.

[No special rule is required for the cases in which the later of two generic names is so defined as to be *less extensive* in signification than the earlier, for if the later includes the type of the earlier genus, it would be cancelled by the operation of § 4; and if it does not include that type, it is in fact a distinct genus.]

But when the later name is *more extensive* than the earlier, the following rule comes into operation:—

[*A later name equivalent to several earlier ones is to be cancelled.*]

The same principle which is involved in § 6, will apply to § 8.

§ 8. If the later name be so defined as to be equal in extent to two or more previously published genera, it must be cancelled *in toto.*

Example.—*Psarocolius,* Wagl. 1827, is equivalent to five or six genera previously published under other names, therefore *Psarocolius* should be cancelled.

If these previously published genera be *separately adopted* (as is the case with the equivalents of *Psarocolius*), their original names will of course prevail; but if we follow the later author in combining them into one, the following rule is necessary:—

[*A genus compounded of two or more previously proposed genera whose characters are now deemed insufficient, should retain the name of one of them.*]

It sometimes happens that the progress of science requires two or more genera, founded on insufficient or erroneous characters, to be combined together into one. In such cases the law of priority forbids us to cancel *all* the original names and impose a *new* one on this compound genus. We must therefore select some one species as a type or example, and give the generic name which it formerly bore to the whole group now formed. If these original generic names differ in date, the oldest one should be the one adopted.

§ 9. In compounding a genus out of several smaller ones, the earliest of them, if otherwise unobjectionable, should be selected, and its former generic name be extended over the new genus so compounded.

Example.—The genera *Accentor* and *Prunella* of Vieillot not being considered sufficiently distinct in character, are now united under the general name of *Accentor*, that being the earliest. So also *Cerithium* and *Potamides,* which were long considered distinct, are now united, and the latter name merges into the former.

We now proceed to point out those few cases which form exceptions to the law of priority, and in which it becomes both justifiable and necessary to alter the names originally imposed by authors.

[*A name should be changed when previously applied to another group which still retains it.*]

It being essential to the binomial method to indicate objects in natural history by means of *two words* only, without the aid of any further designation, it follows that a generic name should only have one meaning, in other words, that two genera should never bear the same name. For a similar reason, no two species in the same genus should bear the same name. When these cases occur, the later of the two duplicate names should be cancelled, and a new term, or the earliest synonym, if there be any, substituted. When it is necessary to form new words for this purpose, it is desirable to make them bear some analogy to those which they are destined to supersede, as where the genus of birds, *Plectorhynchus*, being preoccupied in Ichthyology, is changed to *Plectorhamphus*. It is, we conceive, the bounden duty of an author when naming a new genus, to ascertain by careful search that the name which he proposes to employ has not been previously adopted in other departments of natural history*. By neglecting this precaution he is liable to have the name altered and his authority superseded by the first subsequent author who may detect the oversight, and for this result, however unfortunate, we fear there is no remedy, though such cases would be less frequent if the detectors of these errors would, as an act of courtesy, point them out to the author himself, if living, and leave it to him to correct his own inadvertencies. This occasional hardship appears to us to be a less evil than to permit the practice of giving the same generic name *ad libitum* to a multiplicity of genera. We submit therefore, that

§ 10. A name should be changed which has before been proposed for some other genus in zoology or botany, or for some other species in the same genus, when still retained for such genus or species.

[*A name whose meaning is glaringly false may be changed.*]

Our next proposition has no other claim for adoption than that of being a concession to human infirmity. If such proper names of places as Covent Garden, Lincoln's Inn Fields, Newcastle, Bridgewater, &c., no longer suggest the ideas of gardens, fields, castles, or bridges, but refer the mind with the quickness of thought to the particular localities which they respectively designate, there seems no reason why the proper names used in natural history should not equally perform the office of correct indication even when their etymological meaning may be wholly inapplicable to the object which they typify. But we must remember that the language of science has but a limited currency, and hence the words which compose it do not circulate with the same freedom and rapidity as those which belong to every-day life. The attention is consequently liable in scientific studies to be diverted from the contemplation of the thing signified to the etymological meaning of the sign, and hence it is necessary to provide that the latter shall not be such as to propagate actual error. Instances of this kind are indeed very rare, and in some cases, such as that of *Monodon*, *Caprimulgus*, *Paradisea apoda* and *Monoculus*, they have acquired sufficient currency no longer to cause error, and are therefore retained without change. But when we find a Batrachian reptile named in violation of its true affinities, *Mastodonsaurus*, a Mexican species termed (through erroneous information of its habitat) *Picus cafer*, or an olive-coloured one *Muscicapa atra*, or when a name is derived from an accidental monstrosity, as in *Picus semirostris* of Linnæus, and *Helix disjuncta* of Turton, we feel justified in cancelling these names, and adopting that synonym which stands next in point of date. At the same time we think it right to remark that this privilege is very liable to abuse, and ought therefore to be applied only to extreme cases and with great caution. With these limitations we may concede that

§ 11. A name may be changed when it implies a false proposition which is likely to propagate important errors.

[*Names not clearly defined may be changed.*]

Unless a species or group is intelligibly defined when the name is given, it cannot be recognized by others, and the signification of the name is consequently lost. Two things are necessary before a zoological term can acquire

* This laborious and difficult research will in future be greatly facilitated by the very useful work of M. Agassiz, entitled " Nomenclator Zoologicus."

any authority, viz. *definition* and *publication*. Definition properly implies a distinct exposition of essential characters, and in all cases we conceive this to be indispensable, although some authors maintain that a mere enumeration of the component species, or even of a single type, is sufficient to authenticate a genus. To constitute *publication*, nothing short of the insertion of the above particulars *in a printed book* can be held sufficient. Many birds, for instance, in the Paris and other continental museums, shells in the British Museum (in Dr. Leach's time), and fossils in the Scarborough and other public collections, have received MS. names which will be of no authority until they are published*. Nor can any unpublished descriptions, however exact (such as those of Forster, which are still shut up in a MS. at Berlin), claim any right of priority till published, and then only from the date of their publication. The same rule applies to cases where groups or species are published, but not defined, as in some museum catalogues, and in Lesson's 'Traité d'Ornithologie,' where many species are enumerated by name, without any description or reference by which they can be identified. Therefore

§ 12. A name which has never been clearly defined in some published work should be changed for the earliest name by which the object shall have been so defined.

[*Specific names, when adopted as generic, must be changed.*]

The necessity for the following rule will be best illustrated by an example. The *Corvus pyrrhocorax*, Linn., was afterwards advanced to a genus under the name of *Pyrrhocorax*. Temminck adopts this generic name, and also retains the old specific one, so that he terms the species *Pyrrhocorax pyrrhocorax*. The inelegance of this method is so great as to demand a change of the specific name, and the species now stands as *Pyrrhocorax alpinus*, Vieill. We propose therefore that

§ 13. A new specific name must be given to a species when its old name has been adopted for a genus which includes that species.

N.B. It will be seen, however, below, that we strongly object to the further continuance of this practice of elevating specific names into generic.

[*Latin orthography to be adhered to.*]

On the subject of orthography it is necessary to lay down one proposition,—

§ 14. In writing zoological names the rules of Latin orthography must be adhered to.

In Latinizing Greek words there are certain rules of orthography known to classical scholars which must never be departed from. For instance, the names which modern authors have written *Aipunemia*, *Zenophasia*, *poiocephala*, must, according to the laws of etymology, be spelt *Æpycnemia*, *Xenophasia* and *pœocephala*. In Latinizing modern words the rules of classic usage do not apply, and all that we can do is to give to such terms as classical an appearance as we can, consistently with the preservation of their etymology. In the case of European words whose orthography is fixed, it is best to retain the original form, even though it may include letters and combinations unknown in Latin. Such words, for instance, as *Woodwardi*, *Knighti*, *Bullocki*, *Eschscholtzi*, would be quite unintelligible if they were Latinized into *Vudvardi*, *Cnichti*, *Bullocci*, *Essolzi*, &c. But words of barbarous origin, having no fixed orthography, are more pliable, and hence, when adopted into the Latin, they should be rendered as classical in appear-

* These MS. names are in all cases liable to create confusion, and it is therefore much to be desired that the practice of using them should be avoided in future.

ance as is consistent with the preservation of their original sound. Thus the words *Tockus, awsuree, argoondah, kundoo,* &c. should, when Latinized, have been written *Toccus, ausure, argunda, cundu,* &c. Such words ought, in all practicable cases, to have a Latin termination given them, especially if they are used generically.

In Latinizing proper names, the simplest rule appears to be to use the termination *-us,* genitive *-i,* when the name ends with a consonant, as in the above examples; and *-ius,* gen. *-ii,* when it ends with a vowel, as *Latreille, Latreillii,* &c.

In converting Greek words into Latin the following rules must be attended to:—

Greek.		Latin.	Greek.		Latin.
αι	becomes	æ.	θ	becomes	th.
ει	„	i.	φ	„	ph.
ος	terminal,	us	χ	„	ch.
ον	„	um.	κ	„	c.
ου	becomes	u.	γχ	„	nch.
οι	„	œ.	γγ	„	ng.
υ	„	y.	ʽ	„	h.

When a name has been erroneously written and its orthography has been afterwards amended, we conceive that the authority of the original author should still be retained for the name, and not that of the person who makes the correction.

PART II.

RECOMMENDATIONS FOR IMPROVING THE NOMENCLATURE IN FUTURE.

The above propositions are all which in the present state of the science it appears practicable to invest with the character of laws. We have endeavoured to make them as few and simple as possible, in the hope that they may be the more easily comprehended and adopted by naturalists in general. We are aware that a large number of other regulations, some of which are hereafter enumerated, have been proposed and acted upon by various authors who have undertaken the difficult task of legislating on this subject; but as the enforcement of such rules would in many cases undermine the invaluable principle of priority, we do not feel justified in adopting them. At the same time we fully admit that the rules in question are, for the most part, founded on just criticism, and therefore, though we do not allow them to operate retrospectively, we are willing to retain them for future guidance. Although it is of the first importance that the principle of priority should be held paramount to all others, yet we are not blind to the desirableness of rendering our scientific language palatable to the scholar and the man of taste. Many zoological terms, which are now marked with the stamp of perpetual currency, are yet so far defective in construction, that our inability to remove them without infringing the law of priority may be a subject of regret. With these terms we cannot interfere, if we adhere to the principles above laid down; nor is there even any remedy, if authors insist on infringing the rules of good taste by introducing into the science words of the same inelegant or unclassical character in future. But that which cannot be enforced by law may, in some measure, be effected by persuasion; and with this view we submit the following propositions to naturalists, under the title of *Recommendations for the improvement of Zoological Nomenclature in future.*

[*The best names are Latin or Greek characteristic words.*]

The classical languages being selected for zoology, and words being more easily remembered in proportion as they are expressive, it is self-evident that

§ A. The *best* zoological names are those which are derived from the Latin or Greek, and express some distinguishing characteristic of the object to which they are applied.

[*Classes of objectionable names.*]

It follows from hence that the following classes of words are more or less objectionable in point of taste, though, in the case of *genera*, it is often necessary to use them, from the impossibility of finding characteristic words which have not before been employed for other genera. We will commence with those which appear the least open to objection, such as

a. Geographical names.—These words being for the most part adjectives can rarely be used for *genera*. As designations of *species* they have been so strongly objected to, that some authors (Wagler, for instance) have gone the length of substituting fresh names wherever they occur; others (*e.g.* Swainson) will only tolerate them where they apply *exclusively*, as *Lepus hibernicus*, *Troglodytes europæus*, &c. We are by no means disposed to go to this length. It is not the less true that the *Hirundo javanica* is a Javanese bird, even though it may occur in other countries also, and though other species of *Hirundo* may occur in Java. The utmost that can be urged against such words is, that they do not tell the *whole truth.* However, as so many authors object to this class of names, it is better to avoid giving them, except where there is reason to believe that the species is chiefly confined to the country whose name it bears.

b. Barbarous names.—Some authors protest strongly against the introduction of exotic words into our Latin nomenclature, others defend the practice with equal warmth. We may remark, first, that the practice is not contrary to classical usage, for the Greeks and Romans did occasionally, though with reluctance, introduce barbarous words in a modified form into their respective languages. Secondly, the preservation of the trivial names which animals bear in their native countries is often of great use to the traveller in aiding him to discover and identify species. We do not therefore consider, if such words have a Latin termination given to them, that the occasional and judicious use of them as scientific terms can be justly objected to.

c. Technical names.—All words expressive of trades and professions have been by some writers excluded from zoology, but without sufficient reason. Words of this class, *when carefully chosen*, often express the peculiar characters and habits of animals in a metaphorical manner, which is highly elegant. We may cite the generic terms *Arvicola*, *Lanius*, *Pastor*, *Tyrannus*, *Regulus*, *Mimus*, *Ploceus*, &c., as favourable examples of this class of names.

d. Mythological or historical names.—When these have no perceptible reference or allusion to the characters of the object on which they are conferred, they may be properly regarded as unmeaning and in bad taste. Thus the generic names *Lesbia*, *Leilus*, *Remus*, *Corydon*, *Pasiphae*, have been applied to a Humming bird, a Butterfly, a Beetle, a Parrot, and a Crab respectively, without any perceptible association of ideas. But mythological names may sometimes be used as generic with the same propriety as technical ones, in cases where a direct allusion can be traced between the narrated actions of a personage and the observed habits or structure of an animal. Thus when the name *Progne* is given to a Swallow, *Clotho* to a Spider, *Hydra* to a Polyp, *Athene* to an Owl, *Nestor* to a grey-headed Parrot, &c., a pleasing and beneficial connexion is established between classical literature and physical science.

e. Comparative names.—The objections which have been raised to words of this class are not without foundation. The names, no less than the definitions of objects, should, where practicable, be drawn from positive and self-evident characters, and not from a comparison with other objects, which may be less known to the reader than the one before him. Specific names expressive of comparative size are also to be avoided, as they may be rendered inaccurate by the after-discovery of additional species. The names *Picoides, Emberizoides, Pseudoluscinia, rubeculoides, maximus, minor, minimus*, &c. are examples of this objectionable practice.

f. Generic names compounded from other genera.—These are in some degree open to the same imputation as comparative words; but as they often serve to express the position of a genus as intermediate to, or allied with, two other genera, they may occasionally be used with advantage. Care must be taken not to adopt such compound words as are of too great length, and not to corrupt them in trying to render them shorter. The names *Gallopavo, Tetraogallus, Gypaetos*, are examples of the appropriate use of compound words.

g. Specific names derived from persons.—So long as these complimentary designations are used with moderation, and are restricted to persons of eminence as scientific zoologists, they may be employed with propriety in cases where expressive or characteristic words are not to be found. But we fully concur with those who censure the practice of naming species after persons of no scientific reputation, as curiosity dealers (e. g. *Caniveti, Boissoneauti*), Peruvian priestesses (*Cora, Amazilia*), or Hottentots (*Klassi*).

h. Generic names derived from persons.—Words of this class have been very extensively used in botany, and therefore it would have been well to have excluded them wholly from zoology, for the sake of obtaining a *memoria technica* by which the name of a genus would at once tell us to which of the kingdoms of nature it belonged. Some few personal generic names have however crept into zoology, as *Cuvieria, Mulleria, Rossia, Lessonia*, &c., but they are very rare in comparison with those of botany, and it is perhaps desirable not to add to their number.

i. Names of harsh and inelegant pronunciation.—These words are grating to the ear, either from inelegance of form, as *Huhua, Yuhina, Craxirex, Eschscholtzi*, or from too great length, as *chirostrongylostinus, Opetiorhynchus, brachypodioides, Thecodontosaurus*, not to mention the *Enaliolimnosaurus crocodilocephaloides* of a German naturalist. It is needless to enlarge on the advantage of consulting euphony in the construction of our language. As a general rule it may be recommended to avoid introducing words of more than five syllables.

k. Ancient names of animals applied in a wrong sense.—It has been customary, in numerous cases, to apply the names of animals found in classic authors at random to exotic genera or species which were wholly unknown to the ancients. The names *Cebus, Callithrix, Spiza, Kitta, Struthus*, are examples. This practice ought by no means to be encouraged. The usual defence for it is, that it is impossible now to identify the species to which the name was anciently applied. But it is certain that if any traveller will take the trouble to collect the vernacular names used by the modern Greeks and Italians for the Vertebrata and Mollusca of southern Europe, the meaning of the ancient names may in most cases be determined with the greatest precision. It has been well remarked that a Cretan fisher-boy is a far better commentator on Aristotle's 'History of Animals' than a British or German scholar. The use however of ancient names, *when correctly applied*, is most desirable, for "in framing scientific terms, the appropriation of old words is preferable to the formation of new ones*."

l. Adjective generic names.—The names of genera are, in all cases, essentially substantive, and hence adjective terms cannot be employed for them

* Whewell, Phil. Ind. Sc. v. i. p. lxvii.

without doing violence to grammar. The generic names *Hians, Criniger, Cursorius, Nitidula*, &c. are examples of this incorrect usage.

m. Hybrid names.—Compound words, whose component parts are taken from two different languages, are great deformities in nomenclature, and naturalists should be especially guarded not to introduce any more such terms into zoology, which furnishes too many examples of them already. We have them compounded of Greek and Latin, as *Dendrofalco, Gymnocorvus, Monoculus, Arborophila, flavigaster*; Greek and French, as *Jacamaralcyon, Jacamerops*; and Greek and English, as *Bullockoides, Gilbertsocrinites.*

n. Names closely resembling other names already used.—By Rule 10 it was laid down, that when a name is introduced which is *identical* with one previously used, the later one should be changed. Some authors have extended the same principle to cases where the later name, when correctly written, only approaches in form, without wholly coinciding with the earlier. We do not, however, think it advisable to make this law imperative, first, because of the vast extent of our nomenclature, which renders it highly difficult to find a name which shall not bear more or less resemblance in sound to some other; and, secondly, because of the impossibility of fixing a limit to the degree of approximation beyond which such a law should cease to operate. We content ourselves, therefore, with putting forth this proposition merely as a recommendation to naturalists, in selecting generic names, to avoid such as too closely approximate words already adopted. So with respect to species, the judicious naturalist will aim at variety of designation, and will not, for example, call a species *virens* or *virescens* in a genus which already possesses a *viridis*.

o. Corrupted words.—In the construction of compound Latin words, there are certain grammatical rules which have been known and acted on for two thousand years, and which a naturalist is bound to acquaint himself with before he tries his skill in coining zoological terms. One of the chief of these rules is, that in compounding words all the radical or essential parts of the constituent members must be retained, and no change made except in the variable terminations. But several generic names have been lately introduced which run counter to this rule, and form most unsightly objects to all who are conversant with the spirit of the Latin language. A name made up of the first half of one word and the last half of another, is as deformed a monster in nomenclature as a Mermaid or a Centaur would be in zoology; yet we find examples in the names *Corcorax* (from *Corvus* and *Pyrrhocorax*), *Cypsnagra* (from *Cypselus* and *Tanagra*), *Merulaxis* (*Merula* and *Synallaxis*), *Loxigilla* (*Loxia* and *Fringilla*), &c. In other cases, where the *commencement* of both the simple words is retained in the compound, a fault is still committed by cutting off too much of the radical and vital portions, as is the case in *Bucorvus* (from *Buceros* and *Corvus*), *Ninox* (*Nisus* and *Noctua*), &c.

p. Nonsense names.—Some authors having found difficulty in selecting generic names which have not been used before, have adopted the plan of coining words at random without any derivation or meaning whatever. The following are examples: *Viralva, Xema, Azeca, Assiminia, Quedius, Spisula.* To the same class we may refer *anagrams* of other generic names, as *Dacelo* and *Cedola* of *Alcedo*, *Zapornia* of *Porzana*, &c. Such verbal trifling as this is in very bad taste, and is especially calculated to bring the science into contempt. It finds no precedent in the Augustan age of Latin, but can be compared only to the puerile quibblings of the middle ages. It is contrary to the genius of all languages, which appear never to produce new words by spontaneous generation, but always to derive them from some other source, however distant or obscure. And it is peculiarly annoying to the etymologist, who after seeking in vain through the vast storehouses of human language for the parentage of such words, discovers at last that he has been pursuing an *ignis fatuus*.

q. Names previously cancelled by the operation of § 6.—Some authors consider that when a name has been reduced to a synonym by the operations of the laws of priority, they are then at liberty to apply it at pleasure to any new group which may be in want of a name. We consider, however, that when a word has once been proposed in a given sense, and has afterwards sunk into a synonym, it is far better to lay it aside for ever than to run the risk of making confusion by re-issuing it with a new meaning attached.

r. Specific names raised into generic.—It has sometimes been the practice in subdividing an old genus to give to the lesser genera so formed, the names of their respective typical species. Our Rule 13 authorizes the forming a new specific name in such cases; but we further wish to state our objections to the practice altogether. Considering as we do that the original specific names should as far as possible be held sacred, both on the grounds of justice to their authors and of practical convenience to naturalists, we would strongly dissuade from the *further continuance* of a practice which is gratuitous in itself, and which involves the necessity of altering long-established specific names.

We have now pointed out the principal rocks and shoals which lie in the path of the nomenclator; and it will be seen that the navigation through them is by no means easy. The task of constructing a language which shall supply the demands of scientific accuracy on the one hand, and of literary elegance on the other, is not to be inconsiderately undertaken by unqualified persons. Our nomenclature presents but too many flaws and inelegancies already, and as the stern law of priority forbids their removal, it follows that they must remain as monuments of the bad taste or bad scholarship of their authors to the latest ages in which zoology shall be studied.

[*Families to end in* idæ, *and Subfamilies in* inæ.]

The practice suggested in the following proposition has been adopted by many recent authors, and its simplicity and convenience is so great that we strongly recommend its universal use.

§ B. It is recommended that the assemblages of genera termed *families* should be uniformly named by adding the termination *idæ* to the name of the earliest known, or most typically characterized genus in them; and that their subdivisions, termed *subfamilies*, should be similarly constructed, with the termination *inæ*.

These words are formed by changing the last syllable of the genitive case into *idæ* or *inæ*, as *Strix, Strigis, Strigidæ, Buceros, Bucerotis, Bucerotidæ*, not *Strixidæ, Buceridæ*.

[*Specific names to be written with a small initial.*]

A convenient *memoria technica* may be effected by adopting our next proposition. It has been usual, when the titles of species are derived from proper names, to write them with a capital letter, and hence when the specific name is used alone it is liable to be occasionally mistaken for the title of a genus. But if the titles of *species* were *invariably* written with a *small* initial, and those of *genera* with a *capital*, the eye would at once distinguish the rank of the group referred to, and a possible source of error would be avoided. It should be further remembered that all species are *equal*, and should therefore be written all *alike*. We suggest, then, that

§ C. Specific names should *always* be written with a small initial letter, even when derived from persons or places, and generic names should be always written with a capital.

[*The authority for a species, exclusive of the genus, to be followed by a distinctive expression.*]

The systematic names of zoology being still far from that state of fixity which is the ultimate aim of the science, it is frequently necessary for correct indication to append to them the name of the person on whose authority they have been proposed. When the same person is authority both for the specific and generic name, the case is very simple; but when the specific name of one author is annexed to the generic name of another, some difficulty occurs. For example, the *Muscicapa crinita* of Linnæus belongs to the modern genus *Tyrannus* of Vieillot; but Swainson was the first to apply the specific name of Linnæus to the generic one of Vieillot. The question now arises, Whose authority is to be quoted for the name *Tyrannus crinitus*? The expression *Tyrannus crinitus*, Lin., would imply what is untrue, for Linnæus did not use the term *Tyrannus*; and *Tyrannus crinitus*, Vieill., is equally incorrect, for Vieillot did not adopt the name *crinitus*. If we call it *Tyrannus crinitus*, Sw., it would imply that Swainson was the first to describe the species, and Linnæus would be robbed of his due credit. If we term it *Tyrannus*, Vieill., *crinitus*, Lin., we use a form which, though expressing the facts correctly, and therefore not without advantage in particular cases where great exactness is required, is yet too lengthy and inconvenient to be used with ease and rapidity. Of the three persons concerned with the construction of a binomial title in the case before us, we conceive that the author who *first* describes and names a species which forms the groundwork of later generalizations, possesses a higher claim to have his name recorded than he who afterwards defines a genus which is found to embrace that species, or who may be the mere accidental means of bringing the generic and specific names into contact. By giving the authority for the *specific* name in preference to all others, the inquirer is referred *directly* to the original description, habitat, &c. of the species, and is at the same time reminded of the date of its discovery; while genera, being less numerous than species, may be carried in the memory, or referred to in systematic works without the necessity of perpetually quoting their authorities. The most simple mode then for ordinary use seems to be to append to the original authority for the species, when not applying to the genus also, some distinctive mark, such as (*sp.*) implying an exclusive reference to the *specific* name, as *Tyrannus crinitus*, Lin. (*sp.*), and to omit this expression when the same authority attaches to both genus and species, as *Ostrea edulis*, Lin.* Therefore,

§ D. It is recommended that the authority for a specific name, *when not applying to the generic name also*, should be followed by the distinctive expression (*sp.*).

[*New genera and species to be defined* amply *and* publicly.]

A large proportion of the complicated mass of synonyms which has now become the opprobrium of zoology, has originated either from the slovenly and imperfect manner in which species and groups have been originally defined, or from their definitions having been inserted in obscure local publications which have never obtained an extensive circulation. Therefore, although under § 12, we have conceded that mere insertion in a printed book is sufficient for *publication*, yet we would strongly advise the authors of new groups always to give in the first instance a full and accurate definition of their characters, and to insert the same in such periodical or other works as are likely to obtain an immediate and extensive circulation. To state this briefly,

* The expression *Tyrannus crinitus* (Lin.) would perhaps be preferable from its greater brevity.

§ E. It is recommended that new genera or species be *amply* defined, and *extensively* circulated in the first instance.

[*The names to be given to subdivisions of genera to agree in gender with the original genus.*]

In order to preserve specific names as far as possible in an unaltered form, whatever may be the changes which the genera to which they are referred may undergo, it is desirable, when it can be done with propriety, to make the new subdivisions of genera agree *in gender* with the old groups from which they are formed. This recommendation does not however authorize the changing the gender or termination of a genus already established. In brief,

§ F. It is recommended that in subdividing an old genus in future, the names given to the subdivisions should agree in gender with that of the original group.

[*Etymologies and types of new genera to be stated.*]

It is obvious that the names of genera would in general be far more carefully constructed, and their definitions would be rendered more exact, if authors would adopt the following suggestion:—

§ G. It is recommended that in defining new genera the etymology of the name should be always stated, and that one species should be invariably selected as a type or standard of reference.

In concluding this outline of a scheme for the rectification of zoological nomenclature, we have only to remark, that almost the whole of the propositions contained in it may be applied with equal correctness to the sister science of botany. We have preferred, however, in this essay to limit our views to zoology, both for the sake of rendering the question less complex, and because we conceive that the botanical nomenclature of the present day stands in much less need of distinct enactment than the zoological. The admirable rules laid down by Linnæus, Smith, Decandolle, and other botanists (to which, no less than to the works of Fabricius, Illiger, Vigors, Swainson, and other zoologists, we have been much indebted in preparing the present document), have always exercised a beneficial influence over their disciples. Hence the language of botany has attained a more perfect and stable condition than that of zoology; and if this attempt at reformation may have the effect of advancing zoological nomenclature beyond its present backward and abnormal state, the wishes of its promoters will be fully attained.

(Signed)	H. E. Strickland.	J. S. Henslow.
June 27, 1842.	John Phillips.	W. E. Shuckard.
	John Richardson.	G. R. Waterhouse.
	Richard Owen.	W. Yarrell.
	Leonard Jenyns.	C. Darwin.
	W. J. Broderip.	J. O. Westwood.

Report of a Committee of the British Association for the Advancement of Science, consisting of Lieut.-Colonel W. H. Sykes, *F.R.S., Lord* Sandon, *M.P.,* G. R. Porter, *Esq., F.R.S.,* J. Heywood, *Esq., F.R.S., Dr.* W. P. Alison, *and* E. Chadwick, *Esq., on the Vital Statistics of large Towns in Scotland.*

Your Committee, in pursuance of the Resolution of the General Committee of the Association in 1840, at Glasgow, selected the towns of Edinburgh (with Leith), Glasgow, Aberdeen, Perth and Dundee, as best suited for their inquiries, from their population, the occupations of their inhabitants, and their local positions, not only as affording data for useful comparison between towns having a common character, but also between those with differences in their social organization or in their physical circumstances. Mr. Alexander Watt of Glasgow, who has established a claim to public respect by his Mortality Bills of Glasgow and other statistical works, was good enough to undertake the severe labour of accumulating the facts which constitute the present Report. From the very imperfect state of the Registers of Marriages, Births and Deaths in Scotland, it required no ordinary perseverance and tact to obviate the deficiencies; but Mr. Watt's zeal enabled him to surmount all difficulties, and he presented to the Committee a series of facts absolutely embarrassing from their amount and elaborate and detailed character. Mr. Watt's facts were comprised in 119 tables, and in the state in which they were presented it was found that, together with the text, the report would occupy 199 pages of the annual volume of the Association, a portion of the volume which the Committee felt they ought not to desire to have appropriated to their report. With this feeling a re-arrangement of the tables and text was attempted, and by new modelling, dove-tailing and trifling omissions of certain columns in the tables, and by some omissions and reconstruction of a few paragraphs in the text, the tables have been reduced to eighty in number, and the pages occupied by the report will not exceed eighty-seven. It is believed that these alterations have been effected without the omission of any important facts; it certainly has been effected without the omission of one of the original tables, although it must be admitted that certain columns have been left out in the marriage tables to which Mr. Watt attaches some weight; and in justice to him this explanation is made. But the marriage tables, as a whole, are necessarily imperfect, and the omission therefore of details intended to explain the elements of the totals in the marriage tables it was thought might be made without injury. The original manuscript, however, of the report will be deposited in the archives of the British Association, and will be available to those who may be desirous of instituting comparisons between it and the printed report.

While the sheets of this report were passing through the press, the Fourth Annual Report of the Registrar-General of Births, Deaths and Marriages in England was presented to Parliament. As it contained later information than that on which the tables for English towns, LXXV., LXXVII., LXXIX. and LXXX. of this report, had been originally founded, it was thought right, with a view to insure greater accuracy, to substitute the present tables of the mortality in England for the former tables. The elements for determining the averages in tables LXXV., LXXVII. and LXXIX., are supplied by the Registrar-General's report; and table LXXX., containing the proportion of deaths to the population in certain English towns, has been copied from the same report. The English tables offer valuable standards of comparison with those from the Scottish towns.

The Committee close their Report on the Vital Statistics of large Towns in Scotland with the expression of their regret that the want of a systematic plan for the registration of marriages, births and deaths renders their report less perfect than they could have desired; nevertheless the facts accumulated open out a prospect of ascertaining, in the continued progress of their researches, certain physical laws in vital statistics, the knowledge of which may be of considerable importance, not only in the formation of more correct estimates of the value of life in the different relations of society, but also in guiding the judgement of the legislator and the philanthropist in encountering the physical evils resulting from moral causes.

W. H. Sykes, *Chairman of the Committee.*

TABLE I.—Abstract of the Total Proclamation of Marriages, as engrossed in the Registers of the City of Edinburgh and Suburbs.

	1838.			1839.			1840.			1841.		
	No.	Inc.	Dec.	No.	Inc.	Dec.	No.	Inc.	Dec.	No.	Inc.	Dec.
In the City	374	......	......	406	32	......	401	......	5	458	57	
In St. Cuthbert's	726	......	......	748	22	......	738	......	10	682	......	56
In the Canongate	112	......	......	114	2	......	94	......	20	93	......	1
In the Society of Friends	1	......	......	......	......	1	1	1	......	......	......	1
In the Jewish Society	1	......	......	1	......	......	1	......	......	1		
Total	1214	......	......	1269	56	1	1235	1	35	1234	57	58
Deduct Fems. of double proclamations and marriages not effected	......	......	......	243	......	......	237	......	......	229		
Total marriages	......	......	......	1026*	......	......	998	......	......	1005†		

TABLE II.—Abstract of the Proclamation of Marriages, as engrossed in the Registers of the Parishes of North and South Leith.

	1838.			1839.			1840.			1841.		
	No.	Inc.	Dec.	No.	Inc.	Dec.	No.	Inc.	Dec.	No.	Inc.	Dec.
In South Leith	198	......	......	184‡	......	14	218	34	......	215§	...	3
In North Leith	96	......	......	96	......	......	73	......	23	99	26	
Total	294	......	......	280	......	14	291	34	23	314	26	3
Deduct Fems. of double proclamations and marriages not effected	......	......	......	34	......	......	45	......	......	40		
Total marriages	......	......	......	246	......	......	246	......	......	274		

* Exclusive of 4 irregular marriages. † Exclusive of 2 irregular marriages.

‡ Of 368 individuals proclaimed in S. Leith, 145 single men married single women, 10 single men married widows, 19 widowers married single women, and 10 widowers married widows.

§ 24 widowers married single women, 7 single men married widows, and 3 widowers married widows, the rest were single persons; 149 marriages were celebrated by the Kirk clergy, and 65 by ministers of other denominations.

Table III.

Showing the Number of Proclamations of Marriages, as engrossed Monthly in the Registers of the City of Edinburgh and Suburban Districts of St. Cuthbert's and the Canongate. Distinguishing—I. Those cases in which both parties resided in the same parish; II. Those in which the parties resided in different parishes; and III. Those in which the warrants were not called for.

Months.	1839. I.	1839. II. Mls.	1839. II. Fem.	1839. Total Males.	1839. Total Females.	1839. Total Individ.	1839. III.	1840. I.	1840. II. Mls.	1840. II. Fem.	1840. Total Males.	1840. Total Females.	1840. Total Individ.	1840. III.	1841. I.	1841. II. Mls.	1841. II. Fem.	1841. Total Males.	1841. Total Females.	1841. Total Individ.	1841. III.
January	75	12	14	87	89	176	...	46	14	17	60	63	123	...	62	9	14	71	76	147	...
February	47	9	15	56	62	118	...	45	14	19	59	64	123	...	56	17	12	73	68	141	2
March	65	15	17	80	82	162	...	60	22	20	82	80	162	...	50	10	8	60	58	118	...
April	65	17	21	82	86	168	...	57	14	12	71	69	140	...	62	15	23	77	85	162	...
May	59	15	18	74	77	151	...	89	20	16	109	105	214	1	102	15	23	117	125	242	1
June	122	24	39	146	161	307	1	95	31	40	126	135	261	1	101	17	24	118	125	243	...
July	64	19	24	83	88	171	...	43	16	19	59	62	121	...	86	10	22	96	108	204	...
August	54	4	11	58	65	123	...	70	20	19	90	89	179	...	52	12	8	64	60	124	1
September	56	7	15	63	71	134	...	51	13	13	64	64	128	1	35	20	17	55	52	107	...
October	63	13	17	76	80	156	...	46	14	9	60	55	115	1	45	11	19	56	64	120	...
November	94	14	29	108	123	231	1	102	29	26	131	128	259	...	102	22	34	124	136	260	1
December	94	21	21	115	115	230	...	74	18	22	92	96	188	1	78	21	20	99	98	197	1
Total	858	170	241	1028	1099	2127	2	778	225	232	1003	1010	2013	5	831	179	224	1010	1055	2065	6
Warrants not called for	2	...	...	2	2	4		5	...	...	5	5	10		5	...	1	5	6	11	
Total of mar. in which one or both resided in Edinburgh and Suburbs	856	170	241	1026	1097	2123	...	773	225	232	998	1005	2003	...	826	179	223	1005	1049	2054	
Add total individuals proclaimed in two different parishes						411	...						457	...						403	
Ditto individuals proclaimed but not married						4	...						10	...						11	
Divide by 2						2538	...						2470	...						2468	
Total amount of proclamations of marriages in 1839						1269	...						1235	...						1234	

Table IV.

Showing the Number of Proclamations of Marriages, as engrossed Monthly in the Registers of the Town of Leith. Distinguishing—I. Those cases in which both parties resided in the same parish; II. Those in which the parties resided in different parishes; and III. Those in which the warrants were not called for.

Months.	1839.							1840.							1841.						
	I.	II.		Total Males.	Total Females.	Total Individ.	III.	I.	II.		Total Males.	Total Females.	Total Individ.	III.	I.	II.		Total Males.	Total Females.	Total Individ.	III.
		Mls.	Fem.						Mls.	Fem.						Mls.	Fem.				
January	17	2	...	19	17	36	...	17	1	2	18	19	37	...	10	8	3	18	13	31	1
February	16	2	3	18	19	37	...	16	6	2	22	18	40	1	13	3	4	16	17	33	1
March	11	4	3	15	14	29	...	14	4	5	18	19	37	...	18	4	4	22	22	44	
April	18	3	...	21	18	39	...	11	3	3	14	14	28	...	14	7	5	21	19	40	
May	20	1	...	21	20	41	...	25	5	6	30	31	61	...	22	6	1	28	23	51	
June	30	2	9	32	39	71	...	27	7	4	34	31	65	...	25	11	4	36	29	65	
July	13	1	4	14	17	31	...	8	3	1	11	9	20	...	16	2	1	19	18	37	
August	12	2	1	14	13	27	...	10	2	...	12	10	22	...	12	2	2	14	14	28	
September	21	1	2	22	23	45	...	10	5	2	15	12	27	...	18	2	1	20	19	39	
October	7	2	2	9	9	18	...	6	4	7	10	13	23	...	18	3	2	21	20	41	
November	27	6	6	33	33	66	...	30	4	7	34	37	71	...	30	9	9	39	39	78	
December	25	5	2	30	27	57	...	21	8	5	29	26	55	...	20	2	2	22	22	44	
Total	217	31	32	248	249	497	2	195	52	44	247	239	486	1	216	59	38	276	255	531	2
Warrants not called for	2	...	...	2	2	4	...	1	...	...	1	1	2	...	2	...	...	2	2	4	
Total of mar. in which one or both resided in Leith and Suburbs	215	31	32	246	247	493	...	194	52	44	246	238	484	...	214	59	38	274	253	527	
Add total individuals proclaimed in two different parishes						63	...						96	...						97	
Ditto individuals proclaimed but not married						4	...						2	...						4	
Divide by 2						560	...						582	...						628	
Total amount of proclamations of marriages in 1839						280	...						291	...						314	

TABLE V.—Abstract of the Amount of Proclamations of Marriages, as engrossed in the Registers of St. Nicholas and Old Machar Parishes, Aberdeen.

	1837.			1838.			1839.			1840.			1841.		
	Nos.	Inc.	Dec.	Nos.	Inc.	Dec.	Nos.	Inc.	Dec.	Nos.	Inc.	Dec.	Nos.	Inc.	Dec.
In St. Nicholas	313	...	...	282	...	31	297	15	...	296	...	1	323	26	
In Old Machar	223	...	...	234	11	...	215	...	19	218	3	...	236	18	
In the Society of Friends															
Total	536	...	...	516	11	31	512	15	19	514	3	1	559	44	
Deduct Fems. of double proclamations and marriages not effected.	76	...	...	60	...	...	79	...	...	79	...	...	80		
Total marriages	460	...	...	456	...	...	433	...	...	435	...	...	479		

Table VI.

Showing the Number of Proclamations of Marriages, as engrossed Monthly in the Registers of the City of Aberdeen and Suburban Districts. Distinguishing—I. Those cases in which both parties resided in the same parish; II. Those in which the parties resided in different parishes; and III. Those in which the warrants were not called for.

Months.	1837.							1838.							1839.						
	I.	II.		Total Males.	Total Females.	Total Individ.	III.	I.	II.		Total Males.	Total Females.	Total Individ.	III.	I.	II.		Total Males.	Total Females.	Total Individ.	III.
		Mls.	Fem.						Mls.	Fem.						Mls.	Fem.				
January	22	8	7	30	29	59	...	30	6	4	36	34	70	...	29	5	7	34	36	70	
February	27	6	9	33	36	69	...	26	4	4	30	30	60	...	26	5	3	31	29	60	
March	18	5	5	23	23	46	...	24	2	2	26	26	52	...	25	2	5	27	30	57	
April	31	5	7	36	38	74	...	30	4	3	34	33	67	...	19	5	6	24	25	49	
May	32	10	7	42	39	81	...	32	5	4	37	36	73	...	29	7	15	36	44	80	
June	34	7	10	41	44	85	...	30	12	6	42	46	78	...	42	11	10	53	52	105	
July	35	8	4	43	39	82	...	32	8	7	40	39	79	...	26	3	7	29	33	62	
August	13	4	1	17	14	31	...	28	4	2	32	30	62	1	30	7	2	37	32	69	1
September	29	6	5	35	34	69	...	27	2	4	29	31	60	...	28	3	1	31	29	60	
October	25	4	5	29	30	59	...	36	2	7	38	43	81	...	28	6	5	34	33	67	
November	51	10	12	61	63	124	...	51	11	11	62	62	124	...	41	10	15	51	56	107	
December	59	11	4	70	63	133	...	42	9	5	51	47	98	...	38	9	2	47	40	87	
Total	376	84	76	460	452	912	...	388	69	59	457	447	904	1	361	73	78	434	439	873	1
Warrants not called for	...	...	...	...	...	...	...	...	1	...	1	...	1	...	1	...	...	1	1	2	
Total of mar. in which one or both resided in Aberdeen and Suburbs...	376	84	76	460	452	912	...	388	68	59	456	447	903	...	360	73	78	433	438	871	
Add total individuals proclaimed in two different parishes...						160	...						128	...						151	
Ditto individuals proclaimed but not married						...	...						1	...						2	
Divide by 2						1072	...						1032	...						1024	
Total amount of proclamations of marriages in 1837						536	...						516	...						512	

TABLE VI. (*Continued.*)

Showing the Number of Proclamations of Marriages, as engrossed Monthly, in the Registers of the City of ABERDEEN and Suburban Districts. Distinguishing—I. Those cases in which both parties resided in the same parish; II. Those in which the parties resided in different parishes; and III. Those in which the warrants were not called for.

Months.	1840. I.	1840. II. Mls.	1840. II. Fem.	1840. Total Males.	1840. Total Females.	1840. Total Individ.	1840. III.	1841. I.	1841. II. Mls.	1841. II. Fem.	1841. Total Males.	1841. Total Females.	1841. Total Individ.	1841. III.
January	41	5	4	46	45	91	...	36	3	3	39	39	78	
February	24	1	5	25	29	54	...	27	4	7	31	34	65	
March	20	3	5	23	25	48	...	24	3	5	27	29	56	
April	20	3	4	23	24	47	...	19	2	3	21	22	43	
May	40	9	11	49	51	100	...	45	9	14	54	59	113	
June	40	6	4	46	44	90	...	47	15	10	62	57	119	
July	19	3	6	22	25	47	...	33	8	7	41	40	81	
August	25	7	10	32	35	67	...	27	3	2	30	29	59	
September	24	5	5	29	29	58	...	34	2	7	36	41	77	
October	23	6	4	29	27	56	...	31	4	4	35	35	70	
November	49	12	14	61	63	124	...	45	13	9	58	54	112	
December	44	6	7	50	51	101	...	37	8	9	45	46	91	
Total	369	66	79	435	448	883	...	405	74	80	479	485	964	
Warrants not called for														
Total of mar. in which one or both resided in Aberdeen and Suburbs	369	66	79	435	448	883	...	405	74	80	479	485	964	
Add total individuals proclaimed in two different parishes						145	...						154	
Ditto individuals proclaimed but not married														
Divide by 2						1028	...						1118	
Total proclamations of marriages						514	...						559	

TABLE VII.—Abstract of the Amount of Proclamations of Marriages, as engrossed in the Registers of the City of PERTH and Suburban District of Kinnoul.

	1837.			1838.			1839.			1840.			1841.		
	Nos.	Inc.	Dec.	Nos.	Inc.	Dec.	Nos.	Inc.	Dec.	Nos.	Inc.	Dec.	Nos.	Inc.	Dec.
In the City of Perth	154	...	...	155	1	...	171	16	...	137	...	34	144	7	
In the Parish of Kinnoul	27	...	...	30	3	...	25	...	5	29	4	...	11	...	18
Total	181	...	...	185	4	...	196	16	5	166	4	34	155	7	18
Deduct double proclamations and marriages not effected	39	...	...	40	...	...	43	...	...	39	...	...	23		
Total marriages	142	...	...	145	...	...	153	...	...	127	...	...	132		

TABLE VIII.—Abstract of the Amount of Proclamations of Marriages, as engrossed in the parochial Register of DUNDEE.

	1837.			1838.			1839.			1840.			1841.		
	Nos.	Inc.	Dec.	Nos.	Inc.	Dec.	Nos.	Inc.	Dec.	Nos.	Inc.	Dec.	Nos.	Inc.	Dec.
In the Parish of Dundee	544	...	...	563	19	...	590	27	...	507	...	83	561	54	
Deduct double proclamations and marriages not effected	38	...	...	28	...	...	40	...	...	29	...	...	32		
Total	506	...	...	535	...	...	550	...	...	478	...	...	529		

Table IX.

Showing the Number of Proclamations of Marriages, as engrossed Monthly, in the Registers of the City of PERTH and Suburban district of Kinnoul. Distinguishing—I. Those cases in which both parties resided in the same parish; II. Those in which the parties resided in different parishes; and III. Those in which the warrants were not called for.

Months.	1837.							1838.							1839.						
	I.	II.		Total Males.	Total Females.	Total Individ.	III.	I.	II.		Total Males.	Total Females.	Total Individ.	III.	I.	II.		Total Males.	Total Females.	Total Individ.	III.
		Mls.	Fem.						Mls.	Fem.						Mls.	Fem.				
January	5	3	3	8	8	16	...	7	...	2	7	9	16	...	9	2	9	11	18	29	
February	5	2	1	7	6	13	...	8	1	3	9	11	20	...	5	4	1	9	6	15	
March	3	1	2	4	5	9	...	2	...	2	2	4	6	...	12	1	3	13	15	28	
April	13	...	4	13	17	30	...	5	4	3	9	8	17	...	12	1	1	13	13	26	
May	15	3	4	18	19	37	...	8	2	5	10	13	23	...	18	3	7	21	25	46	
June	6	4	5	10	11	21	...	17	4	2	21	19	40	...	18	3	6	21	24	45	
July	13	2	2	15	15	30	...	9	1	2	10	11	21	...	10	...	1	10	11	21	
August	8	2	5	10	13	23	...	7	1	4	8	11	19	...	7	...	3	7	10	17	
September	5	2	2	7	7	14	...	7	1	1	8	8	16	...	3	1	2	4	5	9	
October	5	4	4	9	9	18	...	11	3	5	14	16	30	...	10	3	2	13	12	25	
November	18	6	4	24	22	46	...	28	4	7	32	35	67	..	14	2	4	16	18	34	
December	13	4	3	17	16	33	...	11	4	4	15	15	30	...	15	...	4	15	19	34	
Total	109	33	39	142	148	290	...	120	25	40	145	160	305	...	133	20	43	153	176	329	
Warrants not called for																					
Total of marriages in which one or both resided in Perth and Suburbs.	109	33	39	142	148	290	...	120	25	40	145	160	305	...	133	20	43	153	176	329	
Add total individuals proclaimed in two different parishes... Ditto individuals proclaimed but not married						72	...						65	...						63	
Divide by 2						362	...						370	...						392	
Total proclamations of marriages						181	...						185	...						196	

Table IX. (*Continued.*)

Showing the Number of Proclamations of Marriages, as engrossed Monthly, in the City of PERTH and Suburban District of Kinnoul. Distinguishing—I. Those cases in which both parties resided in the same parish; II. Those in which the parties resided in different parishes; and III. Those in which the warrants were not called for.

Months.	1840.							1841.						
	I.	II.		Total Males.	Total Females.	Total Individ.	III.	I.	II.		Total Males.	Total Females.	Total Individ.	III.
		Mls.	Fem.						Mls.	Fem.				
January	8	2	3	10	11	21	...	6	2	2	8	8	16	
February	12	3	2	15	14	29	...	9	2	...	11	9	20	
March	6	...	2	6	8	14	...	6	...	...	6	6	12	
April	8	1	2	9	10	19	...	5	5	...	10	5	15	
May	12	6	7	18	19	37	...	16	5	2	21	18	39	
June	12	2	2	14	14	28	2	8	2	2	10	10	20	
July	5	3	1	8	6	14	...	8	2	...	10	8	18	
August	5	2	3	7	8	15	1	8	1	4	9	12	21	
September	4	1	...	6	5	11	...	5	...	2	5	7	12	
October	8	4	1	12	9	21	...	12	5	3	17	15	32	
November	13	5	9	18	22	40	...	8	5	4	13	12	25	
December	7	...	4	7	11	18	...	10	2	4	12	14	26	
Total	100	29	36	130	137	267	3	101	31	23	132	124	256	
Warrants not called for	2	...	1	2	3	5								
Total of marriages in which one or both resided in Perth and Suburbs.	98	29	35	128	134	262	...	101	31	23	132	124	256	
Add total individuals proclaimed in two different parishes						65	...						54	
Ditto individuals proclaimed but not married						5								
Divide by 2						332	...						310	
Total proclamations of marriages						166	...						155	

TABLE X.

Showing the Number of Proclamations of Marriages, as engrossed Monthly, in the Registers of the Town of DUNDEE. Distinguishing—I. Those cases in which both parties resided in the same parish; II. Those in which the parties resided in different parishes; and III. Those in which the warrants were not called for.

Months.	1837.							1838.							1839.						
	I.	II.		Total Males.	Total Females.	Total Individ.	III.	I.	II.		Total Males.	Total Females.	Total Individ.	III.	I.	II.		Total Males.	Total Females.	Total Individ.	III.
		Mls.	Fem.						Mls.	Fem.						Mls.	Fem.				
January	39	3	3	42	42	84	...	33	6	3	39	36	75	2	47	4	4	51	51	102	...
February	36	4	2	40	38	78	...	29	5	1	34	30	64	1	22	2	3	24	25	49	1
March	43	4	...	47	43	90	...	26	2	3	28	29	57	...	31	1	1	32	32	64	...
April	40	4	2	44	42	86	...	18	2	...	20	18	38	...	26	2	1	28	27	55	...
May	53	3	1	56	54	110	...	47	9	1	56	48	104	...	69	6	6	75	75	150	...
June	39	8	3	47	42	89	1	58	4	2	62	60	122	...	56	7	1	63	57	120	...
July	34	3	5	37	39	76	1	30	2	1	32	31	63	...	39	3	5	42	44	86	...
August	14	7	...	21	14	35	...	42	...	2	42	44	86	...	48	1	1	49	49	98	...
September	31	4	3	35	34	69	2	39	2	1	41	40	81	...	29	2	1	31	30	61	1
October	42	1	3	43	45	88	...	42	2	4	44	46	90	1	26	4	3	30	29	59	1
November	51	4	5	55	56	111	2	62	12	3	74	65	139	...	72	8	6	80	78	58	...
December	39	5	6	44	45	89	...	61	6	3	67	64	131	...	43	5	5	48	48	96	...
Total	461	50	33	511	494	1005	6	487	52	24	539	511	1050	4	508	45	37	553	545	1098	3
Warrants not called for	4	1	1	5	5	10	...	4	...	...	4	4	8	...	3	...	...	3	3	6	
Total of marriages in which one or both resided in Dundee	457	49	32	506	489	995	...	483	52	24	535	507	1042	...	505	45	37	550	542	1092	
Add total individuals proclaimed in two different parishes						83	...						76	...						82	
Ditto individuals proclaimed but not married						10	...						8	...						6	
Divide by 2						1088	...						1126	...						1180	
Total proclamations of marriages						544	...						563	...						590	

TABLE X. (*Continued.*)

Showing the Number of Proclamations of Marriages, as engrossed Monthly, in the Registers of the Town of DUNDEE. Distinguishing—I. Those cases in which both parties resided in the same parish; II. Those in which the parties resided in different parishes; and III. Those in which the warrants were not called for.

Months.	1840.							1841.						
	I.	II.		Total Males.	Total Females.	Total Individ.	III.	I.	II.		Total Males.	Total Females.	Total Individ.	III.
		Mls.	Fem.						Mls.	Fem.				
January	48	3	1	51	49	100	...	46	1	2	47	48	95	...
February	37	5	4	42	41	83	...	27	4	...	31	27	58	...
March	24	2	3	26	27	53	1	23	2	1	25	24	49	...
April	28	1	...	29	28	57	...	45	1	1	46	46	92	...
May	53	5	1	58	54	112	...	66	1	3	67	69	136	...
June	25	6	...	31	25	56	...	39	1	4	40	43	83	...
July	26	3	...	29	26	55	1	41	4	4	45	45	90	...
August	38	5	1	43	39	82	1	22	5	1	27	23	50	1
September	15	...	...	15	15	30	...	29	2	1	31	30	61	1
October	36	3	4	39	40	79	2	42	2	...	44	42	86	...
November	57	8	5	65	62	127	1	50	6	6	56	56	112	...
December	54	2	4	56	58	114	...	70	4	5	74	75	149	2
Total	441	43	23	484	464	948	6	500	33	28	533	528	1061	4
Warrants not called for	6	...	...	6	6	12		3	1	...	4	3	7	
Total of marriages in which one or both resided in Dundee	435	43	23	478	458	936	...	497	32	28	529	525	1054	
Add total individuals proclaimed in two different parishes						66	...						61	
Ditto individuals proclaimed but not married						12	...						7	
Divide by 2						1014	...						1122	
Total proclamations of marriages						507	...						561	

MARRIAGES.

Till within these three years the amount of proclamations of marriages has generally been given as the amount of marriages, both in the Glasgow and Dundee mortality bills, the only towns in Scotland where attention has been paid to the regular publication of bills of mortality. The preceding tables of the proclamations of marriages for Edinburgh and Leith, Glasgow, Aberdeen, Perth and Dundee, furnish sufficient evidence, that to assume the total number of the proclamations as the amount of marriages, in any case, is exceedingly fallacious. For example, Table III. shows that in Edinburgh, in 1839, the proclamations of marriages amounted to 1269, whereas the number of regular marriages (Table I.) amounted only to 1026. A similar difference will be observed between the amount of proclamations and the number of marriages during the several years for all these towns, arising from a number of the parties residing in different parishes, in which cases there are two proclamations for one marriage. The arrangement which has been followed in these tables is that lately adopted in the Glasgow mortality bills; and, in the event of the clergyman who celebrated the marriages, as well as the other parties concerned, having adhered to their strict line of duty in enforcing the parties married to produce the proper warrants of the proclamations of banns from their respective parishes, the accuracy of the results in these tables is not to be doubted. It is known, however, that several irregularities take place with regard to the fulfilment of the law, in relation to the proclamations of marriages,—a circumstance which necessarily produces some inaccuracy, however slight, in the results brought out in the marriage tables.

The proclamation fees are considerably lower in some parishes of Scotland than in others, and parties have been known to make false statements of their places of residence to escape paying the higher fee; this has taken place more especially in those cases where one of the parties resided in the parish where the low fees are paid. In other cases this irregularity has taken place to save the payment of double fees, which would be necessary, were the parties proclaimed in their respective parishes as required by law. Cases are also known in which ministers have married parties on the production of one warrant, although the parties were known to have resided in different parishes; so that marriages have taken place in a few instances where the warrants were not called for. On the other hand, some cases have occurred in which the parties were not married although the warrants were called for. These cases may therefore be considered as balancing each other; and notwithstanding these irregularities, the foregoing tables of marriages, constructed as they are from the returns made by the respective session clerks, may be considered as nearer to the truth than any tables in other departments of vital statistics in Scotland, arising from the very defective and partial system of registering births and deaths that exists in the country.

EDINBURGH.

It will be found, that of the inhabitants of the city of Edinburgh, including the parishes of St. Cuthbert's and the Canongate, the average annual number of males married during the years 1839, 1840, and 1841 is $1009\frac{2}{3}$, females $1050\frac{1}{3}$; the total average annual number of individuals married during these years being 2060.

Therefore the average annual number of males married in Edinburgh, compared to the number of male inhabitants ascertained by the Census of 1841, is as .... 1 to 60·725, or 1·646 per cent.
The average annual number of females married, to the female population, as........ 1 to 73·185, or 1·366 per cent.
Greater proportion of the male than of the female population married, by .... 0·280 per cent.

While there is on an average of these three years 0·280 per cent. more of the male than of the female population of Edinburgh married, it appears that on the average of these years there is 3·87 per cent. more females than males married*.

The average annual number of individuals married, to the total population, is as 1 to 67·078, or 1·490 per cent.

It will be observed, that in the different tables of the proclamations of marriages, it is assumed that all the females after marriage went to reside in the parish to which their husbands belonged, and the females of the double proclamations are accordingly deducted to obtain the amount of the resident marriages. The following table is constructed on this principle.

Table XI.

Exhibiting the proportion which the resident marriages in EDINBURGH and suburban districts of St. Cuthbert's and Canongate, during the years 1839, 1840 and 1841, bear to the population of these years.

Years.	Population.	Marriages.	Proportion of Marriages to the Population being as 1 to
1839.	137,756	1030	133·743, or 0·747 per cent.
1840.	137,986	998	138·262, or 0·723 ...
1841.	138,182	1007	137·221, or 0·728 ...

The average annual amount of marriages, to the mean population, of these three years, being as 1 to 136·394, or 0·733 per cent.

Leith.

It will be found, that of the inhabitants of North and South Leith, the average annual number of males married during the years 1839, 1840, and 1841 is 255⅓, females 246; the total average annual number of individuals married during these years being 501⅓.

Therefore the average annual number of males married in Leith, compared with the number of males as ascertained by the Census of 1841, is as........................ 1 to 51·857, or 1·928 per cent.
The average annual number of females married, to the female population, is as...... 1 to 61·508, or 1·625 per cent.
Greater proportion of the male than of the female population married, by .... 0·303 per cent.

While there is on an average of these three years 0·303 per cent. more of the male than of the female population of Leith married, it appears that on the average of these years there is 3·65 per cent. more males than females married†.

* By the Census of 1841, there are 125·37 females to every 100 males in Edinburgh.
† By the Census of 1841, there are 114·27 females to every 100 males in North and South Leith.

The average annual number of individuals married, to the population, is as 1 to 56·593, or 1·767 per cent.

Table XII.

Exhibiting the proportion which the resident marriages in the parishes of North and South LEITH, during the years 1839, 1840 and 1841, bear to the population of these years.

Years.	Population.	Marriages.	Proportion of Marriages to the Population, being as 1 to
1839.	27,846	246	113·195, or 0·883 per cent.
1840.	28,103	246	114·239, or 0·875 ...
1841.	28,372	274	103·547, or 0·965 ...
The average annual amount of marriages, to the mean population of these three years, being as 1 to 110·063, or 0·908 per cent.			

Edinburgh and Leith.

As the inhabitants of Edinburgh and Leith are so intimately connected with each other, the results obtained from the marriages of the two combined, to their united population, may be the nearest to the truth. These are as follows.

Of the inhabitants of Edinburgh and Leith, the average annual number of males married during the years 1839, 1840 and 1841 is 1265, females 1296⅓; the total average annual number of individuals married during these years being 2561⅓.

The average annual number of males married in Edinburgh and Leith, compared with the number of males as ascertained by the Census of 1841, is as.	1 to 58·935, or 1·696 per cent.
The average annual number of females married to the female population, as.	1 to 70·969, or 1·409 per cent.
Greater proportion of the male than of the female population married, by	0·287 per cent.

While there is on an average of these three years 0·287 per cent. more of the male than of the female population of Edinburgh and Leith married, it appears that on the average of these years there is 2·41 per cent. more females than males married*.

The average annual number of individuals married, to the total population, is as 1 to 65·026, or 1·537 per cent.

* By the Census of 1841, there are 123·40 females to every 100 males in Edinburgh and Leith.

TABLE XIII.

Exhibiting the proportion which the resident marriages in EDINBURGH and LEITH, during the years 1839, 1840 and 1841, bear to the population of these years; also the average annual amount of marriages to the mean population.

Years.	Population.	Marriages.	Proportion of Marriages to the Population, being as 1 to
1839.	165,602	1276	129·782, or 0·770 per cent.
1840.	166,089	1244	133·512, or 0·748 ...
1841.	166,554	1281	130·019, or 0·769 ...
The average annual amount of resident marriages, to the mean population of these years, being as 1 to 131·088, or 0·762 per cent.			

GLASGOW.

The tables of marriages published in the Glasgow Mortality Bills for 1839, 1840 and 1841, show that of the inhabitants of the city of Glasgow and the suburban parishes of Barony and Gorbals, the average annual number of males married during the years 1837, 1838, 1839, 1840 and 1841, was $2186\frac{1}{5}$, females $2166\frac{4}{5}$; the total average annual number of individuals married during these years being 4353.

Therefore the average annual number of males married these five years in Glasgow and suburbs, compared with the number of males as ascertained by the Census of 1841, is as	1 to 61·333, or 1·630 per cent.
The average annual number of females married, to the female population, as	1 to 68·325, or 1·463 per cent.
Greater proportion of the male than of the female population married, by	0·167 per cent.

While there was on an average of these five years 0·167 per cent. more of the male than of the female population of Glasgow married, it appears that on the average of these years there was 0·887 per cent. fewer females than males married*.

The average annual number of individuals married, to the total population, is as 1 to 64·813, or 1·542 per cent.

* By the Census of 1841, there were 110·41 females to every 100 males in Glasgow.

Table XIV.

Exhibiting the proportion which the resident marriages in GLASGOW and Suburbs, during the years 1837, 1838, 1839, 1840 and 1841, bear to the population of these years; also the average annual amount of marriages to the mean population.

Years.	Population.	Marriages.	Proportion of Marriages to the Population, being as 1 to
1837.	247,040	1927	128·200, or 0·780 per cent.
1838.	255,390	2193	116·457, or 0·858 ...
1839.	264,010	2177	127·272, or 0·824 ...
1840.	272,900	2294	118·962, or 0·840 ...
1841.	282,134	2382	118·444, or 0·844 ...

The average annual amount of marriages, to the mean population of these five years, being as 1 to 120·290, or 0·831 per cent.

Aberdeen.

It will be found, that of the inhabitants of New and Old Aberdeen, the average annual number of males married during the years 1837, 1838, 1839, 1840 and 1841 is $452\frac{3}{5}$, females 454; the total average annual number of individuals married during these five years being $906\frac{3}{5}$.

The average annual number of males married in Aberdeen, compared with the number of males as ascertained by the Census of 1841, is as	1 to 62·609, or 1·597 per cent.
The average annual number of females married, to the female population, as	1 to 80·266, or 1·245 per cent.
Greater proportion of the males than of the female population married, by	0·352 per cent.

While there is on an average of these five years 0·352 per cent. more of the male than of the female population of Aberdeen married, it appears that on the average of these years there is 0·30 per cent. more females than males married*.

The average annual number of individuals married, to the total population, is as 1 to 71·451, or 1·399 per cent.

* By the Census of 1841, there were 128·59 females to every 100 males in Aberdeen.

TABLE XV.

Exhibiting the proportion which the resident marriages in ABERDEEN, during the years 1837, 1838, 1839, 1840 and 1841, bear to the population of these years; also the average annual amount of marriages to the mean population.

Years.	Population.	Marriages.	Proportion of Marriages to the Population, being as 1 to
1837.	61,985	460	134·750, or 0·742 per cent.
1838.	62,672	456	137·438, or 0·727 ...
1839.	63,366	433	146·341, or 0·683 ...
1840.	64,068	435	147·282, or 0·678 ...
1841.	64,778	479	135·235, or 0·739 ...
The average annual amount of resident marriages, to the mean population of these five years, being as 1 to 140·004, or 0·714 per cent.			

PERTH.

It will be found, that of the inhabitants of Perth and suburban district of Kinnoul, the average annual number of males married during the years 1837, 1838, 1839, 1840 and 1841 is 140, females $148\frac{2}{5}$; the total average annual number of individuals married during these years being $288\frac{2}{5}$.

The average annual number of males married in Perth and Kinnoul, compared with the number of males as ascertained by the Census of 1841, is as	1 to 73·471, or 1·361 per cent.
The average annual number of females married, to the female population, is as	1 to 80·094, or 1·248 per cent.
Greater proportion of the male than of the female population married, by	0·113 per cent.

While there is on an average of these five years 0·113 per cent. more of the male than of the female population of Perth married, it appears that on the average of these years there is 5·66 per cent. more females than males married*.

The average annual number of individuals married, to the total population, is as 1 to 76·879, or 1·300 per cent.

* By the Census of 1841, there were 115·55 females to every 100 males in Perth.

Table XVI.

Exhibiting the proportion which the resident marriages in PERTH and the suburban district of Kinnoul, during the years 1837, 1838, 1839, 1840 and 1841, bear to the population of these years; also the average annual amount of marriages to the mean population.

Years.	Population.	Marriages.	Proportion of Marriages to the Population, being as 1 to
1837.	22,489	142	158·373, or 0·631 per cent.
1838.	22,409	145	154·544, or 0·647 ...
1839.	22,330	153	145·947, or 0·685 ...
1840.	22,251	127	175·204, or 0·570 ...
1841.	22,172	132	167·969, or 0·595 ...
The average annual amount of resident marriages, to the mean population of these five years, being as 1 to 159·728, or 0·626 per cent.			

Dundee.

It will be found, that of the inhabitants of the town of Dundee, the average annual number of males married during the years 1837, 1838, 1839, 1840 and 1841 is 519$\frac{3}{5}$, females 504$\frac{1}{5}$; the total average annual number of individuals married during these years being 1023$\frac{4}{5}$.

Therefore the average annual number of males married in Dundee, compared with the total number of males as ascertained by the Census of 1841, is as..................	1 to 54·486, or 1·835 per cent.
The average annual number of females married, to the female population, is as	1 to 65·904, or 1·517 per cent.
Greater proportion of the male than of the female population married, by	0·318 per cent.

While there is on an average of these five years 0·318 per cent. more of the male than of the female population of Dundee married, it appears that on the average of these years there is 2·96 per cent. more males than females married *.

The average annual number of individuals married, to the total population, is as 1 to 60·109, or 1·663 per cent.

* By the Census of 1841, there were 117·37 females to every 100 males in Dundee.

TABLE XVII.

Exhibiting the proportion which the resident marriages in DUNDEE, during the years 1837, 1838, 1839, 1840 and 1841, bear to the population of these years; also the average annual amount of marriages to the mean population.

Years.	Population.	Marriages.	Proportion of Marriages to the Population, being as 1 to
1837.	54,467	506	107·642, or 0·929 per cent.
1838.	56,156	535	104·964, or 0·952 ...
1839.	57,897	550	105·267, or 0·949 ...
1840.	59,691	478	124·876, or 0·800 ...
1841.	61,540	529	116·332, or 0·859 ...
The average annual amount of resident marriages, to the mean population of these five years, being as 1 to 111·426, or 0·897 per cent.			

TABLE XVIII.

Average annual proportion of marriages in the towns comprised in the Report compared with each other.

	Marriages of Individuals as 1 to	Percentage.	Marriages to Population as 1 to	Percentage.
Edinburgh and Leith	65·026	1·537	131·088	0·762
Glasgow and Parishes.....	64·813	1·542	120·290	0·831
Aberdeen.....................	71·451	1·399	140·004	0·714
Perth and Kinnoul..........	76·879	1·300	159·728	0·626
Dundee	60·109	1·663	111·426	0·897

GENERAL REMARKS.

The principal objects held in view in arranging the foregoing statistical information, have been to exhibit as accurately as possible the annual number of individuals married who are resident within the boundaries of the chief towns in Scotland, and to compare the amount of annual marriages which take place on an average of years, in the belief that observations on the difference in the amount of annual marriages in those towns where the condition of the inhabitants is so various may lead to interesting results.

The differences in the amount of these annual marriages are found to be very great; but to point out the exact causes of these differences would require a more minute and accurate knowledge of the moral condition and physical circumstances of the people than we are possessed of, and would exceed the limits of this Report; but by the statement of facts contained in the preceding pages an advance is made which has long been desired in Scotland, where so little attention has been generally paid to vital statistics. The tables open a new field, though still a limited one, to the statist whose object it is to trace the immediate causes of changes which affect the welfare of the people, with a view to suggest such improvements as may arrest in its progress a retrograde movement in the condition of the inhabitants of large towns: a movement to which public attention has lately so frequently been drawn.

To acquire, for instance, a correct knowledge of the causes of the great difference in the amount of annual marriages in Perth and in Dundee, would be of moment. These two towns are situated within twenty miles of each other, with every facility of intercourse by coach and by steam-boat.

A large proportion of the inhabitants of Perth are in easy and comfortable circumstances; and it will be observed, that the average annual amount of marriages in that city for the last five years is 1 to 159·72, while in Dundee, where there is a large proportion of poor and destitute people, as appears from the great proportion of burials at the public expense, the average annual amount of marriages for the last five years, to the mean population, is as 1 to 111·42!

In Edinburgh, exclusive of Leith, the average annual amount of marriages for the last three years, to the mean population, is as 1 to 136·39, while in Leith, with numerous poor, they are as 1 to 110·06 to the mean population of these years. In Glasgow and suburbs, where a very large proportion of the inhabitants is in destitute circumstances, arising from the influx of labour being greater than the demand, and from other causes, the average annual amount of marriages, to the mean population, for the last five years, is as 1 to 120·29.

And in Aberdeen, where the poor and destitute bear a much smaller proportion to the whole inhabitants than they do in Glasgow, the average annual amount of resident marriages is as 1 to 140·00*. It would appear from these observations, therefore, that in those towns where there is the greatest amount of poverty and destitution, and where, as will afterwards appear, the mortality is greatest, the annual number of marriages is the greatest. It is to be feared a moral law is here shadowed out, the result of physical causes; but we would not, however, be understood as coming at once to this conclusion, although in accordance with other observations, as there is much yet required to be done by the statist before we can arrive at a full and accurate knowledge of the social condition of the inhabitants of large towns in Scotland. Were the registers so kept that we could ascertain the ages and occupations of the parties married, more light would be thrown on this subject.

The law for the regulation of marriages in England allows parties from a distance, by a residence of eight days before marriage in any of the towns, to be recorded in the Register of Marriages as inhabitants of the town. This is understood frequently to take place, and more especially where one of the parties is an inhabitant of the town; consequently the amount of marriages for some of these towns, as exhibited in the reports of the Registrar-General, must appear greater than they really are; and, compared with those towns of Scotland for which the marriages are stated in the preceding pages, would lead to inaccurate results. It would be desirable to ascertain the amount of the male and of the female inhabitants married of each town and district, which is not shown in the Registrar-General's reports, with a view to give an accurate knowledge of the proportion of the marriages in any given place to the population of that place. It is necessary to remark, that in the preceding tables of marriages, instead of deriving our information from the amount of marriages which take place, and which are nearly as imperfectly recorded in some registers as the births, owing to the carelessness and inattention of the parties themselves, we were obliged to have recourse to the records of the proclamations of marriages, to which, in all cases of regular marriages in Scotland, both the parties married and the

* It is also worthy of observation, that in Perth, on an average of years, there are annually married $8\frac{2}{5}$ more females than males; in Dundee $15\frac{2}{5}$ more males than females; in Edinburgh $41\frac{1}{3}$ more females than males; in Leith $9\frac{1}{3}$ more males than females; in Glasgow $20\frac{3}{5}$ more males than females; and in Aberdeen $1\frac{2}{5}$ more females than males.

clergymen who celebrate the marriages, are bound by law strictly to adhere. Were records of marriages as strictly enforced as those of the proclamations, we would have been enabled to avoid errors to which our present statements are liable.

A uniform and well-digested plan of registers for England, Scotland and Ireland, and also for exhibiting the information deduced from them, would obviously be of high importance; and the results obtained by this uniform plan, by showing the effects produced on the amount of births, marriages, disease and death, by the condition of the people in different states of society, whether of town or country, rich or poor, of sedentary or of laborious employments, might ultimately lead to salutary laws for the amelioration of the condition of the people.

The system adopted in the registers of marriages in England, and the mode of publishing the amount of individuals married in the large towns, do not admit of an accurate comparison with the amount of individuals married in towns similarly situated as to local circumstances in Scotland.

The extent to which prudential motives operate on the respectable portion of the mechanics and artizans of towns in prevention of early marriages, appears to be considerable. The desire to establish themselves first in comfortably furnished houses is alone a sufficient check. But if we look to the condition of that numerous class of the inhabitants of towns who have sunk—more especially of late years—into a reckless state of poverty, and where the prevalence of fever and other diseases, together with a limited supply of work by which they can earn a livelihood, have reduced masses of them to an extreme state of wretchedness, we shall find a very different feeling. In the large towns of Scotland this wretchedness is known to exist not only from personal inquiry, but it has been ably pointed out in late publications *. So far from it operating as a check, the very hopelessness of their condition would seem to make this class blind and callous to consequences; and unions are formed which ultimately can only enhance their sufferings.

The importance of obtaining correct statistical information, therefore, as to the amount of annual marriages among the *different classes* of society requires no further illustration; and though we are aware of the caution to be observed in coming to any conclusion from the facts yet obtained and detailed in the foregoing pages (imperfect as the system of registration may be from which our data are obtained), yet these data prove that the greatest amount of marriages is found to take place in those localities where the greatest proportion of the wretchedly poor are congregated together; and this fact goes far to strengthen the opinion that the diminution of destitution, by raising a great mass of the town population above their present reckless state of poverty, would prove a salutary check upon early marriages, by giving a taste for the comforts and decencies of life †.

* See the work of Dr. Alison, Professor of the Institutes of Medicine in the University of Edinburgh; of the Hon. Archibald Alison, Sheriff of Lanarkshire; and of the Rev. Dr. Chalmers, Professor of Divinity in Edinburgh, on the poor. The publications of C. R. Baird, Esq., Captain Miller and the late Dr. Cowan of Glasgow, Mr. Wilson of Aberdeen, Sheriff Barclay of Perth, the Rev. Mr. Lewis of Dundee, Mr. Simons, Dr. Taylor, and many others.

† It may be noticed in proof of the effect of habitual destitution on marriage and population, that the handloom weavers, the poorest inhabitants of Glasgow, are known to marry earlier than any other class. This fact is stated by Mr. C. R. Baird, in his 'Report on the General and Sanatory Condition of the Working Classes and the Poor in Glasgow.' And 455 weavers out of work, whose cases were examined and reported to the Association for Inquiring into the Pauperism of Scotland, in Edinburgh, by Captain Miller of Glasgow, had among them 1851 children. Many other striking examples to the same effect are stated by Dr. Alison in his work on the Poor-Law of Scotland.

TABLE XIX.—Abstract of Births and Baptisms, as engrossed in the Registers of Edinburgh and Parishes.

	1839.				1840.				1841.			
	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.
In the City	230	173	403	3	210	175	385	4	231	210	441	3
In St. Cuthbert's	374	373	747	8	387	369	756	12	354	317	671	5
In the Canongate	54	58	112	...	51	53	104	1	53	55	108	
In the Society of Friends	1	1	2	...	2	...	2	...	2	1	3	
In the Jewish Society ...	2	2	4	...	2	1	3	...	...	2	2	
Total...........	661	607	1268	11	652	598	1250	17	640	585	1225	8

TABLE XX.—Abstract of Births and Baptisms, as engrossed in the Registers of North and South Leith.

	1839.				1840.				1841.			
	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.
In South Leith	112	94	206	...	122	111	233	1	114	122	236	
In North Leith	100	89	189	...	96	71	167	...	85	88	173	
Total...........	212	183	395	...	218	182	400	1	199	210	409	

TABLE XXI.—Abstract of Births and Baptisms, as engrossed in the Registers of Glasgow and Suburbs.

	1837.				1838.				1839.				1840.				1841.			
	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.
In the City	853	710	1563	8	801	750	1551	7	...	...	1471	...	815	668	1483	6	...	...	1364	
In the Barony	485	489	974	12	556	492	1048	5	...	...	1066	...	533	515	1048	16	...	...	1082	
In the Gorbals	276	260	536	3	282	273	555	4	...	...	503	...	259	254	513	2	...	...	529	
In the Society of Friends	3	1	4	0	1	1	2	0	...	...	2	...	1	2	3	...	...	...	1	
In the Jewish Society ...	3	2	5	0	1	2	3	0	...	...	6	...	2	5	7	...	...	...	5	
Total...........	1620	1462	3082	23	1641	1518	3159	16	1601	1447	3048	18	1610	1444	3054	24	1589	1392	2981	25

TABLE XXII.—Abstract of Births and Baptisms, as engrossed in the Registers of New and Old Aberdeen.

	1837.				1838.				1839.				1840.				1841.			
	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.
In St. Nicholas Parish ...	286	276	562	7	418	196	614	...	282	295	577	3	241	225	466	1	276	242	518	3
In Old Machar Parish ...	154	126	280	1	170	145	315	3	178	140	318	2	136	116	252	1	133	112	245	2
In the Society of Friends	2	0	2	...	1	2	3	...	2	...	2	...	...	1	1	...	1	...	1	...
Total............	442	402	844	8	589	343	932	3	462	435	897	5	377	342	719	2	410	354	764	5

TABLE XXIII.—Abstract of Births and Baptisms, as engrossed in the Registers of the City of Perth and Suburban Parish of Kinnoul.

	1837.				1838.				1839.				1840.				1841.			
	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.	Males.	Femls.	Total.	Twins.
In the City of Perth	197	170	367	...	199	189	388	2	180	175	355	3	165	131	296	2	183	132	315	
In the Parish of Kinnoul	21	21	42	...	12	26	38	...	19	7	26	...	20	20	40	1	13	23	36	
Total............	218	191	409	...	211	215	426	2	199	182	381	3	185	151	336	3	196	155	351	

TABLE XXIV.—Abstract of Births and Baptisms, as engrossed in the Registers of Dundee, during the Years 1837, 1838, 1839, 1840, and 1841.

	Males.	Females.	Total.	Twins.
In 1837.	486	407	893	11
In 1838.	458	447	905	9
In 1839.	461	391	852	6
In 1840.	473	435	908	6
In 1841.	432	345	777	8

BIRTHS AND BAPTISMS.

The inattention which prevails among parents in Scotland in regard to the recording of the births of their children in the public registers, even though the parties themselves continue to experience great inconvenience on many occasions on account of the omission, is so very great, as to render the abstracts of births of no avail to the statist, in so far at least as regards the statistics of human life. If we compare the proportion of births recorded for England and Wales, as exhibited in the Registrar General's Report for 1839–40, the year for which the number of births for England have been most fully ascertained, we may form a pretty correct judgement of the deficiency of the registers of births in Scotland. The proportion of births recorded for England and Wales for 1839–40 to the population of 1841 is 3·153 per cent., while the number of births or baptisms recorded for Edinburgh and Leith for the years exhibited in the preceding abstracts, to the mean population of these years, is 0·992 per cent.; for Aberdeen 1·311 per cent.; for Glasgow 1·160 per cent.; for Dundee 1·497 per cent.; and for Perth 1·704 per cent. It will thus be perceived that the smallest proportion of births or baptisms are recorded for Edinburgh and Leith, and the greatest for Perth; and that the whole of these records are so incomplete, as to give no indication of the true number of births for these towns.

The preceding abstracts of births or baptisms are useless to the statist, and the only advantage to be derived from their publication is the proof they afford of the utter inefficiency of the present mode of registering births in Scotland, and to show the necessity there is for some legislative measure being obtained to remedy this great national defect. Among the public as well as private advantages which would arise from the improvement of Scotch registers of births, it may be mentioned, that, in the event of an alteration taking place in the Poor Laws of the country, complete registers of this nature would be the most legitimate and least inconvenient means of proving the birth-place of parties requiring aid from the public funds.

More than one attempt has been made in Glasgow to obtain complete returns of the amount of children baptised, from the clergymen of all denominations, within the limits of the bills of mortality, without leading to a satisfactory result. It is therefore to be feared, that this very important branch of the vital statistics of Scotland must remain incomplete till Government be induced to apply a remedy.

TABLE XXV.—ABSTRACT OF EDINBURGH MORTALITY BILL.

Abstract of the Number of Burials in the City of EDINBURGH and Suburban Districts of St. Cuthbert's and the Canongate; also showing the Total amount of Deaths, exclusive of still-born children.

Districts.	Burying Places.	1836. Population 137,127.				1837. Population 137,345.				1838. Population 137,527.			
		Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.
City.	Grayfriars	945		81	...	1302		357	...	1172	...	...	130
	St. John's Episcopal Chapel	37		16	...	34		...	3	22	...	...	12
	Total	—	982			—	1336			—	1194		
St. Cuthbert's.	St. Cuthbert's	1408		71	...	1831		423	...	1515		...	316
	Calton, New and Old	619		72	...	738		119	...	591		...	147
	Newington	618		53	...	770		152	...	650		...	120
	Chap. of Ease, or Buccleuch	91		...	14	91		...	...	90		...	1
	Trinity Episcopal Chapel	...		...	...	...		...	...	3		3	...
	Society of Friends	2		1	...	13		11	...	3		...	10
	Jewish Society	4		...	...	2		...	2	2		...	...
	Total	—	2742			—	3445			—	2854		
Canonga.	Canongate	522		173	...	519		...	3	464		...	55
	Chapel Royal, Holyrood	...		...	1	...		...	...	...		...	...
	Total	—	522			—	519			—	464		

Districts.	Burying Places.	1839. Population 137,756.				1840. Population 137,986.				1841. Population 138,182.			
		Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.
City.	Grayfriars	901		...	271	1121		220	...	1101		...	20
	St. John's Episcopal Chapel	28		6	...	31		3	...	22		...	9
	Total	—	929			—	1152			—	1123		
St. Cuthbert's.	St. Cuthbert's	1143		...	372	1211		68	...	1137		...	74
	Calton, New and Old	555		...	36	579		24	...	583		4	
	Newington	548		...	102	548		...	...	448		...	100
	Chap. of Ease, or Buccleuch	74		...	16	82		8	...	68		...	14
	Trinity Episcopal Chapel	7		4	...	2		...	5	4		2	
	Society of Friends	1		...	2	3		2	...	3			
	Jewish Society	...		...	2	1		1	...	1			
	Total	—	2328			—	2426			—	2244		
Canonga.	Canongate	376		...	88	396		20	...	407	...	11	
	Chapel Royal, Holyrood	...		...	...	1		1	...	1			
	Total	—	376			—	397			—	408		

	1836.	1837.	1838.	1839.	1840.	1841.
Total burials in the City and Suburbs	4246	5300	4512	3633	3975	3775
Deduct still-born children and premature births	278	291	336	268	287	268
Total deaths	3968	5009	4176	3365	3688	3507

TABLE XXVI.—ABSTRACT OF LEITH MORTALITY BILL.

Abstract of the Number of Burials in the Town of LEITH; also showing the Total amount of Deaths, exclusive of still-born children.

Districts.	Burying Places.	1836. Population 27,078.				1837. Population 27,331.				1838. Population 27,586.			
		Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.
S. Leith.	South Leith	523		47	...	717		194	...	699		...	18
	Restalrig	49		12	...	31		...	18	33		2	...
	Total		572				748				732		
N. Leith.	North Leith	123		13	...	154		31	...	169		15	...
	New Haven	25		5	...	60		35	...	30		...	30
	Total		148				214				199		

Districts.	Burying Places.	1839. Population 27,846.				1840. Population 28,103.				1841. Population 28,372.			
		Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.
S. Leith.	South Leith	580		...	119	597		17	...	537		...	60
	Restalrig	37		4	...	22		...	15	25		3	
	Total		617				619				562		
N. Leith.	North Leith	120		...	49	152		32	...	133		...	19
	New Haven	15		...	15	25		10	...	25			
	Total		135				177				158		

	1836.	1837.	1838.	1839.	1840.	1841.
Total burials in North and South Leith	720	962	931	752	796	720
Deduct still-born children and premature births	57	76	69	73	80	73
Total deaths	663	886	862	679	716	647

Table XXVII.—Total Burials, Glasgow.

Exhibiting the number of Burials in the different Cemeteries of the City and Suburban Districts of GLASGOW; also showing the Total amount of Burials and of Deaths, exclusive of still-born children, within the limits of the Mortality Bill of that City.

Districts.	Burying Places.	1836. Population 238,950.				1837. Population 247,040.				1838. Population 255,390.			
		Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.
City.	Cathedral Grounds	2954		341	...	3767		813	...	2410		...	1357
	Blackfriars, St. David's Grounds	546		186	...	629		83	...	636		7	...
	Episcopal Chapel Grounds	9		1	...	25		16	...	17		...	8
	St. Mary's Grounds	...		...	...	...		...	...	...		...	...
	Light Hill Do.	...		...	...	...		...	...	...		...	...
	Total in the City	—	3509			—	4421			—	3063		
Gorbals.	Gorbals Grounds	2202		371	...	2130		...	72	1396		...	734
	Sothern Necropolis	...		...	...	...		...	...	...		...	...
	Total in the Gorbals	—	2202			—	2130			—	1396		
Barony.	Necropolis, or Merchant's House Cemetery	546		299	...	676		132	...	517		...	159
	Calton Grounds	988		...	44	1346		358	...	1016		...	330
	Bridgeton Do.	386		9	...	557		171	...	356		...	201
	Tollcross Do.	315		...	15	380		65	...	219		...	161
	Shettleston Do.	36		...	26	61		25	...	38		...	23
	Anderston { Relief Church Grounds	157		...	22	211		36	...	182		...	29
	Anderston { St. Marks Do.	165		58	...	193		28	...	135		...	58
	Maryhill Do.	72		12	...	70		...	2	56		...	14
	Woodside { South Do.	261		41	...	210		...	51	261		51	...
	Woodside { North Do.	454		73	...	599		145	...	260		...	339
	Wellington-street Church Crypt	33		10	...	31		...	2	15		...	16
	Society of Friends	1		...	...	1		...	...	1		...	...
	Total in Barony Parish	—	3432			—	4335			—	3056		

Districts.	Burying Places.	1839. Population 264,010.				1840. Population 272,900.				1841. Population 282,134.			
		Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.
City.	Cathedral Grounds	2432		22	...	2557		125	...	2099		...	458
	Blackfriars, St. David's Grounds	818		182	...	788		...	30	595		...	193
	Episcopal Chapel Grounds	19		2	...	19		...	...	11		...	8
	St. Mary's Grounds	177		177	...	1129		952	...	1261		132	...
	Light Hill Do.	...		...	...	304		304	...	504		200	...
	Total in the City	—	3446			—	4797			—	4470		
Gorbals.	Gorbals Grounds	1383		...	13	1207		...	176	898		...	309
	Sothern Necropolis	...		...	...	131		131	...	758		627	...
	Total in the Gorbals	—	1383			—	1338			—	1656		
Barony.	Necropolis, or Merchant's House Cemetery	520		3	...	473		...	47	685		212	...
	Calton Grounds	1045		29	...	941		...	104	830		...	111
	Bridgeton Do.	547		191	...	647		100	...	665		18	...
	Tollcross Do.	218		...	1	341		123	...	348		7	...
	Shettleston Do.	45		7	...	62		17	...	65		3	...
	Anderston { Relief Church Grounds	133		...	49	127		...	6	159		32	...
	Anderston { St. Marks Do.	161		26	...	143		...	18	119		...	24
	Maryhill Do.	53		...	3	70		17	...	64		...	6
	Woodside { South Do.	234		...	27	279		45	...	209		...	70
	Woodside { North Do.	325		65	...	294		...	31	311		17	...
	Wellington-street Church Crypt	20		5	...	29		9	...	23		...	6
	Society of Friends	0		...	1	...		...	...	1		1	...
	Total in Barony Parish	—	3301			—	3406			—	3479		

	1836.	1837.	1838.	1839.	1840.	1841.
Total burials in the City and Suburbs	9143	10886	7515	8130	9541	9605
Deduct still-born children and premature births	702	616	583	605	720	719
Total deaths	8441	10270	6932	7525	8821	8886

Table XXVIII.—Abstract of Aberdeen Mortality Bill.

Abstract of the Number of Burials in the City of ABERDEEN and Suburban Districts; also showing the Total amount of Deaths, exclusive of still-born children.

Districts.	Burying Places.	1837. Population 61,985.		1838. Population 62,672.				1839. Population 63,366.				1840. Population 64,068.				1841. Population 64,778.			
		Total in each Cemetery.	Total in each District.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.	Total in each Cemetery.	Total in each District.	Increase in Cemeteries.	Decrease in Cemeteries.
St. Nicholas.	St. Nicholas	576		545		...	31	283		...	262	321		38	...	257		...	64
	St. Clement's	115		128		13	...	143		15	...	137		...	6	132		...	5
	John Knox	10		33		23	...	32		...	1	75		43	...	39		...	36
	Society of Friends	1		1		...	...	1		...	...	...		...	1	1		1	
	Total		702		707				459				533				429		
Old Machar.	Old Machar	227		202		...	25	225		23	...	249		24	...	180		...	69
	St. Peter, or Spittal	460		452		...	8	448		...	4	557		109	...	386		...	171
	Nellfield Cemetery	78		89		11	...	78		...	11	101		23	...	104		3	
	Snow Churchyard	2		3		1	...	3		...	...	3		...	...	4		1	
	Total		767		746				754				910				674		

	1837.	1838.	1839.	1840.	1841.
Total burials in the City and Suburbs	1469	1453	1213	1443	1103
Deduct still-born children and premature births	77	42	63	58	69
Total deaths	1392	1411	1150	1385	1034

Returns of the still-born children have only been received from two of the above burying-grounds, viz. St. Nicholas's and St. Peter's, and even in the Registers of these grounds the still-born are but imperfectly recorded; so that the proportion of the amount of burials to the population is greater in Aberdeen than appears from these Tables.

TABLE XXIX.—ABSTRACT OF PERTH MORTALITY BILL.

Abstract of the Amount of Burials in the City of PERTH and Suburban District of Kinnoul; also showing the Total amount of Deaths, exclusive of still-born children.

Districts.	Burying Places.	1837. Population 22,489.	1838. Population 22,409.			1839. Population 22,330.			1840. Population 22,251.			1841. Population 22,172.		
		Total in each Cemetery and District.	Total in each Cemetery and District.	Increase in each Cemetery and District.	Decrease in each Cemetery and District.	Total in each Cemetery and District.	Increase in each Cemetery and District.	Decrease in each Cemetery and District.	Total in each Cemetery and District.	Increase in each Cemetery and District.	Decrease in each Cemetery and District.	Total in each Cemetery and District.	Increase in each Cemetery and District.	Decrease in each Cemetery and District.
Perth......	In the City of Perth Cemetery	704	625	...	79	476	...	49	499	23	...	505	6	
Kinnoul ..	In Kinnoul Churchyard	64	57	...	7	32	...	25	39	7	...	28	...	11
	Total burials	76	682	...	86	508	...	74	538	30	...	533	6	11

	1837.	1838.	1839.	1840.	1841.
Total burials	768	682	508	538	533
Deduct still-born children and premature births	58	47	49	55	39
Total deaths..............................	710	635	459	483	494

It is ascertained that during 1837 and the four following years, there have been on an average seven inhabitants of Kinnoul buried elsewhere.

Table XXX.—Abstract of Dundee Mortality Bill.

Abstract of the Number of Burials in the Town of DUNDEE; also showing the Total amount of Deaths, exclusive of still-born children.

District.	Burying Places.	1838. Population 56,156.	1839. Population 57,857.			1840. Population 59,691.			1841. Population 61,540.		
		Total in each Cemetery.	Total in each Cemetery.	Increase.	Decrease.	Total in each Cemetery.	Increase.	Decrease.	Total in each Cemetery.	Increase.	Decrease.
Dundee	Old Burying-ground	985	696	...	289	516	...	180	529	13	
	New ditto	481	998	517	...	877	...	121	884	7	
	Roodyards ditto	16	17	1	...	12	...	5	9	...	3
	St. Andrew's Churchyard	14	15	1	...	15	...	...	21	6	
	St. Peter's ditto	15	37	22	...	14	...	23	26	12	
	Total number of burials	1511	1763	541	289	1434	...	329	1469	38	3

	1838.	1839.	1840.	1841.
Total number of burials	1511	1763	1434	1469
Deduct still-born children and premature births	114	116	114	111
Total deaths	1397	1647	1320	1358

Table XXXI.

Proportion of Burials and Deaths to the Population in the great Towns of Scotland in the following years.

	Edinburgh.				Leith.				Glasgow.				Aberdeen.				Perth.				Dundee.			
	Burials, to the Population, as 1 to	Per-centage.	Deaths, to the Population, as 1 to	Per-centage.	Burials, to the Population, as 1 to	Per-centage.	Deaths, to the Population, as 1 to	Per-centage.	Burials, to the Population, as 1 to	Per-centage.	Deaths, to the Population, as 1 to	Per-centage.	Burials, to the Population, as 1 to	Per-centage.	Deaths, to the Population, as 1 to	Per-centage.	Burials, to the Population, as 1 to	Per-centage.	Deaths, to the Population, as 1 to	Per-centage.	Burials, to the Population, as 1 to	Per-centage.	Deaths, to the Population, as 1 to	Per-centage.
1836.	...	...	...	...	37·608	2·638	40·841	2·448	26·134	3·826	28·308	3·532												
1837.	25·914	3·858	27·419	3·647	28·410	3·519	30·831	3·241	22·693	4·406	24·054	4·157	42·195	2·369	44·529	2·245	29·282	3·415	31·674	3·157				
1838.	30·480	3·280	32·932	3·036	29·630	3·374	32·002	3·124	33·984	2·942	36·842	2·710	43·132	2·318	44·416	2·251	32·857	3·043	35·289	2·833	37·164	2·690	40·197	2·487
1839.	37·917	2·637	40·937	2·442	37·029	2·700	41·010	2·438	32·473	3·078	35·084	2·850	52·239	1·914	55·100	1·814	43·956	2·722	48·649	2·055	32·840	3·065	35·153	2·844
1840.	34·713	2·880	37·414	2·672	35·305	2·832	39·581	2·526	28·604	3·496	30·973	3·232	44·399	2·252	46·258	2·161	41·358	2·417	46·068	2·170	41·625	2·402	45·220	2·211
1841.	36·604	2·731	39·537	2·529	39·403	2·537	43·851	2·280	29·373	3·404	31·750	3·149	58·728	1·702	62·647	1·596	41·598	2·403	44·882	2·228	41·892	2·387	45·316	2·206

Table XXXII.—Exhibiting the number of fatal cases of disease that occurred in the City of EDINBURGH and 18 periods of life at which they took place; with calculations showing the total number of deaths at each period, and the the population.

1839.—Population

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Accidents	1	...	1	1	3	5	5	2	4	...	1	...	9	3	6	1	6	4	7	4
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	...	...	...	...	...	1	1	4	3	5	7	9	10
Bowel Complaints.	75	51	30	24	3	4	5	1	...	...	...	...	1	1	1	2	...	1	5	3
Catarrh	5	2	...	...	1	...	1	...	1	...	...	1	...	...	1	2	...	1	...	...
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	16	...	7	...	3	...	...
Croup	9	8	5	6	9	7	2	2	...	...	...	...	...	...	...	...	...	...	...	...
Decline	28	21	13	18	16	15	12	13	12	19	18	14	59	49	47	57	48	41	51	45
Dropsy	...	2	1	...	...	2	1	...	1	...	2	4	3	8	4	4	7	13	11	5
Fever	2	3	9	8	13	12	13	10	7	7	12	9	29	24	22	24	28	26	14	15
Head, of	26	18	17	16	17	14	15	12	6	1	2	3	6	5	14	13	11	11	10	12
Heart, of	3	...	...	1	...	...	1	...	2	...	...	4	2	6	4	1	7	4	6	3
Hooping-cough	6	9	7	4	2	5	...	1	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	41	40	20	15	9	16	5	5	2	6	4	3	18	14	11	6	10	8	16	12
Measles	24	18	59	40	30	41	12	7	1	...	...	...	...	...	...	...	...	...	...	...
Nervous	9	2	3	...	1	1	...	1	...	...	...	...	...	...	...	4	...	3	1	2
Scarlet Fever	2	1	2	5	7	10	6	8	6	2	1	...	...	...	...	...	...	...	...	...
Small-pox	14	7	4	3	6	1	1	1	2	...	...	1	1	...	...	...	...	...	...	...
Miscellaneous	5	3	2	1	3	2	4	3	1	1	...	1	8	8	9	11	15	14	8	16
Total ascertained	250	185	173	142	120	135	83	66	45	36	40	40	137	135	123	135	137	136	138	127
Do. not ascertained	47	37	5	7	4	8	6	4	6	3	1	6	14	11	15	19	25	18	15	14
Deaths, M. and F.	297	222	178	149	124	143	89	70	51	39	41	46	151	146	138	154	162	154	153	141
Total	519		327		267		159		90		87		297		292		316		294	
Propor. to whole Deaths is as 1 to	6·4		10·3		12·6		21·1		37·3		38·6		11·3		11·5		10·6		11·4	
To the Population.	265·4		421·2		515·9		866·3		1530·6		1583·4		463·8		471·7		435·9		468·5	

Table XXXIII.—Exhibiting the number of fatal cases of disease that occurred in the City of EDINBURGH an 18 periods of life at which they took place; with calculations showing the total number of deaths at each period, and th the population.

1840.—Populatic

Diseases.	Under 1 Year, M.	Under 1 Year, F.	1 & under 2, M.	1 & under 2, F.	2 & under 5, M.	2 & under 5, F.	5 & under 10, M.	5 & under 10, F.	10 & under 15, M.	10 & under 15, F.	15 & under 20, M.	15 & under 20, F.	20 & under 30, M.	20 & under 30, F.	30 & under 40, M.	30 & under 40, F.	40 & under 50, M.	40 & under 50, F.	50 & under 60, M.	50 & under 60, F.
Accidents	1	1	1	1	4	...	4	4	4	1	2	...	10	...	2	3	9	3	6	[illegible]
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	1	...	...	...	...	1	...	...	2	1	3	2	6	2	6	[illegible]
Bowel Complaints.	69	51	27	21	13	9	1	1	...	1	2	...	...	2	3	4	...	...	3	[illegible]
Catarrh	2	...	...	...	...	...	...	...	...	...	...	...	1	1	2	...	...	...	...	
Childbirth	...	...	...	...	...	...	...	...	...	...	...	1	...	7	...	7	...	5	...	...
Croup	1	5	10	4	8	15	1	2	...	1	...	...	...	...	...	...	...	...	...	...
Decline	25	24	20	12	19	20	17	11	13	19	17	16	61	55	46	45	57	33	40	3[illegible]
Dropsy	2	...	2	...	5	2	3	5	3	2	1	1	3	9	4	13	8	15	7	1[illegible]
Fever	5	5	5	5	8	17	19	18	2	7	4	3	19	13	21	18	27	33	16	1[illegible]
Head, of	26	24	13	21	22	10	12	8	11	6	...	1	8	3	14	3	8	7	22	1[illegible]
Heart, of	1	...	1	...	...	1	1	2	...	1	1	...	3	2	2	2	3	4	3	[illegible]
Hooping-cough	48	46	36	39	37	38	5	15	...	1	...	...	...	...	...	...	...	...	...	...
Inflammation	29	26	18	15	11	19	11	6	3	6	2	7	14	15	15	14	12	11	13	[illegible]
Measles	7	5	12	16	12	14	2	1	...	...	...	...	...	...	...	...	...	...	...	...
Nervous	1	3	...	...	3	...	...	...	1	...	1	...	...	...	1	2	...	...	...	...
Scarlet Fever	2	4	5	8	20	17	9	13	2	5	...	...	...	...	...	...	...	...	...	...
Small-pox	30	29	15	18	21	22	10	9	...	...	1	...	3	3	...	2	...	...	...	...
Miscellaneous	20	14	7	8	2	9	4	3	4	3	3	...	8	12	13	12	18	25	14	1[illegible]
Total ascertained	269	237	172	168	186	193	99	98	43	54	34	29	132	123	126	127	148	138	130	11[illegible]
Do. not ascertained	56	47	10	8	17	9	9	14	3	7	2	2	15	23	16	16	16	17	17	2[illegible]
Deaths, M. and F.	325	284	182	176	203	202	108	112	46	61	36	31	147	146	142	143	164	155	147	13[illegible]
Total	609		358		405		220		107		67		293		285		319		280	
Propor. to whole Deaths is as 1 to	6·05		10·2		9·1		16·76		34·46		55·04		12·58		12·94		11·56		13·17	
To the Population.	226·5		385·4		340·7		627·2		1289·5		2059·3		470·9		484·1		432·5		492·8	

urban districts of St. Cuthbert's and the Canongate during the year ending December 31, 1839, classified according to
portion which these, and the number of deaths from the several diseases, bear to the total number of deaths, and also to
756.

60 & under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		1 to every	1 to every
4	6	1	2	1	...	...	2	...	...	...	...	...	...	...	...	...	...	49	30	79	42·6	1743·7
1	87	30	57	33	54	27	61	8	18	4	9	2	...	...	...	...	...	155	286	441	7·6	312·3
7	8	1	1	...	3	1	1	...	...	...	...	...	...	...	...	...	...	28	34	62	54·2	2221·8
2	6	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	122	94	216	15·5	637·7
1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	7	17	197·9	8103·2
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	26	26	129·4	5298·3
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	25	23	48	70·1	2869·9
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	304	292	596	5·6	231·1
1	7	2	10	4	4	1	...	...	...	...	...	...	...	...	...	...	...	48	59	107	31·4	1287·4
5	6	3	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	167	145	312	10·7	441·5
6	19	7	7	7	5	1	1	1	...	...	...	...	...	...	...	...	...	156	137	293	11·4	470·1
4	5	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	29	25	54	62·3	2551·0
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15	19	34	98·9	4051·6
9	8	1	3	...	3	...	...	...	...	...	...	...	...	...	...	...	...	146	139	285	11·8	483·3
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	126	106	232	14·5	593·7
	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14	14	28	120·1	4919·8
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	24	26	50	67·3	2755·1
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	28	13	41	82·0	3359·9
3	13	2	3	3	1	1	...	...	...	...	...	...	...	...	...	...	...	79	77	156	21·5	883·0
3	165	47	87	48	71	31	65	9	18	4	9	2	...	...	...	...	...	1525	1552	3077	1·1	44·7
2	8	...	1	...	1	1	...	...	...	...	...	...	...	...	...	...	..	151	137	288	11·6	478·3
0	173	47	88	48	72	32	65	9	18	4	9	2	...	...	...	...	...	1676	1689	3365	1·0	40·9
323		135		120		97		27		13		2		...		...		3365				
10·4		24·9		28·0		34·7		124·6		258·8		1682·		...		...		1·0				
26·4		1020·4		1147·9		1420·1		5102·0		10596·		68878·		...		...		40·9				

urban districts of St. Cuthbert's and the Canongate during the year ending December 31, 1840, classified according to
portion which these, and the number of deaths from the several diseases, bear to the total number of deaths, and also to
986.

60 & under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
5	2	1	4	1	3	...	...	...	1	...	...	1	...	...	...	...	...	51	29	80	46·1	1724·8
0	61	21	58	35	52	27	53	21	26	4	10	4	1	1	1	...	...	163	262	425	8·6	324·6
9	8	4	6	...	...	...	...	1	...	...	...	...	...	...	...	...	...	32	25	57	64·7	2420·8
2	4	...	2	1	2	...	...	...	...	...	...	...	...	...	...	4	4	125	104	229	16·1	602·5
1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	2	8	461·0	17248·2
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	20	20	184·4	6899·3
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	20	27	47	78·4	2935·8
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	5	323	271	594	6·2	232·2
5	12	5	2	1	2	1	1	...	...	...	...	...	...	...	...	...	1	50	80	130	28·3	1061·4
0	12	3	...	2	...	...	...	1	...	...	...	...	...	...	...	...	...	142	143	285	12·9	484·1
3	8	1	9	2	4	2	...	...	1	...	...	...	...	...	...	1	3	158	124	282	13·0	489·3
1	1	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	19	16	35	105·3	3942·4
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	126	142	268	13·7	514·8
0	5	2	3	...	...	...	...	...	...	...	...	...	...	...	...	...	4	140	135	275	13·4	501·7
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	33	36	69	53·4	1999·7
	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	6	13	283·6	10614·3
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	38	47	85	43·3	1625·3
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	80	84	164	22·4	841·3
0	9	6	5	1	1	1	...	...	...	...	...	...	...	...	...	4	2	115	118	233	15·8	592·2
9	123	46	89	43	64	31	54	23	28	4	10	5	1	1	1	17	23	1628	1671	3299	1·1	41·8
9	21	1	1	4	1	...	4	1	...	1	1	...	...	...	...	9	10	186	203	389	9·4	354·7
8	144	47	90	47	65	31	58	24	28	5	11	5	1	1	1	26	33	1814	1874	3688	1·0	37·414
272		137		112		89		52		16		6		2		59		3688				
3·55		26·9		32·9		41·44		70·9		230·5		614·66		1844·		62·5		1·0				
07·5		1007·2		1232·0		1550·4		2653·6		8624·1		22997·		68993·		2338·7		37·414				

TABLE XXXIV.—Exhibiting the number of fatal cases of disease that occurred in the City of EDINBURGH a 18 periods of life at which they took place; with calculations showing the total number of deaths at each period, and t the population. 1839.—Populati

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & unde 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F
Accidents	2	1	2	1	7	...	2	4	1	2	4	...	13	4	8	2	6	3	4	
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..
Asthma	...	...	...	...	...	...	...	1	...	...	...	1	2	1	5	5	6	4	5	
Bowel Complaints.	91	66	23	21	7	5	2	...	2	...	2	1	2	2	1	1	1	3	3	
Catarrh	1	5	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2	1	..
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	15	...	18	...	3	...	..
Croup	7	1	6	11	12	12	1	2	...	...	1	...	...	...	...	...	...	...	...	..
Decline	32	27	10	12	16	11	21	13	10	9	22	19	57	63	59	60	43	50	40	4
Dropsy	1	...	1	...	4	2	5	1	...	2	1	1	5	9	4	17	12	19	8	
Fever	4	2	2	3	7	11	15	11	3	12	11	6	21	24	44	42	36	34	25	2
Head, of	42	44	18	16	17	12	10	8	2	7	1	3	7	3	9	11	10	11	20	1
Heart, of	...	1	1	1	1	...	2	...	...	2	5	2	2	5	8	2	6	4	6	
Hooping-cough	12	13	9	4	4	7	...	3	...	...	...	...	...	...	...	...	...	...	...	..
Inflammation	31	22	17	13	11	6	4	13	2	5	5	5	13	23	10	12	9	14	9	1
Measles	4	1	2	...	2	1	...	...	...	...	...	...	...	...	1	...	...	...	...	..
Nervous	5	4	...	1	1	2	1	1	...	...	...	1	...	1	2	...	...	2	2	
Scarlet Fever	8	2	6	4	21	15	7	10	2	...	2	1	2	1	1	...	...	...	...	..
Small-pox	5	3	1	4	6	2	1	2	...	...	1	...	2	...	...	...	...	...	...	..
Miscellaneous	38	40	2	2	6	1	5	3	4	6	3	1	4	9	13	13	6	22	23	1
Total ascertained...	283	232	100	94	122	87	76	72	26	45	58	41	130	160	165	183	135	171	146	14
Do. not ascertained	55	47	14	8	14	10	6	9	7	3	6	4	4	3	7	5	10	13	13	1
Deaths, M. and F...	338	279	114	102	136	97	82	81	33	48	64	45	134	163	172	188	145	184	159	16
Total	617		216		233		163		81		109		297		360		329		323	
Propor. to whole Deaths is as 1 to	5·6		16·2		15·0		21·5		43·2		32·1		11·8		9·7		10·6		10·8	
To the Population.	223·9		639·7		593·0		847·7		1705·9		1267·7		465·2		383·8		420·0		427·8	

TABLE XXXV.—Exhibiting the number of fatal cases of disease that occurred in North and South LEITH duri showing the total number of deaths at each period, and the proportion which these, and the number of deaths from t 1840.—Populati

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & unde 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F
Accidents	...	...	...	...	2	1	3	2	...	1	2	2	4	...	1	...	4	...	2	
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..
Asthma	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	1	3	..
Bowel Complaints.	16	16	10	3	1	1	...	1	...	...	1	...	1	...	1	...	...	1	...	
Catarrh	...	...	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...	...	
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	2	...	...	...	..
Croup	...	2	3	3	1	2	...	1	...	...	...	...	...	...	...	...	...	...	...	..
Decline	6	...	4	...	1	2	2	1	2	2	4	3	8	13	7	9	6	5	3	
Dropsy	...	...	...	...	1	...	1	...	...	...	...	...	1	2	...	1	...	1	...	
Fever	...	...	...	1	1	3	1	2	...	1	...	2	2	3	4	6	6	4	2	
Head, of	1	6	3	1	2	4	4	1	...	...	1	...	...	...	2	1	1	3	...	
Heart, of	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	2	...	...	...	
Hooping-cough	3	6	9	7	5	6	1	1	...	...	...	...	...	...	...	...	...	...	...	.
Inflammation	8	5	5	1	...	2	4	1	...	...	2	...	...	...	2	1	2	3	3	
Measles	3	1	2	1	2	3	1	...	...	...	...	...	...	...	...	...	...	...	...	
Nervous	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.
Scarlet Fever	...	2	4	1	9	6	5	3	1	...	1	...	...	1	...	...	...	1	...	.
Small-pox	1	4	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	.
Miscellaneous	2	1	...	...	...	...	...	...	...	1	...	1	...	3	2	4	4	...	2	
Total ascertained...	41	43	40	18	25	32	23	13	3	5	14	8	16	24	19	28	23	19	15	2
Do. not ascertained	8	10	5	5	8	9	5	1	2	1	2	...	2	5	11	5	8	7	5	
Deaths, M. and F...	49	53	45	23	33	41	28	14	5	6	16	8	18	29	30	33	31	26	20	2
Total	102		68		74		42		11		24		47		63		57		49	
Propor. to whole Deaths is as 1 to	6·7		10·1		9·3		16·4		62·7		28·7		14·6		10·7		12·1		14·	
To the Population.	275·5		413·2		379·9		699·1		2554·8		1170·9		597·9		446·0		493·0		573·	

urban districts of St. Cuthbert's and the Canongate during the year ending December 31, 1841, classified according to
portion which these, and the number of deaths from the several diseases, bear to the total number of deaths, and also to
,182.

60 under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		1 to every	1 to every
3	2	1	3	1	3	1	1	1	1	...	1	...	...	...	...	...	...	56	31	87	40·3	1588·2
55	64	40	65	34	43	23	59	12	22	7	6	1	3	...	...	...	...	172	262	434	8·0	318·3
10	9	2	5	2	...	...	1	...	...	...	...	...	...	...	...	...	1	32	37	69	50·8	2002·6
2	4	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	138	111	249	14·0	554·9
..	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	9	11	318·8	12562·0
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	36	36	97·4	3838·3
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	27	26	53	66·1	2607·2
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	310	307	617	5·6	223·9
13	13	6	5	2	5	1	2	...	...	...	...	...	...	...	...	...	...	63	84	147	23·8	940·0
13	15	5	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	186	192	378	9·2	365·5
12	23	9	8	6	3	3	2	...	...	...	...	...	...	...	...	...	...	166	167	333	10·5	414·9
3	6	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	36	28	64	54·7	2159·0
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	25	27	52	67·4	2657·3
5	6	...	4	...	2	...	...	...	...	...	...	...	...	...	...	...	1	116	138	254	13·8	544·0
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	2	11	318·8	12562·0
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11	13	24	146·1	5757·5
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	49	33	82	42·6	1685·1
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	11	27	129·8	5117·8
14	7	6	5	1	1	1	1	...	1	...	...	...	...	...	...	1	...	127	129	256	13·6	539·7
30	150	72	100	47	57	29	66	13	24	7	7	1	3	...	...	1	3	1541	1643	3184	1·1	43·3
14	17	7	8	2	2	...	1	...	...	...	...	...	...	...	...	7	11	166	157	323	10·8	427·8
44	167	79	108	49	59	29	67	13	24	7	7	1	3	...	...	8	14	1707	1800	3507	1·0	39·401
311		187		108		96		37		14		4		...		22		3507				
11·2		18·7		32·4		36·5		94·7		250·5		876·		...		159·4		1·0				
444·3		738·9		1279·4		1439·3		3734·6		9870·1		34545·		...		6281·0		39·401				

year ending December 31, 1840, classified according to 18 periods of life at which they took place; with calculations
eral diseases, bear to the total number of deaths, and also to the population.
103.

60 under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
1	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	21	7	28	24·6	1003·6
9	6	14	16	11	15	9	11	2	5	...	3	...	1	...	...	...	...	45	57	102	6·7	275·5
4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	3	10	69·0	2810·3
1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	31	24	55	12·5	510·9
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	2	3	230·0	9367·6
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	4	172·5	7025·7
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	8	12	57·5	2341·9
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	43	40	83	8·3	338·5
5	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	13	21	32·8	1338·2
2	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	19	24	43	16·0	653·5
1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	20	36	19·1	780·6
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	4	172·5	7025·7
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	18	20	38	18·1	739·5
..	2	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	28	16	44	15·6	638·7
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	5	13	53·0	2161·7
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	690·0	28103·0
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	20	14	34	20·2	826·5
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	5	7	98·5	4014·7
2	1	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	12	15	27	25·5	1040·8
25	14	18	16	13	17	9	11	2	5	...	3	...	1	...	...	...	...	286	279	565	1·2	49·7
11	8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	67	58	125	5·5	224·8
36	22	18	16	13	17	9	11	2	5	...	3	...	1	...	...	...	...	353	337	690 *	1·0	40·728
58		34		30		20		7		3		1		...		...		690				
11·8		20·2		23·0		34·5		98·5		230·0		690·		...		...		1·0				
484·5		826·5		936·7		1405·1		4014·7		9367·6		28103·		...		...		40·728				

* Exclusive of 26 in Newhaven.

TABLE XXXVI.—Exhibiting the number of fatal cases of disease that occurred in North and South LEITH durin showing the total number of deaths at each period, and the proportion which these, and the number of deaths from th 1841.—Populatio

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Accidents	...	...	...	...	1	...	2	1	...	...	3	1	4	...	4	1	2	...	3	...
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	1	2	2	3	...
Bowel Complaints	20	24	4	4	...	...	...	...	...	...	...	...	1	...	...	2	...	...	1	...
Catarrh	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...
Croup	2	1	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Decline	7	6	1	...	2	1	...	2	3	1	5	2	13	7	9	7	7	9	4	6
Dropsy	...	...	...	...	...	...	4	...	...	...	1	1	...	3	1	1	...	...	3	4
Fever	1	2	2	4	4	2	3	1	...	3	2	1	6	7	15	5	10	14	6	10
Head, of	5	1	5	3	4	5	3	1	1	...	1	...	...	1	3	2	3	1	6	1
Heart, of	...	1	...	...	...	...	1	...	...	...	...	...	...	1	1	...	...	...	1	1
Hooping-cough	2	2	5	4	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	6	8	...	3	1	...	...	2	...	1	...	1	...	2	2	3	1	2	1	1
Measles	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nervous	2	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	1	...	...	...
Scarlet Fever	...	1	1	2	...	3	...	2	...	1	...	...	...	1	...	1	...	...	1	...
Small-pox	4	4	1	3	3	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Miscellaneous	...	2	...	...	...	1	...	...	...	...	...	...	...	...	2	1	3	1	2	1
Total ascertained	50	53	20	24	17	16	13	10	4	6	12	6	25	24	38	25	29	29	32	24
Do. not ascertained	...	3	...	1	...	...	...	...	...	1	1	1	3	...	2	...	2	1	2	...
Deaths, M. and F.	50	56	20	25	17	16	13	10	4	7	13	7	28	24	40	25	31	30	34	24
Total	106		45		33		23		11		20		52		65		61		58	
Propor. to whole Deaths is as 1 to	5·7		13·6		18·5		26·6		55·7		30·6		11·7		9·4		10·0		10·5	
To the Population.	267·6		630·4		859·7		1233·5		2579·2		1418·6		545·6		436·4		465·1		489·1	

TABLE XXXVII.—Exhibiting the number of fatal cases of disease that occurred in the City of ABERDEEN an calculations showing the total number of deaths at each period, and the proportion which these, and the number o 1837.—Populatio

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Accidents	...	...	1	...	2	2	2	2	...	...	2	...	2	...	2	...	1	1	2	...
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	1	2	2	3
Bowel Complaints	11	3	8	7	6	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Catarrh	3	...	1	...	...	...	...	1	...	...	...	...	...	1	...	...	2	4	2	2
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	8	...	...	...	...
Croup	1	...	1	...	2	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...
Decline	1	...	...	...	...	...	5	4	2	2	4	1	5	4	5	9	5	8	2	5
Dropsy	1	2	3	1	2	3	...	1	...	...	1	1	...	1	...	1	3	2	1	2
Fever	1	1	...	1	2	6	...	1	1	2	1	1	5	6	8	6	4	4	6	3
Head, of	2	...	...	...	5	5	3	1	...	1	...	...	...	1	...	1	1	...	...	2
Heart, of	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hooping-cough	...	1	1	...	1	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...
Inflammation	2	...	...	1	2	...	1	2	1	...	1	1	2	3	2	...	6	1	1	1
Measles	1	1	2	1	5	3	...	...	...	...	...	...	...	...	...	2	...	...	...	...
Nervous	17	18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Scarlet Fever	...	...	...	...	4	8	2	2	...	...	...	1	...	...	...	1	...	...	...	...
Small-pox	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Miscellaneous	...	...	6	6	3	6	...	...	1	...	2	...	3	2	2	1	4	2	6	6
Total ascertained	41	28	23	18	34	38	13	14	6	5	12	5	17	19	19	33	27	24	22	24
Do. not ascertained	56	44	31	22	29	35	40	25	15	14	17	23	25	26	31	40	27	35	28	27
Deaths, M. and F.	97	72	54	40	63	73	53	39	21	19	29	28	42	45	50	73	54	59	50	51
Total	169		94		136		92		40		57		87		123		113		101	
Propor. to whole Deaths is as 1 to	8·2		14·8		10·2		15·1		34·8		24·4		16·0		11·3		12·3		13·7	
To the Population.	366·7		659·4		455·7		673·7		1549·6		1087·4		712·4		503·9		548·5		613·7	

year ending December 31, 1841, classified according to 18 periods of life at which they took place; with calculations
eral diseases, bear to the total number of deaths, and also to the population.
372.

60 under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		1 to every	1 to every
2	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	21	5	26	23·5	1091·2
8	9	9	12	7	7	3	13	6	5	1	...	...	...	...	...	...	...	34	46	80	7·6	354·6
1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	6	13	47·1	2182·4
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	26	30	56	10·9	506·6
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	1	3	204·3	9457·3
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	613·0	28372·0
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	2	5	122·6	5674·4
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	51	41	92	6·6	308·3
3	4	...	3	1	...	...	...	...	...	...	...	...	...	...	...	...	...	13	16	29	21·1	978·3
8	4	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	58	55	113	5·4	251·0
6	5	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	38	20	58	10·5	489·1
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	3	6	102·1	4728·6
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	8	16	38·3	1773·2
1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12	24	36	17·0	788·1
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	613·0	28372·0
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	1	5	122·6	5674·4
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	11	13	47·1	2182·4
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	10	18	34·0	1576·2
5	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12	10	22	27·8	1289·6
4	29	11	18	8	8	3	13	6	5	1	...	...	...	...	...	...	...	303	290	593	1·0	47·8
1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11	9	20	30·6	1418·6
5	30	11	19	8	8	3	13	6	5	1	...	...	...	...	...	...	...	314	299	613 *	1·0	46·283
65		30		16		16		11		1		...		...		...		613				
9·4		20·4		38·3		38·3		55·7		613·		...		...		...		1·0				
432·8		945·7		1773·2		1773·2		2572·2		28732·		...		...		...		46·283				

urbs during the year ending December 31, 1837, classified according to 18 periods of life at which they took place; with
ths from the several diseases, bear to the total number of deaths, and also to the population.
985.

60 under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	16	5	21	66·2	
2	24	11	14	7	13	5	15	7	10	...	3	1	...	...	...	...	...	43	79	122	11·4	
7	8	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	11	17	28	49·7	
2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	27	14	41	33·9	
1	3	1	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	10	13	23	60·5	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	9	154·6	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	...	5	278·4	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	29	33	62	22·4	
..	2	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11	17	28	49·7	
2	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	30	33	63	22·0	
1	1	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	14	12	26	53·5	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	2	3	464·0	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	2	5	278·4	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	18	9	27	51·5	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	7	15	92·8	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	17	18	35	39·7	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	12	18	77·3	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1392·0	
1	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	28	27	55	25·3	
7	44	13	16	8	13	7	16	7	10	...	3	1	...	...	...	...	...	277	310	587	2·3	
0	49	15	23	10	22	11	15	7	13	...	6	...	4	...	...	...	...	382	423	805	1·7	
7	93	28	39	18	35	18	31	14	23	...	9	1	4	...	...	...	...	659	733	1392	1·0	
160		67		53		49		37		9		5		...		...		1392				
8·7		20·7		26·2		28·4		37·6		154·6		278·		...		...		1·0				
387·4		925·1		1165·9		1265·0		1675·2		6887·2		12397·		...		...		44·529				

* Exclusive of 34 in Newhaven.

Table XXXVIII.—Exhibiting the number of fatal cases of disease that occurred in the City of ABERDEEN and calculations showing the total number of deaths at each period, and the proportion which these, and the number of 1838.—Population

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Accidents	...	...	...	...	2	2	1	1	1	...	2	...	2	...	2	1	1	...	1	1
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	...	...	...	1	...	...	1	2	1	...	2	2	4
Bowel Complaints	6	8	3	8	1	1	...	...	...	...	...	...	...	1	...	1	...	...	...	...
Catarrh	...	...	...	...	2	2	...	...	...	...	...	...	...	1	...	...	...	1	...	...
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	1	...	...
Croup	2	...	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Decline	3	...	...	...	...	...	3	2	2	3	5	2	8	5	9	9	9	5	1	3
Dropsy	...	...	1	...	...	...	...	...	...	...	...	1	2	...	2	...	...	1	...	1
Fever	1	...	...	2	1	2	2	1	3	1	3	1	7	7	4	6	9	4	5	2
Head, of	4	5	1	...	2	1	3	4	1	1	...	...	1	2	...	...	1	1	3	3
Heart, of	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	2	...	...	...
Hooping-cough	1	3	2	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	2	5	...	...	2	1	2	1	4	...	1	...	6	1	4	2	4	3	2	2
Measles	2	1	2	1	4	2	...	1	...	...	...	...	...	1	...	...	...	...	...	...
Nervous	15	13	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Scarlet Fever	1	2	...	...	5	1	2	3	...	...	...	...	...	...	1	...	...	...	...	...
Small-pox	6	7	4	3	5	1	4	1	1	...	1	1	2	2	2	1	2	...	...	...
Miscellaneous	6	1	...	2	1	1	2	...	1	...	2	1	3	1	4	3	3	3	5	4
Total ascertained	49	45	14	18	27	15	20	14	13	5	15	6	32	22	30	26	31	21	19	20
Do. not ascertained	62	55	35	26	58	35	25	28	18	10	15	28	29	28	32	35	33	28	42	42
Deaths, M. and F.	111	100	49	44	85	50	45	42	31	15	30	34	61	50	62	61	64	49	61	62
Total	211		93		135		87		46		64		111		123		113		123	
Propor. to whole Deaths is as 1 to	6·6		15·1		10·4		16·2		30·6		22·0		12·7		11·4		12·4		11·4	
To the Population	297·0		673·8		464·2		720·3		1362·4		979·2		564·6		509·5		554·6		509·5	

Table XXXIX.—Exhibiting the number of fatal cases of disease that occurred in the City of ABERDEEN an calculations showing the total number of deaths at each period, and the proportion which these, and the number 1839.—Populatio

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Accidents	...	...	...	...	1	1	...	...	2	...	1	...	...	...	...	...	1	1	1	...
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	1	...
Bowel Complaints	3	2	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...
Catarrh	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...
Croup	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Decline	1	1	...	2	2	...	...	...	2	1	1	3	4	6	4	2	2	3	2	2
Dropsy	...	...	...	...	...	...	1	...	...	...	...	...	...	...	2	1	2	...	...	1
Fever	...	...	...	...	...	1	1	1	1	...	1	1	3	3	7	1	1	5	3	1
Head, of	1	4	2	...	1	5	...	1	...	...	1	...	1	1	1	1	...	...	1	2
Heart, of	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	1	...	...
Hooping-cough	2	1	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	4	1	...	...	2	...	2	2	2	...	2	1	1	1	1	4	2	2	3	...
Measles	1	1	2	2	3	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...
Nervous	2	3	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...
Scarlet Fever	...	...	1	...	1	...	1	...	...	...	4	...	...	...	...	...	...	...	...	...
Small-pox	...	...	...	...	...	...	...	1	...	...	3	...	1	1	...	...	...	...	...	...
Miscellaneous	...	1	...	2	...	...	...	...	...	...	...	...	...	...	...	3	2	3	1	2
Total ascertained	14	14	6	11	11	10	6	6	7	1	13	5	10	13	15	13	12	19	13	8
Do. not ascertained	52	53	37	35	51	45	31	20	11	10	19	14	29	32	30	23	27	35	41	35
Deaths, M. and F.	66	67	43	46	62	55	37	26	18	11	32	19	39	45	45	36	39	54	54	43
Total	133		89		117		63		29		51		84		81		93		97	
Propor. to whole Deaths is as 1 to	8·6		12·9		9·8		18·2		39·6		22·5		13·6		14·1		12·3		11·8	
To the Population	476·4		711·9		552·7		1005·8		2185·0		1242·4		754·3		782·2		681·3		653·2	

uburbs during the year ending December 31, 1838, classified according to 18 periods of life at which they took place; with deaths from the several diseases, bear to the total number of deaths, and also to the population.
2,672.

60 & under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		1 to every	1 to every
...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	13	5	18	78·3	
9	15	6	16	6	12	8	13	2	9	1	1	...	1	...	...	...	...	32	67	99	14·2	
3	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	11	19	74·2	
2	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	13	19	32	44·0	
...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	5	7	201·5	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	3	470·3	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	1	5	282·2	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40	29	69	20·4	
1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	3	9	156·7	
2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	37	27	64	22·0	
2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	18	18	36	39·1	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	3	470·3	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	4	8	176·3	
4	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	31	17	48	29·3	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	6	14	100·7	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	14	30	47·0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	6	15	94·0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	27	16	43	32·8	
5	5	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	33	21	54	26·1	
28	28	8	16	6	12	9	13	2	9	1	1	...	1	...	...	...	...	304	272	576	2·4	
28	32	12	24	14	13	14	17	6	7	1	2	...	...	...	1	...	...	424	411	835	1·6	
56	60	20	40	20	25	23	30	8	16	2	3	...	1	...	1	...	...	728	683	1411	1·0	
116		60		45		53		24		5		1		1		...		1411				
12·1		23·5		31·3		26·6		58·7		282·		1411·		1411·		...		1·0				
540·2		1044·5		1392·7		1182·4		2611·3		12534·		62672·		62672·		...		44·416				

burbs during the year ending December 31, 1839, classified according to 18 periods of life at which they took place; with aths from the several diseases, bear to the total number of deaths, and also to the population.
,366.

60 & under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		1 to every	1 to every
..	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	4	10	114·9	
3	7	6	13	3	9	6	9	2	3	2	3	1	...	...	...	...	...	23	44	67	17·1	
2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	2	7	164·1	
..	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	7	10	114·9	
1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	2	574·5	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	574·5	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	574·5	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	18	20	38	30·2	
2	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	4	11	104·4	
2	1	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	20	15	35	32·8	
1	...	1	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	11	15	26	44·1	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	1	3	383·0	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	3	5	229·8	
1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	21	13	34	33·7	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	5	11	104·4	
1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	5	9	127·6	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	...	7	164·1	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	2	6	191·5	
1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	12	16	71·8	
4	15	8	16	4	10	7	9	2	3	2	3	1	...	...	...	...	...	145	156	301	3·8	
2	39	20	20	15	18	18	21	4	7	6	5	...	3	...	...	1	...	433	415	848	1·3	
6	54	28	36	19	28	25	30	6	10	8	8	1	3	...	...	1	...	578	571	1149	1·0	
110		64		47		55		16		16		4		...		...		1149				
10·4		17·9		24·4		20·8		71·8		71·8		287·		...		...						
67·0		990·0		1348·2		1152·1		3960·3		3960·3		15841·		...		...		55·148				

TABLE XL.—Exhibiting the number of fatal cases of disease that occurred in the City of ABERDEEN and calculations showing the number of deaths at each period, and the proportion which these, and the number of
1840.—Population

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.	
	M	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Accidents	...	...	1	...	...	1	...	2	2	...	...	...	1	...	...	...	2	1	...	...
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	...	...	...	2	...	1	...	2	...	...	...	1	...
Bowel Complaints.	2	2	3	1	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...
Catarrh	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...
Croup	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Decline	...	...	...	...	1	2	...	...	2	1	2	4	7	6	2	2	2	1	3	1
Dropsy	1	...	...	...	1	1	...	2	...	...	...	...	1	...	2	...	...	...	...	3
Fever	2	1	...	1	2	4	6	...	1	2	6	3	12	9	13	5	15	10	3	8
Head, of	1	3	1	...	1	4	1	3	...	...	...	...	1	...	...	2	4	...	1	1
Heart, of	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hooping Cough	4	...	2	1	1	3	...	1	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	...	1	...	...	1	...	...	...	3	...	...	...	2	1	...	1	1	1	5	1
Measles	...	...	...	1	1	5	2	2	...	...	...	...	...	...	...	...	...	...	...	...
Nervous	2	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Scarlet Fever	...	1	3	1	7	2	4	2	...	...	1	...	...	...	...	...	...	...	...	...
Small-Pox	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Miscellaneous	1	...	1	...	2	1	...	3	...	...	...	2	1	2	3	1	2	7	4	2
Total ascertained	13	10	12	5	19	24	13	15	8	3	11	10	26	18	22	13	26	20	17	16
Do. not ascertained	60	48	47	40	64	56	38	47	15	20	11	19	36	58	40	48	38	38	40	36
Deaths, M. and F.	73	58	59	45	83	80	51	62	23	23	22	29	62	76	62	61	64	58	57	52
Total	131		104		163		113		46		51		138		123		122		109	
Propor. to whole Deaths is as 1 to	10·5		13·3		8·4		12·2		30·0		27·1		10·0		11·2		13·3		12·6	
To the Population.	489·0		616·0		393·0		566·9		1392·7		1256·2		464·2		520·8		525·1		587·7	

TABLE XLI.—Exhibiting the number of fatal cases of disease that occurred in the City of ABERDEEN and calculations showing the total number of deaths at each period, and the proportion which these, and the number of
1841.—Population

Accidents	...	...	...	...	1	1	...	...	1	...	...	...	1	...	1	1	1	1	2	1
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	2	...
Bowel Complaints.	3	6	1	4	...	...	1	...	1	...	...	...	...	...	...	...	...	...	1	...
Catarrh	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...
Croup	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Decline	...	...	...	...	1	...	...	1	2	1	5	7	6	8	6	6	4	2	2	3
Dropsy	...	1	...	...	1	...	...	1	...	...	1	...	2	1	...	...	...	...	...	...
Fever	1	...	...	...	1	1	3	2	1	...	1	1	4	6	1	3	3	1	2	...
Head, of	2	...	3	2	1	2	2	1	...	...	...	...	1	...	2	...	...	1	2	1
Heart, of	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hooping-cough	1	1	1	2	...	2	...	1	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	1	...	...	...	2	...	...	1	...	...	1	...	1	1	2	1	3	1	...	2
Measles	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nervous	1	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Scarlet Fever	...	...	1	...	...	1	1	...	1	1	...	...	...	...	1	...	...	...	...	...
Small-pox	...	...	...	2	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...
Miscellaneous	2	1	1	2	2	...	...	...	...	2	...	...	1	...	3	2	3	1	3	2
Total ascertained	12	16	8	12	9	7	7	7	6	4	9	9	17	17	17	13	14	7	14	9
Do. not ascertained	65	44	30	33	29	33	25	21	13	7	13	16	27	31	26	24	27	23	28	1[illegible]
Deaths, M. and F.	77	60	38	45	38	40	32	28	19	11	22	25	44	48	43	37	41	30	42	2[illegible]
Total	137		83		78		60		30		47		92		80		71		68	
Propor. to whole Deaths is as 1 to	7·7		12·4		13·2		17·2		34·4		22·0		11·2		12·9		14·5		15·[illegible]	
To the Population.	472·8		780·4		830·4		1079·6		2159·2		1378·2		704·1		807·7		912·3		952·[illegible]	

suburbs during the year ending December 31, 1840, classified according to 18 periods of life at which they took place; with deaths from the several diseases, bear to the total number of deaths, and also to the population.
64,068.

60 & under 70. M.	60 & under 70. F.	70 & under 75. M.	70 & under 75. F.	75 & under 80. M.	75 & under 80. F.	80 & under 85. M.	80 & under 85. F.	85 & under 90. M.	85 & under 90. F.	90 & under 95. M.	90 & under 95. F.	95 & under 100. M.	95 & under 100. F.	100 & upwards. M.	100 & upwards. F.	Ages not ascertained. M.	Ages not ascertained. F.	Total. M.	Total. F.	Total Deaths.	Proportions to the Whole Deaths. 1 to every	Proportions to the Population. 1 to every
1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	4	11	125·8	
5	1	6	8	4	3	2	5	1	3	...	2	1	...	...	...	...	...	19	22	41	33·7	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	...	6	230·6	
1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	6	13	106·4	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	692·0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	1384·0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	19	17	36	38·4	
2	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	8	15	92·2	
3	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	64	45	109	12·6	
5	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15	14	29	47·7	
...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1384·0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	5	12	115·3	
2	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14	7	21	65·9	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	8	11	125·8	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	4	346·0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15	6	21	65·9	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	1384·0	
8	4	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	24	22	46	30·0	
27	13	8	9	4	3	3	5	1	3	...	2	1	...	...	...	...	...	211	169	380	3·6	
40	35	29	23	11	19	8	18	6	10	2	3	1	...	...	...	...	...	486	518	1004	1·3	
67	48	37	32	15	22	11	23	7	13	2	5	2	...	...	...	...	...	697	687	1384	1·0	
115		69		37		34		20		7		2		...		...		1384				
12·0		20·5		37·4		40·7		69·2		196·7		692·0		...		...		1·0				
557·1		928·5		1731·5		1884·3		3203·4		9152·5		32034·		...		...		46·291				

uburbs during the year ending December 31, 1841, classified according to 18 periods of life at which they took place; with eaths from the several diseases, bear to the total number of deaths, and also to the population.
ⅰ,778.

60 & under 70. M.	60 & under 70. F.	70 & under 75. M.	70 & under 75. F.	75 & under 80. M.	75 & under 80. F.	80 & under 85. M.	80 & under 85. F.	85 & under 90. M.	85 & under 90. F.	90 & under 95. M.	90 & under 95. F.	95 & under 100. M.	95 & under 100. F.	100 & upwards. M.	100 & upwards. F.	Ages not ascertained. M.	Ages not ascertained. F.	Total. M.	Total. F.	Total Deaths.	Proportions to the Whole Deaths. 1 to every	Proportions to the Population. 1 to every
...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	7	5	12	86·1	
5	8	8	10	5	7	7	9	3	9	1	1	...	2	...	...	...	...	29	46	75	13·7	
1	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	3	8	129·2	
...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	11	18	57·4	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1034·0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	2	517·0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	26	28	54	19·1	
1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	3	8	129·2	
3	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	20	16	36	28·7	
2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15	7	22	47·0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1034·0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	6	8	129·2	
4	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15	7	22	47·0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	6	7	147·7	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	2	6	172·3	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	3	4	258·5	
2	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	17	12	29	35·6	
18	14	9	13	5	7	7	10	3	9	1	1	...	2	...	...	...	...	156	157	313	3·3	
27	40	13	27	13	16	11	17	5	12	1	4	...	2	1	...	...	...	354	367	721	1·4	
45	54	22	40	18	23	18	27	8	21	2	5	...	4	1	...	...	...	510	524	1034	1·0	
99		62		41		45		29		7		4		1		...		1034				
10·4		16·6		25·2		22·9		35·6		147·7		258·5		1034·		...		1·0				
654·3		1044·8		1579·9		1439·5		2233·7		9254·0		16194·		64778·		...		62·647				

TABLE XLII.—Exhibiting the number of fatal cases of disease that occurred in the City of PERTH (not including they took place; with calculations showing the total number of deaths at each period, and the proportion which these, 1837.—Population

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Accidents	...	...	...	...	...	...	1	3	...	...	...	...	2	...	3	1	2	...	1	...
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	3	3	6
Bowel Complaints.	8	11	5	5	...	...	...	...	...	...	...	...	...	...	1	1	...	3	...	1
Catarrh	...	2	...	...	2	1	...	1	...	...	1	...	1	2	...	1	2	4	3	1
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	2	...	...	...	...
Croup	2	1	3	2	2	3	2	1	1	...	...	...	...	...	...	...	...	...	...	...
Decline	...	3	1	...	...	1	...	3	1	5	4	2	6	6	8	6	1	4	10	9
Dropsy	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	3	3	...	1	1
Fever	...	2	2	...	1	3	3	2	2	...	1	1	7	4	9	9	9	8	4	7
Head, of	1	1	1	1	4	3	3	1	1	...	...	...	1	1	3	2	3	1	1	3
Heart, of	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...
Hooping-cough	4	6	5	3	2	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	1	1	1	2	1	2	...	1	...	1	2	2	2	1	...	1	3	1	2	1
Measles	1	3	6	3	4	4	1	...	...	...	...	1	...	...	...	...	...	...	...	...
Nervous	11	7	1	...	1	2	...	...	1	...	...	...	...	...	...	...	...	...	2	1
Scarlet Fever	...	...	...	...	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...
Small-pox	1	1	...	...	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Miscellaneous	...	2	...	...	...	...	...	...	2	...	...	...	...	1	2	...	...	1	3	1
Total ascertained	29	40	25	16	20	24	11	12	8	6	8	6	24	16	27	26	23	25	30	31
Do. not ascertained	1	1	...	...	...	...	...	1	...	...	...	...	...	...	1	1	2	...	1	1
Deaths, M. and F.	30	41	25	16	20	24	11	13	8	6	8	6	24	16	28	27	25	25	31	32
Total	71		41		44		24		14		14		40		55		50		63	
Propor. to whole Deaths is as 1 to	9·1		15·8		14·7		27·0		46·3		46·3		16·2		11·8		12·9		10·3	
To the Population.	275·7		477·5		444·9		815·7		1398·5		1398·5		489·4		355·9		391·5		310·7	

TABLE XLIII.—Exhibiting the number of fatal cases of disease that occurred in the City of PERTH (not including they took place; with calculations showing the total number of deaths at each period, and the proportion which these, 1838.—Population

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Accidents	...	...	1	...	...	1	...	1	...	...	...	...	6	...	1	...	1	...	1	...
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	3	3	2
Bowel Complaints.	7	10	7	5	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	1
Catarrh	...	1	...	...	...	...	...	...	1	1	...	...	1	...	...	...	...	1	...	...
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...
Croup	3	2	2	1	5	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Decline	1	3	1	2	5	...	4	...	1	1	2	7	5	8	8	5	5	6	3	6
Dropsy	...	...	1	...	...	...	...	...	...	...	1	...	1	...	...	...	...	1	3	5
Fever	...	...	1	1	1	2	...	2	...	1	1	2	5	3	5	3	5	5	1	7
Head, of	...	2	2	2	2	6	1	...	...	...	...	...	...	2	2	1	4	2	4	6
Heart, of	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1
Hooping-cough	...	4	4	4	2	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	1	2	1	1	5	...	...	...	1	...	...	...	2	...	2	3	2	1	2	...
Measles	...	6	3	3	4	4	...	1	...	...	...	...	...	...	...	...	...	...	...	...
Nervous	8	6	...	...	1	1	1	2	...	1	...	...	...	...	...	...	...	...	...	...
Scarlet Fever	...	5	2	1	9	9	4	6	1	2	...	...	...	...	...	...	...	...	...	1
Small-pox	6	5	1	5	12	5	1	...	...	...	...	...	1	...	...	...	...	...	...	...
Miscellaneous	1	...	...	...	...	...	...	...	1	...	2	...	...	2	2	1	1	3	2	3
Total ascertained	27	46	26	25	46	37	11	13	5	6	6	9	21	15	21	16	18	22	20	32
Do. not ascertained	2	5	...	...	1	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...
Deaths, M. and F.	29	51	26	25	47	37	12	13	5	6	6	9	22	15	21	16	18	22	20	32
Total	80		51		84		25		11		15		37		37		40		52	
Propor. to whole Deaths is as 1 to	7·2		11·3		6·8		23·1		52·5		38·5		15·6		15·6		14·4		11·1	
To the Population.	243·8		382·4		232·2		780·2		1773·3		1300·4		527·2		527·2		487·6		375·1	

he suburban district of Kinnoul) during the year ending December 31, 1837, classified according to 18 periods of life at which
nd the number of deaths from the several diseases, bear to the total number of deaths, and also to the population.
19,579.

60 & under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		1 to every	1 to every
...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	6	15	43·2	1305·2
15	20	16	16	8	12	12	23	4	2	1	1	...	...	...	...	...	...	56	74	130	4·9	150·6
6	9	3	4	...	1	...	...	...	...	...	...	...	...	...	...	...	...	14	23	37	17·5	529·1
...	2	1	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	16	24	40	16·2	489·4
6	7	3	6	1	2	1	1	...	...	...	...	...	...	...	...	...	...	20	28	48	13·5	407·8
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	3	216·3	6526·3
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	7	17	38·1	1151·7
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	31	39	70	9·2	279·7
3	2	...	2	2	...	...	...	...	...	...	...	...	...	...	...	...	...	11	8	19	34·1	1030·4
2	4	...	1	2	1	1	...	...	...	...	...	...	...	...	...	...	...	43	42	85	7·6	230·3
5	6	4	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	28	19	47	13·8	416·5
...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	3	216·3	6526·3
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11	12	23	28·2	851·2
1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	13	15	28	23·1	699·2
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12	11	23	28·2	851·2
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	10	26	24·9	753·0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	1	3	216·3	6526·3
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	2	5	129·8	3915·8
1	2	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	10	8	18	36·0	1087·7
39	55	27	32	16	16	16	24	4	2	1	1	...	...	...	...	...	...	308	332	640	1·0	30·5
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	4	9	72·1	2175·4
39	55	27	32	16	16	16	24	4	2	1	1	...	...	...	...	...	...	313	336	649	1·0	30·167
94		59		32		40		6		2		...		...		...		649				
6·9		11·0		20·2		16·2		108·1		324·5		...		...		...		1·0				
208·2		331·8		611·8		489·4		3263·1		9789·5		...		...		...		30·167				

he suburban district of Kinnoul) during the year ending December 31, 1838, classified according to 18 periods of life at which
nd the number of deaths from the several diseases, bear to the total number of deaths, and also to the population.
9,507.

60 & under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		1 to every	1 to every
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	2	12	48·1	1625·5
12	8	12	17	7	11	8	12	2	4	...	1	...	1	...	...	...	...	41	54	95	6·0	205·3
3	5	1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	9	13	22	26·2	886·6
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14	18	32	18·0	609·5
...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	4	6	96·3	3251·1
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	289·0	9753·5
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	7	17	34·0	1147·4
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	35	38	73	7·9	267·2
3	2	...	...	2	...	...	1	...	...	...	...	...	...	...	...	...	...	11	9	20	28·9	975·3
5	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	25	27	52	11·1	375·1
2	3	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	18	25	43	13·4	453·6
1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	4	144·5	4876·7
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	12	18	32·1	1083·7
...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	9	25	23·1	780·2
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	14	21	27·5	928·9
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	10	20	28·9	975·3
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	24	40	14·4	487·6
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	21	15	36	16·0	541·8
2	4	3	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	14	14	28	20·6	696·6
28	25	18	20	10	13	8	14	2	4	...	1	...	1	...	...	...	...	267	299	566	1·0	34·4
1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	6	12	48·1	1625·5
29	26	18	20	10	13	8	14	2	4	...	1	...	...	...	...	...	...	273	305	578	1·0	33·749
55		38		23		22		6		1		1		...		...		578				
10·5		15·2		25·1		26·2		96·3		578·		578·		...		...		1·0				
354·6		513·3		848·1		886·6		3251·1		19507·		19507·		...		...		33·749				

TABLE XLIV.—Exhibiting the number of fatal cases of disease that occurred in the City of PERTH (not including which they took place; with calculations showing the total number of deaths at each period, and the proportion which 1839.—Population

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Accidents	...	...	...	...	1	...	...	...	...	1	3	...	2	...	2	...	1	...	1	...
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1
Bowel Complaints.	13	6	2	10	1	1	1	...	...	...	...	...	...	...	1	...	...	...	1	...
Catarrh	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	1	...
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	1	...	...
Croup	2	1	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...
Decline	3	2	1	...	2	...	1	1	...	2	4	1	10	5	1	6	9	2	2	5
Dropsy	...	...	...	...	1	...	1	...	...	...	...	...	1	2	2	1	5	2	3	2
Fever	...	...	...	...	...	1	1	...	2	...	...	1	...	3	3	3	1	2	...	1
Head, of	...	2	4	2	3	1	1	...	...	...	1	...	1	...	3	1	1	2	4	2
Heart, of	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	2	...	...	2	...
Hooping-cough	1	3	1	1	2	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	11	3	1	...	...	1	...	...	1	1	1	...	2	...	1	1	...	2	1	2
Measles	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nervous	6	11	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Scarlet Fever	1	...	2	2	2	3	2	3	...	...	...	...	...	...	...	...	...	...	...	...
Small-pox	...	...	...	...	2	2	...	...	...	1	...	...	1	...	1	...	...	...	...	...
Miscellaneous	3	...	...	...	...	...	...	1	...	1	...	...	1	1	1	4	3	...	3	1
Total ascertained	30	28	14	15	14	13	7	6	3	6	9	2	18	15	15	18	20	12	19	14
Do. not ascertained	4	2	...	...	...	...	...	...	...	...	...	...	...	...	...	1	2	...	...	...
Deaths, M. and F.	34	30	14	15	14	13	7	6	3	6	9	2	18	15	15	19	22	12	19	14
Total	64		29		27		13		9		11		33		34		34		33	
Propor. to whole Deaths is as 1 to	6·6		14·7		15·8		32·9		47·5		38·9		12·9		12·5		12·5		12·9	
To the Population.	303·6		670·1		719·8		1495·0		2159·4		1766·8		588·9		571·6		571·6		588·9	

TABLE XLV.—Exhibiting the number of fatal cases of disease that occurred in the City of PERTH (not including which they took place; with calculations showing the total number of deaths at each period, and the proportion which 1840.—Population

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Accidents	...	...	...	...	1	...	1	1	1	...	1	...	1	...	1	...	4	1	...	...
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	1	2	5	1
Bowel Complaints.	6	2	7	2	1	...	...	...	...	...	...	...	...	...	...	...	...	2	1	...
Catarrh	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1	1
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...
Croup	1	1	...	1	1	2	2	...	...	...	...	...	...	...	...	...	...	...	...	...
Decline	1	1	...	1	2	3	2	1	5	1	2	3	9	9	3	5	6	3	3	3
Dropsy	...	1	...	...	...	...	1	...	...	...	1	...	...	2	...	...	...	2	1	1
Fever	1	1	1	...	2	2	2	2	2	...	...	1	...	2	...	...	1	1	...	...
Head, of	1	1	...	1	2	1	1	1	...	1	...	...	1	2	1	...	5	1	1	2
Heart, of	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hooping-cough	3	3	4	3	6	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	1	2	...	1	...	...	2	...	2	...	...	...	3	2	1	...	3	...	2	2
Measles	6	5	6	5	5	4	...	1	1	...	...	...	...	...	...	...	...	...	...	...
Nervous	4	9	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	1	...	...
Scarlet Fever	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Small-pox	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...
Miscellaneous	...	1	...	...	...	...	...	...	...	...	...	...	1	...	1	1	2	...	1	1
Total ascertained	24	27	18	14	22	18	12	7	11	2	4	4	15	19	7	9	22	13	15	11
Do. not ascertained	2	3	...	1	1	1	...	...	...	...	...	2	1	...	1	2	4	2	1	1
Deaths, M. and F.	26	30	18	15	23	19	12	7	11	2	4	6	16	19	8	11	26	15	16	12
Total	56		33		42		19		13		10		35		19		41		28	
Propor. to whole Deaths is as 1 to	7·9		13·4		10·5		23·4		34·2		44·5		12·7		23·4		10·5		15·8	
To the Population.	345·8		586·8		461·0		1019·2		1489·6		1936·5		553·2		1019·2		472·3		691·6	

e suburban district of Kinnoul) during the year ending December 31, 1839, classified according to 18 periods of life at
ese, and the number of deaths from the several diseases, bear to the total number of deaths, and also to the population,
,435.

60 & under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		1 to every	1 to every
...	...	1	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	12	2	14	30·5	1388·2
14	5	5	9	8	4	10	12	6	5	...	2	...	...	...	...	...	...	43	37	80	5·3	242·9
4	4	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	8	13	32·9	1495·0
3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	22	17	39	10·9	498·3
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	2	3	142·6	6478·3
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	3	142·6	6478·3
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	3	5	85·6	3887·0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	33	24	57	7·5	340·9
2	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	7	23	18·6	845·0
2	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	12	21	20·3	925·4
5	8	4	1	...	2	...	...	1	...	...	...	...	...	...	...	...	...	28	21	49	8·7	396·6
...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	4	3	7	61·1	2776·4
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	6	10	42·8	1943·5
2	1	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	12	11	23	18·6	845·0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	428·0	19435·0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	11	19	22·5	1022·8
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	8	15	28·5	1295·6
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	3	7	61·1	2776·4
2	3	1	2	1	...	1	...	...	...	...	...	...	...	...	...	...	...	16	13	29	14·7	670·1
34	21	13	15	11	7	13	12	7	5	...	2	...	...	...	...	...	...	227	191	418	1·0	46·4
...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	6	4	10	42·8	1943·5
34	21	13	15	11	8	13	12	7	5	...	2	...	...	...	...	...	...	233	195	428	1·0	45·408
55		28		19		25		12		2		...		...		...		428				
7·7		15·2		22·5		17·1		35·6		214·0		...		...		...		1·0				
353·3		694·1		1022·8		777·4		1619·5		9717·5		...		...		...		45·408				

e suburban district of Kinnoul) during the year ending December 31, 1840, classified according to 18 periods of life at
ese, and the number of deaths from the several diseases, bear to the total number of deaths, and also to the population,
,365.

60 & under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	11	3	14	31·7	1383·2
2	16	9	19	8	10	11	18	2	6	1	3	...	...	...	...	...	...	33	72	105	4·2	184·4
1	4	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	9	11	20	22·2	968·2
1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	7	23	19·3	841·9
...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	3	5	89·0	3873·0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	445·0	19365·0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	4	8	55·6	2420·6
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	33	30	63	7·0	307·3
...	1	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	3	9	12	37·0	1613·7
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	9	18	24·7	1075·8
2	4	1	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	17	15	32	13·9	605·1
...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	2	222·5	9682·5
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	13	12	25	17·8	774·6
2	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	18	7	25	17·8	774·6
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	18	15	33	13·4	586·8
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	11	16	27·8	1210·3
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	445·0	19365·0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	445·0	19365·0
1	1	2	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	9	6	15	29·6	1291·0
9	28	14	25	14	12	12	19	2	6	1	3	...	...	...	...	...	...	202	217	419	1·0	46·2
1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12	14	26	17·1	744·8
0	29	15	26	14	12	12	19	2	6	1	3	...	...	...	...	...	...	214	231	445	1·0	43·516
39		41		26		31		8		4		...		...		...		445				
11·4		10·5		17·1		14·3		55·6		111·2		...		...		...		1·0				
496·5		472·3		744·8		624·6		2420·6		4841·2		...		...		...		43·516				

Table XLVI.—Exhibiting the number of fatal cases of disease that occurred in the City of PERTH (not including they took place; with calculations showing the total number of deaths at each period, and the proportion which these, 1841.—Population

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Accidents	1	1	...	...	1	1	...	1	...	...	2	...	...	1	...	...	1	1	...	...
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	1	2	...	4	2
Bowel Complaints	10	8	5	3	1	1	...	...	...	...	1	1	1	...	...	1	...	...	...	...
Catarrh	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	3	...	...	...	...
Croup	...	...	2	1	3	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Decline	2	3	1	1	3	1	1	...	...	...	3	3	6	8	2	4	1	7	3	7
Dropsy	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	...	1	2	2	4
Fever	...	...	3	1	2	3	1	...	...	1	1	...	...	1	...	...	1	...	1	...
Head, of	1	...	2	2	2	2	2	1	...	1	...	...	1	1	1	2	3	1	4	3
Heart, of	...	...	...	...	...	...	...	...	...	2	1	...	1	...	...	1	...	1	2	...
Hooping-cough	2	3	3	3	3	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	4	5	2	2	...	3	...	1	...	...	1	...	...	1	1	2	1	4	1	...
Measles	...	1	3	1	3	2	2	...	...	...	...	...	...	...	...	...	...	...	...	...
Nervous	8	13	2	1	3	...	1	...	...	...	...	...	...	...	1	...	...	...	...	1
Scarlet Fever	...	...	...	1	1	2	3	...	1	1	...	...	...	...	...	...	...	...	...	...
Small-pox	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Miscellaneous	...	...	...	1	...	...	...	...	...	...	...	...	...	2	...	...	2	3	2	3
Total ascertained	30	35	23	17	22	19	10	3	1	5	10	4	10	19	6	14	12	19	19	20
Do. not ascertained	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	1
Deaths, M. and F.	32	36	23	17	22	19	10	3	1	5	10	4	10	19	6	16	12	19	19	21
Total	68		40		41		13		6		14		29		22		31		40	
Propor. to whole Deaths is as 1 to	6·8		11·6		11·3		35·8		77·6		33·2		16·0		21·1		15·0		11·6	
To the Population	283·7		482·3		470·5		1484·0		3215·5		1378·0		665·7		876·9		622·3		482·3	

Table XLVII.—Exhibiting the number of fatal cases of disease that occurred in the town of DUNDEE during the the total number of deaths at each period, and the proportion which these, and the number of deaths from the several 1839.—Population

Diseases.	Under 1 Year M.	Under 1 Year F.	1–2 M.	1–2 F.	2–5 M.	2–5 F.	5–10 M.	5–10 F.	10–15 M.	10–15 F.	15–20 M.	15–20 F.	20–30 M.	20–30 F.	30–40 M.	30–40 F.	40–50 M.	40–50 F.	50–60 M.	50–60 F.
Accidents	...	...	...	1	2	1	1	...	2	...	5	...	5	...	2	...	5	2	2	...
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	...	...	...	...	...	1	2	1	2	7	4	5	6
Bowel Complaints	57	41	15	20	6	6	...	2	...	...	...	...	1	1	...	2	...	...	1	2
Catarrh	2	...	...	...	2	...	...	...	...	...	...	...	...	...	...	1	1	2	1	...
Childbirth	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	5	...	2	...	...
Croup	...	6	1	7	5	9	...	2	...	...	...	...	...	...	...	...	...	...	...	...
Decline	7	13	9	4	10	7	3	5	3	6	5	4	15	14	10	16	14	10	5	11
Dropsy	1	1	1	...	6	1	...	2	4	3	...	...	1	1	1	6	3	6	5	9
Fever	2	2	4	7	9	12	11	5	2	5	3	5	12	13	15	17	11	14	9	6
Head, of	7	2	2	2	9	8	2	4	2	1	2	1	5	1	1	3	6	2	8	3
Heart, of	1	1	...	...	...	...	...	...	1	1	...	1	1	2	1	...	5	1	...	1
Hooping-cough	20	19	15	15	11	20	3	2	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	12	15	6	6	3	6	3	2	...	2	3	1	7	7	...	4	6	5	2	3
Measles	17	20	24	40	33	41	9	12	1	...	...	...	...	...	...	...	...	...	...	...
Nervous	6	13	1	3	...	...	1	...	...	...	...	...	...	...	...	1	...	1	...	...
Scarlet Fever	2	2	8	4	12	21	10	4	3	3	3	...	2	...	...	1	...	2	...	2
Small-pox	14	15	7	10	9	16	...	2	...	...	...	...	2	...	1	...	1	...	...	...
Miscellaneous	11	12	...	3	2	4	1	...	2	1	...	...	3	4	9	1	1	4	3	5
Total ascertained	159	162	93	122	119	152	44	42	20	22	21	13	55	46	41	59	60	55	41	48
Do. not ascertained	19	18	...	...	...	...	...	1	...	...	...	...	1	1	2	...	...	...	...	1
Deaths, M. and F.	178	180	93	122	119	152	44	43	20	22	21	13	56	47	43	59	60	55	41	49
Total	358		215		271		87		42		34		103		102		115		90	
Propor. to whole Deaths is as 1 to	4·6		7·6		6·0		18·9		39·2		48·4		15·9		16·1		14·3		18·3	
To the Population	161·7		269·2		213·6		665·4		1378·5		1702·8		562·1		567·6		503·4		643·3	

e suburban district of Kinnoul) during the year ending December 31, 1841, classified according to 18 periods of life at which
d the number of deaths from the several diseases, bear to the total number of deaths, and also to the population.
,293.

60 & under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
I.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		1 to every	1 to every
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	5	10	46·6	1929·3
4	8	9	16	13	18	11	18	2	11	...	5	2	...	...	...	...	...	41	76	117	3·9	164·8
4	5	3	2	...	2	...	...	...	...	...	...	...	...	...	...	...	...	14	13	27	17·2	714·5
...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	18	15	33	14·1	584·6
.	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	3	2	5	93·2	3858·6
.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	6	77·6	3215·5
.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	4	9	51·7	2143·6
.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	22	34	56	8·3	344·5
.	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	8	15	31·0	1286·2
.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	6	15	31·0	1286·2
4	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	20	16	36	12·9	535·9
.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	4	8	58·2	2411·6
.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	7	15	31·0	1286·2
4	1	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	15	20	35	13·3	551·2
.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	4	12	38·8	1607·7
.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15	15	30	15·5	643·1
.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	4	9	51·7	2143·6
.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	2	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	10	11	21	22·1	918·7
)	17	15	22	15	22	11	18	3	11	...	5	2	...	...	...	...	...	209	250	459	1·0	42·0
l	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	4	7	66·5	2756·1
l	17	15	22	15	22	11	18	3	11	...	5	2	...	...	...	...	...	212	254	466	1·0	41·401
38		37		37		29		14		5		2		...		...		466				
12·2		12·5		12·5		16·0		33·2		93·2		233·0		...		...		1·0				
07·7		521·4		521·4		665·7		1378·0		3858·6		9646·5		...		...		41·401				

r ending December 31, 1839, classified according to 18 periods of life at which they took place; with calculations showing
eases, bear to the total number of deaths, and also to the population.
397.

60 & under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
	...	1	...	...	...	...	1	...	...	...	...	...	1	...	...	...	...	27	6	33	49·9	1754·4
	19	12	20	10	12	11	16	1	3	1	3	...	...	1	...	...	...	49	73	122	13·5	474·5
	4	2	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	28	18	46	35·8	1258·6
	3	2	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	83	78	161	10·2	359·6
	2	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	10	5	15	109·8	3859·8
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	9	183·0	6433·0
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	24	30	54·9	1929·9
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	81	90	171	9·6	338·5
	8	2	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	29	39	68	24·2	851·4
	3	3	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	87	90	177	9·3	315·8
	2	2	4	1	...	...	...	...	...	...	...	...	...	...	...	...	...	51	33	84	19·6	689·2
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	7	17	96·8	3405·7
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	49	56	105	15·6	551·4
	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	47	55	102	16·1	567·6
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	84	113	197	8·3	293·8
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	18	26	63·3	2226·8
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40	39	79	20·8	732·8
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	34	43	77	21·3	751·9
	6	1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	41	42	83	19·8	697·5
	51	25	29	13	13	13	17	1	3	1	3	...	1	1	...	...	...	764	838	1602	1·0	36·1
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	24	21	45	36·6	1286·6
	51	25	29	13	13	13	17	1	3	1	3	...	1	1	...	...	...	788	859	1647	1·0	35·153
10		54		26		30		4		4		1		1		...		1647				
4·9		30·5		63·3		54·9		411·		411·		1647·		1647·		...		1·0				
6·3		1072·1		2226·8		1929·9		14474·		14474·		57897·		57897·		...		35·153				

TABLE XLVIII.—Exhibiting the number of fatal cases of disease that occurred in the Town of DUNDEE during the the total number of deaths at each period, and the proportion which these, and the number of deaths from the several 1840.—Population

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Accidents	...	...	1	...	2	...	2	1	...	1	...	...	3	1	3	...	7	2	2	...
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	1	...	...	...	...	...	...	1	2	2	2	3	8	7
Bowel Complaints.	50	28	13	22	5	4	1	3	...	1	...	2	2	1	1	1	2	1	3	1
Catarrh	1	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	1	2
Childbirth	...	...	...	...	...	...	...	...	...	...	...	1	...	6	...	4	...	2	...	...
Croup	1	4	2	2	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Decline	15	12	9	1	9	4	10	5	4	6	3	5	24	20	8	12	19	16	3	8
Dropsy	2	...	...	...	...	3	1	3	...	2	...	1	2	1	3	3	2	3	5	7
Fever	3	6	1	...	5	5	2	4	3	3	5	3	7	8	16	9	11	9	4	7
Head, of	12	5	3	4	5	5	3	6	1	...	...	1	1	1	4	2	4	3	3	3
Heart, of	...	...	...	...	...	...	...	2	...	1	...	...	2	1	2	...	...	...	2	...
Hooping-cough	9	5	13	9	6	10	3	3	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	20	6	6	4	4	2	4	2	1	2	1	1	3	...	2	2	5	1	4	2
Measles	1	3	2	3	3	3	1	...	...	...	...	...	...	...	...	...	...	...	...	...
Nervous	10	8	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Scarlet Fever	...	2	2	2	4	2	3	1	1	...	1	...	...	...	1	...	...	...	...	...
Small-pox	22	31	20	14	23	18	9	7	2	1	...	1	2	3	...	4	...	...	...	...
Miscellaneous	8	4	...	...	2	1	2	2	2	...	1	...	4	1	3	5	4	5	3	7
Total ascertained	154	114	73	63	74	58	42	39	14	17	11	15	50	44	45	44	56	45	38	44
Do. not ascertained	20	15	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	1	...	...
Deaths, M. and F.	174	129	73	63	74	58	42	39	14	17	11	15	50	44	46	44	57	46	38	44
Total	303		136		132		81		31		26		94		90		103		82	
Propor. to whole Deaths is as 1 to	4·3		9·7		10·0		16·2		42·5		50·7		14·0		14·6		12·8		16·0	
To the Population.	197·0		438·9		452·2		736·9		1925·5		2295·8		635·0		663·2		579·5		727·9	

TABLE XLIX.—Exhibiting the number of fatal cases of disease that occurred in the Town of DUNDEE during the the total number of deaths at each period, and the proportion which these, and the number of deaths from the several 1841.—Population

Diseases.	Under 1 Year.		1 & under 2.		2 & under 5.		5 & under 10.		10 & under 15.		15 & under 20.		20 & under 30.		30 & under 40.		40 & under 50.		50 & under 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Accidents	...	...	1	...	2	2	2	3	1	...	4	1	3	2	3	...	2	1	3	...
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asthma	...	...	...	...	...	...	...	1	...	...	...	1	...	2	3	1	10	6	4	8
Bowel Complaints.	43	34	21	23	6	3	...	...	2	1	...	...	1	1	1	4	...	3	2	2
Catarrh	3	2	...	...	2	...	...	...	...	...	1	...	1	1	...	1	...	...	5	4
Childbirth	...	...	...	...	...	...	...	...	...	...	...	...	...	5	...	7	...	...	...	...
Croup	3	3	1	4	3	5	1	1	...	...	...	...	...	...	...	...	...	...	...	...
Decline	7	6	4	4	6	5	2	4	7	4	9	4	15	21	18	16	11	11	6	13
Dropsy	...	...	1	...	4	6	3	4	1	2	2	1	3	2	1	4	3	6	4	7
Fever	3	5	1	1	3	2	8	2	3	3	...	2	2	5	2	4	3	3	2	1
Head, of	12	6	4	5	9	8	4	5	2	1	...	...	...	2	3	5	5	5	1	4
Heart, of	3	1	...	...	...	...	...	...	1	...	...	...	1	1	...	...	...	1	...	1
Hooping-cough	13	9	6	9	6	15	...	1	...	...	...	...	...	...	...	...	...	...	...	...
Inflammation	13	6	7	5	4	7	1	...	2	...	3	1	3	4	4	3	2	2	5	2
Measles	10	5	28	19	15	20	4	2	1	...	...	1	...	...	...	...	...	...	...	...
Nervous	7	6	1	...	...	1	1	2	1	1	...	1	...	...	...	...	...	...	...	...
Scarlet Fever	4	5	10	6	31	26	15	12	1	5	...	1	...	...	...	1	...	...	...	...
Small-pox	4	6	1	2	1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...
Miscellaneous	1	1	4	...	...	2	3	1	4	1	...	2	3	3	6	5	1	7	5	6
Total ascertained	126	95	90	78	92	103	45	39	26	18	19	15	32	49	41	51	37	45	37	48
Do. not ascertained	17	9	...	...	...	...	...	...	...	...	...	...	...	1	...	3	...	...	1	...
Deaths, M. and F.	143	104	90	78	92	103	45	39	26	18	19	15	32	50	41	54	37	45	38	48
Total	247		168		195		84		44		34		82		95		82		86	
Propor. of whole Deaths is as 1 to	5·4		8·0		6·9		16·1		30·8		39·9		16·5		14·2		16·5		15·7	
To the Population.	249·1		366·3		315·5		732·6		1398·6		1810·0		750·4		647·7		750·4		715·5	

ear ending December 31, 1840, classified according to 18 periods of life at which they took place; with calculations showing seases, bear to the total number of deaths, and also to the population.
,691.

60 & under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		1 to every	1 to every
2	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	24	5	29	45·5	2058·3
8	34	20	16	6	14	10	10	1	5	2	2	...	1	...	...	...	...	57	82	139	9·4	429·4
7	3	3	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	23	20	43	30·6	1388·1
4	2	3	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	85	67	152	8·6	392·7
..	2	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	7	9	146·6	6632·3
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	13	13	101·5	4591·6
1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	6	15	80·0	3979·4
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	104	89	193	6·8	309·2
..	3	...	3	1	...	...	1	...	...	...	...	...	...	...	...	...	...	16	30	46	28·6	1297·6
1	8	1	1	1	2	...	...	...	...	...	...	...	...	...	...	...	...	60	65	125	10·5	477·5
6	5	3	3	4	1	1	...	...	1	...	...	...	...	...	...	...	...	50	40	90	14·6	663·2
1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	4	11	120·0	5426·4
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	31	27	58	22·7	1029·1
..	2	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	51	25	76	17·3	785·4
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	9	16	2·5	3730·6
1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	13	9	22	60·0	2713·2
.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12	7	19	69·4	3141·6
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	78	79	157	8·4	380·1
6	3	3	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	39	29	68	19·4	877·8
7	62	36	29	14	18	11	12	1	6	2	2	...	1	...	...	...	...	668	613	1281	1·0	46·5
1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	23	16	39	33·8	1530·5
3	62	36	29	14	18	11	12	1	6	2	2	...	1	...	...	...	...	691	629	1320	1·0	45·2
110		65		32		23		7		4		1		...		...		1320				
12·0		20·3		41·2		57·3		188·5		330·		1320·		...		...		1·0				
42·6		918·3		1865·3		2595·2		8527·2		14922·		59691·		...		...		45·2				

ending December 31, 1841, classified according to 18 periods of life at which they took place; with calculations showing ases, bear to the total number of deaths, and also to the population.
40.

60 & under 70.		70 & under 75.		75 & under 80.		80 & under 85.		85 & under 90.		90 & under 95.		95 & under 100.		100 & upwards.		Ages not ascertained.		Total.		Total Deaths.	Proportions to the Whole Deaths.	Proportions to the Population.
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		1 to every	1 to every
	2	2	1	1	1	1	...	...	...	...	1	...	...	...	...	...	...	26	14	40	33·9	1538·5
	20	10	33	10	12	8	12	3	7	1	5	...	1	...	1	...	...	45	91	136	9·9	452·5
	11	1	4	1	...	...	...	...	...	...	...	...	...	...	...	...	...	27	34	61	22·2	1008·8
	3	1	3	1	2	...	...	...	...	...	...	...	...	...	...	...	...	79	79	158	8·5	389·4
	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15	10	25	54·3	2461·6
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12	12	113·1	5128·3
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	13	21	64·6	2930·4
	5	1	2	3	1	...	1	...	...	...	...	...	...	...	...	...	...	85	88	173	7·8	355·7
	1	2	1	1	...	...	...	...	1	...	...	...	...	...	...	...	...	29	41	70	19·4	879·1
	6	1	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	31	31	62	21·9	992·5
	2	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	43	50	93	14·6	661·7
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	7	12	113·1	5128·3
	1	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	25	34	59	23·0	1043·0
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	47	32	79	17·1	778·9
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	58	47	105	12·9	586·0
	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	11	21	64·6	2930·4
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	62	56	118	11·5	521·5
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	10	17	94·7	3620·0
	3	2	3	1	...	...	...	...	...	...	...	...	...	...	...	...	...	31	34	65	23·6	946·7
3	55	23	53	18	16	9	13	3	8	1	6	...	1	...	1	...	...	633	694	1327	1·0	46·3
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	18	13	31	43·8	1985·1
3	55	23	53	18	16	9	13	3	8	1	6	...	1	...	1	...	...	651	707	1358	1·0	45·3
9		76		34		22		11		7		1		1		...		1358				
5·2		17·8		39·9		61·7		123·4		194·0		1358·		1358·		...		1·0				
1·4		809·7		1810·0		2797·2		5594·5		8791·4		61540·		61540·		...		45·3				

[It being found inconvenient to bring in Tables L. to LIV. in their proper order, the reader is referred to the end of this Report, after p. 204.]

Fevers and Eruptive Diseases.

EDINBURGH.

Table LV.—Exhibiting the average annual number of fatal cases of FEVER at different ages which occurred in the City of Edinburgh, including St. Cuthbert's and Canongate, during the years 1839, 1840, and 1841, with the proportion which the deaths by fever at these ages bear to the whole deaths by fever; also the proportion which the total amount of these deaths bear to the mean population.

Ages.	Males.	Females.	Total.	Proportions. 1st. To the whole of the deaths by Fever.	Proportions. 2nd. To the population, 137,986.
				Per cent.	Per cent.
Under 5 years	18⅓	22	40⅓	12·410	0·029
Under 20 years	47	49⅔	96⅔	29·743	0·070
20 years and upwards	118	110⅓	228⅓	70·256	0·165
Totals	165	160	325	100·000	0·235
Cases of MEASLES.					
Under 5 years	50⅔	45⅓	96	92·307	0·069
Under 20 years	55⅔	48	103⅔	99·679	0·075
20 years and upwards	0⅓	0	0⅓	0·320	0·000
Totals	56	48	104	100·000	0·075
Cases of SCARLET FEVER.					
Under 5 years	24⅓	22	46⅓	64·055	0·033
Under 20 years	36	35	71	98·156	0·051
20 years and upwards	1	⅓	1⅓	1·843	0·000
Totals	37	35⅓	72⅓	100·000	0·052
Cases of SMALL-POX.					
Under 5 years	34	29⅔	63⅔	82·683	0·046
Under 20 years	39⅓	34	73⅓	95·238	0·053
20 years and upwards	2	1⅔	3⅔	4·761	0·002
Totals	41⅓	35⅔	77	100·000	0·056
Cases of FEVERS and ERUPTIVE DISEASES.					
Under 5 years	129⅓	119	248⅓	42·939	0·179
Under 20 years	178	166⅔	344⅔	59·596	0·249
20 years and upwards	121⅓	112⅓	233⅓	40·403	0·169
Totals	299⅓	279	578⅓	100·000	0·419

GLASGOW.

Table LVI.—Exhibiting the average annual number of fatal cases of FEVER at different ages which occurred in the City of Glasgow and suburbs during the years 1837, 1838, 1839, 1840, and 1841, with the proportion which the deaths by fever at these ages bear to the whole deaths by fever; also the proportion which the total amount of these deaths bear to the mean population.

Ages.	Males.	Females.	Total.	Proportions. 1st. To the whole of the deaths by Fever.	Proportions. 2nd. To the population, 264,010.
				Per cent.	Per cent.
Under 5 years	72⅕	69⅘	142	12·072	0·053
Under 20 years	166⅕	175⅗	341⅘	29·059	0·129
20 years and upwards	476⅕	358⅕	834⅖	70·940	0·316
Totals	642⅖	533⅘	1176⅕	100·000	0·445

GLASGOW—(*continued*).

TABLE LVII.—Cases of MEASLES.

Ages.	Males.	Females.	Total.	Proportions. 1st. To the whole of the deaths by Measles.	Proportions. 2nd. To the population, 264,010.
				Per cent.	Per cent.
Under 5 years.........	$235\frac{1}{5}$	$226\frac{1}{5}$	$461\frac{2}{5}$	88·087	0·174
Under 20 years	$265\frac{4}{5}$	$254\frac{3}{5}$	$520\frac{2}{5}$	99·350	0·197
20 years and upwards	$1\frac{1}{5}$	$2\frac{1}{5}$	$3\frac{2}{5}$	0·649	0·001
Totals	267	$256\frac{4}{5}$	$523\frac{4}{5}$	100·000	0·122
Cases of SCARLET FEVER.					
Under 5 years.........	$93\frac{1}{5}$	$87\frac{3}{5}$	$180\frac{4}{5}$	70·957	0·068
Under 20 years	$127\frac{1}{5}$	$122\frac{2}{5}$	$249\frac{3}{5}$	97·959	0·094
20 years and upwards	$2\frac{3}{5}$	$2\frac{3}{5}$	$5\frac{1}{5}$	2·040	0·001
Totals	$129\frac{4}{5}$	125	$254\frac{4}{5}$	100·000	0·096
Cases of SMALL-POX.					
Under 5 years.........	$169\frac{2}{5}$	$157\frac{2}{5}$	$326\frac{4}{5}$	85·729	0·123
Under 20 years	$186\frac{4}{5}$	$175\frac{4}{5}$	$362\frac{3}{5}$	95·120	0·137
20 years and upwards	11	$7\frac{3}{5}$	$18\frac{3}{5}$	4·879	0·007
Totals	$197\frac{4}{5}$	$183\frac{2}{5}$	$381\frac{1}{5}$	100·000	0·144
Cases of FEVERS and ERUPTIVE DISEASES.					
Under 5 years.........	570	541	1111	47·559	0·420
Under 20 years	746	$728\frac{2}{5}$	$1474\frac{2}{5}$	63·116	0·558
20 years and upwards	491	$370\frac{3}{5}$	$861\frac{3}{5}$	36·883	0·326
Totals	1237	1099	2336	100·000	0·884

PERTH.

TABLE LVIII.—Exhibiting the average annual number of fatal cases of FEVER at different ages which occurred in the City of Perth, exclusive of the suburban district of Kinnoul, during the years 1837, 1838, 1839, 1840, and 1841, with the proportion which the deaths by fever at these ages bear to the whole deaths by fever; also the proportion which the total amount of these deaths bear to the mean population.

Ages.	Males.	Females.	Total.	Proportions. 1st. To the whole of the deaths by Fever.	Proportions. 2nd. To the population, 19,435.
				Per cent.	Per cent.
Under 5 years.........	$2\frac{4}{5}$	$3\frac{1}{5}$	6	15·706	0·030
Under 20 years	6	$5\frac{4}{5}$	$11\frac{4}{5}$	30·890	0·060
20 years and upwards	13	$13\frac{2}{5}$	$26\frac{2}{5}$	69·109	0·135
Totals	19	$19\frac{1}{5}$	$38\frac{1}{5}$	100·000	0·196
Cases of MEASLES.					
Under 5 years.........	$8\frac{2}{5}$	$8\frac{1}{5}$	$16\frac{3}{5}$	92·222	0·085
Under 20 years	$9\frac{1}{5}$	$8\frac{4}{5}$	18	100·000	0·092
20 years and upwards					
Totals	$9\frac{1}{5}$	$8\frac{4}{5}$	18	100·000	0·092
Cases of SCARLET FEVER.					
Under five years	$3\frac{4}{5}$	$4\frac{4}{5}$	$8\frac{3}{5}$	63·235	0·044
Under 20 years	$6\frac{1}{5}$	$7\frac{1}{5}$	$13\frac{2}{5}$	98·529	0·068
20 years and upwards	...	$\frac{1}{5}$	$\frac{1}{5}$	1·470	0·001
Totals	$6\frac{1}{5}$	$7\frac{2}{5}$	$13\frac{3}{5}$	100·000	0·070

PERTH—(*continued*).

TABLE LIX.—Cases of SMALL-POX.

Ages.	Males.	Females.	Total.	Proportions. 1st. To the whole of the deaths by Small-pox.	Proportions. 2nd. To the population, 19,435.
				Per cent.	Per cent.
Under 5 years.........	$4\frac{4}{5}$	$3\frac{1}{5}$	$8\frac{3}{5}$	87·755	0·044
Under 20 years	5	4	9	91·836	0·046
20 years and upwards	$\frac{3}{5}$	$\frac{1}{5}$	$\frac{4}{5}$	8·163	0·004
Totals	$5\frac{3}{5}$	$4\frac{1}{5}$	$9\frac{4}{5}$	100·000	0·050
Cases of FEVERS and ERUPTIVE DISEASES.					
Under 5 years.........	$19\frac{4}{5}$	20	$39\frac{4}{5}$	50·000	0·204
Under 20 years	$26\frac{2}{5}$	$25\frac{4}{5}$	$52\frac{1}{5}$	65·577	0·268
20 years and upwards	$13\frac{3}{5}$	$13\frac{4}{5}$	$27\frac{2}{5}$	34·422	0·140
Totals	40	$39\frac{3}{5}$	$79\frac{3}{5}$	100·000	0·409

DUNDEE.

TABLE LX.—Exhibiting the average annual number of fatal cases of FEVER at different ages which occurred in the Town of Dundee, during the years 1839, 1840, and 1841, with the proportion which the deaths by fever at these ages bear to the whole deaths by fever; also the proportion which the total amount of these deaths bear to the mean population.

Ages.	Males.	Females.	Total.	Proportions. 1st. To the whole of the deaths by Fever.	Proportions. 2nd. To the population, 59,691.
				Per cent.	Per cent.
Under 5 years.........	$10\frac{1}{3}$	$13\frac{1}{3}$	$23\frac{2}{3}$	19·505	0·039
Under 20 years	$29\frac{2}{3}$	$32\frac{2}{3}$	$62\frac{1}{3}$	51·373	0·104
20 years and upwards	$29\frac{2}{3}$	$29\frac{1}{3}$	59	48·626	0·098
Totals	$59\frac{1}{3}$	62	$121\frac{1}{3}$	100·000	0·203
Cases of MEASLES.					
Under 5 years.........	$44\frac{1}{3}$	$51\frac{1}{3}$	$95\frac{2}{3}$	90·251	0·160
Under 20 years	$49\frac{2}{3}$	$56\frac{1}{3}$	106	100·000	0·177
20 years and upwards	...	...	...	...	0·000
Totals	$49\frac{2}{3}$	$56\frac{1}{3}$	106	100·000	0·177
Cases of SCARLET FEVER.					
Under 5 years.........	$24\frac{1}{3}$	$23\frac{1}{3}$	$47\frac{5}{3}$	66·203	0·079
Under 20 years	$36\frac{2}{3}$	32	$68\frac{2}{3}$	95·370	0·115
20 years and upwards	$1\frac{1}{3}$	2	$3\frac{1}{3}$	4·629	0·005
Totals	38	$34\frac{2}{3}$	72	100·000	0·120
Cases of SMALL-POX.					
Under 5 years.........	$33\frac{2}{3}$	$37\frac{2}{2}$	$71\frac{1}{3}$	85·258	0·119
Under 20 years	$37\frac{2}{3}$	$41\frac{2}{3}$	$79\frac{1}{3}$	94·820	0·132
20 years and upwards	2	$2\frac{1}{3}$	$4\frac{1}{3}$	5·179	0·007
Totals	$39\frac{2}{3}$	44	$83\frac{2}{3}$	100·000	0·140
Cases of FEVERS and ERUPTIVE DISEASES.					
Under 5 years.........	$112\frac{2}{3}$	$125\frac{1}{3}$	$238\frac{1}{3}$	62·228	0·398
Under 20 years	$153\frac{2}{3}$	$162\frac{2}{3}$	$316\frac{1}{3}$	82·593	0·529
20 years and upwards	33	$33\frac{2}{3}$	$66\frac{2}{3}$	17·406	0·111
Totals	$186\frac{2}{3}$	$196\frac{1}{3}$	383	100·000	0·641

N.B.—The Aberdeen records are not sufficiently perfect to admit of similar tables for that town.

Mortality exhibited Monthly.

EDINBURGH.

Table LXI.—Exhibiting the amount of deaths and of still-born children, as recorded in the Burying-ground Registers of the City and Suburbs of Edinburgh during the years 1839, 1840, and 1841, with the proportion which the total amount of deaths in the several months bear to the total amount of deaths during these years; and the comparative rate of mortality in Edinburgh and Glasgow during these months*.

Months.	1839.		1840.		1841.		Totals.		Per cent. of deaths in Edinburgh to all deaths.	Per cent. of deaths in Glasgow to all deaths.	Comparative rate of mortality.	
	Total deaths.	Still-born.	Total deaths.	Still-born.	Total deaths.	Still-born.	Total deaths.	Still-born.			Excess in Edinburgh.	Excess in Glasgow.
January	324	18	331	22	422	26	1077	66	10·198	12·428	...	2·230
February.........	291	24	289	23	281	23	861	70	9·026	10·465	...	1·439
March	288	29	307	32	306	28	901	89	8·532	9·534	...	1·002
April	254	21	335	26	298	25	887	75	8·679	8·279	0·400	
May..............	256	21	331	25	263	22	850	68	8·049	7·392	0·657	
June...	241	21	336	22	243	17	820	60	8·023	7·171	0·852	
July..............	279	33	288	31	256	14	823	78	7·793	7·189	0·604	
August	253	18	287	11	247	20	787	51	7·452	7·984	...	0·532
September	282	21	263	21	295	24	840	66	8·219	7·558	0·661	
October	253	19	276	29	270	24	799	74	7·566	7·154	0·412	
November	298	19	303	26	309	24	910	69	8·904	7·902	1·002	
December	346	24	342	19	317	21	1005	64	9·517	8·948	0·649	
Totals.........	3365	268	3688	287	3507	268	10,560	830				
Total burials	3633		3975		3775		11,390					

* In those months in which there are fewer than thirty-one days the proportion is taken as if the mortality in those months had extended at the same rate to that number of days.

Mortality exhibited Monthly.

GLASGOW.

Table LXII.—Exhibiting the amount of deaths and of still-born children, as recorded in the Burying-ground Registers of the City and Suburbs of Glasgow during the years 1837, 1838, 1839, 1840, and 1841, with the proportions which the total amount of deaths in the several months bear to the total amount of deaths during these years; and the comparative rate of mortality in Glasgow and Edinburgh during these months.

Months.	1837.			1838.			1839.			1840.			1841.			Total deaths.	Total still-born.	Per cent. of deaths in Glasgow to all deaths.	Per cent. of deaths in Edinburgh to all deaths.	Comparative rate of mortality.	
	M.	F.	Still-born.	M.	F.	Still-born.	M.	F.	Still-born.	M.	F.	Still-born.	M.	F.	Still-born.					Excess in Glasgow.	Excess in Edinburgh.
January	1023	949	76	463	436	74	283	271	54	385	380	79	538	546	88	5274	371	12·428	10·198	2·230	
February	489	495	57	420	421	42	310	292	48	340	346	51	441	457	78	4011	276	10·465	9·026	1·439	
March	490	453	67	363	354	49	336	305	54	436	407	59	477	425	85	4046	314	9·534	8·532	1·002	
April	444	382	59	279	294	66	325	287	40	362	322	67	373	332	67	3400	299	8·279	8·679	...	0·400
May	381	370	53	284	249	61	298	246	48	311	314	74	340	344	49	3137	285	7·392	8·049	...	0·657
June	349	316	49	227	207	41	277	272	43	339	297	54	306	355	51	2945	238	7·171	8·023	...	0·852
July	384	328	44	196	215	42	331	320	56	330	321	56	327	299	43	3051	241	7·189	7·793	...	0·604
August	477	371	40	227	232	41	359	354	47	327	343	42	353	345	54	3388	224	7·984	7·452	0·532	
September	350	295	47	240	234	35	298	275	45	394	384	51	345	289	62	3104	240	7·558	8·219	...	0·661
October	290	275	40	254	241	33	312	316	50	363	376	64	297	312	49	3036	242	7·154	7·566	...	0·412
November	359	271	42	231	268	46	364	304	52	388	377	60	361	322	52	3245	252	7·902	8·904	...	1·002
December	387	342	42	306	291	53	405	385	62	495	484	63	356	346	41	3797	261	8·948	9·517	...	0·569
Totals	5423	4847	616	3490	3442	583	3898	3627	605	4470	4351	720	4514	4372	719	42,434	3243				
Total deaths ...	10,270			6932			7525			8821			8886			42,434					
Do. still born..	616			582			605			720			719			3,243					
Total burials...	10,886			7515			8130			9541			9605			45,677					

Mortality exhibited Monthly.

ABERDEEN.

Table LXIII.—Exhibiting the amount of deaths and of the few still-born children, as recorded in the Burying-ground Registers of the City and Suburbs of Aberdeen, during the years 1837, 1838, 1839, 1840, and 1841, with the proportion which the total amount of deaths in the several months bear to the total amount of deaths during these years; and the comparative rate of mortality in Aberdeen and Edinburgh during these months.

Months.	1837.		1838.		1839.		1840.		1841.		Total deaths.	Total still-born.	Per cent. of deaths in Aberdeen to all Deaths.	Per cent. of deaths in Edinburgh to all Deaths.	Comparative rate of mortality.	
	M. & F.	Still-born.	M. & F.	Still-born.	M. & F.	Still-born.	M. & F.	Still-born.	M. & F.	Still-born.					Excess in Aberdeen.	Excess in Edinburgh.
January	202		141		114		124		144		725		11·379	10·198	1·181	
February	133		166		94		123		113		629		10·930	9·026	1·904	
March	124		132		114		118		113		601		9·433	8·532	0·901	
April..................	104		120		109		141		78		552		8·953	8·679	0·274	
May	94		158		82		121		79		534		8·381	8·049	0·332	
June..................	106		131		81		98		71		487		7·898	8·023	...	0·125
July	76		122		72		99		77		446		7·000	7·793	...	0·793
August................	104		73		93		80		64		414		6·498	7·452	...	0·954
September	109		89		79		106		55		438		7·104	8·219	...	1·115
October	93		75		91		134		64		457		7·173	7·566	...	0·393
November	119		88		110		104		73		494		8·012	8·904	...	0·892
December	128		116		111		136		103		593		9·307	9·517	...	0·210
Totals...............	1392	77	1411	42	1150	64	1384	59	1034	69	6371	311*				

* As the total number of still-born children is not ascertained for Aberdeen, the total burials each year cannot be exhibited in the above Table.

Mortality exhibited Monthly.

PERTH.

Table LXIV.—Exhibiting the amount of deaths and of still-born children, as recorded in the Burying-ground Registers of the City of Perth, exclusive of the Suburban District of Kinnoul, during the years 1837, 1838, 1839, 1840, and 1841, with the proportion which the total amount of deaths in the several months bear to the total amount of deaths during these years; and the comparative rate of mortality in Perth and Edinburgh during these months.

Months.	1837.			1838.			1839.			1840.			1841.			Total deaths.	Total still-born.	Per cent. of deaths in Perth to all Deaths.	Per cent. of deaths in Edinburgh to all Deaths.	Comparative rate of mortality.	
	M.	F.	Still-born.	M.	F.	Still-born.	M.	F.	Still-born.	M.	F.	Still-born.	M.	F.	Still-born.					Excess in Perth.	Excess in Edinburgh.
January	62	87	7	27	28	8	15	18	6	23	21	5	28	39	6	348	32	13·561	10·198	3·363	
February	26	22	4	32	32	3	21	21	5	18	25	8	23	31	4	251	24	10·829	9·026	1·803	
March	23	28	2	24	25	5	22	15	3	21	24	4	21	20	2	223	16	8·690	8·532	0·158	
April...............	36	37	6	32	25	4	13	19	3	9	11	4	14	22	5	218	22	8·778	8·679	0·099	
May	31	25	5	19	21	5	32	12	4	20	21	5	20	21	4	222	23	8·651	8·049	0·602	
June...............	24	18	4	11	19	4	12	11	3	16	17	6	13	9	1	150	18	6·040	8·023	...	1·983
July	21	17	4	23	19	4	20	13	4	16	16	7	13	18	1	176	20	6·858	7·793	...	0·935
August	23	24	4	22	27	2	32	20	3	14	7	2	10	18	2	197	13	7·677	7·452	0·225	
September	15	24	4	17	34	3	20	10	5	23	17	0	14	14	1	188	13	7·570	8·219	...	0·649
October	15	19	1	22	32	0	14	17	6	14	16	3	16	18	5	183	15	7·131	7·566	...	0·435
November	19	22	6	31	20	5	16	10	4	18	26	2	20	18	4	200	21	8·054	8·904	...	0·850
December	18	13	8	13	23	4	16	29	2	22	30	8	20	26	4	210	26	8·183	9·517	...	1·334
Totals............	313	336	55	273	305	47	233	195	48	214	231	54	212	254	39	2566	243				
Total deaths ...	649			578			428			445			466			2566					
Do. still born...	55			47			48			54			39			243					
Total burials ...	704			625			476			499			505			2809					

MORTALITY EXHIBITED MONTHLY.

DUNDEE.

TABLE LXV.—Exhibiting the amount of deaths and of still-born children, as recorded in the Burying-ground Registers of the Town of Dundee, during the years 1837, 1838, 1839, 1840, and 1841, with the proportion which the total amount of deaths in the several months bear to the total amount of deaths during these years; and the comparative rate of mortality in Dundee and Edinburgh during these months.

Months.	1837.			1838.			1839.			1840.			1841.			Total deaths.	Total still-born.	Per cent. of deaths in Dundee to all Deaths.	Per cent. of deaths in Edinburgh to all Deaths.	Comparative rate of mortality.	
	M.	F.	Still-born.	M.	F.	Still-born.	M.	F.	Still-born.	M.	F.	Still-born.	M.	F.	Still-born.					Excess in Dundee.	Excess in Edinburgh.
January	58	73	15	235	230	13	63	83	12	104	96	13	70	83	8	1095	61	14·516	10·198	4·318	
February	62	80	9	82	106	15	62	64	10	65	69	11	55	68	4	713	49	10·465	9·026	1·439	
March	67	86	4	86	78	14	56	59	8	69	60	13	38	62	10	661	49	8·763	8·532	0·231	
April..............	52	66	8	86	48	7	69	73	14	61	41	13	52	51	12	599	54	8·205	8·679	...	0·474
May	69	67	11	72	64	15	84	79	10	65	60	12	39	42	10	641	58	8·497	8·049	0·448	
June..............	64	48	12	65	64	16	51	77	12	53	49	5	38	43	13	552	58	7·561	8·023	...	0·462
July	52	49	8	47	53	11	86	70	8	37	43	8	52	37	6	526	41	6·973	7·793	...	0·820
August............	41	45	10	55	42	11	67	63	4	45	32	8	59	55	13	504	46	6·681	7·452	...	0·771
September	47	53	17	50	49	6	52	56	8	36	41	3	46	51	12	481	46	6·589	8·219	...	1·630
October	57	50	12	40	50	8	59	85	11	49	35	11	66	70	10	561	52	7·437	7·566	...	0·129
November	46	46	3	43	49	13	55	65	11	49	41	8	67	65	6	526	41	7·205	8·904	...	1·699
December	56	63	5	62	65	13	84	85	8	58	62	9	69	80	7	684	42	9·068	9·517	...	0·449
Totals............	923	898	142	671	726	114	788	859	116	691	629	114	651	707	111	7543	597				
Total deaths ...		1821			1397			1647			1320			1358		7543					
Do. still born...		142			114			116			114			111		597					
Total burials ...		1963			1511			1763			1434			1469		8140					

TABLE LXVI.—Comparative per-centage of Monthly Mortality in the different Towns reported on.

	Monthly per-centage of Deaths to the whole Deaths; average of five years.				
	Edinburgh.	Glasgow.	Aberdeen.	Perth.	Dundee.
January	10·198	12·428	11·379	13·561	14·516
February	9·026	10·465	10·930	10·829	10·465
March	8·532	9·534	9·433	8·690	8·763
April	8·679	8·279	8·953	8·778	8·205
May	8·049	7·392	8·381	8·651	8·497
June	8·023	7·171	7·898	6·040	7·561
July	7·793	7·189	7·000	6·858	6·973
August	7·452	7·984	6·498	7·677	6·681
September	8·219	7·558	7·104	7·570	6·589
October	7·566	7·154	7·173	7·131	7·437
November	8·904	7·902	8·012	8·054	7·205
December	9·517	8·948	9·307	8·183	9·068

PROPORTION OF MALE AND FEMALE DEATHS.

EDINBURGH, INCLUDING ST. CUTHBERT'S AND CANONGATE.

By referring to Table L., it will be seen that the total amount of male deaths during the three years 1839, 1840, and 1841, is 5197, and the female deaths 5363; being in the proportion of 103·194 females to every 100 males.

The average annual amount of male deaths during these three years ending with 1841, is $1732\frac{1}{3}$, and of female deaths $1787\frac{2}{3}$; while the males living in 1841 is 61,313, and the females 76,869; being in the proportion of 125·37 females to every 100 males.

The average annual number of male deaths, compared to the males living in 1841, is therefore as	1 to 35·393, or 2·825 per cent.
And the average annual number of female deaths to the females living in the same year, as	1 to 42·999, or 2·325 per cent.
Difference	0·500 per cent.

The female life in Edinburgh and suburbs, exclusive of Leith, is therefore better than the male life by 0·500 per cent.; while the number of female deaths during these three years is 3·194 per cent. greater than the number of male deaths.

TOTAL DEATHS, EDINBURGH.

TABLE LXVII.—Exhibiting the proportion which the deaths, exclusive of still-born children, in Edinburgh and suburban districts of St. Cuthbert's and Canongate, during the years 1837, 1838, 1839, 1840, and 1841, bear to the population of these years; also the proportion of the average annual amount of deaths to the mean population of these years.

Years.	Population.	Deaths.	Proportion of Deaths to the Population, being as 1 to
1837.	137,345	5,009	27·419, or 3·647 per cent.
1838.	137,527	4,176	32·932, or 3·036 ...
1839.	137,756	3,365	40·937, or 2·442 ...
1840.	137,986	3,688	37·414, or 2·672 ...
1841.	138,182	3,507	39·401, or 2·537 ...

The average annual amount of deaths these five years to the mean population being as 1 to 34·904, or 2·864 per cent.

As the Registers of Deaths are not complete for the whole of Leith, we are unable to give the proportion of male and female deaths to the living. The following table gives those of the total deaths:—

TOTAL DEATHS, LEITH.

TABLE LXVIII.—Exhibiting the proportion which the deaths, exclusive of still-born children, in North and South Leith, during the years 1837, 1838, 1839, 1840, and 1841, bear to the population of these years; also the proportion of the average annual amount of deaths to the mean population of these years.

Years.	Population.	Deaths.	Proportion of Deaths to the Population, being as 1 to
1837.	27,331	886	30·831, or 3·241 per cent.
1838.	27,586	862	32·002, or 3·124 ...
1839.	27,846	679	41·010, or 2·438 ...
1840.	28,103	710	39·581, or 2·526 ...
1841.	28,372	647	43·851, or 2·280 ...

The average annual amount of deaths these five years to the mean population being as 1 to 36·794, or 2·717 per cent.

TOTAL DEATHS, EDINBURGH AND LEITH.

TABLE LXIX.—Exhibiting the proportion which the deaths, exclusive of still-born children, in Edinburgh and Leith, during the years 1837, 1838, 1839, 1840, and 1841, bear to the population of these years; also the proportion of the average annual amount of deaths to the mean population of these years.

Years.	Population.	Deaths.	Proportion of Deaths to the Population, being as 1 to
1837.	164,676	5895	27·934, or 3·579 per cent.
1838.	165,113	5038	32·773, or 3·051 ...
1839.	165,602	4044	40·950, or 2·441 ...
1840.	166,089	4398	37·764, or 2·647 ...
1841.	166,554	4142	40·211, or 3·486 ...

The average annual amount of deaths these five years to the mean population being as 1 to 35·208, or 2·840 per cent.

GLASGOW.

By referring to Table LI., it will be seen that the total amount of male deaths in Glasgow and suburban districts, during the years 1837, 1838, 1839, 1840, and 1841, is 21,795, and the female deaths 20,639; being in the proportion of 94·696 females to every 100 males.

The average annual amount of male deaths during these five years ending with 1841, is 4359, and of female deaths 4127$\frac{4}{5}$; while the males living within the range of the Glasgow Mortality Bill, in 1841, is 134,087, and the females 148,047; being in the proportion of 110·41 to every 100 males.

The average annual number of male deaths, compared to the males living, in 1841, is therefore as.	1 to 30·760, or 3·250 per cent.
And the average annual number of female deaths to the females living in the same years, as.	1 to 35·865, or 2·788 per cent.
Difference	0·462 per cent.

The female life in Glasgow and suburbs is therefore better than the male life by 0·462 per cent.; while the number of male deaths during these five years is 5·303 per cent. greater than the number of female deaths.

TOTAL DEATHS, GLASGOW AND SUBURBS.

TABLE LXX.—Exhibiting the proportion which the deaths, exclusive of still-born children, in Glasgow and suburbs, during the years 1837, 1838, 1839, 1840, and 1841, bear to the population of these years; also the proportion of the average annual amount of deaths to the mean population of these years.

Years.	Population.	Deaths.	Proportion of Deaths to the Population, being as 1 to
1837.	247,040	10,270	24·05, or 4·15 per cent.
1838.	255,390	6,932	36·84, or 2·71 ...
1839.	264,010	7,525	35·08, or 2·85 ...
1840.	272,900	8,821	30·93, or 3·23 ...
1841.	282,134	8,886	31·75, or 3·14 ...
The average annual amount of deaths these five years to the mean population being as 1 to 31·108, or 3·214 per cent.			

ABERDEEN.

By referring to Table LII., it will be seen that the total number of male deaths in Aberdeen and suburban district, during the years 1837, 1838, 1839, 1840, and 1841, is 3172, and the female deaths 3198; being in the proportion of 100·819 females for every 100 males.

The average annual amount of male deaths, during these five years ending with 1841, is 634$\frac{2}{5}$, and the females 639$\frac{3}{5}$; while the males living in 1841 is 28,337, and the females 36,441; being in the proportion of 128·59 females to every 100 males.

The average annual number of male deaths, compared to the number of males living in 1841, is therefore as	1 to 44·667, or 2·238 per cent.
The average annual number of female deaths to the females living in the same year, is as	1 to 56·974, or 1·755 per cent.
Difference	0·483 per cent.

The female life in Aberdeen and suburban district is therefore better than the male life by 0·483 per cent. The number of male deaths during these five years is 0·819 per cent. greater than the number of female deaths.

TOTAL DEATHS, ABERDEEN.

TABLE LXXI.—Exhibiting the proportion which the deaths, exclusive of still-born children, in Aberdeen and suburbs, during the years 1837, 1838, 1839, 1840, and 1841, bear to the population of these years; also the proportion of the average annual amount of deaths to the mean population of these years.

Years.	Population.	Deaths.	Proportion of Deaths to the Population, being as 1 to
1837.	61,985	1392	44·529, or 2·249 per cent.
1838.	62,672	1411	44·416, or 2·251 ...
1839.	63,366	1150	55·100, or 1·814 ...
1840.	64,068	1385	46·258, or 2·161 ...
1841.	64,778	1034	62·647, or 1·596 ...
The average annual amount of deaths these five years to the mean population being as 1 to 49·722, or 2·011 per cent.			

PERTH.

By referring to Table LIII., it will be seen that the total number of male deaths in Perth, exclusive of the suburban dictrict of Kinnoul, during the years 1837, 1838, 1839, 1840, and 1841, is 1245, and the female deaths 1321; being in the proportion of 106·104 females to every 100 males.

The average annual amount of male deaths during these five years, ending with 1841, is 249, and the female deaths $264\frac{1}{5}$; while the males living in 1841 is 8988, and the females 10,305; being in the proportion of 115·55 females to every 100 males.

The average annual number of male deaths, compared to the number of males living in 1841, is therefore as................... 1 to 36·096, or 2·770 per cent.
And the average annual number of female deaths, to the females living in the same year, as .... 1 to 39·004, or 2·563 per cent.

Difference........................ 0·207 per cent.

The female life in the city of Perth is therefore better than the male life by 0·207 per cent. The number of female deaths is, however, greater than the number of male deaths by 6·104 per cent.

Total Deaths, Perth.

Table LXXII.—Exhibiting the proportion which the deaths, exclusive of still-born children, in the City of Perth (not including the suburban district of Kinnoul), during the years 1837, 1838, 1839, 1840, and 1841, bear to the population of these years; also the proportion of the average annual amount of deaths to the mean population of these years.

Years.	Population.	Deaths.	Proportion of Deaths to the Population, being as 1 to
1837.	19,579	649	30·167, or 3·314 per cent.
1838.	19,507	578	33·749, or 2·963 ...
1839.	19,435	428	45·408, or 2·202 ...
1840.	19,365	445	43·516, or 2·297 ...
1841.	19,293	466	41·401, or 2·415 ...
The average annual amount of deaths these five years to the mean population being as 1 to 37·870, or 2·640 per cent.			

Dundee.

By referring to Table LIV., it will be seen that the total number of male deaths in Dundee during the years 1839, 1840, and 1841, is 2130, and the female deaths 2195. And by referring to the Dundee Mortality Bills, it will be found that the male deaths, during 1837 and 1838, amounted to 1594, and the female deaths during these two years to 1624; the whole amount of male deaths, during these five years in Dundee, is therefore 3724, aud the female deaths 3819; being in the proportion of 102·551 females to 100 males.

The average annual amount of male deaths during these five years, ending with 1841, is 744$\frac{4}{5}$, and the female deaths 763$\frac{4}{5}$, while the males living in 1841 is 28,311, and the females 33,229; being in the proportion of 117·37 females to every 100 males.

The average annual number of male deaths, compared to the number of males living in 1841, is therefore as....................	1 to 38·011, or 2·630 per cent.
And the average annual number of female deaths, to the females living in the same year, as..........................	1 to 43·504, or 2·298 per cent.
Difference	0·332 per cent.

The female life in the town of Dundee is therefore better than the male life by 0·332 per cent. The number of female deaths is greater than the number of male deaths by 2·551 per cent.

Total Deaths, Dundee.

Table LXXIII.—Exhibiting the proportion which the deaths, exclusive of still-born children, in Dundee, during the years 1837, 1838, 1839, 1840, and 1841, bear to the population of these years; also the proportion of the average annual amount of deaths to the mean population of these years.

Years.	Population.	Deaths.	Proportion of Deaths to the Population, being as 1 to
1837.	54,467	1821	29·910, or 3·343 per cent.
1838.	56,156	1397	40·197, or 2·487 ...
1839.	57,897	1647	35·153, or 2·844 ...
1840.	59,691	1320	45·220, or 2·211 ...
1841.	61,540	1358	45·316, or 2·206 ...
The average annual amount of deaths these five years to the mean population being as 1 to 38·377, or 2·605 per cent.			

SCOTCH TOWNS.

TABLE LXXIV.—Exhibiting the annual average* number of deaths under five years of age, in five of the principal towns of Scotland, with the proportion which these deaths bear to the total average annual amount of deaths, as well as to the population, in the different towns; also the comparative rate of mortality at these ages in Edinburgh and the other towns mentioned in the Table.

Towns.	Males.	Females.	Total.	Mean population.	Proportion of the average annual deaths at these ages to the whole average annual deaths.	Comparative rate to the average annual deaths.		Percentage of the mean population.	Comparative rate to the mean population.	
						Greater than in Edinb.	Less than in Edinb.		Greater than in Edinb.	Less than in Edinb.
						Per cent.	Per cent.			
Edinburgh.	$632\frac{1}{3}$	$551\frac{1}{3}$	$1183\frac{2}{3}$	137,986	33·626	...	...	0·857		
Glasgow ...	2015	1769	3784	264,010	44·586	10·960	...	1·433	0·576	
Aberdeen ..	$199\frac{3}{5}$	175	$374\frac{3}{5}$	63,366	29·399	...	4·227	0·591	...	0·266
Perth	$76\frac{3}{5}$	$77\frac{3}{5}$	$154\frac{1}{5}$	19,435	30·046	...	3·580	0·793	...	0·064
Dundee ...	$345\frac{1}{3}$	$329\frac{2}{3}$	675	59,691	46·820	13·194	...	1·130	0·273	

TABLE LXXVI.—Exhibiting the annual average number of deaths under twenty years of age, in five of the principal towns of Scotland, with the proportion which these deaths bear to the total average annual amount of deaths, as well as to the population, in the different towns; also the comparative rate of mortality at these ages in Edinburgh and the other towns mentioned in the Table.

Towns.	Males.	Females.	Total.	Mean population.	Proportion of the average annual deaths at these ages to the whole average annual deaths.	Comparative rate to the average annual deaths.		Percentage of the mean population.	Comparative rate to the mean population.	
						Greater than in Edinb.	Less than in Edinb.		Greater than in Edinb.	Less than in Edinb.
					Per cent.	Per cent.	Per cent.			
Edinburgh.	$815\frac{2}{3}$	729	$1,544\frac{2}{3}$	137,986	43·882	...	...	1·119		
Glasgow ...	$2,510\frac{4}{5}$	$2,238\frac{1}{5}$	4,749	264,010	55·957	12·075	...	1·798	0·679	
Aberdeen ..	$292\frac{3}{5}$	$257\frac{1}{5}$	$549\frac{4}{5}$	63,366	43·148	...	0·734	0·867	...	0·252
Perth	100	$96\frac{2}{5}$	$196\frac{2}{5}$	19,435	38·269	...	5·613	1·010	...	0·109
Dundee ...	426	$403\frac{1}{3}$	$829\frac{1}{3}$	59,691	57·526	13,644	...	1·389	0·270	

TABLE LXXVIII.—Exhibiting the annual average number of deaths at twenty years of age and upwards, in five of the principal towns of Scotland, with the proportion which these deaths bear to the total average annual amount of deaths, as well as to the population, in the different towns; also the comparative rate of mortality at these ages in Edinburgh and the other towns mentioned in the Table.

Towns.	Males.	Females.	Total.	Mean population.	Proportion of the average annual deaths at these ages to the whole average annual deaths.	Comparative rate to the average annual deaths.		Percentage of the mean population.	Comparative rate to the mean population.	
						Greater than in Edinb.	Less than in Edinb.		Greater than in Edinb.	Less than in Edinb.
					Per cent.	Per cent.	Per cent.			
Edinburgh.	$916\frac{2}{3}$	$1,058\frac{2}{3}$	$1,975\frac{1}{3}$	137,986	56·117	...	...	1·431		
Glasgow ...	$1,848\frac{1}{5}$	$1,889\frac{3}{5}$	$3,737\frac{4}{5}$	264,010	44·042	...	12,075	1·415	...	0·016
Aberdeen ..	$341\frac{4}{5}$	$382\frac{3}{5}$	$724\frac{2}{5}$	63,366	56·851	0·734	...	1·142	...	0·289
Perth	149	$167\frac{4}{5}$	$316\frac{4}{5}$	19,435	61·730	5·613	...	1·630	0·199	
Dundee ...	284	$328\frac{1}{3}$	$612\frac{1}{3}$	59,691	42·473	...	13,644	1·025	...	0·406

* It has to be observed, that the average is for five years in Glasgow, Aberdeen and Perth, while for Edinburgh and Dundee the average is only for three years.

Table LXXV.—Exhibiting the annual Deaths under five years of age in England, London and Manchester for the four years ending June 30th, 1838, 1839, 1840, 1841.

	Population Census.				Rate of annual increase.		Deaths Registered.								Average annual deaths under 5 years.	Average annual deaths at all ages.	Per cent. of deaths under five years to whole deaths.	Per cent. of deaths under five years to mean populat.
	May 31, 1821.		1841.				1838.		1839.		1840.		1841.					
	Males.	Females.	Males.	Females.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.				
England & Wales ...	5,835,318	6,146,022	7,773,411	8,138,314	1·0145	1·0141	69,770	61,264	69,746	60,949	76,024	65,723	74,914	65,175	135,891	343,171	39·59	0·871
London........	...	...	877,951	996,726	...	...	11,162	10,394	9,900	8,913	9,655	8,800	10,281	9,238	19,586	48,368	40·49	1·066
Manchester & Salford	...	...	126,789	135,838	1·0202	1·0186	2,062	1,885	2,691	2,454	2,388	2,170	2,091	1,816	4,389	8,552	51·32	1·705

Table LXXVII.—Exhibiting the annual Deaths under 20 years of age in England, London and Manchester for the four years ending June 30th, 1838, 1839, 1840, 1841.

	Population Census.				Rate of annual increase.		Deaths under 20 years of age.								Average annual deaths under 20 years.	Average annual deaths at all ages.	Per cent. of deaths under 20 to whole deaths.	Per cent. of deaths under 20 to mean population.
	1821.		1841.				1838.		1839.		1840.		1841.					
	Males.	Females.	Males.	Females.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.				
England & Wales ...	5,835,318	6,146,022	7,773,411	8,138,314	1·0145	1·0141	87,053	79,551	87,528	79,574	95,660	86,360	95,390	86,614	174,432	343,171	50·83	1·118
London........	...	...	877,951	996,726	...	...	13,285	12,542	12,165	11,055	11,786	10,847	12,394	11,182	23,814	48,368	49·23	1·296
Manchester & Salford	...	...	126,789	135,838	1·0202	1·0186	2,434	2,264	3,067	2,903	2,862	2,659	2,484	2,189	5,216	8,552	60·99	2·027

Table LXXIX.—Exhibiting the annual Deaths at and above 20 years of age in England, London and Manchester for the four years ending June 30th, 1838, 1839, 1840, 1841.

	Population Census.				Rate of annual increase.		Deaths above 20 years of age.								Average annual deaths above 20 years.	Average annual deaths at all ages.	Per cent. of deaths at and above 20 to whole deaths.	Per cent. of deaths at and above 20 to mean populat.
	1821.		1841.				1838.		1839.		1840.		1841.					
	Males.	Females.	Males.	Females.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.				
England & Wales ...	5,835,318	6,146,022	7,773,411	8,138,314	1·0145	1·0141	83,910	85,440	81,584	82,321	82,266	85,815	84,595	89,023	168,738	343,171	49·17	1·082
London.......	...	...	877,951	996,726	..	...	13,996	13,774	10,972	11,762	11,351	11,148	11,973	12,427	24,554	48,368	50·77	1·336
Manchester & Salford	...	...	126,789	135,838	1·0202	1·0186	1,924	1,751	1,700	1,613	1,597	1,549	1,590	1,628	3,336	8,552	39·01	1·296

TABLE LXXX.—Annual Mortality per cent. in the Metropolis and in Ten large Town Districts, in each of the three years ending December 31st, 1838, 1839, 1840.

Districts.	Area.		Population (Enumerated).						Deaths.					
			May 31st, 1831.			June 6th, 1841.			Males.			Females.		
	Acres.	Square Miles.	Males.	Females.	Total.	Males.	Females.	Total.	1838.	1839.	1840.	1838.	1839.	1840.
Metropolis	44,764	69·94	739,719	855,171	1,594,890	874,311	996,726	1,871,037	25,254	21,855	22,357	24,600	21,465	21,639
Liverpool	1,560	2·44	76,626	88,549	165,175	108,644	114,359	223,003	3,420	3,874	4,405	3,207	3,561	4,065
West Derby	36,500	57·03	24,389	28,669	53,058	40,760	47,920	88,680	825	852	1,107	800	894	1,099
Manchester	13,890	21·70	79,486	86,481	165,967	92,940	99,463	192,403	3,458	3,473	3,359	3,249	3,301	3,130
Salford	3,870	6·05	24,298	26,479	50,777	33,849	36,375	70,224	1,140	1,244	1,062	1,067	1,205	936
Leeds	41,520	64·87	66,555	69,026	135,581	82,101	86,595	168,696	2,202	2,293	2,296	2,087	2,095	2,192
Birmingham	2,660	4·16	54,593	56,321	110,914	67,317	70,898	138,215	1,766	1,917	1,979	1,593	1,722	1,788
Aston	30,760	48·06	15,510	16,608	32,118	25,106	25,822	50,925	549	541	634	550	517	584
Sheffield............	10,590	16·55	36,913	37,145	74,058	42,176	43,117	85,293	1,325	1,425	1,305	1,104	1,278	1,105
Bristol	1,840	2·87	26,496	32,578	59,074	29,483	34,796	64,279	927	886	1,210	915	789	1,120
Clifton	30,650	47·89	23,356	28,477	51,833	29,294	36,474	65,768	677	578	853	651	572	886

Districts.	Population to a Square Mile.	Annual Rate of Mortality per cent.								
		Males.			Females.			Mean.		
		1838.	1839.	1840.	1838.	1839.	1840.	Males.	Females.	Males and Females.
Metropolis	26,751	3·248	2·741	2·771	2·691	2·297	2·289	2·920	2·426	2·673
Liverpool	91,488	3·393	3·746	4·152	3·022	3·271	3·640	3·764	3·311	3·537
West Derby	1,555	2·353	2·308	2·849	1·941	2·060	2·406	2·503	2·136	2·320
Manchester	8,865	3·876	3·839	3·662	3·403	3·410	3·188	3·792	3·334	3·563
Salford	11,613	3·696	3·907	3·232	3·219	3·522	2·650	3·612	3·130	3·371
Leeds	2,600	2·866	2·917	2·856	2·575	2·527	2·585	2·879	2·562	2·720
Birmingham	33,255	2·806	2·977	3·003	2·393	2·539	2·576	2·929	2·503	2·716
Aston	1,060	2·489	2·346	2·631	2·424	2·180	2·356	2·489	2·320	2·405
Sheffield............	5,155	3·282	3·477	3·137	2·675	3·050	2·599	3·299	2·775	3·037
Bristol	22,358	3·205	3·044	4·129	2·681	2·296	3·238	3·459	2·738	3·098
Clifton	1,376	2·485	2·070	2·980	1·919	1·645	2·486	2·512	2·016	2·264

Burials at the Public Expense.

The returns for Edinburgh and Glasgow for these burials have not yet been fully received for 1840 and 1841.

	in 1839.	in 1838.	in 1837.
The per-centage of the whole burials which took place at the public expense in Edinburgh and Leith*	13·59	14·84	13·50 per cent.
And in Glasgow	21·66	23·20	26·30 per cent.

Aberdeen.—In the city of Aberdeen the average annual amount of burials at the public expense these five years is 4·115 per cent of the whole burials.

Perth.—In the city of Perth the average annual amount of burials at the public expense these five years is 4·398 per cent. of the whole burials.

Dundee.—In the town of Dundee the average annual amount of burials at the public expense these five years is 11·560 per cent of the whole deaths.

GENERAL REMARKS.

MORTALITY.

The principal object of the preceding tables being, as far as possible, to supply that defect in the knowledge of the vital statistics of large towns in Scotland which has so long existed, care has been taken to exhibit, on an uniform plan, as extensive a collection of facts relative to disease and death as the defective state of the registers in these towns will afford; from which deductions may be drawn as to how far the amount of deaths is influenced by the local circumstances of the various towns, or to the moral and physical condition of their inhabitants—differing, as they do, in the occupations in which the people are engaged, and the comparative numbers of those in extreme poverty, and of those in comfortable or wealthy circumstances.

The mortality of the towns reported on being so various, and all of the towns showing a greater proportion of deaths than is observable in country districts, it becomes a matter of high importance to trace these differences to their true causes, by which means the philanthropist and the legislator might be guided in adopting such measures as might tend to remove these causes, and ultimately lead to an effectual amelioration of the condition of the people.

But to trace the causes of the numerous results exhibited in the preceding tables to the local peculiarities of these towns or to the condition of the people, would require a very minute knowledge of the circumstances of the inhabitants, and would inconveniently extend the limits of this Report. All that can be here attempted, therefore, is to point out some of the most remarkable of the results, and to offer a few observations as to how far these results may have been occasioned by local circumstances, and to endeavour to discover—limited as our present knowledge is with regard to the vital statistics of the country—if there be not general laws governing the distribution of disease, and the amount of deaths from each disease, at the different ages of the town population.

Before proceeding to a summary of the leading facts elicited in these tables, a few observations may be necessary in explanation of the tables themselves, and of the manner in which they have been constructed.

The want of a proper system for the registration of deaths as well as of births and marriages, has long been much felt in Scotland, and repeated attempts have been made to introduce a legislative measure for its improvement, but without success. In the absence of a proper system for the registration of deaths, considerable attention has been paid by the magistrates, kirk sessions, and other parties of some of the large towns, in whom

* Paper read at the Statistical Section of the British Association at Glasgow in 1840.

is vested the management of burial-grounds, to procure registers of burials. No uniform or systematic method of recording the causes of death has been adopted; but in some of the towns the names of the fatal diseases, as stated by the friends of the deceased, together with the ages at which death took place, have been carefully noted; and the data from which the preceding tables have been constructed have been obtained from these records. In Aberdeen the causes of death have been but partially recorded, which renders the tables for that city less satisfactory than we could have desired. In all cases, however, the ages at which death took place appear to have been carefully attended to, which is an important feature in the tables.

The only portion of these towns where a proper system of recording the diseases which cause death is to be found, is in the parish of South Leith, where Mr. Lyon has introduced the system recommended by the Committee of the Royal College of Physicians of Edinburgh, appointed to consider the best mode of framing public registers of deaths. This system is admirably adapted for the purpose, and it would be most advantageous to the advancement of our knowledge of the vital statistics of the country were it uniformly adopted for all burying-ground registers. It is to be feared, however, that there is no hope of this being done till government be prevailed upon to introduce a legislative measure. There is proof of this, in no register whatever being kept for the burial-ground of Newhaven, situated in North Leith, which prevents us from completing the mortality tables of that town on the same principles as the others, though for one of the burying-grounds (South Leith) there is at present one of the best registers in the country.

The classification of diseases used in the foregoing tables is far from being so perfect as would be attainable were the system of registration recommended by the Edinburgh Royal College of Physicians adopted. The arrangement followed in these tables was first drawn up, with the assistance of medical gentlemen, in 1835, for the construction of the tables given in the Glasgow Mortality Bills. This arrangement, *which will be found in the Appendix*, though by no means so complete as could be wished, is probably as much so as it can be made in the present state of the registers of deaths in Scotland.

Whatever defects, however, may be observable in the arrangement of diseases in these tables, as the registers from which our information is obtained are kept in a manner similar to each other, and as the results are brought out in the tables on an uniform plan, a comparison of the amount of mortality exhibited under the heads of the different diseases and at various ages in the different towns, will necessarily afford useful information.

It will be observed, that one of the distinguishing features of these disease tables is, that the number of deaths at the different ages is made to appear under the head of the diseases which caused death at these ages; and for those whose local and general information on these matters may enable them to assist in advancing our knowledge of the physical and moral condition of the people, the proportions which the deaths at the different ages, and the proportions which the amount of fatal diseases bear to the whole deaths, and also to the population of the different towns, are carefully exhibited in separate columns.

In those tables in which the amount of deaths by the several diseases at different ages is specified, in some cases for five and in others for three years, not only the number as compared with the population is given, but the proportion per cent. of the deaths at the different ages, and of the causes of death, are added; these proportions being well suited to a comparison of the mortality which takes place in the several towns.

Comparing the mortality of the different towns each year with their population as ascertained by the census of 1841, it is obvious that the proportion of deaths, in all the years antecedent to 1841, would appear under the truth. As we may assume that the increase of population from 1831 to 1841 has been progressively uniform during the intervening years, the amount of population for the several towns of Scotland, as exhibited in the tables, has been calculated accordingly; and on the amount of population thus obtained, the proportions of the relative mortality of the different towns have been calculated.

As it is an object of great interest and importance to observe the effect of the seasons on the amount of mortality in different localities, tables are added, showing the amount of deaths monthly for these towns, and also exhibiting the proportions which the average of deaths in each month bear to the annual average of deaths.

Tables are also added, showing the amount of burials in each burying place within the boundaries of the different towns; but, as it does not always follow that the inhabitants of the different localities make use of the burying-ground in their immediate neighbourhood, no great reliance can be placed on any information of this nature. These tables, however, assist to test the accuracy of the other tables.

Tables are also given, showing the amount of deaths by fever and eruptive diseases under five, under twenty, and above twenty years of age, and the proportion the deaths by these diseases bear to the whole deaths. The results exhibited in these tables are well worthy of consideration. In the present limited state of our knowledge of the vital statistics of the country, it is obviously desirable that a minute analysis should be made of the fatal effects produced by the various diseases on the population at different ages, and under every variety of circumstances. By such analysis we may be enabled to trace those general laws by which nature appears to govern the distribution of disease and mortality. Should this object be attained, a most important step would be gained in the progress of our knowledge of vital statistics, and the science itself be enhanced in utility.

For several years past much labour has been bestowed on the Mortality Bills of Glasgow, in order to exhibit the amount of mortality arising from the various diseases at different ages; considerable uniformity was noted in the results of the fever and eruptive fever tables of Glasgow and other towns; and the confirmation this uniformity has received from the more extended results now before us, leads to the belief that it cannot be looked upon as a matter of chance, but that it indicates the possibility of our arriving, by a still more extended sphere of observation, and by a more correct system in the registration of the fatal diseases, at a knowledge of precise laws which seem to regulate the amount of deaths at different ages by fever and eruptive diseases. It may be too much to speak confidently of arriving at this very desirable result, yet the evidence is sufficiently strong to justify the bringing these circumstances under particular notice, which will be done in the remarks we have to make on the leading results brought out in these tables.

With regard to the hospitals and dispensaries for the poor inhabitants of these towns, they are placed on a very equal footing. To visit the Royal Infirmary or the Dispensary of any one of these towns will lead to a correct judgment of all the others. Differences may be observed as to the newness of the building, or in some of the minor arrangements, but superintended as they all are by suitable officers, the same high character of efficiency is common to all of them, and renders the benefit they confer on the poor and destitute in time of sickness and bodily distress one of the greatest blessings they enjoy. The differences, therefore, that are to be observed in the amount of mortality in the towns, are not traceable to differences in the means of affording medical relief!

The first difference to be observed in the amount of the annual mortality in the towns reported on, is that which appears to arise from atmospheric influence or some other unknown cause, which seems to have a greater or less effect on the human frame in different years. The influence of extreme cold on the amount of mortality has been frequently noticed by writers on this subject; and though others have attributed the excess of mortality which is sometimes observable more to sudden changes of temperature than to extreme cold, it is very evident that excessive cold, though it is not the only atmospheric influence to be guarded against, has a powerful influence in producing a great mortality, and the effect of that influence is inversely as the abundance of nutritive food, clothing and fuel at the command of the people to guard against it. Table LXVI. testifies in the strongest manner to the effects of temperature and the changes of the seasons upon vitality.

The most fatal month in the year to human life is January, the per-centage deaths of the total number of deaths ranging from 10 to $14\frac{1}{2}$ per cent. The next most fatal month is February; and a singular uniformity prevails in the per-centage deaths to the whole deaths in all the towns; then follow December and March, and the mortality diminishes until July—August, gradually increasing again with the fall of the year until it is at its maximum in January; in short, having a close correspondence with the progress of the sun in the ecliptic, the maximum intensity being when the sun is furthest removed from our latitudes, and its minimum effects occurring when the sun is in the neighbourhood of the northern tropic. It might probably be more correct to say that the mean mortality accords with the monthly mean temperature. The tables exhibit a somewhat singular feature in the proportional excess of deaths in Edinburgh in the summer months over the other towns, combined with a somewhat smaller proportion in the month of January, but an excess in the month of December. These anomalies may possibly originate in the topography of the town, or in the averages being for three years only for Edinburgh and for five years for the other towns. The influence of high winds in removing infection and disease has also been noticed by writers, and is a subject of great interest in connexion with the sanitary condition of great towns, where the inhabitants are often crowded together in closely pent-up houses, where a free circulation of air is not to be expected.

Sir Gilbert Blane, in describing the effects of a hurricane which took place in the West Indies, in October 1780, after some observations on its beneficial effects on the prevailing diseases of the country, except where the old and delicate suffered from mechanical violence, says, "This is a fact so paradoxical, that if I had not a concurrence of testimony, and in some degree my own observation, I could neither credit nor would venture to relate it. It had a visibly good effect on the diseases of the country; fevers, fluxes, and chronic diarrhœas, the consequence of dysenteries, were also cured by it. But the diseases upon which it operated most visibly and sensibly were pulmonic complaints. Some cases, supposed to be beginning consumption, and even the acute state of pleurisy, were cured by it*."

In connexion with any inquiry into the sanitary condition of large towns, it is therefore of importance to ascertain what state of the atmosphere is most prejudicial or most favourable to health, operating as its changes do to a greater or less extent, according to the local circumstances of these towns, in regard to the free circulation of air, proper drainage, cleanliness, and the comforts of the people in lodging, food and clothing†. It is to be feared, however,

* Select Dissertations on several subjects of Medical Science, by Sir Gilbert Blane, Bart., F.R.S., p. 370.

† The propriety of publishing meteorological tables for these towns in connexion with this subject is sufficiently obvious, and would have been attended to, had not the construction of the preceding tables necessarily occupied much more time than was anticipated.

that our meteorological observations are not yet sufficiently extensive to enable us to form a correct judgment of the specific effects of atmospheric phænomena, when combined with the local circumstances of large towns, nor to point out how these effects are to be most effectually obviated. "It is not only necessary to know the temperature and weight of the air at particular times but also the *direction and force of the wind*, with the quantity of moisture it contains; also *its electrical* state, together with the quantity of rain that falls."

From the imperfect system followed in recording the deaths in many of the registers, we are obliged to assume that those deaths which occur beyond the limits of any of these towns, and in which burial takes place within their limits, are balanced by those cases in which death takes place in the towns and the burials elsewhere. In Perth, where there is a steady and somewhat decreasing population, there may perhaps be rather an excess of those who die at a distance buried within the limits of the city. With regard to Aberdeen, Bailie Forbes and others, whom we have consulted on the subject, inform us that a considerable number of inhabitants who die in that city are buried at a distance, often where the family of the party may have originally been seated; and although the ages at which death takes place in that town, and other circumstances, clearly prove that Aberdeen is favourably situated as to its sanitary condition, we are inclined to believe that the average annual mortality of that town is very considerably understated at 1 in 49·737, as in the preceding tables. With regard to the other towns, it would be difficult to form an estimate as to whether the amount of those who die beyond and are buried within their limits, or those who die within and are buried beyond the limits, is the greatest. As the proportion of such burials, however, may be considered uniform throughout the year, a fair judgment may be formed as to the relative effect of the seasons in connexion with other causes on the mortality of the different towns.

In Aberdeen, it will be observed, there is an excess in the proportion of deaths over those of Edinburgh during the months of January, February, March, April and May. It will be perceived that in February the excess is the greatest, and amounts to 1·90 per cent. of the average annual deaths. During the seven last months of the year the proportion of deaths is greater in Edinburgh than in Aberdeen; the greatest difference being in September, in which month the excess in Edinburgh amounts to 1·11 per cent. of the average annual deaths. For the relative mortality in these towns for the different months, see Table LXIII.

From Table LXIV. it will be found that there is an excess of deaths in Perth over those in Edinburgh during the months of January, February, March, April, May and August; the greatest excess is in January, amounting to 3·36 per cent. of the whole deaths*; and in June, July, September, October, November and December, there is an excess of deaths in Edinburgh as compared with Perth; the greatest excess is in June, amounting to 1·98 per cent. of the annual average of deaths.

In Dundee there is an excess of deaths in the months of January, February, March, and May as compared with Edinburgh; the greatest excess is in January, and amounts to 4·31 per cent. of the annual average of deaths. During all the other months the excess of deaths is in Edinburgh, amounting in September to 1·63, and in November to 1·69 per cent. See Table LXV.

It is much to be regretted that circumstances have prevented the construction of monthly tables of mortality for five years instead of three for Edinburgh. Had this been the case, the proportionate mortality would not have

* The great mortality which was caused by fever and influenza in January 1837, is the reason of this proportion being so high.

been quite so favourable for that city during the winter months as is made to appear by these tables. The amount of deaths from fever and influenza, which was excessive in the beginning of 1837, is included in the results brought forward for the other towns, but it has not been obtained for Edinburgh. The relative proportions of the deaths during the different months, as exhibited in these tables, are therefore more correct for the other towns than they are for that city.

Whatever influence the vicissitudes of the atmosphere may have, there are obviously other causes greatly affecting mortality, such as a free circulation of air, drainage, cleanliness, temperance, the abundance of wholesome food, clothing, fuel, and the occupations of the people.

One of the objects of research in vital statistics is to make comparisons of the effects produced on different communities similarly situated with regard to these various circumstances, and to observe how far the same causes produce the same results on the human frame.

But it must be of rare occurrence to find two towns similarly situated in all these respects. In the towns for which these tables are constructed, it will be observed, that while some approach near to each other in some points, both in regard to their sanitary condition and the circumstances of the people, yet they differ in others, and the difference is accompanied with a greater or less amount of mortality.

From the tables in which the deaths are brought forward for a series of years, it will be seen (Tables XXXII. to XLIX.) that the greatest number of deaths at the very early ages takes place in Glasgow and Dundee, towns possessing many features common to both; their manufactures, commerce and public works resemble each other, the wages of the working classes, the appearance of their houses, and the rents paid for them, are much the same, and the price of food is nearly equal in both places. The deficiency of proper drainage, the accumulation of impurities, and the want of a free circulation of air, are very observable in both cases. In both towns there is a large proportion of the wretchedly poor, though the largest proportion is decidedly in Glasgow.

It appears (Tables LI. and LIV.) that the average annual amount of mortality in Glasgow for the last five years is as 1 to 31·10, or 3·21 per cent.; and in Dundee, for the same years, as 1 to 38·37, or 2·60 per cent. We have already stated that the accuracy of these results depends on whether or not the number of deaths which take place in these towns, with burial in the country, or the deaths that take place in the country, with burial in the towns, balance each other. A more correct judgment may therefore be formed of the relative mortality of these towns by a comparison of the ages at which death takes place than by these general results.

By referring to Tables LI. and LIV., it will be found that the proportion of deaths at Glasgow under one year of age, to the population on an average of years, exceeds that of Edinburgh by 0·178 per cent. In Dundee the proportion is greater than in Edinburgh by 0·086 per cent. The excess of deaths at one and under two years of age in Glasgow over those in Edinburgh, is 0·21 per cent.; in Dundee, 0·07 per cent. At two and under five years of age the excess of deaths in Glasgow is greater than in Edinburgh by 0·18 per cent.; and in Dundee by 0·11 per cent. Again (Table LXXIV.), it appears that in Glasgow the average annual proportion of deaths under five years of age, to the mean population, is 1·43 per cent., and to the whole average annual deaths is 44·58 per cent.; while in Dundee the proportion of deaths under these years, to the population, is 1·13 per cent., and to the whole average deaths is 46·82 per cent. Table LXXVI. shows that in Glasgow 1·79 per cent. per annum of the population die under twenty years of age, and in Dundee 1·38 per cent. It will be observed, however, that the proportion of deaths under twenty years of age in Glasgow, to the total deaths, is 55·95 per cent., whereas in Dundee it amounts to 57·52 per cent.

It will also be observed that at the higher ages there is an excess of deaths in Edinburgh over either Glasgow or Dundee, with the exception of those above ninety-five years of age, at which ages the excess of deaths takes place in Glasgow and Dundee. Table LXXVIII. shows that 1·41 per cent. per annum of the population of Glasgow die above twenty years of age, and that 1·02 per cent. of the population of Dundee die above that age; 44·04 per cent. of the whole deaths taking place in Glasgow above that age, and 42·47 per cent. in Dundee.

It is plain, therefore, that as the proportion of deaths at the different ages under five years, under twenty, and above twenty years of age, to the whole deaths, leads to the belief that Dundee is a less healthy town than Glasgow, and that the deaths at the two former ages, to the population, show that Glasgow is the least healthy of the two towns, the inference to be drawn is either that those deaths which take place beyond the limits of Glasgow, and in which burial takes place within the limits, exceed the number of those cases in which death takes place in the town, and the burials elsewhere, or that the opposite of this is the case in Dundee.

It is to be regretted that we are unable to give tables of mortality and of marriages for the town of Ayr. As that town is so similarly situated in many respects to Perth, a very interesting and useful comparison might have been made of the relative amount of the marriages and deaths in these towns.

There is a very considerable difference between the local circumstances of Perth and those of Glasgow or Dundee. This town is chiefly dependent on its connexion with the rich agricultural districts that surround it; it has some factories of flax, woollen and cotton, but these are of inconsiderable extent*. Of the towns for which we have constructed tables, Edinburgh approaches

* Of the population of Perth there are about 900 adults employed as hand-loom weavers, and a considerable portion of them produce a fabric somewhat peculiar to themselves; and as the manufacture of this species of goods has not fallen off so much as the goods manufactured in Paisley, the weavers have been comparatively well off in this district lately, many of them making from 10*s.* to 12*s.* per week; some of them, however, do not make half so much. The wages of the ordinary labourer are rather lower than in some other towns; the price of food, however, is considerably lower. The 4lb. loaf retails at 7*d.*, whereas at Glasgow it is 9*d.*, and till very lately 10*d.*; and all other kinds of food seem to be cheaper than at Glasgow. On inspection, it does not appear that there is so much of that extreme destitution and utter wretchedness which is to be met with in some other towns. The houses of the poorer classes are better, and the rents more moderate than elsewhere. Some of the lodging-houses for the poor, though better than in some other towns, are certainly capable of improvement; but, generally speaking, good beds, blankets and sheets are provided, and considerable attention seems to be paid to their cleanliness. It does not appear that there are so many lodgers crowded into one room as at Aberdeen, Dundee, or Glasgow.

Perth is a fine, open, well-aired town. With regard to drainage, it possesses great advantages in the command of a fine stream of water, which enters at the north-west part of the town, and is there divided into three branches, passing through different portions of the city, carrying off the impurities which are thrown into it from various parts of the town by surface drains. The improvement of covered drains, as contemplated by the Lord Provost, must still further add to the comfort and health of the inhabitants. The greatest attention is paid to the scavenger department of the police, and the manure is carefully removed to the outskirts of the town. Accumulations of this kind are unknown in any part of Perth.

As the county of Perth is well known to be a wool-growing country, it may be mentioned that great encouragement has been extended by the Lord Provost and magistrates to the woollen manufactures, and various premiums have been offered to those who may introduce or increase these manufactures; and as the county town should form a very suitable mart for these manufactures, a wool fair has lately been established under the same auspices, and it has been very successful.

Without entering into further detail, it may be stated that Perth, without being subject to a high state of prosperity or of adversity, possesses many advantages which tend to promote the comfort and well-being of the inhabitants.

the nearest to it, though there are some important particulars in which they differ considerably.

It will be seen (Table LXVII.) that the average annual mortality in Edinburgh for the last five years, to the mean population of these years, is as 1 to 34·90, or 2·86 per cent., and in Perth it is as 1 to 37·87, or 2·64 per cent. It will also be observed (Table LIII.), that there is an excess in the proportion of deaths in Edinburgh at nearly all the ages up to fifty years, over those which took place at Perth, with the exception of those at two and under five, and those at fifteen and under twenty years; and that the greatest proportion of deaths at all the ages above fifty years in these towns is in Perth. It will be observed, that the difference in the proportion of these deaths, at any of the ages stated in the table, does not extend to high numbers; the greatest excess in Edinburgh being of the deaths under one year, which amounts to 0·07 per cent. of the whole population; and the greatest proportion of deaths in Perth over those of Edinburgh is at the age of seventy and under seventy-five years, which amounts to 0·09 per cent.

It may further be observed (Table LXXVI.), that in Edinburgh the deaths under twenty years of age amount annually to 1·11 per cent. of the population, and to 43·88 per cent. of the whole deaths; while in Perth the deaths under the same age amount to 1·01 per cent. of the population, and to 38·26 per cent. of the whole deaths. Again (Table LXXVIII.), the deaths in Edinburgh above twenty years of age amount to 1·43 per cent. of the population, and to 56·11 per cent. of the whole deaths; while in Perth the deaths above the same age amount to 1·63 per cent. of the population, and to 61·73 per cent. of the whole deaths.

The differences in the mortality of these two cities might be traced to the local circumstances of the inhabitants, but to pursue this subject further would lead us beyond the limits of this Report.

With regard to Aberdeen, partaking as it does partly of the character of Perth as a county town, and of the character of Glasgow and Dundee in the extent of its factories for the manufacture of flax, cotton and woollen goods, the defective state of the registers prevents us from making the tables showing the causes of death so complete as for the other towns*. By a careful examination of the mortality tables for this town, it will be found that they afford good reason to believe that Aberdeen is very healthy†; although, as

* We have been very obligingly favoured with extracts of Registers and Reports from the Hospitals and Royal Infirmary, by several of the medical gentlemen of that city, for the purpose of supplying this deficiency to a certain extent.

† Much has been done of late years to improve the city of Aberdeen, by removing old, closely-built and ill-aired houses, and by building wider streets, more healthy houses, and elegant public buildings in their stead. A considerable number of lanes and closes, surrounded by the worst description of houses, have been in this manner removed. And in visiting any of those closes where this class of houses is still to be found, it is gratifying to observe that great attention is paid to the scavenger department of the police. None of those offensive accumulations of animal and vegetable matter, which are so conspicuous in some parts of Glasgow, Leith and Dundee, are allowed to remain to destroy the comfort and the health of the inhabitants. Through the kind attention of Captain Barclay, superintendent of police, we have been able to compare the condition of the poorest class of the inhabitants with the condition of those in other towns. There is perhaps no town in which there are worse cases of miserable destitution than are to be met with in Aberdeen, but, fortunately for that city, these cases bear a much smaller proportion to the population than is to be met with in Glasgow, Edinburgh, and Dundee, or perhaps in Liverpool. The lodging-houses for the poor in Aberdeen are often densely crowded. In Peacock's Close, for example, above twenty people are frequently to be found sleeping in a room from ten to twelve feet square, with a small closet adjoining. In the majority of these lodging-houses, however, the whiteness of the sheets and blankets indicates a much higher degree of comfort than is to be observed among the same class of people in the towns above alluded to.

The trade and commerce of Aberdeen have long been of a steady and prosperous nature; bankruptcies are of very rare occurrence in that city. The price of animal food is conhas been already stated, from some of the inhabitants being buried beyond the limits of the town, the probability is that the deaths which are recorded are not the whole deaths, and therefore the returns from the burying-grounds may be considered incomplete, and make the proportionate mortality of this town appear somewhat less than it really is.

The average annual mortality in Aberdeen appears (Table LXXI.) to be as 1 to 49·72, or 2·01 per cent.; and it will be observed (Table LII.), that with the exception of the ages at fifteen and under twenty years, there is an excess of mortality at all the ages specified in the tables up to eighty years in Edinburgh over the proportion which takes place at these ages in this town. At all the ages above eighty years, consequently, the greatest proportion of deaths which take place in these towns is in Aberdeen. It is further shown (Table LXXVI.), that in Aberdeen the deaths under twenty years of age amount to 0·86 per cent. of the population, and to 43·14 per cent. of the whole deaths; and that (Table LXXVIII.) the deaths above twenty years of age amount to 1·14 per cent. of the population, and to 56·85 per cent. of the whole deaths.

DISEASES.

The tables commencing with No. XXXII. and ending with No. XLIX., exhibit the number of fatal cases of disease that occurred in the different towns during successive years, classified according to eighteen periods of life at which they took place; and show also the total number of deaths at each period, and the proportions which these and the number of deaths, from the several diseases, bear to the total number of deaths, and also to the population. It will be observed, that our information on these heads extends only to three years for Edinburgh and for Dundee*. Circumstances have prevented tables of this description from being made for these towns for the years 1837 and 1838, as was intended. For the other towns, with the exception of Leith, these tables extend to five years. It is to be regretted that the state of the registers of Leith prevents tables of this kind from being made out for more than two years; and even these are not so complete as the others, owing to no registers being kept for the burying-ground of Newhaven. The amount of mortality in these towns, caused by the various diseases at different ages during successive years, may be seen by referring to the tables. We may here, however, notice some of the more marked results brought out in the five following tables, No. L. to LIV., in which the results are brought forward and comparisons are made for the several towns, on an average of the different years for which these tables have been constructed.

It will be observed (Table L.), that there is a proportionate excess of deaths in Edinburgh over those in Glasgow, by the causes classed under the heads "aged," "diseases of the head," "of the heart," "inflammation," and by those diseases which are not distinctly brought out, as stated in the Appendix, but which are classed under the head of miscellaneous diseases. The greatest proportion of deaths by all the other diseases takes place in Glasgow. The greatest excess of deaths in Edinburgh over those of Glasgow, appears to be

siderably lower than in Glasgow. Fish is about one-third cheaper than in that town. The wages of the working classes appear to be much the same as in other towns. There does not appear to be too great a supply of labour for the demand for it. We have the authority of Lord Provost Blackie for stating that, till the late severe depression of trade, no man who was willing to work could be at a loss to procure employment.

* These tables for Dundee have been constructed from extracts from the registers of that town for the purpose. The data which have enabled us to extend the other mortality tables for that town to five years, have been obtained from the Dundee Mortality Bills, which have been very ably drawn up by W. B. Baxter, Esq. And the data from which the other tables for Edinburgh have been constructed were obtained from the paper on Vital Statistics, read to the Statistical Section of the British Association at Glasgow, by Mr. Alexander Watt.

caused by diseases of the head, amounting to 0·047 per cent. The greatest excess in Glasgow is by fever, amounting to 0·21 per cent. It is here to be observed, however, that the great excess of deaths by fever during 1837, in these towns, is included for Glasgow, though the amount has not been obtained, and is not included in this table for Edinburgh: so that the excess of deaths by fever in Glasgow over those in Edinburgh appears greater than it really is. The excess of deaths by bowel complaint in Glasgow, over those in Edinburgh, amounts to 0·20 per cent. *For the per-centage of other diseases see the Table.*

As Table LIV. gives the amount of deaths in Dundee by the different diseases for the same years as those in which it has been obtained for Edinburgh, the comparison is still more satisfactory than for the other towns. It will be observed, that the greatest excess of deaths in Dundee over those in Edinburgh is caused by asthma, bowel complaint, catarrh, croup, dropsy, hooping-cough, measles, nervous diseases, scarlet fever, and small-pox; the highest excess being by measles, amounting to 0·102 per cent. The greatest proportion of deaths by all the other diseases is in Edinburgh. The highest proportion of deaths in that town over those of Dundee is by decline, and amounts to 0·137 per cent. *For the other proportions see the Table.*

The names of only 33·8 per cent. of the fatal cases of disease have been ascertained for Aberdeen, and exhibited in the tables for that town; and as these bear but a small proportion to the total amount of deaths, the proportions to the population have been omitted in the tables, as they could form no data for comparison with the amount of fatal cases of disease ascertained for the other towns. The proportion of deaths by the several diseases ascertained, to the whole of the fatal cases of ascertained disease, is, however, given in Table LII.

It should be noticed, that for the different towns, with the exception of Aberdeen, the diseases stated under the head "not ascertained," consist chiefly of such diseases as the relatives of the deceased could not exactly describe; several of them being named in the registers "inward complaints," &c. It is obvious, that to whichever columns the numbers under this head ought to be transferred, very few of them belong to the columns of fever, or eruptive fevers, the characteristics of which are so strongly marked.

There are some cases upon the recording of which due attention has not been bestowed; yet the proportion of deaths stated in all the tables, but those for Aberdeen, may be considered as being tolerably accurate.

We have already called attention to the uniformity in the proportion of deaths at the different periods of life by fever and eruptive fevers, to the whole deaths, by these several diseases. Although in several instances there is a considerable difference in the proportion of these diseases to the amount of population, yet the uniform proportion of the mortality by these diseases which falls on the different ages is very striking, and leads to the belief, as before stated, that by a still more extended range of observation, and by a more correct system of registration of the fatal diseases, we might find that fixed laws regulate the amount of deaths at different ages by the several diseases.

Table LV. shows, that while the proportion of deaths by fever, under five years of age, for the last three years in Edinburgh, amounted to 0·029 per cent. of the population, it amounted to 12·41 per cent. of the whole deaths by fever. In Glasgow (Table LVI.), while the deaths by fever, at the same age, for the last five years, amounted to 0·053 per cent. of the population, they amounted to 12·07 per cent. of the whole deaths by fever; being *very* nearly the same proportion to the whole deaths by fever as in Edinburgh. Again (same tables), while the deaths by fever, under twenty years of age, for the last three years in Edinburgh, amounted to 0·070 per cent. of the population, they amounted to 29·74 per cent. of the whole deaths by fever.

In Glasgow, while the deaths by fever, at the same age, for the last five years, amounted to 0·129 per cent. of the population, they amounted to 29·05 per cent. of the deaths by fever, being still *very* nearly in the same proportion to the whole deaths by fever as in Edinburgh. Again, in Edinburgh, while the deaths by fever, above twenty years of age, during the last three years, amount to 0·165 per cent. of the population, they amount to 70·25 per cent. of the whole deaths by fever. And in Glasgow, while the deaths by fever, above that age, amount to 0·316 per cent of the population, they amount to 70·94 per cent. of the whole deaths by fever.

By referring to the tables for the other towns, it will be perceived that the proportions of the deaths by fever, at the different ages, to the whole deaths by fever, are not so *very* close to each other as they are in Edinburgh and Glasgow; yet the difference is not great, and may be accounted for partly by the defective state of the registers, as well as by some local circumstances which cannot yet be clearly traced.

We have had time only to construct tables similar to those immediately referred to, for a few of the fever cases, exhibited in the Reports of the Registrar-General for towns in England. As those we have constructed, however, show very striking results for Manchester and Liverpool, we here insert the results corresponding with those above quoted.

Proportions of Deaths by Fever, at different ages, during 1839*.

	In Manchester.		In Liverpool.	
	Of the whole Deaths by Fever.	Of the Population.	Of the whole Deaths by Fever.	Of the Population.
	Per cent.	Per cent.	Per cent.	Per cent.
Under 5 years of age...	16·037	0·018	15·081	0·016
Under 20 years	38·679	0·043	30·163	0·033
20 years and upwards..	61·320	0·069	69·836	0·077
Total...........	100·000	0·113	100·000	0·111

The uniformity of the following proportions of deaths by the several diseases at certain ages, to the whole deaths by these diseases, is still more striking, although the amount of deaths, when compared to the population, was very different.

Proportion of Deaths by Measles, at different ages, during 1839†.

	In Manchester.		In Liverpool.	
	Of the whole Deaths by Measles.	Of the Population.	Of the whole Deaths by Measles.	Of the Population.
	Per cent.	Per cent.	Per cent.	Per cent.
Under 5 years of age...	92·496	0·254	91·271	0·133
Under 20 years	99·353	0·273	99·750	0·146
20 years and upwards..	0·646	0·002	0·249	0·000
Total...........	100·000	0·275	100·000	0·146

* The data from which these proportions are obtained will be found in the Third Annual Report of the Registrar-General of Births, Deaths and Marriages in England, see pages 70 and 74. It will be observed, that the deaths by remittent fever and typhus are included in these proportions.

† See pages 70 and 74 of the Report of the Registrar-General of Births, Deaths and Marriages in England.

Proportion of Deaths by Scarlatina, at different ages, during 1839.

	In Manchester.		In Liverpool.	
	Of the whole Deaths by Scarlatina.	Of the Population.	Of the whole Deaths by Scarlatina.	Of the Population.
	Per cent.	Per cent.	Per cent.	Per cent.
Under 5 years of age...	72·659	0·069	74·598	0·101
Under 20 years	97·752	0·093	98·930	0·135
20 years and upwards..	2·247	0·002	1·069	0·001
Total...........	100·000	0·095	100·000	0·136

Proportion of Deaths by Small-pox, at different ages, during 1839.

	In Manchester.		In Liverpool.	
	Of the whole Deaths by Small-pox.	Of the Population.	Of the whole Deaths by Small-pox.	Of the Population.
	Per cent.	Per cent.	Per cent.	Per cent.
Under 5 years of age...	87·341	0·073	85·328	0·087
Under 20 years	98·312	0·082	97·683	0·092
20 years and upwards..	1·687	0·001	2·316	0·002
Total...........	100·000	0·084	100·000	0·094

For the proportions of the deaths by measles, scarlet fever and small-pox at the different ages, to the whole deaths, for the towns in Scotland, and their striking correspondence with the above, we have to refer to the preceding tables, in which they are exhibited. The following results brought out for other diseases, in a similar manner, show, that were the Scotch registers so improved that we could rely upon their accuracy, there is a great probability that the proportion of deaths at different ages, in a given population, by any particular disease, would be found to be nearly uniform, whatever the total amount might be; and that when there was a departure from a certain proportion at these ages, a local cause might be found to account for it.

It will be found from the tables showing the average annual amount of deaths by the several diseases, that the proportion of the total deaths by the diseases included under the head of bowel complaints, amounts to 0·167 per cent. of the population in Edinburgh; to 0·171 per cent. of the population in Perth; to 0·263 per cent. in Dundee; and to 0·370 per cent. in Glasgow.

The following is the annual average proportion which the deaths by Bowel Complaint, at different ages, bear to the whole annual average deaths by that complaint, in different towns, and also to the population.

Ages.	Edinburgh.		Perth.		Dundee.		Glasgow.	
	Proportion to whole Deaths.	Proportion to the Population.	Proportion to whole Deaths.	Proportion to the Population.	Proportion to whole Deaths.	Proportion to the Population.	Proportion to whole Deaths.	Proportion to the Population.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Under 3 years of age.	79·106	0·132	79·041	0·135	77·919	0·204	84·066	0·311
Under 5 years.........	85·014	0·142	82·634	0·142	84·288	0·221	90·693	0·335
Under 20 years	87·608	0·146	85·029	0·146	86·836	0·228	93·475	0·346
20 years and upwards.	12·391	0·020	14·970	0·025	13·163	0·034	6·524	0·023

We have made out tables like the above for some of the other diseases. The results are all similar to those in the following table for Inflammation, in which there is a great variation in the proportions for the different towns. It is to be doubted, however, if much reliance can be placed on the accuracy with which these diseases are recorded in the registers.

It will be found by the tables above referred to, that the proportion of the total annual average deaths by inflammation to the mean population of Edinburgh amounts to 0·196 per cent.; in Glasgow to 0·185 per cent.; in Perth to 0·139 per cent.; in Dundee to 0·143 per cent.

The following is the proportion which the deaths by Inflammation, at different ages, bear to the whole deaths by inflammation, in different towns, and also to the population.

Ages.	Edinburgh.		Glasgow.		Perth.		Dundee.	
	Proportion to whole Deaths.	Proportion to the Population.	Proportion to whole Deaths.	Proportion to the Population.	Proportion to whole Deaths.	Proportion to the Population.	Proportion to whole Deaths.	Proportion to the Population.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Under 5 years of age.	44·103	0·086	44·934	0·083	32·352	0·045	51·361	0·073
Under 20 years	55·651	0·109	58·006	0·107	44·117	0·061	62·645	0·089
20 years and upwards.	44·348	0·087	41·993	0·077	55·882	0·078	37·354	0·053

The tables from No. LXXIV. to LXXX. exhibit the average annual number of deaths under five, under twenty and above twenty years of age, in five of the principal towns of Scotland, and also for all England, and for the City of London and town of Manchester; with the proportions which the average annual deaths at these ages bear to the whole average annual deaths, and to the mean population.

Tables LXXIV. and LXXV. show, that the proportion of deaths under five years of age amounted in the three years specified to 0·85 per cent. of the population in Edinburgh, and to 33·62 per cent. of the whole deaths in that town. For England it was 0·871 per cent. and 39·59 per cent. of deaths. In London the proportion of deaths under the same age, in the years specified, amounted to 1·066 per cent. of the population, and to 40·49 per cent. of the whole deaths. In Glasgow the proportion of deaths under five years of age in five years specified, amounted to 1·43 per cent. of the population, and to 44·58 per cent. of the whole deaths. By referring to the tables, it will be found that there is a greater mortality under five years in London than in the Scotch towns; but the mortality in Manchester exceeds that of the most unhealthy Scotch towns.

Tables LXXVI. and LXXVII. show, that in Edinburgh the proportions of deaths under 20 years of age amounted to 1·119 per cent. of the population, and to 43·88 per cent. of the whole deaths. For all England the proportions were respectively 1·118 and 50·83 per cent. In London the proportion of deaths under that age amounted to 1·296 per cent. of the population, and to 49·23 per cent. of the whole deaths. In Glasgow the proportion of deaths under that age amounted to 1·79 per cent. of the population, and to 55·95 per cent. of the whole deaths; and in Manchester the proportion of deaths under the same age amounted to 2·027 per cent. of the population, and to 60·99 per cent. of the whole deaths.

Tables LXXVIII. and LXXIX. show, that in Edinburgh the proportion of deaths above 20 years of age amounted to 1·43 per cent. of the population, and to 56·11 per cent. of the whole deaths. In England these proportions were respectively 1·082 and 49·17 per cent. And in London the proportion of deaths amounted to 1·36 per cent. of the population, and to 50·77 per cent. of the whole deaths. In Manchester only 39·01 per cent. of the whole deaths take place above 20 years of age, and 1·296 per cent. of its population.

It is worthy of observation, that the mortality at the different ages in Manchester (the greatest manufacturing town in England) bears nearly the same proportion to that of London, as the mortality at these ages in Glasgow (the greatest manufacturing town in Scotland) bears to that of Edinburgh.

It will be seen (Tables LXXIV. and LXXV.) that the proportion of deaths under 5 years in Manchester is 10·83 per cent. of the whole deaths, and 0·639 per cent. of the population greater than in London; and in Glasgow the proportion of deaths under the same age is 12·07 per cent. of the whole deaths, and 0·67 per cent. of the population greater than in Edinburgh. Again, it will be found (Tables LXXVIII. and LXXIX.) that the proportion of deaths above 20 years of age in Manchester is 11·76 per cent. of the whole deaths, and 0·040 per cent. of the population less than in London; and in Glasgow the proportion of deaths above that age is 12·07 per cent. of the whole deaths, and 0·016 per cent. of the population less than in Edinburgh.

The average annual proportions of deaths to the mean population in the towns of England, is exhibited in Table LXXX. In London the average annual proportion of deaths during the years 1837–38, 1838–39, and 1839–40, to the mean population of these years, was as 1 to 37·34, or 2·67 per cent.; in Manchester as 1 in 28·06, or 3·563 per cent.; in Liverpool as 1 to 28·30, or 3·537 per cent.; in Leeds as 1 to 36·76, or 2·720 per cent.; and in Birmingham as 1 to 36·82 or 2·716 per cent.*

We have already had occasion to notice the tendency which reckless poverty and the absence of artificial comforts in the dwellings of a large proportion of the town population has to increase the number of improvident marriages, and consequently of births. The effect of extreme poverty in extending disease and mortality among the inhabitants of these towns, is also apparent from the results exhibited in the preceding pages. Other causes are mentioned as having a powerful influence in producing those fatal effects observable in the amount of mortality in large towns, such as intemperance and inattention to cleanliness, together with a want of proper drainage and a free circulation of air among the houses of the poor.

The abuse of spirituous liquors has been well described as "at once the

* In regard to this comparison of the mortality in the English and Scotch towns, particularly in early life, it is to be observed, that in several of the former, in the years compared, there were unusually severe epidemics of small-pox, measles and scarlet fever, the mortality from which falls almost entirely on the early periods of life. Thus in London, in 1838–39, small-pox caused 3817 deaths, or 1 in 13·8 of the whole mortality, and in 1839–40 measles and scarlet fever together caused 4535 deaths, or 1 in 10 of the whole mortality; in Manchester in 1839–40 measles alone caused 1131 deaths, or 1 in 8·1 of the whole mortality; in Liverpool in 1837–38 small-pox caused 634 deaths, or 1 in 7·7 of the whole mortality, and in 1839–40 measles and scarlet fever caused 934 deaths, or 1 in 9·8 of the whole mortality; while in Glasgow, and still more in Edinburgh, there have been no such virulent epidemics of these diseases.

Now these are epidemics which no doubt affect the poorer classes of the population in any town more than the richer, but which extend rapidly through all ranks, and the extension of which must be regarded as *accidental*, depending apparently more on the peculiar virulence of the specific poisons than on any remediable causes. In estimating the average degree of unhealthiness of a town, or drawing any inference as to the social condition of the people, the mortality from such epidemics should be omitted from the calculation, or else the estimate should be framed on the comparison of such a number of years that unusually severe epidemics may be included in the records of all the towns.

cause and consequence of destitution*;" and as inattention to cleanliness may also be considered as an universal attendant of extreme poverty, it is not easy to see how the effects of the one can be traced without these effects being found in some degree to be influenced by the other; nor, indeed, does it seem possible to distinguish the effects of extreme poverty from those of defective ventilation and draining, because the poorest people have no choice of residence, and cannot avoid congregating in such numbers as to imply very deficient ventilation.

The effect of intemperance on the human constitution in producing disease and death is undoubted; and we too often witness the pernicious effects produced on the family of the drunkard by his expending on what is to injure his health, degrade him in the eyes of his fellow men, and bring him to an early grave, those funds whereby he would be enabled to procure a greater abundance of wholesome food, clothing and fuel for his family, to protect them against the inclemency of the seasons and the ravages of disease, and by bestowing upon them a better education at once to procure a more happy home for himself and for them. It is gratifying, however, to learn from well-informed parties in the towns reported on, that marked improvement has taken place in the temperance habits of the people: and too much praise cannot be bestowed on those philanthropic individuals whose exertions have been the means of urging forward this salutary reformation.

We have endeavoured, but without success, to ascertain the exact quantity of spirituous liquors consumed by the population of Glasgow. The quantity brought into the city may be easily ascertained; but the quantity that is sent out of Glasgow, in such portions as may not require a permit for its protection, or even where the requirement of a permit may not be attended to, and which is consumed by the agriculturists, and by many inhabitants of the towns and villages to a considerable distance round Glasgow, cannot be ascertained, and therefore the amount of population by which the spirits entered in the books of the Excise is consumed cannot be stated.

Without being in possession of sufficiently accurate information to enable us to state whether a greater excess in the use of intoxicating liquors is more customary in Glasgow than in the other towns for which our tables are constructed, it will readily be admitted that this pernicious vice is too prevalent in all of them; and the amount of destitution and misery arising in consequence of it is greatly to be deplored. It has frequently been stated as one of the principal causes of female life being better than that of the males, that the men are more intemperate in their habits than the women. Were this the case, the greatest abuse of spirituous liquors may be looked for in Edinburgh, as the female life in that town is 0·50 per cent. better than the male life. And the most moderate use of spirituous liquors may be looked for in Perth, as the male life is only 0·20 per cent. worse than the female life in that town. In Glasgow the female life is better than the male life by 0·46 per cent.; in Aberdeen by 0·48 per cent.; and in Dundee by 0·33 per cent.† Were, therefore, the relative mortality of men and women as the indulgence in intoxicating liquors, and the women alike temperate in their habits in the different towns, then these figures would form a sort of index of the degree of intemperance indulged in by the men. It may be objected to this, that the number of females employed at the factories of Glasgow, Aberdeen and Dundee, may have injurious effects on female life, and make the difference in the proportion of male and female deaths in these towns to be less than it otherwise would be. As, however, the inhabitants

* Dr. Arrot's Report on the fever cases of Dundee.

† See abstracts of the proportion of male and female deaths.

of Edinburgh and Perth are more like each other as to the nature of their employments, should intemperance on the part of the males be a principal cause of the difference in male and female deaths, then the proportion of intemperance should be as five in Edinburgh to two in Perth.

Whatever may be the influenee of intemperance in producing a high rate of mortality, both by the direct effects it produces on the human frame and by the destitution and misery which result from it, there are too many cases of extreme destitution in the towns of Scotland, arising from causes beyond the control of the sufferers, and for which there is no adequate relief provided by law. The effect of destitution in producing disease and death, seems to be admitted by all writers on the subject. Differences may arise as to the particular disease or diseases most affected by it; but all agree, that where a great degree of destitution exists, there is to be found a high amount of mortality.

It is especially to be observed with regard to the years of severe depression of trade, that the case of the really destitute poor in the manufacturing towns of Scotland is not then so bad as during the years of ordinary prosperity. Many of the better class of operatives require to submit to a much greater degree of suffering and privation than they are accustomed to, and the effects of these privations are much to be dreaded in the event of an unhealthy season setting in upon them. But the extraordinary exertions made by subscriptions from the more wealthy inhabitants, and from public funds, to supply food and clothing to the poor—by means of soup-kitchens, distribution of old clothes and otherwise, over and above the ordinary parochial relief,—often renders the condition of the really destitute much better at these times than it is under ordinary circumstances. We cannot, therefore, form such a correct judgment of the effects of destitution during these years on the mortality of large towns in Scotland as is generally imagined.

Were the local distribution of the population in towns the same as in Edinburgh and Glasgow, where the rich and the poor are found to occupy distinct districts, a more correct knowledge of the mortality among the different classes of the people would be come to than has yet been obtained. In the report of Monsieur Villermé, in vol. x. of *Archives Générales*, it is shown, that in the three districts of Paris in which the mortality is least the inhabitants are the wealthiest, and in the three districts in which the inhabitants are the poorest the mortality is the greatest.

In a valuable paper *, "On the best means of supplying the poor with cheap and nutritious food," read to the Philosophical Society of Glasgow by Dr. R. D. Thomson, he says,—"We trust the day is fast approaching when the light of science will enable the guardians of the poor to manage our poverty-stricken fellow-men by precise and definite rules, and will teach all classes of the community that the quantity of vital air supplied by the Creator to man is based on fixed laws which require the imbibition of a certain amount of food. An adult consumes every day 30½ ounces of oxygen or vital air from the atmosphere. To consume this, and to convert it into carbonic acid, he requires, according to Liebig, about 13 ounces of carbon, in the form of food. If the food is withheld, the carbon must be supplied from the muscles and substance of the body; the latter becomes thinner and weaker, and, like an expiring taper, is extinguished by the influence of the most trivial causes." Dr. Thomson, after noticing the amount of deaths in England by starvation, or purely from want of food, also says, "how many persons died by piecemeal starvation, or by disease engendered by bad food or want

* See Proceedings of the Philosophical Society of Glasgow, Fourteenth Session, 1841–42.

of it, has not yet been pointed out by statistical data." Though we may not be able to trace the effects of destitution in its different stages on the increase of disease and death, yet by the improvement of registers, and by greater attention to the vital statistics of various localities, and of different classes of the people, more certain knowledge may be attained on this most important subject. The proof, however, which the preceding tables afford that the mortality for the different towns is in proportion to the amount of the poor and destitute in these towns, is supported by the amount of burials which take place in them at the public expense.

Appendix.

Classification of Diseases used in the preceding Tables.

Classes.	Species.	Synonyms.
Accidents		Fractures, Wounds, Burns, Bruises, Drowning.
Aged	Decline above 60 years	And without any particular Disease.
Asthma		Shortness of Breath.
Bowel Complaints	Dysentery	Flux, Bloody Flux.
	Bowel Hives	Inflammation of Bowels in Children.
	Looseness	Diarrhœa.
	Teething.	
	Cholic	Iliac Passion.
	Cholera.	
Catarrh		Cold, Influenza.
Child-birth		Puerperal Fever.
Croup		Stopping.
Decline	Consumption	Pulmonary, Phthisis, Wasting.
	Tabes Mesenterica	Consumption of Young from Diseased Glands.
Dropsy	Dropsy, General.	
	—— of Chest.	
	—— of Belly.	
Fevers		Typhus, continued Fever, or Nervous, or Putrid.
Head, diseases of	Apoplexy	Rupture of Vessel in, or overflow of Blood to, Head.
	Palsy	Paralysis.
	Water in the Head	Hydrocephalus.
	Inflammation of Head	Head or Brain Fever.
Hooping-cough		Chin-Cough.
Heart, diseases of		Aneurism, Ossification.
Inflammation	General, or	Not specified.
	of Chest.	
	of Bowels.	
	of Liver.	
	of Throat.	
Measles.		
Nervous Diseases		Convulsions, Fits, Lock-jaw, Epilepsy.
Scarlet Fever.		
Small-pox.		
Miscellaneous Diseases	Abscess Lumbar	Suppuration of the Loins.
	Cancer	Of Breast, of Lips, of Bowels; Schirrus.
	Carbuncle.	
	Diabetes.	
	Dyspepsia	Stomach Complaints.
	Erysipelas	Rose.
	Flooding.	
	Jaundice.	
	Joints Diseased	White Swelling, Diseased Hip-joint.
	Rheumatism.	
	Rupture	Hernia.
	Spine Diseased.	
	Spitting of Blood.	
	Stone in Bladder.	

H.

TABLE L.

and 1841, classified ac showing the total average total average annual n comparative rates of mor-

e years 137,986.

	85 & under 90.		90 & under 95.			Comparative rate of Mortality from each kind of Disease.		Diseases, &c.
F.	M.	F.	M.	F.	M	Excess in Edinburgh.	Excess in Glasgow.	
						Per cent.	Per cent.	
3	1	2	...	1	1	...	0·012	Accidents.
73	41	66	15	25	7	0·032	...	Aged.
2	1	...	...	...	...	...	0·032	Asthma.
..	...	...	...	...	...	...	0·203	Bowel Complaints.
..	...	...	...	...	...	...	0·029	Catarrh.
..	...	...	...	...	...	...	0·012	Childbirth.
..	...	...	...	...	...	...	0·027	Croup.
..	...	...	...	...	...	...	0·087	Decline.
3	...	...	...	...	...	...	0·007	Dropsy.
..	1	...	...	...	...	...	0·210	Fever.
3	1	1	...	...	...	0·047	...	Head, of.
..	...	...	...	...	...	0·016	...	Heart, of.
..	...	...	...	...	...	...	0·080	Hooping-cough.
..	...	...	...	...	...	0·011	...	Inflammation.
..	...	...	...	...	...	...	0·123	Measles.
..	...	...	...	...	...	...	0·005	Nervous.
..	...	...	...	...	...	...	0·044	Scarlet Fever.
..	...	...	...	...	...	...	0·088	Small-pox.
1	...	1	...	...	...	0·049	...	Miscellaneous.
85	45	70	15	26	8	0·084	...	Total ascertained.
5	1	...	1	1	..	0·141	...	Do. not ascertained.
90	46	70	16	27	8	...	0·664	Deaths, M. and F.

	85 & under 90.	90 & under 95.	
	116	43	
	$38\frac{2}{3}$	$14\frac{1}{3}$	
46	91·034	245·581	
36	3568·603	9626·930	344
68	0·028	0·010	
49	0·017	0·006	
19	0·011	0·004	
	...	...	

verage annual Deaths is as 1 to the

EDINBURGH.

TABLE L.

Exhibiting the number of fatal cases of disease that occurred in the City and Suburbs of EDINBURGH during the years 1839, 1840 and 1841, classified according to 18 periods of life at which they took place; with calculations showing the total average number of deaths at each period, and the proportion which these, and the number of deaths from the several diseases, bear to the total average annual number of deaths, and also to the mean population of these years; with the comparative rates of mortality in Edinburgh and Glasgow.

Mean Population of these three years 137,986.

Diseases, &c.	Under 1 Year. M	Under 1 Year. F	1 & under 2 M	1 & under 2 F	2 & under 5 M	2 & under 5 F	5 & under 10 M	5 & under 10 F	10 & under 15 M	10 & under 15 F	15 & under 20 M	15 & under 20 F	20 & under 30 M	20 & under 30 F	30 & under 40 M	30 & under 40 F
Accidents	4	2	4	3	14	5	11	10	9	3	7	...	32	7	16	6
Aged				...	...			...	...		...	...				
Asthma		...			1	...	...	1	...	1		1	5	3	12	10
Bowel Complaints	235	168	80	66	23	18	8	2	2	1	4	1	3	5	5	7
Catarrh	8	7	...	1	1	...	1	...	1	...		1	1	1	3	2
Childbirth	...	...	...	...	...	...	...	...	...		...	1		38		32
Croup	17	14	21	21	29	34	4	6	...	1	1	...	...	...	...	...
Decline	85	72	43	42	51	46	50	37	35	47	57	49	177	167	152	162
Dropsy	3	2	4	...	9	6	9	6	4	4	4	6	11	26	12	34
Fever	11	10	16	16	28	40	47	39	12	26	27	18	69	61	87	84
Head, of	94	86	48	53	56	36	37	28	19	14	3	7	21	11	37	27
Heart, of	4	1	2	2	1	1	4	2	2	3	6	6	7	13	14	5
Hooping-cough	66	68	52	47	43	50	5	19	...	1	...	...	...	...	...	...
Inflammation	101	88	55	43	31	41	20	24	7	17	11	15	45	52	36	32
Measles	35	24	73	56	44	56	14	8	1	...	...	...	...	...	1	...
Nervous	15	9	3	1	5	3	1	2	1	...	1	1	...	1	3	6
Scarlet Fever	12	7	13	17	48	42	22	31	10	7	3	1	2	1	1	...
Small-pox	49	39	20	25	33	25	12	12	2		2	1	6	3	...	2
Miscellaneous	65	57	11	11	11	12	13	9	9	10	6	2	20	29	35	36
Total ascertained	802	654	445	404	428	415	258	236	114	135	132	110	399	418	414	445
Ditto not ascertained	158	131	29	25	35	27	21	27	16	13	9	12	33	37	38	40
Deaths, Males & Females	960	785	474	427	463	442	279	263	130	148	141	122	432	455	452	485

Diseases, &c.	40 & under 50 M	40 & under 50 F	50 & under 60 M	50 & under 60 F	60 & under 70 M	60 & under 70 F	70 & under 75 M	70 & under 75 F	75 & under 80 M	75 & under 80 F	80 & under 85 M	80 & under 85 F	85 & under 90 M	85 & under 90 F	90 & under 95 M	90 & under 95 F	95 & under 100 M	95 & under 100 F	100 & upwards M	100 & upwards F	Ages not ascertained M	Ages not ascertained F
Accidents	21	10	17	13	12	10	3	9	3	6	1	3	1	2	...	1	1		..		..	...
Aged					156	212	91	180	102	149	77	173	41	66	15	25	7	4	1	1	..	
Asthma	17	13	20	24	26	25	7	12	2	3	1	2	1	..		...	...	..	..	...	..	1
Bowel Complaints	1	4	11	13	6	11	1	4	2	2											4	4
Catarrh		3	1	1	2	1	...	1		...											...	...
Childbirth		11																			...	...
Croup		...																			..	
Decline	148	124	131	118																	8	6
Dropsy	27	47	26	28	29	32	13	17	7	11	3	3									..	1
Fever	91	93	55	55	38	53	11	4	2	1			1									
Head, of	29	29	52	44	44	50	17	24	15	12	6	3	1	1							1	3
Heart, of	16	12	15	11	8	12	5	1														
Hooping-cough		...	...																			3
Inflammation	31	33	38	28	24	19	5	10		5												5
Measles																						...
Nervous		5	3	3		1		1														...
Scarlet Fever																						...
Small-pox																						1
Miscellaneous	59	61	45	48	42	29	14	13	5	5	3	1		1							5	2
Total ascertained	420	445	444	386	387	438	165	276	138	192	91	185	45	70	15	26	8	4	1	1	18	26
Ditto not ascertained	51	48	15	52	35	46	8	10	6	4	1	5	1		1	1					16	21
Deaths, Males & Females	471	493	459	438	422	484	175	286	144	196	92	190	46	70	16	27	8	4	1	1	34	47

Diseases, &c.	Total. M.	Total. F.	Total of Deaths during the years 1839, 1840 and 1841.	Average annual Deaths during these years.	Proportions: To the total average annual Deaths during these years.	Proportions: To the mean Population of these years.	Proportions: Of Deaths to the mean Population in Edinburgh these three years.	Deaths to the mean Population for the five years ending with 1841, in Glasgow.	Comparative rate of Mortality from each kind of Disease: Excess in Edinburgh	Comparative rate of Mortality from each kind of Disease: Excess in Glasgow.	Diseases, &c.
					1 to every	1 to every	Percent.	Percent.	Percent.	Percent.	
Accidents	156	90	246	82	42·926	1682·756	0·059	0·071	...	0·012	Accidents.
Aged	490	810	1300	433 1/3	8·123	318·429	0·314	0·282	0·032	...	Aged.
Asthma	92	96	188	62 2/3	56·170	2201·904	0·045	0·077	...	0·032	Asthma.
Bowel Complaints	385	309	694	231 1/3	15·216	596·481	0·167	0·370	...	0·203	Bowel Complaints.
Catarrh	18	18	36	12	293·333	11498·833	0·008	0·037	..	0·029	Catarrh.
Childbirth	...	82	82	27 1/3	128·780	5048·268	0·019	0·031	..	0·012	Childbirth.
Croup	72	76	148	49 1/3	71·351	2797·013	0·035	0·062	...	0·027	Croup.
Decline	937	870	1807	602 1/3	5·843	229·086	0·436	0·523		0·087	Decline.
Dropsy	161	223	384	128	27·000	1078·015	0·092	0·099	...	0·007	Dropsy.
Fever	495	480	975	325	10·830	424·572	0·235	0·445		0·210	Fever.
Head, of	480	428	908	302 2/3	11·629	455·900	0·219	0·172	0·047	...	Head, of.
Heart, of	84	69	153	51	69·019	2705·607	0·036	0·020	0·016	..	Heart, of.
Hooping-cough	166	188	354	118	29·830	1169·372	0·085	0·165	.	0·080	Hooping-cough.
Inflammation	402	412	814	271 1/3	12·972	508·547	0·196	0·185	0·011		Inflammation.
Measles	168	144	312	104	33·846	1326·788	0·075	0·198		0·123	Measles.
Nervous	32	33	65	21 2/3	162·461	6368·581	0·015	0·020	.	0·005	Nervous.
Scarlet Fever	111	106	217	72 1/3	48·663	1907·640	0·052	0·096	.	0·044	Scarlet Fever.
Small-pox	124	108	232	77 1/3	45·517	1784·301	0·056	0·144		0·088	Small-pox.
Miscellaneous	321	324	645	215	16·372	641·795	0·156	0·107	0·049		Miscellaneous.
Total ascertained	4694	4866	9560	3186 2/3	1·104	43·301	2·309	3·113	0·084	...	Total ascertained.
Ditto not ascertained	503	497	1000	333 1/3	10·560	413·958	0·241	0·100	0·141		Do. not ascertained.
Deaths, Males & Females	5197	5363	10560	3520	1·000	39·200	2·550	3·214		0·664	Deaths, M. and F.

	Under 1	1 & under 2	2 & under 5	5 & under 10	10 & under 15	15 & under 20	20 & under 30	30 & under 40	40 & under 50	50 & under 60	60 & under 70	70 & under 75	75 & under 80	80 & under 85	85 & under 90	90 & under 95	95 & under 100	100 & upwards	Ages not ascertained	Total	
Total	1745	901	905	542	278	263	887	937	964	897	906	459	340	282	116	43	12	2	81	10560	Grand Total Deaths.
Average annual Deaths these 3 years	581 2/3	300 1/3	301 2/3	180 2/3	92 2/3	87 2/3	295 2/3	312 1/3	321 1/3	299	302	153	113 1/3	94	38 2/3	14 1/3	4	0 2/3	27	3520	Average annual Deaths these three years.
Proportion of above to average annual Deaths is as 1 to	6·051	11·720	11·668	19·483	37·985	40·152	11·905	11·270	10·954	11·772	11·655	23·006	31·058	37·446	91·034	245·581	880·000	5280·000	130·370	1·000	The Proportion which the above bear to the average annual Deaths is as 1 to the foregoing.
To the mean Population as 1 to	237·225	459·442	457·401	763·760	1489·57	1573·984	466·694	441·790	429·417	461·491	456·907	901·869	1217·523	1467·136	3568·603	9626·930	34496·500	206979·000	5110·592	39·200	And to the mean Population as 1 to these.
Per-centage of the Population in Edinburgh	0·421	0·217	0·218	0·130	0·067	0·063	0·214	0·226	0·232	0·216	0·218	0·110	0·082	0·068	0·028	0·010	0·000	0·000	0·019	2·550	Per-centage of the Population in Edinburgh.
Per-centage of the Population in Glasgow	0·599	0·431	0·402	0·184	0·077	0·104	0·264	0·267	0·251	0·194	0·200	0·097	0·063	0·049	0·017	0·006	0·002	0·000	0·000	3·214	Per-centage of the Population in Glasgow.
Excess of Deaths in Edinburgh	..	..	...	...	.	...	...	...	..	0·022	0·018	0·013	0·019	0·019	0·011	0·004	.	.		.	Excess of Deaths at these ages in Edinburgh.
Excess of Deaths in Glasgow	0·178	0·214	0·184	0·054	0·010	0·041	0·050	0·041	0·019	...	..	..	...	...	...	...	0·002	.	.	0·664	Excess of Deaths at these ages in Glasgow.

8, 1839, 1840 and 18ulations showing the
al diseases, bear to th years; with the com-

ive years 264,010

80 & under 85. M.	80 & under 85. F.	85 & under 90. M.	85 & under 90. F.	90 & und 95. M.	arative Mortality ach kind isease. Excess in Edinburgh.	Diseases, &c.
					Percent.	
2	3	...	2	...	...	Accidents.
235	338	78	130	27	0·032	Aged.
6	10	1	2	...	...	Asthma.
1	4	...	...	...	...	Bowel Complaints.
1	2	1	...	...	...	Catarrh.
...	...	...	...	...	...	Childbirth.
...	...	...	...	...	...	Croup.
...	...	...	...	...	...	Decline.
4	7	3	1	1	...	Dropsy.
4	2	...	1	...	...	Fever.
9	6	1	1	...	0·047	Head, of.
1	...	...	...	...	0·016	Heart, of.
...	...	...	...	...	...	Hooping-cough.
...	2	...	...	...	0·011	Inflammation.
...	...	...	...	...	...	Measles.
...	...	...	...	...	...	Nervous.
...	...	...	...	...	...	Scarlet Fever.
...	...	...	...	...	...	Small-pox.
2	2	...	1	2	0·049	Miscellaneous.
265	376	84	138	30	...	Total ascertained.
5	9	3	9	1	0·141	Do.not ascertained.
270	385	87	147	31	...	Deaths, M. and F.

80 & under 85.	85 & under 90.	90 & und 95.	
655	234	91	
131	46⅘	18	
64·784	181·341	466·	verage annual Deaths du-
1015·343	5641·239	14506·	
0·049	0·017	0·	
0·068	0·028	0·	
...	...	...	
0·019	0·011	0·0	

Exhibiting the number of fatal cases of disease that occurred in the City and Suburbs of GLASGOW during the years 1837, 1838, 1839, 1840 and 1841, classified according to 18 periods of life at which they took place; with calculations showing the total average annual number of deaths at each period, and the proportion which these, and the number of deaths from the several diseases, bear to the total average annual number of deaths, and also to the mean population of these years; with the comparative rates of mortality in Glasgow and Edinburgh.

Mean Population of these five years 261,010

Diseases, &c.	Under 1 Year M	F	1 & under 2 M	F	2 & under 5 M	F	5 & under 10 M	F	10 & under 15 M	F	15 & under 20 M	F	20 & under 30 M	F	30 & under 40 M	F	40 & under 50 M	F	50 & under 60 M	F	60 & under 70 M	F	70 & under 75 M	F	75 & under 80 M	F	80 & under 85 M	F	85 & under 90 M	F	90 & under 95 M	F	95 & under 100 M	F	100 & upwards M	F
Accidents	13	7	16	9	17	11	19	33	31	17	60	10	147	30	104	21	109	25	49	30	28	18	11	15	2	1	2	3		2		1				...
Aged	...	...	...	...					...	...	...	...	...		...	...	...		...	...	546	702	378	545	265	389	235	338	78	130	27	54	10	16	5	6
Asthma		1	2		1	4	3	5	1	2	11	7	18	31	13	53	76	112	133	105	115	137	37	35	20	14	6	10	1	2						.
Bowel Complaints	1707	1353	568	482	174	150	41	43	20	15	8	9	22	23	20	33	21	30	45	31	31	34	10	9	2	3	1	4	.	..	...	.	...	...	..	...
Catarrh	32	21	23	18	25	28	10	5	7	6	4	5	12	25	22	32	22	25	22	49	23	35	5	18	8	5	1	2	1	..	...	.	...	...	...	...
Childbirth		...	...		...		...	..	...	...	..	13	...	173	..	187	...	48	...	...	...	...	...	...	...	...	...	...	...	.	...	...	...	...	.	...
Croup	131	107	147	130	131	109	25	21	3	10	...	2	2	2	...		..	2	1	...	.	..	...	..	.	.	...	...		.	...		.	...	..	..
Decline	372	353	352	294	356	324	223	177	154	164	239	268	592	573	471	505	400	406	302	379	...			...	...	...	...	..		..	...			.		..
Dropsy	20	6	24	19	72	49	72	32	30	16	20	15	50	65	57	99	79	122	86	102	89	100	23	30	11	18	4	7	3	1	1		...	1	...	..
Fever	101	57	97	95	160	197	174	170	86	128	210	231	579	479	708	476	619	456	314	259	131	92	22	19	4	5	4	2	..	1	...	2	..	...	...	.
Head, of	287	217	212	185	231	172	101	99	36	20	20	12	45	28	89	39	78	43	81	46	90	45	27	22	23	15	9	6	1	1	...	2	1	.	.	.
Heart, of	9	2	6	11	16	3	12	9	3	8	5	6	17	10	21	12	21	16	26	15	15	11	4	4	2	..	1	...	...		...	...		...	...	
Hooping-cough	368	332	384	365	268	281	67	95	5	9	4	...	1	1	2		...	...		1		...	..	...	...	.	...	.	...	...	...	...	...	.	..	.
Inflammation	273	194	187	137	168	141	91	79	30	36	45	39	111	146	113	118	133	99	77	79	86	43	7	6	3	5	..	2	...	...	...	...	..	.	...	
Measles	265	266	435	416	476	449	135	125	15	13	3	4	1	7	2	2	2		1	2	..	...		..	.	...	...	.	..		.	..	...	...		...
Nervous	49	46	18	14	20	18	5	4	3	4	3	9	4	12	5	6	11	9	8	11	5	10	1	1	.	..	...	...	...		.	...	...	...	...	
Scarlet Fever	87	97	132	135	247	206	144	139	25	27	1	8	6	4	3	5	1	4	2	...	1	...	.	.	.	...	..	...		..	.	.	..	..	.	.
Small-pox	304	265	278	254	265	268	63	58	13	18	11	16	43	25	10	10	2	3		.	.	...	..	...	.	...	...	...	.	...	..		...	...	.	.
Miscellaneous	83	69	48	50	37	42	32	22	23	22	25	16	55	64	74	81	103	118	98	120	97	74	18	16	15	9	2	2	..	1	2	...		..	...	.
Total ascertained	4107	3393	2929	2614	2701	2482	1247	1116	491	515	669	670	1705	1698	1747	1680	1680	1518	1245	1229	1287	1301	543	720	358	467	265	376	84	158	30	59	11	17	5	6
Do. not ascertained	203	208	76	80	59	68	39	28	9	2	24	15	41	43	62	42	64	58	47	40	38	20	15	12	5	5	5	9	3	9	1	1	...	..	...	..
Deaths, Males & Females	4310	3601	3005	2694	2760	2550	1286	1144	500	517	693	685	1746	1741	1809	1722	1744	1576	1292	1269	1325	1321	558	732	363	472	270	385	87	167	31	60	11	17	5	6

Diseases, &c.	Total M.	Total F.	Total Deaths during five years	Average annual Deaths during five years	Proportions: To the total average annual Deaths during five years (1 to every)	Proportions: To the mean Population of five years (1 to every)	Proportions: Of Deaths by these diseases to the mean Population in Glasgow (Percent)	Average Deaths in three years in Edinburgh to the mean Population (Percent)	Comparative rate of Mortality from each kind of Disease: Excess in Glasgow (Percent)	Excess in Edinburgh (Percent)	Diseases, &c.
Accidents	671	276	947	189⅖	11·808	1393·928	0·071	0·059	0·012	...	Accidents.
Aged	1544	2180	3721	744⅕	11·394	354·470	0·282	0·314	...	0·032	Aged.
Asthma	500	518	1018	203⅗	41·653	1296·709	0·077	0·045	0·032	...	Asthma.
Bowel Complaints	2670	2219	4889	977⅘	8·679	270·001	0·370	0·167	0·203	...	Bowel Complaints.
Catarrh	217	274	491	98⅕	86·123	2688·492	0·037	0·008	0·029	...	Catarrh.
Childbirth	...	421	421	84⅕	100·793	3135·510	0·031	0·019	0·012	...	Childbirth.
Croup	443	383	826	165⅕	51·372	1598·123	0·062	0·035	0·027	...	Croup.
Decline	3474	3443	6917	1383⅖	6·134	190·841	0·523	0·436	0·087	.	Decline.
Dropsy	644	673	1317	263⅖	32·220	1002·315	0·099	0·092	0·007	...	Dropsy.
Fever	3212	2669	5881	1176⅕	7·215	224·459	0·445	0·235	0·210	...	Fever.
Head, of	1331	952	2283	456⅗	18·586	578·208	0·172	0·219	...	0·047	Head, of.
Heart, of	158	107	265	53	160·128	4981·320	0·020	0·036	...	0·016	Heart, of.
Hooping-cough	1099	1084	2183	436⅗	19·438	604·695	0·165	0·085	0·080	...	Hooping-cough.
Inflammation	1324	1121	2445	489	17·331	539·236	0·185	0·196	...	0·011	Inflammation.
Measles	1335	1284	2619	523⅘	16·202	504·028	0·198	0·075	0·123	...	Measles.
Nervous	132	144	276	55⅕	153·746	1782·789	0·020	0·015	0·005	...	Nervous.
Scarlet Fever	649	625	1274	254⅘	33·307	1036·145	0·096	0·052	0·044	...	Scarlet Fever.
Small-pox	989	917	1906	381⅕	22·263	692·576	0·144	0·056	0·088	...	Small-pox.
Miscellaneous	712	706	1418	283⅗	29·925	930·923	0·107	0·156	...	0·049	Miscellaneous.
Total ascertained	21,104	19,999	41,103	8220⅗	1·032	32·115	3·149	2·309	0·804		Total ascertained.
Do. not ascertained	691	640	1331	266⅕	31·881	991·773	0·100	0·241	...	0·141	Do. not ascertained.
Deaths, Males & Females	21,795	20,639	42,434	8486⅘	1·000	31·108	3·214	2·550	0·664	..	Deaths, M. and F.

	Under 1 Year	1 & under 2	2 & under 5	5 & under 10	10 & under 15	15 & under 20	20 & under 30	30 & under 40	40 & under 50	50 & under 60	60 & under 70	70 & under 75	75 & under 80	80 & under 85	85 & under 90	90 & under 95	95 & under 100	100 & upwards	Total	
Total	7911	5699	5310	2430	1017	1378	3487	3531	3320	2561	2646	1290	835	655	234	91	28	11	42,434	Grand Total Deaths.
Average annual Deaths these 5 years	1582⅕	1139⅘	1062	486	203⅖	275⅗	697⅖	706⅕	664	512⅕	529⅕	258	167	131	46⅘	18⅕	5⅗	2⅕	8486⅘	Average annual Deaths these five years.
Proportion of these to average annual Deaths is as 1 to	5·363	7·445	7·991	17·462	41·724	30·793	12·169	12·017	12·781	16·569	16·034	32·894	50·819	64·781	181·311	466·307	1515·500	3857·636	1·000	The proportion which the above bear to the total average annual Deaths during these years is as 1 to the foregoing.
To the mean Population as 1 to	166·862	231·628	248·596	543·230	1297·984	957·946	378·563	373·845	397·605	515·143	498·885	1023·294	1580·898	1015·343	5641·239	14506·143	47144·642	120004·545	31·108	And to the Population as 1 to these.
Per-centage of the Population in Glasgow	0·599	0·431	0·402	0·184	0·077	0·104	0·264	0·267	0·251	0·194	0·200	0·097	0·063	0·049	0·017	0·006	0·002	0·000	3·214	Per-centage of the Population in Glasgow.
Per-centage of the Population in Edinburgh	0·421	0·217	0·218	0·130	0·067	0·063	0·214	0·226	0·232	0·216	0·218	0·110	0·082	0·068	0·028	0·010	0·000	0·000	2·550	Per-centage of the Population in Edinburgh.
Excess of Deaths in Edinburgh	0·178	0·214	0·184	0·054	0·010	0·041	0·050	0·041	0·019	...	...	...	...	...	...	...	0·002	...	0·664	Excess of Deaths at these ages in Glasgow.
Excess of Deaths in Glasgow	..	...	...	...	...	...	...	...	...	0·022	0·018	0·013	0·019	0·019	0·011	0·004	...	...	...	Excess of Deaths at these ages in Edinburgh.

1841, classifi
e several dis

90 & under 95.		
M.	F.	M
...	...	..
4	10	3
...	...	..
...	...	..
...	...	...
...	...	...
...	...	..
...	...	..
...	...	..
...	...	..
...	...	...
...	...	..
...	...	..
...	...	..
...	...	..
...	...	...
...	...	...
...	...	...
...	...	...
4	10	3
10	20	1
14	30	4
44		
$8\frac{4}{5}$		[illegible]
144·772		[illegible]
7200·681		[illegible]
0·013		
0·010		
0·003		
...		

Exhibiting the number of fatal cases of disease that occurred in the City of ABERDEEN and Suburbs during the years 1837, 1838, 1839, 1840 and 1841, classified according to 18 periods of life at which they took place; with calculations showing the total average annual number of deaths at each period, and the proportion which these, and the number of deaths from the several diseases, bear to the total average annual number of deaths, and also to the mean population of these years; with the comparative rates of mortality in Aberdeen and Edinburgh.

Mean Population of these five years 63,366.

Diseases, &c.	Under 1 Year. M	F	1 & under 2. M	F	2 & under 5. M	F	5 & under 10. M	F	10 & under 15. M	F	15 & under 20. M	F	20 & under 30. M	F	30 & under 40. M	F	40 & under 50. M	F	50 & under 60. M	F	60 & under 70. M	F	70 & under 75. M	F	75 & under 80. M	F	80 & under 85. M	F	85 & under 90. M	F	90 & under 95. M	F	95 & under 100. M	F	100 & upwards. M	F	Total. M	F	Ages and Sexes not ascertained.	Total deaths during five years in Aberdeen.	Average annual number of deaths during five years.	Proportion of the total cases of disease to the total number of those ascertained.	Diseases, &c.
																																										1 to every	
Accidents	...	...	2		6	7	3	5	6	..	5	...	6	..	5	2	6	4	6	2	2	2	1	...	1	...	..	1		...	...	...	...	...	...	...	49	23	...	72	14 2/5	29·958	Accidents.
Aged																					34	55	37	61	25	44	28	51	15	34	4	10	3	3	...	...	146	258	...	404	80 4/5	5·339	Aged.
Asthma											3	...	2	1	5	5	3	6	8	7	13	11					1								...	...	35	33	...	68	13 3/5	31·720	Asthma
Bowel Complaints	25	21	15	22	8	6	1		1	...		1	..	1	...	1		1	1	..	5	3		1			1	...							...	...	57	57	...	114	22 4/5	18·921	Bowel Complaints.
Catarrh	3		1		2	2	...	1						2			2	5	3	2	2	4	1	1				1							...	...	14	18	...	32	6 2/5	67·406	Catarrh.
Childbirth	...													3		13	...	1																	...	...	...	17	...	17	3 2/5	126·882	Childbirth.
Croup	4	...	3	1	4	2					1																								...	...	12	3	...	15	3	143·800	Croup.
Decline	5	1	...	2	4	2	8	7	10	8	17	17	30	29	26	28	22	19	10	14															...	...	132	127	..	259	51 4/5	8·328	Decline.
Dropsy	2	3	4	1	4	4	1	4			2	2	5	2	6	2	5	3	1	7	6	5		2											...	...	36	35	...	71	14 1/5	30·380	Dropsy.
Fever	5	2		4	6	14	12	5	7	5	12	7	31	31	33	21	32	24	19	14	12	7	1	2	1										...	...	171	136	...	307	61 2/5	7·026	Fever.
Head, of	10	12	7	2	10	17	9	10	1	2	1		4	4	3	4	6	2	7	9	11	3	2	..		1	2	...	...						...	...	73	66	...	139	27 4/5	15·517	Head, of.
Heart, of	1	3			1		1						1				2	1				1													...	...	6	5	...	11	2 1/5	196·090	Heart, of.
Hooping-cough	8	6	6	5	2	7	1	2	1	...																									...	...	18	20	...	38	7 3/5	56·763	Hooping-cough.
Inflammation	9	7	..	1	9	1	5	6	10	.	5	2	12	7	9	8	16	8	11	6	11	5	2	2											...	...	99	53	...	152	30 2/5	14·190	Inflammation.
Measles	4	3	6	5	13	11	2	4					..	1	...	2																			...	...	25	26	...	51	10 1/5	42·294	Measles.
Nervous	37	42	2	2														1			1														...	...	40	45	...	85	17	25·376	Nervous.
Scarlet Fever	1	3	5	1	17	12	10	7	1	1	5	1	...	...	2	1																			...	...	41	26	...	67	13 2/5	32·194	Scarlet Fever.
Small-pox	6	7	4	6	6	1	4	2	1	.	5	2	3	3	2	1	2																		...	...	33	22	...	55	11	39·218	Small-pox.
Miscellaneous	9	3	8	12	8	8	2	3	2	2	4	3	8	5	12	10	11	16	19	16	17	15	2	1											...	..	106	94	...	200	40	10·785	Miscellaneous.
Total ascertained	129	113	63	64	100	94	59	56	40	18	60	35	102	89	103	98	110	91	85	77	114	114	46	70	27	15	33	53	15	34	4	10	3	3	...	...	1093	1064	...	2157	431 2/5	1·000	Total ascertained.
Do. not ascertained	295	244	180	156	231	204	159	141	72	61	75	100	145	175	159	170	152	159	179	157	177	195	89	117	63	88	62	88	28	49	10	20	1	9	1	1	2079	2134	1	4214	842 4/5		Do. not ascertained.
Deaths, Males & Females	424	357	243	220	331	298	218	197	112	79	135	135	248	264	262	268	262	250	264	234	291	309	135	187	90	133	95	141	43	83	14	30	4	12	1	1	3172	3198	1	6371	1274 1/5		Deaths, M. and F.

	Under 1 Year	1 & under 2	2 & under 5	5 & under 10	10 & under 15	15 & under 20	20 & under 30	30 & under 40	40 & under 50	50 & under 60	60 & under 70	70 & under 75	75 & under 80	80 & under 85	85 & under 90	90 & under 95	95 & under 100	100 & upwards	Total	
Total	781	463	629	415	191	270	512	530	512	498	600	322	223	236	126	44	16	2	6371	Grand Total Deaths.
Average annual Deaths these 5 years	156 1/5	92 3/5	125 4/5	83	38 1/5	54	102 2/5	106	102 2/5	99 3/5	120	64 2/5	44 3/5	47 1/5	25 1/5	8 4/5	3 1/5	0 2/5	1274 1/5	Average annual Deaths these five years.
Propor. of above to aver. an. Deaths is as 1 to	8·156	13·758	10·127	15·349	33·351	23·592	12·440	12·018	12·440	12·791	10·616	19·782	28·565	26·991	50·555	144·772	398·125	3185·000	1·000	The proportion which the above bear to the total average annual Deaths during these years is as 1 to the foregoing.
To the mean population is as 1 to	405·673	684·298	503·701	763·145	1658·795	1173·448	618·808	597·792	618·808	636·204	528·050	983·944	1420·762	1342·500	2514·523	7200·681	19801·875	158415·000	49·737	And to the population as 1 to these.
Per-centage of the Population in Aberdeen	0·246	0·146	0·198	0·130	0·060	0·085	0·161	0·167	0·161	0·157	0·189	0·101	0·070	0·074	0·039	0·013	0·005	0·000	2·010	Per-centage of the whole Population in Aberdeen.
Per-centage of the Population in Edinburgh	0·421	0·217	0·218	0·130	0·067	0·063	0·214	0·226	0·232	0·216	0·218	0·110	0·082	0·068	0·028	0·010	0·000	0·000	2·550	Per-centage of the whole Population in Edinburgh.
Excess of deaths in Aberdeen	...	...	.	...	..	0·022	..	...	...	...	..	...	...	0·006	0·011	0·003	0·005	...	...	Excess of Deaths at these ages in Aberdeen.
Excess of deaths in Edinburgh	0·175	0·071	0·020		0·007		0·053	0·059	0·071	0·059	0·029	0·009	0·012				..	...	0·540	Excess of Deaths at these ages in Edinburgh

rs 1
eath

90
nd und
95.

Ac
Ag 1
As
Bo
Ca
Ch
Cr
De
Dr
Fe
He
He
Ho
Inf
Me
Ne
Sca
Sm
Mi

To 1
Do

De 1

Av 14
th 2 4/5
Pro
a 83·2
To
ti 37·5
Per
p 0·0
Per
p 0·0

Exc
P 0·0
Exc
E ...

PERTH.

TABLE LIII.

Exhibiting the number of fatal cases of disease that occurred in the City of PERTH (exclusive of the Suburban parish of Kinnoul) during the years 1837, 1838, 1839, 1840 and 1841, classified according to 18 periods of life at which they took place; with calculations showing the total average annual number of deaths at each period, and the proportion which these, and the number of deaths from the several diseases, bear to the total average annual number of deaths, and also to the mean population of these years; with the comparative rates of mortality in Perth and Edinburgh.

Mean Population of these five years 19,435.

Diseases, &c.	Under 1 Year.		1 and under 2		2 and under 5.		5 and under 10		10 and under 15.		15 and under 20.		20 and under 30.		30 and under 40.	
	M	F	M	F.	M.	F	M	F	M	F.	M	F	M	F	M	F
Accidents	1	1	1		3	2	2	6	1	1	6	...	11	1	7	1
Aged																..
Asthma			...	..							1		1	1	2	5
Bowel Complaints	14	37	26	25	3	3	1	1			1	1	1		2	2
Catarrh	2	4	...		2	2	1	1	1	1	1	...	2	3		1
Childbirth	..		...	...	..	...	.	...	..	...	...	.		7		7
Croup	8	5	7	5	11	13	4	2	1	..	.		...			...
Decline	7	12	4	4	12	5	8	5	7	9	15	16	36	36	22	26
Dropsy		1	1		1		2	...			2		5	5	3	4
Fever	1	3	7	2	6	11	7	6	6	2	3	5	12	13	17	15
Head, of	3	6	9	8	13	13	8	3	1	2	1		4	6	10	6
Heart, of			.	...	...	...		...	..	2	1	...	3	1		3
Hooping-cough	10	19	17	14	15	16		...			.		..			
Inflammation	8	13	5	6	6	6	2	2	4	2	4	2	9	1	5	7
Measles	7	15	19	12	16	14	3	2	1	...		1	..			...
Nervous	37	46	5	1	6	3	2	3	1	1	...	...	.		1	
Scarlet Fever	1	5	4	4	14	15	10	9	2	3		...	...			
Small-pox	7	6	1	5	16	8	1	...	...	1			2	1	1	...
Miscellaneous	4	3	...	1	.	...	...	1	3	1	2		2	6	6	6
Total ascertained	140	176	106	87	124	111	51	41	28	25	37	25	88	84	76	83
Do. not ascertained	11	12	..	1	2	1	1	1			...	2	2		2	6
Deaths, M. and F.	151	188	106	88	126	112	52	42	28	25	37	27	90	84	78	89

Diseases, &c.	40 and under 50		50 and under 60.		60 and under 70.		70 and under 75.		75 and under 80.		80 and under 85.		85 and under 90.		90 and under 95.		95 and under 100.		100 and upwards	
	M	F	M	F.	M.	F	M	F	M	F.	M.	F.	M	F.	M	F.	M	F	M	F
Accidents	9	2	3	...		2	1		2	2	...	...	..	...	..	...	...	...	...	.
Aged			.	.	47	57	51	77	44	55	52	83	16	28	2	12	2	1		
Asthma	3	9	15	12	18	27	7	10	3	4	...	..	.							
Bowel Complaints		5	2	2	4	3	1	1		1	1	...	.			..	...		..	
Catarrh	2	5	5	2	6	9	3	8	2	2	1	1	...	...	...	...	...	.	...	..
Childbirth	...	1	..	.	..	...	...	...	...	...	...	...	...	...	.	...	.	..	...	...
Croup		.	.	...	.	.	. .	.	...	...	...	...	...	...	.	...	.		...	...
Decline	22	22	21	30	..			...	...											..
Dropsy	9	7	10	13	8	6	3	3	4		..	2	...					...		...
Fever	17	16	6	15	9	5	1	2	2	1	1		...	..		...		...	...	...
Head, of	16	7	14	16	18	21	10	5	1	3	2	...	1	. .	.	...	...	...	.	.
Heart, of		1	5	1	1	...	2	2	2	...	...	...	...	...	..	...	. .	...	...	...
Hooping-cough	...	.					...			...	..							.		...
Inflammation	9	8	8	5	9	4	2	2	1	1	2				.	...		..		
Measles	..	...	...	...	...	...	...	...	..	...	...	.	...	...	.	...	.	...	...	...
Nervous	. .	1	2	2	...	...	...	..	...	...	...	...	...	...	. .	...	. .	...	. .	...
Scarlet Fever		...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	. .	.
Small-pox				...	.	...	...		. .	...	. .	..	...	...	...	...	.	...	.	.
Miscellaneous	8	7	11	9	10	12	6	4	5	1	1	1	1		.	...	.		.	.
Total ascertained	95	91	103	108	130	146	87	114	66	70	60	87	18	28	2	12	2	1	.	.
Do. not ascertained	8	2	2	3	3	2	1	1	..	1										
Deaths, M. and F.	103	93	105	111	133	148	88	115	66	71	60	87	18	28	2	12	2	1		

Total. M.	Total. F	Total Deaths.	Average annual Deaths during five years.	Proportions: To the total average annual Deaths during five years.	Proportions: To the mean Population of five years.	Proportions: Of Deaths to the mean Population in Perth for five years	Deaths to the mean Population of Edinburgh for five years	Comparative rate of Mortality from each kind of Disease: Excess in Perth.	Comparative rate of Mortality from each kind of Disease: Excess in Edinburgh.	Diseases, &c.
				1 to every	1 to every	Percent.	Percent.	Percent	Percent	
47	18	65	13	39·476	1494 230	0 066	0·059	0·007	...	Accidents.
214	313	527	105⅖	4 869	184·297	0·542	0·314	0·228	. .	Aged.
51	68	119	23⅘	21·563	816·176	0·122	0 045	0·077	...	Asthma.
86	81	167	33⅖	15 365	581·586	0·171	0·167	0·004	. .	Bowel Complaints.
28	39	67	13⅖	38·298	1449·626	0·068	0·008	0·060	...	Catarrh.
. .	15	15	3	171·066	6475·000	0 015	0·019	...	0·004	Childbirth.
31	25	56	11⅕	45·821	1734·375	0·057	0·035	0·022	...	Croup.
154	165	319	63⅘	8·043	304·467	0 328	0·436	...	0·108	Decline.
48	41	89	17⅘	28 831	1091·292	0·091	0·092	...	0·001	Dropsy.
95	96	191	38⅕	13 434	508·507	0·196	0 235	...	0·039	Fever.
111	96	207	41⅖	12·396	469·202	0·213	0·219	...	0·006	Head, of.
14	10	24	4⅘	106·916	4046·875	0·024	0·036	...	0·012	Heart, of.
42	49	91	18⅕	28 197	1067 307	0·093	0·085	0·008	...	Hooping-cough.
74	62	136	27⅕	18 867	714·154	0·139	0 196		0·056	Inflammation.
46	44	90	18	28·511	1079·166	0 092	0·075	0·022	...	Measles.
54	57	111	22⅕	23·117	875·000	0·114	0·015	0·099	...	Nervous.
31	37	68	13⅗	37·735	1428 308	0·070	0·052	0·018	...	Scarlet Fever.
28	21	49	9⅘	52 567	1982 142	0 050	0·056	...	0·006	Small-pox.
59	52	111	22⅕	23·117	875·000	0·114	0·156	...	0·042	Miscellaneous.
1213	1289	2502	500⅖	1·025	38·818	2·576	2·309	0·267	...	Total ascertained.
32	32	64	12⅘	40·093	1517·578	0·065	0·241		0·176	Do. not ascertained.
1245	1321	2566	513	1·000	37·850	2·641	2·550	0·091	. .	Deaths, M. and F

	Under 1 Year	1 and under 2	2 and under 5	5 and under 10	10 and under 15	15 and under 20	20 and under 30	30 and under 40	40 and under 50	50 and under 60	60 and under 70	70 and under 75	75 and under 80	80 and under 85	85 and under 90	90 and under 95	95 and under 100	100 and upwards	Total	
Total	339	194	238	94	53	64	174	167	196	216	281	203	137	147	46	11	3	..	2566	Grand Total Deaths
Average annual Deaths these 5 years	67⅘	38⅘	47⅗	18⅘	10⅗	12⅘	34⅘	33⅖	39⅕	43⅕	56⅕	40⅗	27⅖	29⅖	9⅕	2⅕	0⅗	...	513⅕	Average annual Deaths these five years.
Proportion of above to aver. ann. Deaths as 1 to	7·569	13·226	10·781	27·297	48·415	40·093	14·747	15·365	13·091	11·879	9·131	12·640	18·729	17·455	55·782	183·285	855·333	...	1·000	The proportion which the above bear to the total average annual Deaths during these years is as 1 to the foregoing.
To the mean Population as 1 to	286·504	500·614	408·088	1033·244	1832·547	1517·578	558·189	581·586	495·535	449·652	345·640	478·448	708·941	660·714	2111·413	6937·500	32375·000	..	37·850	And to the Population as 1 to these.
Per-centage of the Population in Perth	0·349	0·199	0·245	0·096	0·054	0·065	0·179	0·171	0·201	0·222	0·289	0·209	0·141	0·151	0·047	0·014	0·003	...	2·641	Per-centage of the whole Population in Perth.
Per-centage of the Population in Edinburgh	0·421	0·217	0·218	0·130	0·067	0·063	0·211	0·226	0·232	0·216	0·218	0·110	0·082	0·068	0.028	0·010	0·000	...	2·550	Per-centage of the whole Population in Edinburgh.
Excess of Deaths in Perth	.	...	0·027	..	...	0·002	..		...	0·006	0·071	0·099	0·059	0·083	0·019	0·004	0·003	.	0·091	Excess of Deaths at these ages in Perth.
Excess of Deaths in Edinburgh	0·072	0·018	.	0·034	0·013	...	0·035	0·055	0·031				...	...	..	..		...	..	Excess of Deaths at these ages in Edinburgh.

Exh ig
nn

D an	M
Acciden	..
Aged ..	4
Asthma	..
Bowel (	..
Catarrh	..
Childbi	..
Croup .	..
Decline	..
Dropsy	..
Fever .	..
Head, c	..
Heart, (	..
Hoopin	..
Inflamn	..
Measles	..
Nervou	..
Scarlet	..
Small-p	..
Miscell	..
Total as	..
Do. not	..
Deaths	..
T	
Averag these	
Propor. ann. I	
To the tion a	1
Per-cen pulati	
Per-cen pulati	
Excess Dund	
Excess Edinb	

DUNDEE.

TABLE LIV.

Exhibiting the number of fatal cases of disease that occurred in the Town of DUNDEE during the years 1839, 1840 and 1841, classified according to 18 periods of life at which they took place; with calculations showing the total average annual number of deaths at each period, and the proportion which these, and the number of deaths from the several diseases, bear to the total average annual number of deaths, and also to the mean population of these years; with the comparative rates of mortality in Dundee and Edinburgh.

Mean Population of these three years 59,691.

Diseases, &c.	Under 1 year M.	Under 1 year F.	1 and under 2 M.	1 and under 2 F.	2 and under 5 M.	2 and under 5 F.	5 and under 10 M.	5 and under 10 F.	10 and under 15 M.	10 and under 15 F.	15 and under 20 M.	15 and under 20 F.	20 and under 30 M.	20 and under 30 F.	30 and under 40 M.	30 and under 40 F.
Accidents	...	...	2	1	6	3	5	4	3	1	9	1	11	3	8	...
Aged	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...
Asthma	...	...	...	...	...	...	1	1	...	...	...	1	1	5	6	5
Bowel Complaints	150	103	49	65	17	13	1	5	2	2	...	2	4	3	2	7
Catarrh	6	2		1	4	1	...	...	...	...	1	...	1	1		2
Childbirth	...	...	...		...	...	...	...	...		...	2		12		16
Croup	4	13	4	13	13	14	1	3	...	...	..	...	...	..		
Decline	29	31	22	9	25	16	15	14	14	16	17	13	54	55	36	44
Dropsy	3	1	2	...	10	10	4	9	5	7	2	2	6	4	5	13
Fever	8	13	6	8	17	19	21	11	8	11	8	10	21	26	33	30
Head, of	31	13	9	11	23	21	9	15	5	2	2	2	6	4	8	10
Heart, of	4	2		..	...	...	...	2	2	2	...	1	4	4	3	
Hooping-cough	42	33	34	33	23	45	6	6	...		..	..	...	..		
Inflammation	45	27	19	15	11	15	8	4	3	4	7	3	13	11	6	9
Measles	28	28	54	62	51	64	14	14	2	...	...	1	...	..	..	..
Nervous	23	27	3	4	1	1	2	2	1	1	..	1	...	...		1
Scarlet Fever	6	9	20	12	47	49	28	17	5	8	4	1	2	...	1	2
Small-pox	40	52	28	26	33	35	10	10	2	1	...	1	4	3	1	4
Miscellaneous	20	17	4	3	4	7	6	3	8	2	1	2	10	8	18	11
Total ascertained	439	371	256	263	285	513	131	120	60	57	51	43	137	139	127	154
Do not ascertained	56	42	..	...	.	...	...	1	..	...	...	...	1	2	3	3
Deaths, Males & Females	495	413	256	263	285	313	1	121	60	57	51	43	138	141	130	157

Diseases, &c.	40 and under 50 M.	40 and under 50 F.	50 and under 60 M.	50 and under 60 F.	60 and under 70 M.	60 and under 70 F.	70 and under 75 M.	70 and under 75 F.	75 and under 80 M.	75 and under 80 F.	80 and under 85 M.	80 and under 85 F.	85 and under 90 M.	85 and under 90 F.	90 and under 95 M.	90 and under 95 F.	95 and under 100 M.	95 and under 100 F.	100 and upwards M.	100 and upwards F.
Accidents	14	5	7	..	5	2	5	1	1	1	1	1	...	...	...	1	...	1	...	...
Aged	...	...	...	...	44	73	42	69	26	38	29	38	5	15	4	10	...	2	1	1
Asthma	19	13	17	21	26	18	6	8	1	...	1	...	...	...	...	...	...	...	...	...
Bowel Complaints	2	4	6	5	5	8	6	4	3	2	..	1						...	..	...
Catarrh	1	2	7	6	6	5		2	...	..	1				...		.	...	...	...
Childbirth		4								...		...						...	...	...
Croup				...	1							...			...	...	...	...	...	...
Decline	44	37	14	32	...	...	...	...	...	...	...	...	...	...	.	..	...	...	...	...
Dropsy	8	15	14	23	8	16	3	7	4	1	...	2	...	...	...	...	...	...	...	...
Fever	25	26	15	14	8	12	6	3	2	2	...	..	..	1	...	...	...	...	...	...
Head, of	15	10	12	10	12	13	6	10	5	1	1	...	..	1	..	...	...	...	...	...
Heart, of	5	2	2	2	2	2		1	...					...				...	...	..
Hooping-cough						...										..		...	...	..
Inflammation	13	8	11	7	6	7	3	2				..		.		...		...	...	...
Measles		...		...	...	...							.		...	...		...	...	...
Nervous		1		...	1							..	...		.			...	..	...
Scarlet Fever	...	2	..	2	...	...	1	..	...	..	...	..	.	...	...	...	...	...	...	...
Small-pox	1	...	..	...	...	...	...	...	.	.	...	...	...	...	...	...	...	...	...	...
Miscellaneous	6	16	11	18	11	12	6	4	3	2		...			...	.		...	..	...
Total ascertained	153	145	116	140	138	168	84	111	45	47	33	42	5	17	4	11	...	3	1	1
Do not ascertained	1	1	1	1	3	...	...		.		..						...	...	...	...
Deaths, Males & Females	154	146	117	141	141	168	84	111	15	17	33	42	5	17	4	11	...	3	1	1

Diseases, &c.	Total M.	Total F.	Total Deaths during three years	Average annual Deaths during three years	Proportions: To the total average annual Deaths during three years, 1 to every	Proportions: To the mean Population of three years, 1 to every	Of Deaths by these diseases to the mean Population in Dundee, Percent.	Deaths to the mean Population of Edinburgh these three years, Percent.	Comparative rate of Mortality from each kind of Disease: Excess in Dundee, Percent.	Excess in Edinburgh, Percent.	Diseases, &c.
Accidents	77	25	102	34	42·421	1755·617	0·056	0·059	...	0·003	Accidents.
Aged	151	246	397	132⅓	10·894	451·065	0·221	0·314	...	0·093	Aged.
Asthma	78	72	150	50	28·833	1193·820	0·083	0·045	0·038	...	Asthma.
Bowel Complaints	247	224	471	157	9·182	380·197	0·263	0·167	0·096	...	Bowel Complaints.
Catarrh	27	22	49	16⅓	88·265	3654·551	0·027	0·008	0·019	...	Catarrh.
Childbirth	...	34	34	11⅓	127·205	5266·852	0·018	0·019	...	0·001	Childbirth.
Croup	23	43	66	22	65·530	2713·227	0·036	0·035	0·001	...	Croup.
Decline	270	267	537	179	8·054	333·469	0·299	0·436	...	0·137	Decline.
Dropsy	74	110	184	61⅓	23·505	973·222	0·102	0·092	0·010	...	Dropsy.
Fever	178	186	364	121⅓	11·881	491·958	0·203	0·235	...	0·032	Fever.
Head, of	144	123	267	89	16·198	670·685	0·149	0·219	...	0·070	Head, of.
Heart, of	22	18	40	13⅓	108·125	4476·825	0·022	0·036	...	0·014	Heart, of.
Hooping-cough	105	117	222	74	19·481	806·635	0·123	0·085	0·038	...	Hooping-cough.
Inflammation	145	112	257	85⅔	16·828	696·782	0·143	0·196	...	0·053	Inflammation.
Measles	149	169	318	106	13·600	563·122	0·177	0·075	0·102		Measles.
Nervous	31	38	69	23	62·681	2595·260	0·038	0·015	0·023		Nervous.
Scarlet Fever	114	102	216	72	20·023	829·041	0·120	0·052	0·068	...	Scarlet Fever.
Small-pox	119	132	251	83⅔	17·231	713·438	0·140	0·056	0·084	...	Small-pox.
Miscellaneous	111	105	216	72	20·023	829·041	0·120	0·156	...	0·036	Miscellaneous.
Total ascertained	2065	2145	4210	1403⅓	1·027	42·535	2·350	2·309	0·041	..	Total ascertained.
Do not ascertained	65	50	115	38⅓	37·608	1557·146	0·064	0·241	...	0·177	Do. not ascertained.
Deaths, Males & Females	2130	2195	4325	1441⅔	1·000	41·404	2·415	2·550	...	0·135	Deaths, M. and F.

	Under 1	1–2	2–5	5–10	10–15	15–20	20–30	30–40	40–50	50–60	60–70	70–75	75–80	80–85	85–90	90–95	95–100	100 and upwards	Total	
Total	908	519	598	252	117	94	279	287	300	258	309	195	92	75	22	15	3	2	4325	Grand Total Deaths.
Average annual Deaths these 3 years	302⅔	173	199⅓	84	39	31⅓	93	95⅔	100	86	103	65	30⅔	25	7⅓	5	1	0⅔	1441⅔	Average annual Deaths these three years.
Propor. of above to aver. ann. Deaths is as 1 to	4·763	8·333	7·232	17·162	36·965	46·010	15·483	15·069	14·416	16·763	13·996	22·179	47·010	56·333	192·045	288·333	1441·666	2162·500	1·000	The proportion which the above bear to the total average annual Deaths during these years is as 1 to the foregoing.
To the mean Population as 1 to	197·216	345·034	299·453	710·607	1530·538	1905·031	641·838	623·917	596·910	694·081	579·524	918·323	1946·145	2387·640	8139·681	11938·200	59691·000	89536·500	41·404	And to the mean Population as 1 to these.
Per-centage of the Population in Dundee	0·507	0·289	0·333	0·140	0·065	0·052	0·155	0·160	0·167	0·144	0·172	0·108	0·051	0·041	0·012	0·008	0·001	0·000	2·415	Per-centage of the whole Population in Dundee.
Per-centage of the Population in Edinburgh	0·421	0·217	0·218	0·130	0·067	0·063	0·214	0·226	0·232	0·216	0·218	0·110	0·082	0·068	0·028	0·010	0·000	0·000	2·550	Per-centage of the whole Population in Edinburgh.
Excess of Deaths in Dundee	0·086	0·072	0·115	0·010	...	...	...	...	...	...	...	...	...	...	...	..	0·001	...	...	Excess of Deaths at these ages in Dundee.
Excess of Deaths in Edinburgh	...	...	...	...	0·002	0·011	0·059	0·066	0·065	0·072	0·046	0·002	0·031	0·027	0·016	0·002	...	...	0·135	Excess of Deaths at these ages in Edinburgh.

PROVISIONAL REPORTS, AND NOTICES OF PROGRESS IN SPECIAL RESEARCHES ENTRUSTED TO COMMITTEES AND INDIVIDUALS.

Report of the Committee for the Reduction of Lacaille's Stars.

Collingwood, June 3, 1842.

A COMMITTEE having been appointed, consisting of myself, Mr. Henderson, and Mr. Airy, for the purpose of effecting the reduction of Lacaille's stars, I have the pleasure to report, that under the superintendence of Mr. Henderson, the whole of that work is now completed, and the resulting catalogue, being arranged in order of right ascension, is fairly written out and ready for the press. The total number of stars reduced and catalogued is about 10,000, —the sum of 105*l.* remaining of the original grant unappropriated; which the Committee recommend to be applied (with such additional grant as may be needed) to the printing and publication of the catalogue, without which, it is evident, that little or no benefit can result to Astronomical Science from the work so accomplished. With the catalogue, and forming an introduction to it, an account of the process pursued in the reductions, the constants used, and all other matter needful for a complete understanding of the work, ought also to be printed, and should it be the pleasure of the Association to order the publication, will be furnished by Mr. Henderson. The estimated cost of the publication so recommended, may be roughly stated at about 250*l.* for printing, paper, &c. of 500 copies of the catalogue and introduction.

J. F. W. HERSCHEL.

Report of the Committee for the Reduction of the Stars in the Histoire Céleste.

June 16, 1842.

I HAVE the satisfaction of reporting that the whole of the stars in the 'Histoire Céleste' have been reduced, agreeably to the method proposed: those only being omitted for which there are no tables of reduction; and that there is now remaining, of the grant for this purpose, the sum of £9, which will not be required in the further prosecution of this portion of the work. But the main object of this undertaking will be defeated, if the catalogue be not printed for general use and information. The number of stars reduced is upwards of 47,000; and I have caused an estimate to be made of the expense of printing 500 copies in an octavo form. And it appears that the cost of paper and printing will be about £415, but that 1000 copies will cost £100 more. There is, however, another expense which must be taken into the account, which is the copying of the catalogue, in a proper order for the press, and the correction of the press during the printing, which I apprehend will be £60 or £70 more. Taking the whole of those estimates together, it would appear that 500 copies would cost about £500, and that 1000 copies would cost about £600. Should the British Association decide on the printing of the catalogue, I would draw up a statement of the method pursued in making the reductions, together with such other remarks as might be requisite. This probably would not add another sheet to the work.

FRANCIS BAILY.

Report of the Committee on the British Association Catalogue of Stars.

I HAVE the honour to report on the subject of this catalogue, that the calculations of the places of the stars, with the annual precessions, secular variations, and proper motions, together with the logarithms of the requisite constants, are completed for nearly 8300 stars, which is about the number originally contemplated;—that the same are fairly copied out for the press; and that the construction of the table of synonyms is now in progress, two-thirds of which are already completed; that the whole of the sum granted at the last meeting of the Association has been expended, and that a further sum of £25 will be required for the completion of some of the above stars in peculiar positions, and for the final completion of the synonyms; that the above sum of £25 is all that will be wanting in future, as Mr. Farley (the principal computer and superintendent) has undertaken to complete the work, ready for the press, without any further remuneration, and which will be ready for delivery in a few weeks. Under these circumstances, I have caused an estimate to be made of the expense of printing the same: and I find, that the cost of paper and printing 500 copies in quarto, will be about £550, but that 1000 copies will cost £150 more. It will be requisite, however, to employ some one to correct the press, and to superintend the arrangement of the work, which will add to the expense here mentioned. A pretty large preface will be requisite, explanatory of the mode adopted in bringing up the several stars to the given epoch, and of various circumstances connected with the investigation, as well as descriptive of the method of using the catalogue in its present form. But on these points I am willing to render any assistance in my power. FRANCIS BAILY.

On the erection of one of Mr. Osler's Anemometers at Inverness, one of the Stations at which Hourly Observations with the Barometer and Thermometer have been made at the request of the British Association. By Sir DAVID BREWSTER.

OWING to the difficulty of obtaining a suitable place for the erection of the anemometer, the observations did not commence till the 15th of April. The indications of the rain-gauge commenced on the 6th of May, so that a complete series of observations for one year will be laid before the meeting of the Association for 1843. The observations are registered and superintended by Mr. Thomas Mackenzie and the Rev. Mr. Gray, Rector of the Royal Academy of Inverness.

On the Hourly Series of Meteorological Observations made at Inverness during the Meteorological year from the 1st *of November* 1840, *to the* 1st *of November* 1841. *By Sir* DAVID BREWSTER.

THE mean temperature of Inverness for the summer months was $52^{\circ}{\cdot}258$; the mean temperature of the winter months $40^{\circ}{\cdot}287$; and the mean temperature for the whole year $46^{\circ}{\cdot}272$. This mean temperature occurred at $8^{h}\ 33^{m}$ A.M. and $7^{h}\ 42^{m}$, the critical interval being $11^{h}\ 9^{m}$, differing only a few minutes from the result obtained by similar hourly observations made at Leith. The observations made with the barometer, when reduced to the level of the sea, and to the temperature of 60°, indicate very distinctly the daily variation, with its two maxima and minima. The mean annual average of all the observations was 29·680 inches. The monthly mean indicated a *maximum* in December and in June, and a *minimum* in March and in October.

Letter from Dr. LAMONT *of Munich to Col.* SABINE *on the System of Meteorological and Magnetical Observations on the Continent.*

Munich, June 12, 1842.

MY DEAR SIR,—My time has been so entirely taken up with magnetic experiments and the usual business of the observatory, that I am sorry to say I have been unable to draw up the report I intended to lay before the Council of the British Association on the system of meteorological and magnetical observations lately commenced on the Continent. I therefore request you, merely for the present, to mention, that the system in general is the same as that of the "*Societas Pälatina*," instituted at Manheim in 1780. At the most part of our stations only the meteorological instruments are observed; at the principal places magnetic observations are also made three or four times a day. The results are given in the 'Annalen für Meteorologie und Erdmagnetismus,' published by Prof. Grunert of Greifswald, Prof. Koller of Kremsmünster, Prof. Kreil of Prague, Prof. Plieninger of Stuttgard, Prof. Stieffel of Carlsruhe and myself. Prof. Grunert furnishes meteorological and magnetic observations made by himself at Greifswald, and meteorological observations made at five other stations in the North of Prussia. Prof. Kreil and Prof. Koller send observations from Prague (magnetic term days), Kremsmünster (magnetic and meteorological observations), Milan (magnetic observations), Pavia, Venice, Lemberg, Ofen (meteorological observations). Prof. Plieninger has superintended for many years the meteorological observations made in Wurtemberg: the number of stations is eleven. The whole of these observations will now be published in the 'Annalen.' Prof. Stieffel communicates the observations made by himself at Carlsruhe. Besides, he is now arranging meteorological observations at many other places in Baden; twenty-five of these places have been furnished with instruments from the observatory of Munich. The observations in Bavaria are superintended by myself: the system has already been mentioned at the meeting of the Association at Glasgow. A considerable addition has been made of late, the members of the "Pfälzische Gesellschaft" in the Rhine province having joined us with twenty-three stations. Contributions for the 'Annalen' (*regular* series of meteorological or magnetic observations) have been promised by Prof. Kaiser of Leyden, Prof. van Rees of Utrecht, Prof. Wenckebach of Breda, Prof. Moebius of Leipzig, Prof. Reich of Freyburg (Saxony), Prof. Weisse of Cracau, M. Becker of Cronberg (near Frankfurt), M. Voigt of Bensberg (military school near Cologne), M. Littrow of Vienna, Prof. Kottinger of Salzburg, Prof. Gintl of Grätz, M. Valz of Marseilles, M. Colla, Director of the meteorological observatory of Parma. Communications may be expected (though I do not know at present to what extent) from Prof. Fournet at Lyons, M. Amici at Florence, M. Capocci at Naples, M. Keserü, Director of the Observatory of Carlsburg (near the Turkish frontier). In Greece, a magnetic station and several meteorological stations are shortly to be established. A very extensive correspondence is carried on at present, and if the future success is equal to the past, there is reason to expect that in a short time the 'Annalen' will present a regular and systematic meteorological account of the vast tract between the Pyrenees and the Russian frontier. In communicating this to the British Association, I must request you to mention that the undertaking was commenced only seven months ago; at the same time I beg to express my regret that other avocations have prevented me from laying a full report of our proceedings before the Association; I hope, however, I shall be able to do so at the next meeting.

LAMONT.

Report of the Committee for the Reduction of Meteorological Observations.

It was the earnest wish of your Committee to have made their final report on this subject at the present meeting; owing, however, to the severe illness of Mr. Birt, to whom the execution of the reduction and projection of the observations has been intrusted, and his subsequent change of residence, together with the unusually early period of the meeting this year, it must be deferred yet another year. Meanwhile the annexed letter from that gentleman will show the present state of the inquiry and the progress made:—

"Western Literary and Scientific Institution,
47 Leicester Square, June 6, 1842.

"Dear Sir,—I regret exceedingly that I am unable to send you a greater number of the projected curves than those now inclosed, which nearly complete the European series, including the British isles, during the years 1836, 1837 and 1838. The following are the stations omitted:—Greenwich, two sets in 1836; Geneva, June 1837; Turin, March, June, September and December 1837; Kremsmünster, March 1838; Gibraltar, March and June 1837; and Cadiz, for 1837 and March 1838. The Turin curves were omitted in consequence of the reduction of sidereal to mean time not having been accomplished, and the remainder, with the exception of Greenwich, not presenting those marked features of agreement which are so conspicuous in most of the others.

"I have just discovered that the European curves for December 1836 have not been projected, and as the time of the meeting is now so rapidly approaching, I have thought it best to forward those completed without waiting for this sheet, which I will immediately proceed with.

"I have not included the tables which I have been unable to complete, principally in consequence of my illness during the autumn, which, with the loss of strength resulting therefrom, prevented my close attention to them for nearly four months. Had this not have occurred, I have no doubt the whole of the projections and tables would have been completed by this time.

"I inclose in this parcel the American curves formerly sent,—namely, December 1835, and March 1838,—as I considered it probable that you might wish to see the contemporaneous observations on each side of the Atlantic. I have also included South Africa and Asia for June 1836.

"I have had no time on this occasion to look over the sheets previous to sending them to you; in the mere glance I have given them the curves of December 1837 strike me as peculiarly interesting, especially the fall westward and the rise eastward of Brussels.

"Apologizing for the inconvenienee which I feel you will experience in not having had the whole completed,

"I remain, dear Sir,
"Yours very respectfully,
"*Sir John F. W. Herschel, Bart.*" "W. R. Birt."

Your Committee pray the continuance of the grant, on which no further charges have been made this year. J. F. W. Herschel.

In reference to the Report which had been requested from Mr. A. D. Bache of Philadelphia, relative to the meteorology of the United States of America, Col. Sabine made the following statement to the Section. "Our valued corresponding member Mr. Bache has requested me to explain to the Section the causes which have prevented him from completing in time for the present meeting the report which has been just called for. Mr. Bache was requested to prepare this report at the Meeting at Newcastle in 1838, which he personally attended; it was also at that Meeting that the system originated of combined magnetical and meteorological observations which is now in full and successful action, and in which various governments and scientific individuals of all nations participate. In our own and most other countries the expenses of the establishments at which these observations are made have been defrayed from national funds; but in the United States this has not been done; and the task of procuring the necessary funds by private subscription for the magnetic observatory at Philadelphia has been undertaken by Mr. Bache, in addition to that of establishing it and superintending its progress. His exertions in carrying into effect the wishes of the Association on this subject have engrossed the time which he could otherwise have devoted to the preparation of the report on the meteorology of the United States. We may, however, expect that the report will be ready for a future meeting, and I need not say to those who are acquainted with Mr. Bache's qualifications, that whenever presented it cannot fail to form a very valuable contribution to our Transactions." In reference to the progress and present state of the magnetic observatory at Philadelphia, Colonel Sabine read the following communication from Mr. Bache.

"Philadelphia, May 10, 1842.

"My dear Colonel,—As I shall not have the advantage of joining the *magneticians* in June, will you report to Section A. what we have been doing here in concert with them? The bi-hourly observations of declination and horizontal and vertical force have been carried on regularly since their commencement in June 1840, as well as the term-day observations. The meteorological instruments, including the barometer, the dry and wet bulb thermometer, Daniell's hygrometer, the blackened bulb and radiation thermometers, have also been observed at the intervals assigned in the general instructions. Osler's self-registering anemometer and rain-gauge have been kept at work. Saussure's hair hygrometer has been observed for comparison. The meteorological term-days have been kept as well as the magnetic, making two during the month. These observations have been made with instruments and in an observatory belonging to the Girard College of Philadelphia, and have been kept up by voluntary contributions, chiefly from members of the American Philosophical Society, and by funds furnished by the Society.

"We have made some changes in the instruments which we consider improvements. Since January 1841 the vertical-force instrument has been provided with a mirror, and is observed at a distance, like the declination and horizontal-force instruments of Gauss. The only disadvantage which has occurred in this is an increase in the correction for temperature, but the facility and certainty of the observations compensate for this. The arrangement of the force part of the Anemometer has been greatly improved by connecting the plate which receives the action of the wind with slightly-curved brass bars, or springs, placed at the side of the registering table; the action of the instrument is thus rendered much more regular. As we have much snow in the course of a season, it was a problem of some interest to measure its fall by the registering apparatus: this has been effected by raising the temperature of the funnel of the gauge slightly above the freezing point, by vapour from a boiler within the observatory.

"During the first year the observatory was not heated artificially, but the large and uncertain amount of the corrections for temperature induced me to adopt a different course during the past winter, and without any of the bad results which I had apprehended from currents of air. The instruments, however, are the large ones of the German makers. In regard to the correction for temperature of the horizontal-force instrument, I arrived at no satisfactory result by the ordinary method of obtaining it. This winter *an approximation* to the correction has been obtained by allowing the observatory to cool down on Sunday. If we had had a second set of instruments for comparison these results would have been unexceptionable; as it is, the method of vibrating a declinometer bar and of observing a portable vertical-force instrument for comparison, led to no satisfactory result. Had the winter been of its usual severity so as to give us a result every week, this comparison would have been of less consequence.

"Having ascertained by the observations in 1840 and 1841 nearly the hours of maximum and minimum of the magnetic phænomena, I have during the present year caused observations to be made within those limits as frequently as on term-days. As these observations occupy, with moderate intervals, the whole twenty-four hours, I hope to be able to render a better account of disturbances than heretofore. This makes me more than ever anxious to keep up the observatory during the present year. The *regular* bi-hourly observations form a part of this series.

"You have doubtless a report from the observatory at Harvard, and know how zealously they are at work. Mr. Gilliss, of the navy, keeps up his observations of the declination and vertical force at the observatory at Washington city.

"In reference to our knowledge of the magnetic elements in different parts of the United States, the work goes bravely on. Prof. Loomis has contributed within the year a large quota in his observations of dip, chiefly in Ohio, Indiana, Illinois and Missouri. Mr. Nicolet has observed in the same region, and has added a few observations of horizontal intensity to those of the dip. You will see an account of these results in the Proceedings of the American Philosophical Society, and at a later day in their Transactions. Dr. Locke has also made his contribution, which you will find in Silliman's Journal. I completed last summer a systematic survey of Pennsylvania commenced the year before, and hope to be able to calculate the observations during the coming vacation. The observations were for declination, dip, and horizontal intensity at the chief stations, and for dip and total intensity by Lloyd's method, at the subsidiary points. By observations made at the same station with different instruments, it appears that we now have several dipping circles which may be relied on to furnish accordant results, and they are in hands which will not let any opportunity pass of using them. The visit of Lieut. Lefroy will doubtless stimulate us to further exertion by showing an example of activity near.

"The Association have now a great work before them in drawing out of the results at the magnetic and meteorological observatories the interesting laws which they must furnish. Wishing you and your co-labourers all success,

"I remain, very truly yours,

"*Lieut.-Colonel Sabine.*" "A. D. BACHE."

Report of the Committee for the Translation and Publication of Foreign Scientific Memoirs.

SINCE the last meeting of the British Association the Committee have obtained and published in the ninth Number of Taylor's "Foreign Scientific Memoirs," translations of the two following works, viz. *Gauss,* 'General Propositions relating to Attractive and Repulsive Forces, acting in the inverse ratio of the square of the distance;' and *Dove*, 'On the Law of Storms.'—These translations were presented to the Committee by Lieut.-Col. Sabine, and as no illustrations were requisite, it has not been necessary to expend any portion of the grant placed at the disposal of the Committee.

EDWARD SABINE.

On the Mode of conducting Experiments on the Resistance of Air. By EATON HODGKINSON, *F.R.S.*

MR. HODGKINSON said, that, having been honoured by the Association with a request to pursue some experiments on the resistance of the air, he was desirous of exhibiting an instrument prepared for making the first series of those experiments. He proposed, in the first instance, to seek for the force of the wind moving at different velocities upon plane surfaces of given dimensions, these surfaces being either perpendicular, or inclined at any angle, to its current: to determine this, he intended to place the apparatus upon the front of the first carriage of a railway train; the road along which the train passed having for a short distance poles stuck up, 100 or 200 yards asunder. He would try the experiment only on days when there was no perceptive wind: and then, if the time in seconds taken in passing between two poles be carefully observed, and the pressure indicated upon the discs (which were of two and of four feet area, both round and square), the resistance per square foot, with a given velocity, would be obtained. He hoped to determine these facts, with various velocities and at different angles of inclination in the discs; trying the same experiments with both discs at the same time, to ascertain whether the resistance to a square surface and a round one, of equal area, was the same, and that the results might correct each other. The directors of the Manchester and Birmingham Railway had kindly consented, at Mr. Buck's request, to allow him to make these experiments; and he was indebted to Mr. Fairbairn for the apparatus. This was placed on the table. It consists of two discs of wood (which may be of any form), made inclinable at any angle by means of screws, and having an attached quadrant to measure the angle. To ascertain the force of the wind, one of Salter's balance springs is placed behind each disc, attached to the cross piece which connects the two rods of the discs; and this, it was expected, would indicate the force of the wind at any moment. If other apparatus were found necessary it would be applied.

Experimental Inquiries on the Strength of Stones and other Materials. By EATON HODGKINSON, *F.R.S.*

AFTER noticing the present state of knowledge on this subject, and the experiments of Barlow, Rennie, and experimentalists on the continent, Mr. Hodgkinson said, he had long felt anxious to ascertain how the three forces —the crushing, the tensile, and the transverse strength—and the position of the neutral line (that separating the extended and compressed fibres in a bent body)—were connected in bodies generally: and his experiments had for several years been directed to discovering facts upon each of these matters, in order to determine the question. His experiments some years ago, made for the British Association, with respect to the values of hot and cold blast iron, had shown that the ratio of the forces of ultimate tension and compression was nearly constant in all the species of cast iron; and a few experiments made at that time on sandstone and marble, had led him to suspect that nearly the same would be the case in these and other hard bodies. Through the liberality of his friend Mr. Fairbairn (who had, as usual, given him every assistance his establishment afforded), he (Mr. Hodgkinson) had made a great many experiments upon wood, sandstones, marbles, glass, slate, ivory, bone, &c., to ascertain the tensile, crushing, and transverse strength of each; also, as far as possible, the situation of the neutral line. He had sought for these in thirteen kinds of timber, including oaks, pines, teak, &c.; all the different sorts of experiments were made, as far as possible, out of the same specimen in each case. The wood was of good quality, and perfectly dry, having been chosen for this purpose, and laid in a warm dry place for four years or more. After describing the mode and character of his experiments on the various substances named above (specimens of which he produced), Mr. Hodgkinson gave the following summary of their comparative results on marbles and stones of various degrees of hardness:—

Description of Stone.	Crushing force per square inch, called 1000.	Tensile force per square inch.	Transverse strength of bar 1 inch square, and 1 foot long.
Black marble	1000	143	10·1
Italian marble	1000	84	10·6
Rochdale flagstone	1000	104	9·9
High Moor stone	1000	100	
Stone called Yorkshire flag	1000	...	9·5
Stone from Little Hulton, near Bolton	1000	70	8·8
Mean rates....	1000	100	9·8

or calling the mean crushing strength per square inch, in the different articles experimented upon, 1000, we have,—

Crushing strength 1000.	Tensile strength.	Transverse strength.	Ratio of mean tensile to crushing strength.
In timber 1000	1900	85·1	1 to 0·55
Cast iron 1000	158	19·8	1 „ 6·6
Glass (plate and crown)..1000	123	10·	1 „ 7·8
Stone and marble 1000	100	9·8	1 „ 10·5, or, taking the hardest only, 8·9.

The ratio of the crushing force to the transverse force is nearly the same in glass, stone, and marble, including the hardest and the softest kinds. Hence, if we know the transverse strength in any of these bodies, we may predict the other; and, as glass and the hardest stones resist crushing with from seven to nine times the energy that they do being torn asunder, we may get an approximate value of the tensile force from the crushing force, or *vice versâ*. These results render it probable that the hardest bodies, whether cast-iron, glass, stone, or marble, admit of certain atomic displacements, either in tearing asunder or crushing; these displacements being in a given ratio to each other, or nearly so. In future calculations as to the strength of bodies, the crushing strength ought to be made the fundamental datum, for the reasons shown in this notice. The ratio of the transverse strength to the crushing strength is greater in cast-iron than in glass, marble, and sandstones, arising from the ductility of that metal. The necessity of enlarged inquiries in these matters will be seen, when it is reflected that calculations of the tensile strength of cast-iron, or marble, or stones in general, made from the transverse strength by the modes used by Tredgold, Navier, and others, give the tensile strength twice or three times as great as it ought to be. The paper, of which a short notice is here given, will, when completed according to the author's wish, be offered to the Royal Society.

Report of the Committee for Deep Dredging.

Mr. Patterson stated that the Dredging Committee were continuing to collect the materials for their Report on the Marine Zoology of Britain, and announced the results of dredging at depths varying from fifty to one hundred and forty-five fathoms, off the Mull of Galloway, by Captain Beechey, R.N., drawn up by William Thompson, Esq.*; also results of dredging by Mr. Hyndman* off the Mull of Cantire, and off Ballyally Head, co. Antrim, by Mr. Patterson.

To the Committee of the British Association for advancing our knowledge of British Belemnites.

In consequence of receiving from the British Association, through the Committee appointed at Plymouth in 1841, "for the purpose of advancing our knowledge of Belemnites," the sum of 50*l*., I have renewed the preparations for publishing the Figures and Descriptions of British Belemnites, which were presented (by request) to the Meeting of the Association at Dublin. Notwithstanding the lapse of time since that meeting, but few additional species have come to my knowledge, though doubtless such may be known to other geologists. I propose, by circulating proof plates already engraved, and of others in progress, to collect information regarding the localities of the known, and the nature of any new species, before printing the descriptions already prepared; but I hope to lay before the Committee, previous to or at the meeting in 1842, specimen pages and plates for their consideration; and I entertain no doubt that previous to the meeting in 1843, if not in the beginning of that year, I may be able to complete and publish the work. It is proposed to print in quarto, on the same size and general plan as the works of Voltz and Blainville: there will be from ten to twenty plates, arranged with as much regard both to natural affinity and geological position as practicable. The number of plates already in hand is six.

Malvern, May 13, 1842. John Phillips.

* For these two communications see Transactions of the Sections, pp. 70–75.

NOTICES

AND

ABSTRACTS OF COMMUNICATIONS

TO THE

BRITISH ASSOCIATION

FOR THE

ADVANCEMENT OF SCIENCE,

AT THE

MANCHESTER MEETING, JUNE 1842.

ADVERTISEMENT.

The Editors of the following Notices consider themselves responsible only for the fidelity with which the views of the Authors are abstracted.

CONTENTS.

NOTICES AND ABSTRACTS OF MISCELLANEOUS COMMUNICATIONS TO THE SECTIONS.

CHEMISTRY.

GEOLOGY AND PHYSICAL GEOGRAPHY.

STATISTICS.

MECHANICS.

ADDENDUM TO MATHEMATICS AND PHYSICS.

NOTICES AND ABSTRACTS

OF

MISCELLANEOUS COMMUNICATIONS TO THE SECTIONS.

Correction of an Error in this part of the Report for 1841.

In the Addendum to the Report of the Transactions of the Sections in 1839, one of the documents, viz. the Letter on p. 5, from Mr. Phillips to Mr. Nasmyth, dated August 10, 1840, is incorrectly terminated. The last sentence of the letter should have been in these words:—"Should you, however, instead of this easy and obvious mode of correcting any error of mine, resolve to appeal to another tribunal, the public, I can make no other objection than that I fear you will not have chosen the course most advantageous to your views," instead of "Should you, however, instead of this easy and obvious method of correcting any error of mine, resolve to appeal to another tribunal, the public, I will give you the only proof in my power to offer of an unbiassed mind, by transmitting copies of all the letters I have received from you, to render any statement you may think proper to make as complete as possible."

The mistake was pointed out by Mr. Nasmyth, in a communication to the President, dated June 7th, 1842, and appears to have occurred in the following manner:—There was a prior draft of the same letter, and this by some mistake was preserved, and after a very long interval of time was, with other documents in Mr. Phillips's possession, bearing upon the subject, sent to be examined by the authority of the Council. It was this draft, supposed to have been followed in the actual letter, that the printer copied, and hence the error which Mr. Nasmyth has pointed out.

MATHEMATICS AND PHYSICS.

On the Astronomical Clock. By M. Bessel *of Königsberg.*

Having ever been of opinion that the most indispensable of astronomical instruments, the transit-clock, will only acquire the greatest possible perfectness, if the *pendulum, separated from the wheel-work*, is made to vibrate in equal time, whatever the temperature and the arc may be, I beg leave to communicate to this Association some hints relative to this matter. Some artists have endeavoured to compensate a variation of the arc, from summer to winter, by not completely compensating the pendulum for the variation of heat; others have contrived very ingenious means for producing always an equal arc. But experience, at least my own, has shown no so complete success, that astronomers, though they feel themselves truly indebted to the skill and the ingenuity of artists, should not be tempted to wish that further endeavours might not be considered as useless.

Some years ago, Mr. Frodsham communicated to this Association a very ingenious contrivance, which he calls the *isochronal piece*, the purpose of which is to compensate, by the effect of the suspension spring, that of a variation of the arc. Supposing that experiments of this universally celebrated artist have shown this contrivance to answer the purpose, there will be no longer a difficulty in making the rate of a pendulum independent, as well of the arc as of the heat. What I wish to submit to his judgement, is only whether the very expeditious method of *coincidences* might not be employed for checking a pendulum in both respects. The pendulum, without the clock, being suspended from the wall, a clock, taken out of its case, may be placed before it at a distance of 6 or 8 feet; an object-glass, of 3 or 4 feet focal length, may be placed between both, so that it produces, exactly at the lower end of the pendulum of the clock, an image of the lower end of the other. Then the coincidences of both pendulums may be very accurately observed with a telescope, placed in the straight line with both, at a convenient distance. A similar contrivance has been described in the account of pendulum experiments made at Königsberg; and I may here be permitted to add, that the accuracy of the method is such, that the relative rate of both pendulums may be ascertained with the required accuracy in a time of ten or twenty minutes. This arrangement supposed, it will be very easy to adjust the isochronal piece of Mr. Frodsham. After this has been effected, the rate of the pendulum is to be tried in different temperatures. A box, having at its lower end an opening covered with glass, may be fastened to the wall, so that the pendulum swings within it. A couple of metal tubes pass through this box, and may be heated by boiling water or steam, in order to heat the air within the box. Previously to the heating, the air is to be deprived of its moisture. Two or three thermometers will show whether the heat within is pretty uniform. The pendulum being swung before and after the heating, it will be easy to correct the compensation for heat.

I believe that not only the readiness with which both these experiments may be made, but also the perfect isolation of the pendulum will recommend this method to artists and astronomers. I have indeed been desirous of trying it myself before proposing it to others, but having been delayed beyond expectation with the construction of a pendulum provided with Mr. Frodsham's isochronal piece, I am obliged to leave the experiment to others.

With respect to the construction of the pendulum, I believe that attention should be paid to one point of view, which hitherto seems to have been overlooked. It often happens that thermometers fixed at the top and at the foot of the case of a clock do not agree; whence it is evident that a compensation acting only below will not always compensate the variation of the length of the whole rod. I should prefer, for this reason, the gridiron pendulum to the mercurial pendulum, especially if the former is constructed in such a manner that the several rods begin as little as possible below the point of suspension, and end at the centre of gravity of the lens. I should also think proper to make the several rods of equal diameter, and to coat them uniformly. Perhaps the application of galvanism, which the deservedly famed Mr. Dent has made for coating the balance-spring of chronometers with gold, would best answer the purpose. I finally believe that the utmost care in the construction of the pendulum is very essential, in order to remove every danger of its derangement by the spring of the metals.

Supposing a pendulum perfectly regulated, as well with respect to the heat as to the arc of vibrations, only one cause will interfere with the regularity of its vibration time; this is the effect of that part of the buoyancy of the air which depends upon the variations of the height of the barometer. The other part, depending upon the variations of the thermometer, is comprised in the adjustment of the compensation for heat, if made by the above-described process. There is indeed the possibility to compensate the former part too, by fastening a barometer-tube to the pendulum; and it would not be difficult to find the suitable diameter of this tube; but I am aware that this complication of the pendulum would be rather inconvenient. At all events, the effect of the variations of the barometer is not very great, especially if the specific gravity of the pendulum is made as great as possible.

The pendulum of a clock being carefully adjusted, every variation of the rate of the clock, not explicable by a variation of the barometer, will originate in the escapement or the wheels. Though the uniformity of the rate of many clocks is more to be wondered at than their occasional small variations, yet I believe that further improvements are possible, and that they only will be obtained by the separation of the causes of perturbations. From this point of view I might consider it as very desirable severely to test the *isolated pendulum* by the method which I have submitted to the judgement of the celebrated artists, whose admired works have lately so greatly contributed to the accuracy, as well of astronomical observations as of the determination of longitudes.

On a New General Principle of Analytical Mechanics. By M. JACOBI *of Königsberg.*

In the different problems relative to the motion of a system of material points which have been hitherto considered, one may make an important and curious remark, "that whenever the forces are functions of the coordinates of the moving points only, and the problem is reduced to the integration of a differential equation of the first order of two variables, it may also be reduced to quadratures." Now I have succeeded in proving the general truth of this remark, which appears to constitute a new principle of mechanics. This principle, as well as the other general principles of mechanics, makes known an integral, but with this difference, that whilst the latter give the first integrals of the dynamical differential equations, the new principle gives the last. It possesses a generality very superior to that of other known principles, inasmuch as it applies to cases in which, when the analytical expressions of the forces, as well as the equations by which we express the nature of the system, are composed of the coordinates of the moveables in any manner whatever, principles (such as the principle of the *conservation of living forces*, of the conservation of areas, and of the conservation of the centre of gravity) are superior to the new principle in several respects. In the first place, these principles afford a finite equation between the coordinates of the moveables and the components of their velocities, whilst the integral found by the new principle is simply reduced to quadratures. In the second place, we suppose in the application of the new principle that we have already succeeded in discovering all the integrals but one, a supposition which will be realized in a small number of problems only. This will be sufficient to convince us of the importance of the new principle; but this may be made still more manifest, if I am permitted to illustrate its application by a few examples.

1st. Let us consider the orbit described by a planet in its motion round the sun. The differential equations in dynamical problems being of the second order, we may present them under the form of differential equations of the first order, by introducing the first differentials as new variables. In this manner the determination of the orbit of the planet will depend upon the integration of three differential equations of the first order between four variables. We find two integrals by the principles of *living forces* (forces vives) and areas. The question is thus reduced to the integration of a single differential equation of two variables and of the first order. Now, by *my* general theorem, this integration may always be reduced to quadratures. If therefore we choose to reckon this theorem amongst the other principles of mechanics, we see that the general principles of mechanics alone are sufficient to reduce the determination of the orbit of a planet to quadratures.

2nd. Let us consider the motion of a point attracted to two centres of force, after Newton's law of gravitation. The initial velocity being directed in the plane passing through the body and the two centres of attraction, we still have to integrate three differential equations of the first order amongst four variables, one integral of these equations being furnished by the principle of *living forces*. Euler has discovered another, and thus has succeeded in reducing the problem to a differential equation of the first order between two variables. But this equation was so complicated, that any person but this intrepid geometer would have shrunk from the idea of attempting its integration and reducing it to quadratures. Now, by my general principle, this reduction would have been effected by a general rule without any tentative process, without any extraordinary effort of the mind.

3rd. Let us consider also the famous problem of the rotatory movement of a solid body round a fixed point, the body being under the influence of no accelerating force. In this problem we shall have to integrate five differential equations of the first order amongst six variables. The principle of living forces gives one integral, that of areas gives three others, and the fifth is found by my new principle. We thus see all the integrals of this difficult problem found by the general principles of mechanics alone, without our being required to write a single formula, or even to make a choice of variables.

I will endeavour now to enunciate the rule itself, by means of which the last integration to be effected in the problems of mechanics is found to be reduced to quadratures, the forces being always functions of the coordinates alone. Let us suppose, in the first instance, any system whatsoever of material points entirely free. Let there be found a first integral $f' = \text{const.}$, the variables which enter into the function f' being the coordinates of the moveables, and their first differentials taken with respect to the time. I avail myself of the equation

$$f' = \text{const.}$$

for the purpose of eliminating any one of the variables, and I call p' the partial difference of f', taken with respect to this variable. Let $f'' =$ const. be a second integral. By means of this equation I eliminate a second variable, and I call p'' the partial difference of f'' with respect to this variable. Let us suppose that we know all the integrals of the problem but one, and that with respect to each integral $f =$ const. we seek the corresponding partial difference p with respect to the variable, which we eliminate by means of this integral. The number of variables exceeds by unity that of the integrals: we eliminate by means of each integral a new variable, and we thus succeed in expressing all the variables by means of two of them. Let us call these two variables x and y and x' and y', their first differentials taken with respect to the time. We shall express by means of x and y the quantities x' and y', as well as all the quantities p', p'', &c.: since x' and y' are the first differentials of x and y taken with respect to the time, we shall have the equation

$$y'\,dx - x'\,dy = 0,$$

where x' and y' are known functions of the two variables x and y. It is this differential equation, the last of all of them, which we must integrate in order to obtain the complete solution of the problem. Now I show that on dividing this equation by the product of the variables p', p'', &c., its first member becomes an exact differential, and therefore the integration of this equation is generally reduced to quadratures.

When we have any system whatsoever of material points, the simplicity of the preceding theorem is in no respect altered, provided we give to the dynamical differential equations that remarkable form under which they have been presented for the first time by the illustrious Astronomer Royal of Dublin, and under which they ought to be presented hereafter in all the general researches of analytical mechanics. It is true that the formulas of Sir W. Hamilton are referrible only to the cases where the components of the forces are the partial differences of the same function of the coordinates; but it has not been found to be difficult to make the changes which are necessary in order that these formulas may become applicable to the general case, where the forces are any functions whatever of the coordinates.

When the time enters explicitly into the analytical expressions for the forces, and into the equations of condition of the system, the principle of the final multiplier, found by a general rule, is applicable also to this class of dynamical problems. There are also some particular problems into which enters the resistance of a medium, which give rise to similar theorems. It is the case of a planet revolving round the sun in a medium whose resistance is proportional to any power of the velocity of the planet.

The analysis which has conducted me to the new general principle of analytical mechanics, which I have the honour to communicate to the Association, may be applied to a great number of questions in the integral calculus. I have collected these different applications in a very extensive memoir, which I hope to publish upon my return to Königsberg, and which I shall have the honour of presenting to the Association as soon as it shall be printed.

Extract from a Memoir entitled "Considerations on the Principles of Analytical Mechanics." By Professor BRASCHMANN *of Moscow.*

The principle of virtual velocities, on which is based the theory of equilibrium and of motion, has not, in my opinion, been explained in a manner which is clear and unobjectionable; and I am also inclined to believe that the problem of equilibrium has not been treated analytically in a point of view sufficiently general, and that there are still many observations to be made on the correctness of the application of the principle of virtual velocities to certain problems.

Similar observations may be made also with regard to the theory of motion. M. Ostrogradsky brought forward, some years ago, some new and general ideas on the laws of equilibrium and of motion in two memoirs, one of which bears the title, "On the Momenta of Forces;" and the other, "On the instantaneous Displacements of the points of a System." Profiting by his enlightened views, I published, in 1837, a treatise in the Russian language on the equilibrium of solid and fluid bodies, from which I will now give a very short extract relating to the method I have there followed, and I shall add some observations which escaped me at the time of the publication of that work, respecting the number and the character of conditions of equilibrium.

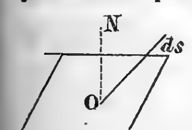
In the first place, I demonstrate the parallelogram of forces*, and then pass on to the composition and decomposition of forces, and to the equilibrium of a free point.

To find the conditions of a point, or of a system of points, which is not free, it is necessary, and at the same time sufficient, *that the forces cannot effect any displacement which the obstacles allow of*, or that they can only produce impossible displacements. It is this condition which we will endeavour to express analytically.

I show that a force acting on a point subjected to a certain obstacle can never give rise to a displacement, forming either a right or obtuse angle with the direction of the force, but that it can cause a displacement which forms an acute angle with the direction of this force. As a point can sometimes only be displaced in a straight line by an infinitely small quantity, I shall only consider infinitely small displacements, but perfectly arbitrary. I will designate one of these displacements by ds, and its projections on the rectangular axes x, y, z, by dx, dy, dz, then the condition that a force R cannot cause a displacement ds will be expressed by $\cos(\mathrm{R}\, ds) \leqq 0$; or since R and ds are positive quantities, and $\cos(\mathrm{R}, ds) = \frac{\mathrm{X}\,dx}{\mathrm{R}\,ds} + \frac{\mathrm{Y}\,dy}{\mathrm{R}\,ds} + \frac{\mathrm{Z}\,dz}{\mathrm{R}\,ds}$, the analytical expression of the condition *that a force does not tend to produce the displacement* ds will be

$$\mathrm{X}\,dx + \mathrm{Y}\,dy + \mathrm{Z}\,dz \leqq 0 \ldots\ldots\ldots\ldots (1.)$$

where X, Y, Z are the projections of R on the three axes x, y, z. Let us now see how we can express the condition that the displacement of a point subjected to obstacles is possible, independently of the means which may occasion this displacement. For this purpose I observe, that whatever may be the condition which hinders some displacements, it may always be represented by one or by several fixed planes. I suppose, at first, that there is but one sole plane of dimensions infinitely small which prevents the displacement of the point. I imagine a normal prolonged from the point in space where the displacement is possible, and I designate the angles of this normal with the axes x, y, z, by α, β, γ; it is then evident that only such displacements are possible as form a right or acute angle with the normal, *i.e.* that $\cos(\mathrm{N}, ds)$, or $\cos\alpha \frac{dx}{ds} + \cos\beta \frac{dy}{ds} + \cos\gamma \frac{dz}{ds} \geqq 0$ expresses the condition that one displacement is possible; $\cos\alpha$, $\cos\beta$, $\cos\gamma$ may be functions of the coordinates of the point, which renders this expression an exact differential or not; in the first case the point will be found on a curved surface, and α, β, γ will be the angles of the normal of the surface with x, y, z; in the second case it will not be so; consequently, making generally $\cos\alpha\, dx + \cos\beta\, dy + \cos\gamma\, dz = \mathrm{A}\,dx + \mathrm{B}\,dy + \mathrm{C}\,dz$, where this expression is or is not an exact differential, the condition will be expressed that *a displacement is possible* by



$$\mathrm{A}\,dx + \mathrm{B}\,dy + \mathrm{C}\,dz \geqq 0 \ldots\ldots\ldots\ldots (2.)$$

and the whole of these conditions (1.) and (2.) will be the analytical expression that *a force cannot effect a possible displacement, the projections of which are* dx, dy, dz.

Let us see what conclusions we should draw from these two inequalities for the equilibrium of a point.

For the sake of shortness, I make $\mathrm{A}\,dx + \mathrm{B}\,dy + \mathrm{C}\,dz = d\mathrm{L}$, where $d\mathrm{L}$ expresses an arbitrary quantity infinitely small, which is the complete differential of a function of the three variables x, y, z, or simply an infinitely small one, which does not possess this property; I add to this equation two others, perfectly arbitrary,

$$\mathrm{A}_1\,dx + \mathrm{B}_1\,dy + \mathrm{C}_1\,dz = d\mathrm{M},$$
$$\mathrm{A}_2\,dx + \mathrm{B}_2\,dy + \mathrm{C}_2\,dz = d\mathrm{N},$$

where $\mathrm{A}_1, \mathrm{B}_1, \mathrm{C}_1, \mathrm{A}_2 \ldots$ are the arbitrary functions. I find the expressions of these three equations in the following manner:—

$$dx = a\,d\mathrm{L} + b\,d\mathrm{M} + c\,d\mathrm{N},$$
$$dy = a_1\,d\mathrm{L} + b_1\,d\mathrm{M} + c_1\,d\mathrm{N},$$
$$dz = a_2\,d\mathrm{L} + b_2\,d\mathrm{M} + c_2\,d\mathrm{N}.$$

* It seems to have escaped attention, that in order to demonstrate that the resultant of two forces falls within the angle of these forces, it is necessary to admit that the dependence between the resultant and the components must be given by a continuous function.

On substituting these values in the expression $X\,dx + Y\,dy + Z\,dz$, and placing $a X + a_1 Y + a_2 Z = \lambda$ &c., we find

$$X\,dx + Y\,dy + Z\,dz = \lambda\,d L + \mu\,d M + \nu\,d N;$$

but since the values of $d M$ and $d N$ are quite arbitrary and independent of $d L$, the expression $\mu\,d M + \nu\,d N$ may always render the second member $\lambda\,d L + \mu\,d M + \nu\,d N$ positive, whilst that for the equilibrium $X\,dx + Y\,dy + Z\,dz$ must not be positive; it will consequently be requisite at first, for the equilibrium, that $\mu\,d M + \nu\,d N = 0$; and since $d M$ and $d N$ are arbitrary, it is necessary that $\mu = 0$, $\nu = 0$, and $X\,dx + Y\,dy + Z\,dz = \lambda\,d L$.

When a displacement makes $d L = 0$, that is, when the obstacles are expressed by equations, we have $X\,dx + Y\,dy + Z\,dz = 0$ for the possible displacements, the sign of the quantity λ then remains arbitrary; but for the displacements which give $d L > 0$, $X\,dx + Y\,dy + Z\,dz$ must not be positive; it is consequently necessary that λ be negative, or carrying the whole to the other side $X\,dx + Y\,dy + Z\,dz + \lambda\,d L = 0$, or λ is positive; that is, it has the same sign as $d L$ for the possible displacements. On substituting $A\,dx + B\,dy + C\,dz$ for $d L$, and observing that λ is independent of the displacements, and always retains the same value, whatever be the displacements under consideration, we shall obtain, since dx, dy, dz are entirely arbitrary,

$$\left.\begin{aligned} X + \lambda A = 0 \\ Y + \lambda B = 0 \\ Z + \lambda C = 0 \end{aligned}\right\} \ldots\ldots\ldots (3.)^*$$

Hence results $\frac{X}{A} = \frac{Y}{B} = \frac{Z}{C} = \pm \frac{R}{\sqrt{A^2 + B^2 + C^2}} = -\lambda$; but R being positive, and $-\lambda$ a negative quantity, it is necessary to keep the sign $-$; consequently $\frac{X}{R} = -\frac{A}{\sqrt{A^2 + B^2 + C^2}}$, $\frac{Y}{R} = -\frac{B}{\sqrt{\ }}$, $\frac{Z}{R} = -\frac{C}{\sqrt{\ }}$, *i. e.* the force R must be opposed to the normal N, and must press the point against the plane; the magnitude of this force remains arbitrary.

When there are two conditions,

$$A\,dx + B\,dy + C\,dz = d L,$$
$$A_1\,dx + B_1\,dy + C_1\,dz = d M,$$

and the above manner is adopted, it will be shown at first that $\nu = 0$, and $X\,dx + Y\,dy + Z\,dz = \lambda\,d L + \mu\,d M$. Since, for one of the possible displacements, $d M = 0$, and $X\,dx + Y\,dy + Z\,dz = \lambda\,d L$, it is requisite that λ be negative, or, carried to the other side, positive; in the same manner it is shown that μ is positive, *i. e.* that in the expression

$$X\,dx + Y\,dy + Z\,dz + \lambda\,d L + \mu\,d M = 0,$$

λ and μ have the same signs as $d L$ and $d M$ for the possible displacements. From this equation is obtained

$$X + \lambda A + \mu A_1 = 0,$$
$$Y + \lambda B + \mu B_1 = 0,$$
$$Z + \lambda C + \lambda_1 C_1 = 0,$$

whence it results that the point may be considered perfectly free, if to the given force be added two others, the projections of which on the axes are λA, λB, λC, μA, &c.; the value of these forces remains perfectly arbitrary, but their direction will be determined.

When a point is subjected to three conditions, and the same course is adopted as above, it will again be found that $X\,dx + Y\,dy + Z\,dz + \lambda\,d L + \mu\,d L + \mu\,d M + \nu\,d N = 0$, where λ, μ, ν are indeterminate but positive quantities; this equation does not afford any equation for the equilibrium, since the three equations which may be derived from it are identical, when for λ, μ, ν their values are substituted, but the conditions of equilibrium will consist of the three inequalities $\lambda > 0$, $\mu > 0$, $\nu > 0$.

Suppose, for instance, a solid sphere to be situated within the angle of the positive coordinates, and the conditions that the centre is not affected by any displacement be required, then in this case we shall have for the possible displacements three conditions, $dx \geqq 0$, $dy \geqq 0$, $dz \geqq 0$; consequently $X\,dx + Y\,dy +$

* The point might therefore be considered perfectly free, if to the given forces another $\lambda \sqrt{A^2 + B^2 + C^2}$ be added, the projections of which on the axes are λA, λB, λC.

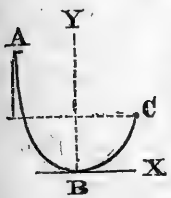
$Z\,dz + \lambda\,dy + \nu\,dz = 0$, whence $\lambda + X = 0$, $\mu + Y = 0$, $\nu + Z = 0$; that is, the magnitude of the force may be arbitrary, but its direction must be such, that X, Y, Z be negative, since λ, μ, ν are positive; whence it results, that the direction of the force must be comprised within the angle of the negative coordinates.

If there are more than three conditions, $\frac{n(n-1)(n-2)}{2.3}$ combinations may be made by three, and $\frac{3.n(n-1)(n-2)}{2.3}$ inequalities are obtained, some of which may be comprised in the others.

By transforming any known demonstration, (I have transformed the demonstration of Cauchy, as well as that of Lagrange,) it may be proved that the condition that a force does not tend to produce displacements, the projections of which on the axes are, for the first point of the system, dx, dy, dz, for the second, dx', dy', dz', &c. .... is expressed by $X\,dx + Y\,dy + Z\,dz + X'\,dx' + Y'\,dy' + Z'\,dz' + X''\,dx'' + \ldots\ldots < 0$, the conditions of the system must be of the form $A\,dx + B\,dy + C\,dz + A'\,dx' + \ldots\ldots \geqq 0$; and by proceeding in the same manner, that for the point λ, μ, ν .... are found to have the same signs as dL, dM, dN .... for the possible displacements, and that the conditions of equilibrium are

$$X + \lambda A + \mu A_1 + \nu A_2 + \ldots\ldots = 0$$
$$Y + \lambda B + \mu B_1 + \nu B_2 + \ldots\ldots = 0$$
$$Z + \lambda C + \lambda C_1 + \lambda C_2 + \ldots\ldots = 0$$
$$X_1 + \lambda A' + \mu B' + \ldots\ldots\ldots = 0.$$

The same is demonstrated for the flexible wire. There is still one observation to be made on the solution of this problem; in the case that gravity alone acts on the wire of a constant thickness, an equation of the following form is obtained for the curve A B C



$$y = \frac{e^{bx} + e^{-bx} - 2}{2b},$$

where b is an arbitrary constant, which is determined by a transcendent equation

$$\frac{e^{\frac{bl}{2}} - e^{\frac{-bl}{2}}}{b} = q,$$

where l and q are known quantities. Then, since a transcendent equation may have an infinity of roots, it is requisite to demonstrate that this equation only admits one real root, which may be done in a very simple manner.

On applying the principle of virtual velocities to the equilibrium of an incompressible fluid, it will be found, by the simple consideration of the sign, which, according to the preceding, a certain indeterminate co-efficient should have, that equilibrium can only take place when the external forces act from without into the fluid which is not indicated by the usual analytical considerations. It is also evident that the form of the surface containing the fluid has no influence on the equilibrium.

With respect to the principles of the curvilinear movement of a point, it is first shown that the space described by a point, during an infinitely small time dt is expressed by an infinitely small quantity of the second order, that this space is the chord; no other straight line can give an approximation which goes beyond this order, consequently it is useless to choose any other.

But if we do not wish to have an exact idea of the magnitude combined with the direction of the movement, but simply to express this magnitude, we are able to obtain it as approximately as desired by choosing a curved arc. From what I have stated above, a sufficient notion may be formed of what M. Ostrogradsky has done for the movement of a system subjected to variable conditions.

On the Report of the Commissioners for the restoration of lost standards of Weights and Measures, and upon their proposal for the introduction of a Decimal System. *By the* Dean of Ely.

After stating that the imperial standards of weights and measures (the yard, the pound, the gallon, and several of their multiples) had been lost in the fire which destroyed the two Houses of Parliament, the author said that a commission (of which he was a member) had been appointed to report on the best means of restoring these standards. The commission recommended to the government that the standards of length and weight should be independent of each other, which was not the case before. The standard pound weight was Troy weight (5780 grains), though the pound avoirdupois (7000 grains) was used throughout the country, in the proportion, perhaps, of 10,000 to one of Troy. The commission recommended that, hereafter, the use of the Troy pound should be abolished, except for a very limited number of transactions, and that the avoirdupois pound should be considered as the standard pound of Great Britain. They recommended that measures of capacity should be determined by measures of weight—by far the most convenient method, inasmuch as weighing was a much more accurate operation than, for instance, the formation of a perfect cube. The commission also ventured to recommend strongly some alterations in the coinage, and the systems of weights and measures, arising out of a more extensive introduction of the decimal scale. The nearly unanimous determination of the commission was, that any attempt to interfere materially with the primary units of the coinage, weights and measures in ordinary use, would produce much confusion and bad consequences in the ordinary transactions of life. They would therefore adhere strictly to all those primary units, viz. the pound sterling, the yard (and also the foot, for there were two primary units in this measure), the acre, the gallon, and the imperial pound. The coinage must necessarily be the basis of any changes leading to the more extended adoption of a decimal scale. Taking the pound sterling as the primary unit, they propose to introduce a coin of the value of 2*s.* (one-tenth of the pound); another, either silver or copper, of one-tenth of 2*s.* (or 2*d.* and a fraction), which might be called a *cent* (the hundredth of a pound) and the thousandth part of the pound sterling, or nearly the value of our farthing (of which there are 960 in the pound), which new coin it was proposed to call a *millet* (or thousandth). The difference in the value of the copper coinage was less important, as it was merely a representative coinage, and had not an approximate intrinsic value like the gold and silver coinage. For the proposed coin of 2*s.* various names had been suggested, as *Victorine*, rupee, or florin; it being not much different from the value of some of the rupees of the East Indies, or the florin of the continent. Under this new decimal scale the shilling would be retained, and also the sixpence (but the latter under another name, more representative of its value). For the half-crown would be substituted the 2*s.*, or *Victorine.* The very rev. gentleman dwelt at some length on the advantages of this change in the extensive money transactions and accounts of bankers and merchants; in the Bank of England, for instance, where a thousand clerks were employed, it would greatly facilitate the operations of calculations and book-keeping. Thus, discarding *millets* (for bankers now excluded the subdivisions of a penny in their accounts), the sum of 17*l.* 3 *Victorines, 7 cents,* would be represented at once by 17·37; only two places of decimals, instead of as now in pounds, shillings, and pence. He showed how the principle was applicable, with still greater advantage, in cases of weights and measures (where the scale was now most anomalous and absurd). Suppose the rental or value of 30·64 acres of land to be required, and that the land cost 69*l.* 3 *Victorines,* 4 *cents* an acre. The reduction in common arithmetic was one of very considerable labour, difficulty, and time. But by this plan the result might be obtained in five lines of decimals, containing only twenty-one figures. As to weights, the most extensive change recommended by the committee would be to introduce the uniform weight of 10lbs. to the stone, instead of the varieties of 8lbs. in some, and 14lbs. or 16lbs. in other parts of the kingdom; the hundred weight to be called *centner* (a German term). These were all the changes proposed in weights; the commission not wishing to interfere with the subdivision of the pound, which admitted of four subdivisions into 8 oz., 4 oz., 2 oz., and 1 oz. The pound and ounce would remain, therefore, exactly the same as at present. As to the measure of length, the commission thought it too violent a change to alter all the milestones; but there would be no difficulty (with reference to the standing orders of Parliament in railway matters, &c.) in introducing the measure of 1000 yards, which might be called a mil*yard*. However, the commission made no recommendations as to nomenclature, leaving that to the legislature. Thus the changes proposed to be introduced, not only to ensure a decimal coinage, but a decimal subdivision of weights and measures, were by no means of that formidable and appalling character which many persons suppose they must of necessity possess.

Letter from Professor Wheatstone to Colonel Sabine, on a New Meteorological Instrument.

The importance of multiplying stations at which simultaneous meteorological observations may be made does not require any discussion. The chief obstacle to their establishment is the necessity for the constant attendance of an observer to register the indications of the instruments, which difficulty is greatly increased when the observations are required to be made by night as well as by day. All attempts to make self-recording thermometers, barometers, &c. by mechanical means have hitherto failed, because the mechanical force exerted by the rise of the mercury in the tubes is insufficient to overcome the frictions of the attached mechanism, and only very inaccurate indications can be obtained. The principle, however, which I employ in my meteorological telegraph, viz. the determination (by means of a feeble electric current) of any required mechanical force by the mere contact of the mercury in the tube with a fine platina wire, enables all these difficulties to be overcome, and a Meteorological Recorder may now be made, which shall register every half hour the varying indications of the barometer, thermometer and psychrometer, as accurately as the most careful observer would be able to do, and which will require only a few minutes attention each day to put it in proper order to act for twenty-four hours. I propose therefore that such an instrument, the cost of which I estimate will not exceed 50*l*., shall be constructed, under my direction, for the Richmond Observatory. If, after a few months' trial at the Observatory, it shall be found to succeed, as I confidently expect it will, a great impediment to the advancement of meteorological science will be removed. Persons in almost every locality may be found who would not object to devote a few minutes per day to prepare such an instrument for use, but who would find it impossible to give the requisite attention to make hourly or half-hourly observations themselves; and the cost of the apparatus (which may hereafter probably be considerably reduced) is, considering the important objects in view, too inconsiderable to stand in the way of its general adoption.

On the Application of the Principle of the Vernier to the Subdividing of Time. By Follet Osler.

Mr. Osler's idea was, to have a pendulum, which should make, say ten swings in the time that the principal pendulum made eleven, furnished with a small dial, and so placed as that the coincidences, or want of coincidence, could be observed. The strokes of such a pendulum being counted, the time of every observed stroke of it, reckoned back from its coincidence with the principal, or seconds pendulum, would, it is obvious, be found in tenths of a second.

On the Longitude of Devonport. By E. J. Dent.

	′	″	
Longitude of the landing-place on the Breakwater in Plymouth Sound by four chronometers	16	33·60	west
Longitude of staff on Mount Wise by Trigonometrical Survey	16	38·10	"
The same, by mean of four chronometers	16	39·80	
Difference	0	1·70	

On the Rate of Protected Chronometer Springs. By E. J. Dent.

The author stated, that by trial at the Royal Observatory, Greenwich, between the temperature of winter and 96° Fahr., it was proved that the rate of going of chronometers, furnished with the gold-covered steel spring, was not injured by that covering.

On the Rate of a Patent Compensating Pendulum. By E. J. Dent.

The invention consisted in giving impulse to the pendulum at the centre of percussion instead of the usual place, which is near to the centre of suspension. Mr. Dent stated the performance of clocks thus made to be very satisfactory. He mentioned, in connection with this subject, the invention of a new escapement by the Astronomer Royal, which had been found of advantage in preventing the stopping of clocks at low temperatures.

On a New Chronometer Compensating Balance. By E. J. Dent.

The ordinary compensation balance is constructed of two segments of a circle, of brass and steel, and from the circular form of these pieces, the compensation weights attached to them are moved out too far from the centre of motion in cold, and not sufficiently in toward the centre in warm weather. Hence chronometers thus constructed gain on their rates at the mean temperature, and lose at both extremes.

Mr. Dent stated, from experiment, that the compensation weights were carried over nearly equal spaces for equal increments and decrements of heat, whereas the mathematical rule requires that they should be carried over spaces proportioned to the square of the distance from the centre of motion.

Mr. Dent's invention of a new compensation balance consisted in the compensation pieces being made into such curves as would practically meet the case required. The experimental investigations on which this construction was founded, were described at length.

On a Mode of expressing Fluctuating or Arbitrary Functions by Mathematical Formulæ. By Sir W. Hamilton.

A simple Method of arriving at the decimal part of the Sine or Tangent below a second of a degree, to the $\frac{1}{10000}$*th or* $\frac{1}{1000000}$*th part of it. By* Moses Holden.

On Decimal Fractions. By Anthony Peacock.

If the successive remainders in finding the reciprocal of a prime number be placed over each quotient figure, the whole will form a table of the decimals equivalent to such number as a denominator, and the respective remainders as numerators. By this arrangement the several properties of pure repetends may be studied with great advantage.

29ths.	1.	10.	13.	14.	24.	8.	22.	17.	25.	18.	6.	2.	20.	26.
	0	3	4	4	8	2	7	5	8	6	2	0	6	8
	28.	19.	16.	15.	5.	21.	7.	12.	4.	11.	23.	27.	9.	3.
	9	6	5	5	1	7	2	4	1	3	7	9	3	1

The figures in the upper line are the several remainders, or numerators, and may be called *the indices of the series*; the under figures are the repetend: thus $\frac{4}{29}$ $=$ ·1379310344, &c., $\frac{27}{29} =$ ·93103448, &c., $\frac{1}{29} =$ ·03448275, &c.

From the two following original properties of a reciprocal repetend various practical rules have been devised.

1st. The product of any two numerators or indices is equal to the numerator standing in the sum of the places, reckoning from right to left, unless the product exceed the denominator, in which case the numerator is the remainder from the product divided by the denominator: thus, in 29ths, 4 and 7 are the indices in the 6th and 8th places, and $4 \times 7 = 28$ is in the $6 + 8 = 14$th place. Again, 12 and 6 are in the 7th and 18th place, and $\frac{12 \times 6}{29}$ gives a remainder 14, which is in the $7 + 18 = 25$th place.

2ndly. If the last index of a reciprocal repetend from a denominator ending in 9 be made a multiplier, and multiplication be made from the last figure, *the unit figures of the successive products* will be the left-hand following digit of the series. In 29ths the last index is 3, and as the several products are placed over the series, this curious property may be seen to advantage.

As this property belongs to all repetends formed from denominators ending in 9, by a knowledge of the last index, and the last figure in the series, any repetend may be very easily calculated by multiplication, *from the last figure of the series to the first*; while by a particular arrangement of the process, no multiplier need be above 9.

The last index may be distinguished as the circulate multiplier, and is always one more than the tens in any number ending in 9; the circulate multiplier for 19 is therefore 2; for 49 it is 5; and for 199 it is 20.

Since every prime number terminates in either 1, 3, 7, 9, and the products of 1, 3, 7 by 9, 3, 7 respectively terminate in 9, the circulate multipliers for numbers ending in 1, 3, 7 will be the circulate multipliers of such products ending in 9; for example, $7 \times 7 = 49$ gives 5 for the circulate multiplier for 7ths.

7ths, or 7 / 49ths.	7.	21.	14.	42.	28.	35.	Indices to be divided by 7 for 7ths.
	1	4	2	8	5	7	

The last figure of the series, from denominators ending in 9, is always the unit figure of the numerator.

Having the circulate multiplier, and the last figure in the series, the repetend, as was before observed, may be found by multiplying the circulate multiplier into the last figure, then into the unit figure of the product, then into the unit of the next product, and so on successively, until the whole of the series is produced *from the end to the beginning.*

Example 1. Required the repetend of $\frac{5}{39}$.

Here 4 is the circulate multiplier, and 5 the last figure of the series.

39ths.	Products.	5.	11.	32.	8.	2.	20.
	Series.	1	2	8	2	0	5

Example 2. Required the circulate of $\frac{65}{119}$.

Here the circulate multiplier is 12, the last figure of the series 5 with 6 to carry into the first product.

Products.	116.	89.	57.	94.	107.	118.	109.	19.	71.	115.	79.	76.	26.	103.	78.	66.
Series.	9	7	4	7	8	9	9	1	5	9	6	6	3	8	6	5
	99.	38.	23.	111.	39.	33.	92.	87.	37.	13.	11.	110.	29.	42.	44.	83.
	8	3	1	9	3	2	7	7	3	1	0	9	2	4	3	6
	65.	55.	74.	26.	22.	101.	58.	104.	88.	47.	113.	59.	114.	69.	95.	117.
	5	4	6	2	1	8	4	8	7	3	9	4	9	5	7	9

When the denominator is not a prime number, the numerator may be commensurable with it, in which case all the products may be divided by the greatest common measure of the fraction; the results will be the indices of a circulate from a prime denominator, of which the given denominator is the product by the common measure.

For example. Required the repetend of $\frac{56}{119}$.

In this question the circulate multiplier is 12, the last figure of the series 6, with 5 to carry in. But $\frac{56}{119} = \frac{8}{17}$; consequently the series will be 17ths. Therefore, if the products be divided by 7 (the common measure), the quotients will be the indices of the repetend of 17ths.

119ths. Products.	56.	84.	7.	70.	105.	98.	28.	42.	63.	35.	112.	49.	14.	21.	91.	77.
119ths. Series.	4	7	0	5	8	8	2	3	5	2	9	4	1	1	7	6
Indices of 17ths.	8.	12.	1.	10.	15.	14.	4.	6.	9.	5.	16.	7.	2.	3.	13.	11.

In a similar manner to the last example, the circulate for any prime denominator whatever may be found.

Extracts from a Letter on the state of the Observatory at Glasgow (25th June, 1842). By Professor NICHOL.

"The members of the Physical Section will be pleased to know, that our great transit circle, made by Ertel, is now in operation. The object-glass of the telescope is 6·2 inches, and the diameter of the directed circle 3¼ feet. The construction of this circle is somewhat different from those formerly furnished by the same celebrated artist. Its circles are placed outside of the pillars on which it rests, and the alidada, instead of verniers, carries microscopes. The position of the alidada, secured roughly by a clamp, is ascertained on any observation, by the state of a delicate level, each of whose divisions values 2·″4 of space, so that the power of the eye to subdivide this quantity along the breadth of a division of this level gives the ultimate limit of the precision of the instrument for a single observation. Two fixed collimators, watched by levels, each of the divisions of which values 3″, enable the observer to determine the position either of the horizontal line or of a line, at a known angle with the horizontal line; and it will be clear that observations on both collimators necessarily indicate the horizontal collimation errors of the middle levers of the telescope, as well as the errors arising from flexure.

"Our meteorological department is nearly complete; and I have just received notice of the arrival of the declination- and horizontal-force magnetometers for our magnetic pavilion, from Meyerstein of Gottingen."

On the Mathematical Expressions which lead to an explanation of all the ordinary Phænomena in Optics. By Professor MACCULLAGH.

On a New Property of the Rays of the Spectrum, with Observations on the Explanation of it given by the Astronomer Royal, on the Principles of the Undulatory Theory. By Sir DAVID BREWSTER.

If we cover half the pupil of the eye with a thin plate of any transparent body, and thus view a prismatic spectrum, so that the rays which pass by the plate interfere with those which pass through it, the spectrum is seen crossed with beautiful black and nearly equidistant bands, whose breadth, generally speaking, increased with the thinness of the plate. If the edge dividing the ray were directed to the red end of the spectrum, then fringes were seen; but no such fringes appeared when it was turned to the violet end of the spectrum. One peculiarity of these fringes, not before noticed, was that they had not the forms of bands, but rather the appearance of screws, or dotted black lines, or as if they were formed by the shadow of a plate of metal perforated by small openings. This, which appeared to be a new property of light, and to indicate a polarity in the simple rays of light, when separated from each other by refraction, he had commented on at the meetings of the Association at Liverpool and Bristol; and Mr. Airy, the Astronomer Royal, had given a paper and two publications on the subject, in which he endeavoured to account for this upon the undulatory theory, arguing that the appearance and magnitude of the fringe depended upon the diameter of the pupil, or of the object-glass. Sir D. Brewster said he had repeated all his experiments under every variety of form, varying the diameter of the pupil from its greatest expansion to its greatest contraction, and the diameter of the object-glass from four inches to a quarter of an inch, and the fringe remained utterly unaffected by these variations. He further found, that these fringes varied in magnitude with the distance of the eye from the refracting body, and not with the magnitude of the pupil. He stated several other results, all of which, he thought, could not be explained on the principles of the undulatory theory.

On the Dichroism of the Palladio-chlorides of Potassium and Ammonium. By Sir DAVID BREWSTER.

Dr. Wollaston had found that a long crystal of either of these salts, when looked through transversely, had a green colour, but when looked through from either end, had a red colour; and he (Sir D. Brewster) placed one of these long crystals transversely over another, in a cruciform shape, and then found that those portions of the centres of both, which were in contact, gave a red colour, while all the ends of the crystals were red.

On the existence of a New Neutral Point, and two Secondary Neutral Points. By Sir DAVID BREWSTER.

After noticing the two neutral points (points where there is no polarization of light) of MM. Arago and Babinet, Sir David Brewster said he had discovered a third. He also mentioned amongst some general results of observations continued for a long time, that instead of the point of maximum polarization being always, as supposed, at 90° from the sun, he had found it more frequently 88° from the sun. He also described a polarimeter or polariscope, by which, he said, the rectilinear bands in polarization were seen more clearly than by other methods.

On certain Cases of Elliptically Polarized Light. By Prof. POWELL.

At the last meeting of the Association, Prof. Lloyd* gave a *theoretical* investigation of certain results obtained by Sir D. Brewster relative to thin films from which polarized light is reflected. Besides completely explaining those results, Prof. Lloyd infers, that such films ought to give the portions of light reflected at their two surfaces differing in phase, and that the light should be consequently in general *elliptically* polarized.

The author of the present paper, before he was aware of the investigation of Prof. Lloyd, had made many observations on the elliptical polarization of light by reflexion from metallic and other surfaces,—the method of observation being by the well-known dislocation of the polarized rings. Some of these experiments went merely to prove the existence of elliptic polarization in cases where it had not previously been detected, as in certain minerals and other bodies in which it is seen though of small amount. In other cases the reflecting surface consisted of the thin films formed on polished metal by tarnish, by heat, or by the galvanic process of Nobili. In these instances, a verification was afforded of Prof. Lloyd's theory by *direct observation*. But, further, these films give periodic colours; and in passing from one tint to another, the ellipticity, as disclosed by the form of the rings, underwent regular changes, passing from a dislocation in one direction to the opposite, through points of no dislocation or of plane polarization, the rings being alternately dark and bright centred. This afforded a further field for the application of theory, and Mr. Airy investigated a formula for the rings under these varying conditions, with which the phænomena are in perfect accordance.

On Crystalline Reflexion. By Sir DAVID BREWSTER.

Having (said Sir David), in a conversation with Prof. Kelland, had my attention directed to Prof. M'Cullagh's interesting memoir on the laws of crystalline reflexion and refraction, I have felt it necessary to make a communication on the subject to the British Association. In consequence of the results which I laid before the Bristol meeting, Prof. M'Cullagh was led to revise the views to which he had been led by my earlier experiments in 1819. I had at that time the advantage of communicating with him personally and by letter; and, having preserved copious abstracts of his paper on the subject, I did not look into the memoir itself till yesterday, when my attention was drawn to the following note:—"I was at this time in doubt whether the phænomena observed with oil of cassia could be reconciled to that theory; and when the note in page 36 was written, I was almost certain that they could not. But I have since, I think, found out the cause of this perplexity: some of Sir David Brewster's experiments were made with natural surfaces of Iceland spar; others with surfaces

* See Report, 1841. Transactions of the Sections, p. 26.

artificially polished. I believe (though I have made very few calculations relative to the point), that the former class of experiments will be perfectly explained by the theory; *the latter I am certain cannot, nor ought we to expect that they should*; for the process of artificially polishing must necessarily occasion small irregularities by exposing little elementary rhombs with their faces inclined to the general surface, and the action of these faces may produce the unsymmetrical effects which Sir David Brewster notices as so extraordinary. If this does not account for such effects, I do not know what will." Had Prof. M'Cullagh communicated to me this explanation of the incapacity of the undulatory theory to account for the extraordinary unsymmetrical phænomena which I described to the British Association, and which exist to a much greater extent than I described; or had it been contained in the two abstracts of his memoir, with which I was familiar, I could at once have removed the difficulty referred to in the preceding note. The view he has taken of the action of an artificially polished surface of Iceland spar, is a mistaken one. The exposure of elementary rhombs with faces oblique to the general surface, would show themselves in separate rays inclined to the principal pencil, especially in solar light. It could not for an instant be overlooked by an experienced observer. Such faces I can produce at pleasure, by a slight chemical action upon the surface, whether polished by crystallization or by art; and it is impossible to confound the pencil which they reflect, with that which is given by the general surface. It is useless, however, to pursue this argument any further, because I have obtained exactly the same results in using natural faces, and in using artificial ones, and especially on planes perpendicular to the axis of the crystal, where I have found the same results with the natural faces of the *Chaux carbonatée basée* of Hauy, and with those produced by artificial grinding. In this case the coincidence is still more remarkable, as the very friction of the finger is capable of developing on this surface the faces of elementary rhombs; but the reflexions from these never disturb in the slightest degree the physical action of the general surface. I have no doubt that Prof. M'Cullagh will concur in the accuracy of these views, and, with that candour which distinguishes him, will acknowledge, as he has almost done already in the preceding note, that the undulatory theory is, generally speaking, incapable of explaining the phænomena of crystalline reflexion.

On a very curious fact connected with Photography, discovered by M. Möser of Königsberg, communicated by Prof. Bessel *to Sir* D. Brewster.

Sir D. Brewster said, he was requested to communicate an account of some remarkable facts connected with the theory of photography. A new process of producing photographic impressions had been discovered by Dr. Möser of Königsberg; and an account of the discovery had been brought to this country by Prof. Bessel, who received it from the discoverer himself. The subject was most important, and it would have been a great misfortune if the Physical Section had separated without being made acquainted with it. The following were the general facts connected with it:—A black plate of horn, or agate, is placed below a polished surface of silver, at the distance of one-twentieth of an inch, and remains there for ten minutes. The surface of the silver receives an impression of the figure, writing, or crest, which may be cut upon the agate or horn. The figures &c. do not appear on the silver at the expiration of the ten minutes, but are rendered visible by exposing the silver plate to vapour, either of amber, water, mercury, or any other fluid. He (Sir D. Brewster) had heard Prof. Bessel say, that the vapours of different fluids were analogous to the different coloured rays of the spectrum; that the different fluids had different effects, corresponding to those of the spectrum; and that they could, in consequence of such correspondence, produce a red, blue, or violet colour. The image of the *camera obscura* might be projected on any surface,—glass, silver, or the smooth leather cover of a book, without any previous preparation; and the effects would be the same as those produced on a silver plate covered with iodine.

On the Dichroism of a Solution of Stramonium in Æther. By Sir David Brewster.

The solution was yellow by transmitted light, but green by reflected light.

On the Geometric Forms, and Laws of Illumination of the Spaces which receive the Solar Rays, transmitted through Quadrangular Apertures. By Sir DAVID BREWSTER.

He said his attention was called to this subject by an accidental discussion on the point, whether or not Aristotle, in explaining the circularity of images formed by quadrilateral apertures, employed the appropriate idea when he said that those images were, to a certain extent, quadrilateral, but appeared circular, from the eye being unable to recognise faint impressions of light. Prof. Whewell, in his 'History of the Philosophy of the Inductive Sciences,' had distinctly stated, that Aristotle had not used the appropriate idea, and that the question was entirely a geometrical one, the appropriate idea being the rectilinear nature of light. Having been led accidentally to consider the subject, he (Sir D. Brewster) had determined in a simple manner the form of the aperture at all distances, and had been led to take the same view of the subject with Aristotle, who seemed to have employed the appropriate idea.

On Luminous Lines in certain Flames corresponding to the defective Lines in the Sun's Light. By Sir DAVID BREWSTER.

After noticing Fraunhofer's beautiful discovery as to the phænomena of the line D in the prismatic spectrum, Sir David said, he had received from the establishment of that eminent man, at Munich, a splendid prism, made for the British Association, and one of the largest, perhaps, ever made; and, upon examining by it the spectrum of deflagrating nitre, he was surprised to find the red ray, discovered by Mr. Fox Talbot, accompanied by several other rays, and that this extreme red ray occupied the exact place of the line A in Fraunhofer's spectrum, and equally surprised to see a luminous line corresponding with the line B of Fraunhofer. In fact, all the black lines of Fraunhofer were depicted in the spectrum in brilliant red light. The lines A and B turned out in the spectrum of deflagrating nitre to be both double lines; and, upon examining a solar spectrum under favourable circumstances, he found bands corresponding to these double lines. He had looked with great anxiety to see if there was anything analogous in other flames, and it would appear that this was a property which belonged to almost every flame.

On the Structure of a Part of the Solar Spectrum hitherto unexamined. By Sir DAVID BREWSTER.

He had, by means of the prism from Munich, been enabled to extend the solar spectrum beyond the point where, according to Fraunhofer, it terminated immediately at the side of the line A, and he (Sir David) found one part to consist of about sixteen lines, placed so near to each other, that it was difficult to recognise the separation; but the lines, as they approached to A, were much nearer to each other than as they receded from it; consequently, that portion of the spectrum appeared concave, resembling so much the scooped-out lines of a moulding on wood, that it was scarcely possible to suppose that the beholder was not looking at such a moulding. He was led to observe an analogous structure near the line B; and upon carrying on this comparison of structure of one part of the spectrum with that of another, it seemed to him, that, by and by, something important would result; for there was a repetition of a group of lines, and similar lines, through different parts of the spectrum, as if the same cause which produced them in one part produced them in another.

On the Luminous Bands in the Spectra of various Flames. By Sir DAVID BREWSTER.

He had endeavoured to procure all the minerals and artificial salts and other substances capable of combustion which could be had; and, in order to have a suitable combination, he used an oxygen light analogous to the Bude light. Every one conducting these experiments was aware that it was necessary to pass the light through a narrow aperture; but this would reduce the intensity of the light so much, as to make it difficult to observe the rays at the extremity of the spectrum; but he found that he could obtain the effect of a small aperture, by merely inclining the prism; so that, with a good prism, the great lines in the solar spectrum might be seen by using an aperture three or four feet wide, the whole breadth of the window, by the mere inclination of the prism, which had the effect of producing a narrowing, facing the light. He had obtained 200 or 300 results, which he had not had any leisure to group; but he would mention some of the general results. When nitrate of lead was thrown into combustion, remarkably fine lines were produced in the spectrum. The luminous line, D, of Fraunhofer, existed in almost every substance, especially in all into which soda entered, particularly in the flame of a common tallow candle; probably owing to the muriate of soda existing in the tallow. The hydrate of strontites gave the lines very remarkably in yellow and green. The iodide of mercury did the same. Also in that remarkable substance, the lithoxanthemate of ammonia, first discovered and published by Mr. Fox Talbot, the fine lines were seen throughout the whole length of the spectrum; and there was a remarkable blue band, which he (Sir David Brewster) had not distinctly recognized in any other flame. Indigo gave fine green and orange lines at equal distances from the D of Fraunhofer. Prussian blue did the same; calomel, nitrate of magnesia, litharge, also showed lines; the sulpho-cyanite of potash gave a violet and orange flame, with the lines extremely distinct. He hoped, at the next year's meeting of the Association, to be able to embody these various results in a regular report.

On the Improvement of the Telescope. By H. Fox Talbot, *F.R.S.*

Mr. Fox Talbot said, that this subject occurred to him about two years ago, when the Earl of Rosse (then Lord Oxmantown) was making much larger specula for reflecting telescopes than had ever been obtained before; and he thought, if once we had a very large and perfect speculum, it might be possible to multiply copies of it by galvanic means. He had observed, that if an electrotype cast were taken from a perfectly polished surface, the cast was also perfectly polished; so that no defect of form from this cause could have an injurious effect on the speculum. The great and obvious defect was, that electrotypes were in copper, which reflected but little light. He mentioned these ideas to Prof. Wheatstone, to whom the same views had occurred previously, as he showed Mr. Talbot a paper which he had drawn up some few months before, in which he suggested the making specula of platina, palladium, silver or nickel, by precipitating a sufficient thickness of these metals upon the mould to obtain a perfect surface, and afterwards precipitating a less valuable metal, as copper, to form the body of the new speculum.

Though it had occurred to Mr. Talbot to precipitate white metals, yet he did not think that platina would have a sufficiently beautiful white metallic polish. Prof. Wheatstone had, however, made choice of platina; and, varying the quantity till he found the required proportion, he obtained a mirror in platina, which appeared to him (Mr. Talbot) to have quite brilliant polish enough, and to be white enough to answer the purpose; and he considered, therefore, that Prof. Wheatstone had proved, that, at least in one form, the specula of telescopes might be made by voltaic precipitation. His own idea was, that it might be possible to whiten the surface of the copper without injuring the form; and, therefore, having obtained a speculum in very bright, polished copper, be (Mr. Talbot) whitened it, and transformed it into sulphuret of copper, by exposing it for a minute to the vapour of hydrosulphuret of ammonia, which did not injure its polish, but after passing through a series of varied colours (scarlet, blue, &c.) rendered it very white; and after having retained this speculum about a year, he did not perceive the smallest alteration in any respect. This, therefore, appeared to him a mode by which important results could be obtained. There was no danger of such a speculum being oxidated by the air, since it was already in combination with sulphur, a more powerful chemical affinity than oxygen.

For the last year, perhaps, nothing further had been done, either by Prof. Wheatstone or himself; but lately, being at Munich, he visited Prof. Steinheil, and saw his inventions, and learned from him that he had discovered a method of making specula by the electrotype. It so happened, that both Prof. Steinheil and himself had published their respective methods about a month or six weeks before; the Professor having read a communication on the subject before the Academy of Sciences at Munich, and printed it, and Mr. Talbot having published his in England. Their modes were, however, different, as Prof. Steinheil precipitated gold upon the speculum which was to be copied, and having precipitated a certain thickness of gold, he then precipitated copper on the back of the gold, to give it sufficient thickness. He (Mr. Talbot) should have thought beforehand that gold would not reflect light enough to be available; but Prof. Steinheil informed him he had found, by careful experiment, that it reflected more light than polished steel. He allowed Mr. Talbot to look through a Gregorian reflecting telescope, of which the speculum was a common one, but gilded, and he found the image perfectly clear and well-defined, though a slight tinge of yellow was thrown over all the objects. Prof. Steinheil said, that in the course of a year he should have a very large telescope, furnished not only with a speculum, but also with other apparatus, voltaically formed, so that telescopes might be made all from a good model, so as to insure greater accuracy of proportions; and in this way even very large telescopes might be constructed at a comparatively trifling expense. With reference to precipitating copper on the back of the gold, the Professor had a simple expedient for securing adhesion. He first precipitated gold from the cyanide of gold, and he mixed with it cyanide of copper, and kept gradually increasing the quantity of the latter, so that an alloy was precipitated, which was continually increasing the copper with respect to the gold, till he had a speculum whose surface was gold, and which then became an alloy, the quality decreasing, till, at the bottom, it became pure copper. This was important; because, without such experiments, one would not have known that such results would have followed; for some philosophers supposed, that, if we attempt to precipitate the salts of two metals, only one is precipitated; but Prof. Steinheil informed him that they precipitated in union. He thus obtained a speculum with a face of gold and a back of copper.

But, supposing the largest, cheapest, and best speculum was obtained, the framework of the telescope would be so gigantic, that few observers would be able to use the instrument. With a focal length of sixty to eighty feet, it would be quite unmanageable for any private individual. The idea occurred to him (Mr. Talbot), to have a tube fixed in an invariable position, and to have a perfectly true plane mirror, of a size somewhat larger than the concave speculum, placed in front of the tube, with an aperture in the centre. This plane reflector should be moveable about its centre in any direction; so that rays from luminous bodies, falling first upon the plane reflector, were then reflected against the concave reflector, and then passed through the aperture. The only motion requisite for the plane mirror would be one about its centre. The mechanical difficulties in the way of this plan would be far less than in the common method. Prof. Steinheil's idea on this point was somewhat different. He (Mr. Talbot) had thought of placing the tube in a horizontal position, which, in the case of a tube of very great length, has manifest advantages. Prof. Steinheil's idea was, that it should be pointed directly to the pole of the heavens.

On the Theory of Magnetism. *By* JOHN GOODMAN.

Having frequently attempted in vain to produce electro-magnetic effects by the current from the electrical machine and metallic conductors, the author at length resolved upon employing such imperfect conductors of the current as would arrest the speed of the frictional fluid, and cause it to progress more in the manner of voltaic electricity. For this purpose he used a slip of common writing-paper as a conductor in place of copper wire employed in electro-magnetism, and instead of the soft iron substituted a plate of thin window-glass. This plate being arranged upon insulating pillars, it was found, after several test experiments, that the greatest weight that could be sustained was supported by suspending the same to a card or paper armature affixed to the under surface of the glass, whilst *a continuous current* from the positive to the negative conductor of the machine was transmitted along the upper surface of the plate by means of two half sheets of writing-paper. In this manner a weight of five ounces and twenty grains was sustained for some time, which, in proportion to the quantity of electricity in the current, is probably as great as is ever supported by any electro-magnet whatever.

From the success of this experiment the author contended, that for anything at present known this may be the principle of magnetic action; nor does he see any reason for seeking other explanation of magnetic phænomena than the simple laws of ordinary electric attraction and repulsion. He also suggested that the crystalline nature of iron may render it more capable of polarization by electric influence than the other metals; and if a polar effect be obtained, so that the electricity of one particle shall pass on to the next in the series, and so on throughout the length of the bar, and shall not be enabled to return without the removal of the inducing force, the elementary particles of such bar will be placed in a condition for exalting the tension of each other from end to end (as is the case in the multiplication of pairs of plates in a voltaic battery), and produce what may be termed "reciprocal polarization."

The particles of steel may be so separated by the carbon which it contains, and by the process of hardening, as entirely to prevent the return of the fluid after polarization has been effected; and finally, if the force of each particle be doubled by the reciprocal polarization of the one next in line, and this by the next, and so on throughout the series, it may readily be conceived that a degree of tension would be produced at each end of a bar magnet, which would be capable of inducing in a piece of metal of a similar kind, the same condition at a considerable distance, and develope indeed all the phænomena exhibited by this wonderful agency.

On the Cause of Dissimilarity of the Voltaic and Ordinary Electricities. *By* John Goodman.

There had arisen on the part of Dr. Faraday and other eminent electricians, objections to the use of the *guarded poles* in decomposing water, described by Dr. Wollaston as being unidentical with voltaic decomposition, but the poles made use of in an apparatus constructed by Mr. Goodman were of fine platina wire *completely unguarded.* Poles of this description, one-eighth or one-sixteenth of an inch in length, had been frequently employed by the author, and had readily decomposed water by the *current alone* from the electrical machine.

Mr. Goodman then proceeded to point out his view of the cause of dissimilarity in the two fluids, and in so doing adverted to the phænomena exhibited in the employment of the condensing electrometer.

On electrolyzing the plate in communication with the gold leaves, the latter instantly diverge, and exhibit considerable "*tension.*" But on drawing near the opposing uninsulated plate, a gradual collapse of the leaves is uniformly the result, approaching each other as the plate advances, and when it has arrived at a given distance, the leaves are found in perfect opposition. But on removing the same they again diverge, and this process may be repeated many times under favorable circumstances. During the period when the leaves are apart, the electricity by which the electrometer is charged is found to possess much "*tension,*" that is (according to the views of the author), powerful *attractive* and *repulsive* properties, and in consequence much elasticity of character, great mechanical force, momentum, and capability of resisting atmospheric pressure, and considerable magnitude of spark, &c.&c.; but when the plates are in a given degree of apposition, all these properties disappear, and are supplanted by others more resembling the character of the voltaic than ordinary electricity. Its high tension is subdued, and the *increased capacity* of the plate for a further supply of electricity of the same kind, evinces the disposition of the fluid to become more and more *condensed,* and assume that condition which may with great propriety be termed "intensity." Hence we may infer, as stated by Dr. Faraday, what "an enormous quantity of electricity is present in matter," the atomic particles of the same being at all times subject to the polarizing influence of each other, at atomic distances, and inducing thus an amazing capacity for, and condensation of fluid. It is not improbable that electricity in this condensed condition *occupies the interior* of metallic bodies, that it is indeed the peculiar fluid of the atomic particles of matter, and yet *that of high tension* resides on the *mere surface* of metallic conductors. The cause then of dissimilarity in the two modifications is, that in the one case (the voltaic) the *elementary particles* of all the matter, fluid and solid concerned in its production, are continually *in contiguous relation to each other;* and in the other modification (the frictional) the *two main antagonist or opposing forces* are removed and *separated* by the revolutions of the cylinder to a considerable distance from each other. The positive fluid upon the surface of the cylinder is removed completely out of the sphere of action of its opposing negative force, situate in the rubber, and is afterwards subject only to polarizing influence from remote bodies. Mr. Goodman exemplified this view of the subject by diagrams and further explanations.

On the Positive and the Negative Streams of Electrified Air, and on an Electrical Machine fitted for examining them. By the Rev. C. J. KENNEDY.

On Improved Magnets, and the different Modes of determining their Powers, with an Account of certain undescribed Phænomena in Permanent Magnetics. By the Rev. W. SCORESBY, *D.D. F.R.S., &c.*

The author having called attention to the varying relations of capacity for, and retention of, the magnetic condition in specimens of steel of different mass, hardness, and quality, showed by experiments with compound magnets, constructed by himself after an extended investigation of their relations, the possibility of communicating and retaining very unusual magnetic energy in systems of bars, suited for various practical purposes. A magnet exhibited was stated to be of nearly ten times the power of one on the ordinary principle of equal mass. The phænomena exhibited by it were, indeed, very striking, particularly its capability of suspending above 10,000 small nails in a loop which could be moulded like plastic clay.

In respect to the different methods of determining the powers of straight bar magnets, Dr. Scoresby showed the superiority in convenience and comparability, of the method of deviations, over that of torsion, and mentioned as a general result, that small bars exhibited greater proportionate magnetic energy than large bars.

It appeared to have escaped notice that a considerable proportion of the energy of magnets taken in combination existed in a state of *elastic suppression*, so that, on separation of the bars, a great increase of energy is exhibited in their individual powers. This weakening of some bars placed in contact might even in some cases proceed so far as to give to such bars an opposite magnetic condition whilst in the mass, and thus really diminish the power of the combination.

The result of his numerous experiments on the subject of the communication and retention of magnetism, was to enable him to show what, for any specific purpose, was the best quality and denomination (as blister-steel, cast-steel, &c.) of steel, and the right degree of hardness. For certain researches concerning the earth's magnetism, Dr. Scoresby proposed powerful short compound bars (six inches or less in length), of sufficient mass to carry reflecting mirrors for determining minute changes of direction.

Colonel Sabine read a letter which enclosed Boguslawski's Report 'On the Observations made by him in Breslau with the Magnetic Instruments belonging to the British Association.'

Supplementary Report of a Committee on Waves. By J. S. RUSSELL, *M.A.*

Much of the difficulty experienced in attaining clear conceptions of the phænomena and mechanism of waves is to be attributed to this circumstance, that we are apt to confound with each other, under the general name of Wave Motion, a variety of phænomena essentially different in their origin, their form and their laws. This essential diversity the author of this paper had formerly endeavoured to establish, more especially in the case of that species of wave which he had called the Wave of Translation. In his memoir of observations made in 1834–35, he had indicated the existence and described some of the phænomena of two other classes of waves, as also in the former printed Reports of the Association; but he had lately embraced an opportunity of extending his observations and maturing a classification, which he now submitted to the Section.

Of waves, there seem to be three great orders obeying very different laws:—

(1.) *Wave of the First Order.*—The wave of translation is solitary, progressive, depending chiefly on the depth of the fluid; has two species, positive and negative.

(2.) *Waves of the Second Order.*—The oscillatory waves are gregarious, the time of oscillation depending on the amplitude of the wave; of two species, progressive and stationary.

(3.) The *waves of the third order* are capillary waves; gregarious: the oscillations of the superficial film of a fluid, under the influence of the capillary forces, extending to a very minute depth, short in duration; of two species, free and constrained.

The last of these classes he had not before minutely examined, and to them he wished to draw the attention of the Section, as amongst the phænomena which we most frequently see and have yet failed to examine. Although these waves were noticed by the author in 1834 and figured in a memoir of his own, which drawing had since been published by M. Poncelet in his 'Mécanique' along with an announcement that he had observed the same waves in running water, yet they had not hitherto attracted notice, or been thoroughly examined by Mr Russell or any one else. He believed them to be the minute waves or dents indicated by the theory of Poisson, he had therefore thought it his duty to examine them.

The waves of the third order were observed by Mr. Scott Russell in the following manner. A slender brass wire was inserted vertically into a still fluid, and drawn in that position slowly along its surface. When the velocity is one foot per second, the surface of the water exhibits a group of waves of great beauty and regularity, extending forwards before the exciting point and spreading on both sides of it in the form of a con-focal group of hyperbolas; the focal distance of each hyperbola and its asymptotes being determined by the velocity of the motion. Although the exciting point was of no more than $\frac{1}{16}$th of an inch in diameter, these waves extend over several feet, and the diagrams exhibited the phænomena as having great regularity and beauty. Numerical results, showing the number of these waves in an inch of distance from the exciting point, were given, and are nearly as follows:—

Velocity of moving point.	Number of waves in an inch.
55 feet per minute.	2
60 ,, ,,	3
65 ,, ,,	4
72 ,, ,,	5
80 ,, ,,	6
90 ,, ,,	7
103 ,, ,,	8
120 ,, ,,	9

These waves were examples of capillary waves not in free but constrained motion. He had generated them in a different manner, so as to examine them in free motion uninfluenced by the generating point, and found that the capillary waves when moving freely have a constant velocity of $8\frac{1}{2}$ inches per second; that their duration is short, becoming insensible in about twelve seconds after describing a path not longer than eight or nine feet: in the free state this breadth is very small at first, gradually increases, and just before vanishing attains an amplitude of nearly an inch.

The capillary waves are among the phænomena we most frequently observe. It is in generating them that a gentle breeze forming over the surface of a smooth lake destroys the translucent and reflective power of the surface; they are also to be observed in all cases of primary and secondary wave motion when the superficial film is by any cause compressed so as to produce corrugation; and they always disappear in about twelve seconds after the exciting cause is removed.

The second order of waves had also been made the subject of careful observation. A mode had been discovered of generating those waves in large groups, so that instead of observing single waves the length of one could be deduced from the measured length of a number, thus getting the advantage of repetition of the quantity observed. It had thus been finally determined that these oscillating waves follow Newton's law, in so far that the velocities of transmission are as the square roots of the amplitudes; but the absolute velocity differs from that of Newton, so that instead of having the wave whose period is a second of an amplitude = 3·26, it is found to be = 3·57. The velocities determined are as follows:—

Velocity of transmission of wave.	Amplitude.
3·01 feet per second	2·65 feet
3·16 ,, ,,	2·94 ,,
3·29 ,, ,,	3·125 ,,
3·37 ,, ,,	3·26 ,,
*3·57 ,, ,,	*3·57 ,,
3·72 ,, ,,	3·913 ,,
3·84 ,, ,,	4·20 ,,
4·16 ,, ,,	5·00 ,,
4·62 ,, ,,	6·25 ,,

He had also completed some further examinations of the wave of the first order, and could now present the subject in a tolerably complete form.

Observations on Oceanic Waves. By WILLIAM WALKER.

After detailing the advantages which the locality where these observations were made (Bovisand, near Plymouth) possessed for such an object, such as complete exposure to the waves of the Atlantic, a series of buoys at ascertained distances, well-observed soundings, a tide gauge fixed at the pier, and elevated cliffs from which the waves in series may be conveniently observed, the author described his methods of observing, and presented in a tabular form the results of his observations made during the last winter.

Observations on Waves; generated in the Atlantic and reaching the Plymouth Breakwater. By WILLIAM WALKER, Queen's Harbour Master.

Time of observation.	Direction of wind.	Height of barom.		Course of wave.	Distance traversed.	Distance between waves.	Time of transit.	Velocity per second.	Velocity per hour.	No. waves in space.	Height of wave above level.	Remarks made at the time of Observation.
1841.		°	feet		feet	feet	sec.	feet	sea miles		feet	
Sept. 7.	S.S.W.	29·7	46	N.E. by N.	2760	110½	136	20·2	11·9	25	2¾	A fresh breeze blowing.
Sept. 5.	N.E.	29·72	48	N.E.	2265	175	66	34·3	20·3	13	2½	Yesterday wind westerly: waves not easily traced: counted them, &c.
Aug. 11.	N.N.W.	29·65	46	E.N.E.	2265	302	61	37	21·9	7½	4	Obs. made after a strong S.W. wind: high seas overtake smaller ones.
Sept. 14.	S.E.	29·7	49	N.E.	2760	345	75	37	21·9	8	4½	These waves came down channel.
Oct. 2.	N.E.	29·7	45	N.E.	2760	306	75	37	21·9	9	—	Long and low swell, subsiding from late gales.
Sept. 30.	N.N.W.	29·24	40	N.E.	2760	408	67	41·2	24·2	6¾	—	Swell of moderate height: wind moderate: small waves have merged into large ones.
Sept. 29.	S.W.	29·23	45	N.E.	2760	442	66	41·8	24·7	6¼	27	*Height of waves correctly* measured: they break in 5 and 6 fathoms water!
Sept. 28.	S.S.W.	29·36	42	N.E. by N.	2760	450	61⅔	44·7	26·5	6⅛	(?)	Strong S.W. wind.
Sept. 28.	S. by W.	29·15	50	N.E. by N.	2760	460	60	46	27·2	6	—	Waves running high and breaking on the Tinker shoal (30 feet): cranes washed down on the breakwater.
Oct. 1.	N.W.	29·57	47	N.E.	2760	345	60	46	27·2	8	5	A long low swell from the Atlantic.
1842. Jan. 14.	Calm	29·6	40	N.E. by N.	2760	394	72	38·3	22·7	7	—	These waves generated by wind of yesterday!
1841. Sept. 13.	E.	29·7	48½	N.E.	2760	345	64	41·5	24·5	8	4	Waves *distinctly* traced: they crowd near beach.
1842. March 2.	N.W.	29·2	49	N.E. by E.	2760	306	75	36·8	21·6	9	irregul.	Weather unsettled: wind shifting about.
April 29.	E. by N.	29·85	48	N.E. by E.	2760	460	65	42½	25·2	6	regular	These waves reach us during a series of strong *easterly winds*.

From these data it does not appear that the ratios between the heights, velocities, and other elements of waves, are regulated by any constant law. On the 28th of September the waves were found to travel at the rate of 46 feet per second, being 460 feet apart, and breaking in five fathoms water; the next day their velocity was only 42 feet per second, and the height of an unbroken wave was 27 feet above the surface level! These waves were breaking in five and six fathoms. On the 1st of October the velocity of the waves travelling at right angles to the wind, was 46 feet per second, the distance between the waves was 345 feet, and their height *only* 5 *feet!*

On the Tidal Phænomena in the Bay of Fundy and the River de la Plata. By Mr. Rook.

On the Meteorology of the Province of Coorg, in the Western Ghâts of India. By Colonel Sykes, *F.R.S.*

In offering a further contribution in support of an almost established law in meteorology, a few prefatory observations may be useful. Towards the end of the last century it was remarked, in a series of barometrical observations made at Calcutta, that there was a periodicity in the daily rise and fall of the mercury; the barometer throughout the whole year being highest between 9 and 10 A.M., and lowest between 4 and 5 P.M., the semi-diurnal oscillation however varying from ·030 to ·150 or even ·170. Humboldt determined the same fact in South America, not only at the level of the sea, but on the elevated plateaux of the Andes, finding however that there appeared to be a gradual diminution of the oscillations between 9—10 A.M. and 4—5 P.M. *in proportion* to the ascent or elevation above the level of the sea. These phænomena led to hourly barometrical observations, and it was found that whereas during the day there was a maximum pressure between 9 and 10 A.M. and a minimum pressure between 4 and 5 P.M., so during the night there was a maximum pressure between 10 and 11 P.M. and a minimum pressure about 4 or 5 A.M.; thus establishing two ascending and two descending waves or tides in the atmosphere during the twenty-four hours. My meteorological observations, carried on for several years in the Deccan at 2000 feet above the sea, and published in the Philosophical Transactions, were entirely confirmatory of those made by Humboldt; there never having occurred a single instance, whatever the season of the year, wet or dry, hot or cold, in which the barometer was not higher at 9—10 A.M. than at 4—5 P.M. The same facts were obtained from the Nilgherry mountains at 8000 feet above the sea—by Colonel Sabine from the coast of Africa—and from numerous other places within the tropics. From the irregular movements of the barometer beyond the tropics, the phænomena escaped observation for some time, but of late years numerous careful observations and a series of averages have eliminated the same facts which characterise the tropics, the amount or range of the semidiurnal oscillation, however, gradually diminishing from the equator towards a parallel not yet determined, in very high latitudes (but which is beyond 70° N.), where the hours of maximum and minimum pressure are not the same as at the equator. Mr. Snow Harris's singularly uniform successions of curves of average pressure of the barometer at Plymouth for several years, show the same hours of maxima and minima that I found in the Deccan; and by a series of observations transmitted to Colonel Sabine from Finmarken, in latitude 70° N., the average height of the barometer is still found in that high latitude to be greater at 9 A.M. than at 3 P.M., the mean annual temperature of the place of observation approximating to the freezing point.

Although there is a perfect accordance in the hours of maximum and minimum pressure within and without the tropics, there is not the same accordance in the extent or range of the semidiurnal oscillation of the barometer. In the tropics it is considerable; in high latitudes very small; and from such observations as have been made in intermediate latitudes, grounds are afforded for the belief, that the amount of the semidiurnal oscillation gradually diminishes from the equator toward the poles, and that the time of the occurrence of maxima and minima are reversed, the exact latitude where this change takes place not being yet satisfactorily determined.

With these prefatory observations I may state, that the meteorological observations obligingly communicated to me by Dr. Blest of the Madras army, from a new locality in the Western Ghâts, are entirely confirmatory of those I made in the Deccan respecting the movements of the barometer.

The following is the acceptable Meteorological Register from Dr. Blest of the Madras Medical Service, which he prefaces by a quotation from an official Report made by Dr. Baikie:—

"*Temperature.*—The temperature of Coorg is one of the most moderate and equable in the world, the daily range in doors never exceeding 6° or 8°, often not beyond 2°, and the thermometer seldom rising higher than 74°, nor sinking below 60°, in the open air. The range is a little higher during the dry season, the daily extremes being between 52° or 53°, and 68° or 70°; the annual extremes are probably 52° and 82°. The want of a maximum and minimum thermometer prevents my even *guessing* at the mean annual temperature, but it cannot exceed 65° or 66°.

"*Pressure.*—The maximum of the barometer occurs during the dry season, the highest noted being 26·220, and the lowest in July during the monsoon 25·912. The greatest daily range observed was ·076; the mean daily range (which is very regular) ·050. The diurnal maximum occurs at 10 A.M., the minimum at 5 P.M., with such regularity that I have often detected an error in the supposed time by looking at the barometer at these hours. The barometer appears to offer no indication whatever of approaching changes of weather, and I have not been able to detect any influence of the lunar phases on it.

"*Moisture.*—The hygrometrical state of the atmosphere during half the year is that of extreme moisture, closely approaching to saturation. During the dry season it is occasionally very dry, and sometimes undergoes most remarkable difference to the eye or feelings."—*Extract from Dr. Baikie's Report.*

The above, in reference to *temperature,* Dr. Blest observes, differs somewhat from the result of his observations, owing to greater exposure of his instruments, which were self-registering thermometers. According to Dr. Blest the following are the results of three years' observations:—

Annual mean maximum	76°·4
Annual mean minimum...........................	60 ·8
Annual mean temperature.........................	68 ·6
Annual mean diurnal range	15 ·6

Monthly Abstract of the daily Meteorological Register kept at Merkara *, in Coorg—the mean for three years, 1838, 1839, and 1840.

Months.	Monthly mean of thermometer.				Monthly mean of the hygrometrical state of the atmosphere, as taken at 9 A.M.						Mean height and daily range of barometer.			Pluviometer. Total fall of rain daily. Inches and cents.
	Maximum.	Minimum.	Mean temperature.	Mean daily range.	Dry bulb, at 9 A.M.	Wet bulb.	Difference.	Quantity of moisture.	Dryness.	Dew-point.	9 A.M.	5 P.M.	Mean daily range.	
Jan.	76·2	57	66·6	19·2	64·7	59	5·7	168	61·8	52·5	26·160	26·100	·060	None.
Feb.	78·8	62·8	70·8	16	71·5	67	4·5	190·7	84·4	57·2	26·172	26·135	·037	·45
March	83·5	63·9	73·7	19·6	75	68·2	6·8	216·2	84·2	62	26·140	26·070	·070	1·51
April	81·5	64·7	73·1	16·8	75·3	68·2	7·1	214·2	88·9	61·7	26·103	26·056	·047	2·60
May	79	64·8	71·9	14·2	74·3	68	6·3	217	79·3	62·2	26·090	26·040	·050	7·37
June	74·3	64	69·1	9·3	72·4	68	4·4	230	49	64·4	26·161	26·012	·049	30·40
July	71·9	62·4	67·1	9·5	67·5	65·5	2	225·2	23·4	63·6	26·088	25·970	·030	55·88
August	72·2	59·9	66	12·3	66·2	64	2·2	213·6	27	61·5	26·007	25·980	·027	27·
Sept.	72·4	58·8	65·6	13·6	67·9	65·2	2·7	219	31·8	62·6	26·050	26·010	·040	11·91
Oct.	76	57·6	66·8	18·4	69·3	65·3	4	213·1	47·2	61·5	26·070	26·020	·050	4·60
Nov.	73·8	59·2	66·5	14·6	65·6	61·3	4·3	187·5	48·7	56·2	26·115	26·080	·035	1·38
Dec.	73·2	55·6	64·4	17·6	63·8	58·5	5·3	125·3	100·3	40·8	26·140	26·100	·040	·25
													Annual mean...	143·35

PREVAILING WINDS.—January, N.E.; February, N.E.E.; March, N.E.; April, W. and variable; May, N.W. by W.; June, W.S.W.; July, S.W.; August, S.W.; September, S.W.; October, S.W. N.E.; November, N.E.; December, N.E.

* N.B. The instruments (with the exception of Pluviometers) were kept in the outer recess of a window in the north side of Merkara Palace, and perfectly exposed to the open air, while protected from glare.

Merkara is the capital of Coorg, seated at an elevation above the sea of 4500 feet, about 65 miles east from Caunanore, in that tract of land lying on the edge of the Western Ghâts, between the parallels of latitude 12° and 12°·52 N., and 73°·30 and 76°·10 E., being about 58 miles long by 25 broad, the whole tract being a mass of hills and narrow valleys, varying in height from 2500 to 5700 feet.

Remarks.—The months of January and February are cold and very dry; the range of temperature is considerable; the morning and evening excessively cold, with dew throughout, and partial fog in the valleys from 3 to 5 P.M., while the heat of the sun in the middle of the day is tempered by a constant cold breeze from the N.E., frequently blowing with such violence as to raise clouds of dust and become unpleasant.

In March the cold of the night becomes less sensible, and the days are warmer, while the wind is less violent and is variable; days clear, the air still continuing in general dry, but fluctuates occasionally; evenings occasionally foggy.

April and May are delightful; the heat of the day, which begins to be oppressive out of doors, being tempered by frequent showers and thunder-storms; occasionally, though rarely, there is some closeness in the air, but the nights are always cool.

In June the monsoon sets in, but at variable periods of the month; the commencement is seldom violent, but about the end of the month the rain frequently falls in torrents.

July. This month is characterised by universal gloom, impenetrable dense mist, high bleak winds saturated with moisture, and incessant rain, the greatest fall in twenty-four hours being inches 11·25 cents; a faint glimmering of sunshine for a few days.

The rain continues more or less during August and September, with occasional short intervals of sunshine, the air loaded with moisture, and when the rain ceases there is usually a dense fog.

In October there is an interval of bright and beautiful weather, rendered the more delightful by contrast, and by the intense green of the luxuriant vegetation; about the commencement of the month the wind usually settles in the N.E., and when strong it is piercingly cold.

November. The weather is extremely bleak and raw, the mornings characterized by dense mist and drizzle, swept along by a strong N.E. wind, the days gradually becoming clearer, but the evenings calm, mild and balmy.

December is intensely dry, sky clear, strong steady wind from the N.E.; weather very pleasant; nights and mornings extremely cold.

Although the amount of rain recorded in the above register does not equal that which falls at Malcolm pait on the Mahabuleshwar hills, viz. 302·21 in., it still attests the deluge-like character of a monsoon in the Ghâts of Western India.

W. H. SYKES.

On a Cycle of Eighteen Years in Atmospherical Phænomena. By LUKE HOWARD, *F.R.S. Accompanied by a Chart, Plate* II.

In a *Cycle of eighteen years*, from 1824 to 1841, the seasons are found, by observation at the *Friends' School at Ackworth* in the West Riding of Yorkshire, to go through their extreme changes of wet and dry, of warmth and coldness; returning at the end to the same (or nearly the same) state again.

The lower figure of the Chart presents on a scale the mean or average *Temperature* of each year, adapted by a curve to a mean line, representing the climatic (or eighteen years) average of the heat of the district. The yearly averages differ to the extent in the whole of 4½ degrees of Fahrenheit; the spaces by which they exceed the climatic mean are coloured *Red*—those by which they fall below it, *Blue*. It will be seen at once that, in point of warmth, *the years run through a cycle*, the warm side of which lies to the left, and the cold side to the right, of the dividing line in the middle.

Above are represented, in two columns, first the proportionate appearance (as indicated by observations made once a day) of the *four classes of winds* through each year; beginning at North (coloured *blue*) and proceeding to the point next the East; thence (coloured *yellow*) to the point next South; thence (coloured *red*) to that next West; and thence (coloured *green*) to North again; the remainder (left blank) representing the number of days on which no decided wind blew. Secondly, on the right, the depth of *rain for each year*, as found by an accurate gauge placed at the level of the ground; *also* its depth *in each season* of the year, shown by a dividing line—the whole of these referrible to a scale of inches on the right.

The reader may thus compare, by a single glance, the state of different seasons, as, 1. in respect of *calm and windy days*, the white blanks differing greatly among themselves, and exceeding greatly in amount on the warm side of the cycle; 2. in respect of the prevalence of *different classes* of winds—as from the North and East during the coldest years of the cycle, and from the South and West in stormy seasons preceding these; 3. in respect of *amounts of rain*, the wet and dry years being conspicuous; and of the *proportions* (found sometimes in gradual increase or decrease from year to year) in which it fell *in the different seasons*; the winter being placed lowest, the autumn at top. All which becomes still more interesting, when we are able to refer by recollection, or by any good register of the weather, to past seasons; or when we may compare what is here presented with seasons occurring hereafter.

Table of the Proportions of the Winds (by observation once a day) in each Year of the Cycle.

	N.—E.	E.—S.	S.—W.	W.—N.	Var. &c.		N.—E.	E.—S.	S.—W.	W.—N.	Var. &c.
1824	44	24	49	106	143	1833	40	10	156	65	94
1825	22	16	95	52	180	1834	44	9	207	70	35
1826	43	12	138	46	126	1835	21	4	225	66	49
1827	34	18	177	58	78	1836	36	6	251	55	18
1828	26	13	165	71	91	1837	39	9	118	100	99
1829	51	16	129	85	84	1838	68	57	77	137	26
1830	16	7	163	73	106	1839	70	47	139	101	8
1831	29	13	150	92	81	1840	62	28	146	97	33
1832	37	15	149	63	102	1841	43	39	166	94	23
Warm side.	302	134	1215	646	991	Cold side.	423	209	1485	785	385

North to East in warm period . .	302	in cold	423
East to South	134	. .	209
South to West	1215	. .	1485
West to North	646	. .	785
Variable and Calm	991	. .	385

If the Variable, &c. be distributed to the four classes in proportion to their amounts, the S.—W. will *exceed* on the warm side.

Meteorological Register for 1841–42, *from Diurnal Observations taken at Beddgelert in the County of Carnarvon. By* JOHN PRICHARD.

Month.	Barometer. Maximum during the Month.	Barometer. Minimum during the Month.	Thermometer. Maximum.	Thermometer. Minimum.	Wind. North.	North-East.	North-West.	West.	South.	South-East.	South-West.	East.	Pluviometer. Fall of Rain.	Weather. Fair.	Rain.	Snow.	Changeable.
1841.													in pts.				
May	30·10	28·60	69	42	1	...	3	...	1	4	22	...	4·21	16	5	...	10
June	30·10	29·08	60	51	2	4	7	2	1	3	11	...	3·13	20	2	...	8
July	29·89	28·90	62	50	1	...	19	3	...	...	8	...	7·77	9	5	...	17
August	30·00	29·11	60	52	5	...	8	3	1	...	14	...	11·76	10	13	...	8
Sept.	29·80	28·40	64	48	2	...	1	2	6	2	17	...	5·39	13	6	...	11
Oct.	29·73	28·16	56	44	5	4	6	3	4	...	9	...	9·72	9	15	...	7
Nov.	30·10	28·00	50	28	3	3	7	...	4	3	10	...	7·28	9	6	3	12
Dec.	29·87	28·35	50	31	5	3	10	1	1	...	10	1	9·32	3	7	1	20
1842.																	
Jan.	30·27	28·50	46	22	6	5	6	1	3	1	7	2	6·09	16	4	2	9
Feb.	30·28	28·64	46	28	2	...	1	4	1	1	19	...	3·84	15	3	...	10
March	30·04	28·75	48	36	2	1	11	1	1	...	15	...	8·19	10	5	...	16
April	30·10	28·86	60	34	3	3	4	...	...	11	3	6	2·35	26	...	1	3
					37	23	83	20	23	25	145	9	79·05	156	71	7	131

The several instruments are read off every day at 8 A.M. In noting the "diurnal state of the weather," it should be observed that by "Fair" is meant, that *no rain* fell—

by "Rain," that the day has been *decidedly wet*—"Snow," when any quantity fell—and "Changeable," showery and otherwise unsettled weather. The village of Beddgelert, where the above observations were taken, is situated on the south-west side of the Snowdonian range of mountains, and about twenty yards above high-water mark. The last summer (1841) was *unusually wet*.

On the Meteorology of the Northern Atlantic, the South-west Monsoon of India, and places adjacent. By THOMAS HOPKINS.

Mr. Hopkins argued that the common mode of accounting for the trade-winds and other great currents of the atmosphere was not correct. The general theory, he said, was that the action of the sun's rays on the earth at the tropics raised the temperature of the atmosphere; and that, as the air thus heated became specifically lighter, it naturally ascended; and, the cold air rushing in to supply its place, a current was produced. He did not mean to deny that such results took place, but he affirmed that the theory in question did not account for the various meteorological phænomena which have been observed, and that there was another cause which accounted for them in a much more satisfactory manner. He then proceeded to show, that the condensation of the air by great mountains, and the consequent precipitation of rain, must not be left out of account in explaining the monsoons and other periodic winds.

On a Meteorological Chart. By THOMAS HOPKINS.

On the Application of the Law of Definite Proportions to the Stratification of Clouds. By JAMES NASMYTH.

Mr. Nasmyth was first led to speculate on this subject by observing the arrangement of clouds in fine weather, when, towards the horizon particularly, they may be seen extended in parallel bands or stripes. He conceived that the excess of vapour floating in the atmosphere beyond what the air could combine with, formed clouds; and that the air, in each electric state, was capable of sustaining a definite proportion of vapour, and consequently that the clouds of one class or description floated (in what might be called a plane of equal electricity) at a uniform distance from the earth.

On the Changes in the Climate of England. By HENRY FAIRBAIRN.

The author proposes to prove that the low temperature of the summers of Europe is caused by the unusual presence of ice in the Atlantic Ocean. This he states to have been the fact during the four last cold summers, and adds, that the intelligence brought on the subject by steam-ships justified the expectation of the summer of 1842 in Europe being also chilled from the same cause in the Atlantic. About half a century since icebergs were a phænomenon in the Atlantic not visible until the autumn; now they increase annually in numbers, and appear as early as the month of March.

Interposed between Great Britain and America, and drifted eastward by the Gulf-stream on the line of the north-west winds which prevail in summer, these mountains of ice cool the air which blows from the west at that season, while the easterly winds are warm.

The augmentation of ice in the Atlantic is referred by the author to the increase of warmth on the North American Continent, consequent on the cutting down of the forests and the extension of civilization. By this means the ice is detached from the circumpolar bays and rivers at an earlier period, and floats further south before being melted than heretofore.

The President presented to the Section a pamphlet, transmitted for the acceptance of the British Association, from M. Lenz, containing two Essays, one 'On the Resistance of the Human Body to Galvanic Currents,' the other 'On the Theory of Magneto-Electric Machines;' also 'A Treatise on Atmospherical Electricity,' by M. Peltier.

On a new Optical Instrument. By Sir JOHN ROBISON.

Sir John Robison informed the Section that he had lately ascertained, by trial, that on a solid rod of glass being plunged into such a cavity as that of the external ear, the light reflected inwards, along the interior of the cylinder, illuminates the bottom of the cavity so as to render it distinctly visible through the matter of the glass, provided it be homogeneous, and the ends of the rod be properly figured and polished. He suggested that instruments on this principle should be made for the examination of such cavities.

TO THE SECRETARIES OF THE TWELFTH MEETING OF THE ASSOCIATION.

I offer my warmest and most sincere thanks to you, illustrious and honoured Sirs, for the honour of the invitation which you had the complaisance to send me in the obliging letter of the 13th April, 1842, to attend the Twelfth Meeting of the British Association for the Advancement of Science. I am very sorry to be unable to be present. In order to respond in some measure, and as much as is in my power, to an honour so conferred on me, I have desired my brother, who is at Turin, to send to the Meeting a copy of my Memoirs, published in Modena since 1836, and I have made an Abstract of my Sixth Memoir (not yet published) upon the Magnetizing Action of Transitory Electric Currents, which I take the liberty of sending you herewith. I trust that these productions may not seem unworthy to merit the attention of the meeting. I confide in your kindness and in that of your learned countrymen, and I hope you will receive my communication as a proof of my good wishes, and as a humble testimony of gratitude and of the high esteem I entertain towards the British Association.

I beg you to accept the sentiments of lively gratitude and profound esteem and consideration with which I am proud to subscribe myself, Gentlemen,

Your most obedient servant, STEFANO MARIANINI.

Modena, 1st June, 1842.

Abstract of an unpublished Memoir upon the Magnetizing Action of Transitory Electric Currents, in which it is proposed to explain the Variations in Magnetic Susceptibility which are frequently observed in Iron as often as it has been magnetized. (Addressed to the Twelfth Annual Meeting of the British Association for the Advancement of Science.) By Professor STEFANO MARIANINI.

A piece of iron magnetized to a certain degree, and afterwards deprived gradually of its polarity by the circulation of electric currents round it, presents the phænomenon, that, by a given current, it is magnetized more strongly or more feebly than it is in its natural state, according as the given current is so directed as to produce the north pole in the same part in which it had been produced from the beginning, or is directed in the contrary way. This phænomenon furnished, three years ago, the subject of my Second Memoir upon the Magnetizing Action of Transitory Electric Currents. But I then limited myself to the study of the laws of the phænomenon itself, of which it may not be inopportune to transcribe some here, for the better understanding of what follows :—

1st. If the magnetic susceptibility of a piece of iron be in one direction increased (that is, so that it may have the north pole at a given extremity), and if it be diminished in an opposite direction, the susceptibility may be inverted by treating the same iron with currents or other magnetizing actions contrary to those first employed.

2ndly. The increase of magnetic susceptibility in one direction equals the decrease of magnetic susceptibility in an opposite direction.

3rdly. If the action of a given magnetizing current is repeated upon the same iron, the alteration in the susceptibility goes on always diminishing.

After having long studied the means of depriving the iron of magnetic polarity, and especially the difference which occurs between the de-magnetizings produced by operations which serve also to magnetize, and those produced by operations which do not serve to produce magnetism in a sensible degree; and after an equally long study of the actions of the transitory currents upon magnetized iron, it seemed to me that I was able to explain this singular phænomenon. The three following propositions, inferred from the said studies, may suffice for my present purpose:—

1st. When an electric current is made to circulate round an iron endowed with magnetic polarity, a second is generated, which, together with that pre-existing, forms a system of two polarities, more or less strong than the first, or even entirely neuter, according to the force and the direction of the current employed.

2nd. The magnetic strengthening or weakening which is observed (when working as above mentioned), is proportionably less when the pre-existing polarity is stronger.

3rd. When magnetism is communicated to iron not magnetized, and not altered in its magnetic susceptibility, and a transitory current is then caused to circulate round it, a greater alteration is caused in the iron when it tends to magnetize it in a contrary direction, that is, to produce the north pole in the extremity in which the south pole is found.

Let us endeavour to demonstrate these three propositions. The co-existence of two conspiring polarities in one piece of iron I should not be able now to prove; but fortunately that is not necessary; and to explain the phænomenon of which we treat, it suffices that the co-existence in a piece of iron of such polarities cannot be doubted when they are contrary.

That such co-existence of opposite polarities is possible, is proved by the known fact, that two magnetic needles connected by poles of different name in contact, present a whole sometimes without any polarity, although, after whatever time they have been disunited they are both magnetized, as they were before they were connected. Still the consecutive points which are sometimes observed in magnetized needles, offer a proof that such magnetic systems may exist in the same iron. But here it is necessary to prove their existence in iron wires, in which not only are no consecutive points, but where there is no other trace of magnetism.

To succeed in this separation, I set to work to study those operations which serve to destroy magnetism, but not to generate it, at least in small masses of iron. Such are heating, blows, shocks, friction, flexure, &c. Wires or cylinders of iron or steel, from four to nine centimetres in length, and weighing from four or five grammes to almost a hundred grammes, I have never succeeded in magnetizing by the said means, especially if the irons had never been magnetized, or, had they been so, if the magnetic state had been taken from them by heating, or by any other of the said operations. Thus, as often as I destroyed by such means the magnetism produced in the iron by the electric currents, or by any other magnetizing agent, I never saw any variation in the magnetic susceptibility. The propositions deduced from the numerous experiments made upon the de-magnetizing action of the above-mentioned operations, cannot be inserted in this abstract. It may suffice to record the following:—

If an iron deprived of magnetism, and whose susceptibility has not been altered, be magnetized, and afterwards subjected to one of the said de-magnetizing operations, the portion of magnetism it will lose will be greater when the magnetization communicated to it has been weak. The following is a proof:—

A large iron wire, eight centimetres in length, and weighing twenty-seven grammes, was magnetized, so that the needle of the magnetometer deviated eight degrees*. Being let fall upon a table from the height of two decimetres, it lost so much force that the needle deviated but one degree. But having then magnetized it so that the needle deviated to 25°, and afterwards subjected it to a shock equal to the preceding, it yet did not lose the half of the magnetism which it had, since it caused the needle to deviate 14°.

* This apparatus consists of a needle, from the extremity of the cap of which rises vertically a stick of brass, to which, by means of a running ring furnished with screws, in order to stop it at a convenient height, is attached a small horizontal rod, which carries a tube of glass surrounded by a coil of copper wire covered with silk. The tube is parallel to the magnetic needle, and its central point is in the perpendicular which passes through the centre of the needle itself. The wire is so placed that its axis coincides with that of the tube, and from the firm deviation of the under needle we may judge of the magnetic force which the iron already possesses, or of that which is acquired by it in discharging the Leyden jar upon the copper coil which surrounds it.

Let us then take a piece of iron, and after having magnetized it, by causing transitory electric currents to circulate around it, let us treat it with contrary and weaker currents than the preceding, until it no longer presents any polarity. If with the said contrary currents I produced in the iron polarities which did not mutually destroy, but only neutralized each other, what should happen if the iron were subjected to some shock? This act destroys a greater portion of the weak polarities than of the strong, and therefore the iron after the shock will appear possessed of some degree of magnetism, in the direction in which it had been more strongly magnetized. And this is conformable to what the experiment shows.

An iron cylinder, nine centimetres in length and weighing fifteen grammes, after being magnetized so that the needle of the magnetometer deviated 60°, was deprived of all polarity by means of several electric currents, so that the needle pointed to zero. After this, having let the iron fall from the height of two metres upon the pavement, it recovered such magnetic force that the needle deviated 16°.

If, instead of acting with moderate or weak currents to neutralize entirely the polarity, some little is still permitted to remain, an iron is obtained, which has only force to cause the needle to deviate 6 or 7 degrees; but after the shock the needle deviated 16 or 17.

And if the weak and contrary magnetizations are made use of until the iron causes the needle to deviate 4 or 5 degrees in a contrary direction (that is, towards the east, if it first deviated towards the west), then is the iron in such a state, that, by means of the shock, it changes polarity, that is, presents the south pole at the extremity which had the north, and *vice versâ*.

These facts, which may be varied in many ways, prove, if I err not, that in a piece of iron treated as I have mentioned, there exist *systems* of magnetic force, which altogether or in part neutralize each other.

Let us proceed now to describe some experiments which show the truth of the other two propositions.

An iron wire eight centimetres long, and weighing 118 decigrammes, was magnetized until the needle of the magnetometer deviated 12°. A small Leyden jar (one square decimetre of coated surface), charged to the tension of 10° of the electrometer on the double quadrant of Volta, was discharged upon the coil in which was the iron, and so as to magnetize it in the same direction in which it was already, and the effect was that the needle of the instrument went from 12° to 25°.

Having destroyed the magnetism of the said iron by means of shocks, and then magnetized until the needle of the magnetometer remained at 59°, and having discharged as above upon the coil the small jar charged to 10 degrees of tension, the needle moved from 59° to 63°.

Whence it is seen, that the more the iron is magnetized the less a given current can strengthen its magnetism.

I magnetized another iron equal to the preceding, so that it made the needle deviate 9°, and after having discharged upon the coil which contained the iron the jar charged to the usual tension, but so that it might tend to magnetize it oppositely, the needle passed from the degree 9°, which it marked on one part to the 1° on the opposite part.

Having magnetized the iron again so that the needle deviated to 20°, and having afterwards discharged upon the coil the jar with its usual tension, and in a contrary direction, the needle moved from the 20° to the 10°.

Magnetism being also taken from the iron which then remained, then magnetized so that the needle remained at 60°, and then having caused to circulate round it the usual current excited by the small jar charged to 10° of tension, and so as to produce a contrary magnetism, the needle moved from 60° and stopped at 44°.

Thus, the more a piece of iron is magnetized, the less is its magnetism neutralized by a contrary current.

Another piece of iron similar to the preceding being magnetized so that the needle was fixed at 29°, and the jar with the usual tension being then discharged, and so as to strengthen the magnetism already possessed by the iron, the needle moved from 29° to 41°.

Having, by the usual mechanical operations, destroyed the magnetism of this iron, then magnetized so that the needle was at 27°, upon the discharge of the jar with the usual tension upon the coil, and so as to produce contrary magnetism, the needle moved from 27° to 12°.

Thus the said current acting so as to strengthen the magnetism of an iron which caused the needle to deviate 10°, increased it so much that it deviated 21°. But that magnetism being removed, and the same experiment being then repeated by causing the current to act in an opposite direction, the deviation of 10° west was changed to 3° east.

A given current, therefore, and the same degree of another magnetizing action has less effect when so directed as to strengthen, than when so as to neutralize the magnetism.

Which things being established, it becomes easy to explain the variations in the magnetic susceptibility of iron, of which we are here treating.

Let us suppose an iron magnetized with some force, as, for example, that the needle of the magnetometer may deviate 40°, and weaker currents being afterwards made to circulate round it, let it be reduced to the point of no deviation. This iron will be in such condition, that by a given current which circulates around it, it will be more strongly magnetized, when this serves to make the south pole appear from the same part at which it appeared when it was strongly magnetized, than when the same current is made so to act that it tends to produce the south pole from the part on which the lesser currents, which were made use of to neutralize the first magnetization, tended to produce it.

In fact, if with these discharges of the Leyden jar I have produced so many magnetic systems, which now exist in the said iron, by causing to circulate around it a given current, so directed as to tend to magnetize the iron, in the direction in which it had been strongly, it is very true that it will but little strengthen the magnetic system having the south pole towards the west, but it is true also that it will much neutralize the weaker and opposite systems. Hence a polarity ought to be manifested in the said direction, stronger than that which would be obtained with the same current before the iron had been treated in the manner we have mentioned. Since things being placed in the state of the preceding experiment, that is, the magnetism of the iron being neutralized, if an equal transitory electric current is made to act so as to produce in the iron the south pole on the opposite part, the neutralization of the strong magnetic system should be small, and equally small the strengthening in the opposite magnetic systems, and thence the resulting magnetization will appear weak.

I conclude this abstract with describing an experiment, in which, with a union of iron wires differently magnetized, the phænomena are imitated which the facts above stated make us suppose to exist in an iron when its magnetic susceptibility is changed.

I magnetized a bundle of six iron wires eight centimetres long, and weighing in all thirty-seven decigrammes, deprived of magnetism, and not changed in magnetic susceptibility, so that the needle of the magnetometer was caused to deviate 48° towards the west. With five other iron wires, slightly magnetized and in different degrees, united to the above bundle so that the north pole of the latter came in contact with the south poles of the former, I made a bundle of eleven wires which did not cause the needle to deviate. Having placed this bundle in the usual coil, and discharged upon it the small Leyden jar with the tension of 10°, and so directed as to produce the north pole in the said bundle, on the side where the six wires united together had it, such a magnetization ensued that the needle deviated 49°. And the experiment being repeated from the beginning, and the jar with the same tension of 10° being then discharged upon the coil, but directed contrarywise, a magnetization of only 22° ensued. Stefano Marianini.

Modena, 31st May, 1842.

CHEMISTRY.

On the Electrolysing Power of a simple Voltaic Circle. By Professor Schönbein *of Basle.*

The object of the experiments detailed in this paper, is to investigate the conditions under which the electrolysis of water takes place when a feeble electric current is employed. He found that when the negative platinum electrode is covered with a thin film of an oxidised substance, water is decomposed by a current, which under ordinary circumstances could not effect its electrolysis. From these experiments he was led to seek for evidence of a polarised state of the electrolyte, and he came to the conclusion, that the effects produced by oxidising and other substances in the vicinity of the electrodes, are partly due to the chemical action which takes place between the ions of the electrolyte and the matters which surround the electrodes, or the substance of which they are composed, and partly to a depolarization of the electrodes effected by those substances.

On the Electric Origin of the Heat of Combustion. *By* J. P. Joule.

The author had endeavoured, in a former paper (vide Phil. Mag. vol. xx. p. 98), to account for the heat evolved by combustion, on the hypothesis of its arising from resistance to electric conduction, and had shown that the affinity of atoms for one another is the measure of the heat evolved by their combination. In that paper he had introduced his own experiments on the quantity of heat generated by combustion. The simplicity of his apparatus had caused him to suspect that he had not collected all the heat evolved; but having lately reduced to English measure the results of Dulong's experiments, which were executed in a manner very well adapted to prevent loss of heat, he finds them to agree so nearly with his own results as to prove that the method he used was not incapable of accuracy.

The following is a table of results both of experiment and theory, reduced to degrees Fahr. per lb. of water:—

Quantities converted into Protoxides by combustion.	Dulong's Experiments.	J. P. Joule's Experiments.	Theoretical Results.	Corrected Theoretical Results.
	°	°	°	°
40 grs. of Potassium	......	17·6	21·47	
33 — Zinc	10·98	11·03	13·83	11·01
28 — Iron	9·00	9·48	12·36	8·06
31·6 — Copper ...	5·18	......	9·97	5·97]
1 — Hydrogen	8·98	8·36	10·47	10·40 *

All the theoretical results in column 4, except that for potassium, which was obtained by a more complicated process, were calculated in the following manner:—The electromotive forces necessary to separate the elements of the various oxides from the solutions of their sulphates were first ascertained; and then the quantity of heat which ought to be produced per equivalent of currents of these intensities, according to the laws which regulate the heat produced by electricity, was calculated, on the assumption that the intensity necessary to separate oxygen and metal from the sulphate is the same as the intensity of current caused by the union of those bodies in combustion.

Latterly, however, the author, finding reason to think that this is not the fact, but that part of the force of a current engaged in electrolyzing these compound bodies is used in separating the acid from the base prior to the decomposition of the latter, has endeavoured to obtain the correct results of theory by subtracting from the results in the fourth column the heat due to that extra intensity of current. These corrections were obtained by ascertaining the heat evolved by the solution of the various oxides in dilute sulphuric acid, and when subtracted from the numbers in the fourth column they leave those in the fifth.

The author is of opinion that he has thus succeeded in rendering evident the fact, that the heat of combustion is an electrical phænomenon, and that the method of its development is by resistance to electric conduction.

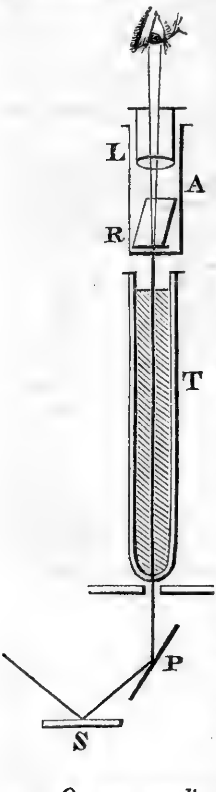
* Prof. Daniell finds that $\frac{3}{4}$ of an equivalent of sulphuric acid goes to the positive electrode when dilute sulphuric acid is electrolyzed. This demands the further reduction of the theoretical result for hydrogen by about one degree.—August, J. P. J.

On Apparatus for applying Circular Polarization to Chemical Inquiries. By Prof. Powell, *F.R.S., &c.*

The application of the phænomena of circular polarization as characterizing certain liquid solutions, has been fully pointed out by M. Biot, and an apparatus has been devised by him of the most perfect and accurate construction, for ascertaining and measuring the effects in question. That apparatus is however complicated, expensive, and very difficult to adjust, especially for those not familiar with optical experiments: and where the object may be rather *general indications* than minute measures, it appeared to the author susceptible of considerable simplification, which though unimportant to the more refined optical inquirer, might be valuable *to the chemical student.*

In general the *essential* parts of any such apparatus are,—1st, a polarizing plate; 2nd, a tube containing the liquid under examination, so constructed that the polarized ray can pass along its axis; 3rd, an analyser of double-refracting crystal.

In M. Biot's apparatus the supports, &c. are complex and difficult to adjust. The tubes are of costly construction, each end being covered with plates of glass, so that when filled with liquid, and the glasses screwed on tight, the original luminous image is seen *distinctly* through a great thickness of the liquid, bounded by truly plane parallel surfaces. To fulfil these conditions is a very troublesome process. The analyser also must consist of calc spar of the greatest purity, cut and adjusted with perfect accuracy to give two truly achromatized images considerably separated.



The simplified form proposed by the author is as follows:—

1st. Instead of the tubes with parallel glass ends, &c., he uses merely *common test tubes,* having a hemispherical bottom and open at the top. The use of these is of course limited to the *vertical* position; and the polarizing plate (P) of black glass must be fixed below at 35½° to the axis of the vertical tube (T).

2ndly. It is consequently necessary to introduce a small silvered mirror (S) to throw the light upon (P) in the proper direction.

3rdly. The tube must be enclosed in an opake case, and the light admitted at the bottom through a small hole. When the eye looks down it, the image of the luminous hole will be very irregular; but,

4thly. This evil is remedied by the remaining peculiarity in the analyser (A); which instead of the double refracting prism, consists simply of a double refracting crystal *in its natural state,* about three-fourths of an inch in thickness (R), on which the light falls through a hole (*h*), about one-twentieth of an inch in diameter; the crystal is enclosed in a tube, in which slides another carrying *a small lens* (L), which at once magnifies the separation, and forms two *distinct* circular discs, *however irregular the light,* and in which all the optical changes are distinctly seen, either by the light of the clouds, or of a lamp, on making the analyser revolve about the axis, and measuring its rotation on a divided circular rim round it.

The supports should be so contrived that the analyser may be adjusted to different heights, to allow of the insertion of tubes of different lengths from about six to eighteen or twenty-four inches.

On some peculiar instances of (so-called) Catalytic Action. By Mr. Mercer.

Mr. Mercer had long considered that instances of catalysis were merely examples of chemical affinity exercised under peculiar circumstances. A body never entirely yields up its chemical characters on uniting with other bodies. The iron in protoxide of iron has still an affinity for more oxygen, and has not lost that affinity by its first union with that element. The intensity of affinity, by which the simple elements are joined in the complex molecule, must be the measure of the stability of the compound. Mr. Mercer argued, that when the elements of a body are in mere static equilibrium, by virtue of a feeble attraction, and when it is acted upon by another body possessing an affinity for one of its constituents, which constituent, on the other hand, from peculiar circumstances, is not prone to combine with it, that in such a case so-called catalysis must ensue. Thus, on mixing oxalic acid and nitric acid with a little water, and raising the temperature to 130°, no action ensues. But if a small portion of any protosalt of manganese be now added, the decomposition immediately commences, and all the nitric is converted into nitrous acid, whilst the oxalic acid passes into carbonic acid. He thus accounts for this singular action:—The carbonic oxide of the oxalic acid possesses a disposition to unite with oxygen. To gratify this disposition, it endeavours to withdraw it from nitric acid, but is not sufficiently powerful to do so; still it places the atoms of the nitric acid in a state of tension. Another body (protoxide of manganese) now being introduced, which also possesses an affinity for oxygen, exerts this affinity, and the combined forces thus acting upon the nitric acid occasion its decomposition. The moment the oxygen is withdrawn from its state of combination, it has two affinities to choose between, and the attraction of the oxalic acid being greater, it passes over to it, converting it into carbonic acid. The protoxide of manganese still remaining will act on fresh portions *ad infinitum*. Most of the vegetable acids may be decomposed in a similar manner. Following up this view, Mr. Mercer had discovered a number of examples of what formerly would have been called catalysis. He showed, that when alumina (precipitated from a hot solution) is placed in contact with dilute nitric acid, no apparent action ensues. But as Dr. Playfair had described a peroxide of aluminium, it ought to have a disposition to unite with oxygen. To discover then whether the atoms of nitric acid were actually in a state of tension, he introduced a slip of calico rendered blue by indigo. When this came in contact with the precipitated alumina, the indigo was immediately discharged, although it remained unaffected in the supernatant liquor. Chlorous acid was a body well fitted for his purpose, as its elements were held together by a feeble affinity, and as its oxygen was very readily yielded. He showed that the peroxide of copper, discovered by Dr. Playfair, occasioned a great evolution of oxygen from a solution of chloride of soda. This was owing to its endeavour to become cupric acid, which under certain circumstances it did form. He had noticed many years since that a dark purple solution is obtained on mixing chloride of lime, a salt of copper, and lime with water, and leaving the mixture at repose. No evolution of oxygen is occasioned by this purple solution, but by the peroxide of copper before passing into it. Peroxides of manganese and cobalt exert a similar action. The reason was, that these metals possessed only a feeble affinity to pass into the metallic acids. Still the affinity was sufficient to occasion the withdrawal of oxygen from chlorous acid. The moment it was withdrawn elasticity came into play, and it escaped as a gas. A similar action is exerted by the peroxides of iron and lead. From these and several other instances which were described, Mr. Mercer concluded that almost all instances of catalytic action may be reduced to feeble chemical affinity. He concluded by some speculations on the atomic constitution of complex molecules.

On Hæmatoxylin, the Colouring Principle of Logwood. By Professor O. L. Erdmann *of Leipsic.*

The hæmatoxylin used by the author in his experiments, was prepared by the process of Chevreul. In a state of purity hæmatoxylin is not red; it is in itself no colouring matter, being merely a substance capable of producing colouring matters in a manner similar to lecanorin, orcein, or phloridzin. The colours which it produces are formed by the simultaneous action of bases (particularly strong alkalies), and the oxygen of the atmosphere. By the action of these it undergoes a process of eremacausis, which, after forming colouring matters, ends in the production of a brown substance resembling mould.

The colour of hæmatoxylin varies from a pale reddish yellow to a pale honey colour. The crystals are transparent, possess a strong lustre, and may be obtained a few lines in length. Their form is a rectangular, four-sided prism, sometimes with a pyramidal summit. The taste of hæmatoxylin is similar to that of liquorice; it is not very soluble in cold water, but dissolves freely, with a yellow colour, in boiling water. Its solutions are reddened by the action of ammonia and oxygen. Oxygen alone is incapable of producing this effect, but the most minute trace of ammonia imparts a purple colour to the solution. Hæmatoxylin forms, therefore, the most delicate test for ammonia, and is the easiest method of proving its presence in the atmosphere. Hæmatoxylin is soluble in alcohol and æther. When exposed to the influence of light it acquires a reddish tinge; on being heated it is decomposed, without giving any sublimate. It contains no nitrogen. When heated in the water-bath it loses 16 per cent. of water. The dry substance possesses the formula $C_{40}\,H_{17}\,O_{15}$. There are two hydrates of hæmatoxylin. Acids do not act so energetically on hæmatoxylin as bases. All the compounds of hæmatoxylin and bases are decomposed by air and moisture.

The formation of the blue or red colouring matters which hæmatoxylin is capable of producing, takes place in general by the mutual influence of bases and oxygen. If an excess of ammonia or potash be added to a solution of hæmatoxylin, the liquid becomes at first of a deep red colour, afterwards opake and of a dark red. After the lapse of some time it loses its red colour altogether, becoming of a dirty brown hue. When acetic acid is added to the solution, a voluminous brown precipitate is obtained; this body the author calls *hæmatein*. When the red solution is cautiously evaporated, a substance of a dark violet colour is deposited; this body is *hæmatein-ammonia*. Hæmatein is analogous to orcein, phloridzein, &c.; it dissolves in water with a purple colour; by evaporating the solution, the whole of the ammonia is expelled, and pure hæmatein remains. Hæmatein differs from orcein in containing no nitrogen: its formula is $C_{40}\,H_{15}\,O_{16}$. Hæmatoxylin, therefore, in passing into hæmatein, under the influence of ammonia, takes up three atoms of oxygen, two of which combine with two of hydrogen to form water, and the third remains in the compound $C_{40}\,H_{17}\,O_{15} + O_3 = C_{41}\,H_{15}\,O_{16} + H_2\,O_2$. Hæmatein-ammonia is composed as follows:—$C_{40}\,H_{22}\,N_2\,O_{17}$, which is equal to $C_{40}\,H_{14}\,O_{15} + 2\,N\,H_4\,O$. Hæmatein must therefore have the following composition:—$C_{40}\,H_{14}\,O_{15} + H\,O$. Hæmatein may be combined with most metallic oxides. Hæmatein is decolorized by sulphuretted hydrogen, but this is not the effect of reduction, for the solution regains its red colour when evaporated *in vacuo*. The author concurs with Chevreul's view, in supposing that sulphuretted hydrogen acts on reddened hæmatoxylin or hæmatein in the same manner as a weak acid.

On the Formation of Cyanuret of Potassium in a Blast Furnace. By Dr. C. Bromeis *of Cassel.*

M. Zincken discovered, at the bottom of the blast furnace at Mägdesprung in the Hartz Mountains, a mass which Dr. Bromeis found to contain ferrocyanuret of potassium. The furnace from which it was obtained had been fed with *charcoal*. The other ingredients of the saline mass were caustic potash, carbonate, silicate, and manganate of potash, together with a large proportion of cyanate of potash and cyanuret of potassium. It is probable that the ferrocyanuret of potassium did not exist ready formed in the mass, but was produced after dissolving the cyanuret of potassium in water. The cyanate of potash, by its decomposition, gives rise to carbonate of potash and ammonia. Dr. Bromeis supposes that the formation of cyanogen must have been occasioned in the following manner:—The nitrogen of the atmosphere being exposed to a great pressure and high temperature, combined directly with the carbon of the carburet of potassium, producing thereby cyanogen and cyanuret of potassium. This explanation accords with the experiments of Defosse.

On the Compounds of Carbon and Iron. By Dr. C. Bromeis.

Dr. Bromeis analysed various kinds of iron by burning them in a tube, with a mixture of chromate of lead and chlorate of potash. The combustion is conducted exactly like an organic analysis, and is the method invented by Regnault. An important point in the determination of the carbon in iron is to ascertain the proportion of carbon in a state of combination, in contradistinction to that which is mechanically mixed with the metal. Dr. Bromeis effected this by dissolving the mixture in muriatic acid; the carbon in chemical combination unites with hydrogen and forms carburetted hydrogen, while the carbon in mechanical mixture takes no part in the action, but remains unaffected, and may be accurately determined. This quantity, being subtracted from the whole carbon obtained by combustion, affords a means of estimating the quantity in chemical combination.

Dr. Bromeis found in crystalline white cast iron, 3·8 per cent. of carbon; but as some white cast iron has been found to contain 4·2, or even 5·3 per cent., Dr. Bromeis considers that manganese may be substituted for it; he sometimes found as much as 7 per cent. of this metal. It appears, therefore, that neither common nor white cast iron are polycarburets of determinate constitution.

In white cast iron Dr. Bromeis found only 0·5 per cent. of mechanically combined carbon, in other kinds nearly 1 per cent., and in gray cast iron 2·3 per cent. Hence it follows that the chemically combined carbon amounts only to 0·9 per cent. Karsten found 0·85 per cent.

Cast steel, according to Gay-Lussac and Wilson, contains 0·93 per cent. carbon. Bromeis found in hard cast steel, 0·97 per cent.

Gray cast iron may be considered as a mixture of very impure cast steel with carbon. This may possibly be the cause that it can be so easily hardened on the surface.

On Kakodylic Acid and the Sulphurets of Kakodyl. By Prof. BUNSEN *of Marburg.*

In the present paper Prof. Bunsen examines the higher stages of oxidation of kakodyl, and the sulphurets corresponding to them. He finds that by the oxidation of alkarsin, either by the direct action of the air or by means of oxide of mercury, kakodylic acid is formed; but there is also an intermediate oxide which cannot be obtained in a state of purity, which seems to be similar to the hyponitric acid, and to be a combination of kakodylic acid with the oxide. Kakodylic acid crystallizes out of alcohol; its composition is $C^4 H^6 As^2 O^3 + H O$, this atom of water being constitutional, and only to be replaced by a base; it is soluble in water but not in æther. A very remarkable fact with respect to this body is, that the poisonous properties of the arsenic seem totally annihilated; eight grains administered to a rabbit exerted no poisonous action.

Kakodyl combines directly with sulphur, forming the protosulphuret which has been already described. This compound takes up another atom of sulphur, and produces the bisulphuret. There appears also to be a tersulphuret analogous to kakodylic acid. Prof. Bunsen has not, however, been able to obtain it in a pure state. From the above results, it appears that kakodyl is precisely similar in its behaviour to some simple metals; and the formation of kakodylic acid by direct oxidation is in exact opposition to the theory of substitution of M. Dumas.

On some New Oxides of certain of the Metals of the Magnesian Family. By Dr. LYON PLAYFAIR.

The author first drew attention to the defective state of our knowledge regarding the oxides of the magnesian family. Iron and manganese possess sesquioxides, but copper and zinc do not. Manganese has a high degree of oxidation represented by the formula $R O_2$, but none of the other metals mentioned have an analogous oxide. There is nothing in the molecular structure of the metals to account for this difference. It is indeed true that Thénard has described compounds of copper, zinc, and calcium, to which he has ascribed the general formula of peroxide of manganese. But these compounds do not possess any chemical characters in common with that oxide. They are very unstable bodies, being decomposed spontaneously in air, and more rapidly so by heat, by alkalies, and by acids; they are formed by the action of peroxide of hydrogen on the protoxides of the metals. The author had found that magnesian protoxides were very apt to form compounds with magnesian peroxides of the general formula $R O + R_2 O_4$. Hydrogen itself possesses all the characters of a magnesian metal, and hence should share this aptitude. Thénard found a deficiency of oxygen in the compounds obtained by him. This deficiency would be accounted for on Dr. Playfair's view, that they consisted of peroxide of hydrogen with a metallic protoxide, of the formula $M O + H_2 O_4$, corresponding to the compounds obtained by the author, $R O + R_2 O_4$. On this view, the proportion of the radical to the oxygen would be 3 : 5, whilst on Thénard's formula of $R O_2$, it would be 3 : 6.

Dr. Playfair then described at length the manner in which he prepared the true peroxides; chloride of soda was employed to effect their oxidation. He had obtained a peroxide of copper of a brown colour, which evolved oxygen when dissolved in acids, and chlorine with muriatic acid. In its highest state of hydration it contained 2 atoms of water; at 212°, $1\frac{1}{2}$ atom is expelled, thus showing that the correct formula of the oxide is $Cu_2 O_4$. The water is held with different degrees of force, and compounds were described in which this water is replaced by oxide of copper. The author also obtained a compound of this peroxide with a sesquioxide of copper, corresponding to the mineral varvacite $(Mn O + Mn_2 O_4) + H O$. The new body possesses the analogous formula $(Cu_2 O_3 + Cu_2 O_4) + H O$.

The author also obtained a peroxide of iron ($Fe O_2$) by similar treatment. It possesses analogous characters with peroxide of copper. Thus it contains 2 atoms of water, half an atom of which is held with considerable force. This peroxide is susceptible of entering into combination with the sesquioxide of iron, and of forming a compound corresponding to varvacite in chemical composition. The author had also obtained a peroxide of aluminium of similar properties with the preceding peroxides, but which differed in its relation to water. He concluded by announcing the discovery of some new oxides of zinc and chromium, the examination of which were not yet completed.

Note on the Composition and Characters of Caryophyllin. By *Dr.* Lyon Playfair.

Caryophyllin may best be prepared by digesting cloves with alcohol for several days, in the manner described in Liebig's 'Organic Chemistry.' When pure, it is a snow-white crystalline substance, insoluble in water, but easily soluble in hot alcohol. The addition of caustic ammonia or caustic potash to the alcoholic solution does not occasion decomposition or precipitation. Caryophyllin has been analysed by Dumas and Ettling, who found it to possess the formula $C_{10} H_{16} O_2$. The author of this paper found that, although this was the correct expression of the composition of *melted* caryophyllin, it was not so of that body in its natural state. He found caryophyllin, kept for three days at 212°, to possess the empirical formula $C_{40} H_{33} O_5$, or the rational formula $C_{40} H_{32} O_4 + H O$. This shows that the formula given by Dumas and Ettling must be quadrupled. The anhydrous caryophyllin would seem to show that it is isomeric with common camphor, but this hydrate proves that it possesses twice its atomic weight, and brings it into the same category of bodies with pinic, silvic, and copahuvic acids. Caryophyllin has always been supposed to be an indifferent body, but the author showed that it is a weak acid, capable of forming salts. Caryophyllite of potash (from which all the metallic salts may be procured by double decomposition) is obtained by dissolving caryophyllin in an alcoholic solution of potash, agitating the mixture with an excess of bicarbonate of potash, evaporating the whole to dryness, and dissolving out the caryophyllite of potash with anhydrous alcohol. The salts formed with metallic oxides and caryophyllin are insoluble. Caryophyllite of potash is a white saponaceous body with a crystalline appearance.

The oil of cloves possesses the formula $C_{10} H_8$. By the absorption of one atom of oxygen it would be converted into caryophyllin, $C_{10} H_8 O = C_{40} . H_{32} O_4$. The simplest view would, therefore, be to suppose that caryophyllin is a product of the oxidation of the indifferent oil of cloves, and not an educt of the cloves themselves.

Contributions to the History of the Magnesian Limestones. *By Mr.* RICHARDSON.

The author, considering the great importance of the magnesian limestones, both to the manufacturer and agriculturist, conceived that an account of their composition might prove acceptable. He examined the various limestones systematically, according to the excellent arrangement of Prof. Sedgwick, and collected the results of his analyses in a tabular form. The insoluble residue of the specimens subjected to analysis contained, in every case, organic matter. The analyses proved a very great variation in the quantities of lime and magnesia. Mr. Richardson argued, that the deposition of the lime and magnesia must have been effected simultaneously, from the fact of layers of limestone existing above and below the magnesian limestones, in which layers no magnesia can be detected. He was inclined to ascribe their deposition to the influx of waters holding chloride of magnesium in solution, which, meeting with calcareous matter held in solution by an excess of carbonic acid, robbed it of that excess, and the two carbonates of lime and magnesia fell together.

On the Agricultural Importance of ascertaining the minute portions of matter derived from Organic Sources that may be preserved in the Surface Soil, and on the Chemical means by which its presence may be detected. By Dr. DAUBENY.

The researches of Sprengel and Liebig, by showing the manner in which minute quantities of certain ingredients may impart to the soil into which they enter as constituents entirely new properties with reference to the purposes of agriculture, have given additional interest to the methods of analysis, which aim at determining the chemical composition of the surface, and of the substratum from which the former principally derives its chief ingredients. The rude mechanical method adopted, even by such chemists as Sir H. Davy, is no longer considered sufficient. The nature, as well as the amount of the organic matter present, and the existence of phosphates, &c. in the proportion of $\frac{1}{1000}$, or even $\frac{1}{10,000}$th part of the entire mass, are points deserving investigation, and afford a clue to the description of manures most likely to be useful, and to the general treatment which the land may require. It is also obvious, that the same importance attaches to a knowledge of the constitution of the subsoil, since the advantages of exposing to atmospheric influences, and thus disintegrating, the portions underneath, by deep ploughing, and other methods of bringing the subsoil to the surface, will in a great degree depend upon its containing ingredients which the crop requires for its subsistence, and of which the superficial soil has been already in a great degree exhausted. Thus, for example, it will often become a question with the farmer, whether it be more economical to mix with the soil a given quantity of phosphate of lime, or to incur the labour of so breaking up a portion of the subjacent rock, as to unlock, as it were, for the use of the crop, that quantity which it contains in close union with its other constituents. This inquiry, however, presupposes a knowledge on his part of the existence of phosphate of lime in the soil, and of the relative proportion it bears to the other ingredients; data which can only be obtained through the assistance of refined chemical analysis. A few simple and easy calculations may show how very small a proportion of this ingredient might suffice during a long period of time, for the demands even of those crops which require the largest amount of it for their nutrition. Suppose the subsoil of a single acre of ground, turned up to the depth of a foot, to weigh 1000 tons: now if this rock should be found to contain only $\frac{1}{1000}$th part of phosphate of lime, it will follow that no less than a ton of this substance might be extracted from the uppermost foot of the subjacent rock, by the action of the elements, or by chemical means. Now one ton of phosphate of lime would be adequate to supply 125 tons of wheat, or 680 tons of turnips. And if we reckon the average crop obtained from an acre of land to be, of wheat, one ton, and of turnips, fifteen, it is evident that we have at hand as much phosphate of lime as would be necessary for 125 crops of the former, or forty-five crops of the latter. Dr. Daubeny said he had great reason to believe, that many of our secondary rocks, those especially which contain organic remains, and which appear in a great measure to be made up of shells, would be found, if examined, to contain as large a quantity of phosphate of lime as that mentioned. Though the soil of Great Britain be found deficient in the phosphates, there is reason to believe the subsoil might in many cases be made, by proper management, to impart to it what was wanting. The discovery by Dr. Buckland, in the lias and other secondary rocks, of the solid fæces of certain extinct animals, consisting of phosphate of lime, induced Dr. Daubeny, some years since, to test a variety of specimens of limestone, with a view of ascertaining whether traces might be found in them of the same ingredient. The result was, that phosphate of lime in minute quantities was much too commonly distributed to be attributed to coprolitic matter, or to afford any independent evidence of its presence. When, indeed, we recollect that the shells of invertebral animals contain from three to six per cent. of phosphate of lime, and that, according to Mr. Connel, the scales of extinct fish, taken from rocks as old as the coal formation, possess no less than fifty per cent. of the same ingredient, it would be wonderful, indeed, if all traces of this substance had disappeared from rocks which appear often to be made up in a great degree of the debris of shells and other marine exuviæ. Dr. Daubeny was, therefore, not surprised at being informed by M. Schweitzer, who is intrusted with the management of the German Spa at Brighton, that he had detected in the chalk of Brighton Downs, as much as $\frac{1}{1000}$th part of phosphate of lime. From experiments since made by Dr. Daubeny on the same rock, taken from various localities, he was inclined to believe, that minute portions of this substance are present not uncommonly in that formation. The frequent occurrence of phosphate of lime in calcareous rocks, and the probability of its having been derived from the shells or bony matter of the living beings contained in the calcareous rock, led Dr. Daubeny to suspect that traces also of the organic matter which contributed to make up the animal structure, might likewise be found accompanying it. He had accordingly availed himself in several instances of the property which a solution of nitrate of silver possesses of becoming black, by being brought into contact with organic matter on exposure to the light, as a ready means of ascertaining the presence of organic matter in a specimen of limestone; and whilst by this test he determined its entire absence from Carrara marble, chalk from the neighbourhood of a basaltic dyke on the coast of Antrim, and even in many instances from petrifactions of shells contained in the secondary rocks, he had obtained indications of the presence of some form of organized matter in several of the tertiary rocks, and even in the chalk.

This test, however, cannot be successfully applied, except when bituminous matter and every other form of mineral carbon are absent, and when the non-existence of common salt has been previously established by the absence of any cloudiness upon the addition of nitrate of silver after an exposure to light has taken place*; nor does this test enable us to determine whether the organic matter is of a vegetable or an animal nature; to ascertain the latter, a modification of Will and Varrentrapp's process for estimating the amount of nitrogen in organic matter might probably be adopted, the insoluble portion being heated with quicklime and caustic alkali in an iron or platina tube, and the vapours being collected in a receiver containing muriatic acid, or tested with turmeric paper.

Dr. Daubeny read a letter from M. Schweitzer, who states that he had been precluded from employing the secondary limestones in obtaining carbonic acid wherewith to impregnate his mineral waters, owing to an empyreumatical odour which the gas carried up, and which he attributed to an organic cause. To obtain a perfectly pure carbonic acid, for his imitation of the spas of the continent, he was compelled to resort to the white kinds of marble. With regard to the presence of organic matter in the subsoil, its detection may be a matter of some agricultural interest, when we remember that the small quantities of nitrogen which are required for the growth of those vegetables that first start up in a new country, could not have been derived from an accumulation of mould by the decay of antecedent plants, but must have arisen in a great measure from the animal matter, which is contained in the rock upon which they grew, and which proceeds from the exuviæ of races of beings belonging to a former period of creation. In a more advanced stage of vegetation, this same material may be of some value to the crops that occupy the soil.

* Common salt is present generally in chalk from the neighbourhood of the sea, and sometimes even in specimens from the interior.

Dr. Daubeny suggested whether the more compact texture of certain calcareous rocks than of others, might not be connected with the existence in them of organic matter, which, by its interposition, may prevent a crystalline arrangement of its particles from taking place. It may be, that the attraction between the particles of matter, which, if uncontrolled, would prove too powerful for the agents of decomposition to overcome, is weakened by the presence of organic matter, which thus enables the rock to supply the vegetables that take root in it with the solid matter which their structure requires. To the geologist, too, it cannot but be of interest to trace the several steps by which the organic matters, which primarily must have constituted so large a portion of the bulk of the various extinct animals and vegetables, have disappeared from the strata which enveloped them.

On the Causes of the Irregularities of Surface which are observable in certain parts of the Magnesian Limestone Formations of this Country. By Dr. Daubeny.

The magnesian limestone rock in some of the quarries near Bolsover and Worksop in Derbyshire and Nottinghamshire, present a remarkable appearance. They do not possess an undulating surface, as limestones generally do, but the upper and under faces are covered with irregular elevations and depressions of a very marked character. In many instances the spicula or indentations run all in one uniform direction, and those on the under side of the block are exactly opposite to those on the upper. Prof. Sedgwick had cursorily noticed the configurations which these magnesian limestones possess, and ascribes them to an arrangement of the particles of the rock which took place during the act of consolidation. Dr. Daubeny, however, was inclined to call in the action of atmospheric influences, and that of water impregnated with carbonic acid, as necessary to be resorted to in order to afford a full explanation of the phænomenon; appealing to the fact, that the exposed surfaces in the quarries of this limestone, in some cases present a similar appearance from the effect of weathering, and also to the circumstance, that some of the irregularities seen upon the faces of the blocks seem to approach in character to those produced in other limestones by these causes.

Dr. Daubeny, in conclusion, referred to the paper he had read last year on the Tyrol, in which he had attempted to explain the appearances presented by the dolomitic rocks of that country, on principles similar to what he now suggested as applicable to those exhibited on the small scale in our own rocks.

On a new Product obtained from Coal Naphtha. By Mr. Leigh.

The substance described was obtained in the course of some investigations on an oil which Mr. Leigh discovered about three years and a half ago, as the result of the action of a mixture of nitric and sulphuric acids on purified coal naphtha. In their behaviour with potassa, both in aqueous and alcoholic solution, the crystals now brought under the notice of the section by Mr. Leigh have much analogy with the oil (like that of bitter almonds) obtained at the same time with them. The oil, when extensively exposed to the action of oxygen, becomes a crystalline solid, having much the same appearance as these crystals. It is probable the crystals differ from the oil in containing a quantity of oxygen. Mr. Leigh had made no analysis of these compounds.

Account of the Mineralogical and Geological Museum of the Imperial Mining Department of Vienna. By Professor Haidinger.

Professor Haidinger, in this communication, gave a detailed account of the arrangements which had been adopted in the preparation of this celebrated museum. The basis of this collection existed in the Museum of the Mining Department previous to the appointment of Professor Mohs. Under the presidency of Prince Augustus Lobkowicz the Museum was considerably augmented, both by the exertions of the mining department and by contributions from private collectors. The method of arrangement employed in the Museum was suggested by Mohs himself, and followed out by Prof. Haidinger after the death of the former; it consisted in dividing the mineral products of the empire into four great general divisions, having in the centre those obtained from the rivers, and those procured from the principal chains of mountains as the boundaries on either side. The cabinets were so arranged as to form a kind of section of the various geological formations. The upper portions of the cabinets are filled with the rocks and minerals from the higher or mountainous districts, whilst the lower divisions contain the specimens taken from the valleys. This arrangement has been found greatly to assist the memory, and to afford numerous points of comparison to those who study the constitution of the mountain chains. The Professor concluded by some speculations on the changes which gradually take place in the metamorphic rocks, and which he considered might all be reduced to processes of oxidation or reduction.

On the Phosphates and Arseniates. By JOHN DALTON, *F.R.S.*

On Microcosmic Salt. By JOHN DALTON, *F.R.S.*

On a new and easy Method of Analysing Sugar. By JOHN DALTON, *F.R.S.*

On the Composition of the Blood and Bones of Domestic Animals. By Professor NASSE.

On the Manufacture of Sulphuric Acid. By WM. BLYTH.

On the Manufacture and Purification of Gases obtained from Coal. By JOHN DAVIES.

On a peculiar Condition of Iron. By Professor SCHÖNBEIN.

On the Advantages and Disadvantages of Hot Air in effecting the Combustion of Coal. By C. WYE WILLIAMS.

On the Production of an Artificial Copper Pyrites. By W. LUCAS.

On some Fires produced from Spontaneous Combustion. By A. BOOTH, *F.L.S.*

On some Thermo-chemical Researches. By Professor T. GRAHAM.

GEOLOGY AND PHYSICAL GEOGRAPHY.

On the Physical Structure of the Appalachian Chain, as exemplifying the Laws which have regulated the elevation of great Mountain Chains generally. By Professors H. D. ROGERS *and* W. B. ROGERS.

The Appalachian Chain of North America is described by the authors as consisting of a series of very numerous parallel ridges or anticlinal lines, forming a mountain belt generally 100 miles in breadth and nearly 1200 miles in length, stretching from the south-eastern angle of Lower Canada to Northern Alabama. 1. The strata which compose this chain are the American representatives of the Silurian, Devonian and Carboniferous systems of Europe, united into one group of conformable deposits. The general direction of the chain being N.E. and S.W., there is a remarkable predominance of S.E. dips throughout its entire length, especially in the south-eastern or most disturbed side of the belt. Proceeding north-westwards, or *from* the quarter of greatest disturbance, N.W. dips begin to appear; at first few and very steep, afterwards frequent and gradually less inclined. 2. The authors consider the frequency of dips to the S.E., or *towards* the region of intrusive rocks, accounted for by the nature of the flexures, which are not symmetric, the strata being more inclined on the N.W. than on the S.E. of each anticlinal, amounting at length to a complete folding under and inversion, especially on the S.E. side of the chain, where the contortions are so closely packed as to present a uniform dip to the S.E. These folds gradually open out, the N.W. side or inverted portion of each flexure becomes vertical, or dips abruptly to the N.W.; proceeding further in this direction the dips gradually lessen, the anticlinals and troughs becoming rounder and flatter, and the intervals between the axes constantly increasing till they entirely subside at about 150 miles from the region of gneiss and intrusive rocks. The authors express their belief that a similar obliquity of the anticlinal axes will be found to obtain in *all* great mountain chains, the axis plane always dipping *towards* the region of chief disturbance. The inverted flexures are regarded by the authors as exhibiting simply a higher development of the same general conditions. The passage of inverted flexure into faults is stated to occur frequently, and invariably along the N.W. side of the anticlinal or S.E. of the synclinal axes; these dislocations, like the axes, maintain a remarkable parallelism. 3. The axes of the Appalachian chain are distributed in natural groups, the members of each group agreeing approximately in length, curvature, amount of flexure and distance apart. Nine principal groups are described, in five of which the axes are straight, whilst the four which *alternate* with them are curved; in two of the curved divisions the line of strike is convex to the N.W., in the other two it is convex to the S.E. In every part of the chain, the axes, whether curved or straight, maintain an approximate parallelism to those of their own division, and in the minor groups within the large divisions the parallelism is still more exact. The axes vary in length from insignificant flexures to lines frequently 100 and sometimes 150 miles in length, and they deviate very little from a rectilinear course, or, as the case may be, from a uniform rate of curvature. Some of the longer curved axes exhibit a difference of strike at their extremities of fifty degrees in a distance of ninety miles, and the rectilinear axes of different divisions vary in their line of direction as much as 60°. As all the flexures were undoubtedly formed at one period, the authors consider these facts at variance with M. Beaumont's hypothesis, that dislocations of the same geological age are parallel to one and the same great circle of the sphere. 4. The general declension in level of the Appalachian strata towards the N.W., or away from the quarter of greatest local disturbance, is considered important by the authors in its bearing upon the subject of the elevation of broad continental tracts. The authors next proceed to notice memoirs, describing what they consider similar phænomena in Europe.

Theory of Flexure and Elevation of Strata.—From the consideration of the preceding general facts the authors have arrived at a theory which they conceive applicable to the bending and elevation of strata generally. They state that the *oblique* form of all normal anticlinal and synclinal flexures "indicates that the force producing the dips was compounded of a wave-like oscillation and a tangential pressure;" —a purely vertical force exerted simultaneously or successively along parallel lines could only produce a series of symmetrical flexures, whilst tangential pressure, unaccompanied by a vertical force, would result in an imperceptible bulging of the whole region, or in irregular plications dependent on local irregularities in the amount of resistance. The alternate upward and downward movements necessary to enable the tangential force to bend the strata into a series of flexures, are such "as would arise from a succession of *actual waves* rolling in a given direction beneath the earth's crust." With this view all the phænomena observed are in accordance; but it would be difficult to account for them by any gradual prolonged pressure exerted either vertically or horizontally. The formation of grand yet simple flexures cannot be explained by a repetition of feeble tangential movements, which could not successively accord in *direction* and *amplitude*, nor by merely vertical pressures, for these could not shift in position through a series of *parallel lines*, nor if feeble and often repeated return always to the *same* lines, until they became conspicuous flexures. The authors suppose the strata of the region in question to have been subjected to excessive upward tension arising from the expansion of molten matter and gaseous vapours; the tension would at length be relieved by many parallel fissures formed in succession, through which much elastic vapour would escape, and, by thus removing the pressure adjacent to the lines of fracture, produce violent pulsations on the surface of the fluid below.

This oscillatory movement would communicate a series of temporary flexures to the overlying crust, which would be rendered permanent by the intrusion of molten matter into the fractured strata. If during this oscillation we conceive the whole heaving tract to be shoved bodily forward in the direction of the waves, the union of this tangential with the vertical movements may explain the peculiar steepening of the anterior side of each flexure, and successive similar operations might occasion under folding or inversion. The authors do not deem it essential to this explanation, that, in the production of axes of elevation, the strata should be permanently fractured to the surface. Fissures sufficient for the escape of vast bodies of elastic vapour, might open and close again superficially; and the strata may often be supported in their new position by subterranean injections not visible on the surface.

Identity of the Undulations which produced the Axes, with the wave-like motion of the Earth in Earthquakes.—The authors suppose all earthquakes to consist in oscillations of the earth's crust propagated with extreme rapidity; and they ascribe this movement to a sudden change of vertical pressure on the surface of an interior fluid mass, throwing it into wave-like undulations, such as would produce permanent flexures in the strata if more energetic, and if accompanied by the formation of dykes. The successive earthquakes of any region usually proceed from the same quarter of the compass, as must have been the case with the movements which gave rise to the parallelism of neighbouring anticlinal axes. In illustration of the power of producing permanent lines of elevation which earthquakes have exhibited in modern times, the authors instance specially the Ullah Bund, an elevated mound extending fifty miles across the eastern arm of the Indus, which was the result of the great earthquake of Cutch in 1819.

Date of the Appalachian Axes.—The authors describe the elevation of this chain as simultaneous with the termination of the carboniferous deposits of the United States, and as the cause which probably arrested the further progress of the coal formation. With one local exception, on the Hudson, the whole series seems to have been deposited conformably, without any emergence of the land. That the elevation did not take place at a later period, is shown by the undisturbed condition of the overlying beds, proximately of the age of the European new red sandstone. The elevation of the chief part of the great belt of metamorphic rocks on the S.E. side of the chain is referred to the same great movement. In conclusion, the authors remark that an incomparably greater change in the physical geography of North America, and perhaps of the globe, seems to have occurred at the close of the carboniferous epoch than at any previous or subsequent epoch; and they consider these changes, and the effect produced by them on the organic world, as affording some of the highest subjects of geological investigation.

On the Production of Sand Storms and Lacustrine Beds, by causes associated with the North American Lakes. By the Rev. Mr. Schoolcraft.

A residence of nearly twenty years in the country whose physical geography is strongly marked by the North American Lakes, had impressed the author with the opinion, that these lakes afford a very striking example of the power of geological action possessed, at the present day, by large bodies of inland water. For more than half the indicated period his location had been in the immediate vicinity of Lake Superior, and the present remarks are confined chiefly to that member of the series.

Lake Superior itself may be considered as occupying an interstice between the most northerly portions of the great secondary and sedimentary formations of the Mississippi valley and the crystalline rocks of British America; and this ancient line of junction may be followed, down its outlet, through the Straits of St. Mary's into Lake Huron, and is continued along parts of its north and north-easterly shores, north of the fossiliferous limestones of the Manatouline chain.

The western and northern sections of this lake exhibit the strongest proofs of ancient action and upheaval. A colossal dyke of trap appears to have crossed the lake, at about two-thirds of its length from east to west. Admitting (what appears to be very probable) that the vast bed of the lake *west* of this dyke was originally produced by the sinking down of the strata and the consequent elevation of its shores, we may attribute to the same disturbing force the central breach and prostration of this barrier, which has been subsequently widened by the force of waters, acting under the pressure of strong west and north-west winds, at an epoch when its water-line rested at one of its higher levels; so that, at this time, Isle Royal, Beaver and Castle islands, and the elevated and precipitous range of Keweena Point, all of which consist of members of the trap rock, are the only existing monuments of this ancient dyke. The heavy beds of trap boulders which lie east of this point, and reach, in blocks of large magnitude, to St. Mary's Falls and the northern shores of Lake Huron, strongly denote the probability of such action.

The most extensive effects of the existing energies of this lake are witnessed upon its grauwacke and sandstones, which have been broken up, comminuted into fine sand, and piled up in elevated ridges, or spread out over wide plains along its southern margin. A coast of winding bays and headlands, which measures, by a reduced computation, 450 miles upon this single section, may be conjectured to have encountered heavy inroads from currents forced across the lake by north winds, or acting diagonally from the north-east or north-west. By far the most extensive field of this action occurs between the easterly termination of the primary series of rocks at or near Granite Point, and their re-appearaace in the elevated mountainous range of *Gros Cape* at the head of St. Mary's Straits. The vast sand dunes on this section, to which the French *Couriers du Bois* early applied the name of *Les Grandes Sables,* constitute a most unique and picturesque object. Their perfect aridity and height above the lake, which has been computed at 300 feet, and the general parallelism of the tops of the series of hills, strongly fix attention. These sandy elevations are found, however, to rest on beds of clay, loam, and gravel, of a compact structure, which are only buried beneath a deep coating or upper stratum of loose yellow sand, manifestly washed up by the waves and driven landward by the winds. Tempests of sand are thus formed, which spread inland, bury or kill the tallest trees, and carry destruction and desolation in their track. Such is also the lake action upon districts of the coasts of Huron and Michigan, the two next in the descending series of the lakes. Dunes are at first formed, which spread inland, carrying sterility over thousands of acres of land formerly fertile and well-wooded; and the tendency of this peculiar formation is constantly to extend its limits and arrest, as with the hand of death, the progress of vegetation. Another effect of these sand-rocks is to form ponds and lagoons at the temporary or fixed points of their terminus on the good land, and thus to destroy and render unfit for the use of man other large belts of country; besides which, these arrested waters are the prolific sources of noxious vapours, generating extensive disease in their vicinity. Evidence of the comparatively recent era of this atmospheric formation is seen in the prostrated and buried trees, freshwater shells and other organic substances, in a perfectly unaltered state, which are in some localities noticed in digging at great depths, and sometimes exposed by recent irruptions of the waves.

Another arenaceous formation due to lake action cannot be mistaken in examining these shores, but is of an *earlier age*, when these lakes stood at a more elevated level, and discharged over their eventual outlet at Niagara a greater volume of water. "I allude to large belts and tracts of sandy plains bordering other sections of the lakes, and bearing a light growth of pines, poplars and birch, which but imperfectly conceal their comparatively recent origin. On penetrating these plains ridges of sand occur, lying in wind-rows, as if recently formed by the winds and waves. The trees are of small diameter, and the wood of a loose and bad texture. The pent-up water between these ridges nourishes an aquatic vegetation, and constitutes a favourite retreat for the small-furred animals. The whole aspect of these plains denotes them to be of freshwater origin, and forces the conclusion, that they must have emerged, at no ancient period, from the watery dominion of the lakes. That these lakes stood, in bygone days, at a higher altitude, that they had several epochs of depression, and were thus endowed with far greater powers of geological action, is clearly denoted by the existing water-lines on the mural faces of these rocks, and by the ancient water-edges of pebble beds and lake exuviæ found at elevated points in the interior."

The power of attrition possessed by these lakes, at this day, is so complete upon the sandstone series, as to allow full scope to the principle of gravitation in the re-arrangement of the comminuted and up-heaved materials. Large portions of the magnetic oxide of iron exist in the northern sandstones. As these surcharged strata are ground down in the great laboratory of the lake, this oxide is liberated from its siliceous connexion, and reproduced upon the shores in separate and pure beds of iron sand, which are not unfrequently twelve or fourteen inches in thickness, and line the shores for miles.

Wave action is indeed more fully apparent as a mechanical power on the southern shores of Superior, than at any other known point in the interior of the continent. The actual process, both of degradation and resistance, in the lighter-coloured and non-metallic sandstone, is nowhere better observed than along the walled and abraded coast, locally known under the name of the Pictured Rocks. About twelve miles of this mural coast is most completely fretted and riddled into curious architectural forms by the force of equinoctial gales. "When I first saw this picturesque part of the coast in 1820, a vast and high headland hung in fearful grandeur over the water, the base of which was supported on pillars of the sandstone rock, forming a single arch of gigantic span with several minor arches. This prominence, locally called *Le Portail*, gave way the next year, throwing into the deep recesses of the lake walled masses of stone, of which it will convey some estimate to add, that for every ton of rock that went down with the Table rock at Niagara, one thousand tons were here engulphed. Some angular points of this engulphed stratum are yet visible above the water, but the latter is annually exerting its strong abrasive powers upon these rock ruins and casting up the product in beach sands."

On the Geography of the North-west Coast of America. By RICHARD KING.

In this communication the author attempted to prove,—1. that it is not the insurmountable obstacles presented by nature that have prevented us from accomplishing the grand problem of centuries—the N.W. passage.

2. He endeavoured to point out the character of the surveyed lands contiguous to parts of the Polar coast unknown.

3. He offered proofs of the probable existence of the Isthmus of Boothia. And,

4. Indications of the remaining portions requiring to be explored, and the modes in which they may be surveyed.

Notice of a Memoir on the Geology of the Western States of North America, by DAVID DALE OWEN, *M.D., of Indiana. By* R. I. MURCHISON, *Pres. G.S.*

This memoir, with sections and characteristic fossils, having been sent to the Geological Society of London, was brought to Manchester *in transitu* by a friend and countryman of the author. Perceiving the great value of this communication, the President of the Geological Society, to whom it was consigned, conceived that greater justice might be done to the author by first exhibiting the fossils and sections to the Geological Section of the British Association, and by giving on his own part a brief exposé of the chief results of Dr. Dale Owen's labours, which in the sequel would find their appropriate resting-place in the Transactions of the Geological Society.

The vast country in which the author had pursued his researches for a series of years, in the capacity of state geologist of Indiana, embraces the states of Illinois, Indiana, Ohio, Kentucky, Tennessee, and the Dubuque and Mineral Point districts of Jowa and Wisconsin.

Illustrating his views by a general section across this region, he shows that the lowest rocks consist of various members of the Silurian system, the chief masses of which occupying high grounds in the east and west, subside in the central districts under an enormous trough of carboniferous limestone and great productive coal-fields, the whole being overtopped by the equivalents of the cretaceous system of Europe. Identifying many Silurian and carboniferous fossils with their types in Great Britain, the author shows that the old red or Devonian rocks are less distinctly developed in this than in the adjoining region to the East. At the same time he points out that the Pentremite limestone occupies such an intermediate position as may entitle it to be referred either to the base of the carboniferous or to the upper part of the Devonian system.

The great lead-bearing magnesian limestone of Ohio and Indiana (Silurian) is stated to agree in great part with that of Niagara.

After thus giving a general sketch of the Memoir, the President then called the attention of the Meeting to the very valuable collection of fossils by which it was illustrated, and expressed his belief that their study, and a close comparison of them with the typical forms of the same age in the British Isles, would lead to very curious results touching the distribution of animal life in deposits of synchronous date found at great distances from each other, and in which the variations in the same species would be found to be analogous to those which now prevail in living nature in similar species which inhabit basins remote from each other.

The President, in highly eulogizing the merits of Dr. Dale Owen, begged to remind the Meeting that the coal-field of which he treated was nearly as large as all England.

On the Geological Structure of Russia (delivered at an Evening Lecture). *By* R. I. Murchison, *Pres. G.S.*

Mr. Murchison gave a general sketch of the geological structure of Russia in Europe and the Ural Mountains, which was illustrated by numerous large coloured sections and a map. In explaining the chief results of the labours of his friends Count Keyserling, M. de Verneuil, and himself, he showed how the researches of two summers had enabled them to produce a classification of the sedimentary deposits which exclusively occupy the flat regions of Russia, where they are exempt from the intrusion of igneous rocks; and also how the older members of the series, when altered by such igneous agency, as in the Ural Mountains, were the seat of various ores and minerals.

After pointing out that, from the very distinct characters of the fossils of each group of the palæozoic rocks, the divisions of Silurian, Devonian (or old red) and carboniferous strata were unequivocally sustained over an enormous area, he stated that these masses were surmounted by a great development of red sands, marls and conglomerates, with beds of magnesian limestone, salt and gypsum, the whole constituting a system which is the equivalent of that group in western Europe of which the zechstein or magnesian limestone is the centre. Insisting upon the independence of the Permian rocks (so called because most spread out in Permia), as proved by their imbedded fauna and flora, including thecodont saurians and plants of peculiar forms, Mr. Murchison dwelt upon the singularity of this vast deposit, in being to so great an extent impregnated with copper ores, which mixed with the sand, grit and marl, form *regular beds*, the origin of which he referred to ancient cupriferous sources having flowed from the Ural Mountains, when the Permian strata were accumulating in an adjacent sea. Passing rapidly over the consideration of the secondary and tertiary deposits, Mr. Murchison then made some statements confirmatory of his opinions expressed at the Glasgow Meeting of the British Association, concerning the transport of the large erratic blocks which cover such large tracts of the northern and central governments of Russia and the adjacent countries of Germany, which having been deposited on what he conceives to have been the bottom of a sea, were, he conceives, carried to their present positions by floating icebergs liberated from ancient glaciers of the North. On the present occasion he showed, that such phænomena, grand as they are, are after all local only, in reference to the surface of the planet; for an examination of the Ural Mountains had convinced him that up to 60° north latitude they never could have been the seat of glaciers, because their flanks are entirely void of coarse and far-transported detritus, though some of their peaks rise to upwards of 5000 feet above the sea. In confirmation of this opinion it was further said, that none of these striæ (which are appealed to as proofs of glacial action) were observed upon the surface of the Ural rocks, though such marks are apparent in some of those tracts of Russia in Europe, over which the northern blocks have been transported.

Mr. Murchison concluded by a warm compliment to the Emperor, and to the Russians of all ranks, for the very kind reception, and for the cordial and liberal manner in which every assistance was afforded; and apologizing for his wish to condense into a brief address the numberless topics to which he wished to have adverted, he referred the assembly to the Proceedings of the Geological Society, and intimated that a work and map descriptive of the geology of Russia would soon be offered to the public.

Contributions to a Geological Sketch of North Asia. *By* ADOLPHE ERMAN, *Professor at the University of Berlin.* (Accompanied by a coloured Geological Sketch of the Land between long. 100° and 160° East from Paris, lat. 51° and 63° North, and a Collection of 200 Geological Specimens.)

In addition to a continued series of magnetical observations and other scientific investigations, the author was led to notice a variety of interesting geological phænomena in the country above defined. The volcano of Klioutchi (14,780 Paris feet in height), with the streams of lava rushing down (to the height of 8000 feet), and the clouds of steam of volcanic ashes and cinders, extending to the height of nearly four English miles, was first noticed; and the author then presents a geographical sketch of the Valley of the Lena, of the Aldan Mountains, and the Marikan belonging thereto, and of the immense volcanic area of the Kamtschatkic peninsula.

The borders of Lake Baikal consist of actual triturative conglomerate, alternating with granite, and belonging to the coal formation. North-east of this lake is wide table land 1600 feet above the sea, giving origin to the sources of the Lena, which flows in a narrow regular valley, with mural cliffs, and having horizontal strata of sandstone and marls, chiefly of red colour, often ripple-marked. This red formation occurs also at Oust Kouck with salt and cellular (magnesigenous?) limestone. Near Kirensk these sandstones fold round a boss of the same limestone in a purer state. Near Jerbinsk this limestone, in lofty ranges, is largely cavernous, and in the caverns (200 feet above the river) are stalactites of ice, which also invests the walls and covers the floor. Referring to his collection placed on the table, M. Erman here drew attention to an *Asaphus* in the red strata of the Lena, near Krywslouzk, and to the probability of these red and variegated strata being of the geological age of the Devonian group.

The Aldan Mountains (4000 Paris feet above the sea) show, on the right bank of the river Aldan, vast limestone rocks of the same kind as those of Jerbinsk in the valley of the Lena. Up the picturesque cross valley of Bjellaja, these calcareous rocks extend, and undulate near some dolerites which have broken through them. At the sources of the Bjellaja river these limestones dip westward, and rest upon slate rocks. Partially calcareous under the limestone, these bluish-gray slates become purely argillaceous in their deeper masses ("chemically of the nature of mica"), and beyond the Allachjuna valley, are followed by grauwacke, occupying a breadth of thirteen miles, and an elevation from 1500 to 4000 feet. The slates contain some small traces of coal. Near the slates are mountains of compact siliceous rock, speckled black hornblende and felspar. It is difficult, especially on going eastward from Lake Tungor through the Aldan chain, to determine whether these spots are crystals or fragments. In the pass called Kapiten Mountain, this rock alternates with conglomerate in vertical strata.

The watershed of the glacial and the great ocean lies in the third or easternmost part of the Aldan system, which consists of petrosiliceous porphyry with hornblende crystals, and judging from the gravel brought down by the affluents to the Ochota, granite and serpentine exist in this part of the chain.

Respecting the mineral called Marekanite, M. Erman made some investigations at Ochotzk, which led him to recognize that these stones occur not merely in loose pebbles, but in massive rocks.

On the eastern side of Ochotzk, granite projects in steep cliffs over the sea; then a felspathic grauwacke rock, in steeply inclined strata, and containing very thin coal-beds, as in the grauwacke Aldan Mountains. Near a great dyke of pyroxenic porphyry, the strata have been altered by heat to marekanite or pearlstone. In a ravine the degrees of metamorphism from this cause may be seen, from the carboniferous grauwacke through pitchstone with hyaline quartz, to marekanite and trachyte.

Regarding the volcanoes and the other interesting geological phænomena of the "beautiful and interesting province of Kamtschatka," M. Erman referred to his map and to the specimens on the table. By these means he illustrated the tertiary and perhaps cretaceous strata of the west coast; the amygdaloid formation; the chain of the now spent volcanoes in the middle of the land; and the magnificent rows of still burning cones, and "elevation craters" formed by andisite (viz. albite and hornblende), interspersed with a few very remarkable fields of serpentine, clay slates, and even granite, which seem to have been scarcely altered by volcanic action.

On the Occurrence of Vegetable Remains, supposed to be Marine, in the New Red Sandstone. By JOHN S. DAWES.

The object of this paper is to communicate the fact, that vegetable remains, probably marine, occur in strata in which they have not, I believe, hitherto been noticed. A new line of canal is now being formed between Birmingham and the collieries near Tipton, through Gravelly Hill, Perry and Great Barr; at the latter place Silurian limestone has been found close to the surface, together with traces of coal and other carboniferous measures, which appear to dip under the new red sandstone on the Birmingham side of the axis, thus affording evidence in favour of a recently expressed opinion, that the South Staffordshire coal-field will, in all probability, be found to extend under that town. Not any organic remains characteristic of the lower new red have yet been met with, although other vegetable impressions are somewhat abundant, particularly in the deep cutting near to the old road from Birmingham to Walsall; the specimens, however, that have yet been examined, are perhaps too imperfect to admit of any positive description; some of them appear to be fucoids, others possibly are of a higher organization; they occur imbedded in dark red, argillaceous, ripple-marked flagstones, and in the adjacent red and light green-coloured marls, the whole being subordinate to a quartzose sandstone of considerable thickness, containing calcareous conglomerates, identical in composition with those found on the flanks of Clent, and which are understood to connect the *grès bigarré* with the lower part of the saliferous system; but as these Devonian-looking beds can scarcely be supposed to belong to the latter division, they must, I should conceive, be included with the overlying marls, sandstone and conglomerates, thus constituting a more extensive equivalent of the magnesian limestone. Should the fossil remains prove to be characteristic, a knowledge of them will materially assist in the examination of this highly important series of rocks.

On the Microscopic Structure of Coal. By JOHN PHILLIPS, *F.R.S.*

Mr. Phillips observed, that there was now no difference of opinion as to the vegetable origin of coal, but only as regarded the circumstances under which those vegetable masses were accumulated. In order to determine this, several modes of investigation might be followed, one of which was to examine the coal itself, in order to ascertain the nature of the plants of which it was composed. In the microscopic examination of polished slices of coal, by means of transmitted light, some results had been obtained by Mr. Hutton of Newcastle; these observations had not been published, but he believed Mr. Hutton had detected a cellular structure in the substance of the Northumberland coal, which at first sight might be imagined of vegetable origin, but from their size, form and distribution, were rather connected with the development of gas in the process of chemical changes to which coal had been subject; analogous cells exist in anthracite. It had been his intention to employ some of the ingenious processes recommended by the Rev. J. Reade, who had discovered the means of making fossil vegetable tissue apparent to the senses by a process of combustion, but having lately observed something remarkable in the combustion of Staffordshire coal, he was induced to examine it microscopically, without waiting to adopt any more refined process. He observed that the ashes of wood and peat differed in appearance and structure; and this Staffordshire coal, which did not cake, but burned to a white ash, resembled in its combustion sometimes wood, and sometimes the laminated peat of the north of England, or the compact black peat of Dartmoor. Upon examining these ashes, he found abundant traces of vegetable structure, consisting of portions of woody tissue imbedded in other tissue, apparently of plants much lower in their organization. He had also detected traces of vegetable structure in the ashes of anthracitic coal received from Sir H. De la Beche. Mr. Phillips considered this evidence, as far as he had collected it, rather in favour of the view that particular beds of coal were in a great measure formed by plants growing on the spot, and not by drifting: the evidence of such drifting existed in many cases, and formerly predominated; but he had met with many phænomena, and this amongst them, which tended to diminish the force and generality of his former conclusions. He was, however, still engaged in the prosecution of this inquiry.

On the Origin of Coal. By W. C. Williamson, *F.G.S.*

In this communication the author had collected all the principal facts and phænomena bearing upon the origin and formation of coal, with the view of proving it to have originated in the drifting of vegetable matter into the sea, and not by the accumulated growth on the same spot now occupied by the coal. The strata separating the coal seams were described as consisting of a great variety of rocks, from the coarse deposits and water-worn pebbles of the lower grits to the fine-grained shales and limestones of Ardwick; they were acknowledged by all to have been sedimentary in their origin, containing the remains of aquatic shells and animals. In many of these strata, as at Colebrook Dale, the scales and other remains of Megalichthys were found abundantly associated with Orthoceratites, Goniatites, Naticæ, and a variety of other shells whose marine character had never been doubted; in the coal-measures of Yorkshire *Pecten papyraceus*, several Goniatites, several species of a genus allied to Modiola, Lingulæ, Crustaceans allied to the recent marine genera Cyamus and Cymothoa, were found, with remains of Megalichthys, Palæoniscus, Platysomus, and other fish. The abundance of shells commonly considered Unionidæ, did not, in the author's opinion, militate against the marine origin of the former, as Dr. Fleming mentions having seen the dead shells of Unios, with their valves still united by the ligament, in abundance at Mount Vernon on the Potomac, and at Montmorenci on the St. Lawrence, *both placed where the tide flows*; and Mr. Williamson inferred that if the current could carry them so far, some might also reach the estuaries of those rivers, and become mixed with marine remains. He then described the conditions under which vegetable remains, such as *Halonia regularis*, Calamites, Sigillariæ, Stigmariæ, Lepidodendra, and the fruit of Trigonocarpon, were found imbedded in the coarse grits and solid sandstones of the Halliwell quarries and Peel. These remains had all lost their stalks or foliaceous appendages, and were so intimately a part of the sandstone, that if one was drifted the other must have been transported in the same way. In the beds of shale unconnected with coal, large accumulations of plants were often found occasionally mixed with Unionidæ and minute Entomostraca, presenting the appearance of having been thrown down together, after floating about in the water; the author considered these layers only differed in amount from the coal-seams; in one case a large and dense mass of vegetable matter had formed the material of a bed of coal, in the other the fewness of the plants and their intermixing with mud, now forming the shale, had limited the process to the conversion of each plant into a thin layer of carbonaceous matter. The author attributed the scarcity of fish-remains in the coal itself to the action by the same chemical process which had converted the accumulated vegetables into coal; the occurrence of scales of Megalichthys in the cannel coal of Dixon Green and Wigan, he attributed to some peculiarity in its origin or composition more favourable to their preservation. The absence of the usual coal-measure plants in the fire-clay underlying the coal proved, in the author's opinion, a want of any connexion between the two; and he was disposed to adopt the view of those who regarded the Stigmaria of the fire-clay as a marine, or at least aquatic plant, growing in those estuaries in which the drifted vegetable remains of the higher country would be sunk, and form a deposit of coal over them; but he observed that, although coal rarely occurred without this subjacent layer of stigmaria, yet the latter was frequently found independent of coal. The author proceeded to state what he considered another proof of the drift origin of coal and associated beds in the disjointed and fragmentary condition of the fossil ferns and other plants, and the almost universal absence of their rhizomas and roots, which he stated he could only account for by supposing the remains had been long exposed to the action of water in rapids and violent currents. The absence or rarity of distinct traces of fructification was also an argument in favour of their being drifted; as in the oolitic deposits of Gristhorpe-bay, which afforded evidence of comparatively tranquil deposition in fresh water, the fronds were not merely grouped together by their rhizomas, but afforded frequent indications of fructification. The prevalence of fine-grained shales immediately over coal seams was, in the author's opinion, highly unfavourable to the theory which accounted for the origin of coal by subsidences; for if a sudden subsidence had taken place, a deposit of water-worn pebbles would have been strewed over the coal, indicating the violent action of aqueous currents; and if the submergence were slow and gradual, the plants, as before argued, would be found much more perfect, as any currents sufficient to tear up the vegetation would also strew the surface with detritus; the absence of unconformability in the members of the coal-measure was also hostile to the idea of partial depressions. The argillaceous partings, which constantly occurred in coal seams, also favoured the supposition of a considerable amount of drifting. Mr. Williamson concluded by attempting to explain the upright position of the trees at Dixon-fold on the Bolton Railway, without having recourse to the supposition that they grew on the spot; one of these trees was described by Mr. Bowman as having its base raised fifteen inches above the surface of the coal, the roots only being in contact, which Mr. Williamson considered could not be accounted for by any condensation of the vegetable remains afterwards constituting the coal seam. One of the largest of these trees presented no trace of roots, which were more likely to be preserved than any other portion. As to their erect position, he considered the weight of their strong branching roots would be sufficient to maintain them erect in water until a deposit of sediment and drift should accumulate round their bases; whilst the absence of trunks inclined at various angles might be accounted for by pressure, which would soon reduce all that were not absolutely vertical to a horizontal position. One of the greatest objections in the author's mind to the drift theory was, the great extent and uniformity of some of the thin seams of coal, especially in the lower measures; he thought, however, the accumulation of vegetable remains in which these seams originated might have been as great as in many of the larger coal seams, but that in the chemical changes which they had undergone, a larger proportion of the gaseous elements had escaped, leaving the mass both thinner and less unequal in thickness than at first. He also mentioned the laminated appearance of peat-bogs in the vicinity of Manchester, as exhibiting by its illustration of the structure of coal a fact favourable to the hypothesis which he had been combating; and stated that as the true explanation of the phænomena was the only end he sought, he was ready to accept that view if the difficulties attending it could be explained on rational grounds.

On the Great Lancashire Coal Field. By E. W. Binney, *Sec. Geol. Soc. of Manchester.*

This carboniferous deposit, generally known as the Lancashire Coal Field, occupies the chief part of the southern division of the county of Lancaster, and extends into portions of the adjoining counties of Chester, Derby and York, in a line from near Macclesfield to Colne it ranges about 46 miles due N. and S., and from Tarbock to Todmorden about 40 miles from W.S.W. to E.N.E. It commences with the lower millstone grit, and extends upwards into the limestone of Ardwick, near Manchester, now generally considered the highest portion of the coal measures hitherto observed in England. The author divides this series into three groups in descending order:—1. *The Manchester coal-field*, containing the limestone of Ardwick, and the isolated coal-measures of Clayton and Bradford, near Manchester, occupying the low tract of country adjoining the new red sandstone plains.—2. *The middle field*, comprising the thick coal seams of Poynton, Ashton, Middleton, Worsley, Wigan, &c., occupying the rising ground between the new red sandstone plains and the higher parts of the country, and containing the richest portion of the field.—3. *The lower coal-seams*, found in the elevated parts of the country, along the sides of the Penine chain, and the moorlands of the northern parts of Lancashire; comprising those of Whaley Bridge, Mellor, Glossop, Rochdale, Todmorden, Colne, Blackburn, Chorley, &c.—seams of no great thickness, but valuable from their quality and position, and remarkable from their adjoining shales containing remains of the genera

Pecten, Goniatites, Posidonia, and other shells of marine origin. The total thickness of the deposits varies in different parts of the field; in a line from Manchester, through Ashton, to the limestone shales of Hollins Brook, the thickness is about 2000 yards; and there are 75 beds of coal exceeding one foot in thickness, forming altogether 150 feet. In a line through Worsley, Bury, Burnley, &c., to the limestone shales of Pendlehill, there are 36 seams, only ten of which are less than one foot in thickness, amounting to 93 feet of coal; in these sections the smaller seams are not taken into account. The author states that the variable character of these coal seams and the accompanying strata, make it difficult to lay them down upon a map; the lower seams can be classed by the gritstone rocks which contain them, as shown by Mr. Elias Hall, but the middle and upper seams divide and thin out in such a manner as to render their identification very difficult. He then proceeds to describe the roofs, or strata immediately overlying the coal seams, the coal itself, and the *floors* or strata immediately underlying the beds of coal.

I. *Roofs.*—The deposits forming the roofs vary at different places, even over the same seam. There are four kinds of roofs:—1. A fine mixture of alumina and silica, with oxide of iron, and a trace of the carbonates of iron and lime; these are generally known as *blue binds*, and are of most frequent occurrence; they almost always contain ferns, and remains of Stigmaria, Sigillaria, Ulodendron and Lepidodendron, and beds of the Unio and other shells. The Sigillariæ, &c. are often found standing erect at right angles to the planes of stratification; these instances chiefly occur in the *middle field*, at Pendleton, Dixon-fold, Wigan, &c. Sometimes they are found with their roots running into and resting on the seams, and more frequently the bole of the tree rests on the coal itself, without exhibiting any trace of roots. The Sigillariæ are by far the most common; at Pendleton and Dixon-fold they occur as abundantly as they could possibly have grown: the author had observed three specimens at Pendleton, 24 feet high and about 3 feet in circumference, standing in a shaft 11 feet in diameter. 2. *Roofs of sandstone* are not common, and where they do occur the coal is generally inferior in quality; the fossils found in the sandstone are usually prostrate coal plants, Stigmariæ, &c. 3. *Black shale roofs* are frequent, and cover most of the best house-fire and caking coal; they seldom contain plants, though, in a few instances, upright Sigillariæ have been found. Bivalve shells, detached scales and teeth of fish frequently occur in them, and with the *Microconchus carbonarius* and casts of Cyprides sometimes constitute nearly the entire mass; almost all the black shale roofs of the lower field teem with remains of Pecten, Goniatites, Posidonia, and remains of fishes. 4. *Shales with highly bituminous schists*, forming roofs, are not of frequent occurrence; they are found at Peel and Pendleton, and contain abundant remains of fish, mostly entire. At Bradford and at Ardwick, in the roof of the thin coal intercalated with the limestones, the detached teeth, bones and scales of fish occur, mingled with countless myriads of the remains of Cypris and Microconchus.

II. *Coal and Cannel Seams.*—The author describes two varieties of coal, the *cubical* where the cross cleavage runs at right angles to the main cleavage, and the *rhomboidal* where it makes an acute angle; the first form generally occurs in the upper and lower portions of the field, the latter prevails in the middle. The main cleavage, he observes, is in most cases parallel with the principal fault in the vicinity. The beds of *cannel* are generally found on the top of the coal, and nearly always contain remains of fishes, often bivalve shells, but hitherto have exhibited no trace of Microconchus, and rarely any leaves or stems of plants, whilst the upper portion of *coal* seams frequently exhibit traces of Sigillariæ, Lepidodendra, Calamites, &c. In the six-feet seam at the new pit of the Pendleton Company, several rounded stones of fine siliceous grit were found, but as they occurred near the great fault of 1000 yards, they might have fallen in during the dislocation. The coal seams are either simple, and continue undivided over large tracts of country, or split and divide into several distinct seams; the former generally occur in the lower portion of the field, the latter in the middle and upper part. It is owing to this tendency to divide, that the thick seams of Clifton and Radcliffe cannot be well identified with the thinner and more numerous seams of Oldham, Ashton and Bradbury; in the four-feet mine at Pendleton the author has observed that the coal on the N.W. forms one undivided seam of 5 feet in thickness, but that towards the S.W. a thin bed of fire-clay full of Stigmariæ appears in it; and in Mr. Fitzgerald's pit to the S.E. it gradually thickens until at a distance of 900 yards from the point first observed, it has increased to 3 feet, separating the coal into two distinct seams. At Alkrington the two Beat Mines are worked together, but to the S.E. a parting of fire-clay appears, which gradually increases in thickness, and at Oldham, 3 miles distant, the two Beat Mines are worked 10 yards apart; other instances of subdivision are known, all of them taking place towards the S. and S.E. Independently of the tendency to divide, many seams diminish in thickness till they become evanescent; this is chiefly observable in the lower division of the coal-field, and in the simple seams six beds which have been worked in that series, give decisive evidence of this fact. The best examples are the *caking coal* of Rochdale and the *Foot mines*, beds known by various names in different parts of the country, but easily identified by the remarkable nature of their floor, which is a hard crystalline stone, called *Ganister*, full of *Stigmaria ficoides*, and employed as a material for mending roads. At Dulesgate, near Todmorden, the upper or "Ganister coal" is 5 feet 8 inches in thickness, and the Foot coal, about 12 yards below it, is 7 inches thick; the author has traced these seams about 11 miles to Quarlton, and ascertained that the Ganister coal gradually diminishes in thickness to *one inch*, while the Foot coal increases to *two feet*, the floors retaining the same character throughout.

III. *Coal Floors.*—The stratum on which the coal rests is always carefully noticed by practical miners, who believe that where a thin seam is found on a thick argillaceous floor full of Stigmariæ, it is certain to become workable if followed. The floors are of three kinds—the *fire clay*, which is the most abundant; the *warrant*, a clay mixed with a larger amount of silica, occurring frequently; and the *rock* floors, of which but two instances are known, namely, the floor of the Featheredge coal at Walmersley, which is a rough quartzose sandstone, and the Ganister, before noticed. The latter is merely a fine-grained admixture of silica and alumina, varying from 8 inches to 2 feet in thickness, always graduating into a fine fire-clay at its bottom. All the floors, with the exception of the rock floor of the Featheredge coal, contain *Stigmaria ficoides*, from the thin seams of the Ardwick limestone, to the two seams in the millstone grit of Gauxholme, near Todmorden, a thickness of nearly 1600 yards; all the fifteen floors of the Manchester coal-field contain it, and at least 69 beds in the middle and lower divisions. The Stigmaria generally occurs with its leaves attached, and in all instances of *true floors* without any intermixture of other plants. These facts seem to indicate that all the deposits were formed under nearly similar conditions; the roofs and floors were evidently very quietly deposited, and formed a strong clay, well adapted for the growth of the vast masses of vegetable matter required for the formation of the coal seams. The absence of alkalies in the clay of the floors, might be expected from the exhausting properties of plants, and seems to strengthen the supposition that these beds supported the vegetation which now constitutes the coal. The remains of bivalve shells and fishes in the *cannel* beds, prove that they were formed under water; but in the Lancashire coal-field no remains of fishes or shells have yet been found in the *coal*, nor is there any indication, either by admixture of sand or silt in the seams of coal, to show that they were drifted into the places they now occupy by rapid currents of water. The occurrence of forests of large trees standing upright on the seams, the pure vegetable matter composing the coal itself, with scarce any admixture of foreign ingredients, the position of the coal upon a rich alluvial deposit well adapted to sustain a luxuriant vegetation, seem to prove that, in most instances, the vegetable matter forming it grew upon the spot where the coal is now found; whilst the splitting and alterations in the thickness of the seams themselves, show that the surface was most probably subject to frequent subsidence.

Statement of the Fossils which have been discovered in the several members of the Carboniferous or Mountain Limestone of Ireland, with a view to show the Zoological identity of the whole Series, together with a Comparison of the Fossils which occur in the Mountain Limestone of Ireland with those which have been obtained from the same Series in Great Britain, and also with the Fossils of North and South Devon, illustrated by Maps, Sections, Drawings and Specimens. By RICHARD GRIFFITH, *F.G.S.*

The substance of this communication had already been printed by Mr. Griffith for distribution amongst the members of the Association; it was accompanied by a catalogue of all the fossils yet discovered in each of the subdivisions of the Irish mountain limestone series, in the strata of North Devon, and in the mountain limestone of Great Britain, arranged in parallel columns for the purpose of comparison; the notice was also illustrated by coloured sections.

Mr. Griffith stated that his object in this communication was to prove, by the evidence of fossils, that the lower members of the mountain series of Ireland, as arranged by him, really belonged to that series, and not to the old red sandstone, as advocated by some geologists. He described this series as containing two great bands of limestone, which he had denominated the *upper and lower limestones*; interposed between these limestones were beds of shale, argillaceous limestone and sandstone, forming a series of great thickness, known by the name of *calp* or calp slate. Beneath the lower limestone was a second series of schistose beds, to which he had given the name *carboniferous slate*; under the slate was a series of sandstone beds, frequently intercalated with slate or shale, and occasionally with limestone; he had denominated this deposit the *yellow sandstone*; its lower beds rested conformably on the old red sandstone. Mr. Griffith stated, that those beds varied in thickness at different localities, but that the relative position of each member of the series was always the same; the upper and lower limestones were generally more persistent than the other members of the series. In some localities the carboniferous slate and yellow sandstone were altogether wanting; in others the carboniferous slate only was absent, the lower limestone resting directly on the yellow sandstone. In the northern and middle districts of Ireland, the calp formed a very thick and important member of the series, but gradually thinned out towards the south; it had not yet been discovered in the counties of Cork and Waterford, and was only occasionally traceable in Clare, Limerick and Kerry. In the middle district, the upper limestone formed the distinguishing feature; in the southern section, the upper and lower limestones were most abundant, and the calp least so, whilst the carboniferous slate and yellow sandstone occupied an inconsiderable superficial extent, but were important, as they contained a great variety of fossils. The carboniferous slate of the South of Ireland differed considerably in lithological character from that of the middle and northern regions, but the number of fossils common to the beds which occupy the same geological position in all three districts, showed the necessity of including the whole in one division. In the tables of fossils before mentioned, the occurrence of each species in the different members of the Irish series, was indicated for each of the three districts, and also their occurrence in North Devon, and in the English mountain limestone. From these general tables, Mr. Griffith had prepared tables of results, showing the number of fossils of each class occurring in every division of the mountain limestone of Ireland; those peculiar to it, those common to it, and all the other members of the series, those that are common to each of the other divisions, and also those that are common to the mountain limestone of Great Britain, and to North Devon. Some of the results obtained were as follows:—*Yellow sandstone*, out of 122 fossils, 9 were peculiar to it: 113, or 92½ per cent., common to the mountain limestone of Ireland generally; 49 species, or 40 per cent., common to the upper limestone; 87, or 71 per cent., to the calp; 75, or 61 per cent., to the lower limestone, and 94, or 77 per cent., common to the carboniferous slate; 35 species, or 30 per cent., were common to North Devon; and 59, or 48 per cent., to the mountain limestone of Great Britain. —*Carboniferous slate*, of 275 fossils, 12 were peculiar to it; 263, or 95½ per cent., common to the mountain limestone of Ireland generally; 99, or 36 per cent., common to the upper limestone; 176, or 64 per cent., to the calp; 162, or 60 per cent., to the lower limestone; and 94, or 34 per cent., common to the yellow sandstone; 65 species, or 24 per cent., were common to North Devon; and 139, or 50 per cent., to the mountain limestone of Great Britain. From these data Mr. Griffith concluded, that the yellow sandstone, which contained 92½ per cent., and the carboniferous slate, which contained 95½ per cent. of fossils common to the other members of the mountain limestone of Ireland, must belong to that series. Mr. Griffith next proceeds to consider whether the moutain limestone of Ireland generally should be classed with that of Great Britain. By the table of results it appeared, that out of 180 species of fossils obtained from the *upper limestone*, 133, or 73 per cent., were common to the British mountain limestone; of the *calp*, out of 267 species, 148, or 55 per cent., and of the *lower limestone*, out of 391 fossils, 234, or 60 per cent., of the carboniferous slate 50 per cent., and of the yellow sandstone 48 per cent., as already mentioned, were common to the British mountain limestone; and if the entire series were taken, it appeared that out of 430 species which had been described as occurring in that series, 287, or 67 per cent., were common to the mountain limestone of Ireland. Hence he concluded, that the mountain limestones of Great Britain and Ireland belonged to the same geological suite, though the Irish series generally, and particularly the lower members, contained a great number of species, which had not hitherto been discovered in the British. From the foregoing data there appeared to be a greater affinity between the upper limestone of Ireland and the British mountain limestone, than between it and the other members of the Irish series. Again, the upper limestone of Ireland contained only 16 species of fossils, or 8 per cent., which were common to North Devon, while the calp contained 43, or 16 per cent., the lower limestone 39, or 10 per cent., the carboniferous slate 65, or 24 per cent., and the yellow sandstone 35, or 29 per cent., in common with the same series. Thus there appeared to be a nearly regular gradation from the upper portion of the mountain limestone of Ireland into the upper Devonian; and although, owing to the predominance of ordinary mountain limestone fossils, the per-centage is not considerable even in the lower members, yet by reference to the table of results it appeared, that out of 122 species of fossils from North Devon, 80, or 65½ per cent., occurred in the mountain limestone of Ireland; and hence Mr. Griffith concluded, that hardly a doubt could be entertained as to the propriety of attaching the fossils of North Devon to the mountain limestone series of Ireland. He considered this a startling result, and one which could not have been foreseen from our previous knowledge of the fossils belonging to the British mountain limestone, which contained only 22 species common to North Devon, and made the conclusion of some distinguished geologists as to the separation of the Devonian system from the mountain limestone, perfectly legitimate, even as regarded the *northern* portion of the district. Mr. Griffith observed, that this comparison between the mountain limestone and the Devonian fossils had been confined to those of North Devon. By a similar comparison with South Devon, the results were essentially different, inasmuch as out of 257 species of fossils obtained from that district, only 94, or 36 per cent., were common to the mountain limestone of Ireland, and 26, or nearly 11 per cent., to that of Great Britain, a result which led to the conclusion, that the fossils of South Devon generally belonged to a different, and, judging from the type of the fossils, to a more ancient period than those of North Devon, though possibly a portion adjoining the culm series might eventually be found to correspond with the period of North Devon. The fossils of North Devon were given in these tables as described by Mr. Sowerby, Mr. Lonsdale and Mr. Phillips, and those of the mountain limestone of Great Britain, by Mr. Sowerby and Mr. Phillips. In regard to the fossils of the mountain limestone of Ireland, nearly the whole of the fossils named in the table had been obtained by, and were in the collection of, the author; of the 568 species which it contained, 166 were supposed to be new by Mr. M'Coy of Dublin, who had examined and named them. Mr. Griffith stated, that the collection also contained upwards of 100 additional new species, which were under examination, including several species of Entomostraca, from the calp of Bundoran, in the county of Donegal, the lower limestone at Armagh, and the carboniferous slate at Howth, in the county of Dublin; numerous remains of fossil fish had also been collected, but they had not yet been sufficiently examined to be named and introduced in the catalogue. Mr. Griffith observed, in conclusion, that these investigations must still be considered as in their *infancy*; the collection from the upper limestone was particularly deficient, which had arisen from the circumstance of the district containing the best development of that member of the series being situated near the summits of elevated crags, where no quarries had been opened; and every geologist was aware of the difficulty of collecting a good suite of fossils under such circumstances.

Notice on the distinction between the Striated Surface of Rocks and Parallel Undulations dependent on Original Structure. By R. I. Murchison, *Pres. G.S.*

The President called attention to an interesting notice just published in the *Scotsman* newspaper and sent to him by the author, Mr. MacLaren, "On the Striated

Rocks of the Corstorphine Hills near Edinburgh;" his object in so doing being to urge geologists to distinguish well between appearances caused by *mechanical action* and those resulting from *structure*. The existence of abraded surfaces of rocks in these hills was (he stated) pointed out long ago by the celebrated Sir James Hall, but when they were inspected by himself in 1840, in company with Mr. MacLaren and Dr. Buckland, the surfaces which he then saw were marked by sets of wavy parallel grooves or undulations (precisely similar to the casts sent formerly to the Museum of the Geological Society of London), which appeared to him to belong to a class of phænomena distinct from the *striated* surfaces so common around Edinburgh and in many parts of Scotland. This opinion was confirmed by discovering in the newly quarried body of the same rock of the Corstorphine Hills and at various levels, undulations and grooves precisely similar to those on the surface, which were thus shown to have been superinduced by original structure, an opinion which he (Mr. M.) expressed upon the spot, and which he has published in his last Anniversary Discourse. This view is indeed accepted by Mr. MacLaren, but that author at the same time goes on to show, that on recent examination Sir G. Mackenzie and himself observed that the surface of parts of the Corstorphine Hills were also marked by the small striæ or irregular parallel scorings directed from west to east, and which they believe must have resulted from powerful abrading agency, whether gravel and water, glaciers or bottoms of icebergs.

In thanking Mr. MacLaren for again calling attention to a subject he had so well illustrated (see MacLaren's 'Sketch of the Glacial Theory'), the President said, that he was quite ready to agree in all that had been written by that author in reference to the Corstorphine Hills; for although he had not seen the rough striæ in his hurried visit to that spot, he was well acquainted with such markings in many other parts of Scotland, in which country, as well as in Sweden and Russia, he had endeavoured to account for their presence by the grating action of the bottom of floating icebergs. It was from this conviction (1840) that he opposed the terrestrial glacial theory of Agassiz, as applied by that naturalist and Dr. Buckland to the *low countries* of Scotland, over which they contended that *glaciers* had advanced, which had scored all the rocks, and which, on melting, had left *moraines* of gravel and sand. He was therefore happy to perceive, that in rendering justice to the merits of Sir J. Hall, Mr. MacLaren had adopted the opinion for which he (Mr. Murchison) originally contended; viz. that whilst icebergs very probably produced striated surfaces, the wavy undulations are unequivocally due to the original structure of the rock *.

On the Stratified and Unstratified Volcanic Products of the West of England. By the Rev. D. Williams, *F.G.S.*

This communication was supplementary to that which Mr. Williams made last year at Plymouth. Subsequent investigation, on a far more extended scale, had confirmed him in the results he then announced, viz. that granite, gneiss, mica-schist, porphyry, greenstone, tufaceous ash, breccia, grit, chloritic, talcose, and clay slate, were all volcanic products, and that no such distinction as the so-called "plutonic rocks" really existed in nature—they were, in short, associated together by evidences of their common origin, and connected together by a series of mutual dependencies, and as such were capable of definite classification, as erupted products, as rocks *in situ*, which have been fused, semi-fused, or had been in some other particular stage of fusion, and as rocks simply altered by contact with ejected burning lavas. His object was to reduce the entire family of ancient volcanic products within the scope of recognized laws, and the ordinary operations of nature. He pointed to a diagram he had constructed, of an ideal volcanic centre in a phasis of activity, which (by admitting modifications to a greater or less amount) he submitted might serve as an illustration of the process of fusion and conversion (so far as the rocks of the earth had been submitted to our view) throughout all regions and all times. He supposed an internal nucleus of white incandescent lava, whose outer border was surrounded by a zone of gneiss, the zone of gneiss by an outer concentric zone of mica-schist, and the mica-schist by any sedimentary strata, as the case might be; under certain circum-

* Mr. Bowman has since (Phil. Mag. Nov. 1841) shown that some structural appearances in the rocks of N. Wales *might* be mistaken for the result of glacial action.

stances, he contended that these strata, and the inner concentric zones of mica-schist and gneiss would be invaded by ramifying and anastomosing veins emanating from the internal fluid, to an extent proportionate to the temperature; these veins (the result of the intense heat which formerly traversed and melted down the walls of the joints, and radiated thence laterally among the laminæ of deposition), instead of being passively injected among the bounding sedimentary or igneous rocks, were the active instruments which fused and converted those rocks into trap, porphyry, or granite, as the case may be; these veins would thus convert the zone of gneiss into incandescent lava, the mica-schist into gneiss, and a proportionate thickness of the sedimentary strata into mica-schist; and if the *vis à tergo* of heat should be maintained, such transformations would progressively advance till the superincumbent or outermost strata being reduced to their point of least resistance, they would necessarily yield to the pressure or expansive force of the augmenting volume of the liquid matter, and present all the phænomena of a crater of elevation. From the whole amount of his observations, taken round the granite of Dartmoor, Bodmin Moor, &c., he considered that if Von Buch had not proposed the theory of "Elevation Craters," geologists would eventually have been constrained to have recourse to some hypothesis of the kind to explain the appearances presented by those granitic domes. With regard to the origin of the schist and slate rocks, a series of specimens might be gathered from many localities in South Devon and Cornwall which would show an insensible transition from the coarser volcanic grits and breccias into the finest clay slate, every variety of which he had traced up to those more typical products. Mr. Williams stated, that his inquiries had resulted in the conviction that granite, gneiss, mica-schist, clay slate, &c. are no evidence of age or position in the geological scale, but that they appertain to all formations, from the most ancient to the most recent; he considered gneiss and mica-schist were not simply "metamorphic" rocks, but rocks in a particular or definite stage of fusion. The term "metamorphic" was perfectly true so far as it went, but did not convey the entire sense which the facts and circumstances of this class of rocks so manifestly conveyed. He therefore suggested that they should be termed intermediate products, and granite, porphyry, trap, breccia, grit, ash, chloritic, talcose, and clay slate, immediate products of volcanic action.

On some peculiar Inorganic Formations and Fossils of the Magnesian Limestone. By EDWIN LANKESTER, *M.D.*

This communication was descriptive of a series of specimens placed on the table, illustrating various appearances and forms assumed by the magnesian limestone.

On the Occurrence of Boulders in the Valley of the Calder. By JOHN TRAVIS CLAY.

In consequence of the information given by Lieut. William Alexander of Halifax, at one of the meetings of the West Riding Geological Society, that in prosecuting the works of the Manchester and Leeds Railway some pieces of granite had been found at Hebden Bridge, the author proceeded to investigate the formation of the alluvial deposits in the valley, and the result of the examination proved that boulders of granite and other hard rocks exist in considerable abundance along a distance of many miles.

"The valley of the Calder along its whole course is bounded on both sides by abrupt hills, which enclose a narrow and almost always level tract of land. The hills are of the regular coal strata, and as far as I have been able to discover, are destitute of a single boulder or even rounded pebble. The level portion, on the contrary, is entirely composed of removed matter, near the surface sand, clay and small pebbles; but at about the depth of five feet there is a bed of boulders of a much larger size, the majority of which are from the neighbouring rocks, but also containing many of granite, and others of similar origin.

"The peculiarity of this deposit, when compared with that which occurs so extensively in the centre and eastern parts of Yorkshire, as well as in Lancashire, consists in its being confined to this narrow stripe, frequently not a quarter of a mile in width, yet extending continuously in nearly an east and west direction for many miles: I have traced it from Hebden Bridge, near Halifax, to Wakefield, a distance of upwards of twenty miles, and I have no doubt that it extends further east till it unites with the great mass of drift which occupies the vale of York."

The author supposes that at the period when the drift was deposited, the elevation of the land was much lower, which would cause the level parts of the country to be submerged, and the narrow dales of Yorkshire would be sea-locks, like those now existing in Scotland, along which icebergs detached from the glaciers of the Cumbrian mountains would be floated in every direction.

Notice of the Fossil Footsteps in the New Red Sandstone Quarry at Lymm, in Cheshire. By Mr. HAWKSHAW.

The Lymm quarry is at a short distance from Lymm on its eastern side, and south of the turnpike road from that place to Altrincham. The general dip of the strata is S.S.W. at an inclination of three inches to the yard. The quarry is near the outcrop of the stratified beds that are worked therein. The nature of these beds will be understood by the measurement of their vertical section as exposed in the quarry, which is as follows:—

Grass.

1ft. 6in. of ...	soil.
6in. to 2ft. of	sand coloured with red oxide of iron.
2ft. of......	gray marl slightly stratified at bottom, passing into a thin stratum of shale in other parts of the quarry.
4ft. of.........	arenaceous shale in laminæ of $\frac{1}{8}$th inch to 1 inch in thickness.
3ft. of.........	arenaceous shale, harder than the overlying stratum.
6in. of.........	gray sandstone.
$\frac{1}{2}$in. of.........	gray shale.
1$\frac{1}{2}$in. of	gray sandstone.
1in. of.........	shale.
1ft. of.........	gray and red sandstone.
$\frac{1}{2}$in. of.........	shale.
1ft. of.........	gray and red sandstone.
2in. of.........	shale.
1ft. 8in. of ...	gray and red sandstone, redder than the upper beds.
2in. of.........	shale.
7in. of.........	red sandstone.
$\frac{1}{2}$in. of.........	shale.
9in. of.........	red sandstone.
$\frac{1}{2}$in. of.........	shale.
9in. of.........	red sandstone.

floor of quarry.

The rock underlying these strata is in thick beds or large homogeneous masses, either altogether or very indistinctly stratified. Most probably it was rapidly deposited from deep water, containing vast quantities of sand in admixture, and the whole deeply impregnated with oxide of iron.

The strata of the quarry have evidently been formed under other circumstances. The thinness and regularity of the layers, varying both in texture and colour, sometimes thin shale, sometimes stone, together with their position and outcrop, would seem to bespeak an ancient shore that had still and quiet waters, but which, nevertheless, were not uniform with respect to the matter they contained in admixture, but left a deposit frequently varying in the space of a few inches.

The thin strata of shale are of a yellowish gray colour. The laminæ of the upper and thick beds of shale have a black coating, probably carbonaceous, as though the waters from which these upper beds were formed had come more into contact with vegetable life. The upper strata of sandstone, as the section explains, are gray; they become variegated with red as they descend, and it is only the bottom beds of the quarry that have the dark red colour so common to this formation.

The fossil footsteps have been found on nearly all the beds of sandstones; on the uppermost small pointed impressions as if from Crustacea, and others resembling the feet of birds. Impressions of Cheirotherium are on the upper strata also, but they are of small dimensions, increasing in magnitude as the beds descend. Referring to the several specimens from this quarry in possession of the Warrington Natural History Society, and now in their museum, we notice a gray sandstone slab on which are footsteps of Cheirotherium, chiefly varying from $\frac{7}{8}$ths of an inch to $1\frac{1}{4}$ inch long, the largest impression being 4 inches in length. The next, a slab of the same colour, has impressions 3 inches in length. Another gray sandstone slab has impressions 4 inches in length. And upon a slab of dark red sandstone is one impression 10 inches long, but of peculiar form, as though the foot that made it had been furnished with claws.

The most remarkable specimens of Cheirotherium from this quarry that I have seen, are in the possession of Mr. John Robson, surgeon, of Warrington. Both are of the deep red sandstone of the lower bed. The largest specimen, a slab of about 20 inches diameter, has two footsteps in the usual position in which they are when left by the same animal, viz. the smaller preceding the larger footstep, which is $9\frac{1}{2}$ inches in length. The other specimen is a footstep of $7\frac{1}{2}$ inches long, on a slab of similar sandstone.

Both these beautiful specimens are from impressions that appear to have been left upon a thin stratum of the finest clay, which was so well prepared to receive the mould as to leave a cast so delicate as to give us the texture of the skin that covered the sole of the foot. This appears to have been covered with small papillæ, about 100 to the square inch in the larger specimen, and about 220 to the square inch in the smaller specimen; showing that the sole of the foot was furnished with a rough skin, such as might have been expected in a creature that walked upon a sandy shore.

Notice of Perforations in Limestone. By Dr. BUCKLAND.

Dr. Buckland laid on the table a slab of limestone from Plymouth, perforated with deep, irregularly rounded holes, which he attributed to the long-continued action of the slime of garden snails (*Helix aspersa*), and stated that he found litmus paper to exhibit a red tint if these snails are made to crawl over it. The feeble action of a small quantity of acid in their slime, continued on the same parts of the same stone during a long series of years, seems to afford an adequate cause for those effects, which were last year adduced at Plymouth as the work of marine animals, and as affording evidence of a raised beach. On visiting the spot, Dr. Buckland found the slab now exhibited, with several living snails, and also shells of dead snails in the holes. In September 1841, he found similar holes, with shells of a smaller wood snail in them, on the under surface of blocks of limestone in Cumberland, and Mr. Baker has recently observed them in the limestone of Cannington Park, near Bridgewater.

On Recent and Fossil Semi-circular Cavities caused by air-bubbles on the surface of soft clay, and resembling impressions of rain-drops. By Dr. BUCKLAND.

In July 1840, Dr. Buckland first noticed cavities of this kind upon the surface of some desiccated mud, which had been laid in small heaps by the side of the railroad near Reading; they were mostly of the size of holes impressed by large raindrops, but could not be referred to rain, because they existed only on certain spots lower than the general surface of the heaps. The origin of these holes appeared to have been the rise of bubbles of air through the bottom of little partial shallow ponds of water on the mud, the general surface of which, from its convex form, had allowed no water to rest upon it. A slab of new red sandstone on the table, from near Birmingham, containing a few impressions of vegetables, was covered with small tubercles in close contact with one another, and apparently caused by the deposition of sand in holes formed by the rise of bubbles of air from a subjacent bed of clay. Dr. Buckland suggested that some of the cavities, and casts of cavities, on beds of sandstone at Storton Hill, near Liverpool, and also near Shrewsbury, which have been attributed to rain-drops, may have been due to the extrication of air-bubbles; care would therefore be necessary to distinguish between these two causes of phænomena, which have hitherto been exclusively attributed to rain.

On the Discovery of Insects in the Lower Beds of Lias of Gloucestershire. By the Rev. P. B. BRODIE.

Such fossils being comparatively of great variety, and with one exception not having been before discovered in the lias, the author was unwilling to delay any notice of the occurrence of these organic remains in the lowest member of our oolitic series. His former discovery of insects in the Wealden led him to a closer investigation of the strata in the neighbourhood of Cheltenham, and the result has proved highly satisfactory. He has already detected elytra of one or more genera of Coleoptera, one or two minute beetles, and a few wings of some insects, one of which resembles that of the Libellula. The above fossils are generally of small size; the largest elytron is a little more than half an inch long, and the largest wing about an inch in length; nor are they by any means abundant.

The beds in which they occur consist of thin courses of blue, green and white limestone, forming some of the lower beds of the lias formation, so extensively developed in the neighbourhood of Cheltenham and Gloucester.

Notices of the Geology of Derbyshire and Neighbouring Counties. By ELIAS HALL.

In illustration of this communication Mr. Hall presented models, maps and sections on a large scale.

A skull which had been found in excavating a lock at the east end of the Forth and Clyde Canal, on the Firth of Forth, at twenty feet below high-water mark, was placed on the table. It belonged probably to the domestic breed of cattle.

On the Structure and Mode of Formation of Glaciers. By JAMES STARK, *M.D., F.R.S.E.*

Dr. Stark presented his views on the stratified structures occurring in glaciers under the following heads:—

1. *On the Occurrence and Mode of Formation of Horizontal Strata.*—Most writers seem to be agreed that these horizontal layers mark the additions which had been annually made to the glacier, each layer being the accumulated snows which fell during one year. Dr. Stark however showed, from a reference to the meteorological tables kept at the Hospice of the Great St. Bernard, that considerable doubts might be entertained as to this being the case. These layers of ice are in general from 1 foot to 3 feet in thickness, but the tables demonstrate that from 300 to 700 inches of snow fall during the six winter months alone, *i. e.* from October to March inclusive. Dr. Stark therefore thought it was quite possible that each horizontal layer denoted the separate storms or falls of snow, or if they marked the annual accumulations, apparently proved, what had not previously been suspected, that snow and ice waste nearly as rapidly in the upper as in the lower regions.

2. *On the Occurrence and Mode of Formation of Longitudinal and Vertical Strata.*—Respecting the structure to which he referred the lamellar, banded, striated or ribboned structure, mentioned by different observers, Dr. Stark offered the following explanation:—Late researches show that glaciers advance at the rate of from 200 to 500 or 600 feet annually, and as it is generally allowed that this takes place only during the spring and summer months, the daily progression of the glacier must be from $1\frac{1}{2}$ to 3 feet. This daily movement extends more or less to the whole extent

of the glacier; and as, in all the upper regions at least, the icy mass progresses from narrower to broader valleys, every movement has the effect of leaving a narrow space between the margin of the glacier and its containing walls. The granular snow which covers the flanks of the valleys, being loosened and softened during the heat of the day, slips down and fills these spaces, when the descent of the temperature during the night, and the contact with the already formed icy mass consolidates it into a layer of solid ice. Layers of ice in this position are recognized to be always more or less granular, but to be divided from each other by plates of purer and more compact ice. Dr. Stark regarded these plates as a superadded structure, occasioned by the trickling of the water of the melted ice or snow over the external surface of each layer where they were in contact, or nearly so, with the containing rocky walls. The water would freeze as it trickled over the icy surface, and form a plate of pure and transparent ice very different from the recognized structure of ice formed from granular snow. From these longitudinal and vertical layers varying in thickness from a fraction of an inch to several inches, Dr. Stark regarded their formation as a matter of daily occurrence, the thicker layers being either produced by the spaces not having been filled up for several days, or from the glacier having advanced more one day than it did another.

3. *On the Combination of Horizontal with Longitudinal and Vertical Strata.*—It was remarked that in this combination the horizontal layers would always be found to occupy the middle of the glacier, whilst the longitudinal and vertical strata would compose its breadth. No writer known to Dr. Stark described such a combination of strata as occurring in any glacier; but it was mentioned that a careful examination of the recorded observations of different authors who described the same glacier, showed that such a combination must exist. Dr. Stark stated that the only possible mode of explaining the apparently discordant statements of authors relative to the position of the strata in glaciers, was to suppose that as the mass composed of horizontal strata advanced onwards, it received in the manner above indicated a lateral increase of longitudinal and vertical strata, which, at the same time they increased its breadth, probably also added to its depth, by running for a greater or lesser extent below the already formed icy mass. It was shown that so long as the glacier remained in the upper regions, it probably received additional horizontal layers from the snows of each year or each storm, which would cover both the already formed horizontal and longitudinal layers. When the glacier however descended so far as to waste away from its upper surface, the horizontal layers from lying uppermost, would first disappear, so that by the time it arrived at the level of the first line or so, only a narrow band of horizontal layers might occupy the middle of the glacier, or the whole might have completely disappeared, leaving the longitudinal alone apparent. The ascertained difference of depth between the glacier in the upper and lower valleys seemed of itself to prove, in Dr. Stark's opinion, that such must be the way in which the horizontal layers disappeared, as all agree in stating that the depth of the icy mass in the upper valleys is three or four times greater than in the lower ones; and as none allow that in these elevated situations they melt away from their lower surface, they must become thinner by wasting away at their upper surface.

4. *On the Appearance of Longitudinal and Vertical Stratification in Layers deposited horizontally.*

5. *On the Occurrence and Mode of Formation of Transverse more or less inclined Strata.*—As the most remarkable and best-known point where this peculiar structure exists, and where it is seen forming, Dr. Stark instanced the terminal portion of the Rhone glacier, after it falls into the valley of the Rhone over the rocky barrier or precipice which separates that valley from the Gallenstock. He stated, that at the central point on which the icy cataract falls no structure was visible, but that at some distance from this an appearance of layers running transversely began to be manifested, and that a series of transverse layers could be traced from this spot to the very termination of the glacier, each layer lying at a lesser angle or dip as that termination was approached. The lowest or terminal layer was mentioned to lie at an angle or dip of from 10° to 15°, whilst every layer above that lay at a higher and higher angle, rising even to an angle of 70°, as the central heap was approached.

Dr Stark offered the following explanation:—As each mass of ice tumbled over the rocky precipice it was dashed into a thousand pieces, in fact, resolved into the irregular crystalline particles of which it was composed. The melting of the surface, &c. saturates this granular mass with water, and so soon as any portion of it gets beyond the disturbing influence of the falling masses, the low temperature of the ice, combined perhaps with the pressure of the overlying loose material, tends to solidify a portion, and thus forms a new layer. As the fall of the ice over the precipice is not a continuous but an interrupted process, each layer has time to acquire a certain amount of thickness and solidity, before another mass, by the concussion it occasions, disturbs the process, and by its additional weight causes the whole mass to move forwards. Dr. Stark thought that the depth and distance to which the concussion reached, and the weight of the overlying materials, would cause the layers to form at a dip of 70°. Every layer was therefore formed originally at this angle or dip, and parallel to each other; but as they advanced forwards in consequence of the successive falls of ice, and the formation of new layers behind them, they were seen to lose their parallelism to each other, and lie at lower and lower angles at every step of advancement towards the termination of the glacier.

Dr. Stark accounted for this by showing, that the melting of the base, which was necessarily greater at the termination of the glacier than where the layers were first formed, gave the whole mass a tendency to fall forwards from the want of the support before and below, a tendency which was increased by the greater amount of friction at the base of the layers retarding the motion of that portion, whilst the forward motion aided still further their falling forwards, as there was no friction on the upper surface to oppose the retardation of the friction at their base. The plastic nature of the whole mass, and the transversely stratified structure, he thought would allow of this change of parallelism and of dip being accomplished with facility.

Dr. Stark, in conclusion, remarked, that a glacier may, and probably in most cases does exhibit during its course all the chief forms of stratification described above. At its origin in the upper valleys the strata are horizontal. A little lower down the horizontal strata occupy only the middle portions of the glacier, whilst the longitudinal and vertical compose its breadth. Still lower down the vertical layers are alone apparent; and at the lower extremity of the glacier, if the original structure has been broken up and destroyed from any cause, the transverse stratification is alone apparent.

On the Discovery of the Remains of Fishes at the base of the Mountain Limestone in the vicinity of Bristol. By the Rev. D. WILLIAMS, *F.G.S.*

The author stated, that having recently discovered remains of mountain-lime fish in a thin conglomerate which mineralogically appeared to belong to the old red sandstone, he was induced to inquire what other evidences existed of a passage between these two formations; in this respect he found them singularly deficient compared with the neutral beds and common alternations he had been accustomed to meet with in Devon and Cornwall, between any two consecutive divisions, of which a notable instance existed between the floriferous and carbonaceous series and the overlying killas: near Bristol, however, it was all a hard junction; the mountain limestone and old red sandstone were there in juxta-location, but the links and ties which determine gradation and uninterrupted succession elsewhere, were all wanting.

The mode adopted by Mr. Williams of ascertaining the genera and species of the fish, as least liable to error, was by first comparing such *palates* as he possessed, with all the care he could, with the plates of Agassiz, and having identified them satisfactorily, he referred to the text for the formation and locality, which in every case gave mountain limestone in either England or Ireland. This process of determination gave the following genera and species, viz. *Cochliodus contortus*, *Helodus simplex*, *Psammodus turgidus*, *P. cinctus*, and *P. reticulatus*.

On the south bank of the Avon (below the red breccia which contained the Ichthyolites so abundantly on the north side) he observed a coarse red conglomerate about twelve feet thick, which, with the thin one containing the fish, and the intermediate grits, he considered as the true representatives of the conglomerate described by Mr. Murchison as extending from Monmouthshire into Pembrokeshire along the base line of the carboniferous limestone, and sometimes attaining a thickness of two hundred feet. On the evidence of this Bristol conglomerate and the fish remains, Mr. Williams referred all above it to the early period of the mountain limestone, and thus placed it in strict parallel with the alternations of limestone and red sandstone delineated by Professor Phillips in four sectional columns in his work on Yorkshire, as resting on the great conglomerate, in as many widely-remote localities. His views necessarily required or implied an original elevation above the sea level, and a subsequent submergence of the old red sandstone to a great depth below it; and this admitted, the red sandstone alternations of Mr. Phillips and the case of the St. Vincent's Rocks are referable to detrital matter abraded from the slowly and unequally submerging old red sandstone at the first formation of the mountain limestone. From the constancy of this conglomerate so interposed between the old red sandstone and carboniferous limestone, Mr. W. inferred that it chronicled an interval in time sufficiently capacious for the reception of the so-called Devonian system, (for that vast succession of mineral masses incompletely developed in the West of England, by terminating upwards with the killas group,) whose true place in the geological scale was intermediate between the old red sandstone and mountain limestone, and (except on their respective confines) perfectly independent of either.

ZOOLOGY AND BOTANY.

On the different Species of Cotton Plants, and of the Culture of Cotton in India. By Professor ROYLE, *M.D. F.R.S., of the East India House, and of King's College, London.*

The author observed, first, that plants yielding true cotton were natives both of the Old and of the New World, that the species (all referred to the genus *Gossypium* by botanists) were distinct. India, for instance, produced two species,—1, *G. arboreum*, or tree cotton, *nurma* of the natives, with red flowers, little cultivated, though yielding a fine silky cotton; 2, *G. herbaceum*, the herbaceous or common Indian cotton, of which there were several varieties, including the Dacca cotton. This species has been spread from India to the south of Europe. Both these species have small seeds with short adhering hairs under the cotton. There are also two distinct American species:—3, *G. Peruvianum*, or *acuminatum*, distinguished by its large black seeds, which adhere to each other, and by its pointed fruit and leaves: this species yields the Brazil, Pernambuco, Bahia, &c. cottons. 4, *G. Barbadense*, is so called from having been early cultivated in Barbadoes. It has black seeds, free of short hairs, and is the same as the Sea Island cotton, and was long since introduced into the Islands of Mauritius and Bourbon. From an examination of specimens and coloured drawings this species appeared to be identical with the short staple or Georgian cotton, which is remarkable for its large seeds being covered with short hairs or fuzz in addition to the cotton. This is also the character of the New Orleans cotton which is said to have been obtained from Mexican seed; and this would appear to be the native country of this species. If the fact were not supported by satisfactory evidence, it would be difficult to believe that cultivation combined with change of soil and climate could so completely alter the nature of the seed, at the same time that the staple became both longer and finer. There may be other species of *Gossypium* in Africa and China, but we are without sufficient evidence on the subject, and the above appear to yield all the commercial cottons.

Dr. Royle then proceeded to observe that these cottons were produced in a great variety of countries, from the line to 40° of north latitude, in very different soils, with great diversity of climate and almost every variation in the mode of culture, and also that some were sold for double and treble the price of others. The Indian cottons were stated to be usually low in price from inferiority in length of staple and defective cleaning; but that they had some useful properties, such as a good colour, taking dyes easily, and swelling in the process of bleaching, by which the cloth looked more substantial. This property the weavers of Dacca objected to as unsuited to their "webs of woven air," and therefore preferred the cotton grown near their town. Dr. R. inquired whether this variety grown in a moist soil and climate might be less disposed to absorb moisture than cotton grown in the drier soil and climate of the north-western provinces of India, which having the property of swelling, was esteemed by the weavers of Benares as well as by those of Manchester. Dr. Royle then contrasted the culture in America with that in India, and found that they differed in every respect; the American being more of the nature of garden culture, that is, where each plant was individually attended to, in the processes of ploughing, hoeing, weeding, heaping earth round it, and sometimes in pruning, besides great attention in picking, drying, and cleaning the cotton from its seeds; in all which the Indian processes differed in being exactly the reverse. In the American method, the spreading of the roots in the soil, the exposure of the leaves to the air, and the due influence on both of the stimuli of heat and light in a soil and climate not too dry nor over moist, were all well calculated to restrain the inordinate growth of leaves, and to favour the due production and perfection of flowers and fruit, and necessarily of cotton. There was nothing, however, in the culture, soil, or climate that could not be imitated in India, though it might no doubt require modification in degree from differences of soil and climate.

It would be remarkable if attempts had not been made to improve the culture of cotton in India. In fact the Directors of the East India Company called the attention of their government in India to this subject as early as 1788. They sent out seeds, instructions, machines, and even an American, Mr. Metcalf, to teach the use of these, and established farms for the improved culture of cotton in 1811, 1818, and lastly in 1829. These are usually stated to have been failures. This the Professor denied, as good cotton had been produced and the culture was considered profitable, and only required planters to take it up on their own account. The American cotton is also said to degenerate in India. This also he considered incorrect. The Bourbon cotton, which is the same kind as the Sea Island, had been introduced into Tinnevelly, in 11° of north latitude, and Mr. Hughes continued to send it to the Liverpool market for a series of years of good quality, and always obtained for it a higher price than any other cotton from India ever sold for. It has fallen off of late, but it has lost Mr. Hughes's skill, which was displayed in the growing of senna as well as in the culture of cotton; Hughes's Tinnevelly senna selling for three and four shillings a pound, when the best Alexandrian senna does not bring more than one shilling and sixpence. The imports of Bourbon cotton from the Tinnevelly district have however increased in quantity, as the natives have taken up the culture. That all the cotton introduced into India has not deteriorated, is also proved by Mr. Elphinstone, Collector of Rutnagherry, and Dr. Burn at Kaira having produced cotton which has been pronounced nearly, if not quite equal to the best New Orleans, and some not much inferior to Sea Island, both from what appears to be acclimated Bourbon seed. Dr. Burn, in 1838, collected his seed from hedges where Dr. Gilders had made his experiments in 1817. Without careful culture cotton will deteriorate in America quite as readily as in India.

Notwithstanding these repeated experiments and apparent failures, the Court of Directors of the East India Company determined upon making another great experiment, which should be sufficiently complete to set the question at rest. As is well known in Manchester, Captain Bayles was deputed to and brought with him ten experienced planters of cotton, of whom three were sent to the Madras, three to the Bombay, and four to the Bengal Presidency, taking with them American seed, ploughs and hoes, gins and machines for cleaning cotton, and presses for packing it in a state fit for transmission to market. The results of their experiments in the first year Dr. Royle then proceeded to relate, chiefly from letters addressed to himself, and the proceedings of the Agricultural Society of India. The Bombay experiment, he was sorry to say, had been a failure; but, in fact, it had not received a fair trial, and for the causes he referred to a letter lately published by the Hon. W. Baring to Mr. M.

Gibson. He added, however, that the planters confined their experiment to the *black* soil produced by disintegrated trap rocks of the Broach district, which only in appearance resembles the black alluvial soil of Louisiana, and which, though agreeing well with the Indian, has in all the former experiments been found unsuitable to the American cottons. This is related in all the printed accounts of these experiments. But even in the present experiment, some American seed sown in a garden which differed in having the common sandy soil of the district, produced good cotton plentifully. The experiment has been ordered to be resumed by a planter from Bengal and another from Madras.

The planters destined for Bengal were detained in this country, and visited Manchester and Liverpool, where they had seen various brokers, spinners, and manufacturers, from whom they received much valuable information respecting the kind of cotton, and quality best suited for the different manufactures. They did not, however, reach their destination until March of last year, and had little time for choosing eligible sites and getting settled in their farms, as sowing usually commences in the middle of June, after the rains have set in. This year they did not begin until the 20th of July, and lasted only six weeks instead of three months, as usual; they were besides supplied with an insufficient number of large bullocks, the small ones of the country being unfitted for the American plough; but still, with all these disadvantages, the experiment may be considered decidedly successful, inasmuch as though the quantity of cotton is small, the quality is good, and it is well cleaned; and one of the planters considers that the culture will be decidedly profitable, as cotton can be produced cheaper than in any other part of the world. But the most important result obtained, was, that the American cotton continued to produce blossoms, bolls and cotton long after the Indian cotton cultivated by the natives had dried up. Also, the Indian cotton cultivated in the American method assumed quite a different appearance, as, instead of growing like a straight stick, it threw out lateral branches, which were covered with flower-buds, and continued, like the American, to bear cotton long after all the same kind of cotton grown by the natives had completely withered up. These points were confirmed by letters from Capt. Bayles, Messrs. Mercer and Finnie, two of the American planters; also by the report of Mr. Lowther, the Revenue Commissioner, who had visited the farms for the purpose of inspection. Mr. Mercer is well pleased with the soil and the people, who readily adopt the improved methods when taught by example. He complains only of the dryness of the climate, and he has had a very trying season in that respect. The great canal which has been sanctioned by the Court of Directors to be made through the centre of the Doab, and which is to be 500 miles in length, and will afford water for irrigating five miles on both sides, as it will render famine impossible, so will it make the cultivation of cotton easy and independent of dry seasons.

The above experiments having been carried on in 27° of N. latitude, it is interesting and extremely important to find that a like result has attended those undertaken in the Madras Presidency in the district of Coimbatore, in about 12° of N. latitude. The planters were first sent to the Tinnevelly district, and afterwards removed to their present localities near Ernaud and Coimbatore; so that in this way some time was unfortunately lost. Their experiments were made both with the New Orleans and with the native seed, in both the *black* and the *red* soil, the latter the result of disintegrated granitic rocks.

The season here seems to have been at first untoward, apparently from the great dryness of the weather, as the accounts which were received by the January mail stated that the experiment had not succeeded in the way that had been anticipated, probably either from unsuitableness of soil or season, in reference to the times of sowing and the modes of culture. Dr. Wight, however, the present superintendent, saw enough to be convinced that the American method, with some modifications, was sure to succeed, and he was ready to rent land for the purpose of establishing this culture. That he was not too sanguine was evident by his subsequent letters, all which gave more encouraging prospects. In that dated 17th April, 1842, he was enabled to say that he considered the experiment to have completely succeeded, as the plants had thrown out fresh leaves and flowers, and that the bolls had set, ripened, and produced good cotton; so that from fields which they thought had ceased to bear, they obtained no less than 15,000 lbs. of seed cotton, and were still collecting cotton. He concludes his letter by saying that next year, if the season is but moderately favourable, they will be enabled to send nearly if not quite 1000 bales of American cotton.

The Professor concluded his paper by stating, that from the results of some of the former, as well as from many of those of the present experiments, and from the modifications in culture, which would be made to suit the several situations, he had no doubt that, by the acclimation of the American cottons in some localities, and by the improvement of the native cottons in others, good cotton, that is, such as is required for many of the Manchester manufacturers, would be produced with profit in India. In fact, the principal question remaining to be determined, was the quantity of cotton which would be produced per acre by adopting or modifying the American method of culture, so as to make them perfectly suitable to India.

The paper was illustrated by drawings of the several species described; the different kinds of seed, as well as with specimens of cotton grown by the American planters in all the three Presidencies, which were all well cleaned by the American gins sent out by the Court of Directors, and made by Mr. Laird, Liverpool, and with which the planters seem generally well satisfied, as well as with the ploughs and hoes.

The cottons produced were pronounced well cleaned and of good quality by some of the Manchester gentlemen present, and the New Orleans cotton grown in the red soil of Coimbatore, as good as any New Orleans cotton received from America, and that it would be a most useful cotton and much consumed in Manchester.

Mr. Bazley exhibited specimens of cotton and living cotton plants.

Mr. Dewbain exhibited the downy fruit of the Black Poplar. It was the produce of a tree that had not hitherto borne fruit, and he had heard of several trees having this year produced fruit in like manner.

On the Promotion of Vegetable Growth. By G. W. Hall.

Mr. Hall showed the importance of the subject, not only to the general resources of the country, but in its direct relation to the scientific objects of the Section. He traced the several causes of vegetable growth, and enumerated the elementary constituents needed for that object; showing the progressive changes through which the simple elements were carried by the several processes of fermentation and combustion on organic vegetable matter. The products of each of these processes of dissolution he claimed as the essential elements for promoting the growth of vegetation, arguing that that which had already been produced by vegetation, could again be applied, by the processes above described, to the same purpose, after separation into its original constituent parts. Founded upon this principle, he then described the mode adopted by Mr. Daniell of Tiverton, in taking advantage of this principle in the laws of vegetation, and by an application of the *sources* of fermentation and combustion to the soil, under circumstances of minute mechanical subdivision, and in a state fitted for solubility, to promote the fertility of the country, and the growth of the most useful and most needed plants. The long-continued experiments under which this had been accomplished were detailed to the Section, showing that the result was highly favourable; while, on the other hand, it was argued, step by step, from the nature of the elementary substances required, and the capability of these being afforded in the required way, that the philosophical reasons for such success were as simple and obvious as the facts were plain.

On Liebig's Theory of Fallow Crops. By the Rev. J. B. Reade, *M.A., F.R.S.*

The fallow time, as Liebig observes, is that period of culture during which land is exposed to a progressive disintegration by means of the influence of the atmosphere, for the purpose of rendering a certain quantity of alkalies capable of being appropriated by plants. Careful tillage increases and accelerates this disintegration, and secures from time to time a new supply of *soluble alkalies.* Now Liebig states that, for the purpose of agriculture, it is quite indifferent whether the land be covered with weeds, or with a plant which *does not abstract the potash* inclosed in it. Accordingly, he would alternate with corn crops, which extract the alkalies of the soil, the usual fallow plants in the family of the *Leguminosæ*, because, "being remarkable on account of the small quantity of alkalies or salts in general which they contain," they neither extract alkalies from the soil, nor do they exercise any injurious influence on the corn which is cultivated after them. The farmer is hereby greatly advantaged in being able thus to steal, as it were, an intermediate crop from his land, inasmuch as an entire absence of plants appropriating these unimportant quantities of salts would of necessity compel him to the constant repetition of bare fallows, in order that the soil, during an interval of rest, might regain its original fertility. Such is the theory. The fact, however, most unquestionably is this, that the plants in the family of the *Leguminosæ* usually cultivated as fallow crops, so far from acting but slightly on the saline constituents of the soil, are remarkable, above all others, for the large quantities of soluble salts contained in them.

The experiments by which this result may be arrived at are very simple. If two pounds of bean straw, and of clover hay, be submitted to the action of fire and allowed to burn till they cease to give any flame, they will yield about two ounces of ashes; and distilled water (about two pints) being poured upon the hot ashes, and repeatedly filtered, after squeezing it from the insoluble residuum, is charged with the soluble matter which, to a certain extent, is set at liberty by the process of combustion. The quantity of soluble matter, chiefly potash, contained in the clover saline solution, appears, upon evaporation, to be about ninety grains, and in the bean saline solution about forty grains; whereas by a similar operation upon the ashes of wheat, barley, and oat straw, the soluble saline matter does not amount to thirty grains. The presence of potash may be detected in these solutions not only by the well-known smell peculiar to *Liquor potassæ*, but also by the characteristic crystalline precipitate on the addition of bichloride of platinum, by the copious insoluble bitartrate of potash on adding the solutions to tartaric acid in excess, and by the salts of potash formed with mineral acids.

The saline solution from bean straw is also remarkable for containing lime in solution, and hence, probably, we have one important cause of the strength of bean straw manure. In twenty-four hours after the clear bean solution is obtained, a crystalline precipitate of carbonate of lime is attached to the sides of a stoppered bottle, and, in the course of a few days, it considerably increases in quantity.

All the solutions, when evaporated to about half an ounce, exhibit a remarkable precipitate, which, upon being separated and washed, ceases to be soluble in water, and the action of acids and alkalies, as well as of the blowpipe upon this substance, is accompanied with phænomena which deserve the attention of agricultural chemists.

The condition of carbon in these solutions ought also to be accurately examined.

The author concludes with the following question: may it not be the case, that the leaves which fall so abundantly from these plants, and the roots which remain in the ground being so copiously supplied with saline matter from the presence of potash in every cell, do really furnish more soluble alkalies by the subsequent process of tillage, than the soil, especially when of a sandy nature, could in any other way obtain for the future production of corn?

Mr. E. Solly, jun. exhibited specimens of the diseased bark of living ash trees, occasioned by insects.

On an Irregular Production of Flowers, in an Aloe, at Ham Court, near Bristol. By Dr. DAUBENY, *Prof. of Botany, Oxford.*

The aloe began to throw up its flower-stem in May 1841. The first blossoms opened about the end of July, and it went on flowering till October.

Several suckers were removed from the plant after the blossom was over, and one which grew on a kind of underground stem of perhaps two feet and a half long, which had apparently been lengthened in seeking for a convenient place to reach the light, had three buds at the end of it. This was planted, and in May 1842 one of the buds opened in the form of an imperfect flower, having some green leaves with spikes on the edge, as in ordinary leaves, and others approaching to the form and colour of true petals, and two perfect stamens, with anthers and farina, and others distorted.

On the Migration of Birds and Flowering of Plants in Cornwall. By Jon. Couch, *Esq., F.L.S.*

List of Summer Birds observed in Denbighshire, in the Spring of 1842. *By* John Blackwall, *Esq., F.L.S.*

On the Nidus and Growth of the Purpura lapillus, *and also on the* Patella pellucida *and* P. lævis. *By* C. W. Peach.

Ellis, in his 'Essay on the British Corallines,' says that the "Sea Cup" is the ovary of the Periwinkle shell-fish; but from a series of observations made by Mr. Peach, commencing in January of the present year and continued up to Monday the 20th of June, it appears that the "Sea Cup" belongs not to *Turbo littoreus*, but *Purpura lapillus.* Mr. Peach had seen the *Purpura lapillus* employed in the formation of these interesting fabrics, and on pulling these shells from the rock on which they were fixed, he found that they enveloped three or four of these cups with their mantles, and that there were indentations in the mantle answering to the number of cups that it had covered. These "Sea Cups" are firmly attached to the rocks, and when left by the whelks the mouth is securely sealed up, and they are then of a pale yellowish colour: after some time the internal part assumes a granular appearance, and is of a pinkish hue; the young fry leave their habitation at the end of about four months, and take refuge in the crevices and shelter afforded by the sea-weeds and shells attached to the rocks. The author exhibited a series of specimens in all their various stages of growth, with some of the nidi, and amongst them some young shells which had been reared in his house from the nidi kept in a dish of salt-water, and which had all the peculiarities of the adult, such as canal, striæ, and propensity of remaining for considerable periods out of the water on the side of the dish; leaving no doubt that they were the *Purpura lapillus.*

The author also stated that, from a series of observations and examination of thousands of specimens in all their various stages of growth, he does not hesitate to say that the *Patella lævis* is the young of the *Patella pellucida.* The *P. lævis* is first found on the leaves of the larger sea-weeds; after a short time it descends to the stem, and as it increases in age lower and lower; and before reaching the lowest part it scoops out a small cavity, and on arriving at age and strength it cuts a road through the roots of the sea-weed and takes possession of its final abode in a cup which it forms at the foot of the weed, and is there suspended apex downwards. The author has never found it attached to the rocks, like the *P. vulgata, P. virginea,* &c.

The transition may be traced from youth to age, and all the beautiful blue rays observed with all the characteristic appearance.

He also exhibited several other shells which had been taken from the corks and ropes used by the crab-catchers on the coast of Cornwall, to show the rapidity of their growth: also specimens of the *Anatifera fascicularis* and *A. lævis* on feathers, cork, coal and wood cinders, straws, wood, the shell of the cuttle-fish, &c. &c., the whole from the Cornish coast.

Mr. Peach exhibited some undescribed species of Cornish zoophyta.

On the Palpi of Spiders. By John Blackwall, *F.L.S.*

As arachnologists do not appear to have bestowed that degree of attention on the palpi of spiders to which their greatly diversified structure and remarkable functions undoubtedly entitle them, a few observations relative to this interesting subject may not perhaps be wholly devoid of utility.

Many spiders employ their palpi in assisting to collect into a small heap the slack line which results from their operations when engaged in ascending or drawing in such silken filaments as are attached to objects distinct from themselves by one extremity only.

In conjunction with the mandibles, the palpi are employed by females of the species *Dolomedes mirabilis* and *Dolomedes fimbriatus* to retain their cocoons under the sternum, in which situation those spiders usually carry them wherever they move; the *Lycosæ* also avail themselves of the same parts in regaining possession of their cocoons when detached from the spinners.

Various species belonging to the genus *Salticus*, to which distinctness and accuracy of vision are of the utmost consequence, as they do not construct snares, but capture their prey by springing suddenly upon it from a distance, have the terminal joint of the palpi abundantly supplied with hairs, and constantly make use of those organs as brushes to remove dust, or any other extraneous matter, from the corneous coat of the anterior eyes.

The palpi appear to afford direct assistance likewise to spiders in general in securing their prey, in changing its position while they are feeding upon it, and in restraining the action of the wings of all their victims which happen to be provided with them.

At the meeting of the Association held at Cambridge, the author communicated to the Section of Zoology and Botany the results of experiments having for their object the determination of the function performed by the remarkable organs connected with the terminal joint of the palpi of male spiders *.

Since that period he has greatly extended and varied his researches in connexion with this subject, and it affords him satisfaction to state, that they promise, when complete, to divest the matter of all uncertainty whatever; indeed, from the decisive character of the evidence at present in his possession, he does not hesitate to assert positively that the palpal organs, whose full development indicates a state of maturity, are the only instruments employed by male spiders in the propagation of their species.

The several joints of the palpi of female spiders differ greatly in their relative proportions, not only in species constituting the same family, but even in those belonging to the same genus; while, on the other hand, it frequently happens that females belonging to different genera bear a striking resemblance to each other in this particular.

It is among male spiders, however, that these peculiarities are the most marked, and to them may be added structural differences and resemblances both of the palpi and palpal organs still more conspicuous.

A great similarity in the form of the palpal organs and in the manner in which they are connected with the digital joint of the palpi may be observed in certain spiders of the family *Dysderidæ*; in *Dysdera erythrina*, *Dysdera Hombergii*, *Segestria perfida*, *Segestria senoculata*, and *Oonops pulcher*, for example; and this similitude is extended to various species belonging to the family *Mygalidæ*.

Between *Manduculus ambiguus* and *Tetragnatha extensa* there is a near approximation in the structure of the palpi and palpal organs, yet these spiders are not included in the same family, the former belonging to the *Theridiidæ* and the latter to the *Epeïridæ*.

If we compare the spiders constituting the genus *Clubiona* with those of the genus *Drassus*, and those of the genus *Linyphia* with the species comprised in the genus *Neriëne*; or, extending the investigation still further, if we compare together the genera *Walckenaëra*, *Theridion*, *Epeïra*, *Eresus*, *Salticus*, *Thomisus*, and *Philodromus*, numerous instances of correspondence in the relative proportions of the joints of the palpi will be perceived immediately, at the same time striking contrasts will present themselves to the eye of the observer, not as regards proportion alone, but organization also, even among nearly allied species.

From these facts the following practical results appear to be fairly deducible:—

As the full development of the palpal organs indicates a state of maturity in male spiders, the skilful arachnologist is enabled, by attending to this circumstance, not

* See Report for 1833, p. 444.

only to distinguish adult males from females, but likewise from immature individuals of both sexes. This knowledge is useful in preventing him from falling into the too common error of mistaking young spiders for old ones, and of describing them, and the sexes of spiders of the same kind, as distinct species.

When any doubts exist respecting the specific identity of spiders of different sexes, which have been regarded as belonging to the same species, they frequently may be set at rest by placing the spiders together in captivity and noticing whether they pair or not.

The great diversity of structure observable in the palpi and palpal organs of male spiders supplies excellent specific characters, and indeed frequently presents the only available means of distinguishing species of similar colours and dimensions from each other; but when we consider that this diversity of structure extends to spiders connected by the closest relations of affinity, it is perhaps in vain to expect that it will ever be applied with much success to the establishment of genera.

Account of a Species of Ichneumon whose Larva is parasitic on Spiders. By JOHN BLACKWALL, *F.L.S.*

Immature spiders of the species *Epeïra autriada* and *Epeïra cucurbitina*, and adults of the species *Linyphia minuta* and *Linyphia pusilla*, are frequently infested by the larva of a small Ichneumon, which feeds upon their juices and ultimately occasions their death. This parasite is always attached to the upper part of the abdomen, near its union with the cephalothorax, generally in a transverse but occasionally in a longitudinal direction, and, though it proves a source of constant irritation, is secured by its position from every attempt of the spider to displace it. Being apodous, it appears to retain its hold upon its victim solely by the instrumentality of the mouth and of a viscid secretion emitted from its caudal extremity. More than one larva is never seen on the same spider, which, indeed, could not supply sufficient nourishment for two.

In the earlier stages of its growth this parasite has an oblong oviform figure, somewhat depressed on the under side; it is whitish with a faint tinge of yellow extending along the medial line, which seems to be occasioned by the contents of the viscera. At this period of its existence the external covering presents a smooth uniform surface; but when it has completed its moultings and attained its full size, the head becomes visible, the body exhibits thirteen distinct segments, and the prevailing hue is pale greenish yellow.

When about to assume the pupa state, it kills the spider which has supplied it with sustenance by rapidly exhausting its physical energies, and quitting it constructs on some adjacent object a cocoon of a quadrilateral figure tapering to its extremities, which is composed of pale yellowish white silk of a compact texture. After the lapse of a month nearly, the perfect Ichneumon issues from the cocoon, and prepares to carry on the work of destruction assigned to its species; a preliminary step towards which is the deposition of her eggs by the female on the bodies of her victims, care being taken that one only is attached to the same spider.

It is a fact deserving of notice, that immature spiders infested with the larva of this Ichneumon do not change their skins. Were it not for this admirable provision of Providence, the larva, cast off with the integuments in the act of moulting, would inevitably perish, and the important purpose which its remarkable economy is so evidently intended to subserve, namely, the keeping of these deadly enemies of the insect tribes within due limits, would fail to be accomplished.

The author described minutely the characters of the female and male Ichneumon, which he conjectures may be unknown to entomologists.

Mr. Turner exhibited specimens of *Goliathus regius* and *Goliathus giganteus.*

Dr. Lankester drew attention to a microscopic animal that had been found the day previous in the Botanic Garden, covering the stems of the *Chara flexilis*, and giving them a loose gelatinous white appearance. The moment they were touched this character disappeared, from some contractile power possessed by the animal.

Mr. Alder had examined the animal alluded to, and found it to be a very large species of Vorticella, which he had never before seen. The bell-shaped summits of the animal were visible to the naked eye.

Notices of Eolis, Doris, &c. By Joshua Alder, *F.L.S.*

Mr. Alder of Newcastle read a description of three new species of Mollusca, of the genus *Eolis,* lately found by Mr. Albany Hancock on the coast of Northumberland; and also exhibited drawings by that gentleman of these, as well as of some other new species of *Nudibranchia,* descriptions of which had appeared in the 'Annals of Natural History.' Mr. Alder took the opportunity of stating that Mr. Hancock and he were still pursuing their examination of the British species of this order, and had lately had a further opportunity of confirming the fact of the existence of eyes in the genus *Doris,* having found a young specimen of the *Doris depressa* in which the eyes were very distinct. He stated that they had made some examinations with the microscope of the elegant appendage in *Melibœa, Tritonia* and *Eolis,* which are usually considered to be branchiæ. They found that in *Melibœa ornata* vibratory cilia existed all over the body, but in a less degree in the supposed branchiæ than in other parts, and that an individual deprived of these appendages lived for several days afterward without apparent diminution of activity; thus proving that these were at least not the only means of respiration that the animal possessed.

Mr. Moore exhibited the head of a Grayling, showing its pear-shaped iris; also specimens of *Argulus foliaceus* and other parasites. The specimens of *Argulus foliaceus* were from the ponds of the Botanic Garden at Manchester, where they attacked the common carp, but not the gold or silver carp.

On a Specimen of Machærium subducens *from Port Essington, New Holland, belonging to the Collection made by Mr. Gilbert, Mr. Gould's Assistant. By Dr.* Richardson.

This fish, except in the teeth, has a strong external resemblance to the *Echiodon Drummondii,* lately discovered by William Thompson, Esq. in the Irish seas. Its dorsal and anal, which are well developed, are united to the caudal, but the rays of the latter are more slender, rather shorter and more crowded, so the difference is readily recognized by the eye. The first ray of the dorsal and anal is simple and flexible, all the rest are branched at the tips. The pectorals are small, and there are no ventrals. The body is much compressed, and its resemblance to the blade of a short sword or butcher's knife is the origin of the generic term*. The teeth, small and subconical, stand in a single series on the intermaxillaries and lower jaw. The palate and vomer are toothless. The orifice of the mouth is moderately large; the maxillary, though sufficiently conspicuous, forms no part of its margin. The pedicles of the intermaxillaries run back over the orbit and permit the upper jaw to be considerably protruded. The lower jaw is articulated far back, the cheek is large and scaly, the opercular pieces smooth and very distinct, and the six branchiostegous rays are very obvious and by no means short. The gill-openings are moderately large. There are no barbels attached to the integument covering the os hyoides, which is the character by which *Machærium* is most readily distinguished as the type of a generic or sub-generic group, from *Ophidium.* Another character may be found in the scales, which, though small, are regularly tiled, and not imbedded in the skin in a scattered manner. The lateral line terminates before the anus, as in the Blennies, to which this fish seems to bear considerable affinity. Mr. Ball has said the same thing of Echiodon, though he afterwards ranged it with Ophidium, with which it is in fact still more closely allied. It would be perhaps better to bring the Blennies and Ophidia together. Agassiz has already separated the Blennies from the Gobies, and placed them in the Gadoid family. The *Anguilliformes,* or *Apodes* would evidently be more natural were the *Ophidia* removed also to take their place near the *Gadi.* The single character of the want of ventrals seems to be insufficient to keep them in sepa-

* *Th. μάχαιρα, gladius.*

rate orders, and we have in fact in the jugular barbels of the typical *Ophidia* a near approach to the single ventral rays of some of the Gadi. Machærium and Echiodon form links in the series terminated by the *Fierasfers*, which have the fins further reduced so that the dorsal becomes a mere fold of the skin.

Notice of Halcyon Smyrnensis. *By* H. E. Strickland, *F.G.S.*

Mr. H. E. Strickland exhibited a specimen of *Halcyon Smyrnensis* (Linn.), transmitted from Asia Minor by Mr. Edward Forbes. This species, described by Albin more than a century ago, from a specimen procured at Smyrna by Consul Sherard, appears not to have been subsequently noticed on the shores of the Mediterranean. The present specimen is therefore of interest, both as verifying the general accuracy of Albin's description, and because it is proved to be specifically identical with the Indian bird figured in Buffon's Pl. Enl. 894, which some ornithologists have supposed to be distinct.

Mr. Gaskell exhibited specimens of the horns of the Wapiti Deer.

On the Varieties of the Human Race. By Dr. Hodgkin.

The immediate object of this paper was to state the progress which had been made in furtherance of the inquiry undertaken by the Section at a former meeting. It announced the further circulation of the copious and systematic queries printed at the expense of the Association, and published in the last volume of the Transactions. The paper concluded by urging the reappointment of the Committee—the application for a further pecuniary grant in aid of the inquiry, and the solicitation of Government assistance in extending the inquiries amongst military and naval officers on foreign service—and more especially in calling for reports from the Protectors of Aborigines appointed in some of our colonies.

Note of Species obtained by deep Dredging near Sana Island, off the Mull of Cantire. By George C. Hyndman, *Member of the Natural History Society of Belfast.*

When cruising about with my friend Edmund Getty, Esq., in the Gannet yacht on the 19th of July 1841, the following result was obtained by dredging at the depth of forty fathoms, about two miles east of Sana Island. The bottom was shelly, with a proportion of shell-sand. The region "coralline," according to Mr. Forbes's definition. Dredge down three times.

Species obtained.	No. of living specimens.	No. of dead specimens.	Observations.
Fishes.			
Aspidophorus europæus	1		
Mollusca.			
Chiton lævis	1	......	On fragment of *Echinus*.
Capulus hungaricus	......	6	Small and worn.
Emarginula fissura	......	4	Small.
Trochus tumidus	......	1	
——— millegranus	1	2	
Buccinum undatum	......	2	Largest size, containing *Pagurus Bernhardus*.
Fusus despectus	......	3	
—— corneus	3	......	One very minute.
Natica glaucina	......	2	Invested with *Actinia* (*Adamsia*) *maculata*, and containing *Pagurus Prideauxiana*.
——— Montagui, Forb.	......	2	
——— Alderi, Forb.	......	1	
Rissoa communis, Forb.	......	1	

Species obtained.	No. of living specimens.	No. of dead specimens.	Observations.
FISHES.			
Orthocera	......	1	In shell-sand.
Anomia	......	14	All upper valves.
Nucula margaritacea	......	4	
—— oblonga, Brown's Illus.	......	1	
Modiola vulgaris	......	6	Small.
Nucula rostrata	......	2	Single valves.
Anatina pubescens	......	4	Single valves.
Kellia suborbicularis	......	1	Odd valve.
Mactra elliptica	......	20	Single valves, chiefly small.
Goodallia triangularis	......	......	All dead; two or three of each species perfect, and several odd valves.
—— minutissima			
Tellina crassa	......	12	Single valves.
Psammobia florida	......	18	Single valves.
Cardium lævigatum	......	3	Single valves, small.
Lima subauriculata	......	1	"Nearly half an inch in length," as was a specimen procured by Mr. Jeffreys at Oban.
—— fragilis	......	12	Single valves.
—— tenera	......	160	Not a single specimen with the valves united, but some of them with the cartilage fresh. Many worn and covered with *Serpulæ* and crustaceous zoophytes. The specimens are generally large—one is $1\frac{1}{2}$ inch in length. Mr. Jeffreys found the species at Oban $1\frac{3}{4}$ inch.
Pecten sinuosus	......	2	Single valves.
—— obsoletus	......	12	Single valves.
—— opercularis	2	50	Of the living specimens, one was full-grown, the other small. The dead valves were separate and much worn; a few of small size.
Pectunculus pilosus	......	300	Only one was perfect, the remainder odd valves mostly old and worn, and incrusted with zoophytes; very few small specimens.
Venus ovata	......	6	Single valves.
—— fasciata	1	2	Single valves.
—— virginea	......	2	Single valves, small and much worn.
—— cassina	3	21	The living specimens and the perfect dead shell (the remainder were odd valves) small; the odd valves mostly full-sized. The animal has a large hatchet-shaped foot, and a long siphonal tube.
Lucina undata	......	2	Single valves.
Nudibranchia Mollusca	......	......	A species of.
ECHINODERMATA.			
Stellonia rubens	1		
Echinus sphæra, Müll.	1	......	Large.
—— miliaris, Leske.	......	3	
Echinocyamus pusillus	......	50	
Spatangus purpureus	6	......	From a very small size up to largest. The intestines filled with fragments of shells. Do they eat the shell-fish and break up the shells, or do they swallow the shell-sand and extract the nourishment from it?
ZOOPHYTES*.			
Flustra foliacea.			
—— truncata.			
—— tuberculata.			
Thuiaria articulata.			
Antennularia antennina.			

* Although Zoophytes were plentiful, no *Algæ* whatever occurred.

Species obtained.	No. of living specimens.	No. of dead specimens.	Observations.
ZOOPHYTES.			
Sertularia abietina.			
——— polyzonias.			
Plumularia falcata*.			
Thoa Beanii.			
Farcemia salicornia.			
Notamia loriculata.			
Campanularia volubilis.			
Cellepora ramulosa.			
——— pumicosa.			
Crisia eburnea.			
Discopora hispida.			
Hippothoa lanceolata.			
——— catenularia.			
Tubulipora obelia.			
——— serpens.			
Lepralia immersa.			
——— variolosa.			
——— nitida.			
Cellepora perlacea. Delle Chiaie†.			
——— Macry. Delle Chiaie?			
——			
Corallina officinalis.			

Results of deep Dredging off the Mull of Galloway. By Capt. BEECHEY, *R.N. Drawn up by* WM. THOMPSON, *V. P. N. H. Soc. of Belfast.*

Captain Beechey, the distinguished navigator, having in the month of April last been engaged in a survey of part of the Scottish coast in H.M. steam-vessel Lucifer, most kindly undertook to use the dredge in the deepest water in which his soundings might be made, and the following are the highly interesting results obtained on three occasions; the products from the different depths being most carefully kept separate.

Species obtained.	From 50 fathoms, 8 miles S.S.W. the Mull of Galloway.			From 110 to 140 fathoms, 5 miles S.W. the Mull of Galloway.			From 145 fathoms in Beaufort's Dyke‡.		
	No. of living specimens.	No. of dead specimens.	Observations.	No. of living specimens.	No. of dead specimens.	Observations.	No. of living specimens.	No. of dead specimens.	Observations.
MOLLUSCA.									
Trochus papillosus	1	...	Adult	...	...	....	1	1	
—— millegranus	...	...	A few alive and several dead.	...	...	Many dead and broken; chiefly small.	2	...	A few dead.
—— tumidus	...	...	....	...	...	A few dead	...	...	A few dead.
Cypræa europæa ...	...	2	....	...	...	Ditto	...	...	Ditto.
Fusus turricola ...	...	1	....	...	...	Ditto.			
—— muricatus ...	...	...	....	...	...	Ditto	1	2	
—— Bamffius......	...	...	....	...	...	Ditto	...	...	A few dead; small
—— linearis	...	...	....	...	1				

* *Pl. myriophyllum* was dredged up near the same locality in June 1842.

† These two species (hitherto unnoticed as British) and other minute ones have been determined by Mr. W. Thompson.

‡ A remarkable dyke, beginning about 5 miles S.W. the Mull of Galloway, and extending northward nearly to Corsewall. It is from a mile to a mile and a quarter wide. Its average depth in the centre is 130 fathoms.

Species obtained.	From 50 fathoms, 8 miles S.S.W. the Mull of Galloway.			From 110 to 140 fathoms, 5 miles S.W. the Mull of Galloway.			From 145 fathoms in Beaufort's Dyke.		
	No. of living specimens.	No. of dead specimens.	Observations.	No. of living specimens.	No. of dead specimens.	Observations.	No. of living specimens.	No. of dead specimens.	Observations.
MOLLUSCA.									
Fusus costatus	...	...	...	...	...	...	1	...	Large.
—— Corneus	...	...	...	...	2	Small	...	1	Small.
Buccinum undatum	...	...	...	...	1	Ditto	...	1	
Natica Alderi	...	...	...	...	1				
—— Montagui	...	...	...	...	3				
Nasa macula	...	...	...	...	...	...	...	1	
Tornatella tornatilis	...	...	...	...	...	...	...	1	
Eulima polita	...	...	...	...	...	...	...	2	Perfect.
Capulus hungaricus	...	...	...	...	...	A few dead; small	...	2	Small.
Emarginula fissura	...	...	...	...	...	Many dead	...	...	Several dead.
Chiton fuscatus, Br.	...	...	...	...	...	...	1		
——discrepans, Br.?	...	...	...	...	...	...	1		
Dentalium entalis	3	...	Several dead	...	...	Several small; some alive.	...	...	A few living.
——									
Astarte Damnoniæ	...	...	Odd valves	...	...	Several; alive	...	...	A few odd valves.
—— scotica	...	...	...	...	...	Several odd valves; chiefly small.	...	...	Ditto; small.
Lucina radula	...	...	...	...	...	Odd valve.			
Venus virginea	...	2	...	...	...	Odd valves; medium size.	...	...	A few odd valves; one perfect shell.
—— ovata	...	...	Several dead	...	...	Ditto chiefly; a few alive.	...	...	Very few alive; and some odd valves.
—— cassina	...	...	A few young, alive.	...	...	Ditto; several small.	...	...	A number of odd valves of all sizes.
Myrtea spinifera	...	...	...	...	...	...	...	...	One valve.
Saxicava rugosa	...	...	...	...	...	A few odd valves.			
Nucula minuta	...	...	Odd valves	...	...	Many ditto	1		
—— margaritacea	...	...	Ditto	...	...	Ditto ditto; small	...	...	A few odd valves.
Cardium nodosum, (Turt. Bivalves.)	...	...	A number, chiefly alive.	...	...	Ditto ditto	...	...	Ditto.
Pectunculus pilosus	...	...	...	...	...		...	...	An odd valve.
Pecten obsoletus	1	...	Several dead	...	...	A few odd valves; all sizes.	...	...	Sev^{l} odd valves.
—— opercularis	...	...	Young, odd valves.	...	...	A few odd valves; very small.	...	...	Ditto; small.
—— sinuosus	...	...	...	...	...	Ditto; medium size.	...	...	Two odd valves.
Lima fragilis	...	...	...	...	...	A few odd valves...	1	...	Sev^{l} odd valves.
Mactra elliptica?	...	...	Odd valve	...	...	Ditto	...	...	Two odd valves.
Amphidesma prismaticum	...	...	Ditto.						
—— Boysii	...	...	...	...	...	Odd valve.			
Montacuta substriata.	1	...	On *Spatangus purpureus*.	...	...	A few alive on *Spatangus purpureus*.			
Modiola communis	2	...	Small	2	...	Living specimens, very small; several odd valves of moderate size.	...	...	Numerous odd valves; moderate size.
—— discors	...	...	...	...	...	...	...	1	
Mya truncata	...	...	...	...	...	...	...	...	Odd valve.
Anomia	...	...	Odd valve	...		Many odd valves...	...	...	A number of odd valves.
Orbicula Norvegica (Crania)	...	...	...	...	...	...	...	1	
Terebratula aurita	...	...	...	...	1	Perfect	...	...	Two odd valves.

Species obtained.	From 50 fathoms, 8 miles S.S.W. the Mull of Galloway.			From 110 to 140 fathoms, 5 miles S.W. the Mull of Galloway.			From 145 fathoms in Beaufort's Dyke*.		
	No. of living specimens.	No. of dead specimens.	Observations.	No. of living specimens.	No. of dead specimens.	Observations.	No. of living specimens.	No. of dead specimens.	Observations.
CIRRIPEDA.									
Balanus	...	...	...	...	...	Fragments	...	...	Fragments.
Creusia verruca	...	...	...	...	...	Few specimens.			
ECHINODERMATA.									
Asterias papposa	...	...	...	...	...	One small.			
Echinus sphæra, Mull	...	...	...	1	1	Very small.			
—— miliaris, Leske	...	...	...	1	1	Ditto.			
Spatangus purpureus.	...	...	A few small and alive.	...	...	Many alive; all under half size.			
Amphidotus roseus	...	...	...	4					
Echinocyamus pusillus.	...	...	A few living and dead.	...	...	A few alive; many dead.	...	...	A number, dead.
CRUSTACEA (all living).									
Ebalia Bryerii	2								
—— Pennantii	3								
Eurynome aspera	1								
Hyas coarctatus	...	...	...	4					
Inachus scorpio	...	...	...	1	...	Small.			
PagurusBernhardus	...	...	In *Buccinum undatum*.	...	...	...	...	...	No crustacea.
Galathea rugosa	...	...	...	...	...	Several small; none exceeding in body 1½ inch in length.			
Arcturus longicornis, Westwood	1								
ANNELIDA.									
Aphrodita aculeata	...	...	...	1					
ZOOPHYTES*.									
Plumularia falcata	1†	...	...	2†					
—— myriophyllum	...	...	...	2					
Sertularia abietina	1								
—— cupressina	...	...	...	2					
—— pinaster, Soland. and Ellis ‡	...	...	...	2	...	One specimen.			
Tubularia indivisa	...	...	...	2	...	Ditto.			
Campanularia dumosa	...	...	...	2	...	...	3†	...	Excepting this there are crustaceous species only, as *Lepralia*, &c.
Farcimia salicornia	...	...	...	2					
Crisia cornuta	...	...	...	2					
Cellepora ramulosa	1	...	...	2					
—— Skenei	...	...	...	2	...	One specimen.			
Flustra foliacea	1								
—— truncata	1								

I beg, in connexion with this and the preceding catalogue (by Mr. Hyndman), to call the attention of naturalists interested in the study of the mollusca to the results obtained in a third locality on the western coast of Scotland—at Oban—by Mr. Jef-

* No *Algæ* were brought from any of the three depths.

† These numbers denote the different depths at which the species of Zoophytes were found; No. 1. at 50, No. 2. at 110, No. 3. at 145 fathoms.

‡ *S. margarita*, Hassall, seems to be identical with this. My specimen is without vesicles. It agrees with the description and magnified figure of Solander and Ellis better than the figure of natural size.

freys, published in Sowerby's 'Malacological Magazine' (No. 2, 1839). Mr. Jeffreys obtained "*Terebratula aurita** plentifully in about 15 fathoms water," and along with it found "*Crania personata* not uncommon." He procured also the three species of *Lima*—*L. tenera*, *L. fragilis*, *L. subauriculata*—taken off Sana Island. *Nucula minuta* was dredged at Oban as well as off the Mull of Galloway; it has been procured on different occasions by deep dredging in Belfast Bay, and many years ago was found at the Giant's Causeway. The *Myrtea spinifera*, of which a single valve was brought up off the Mull of Galloway, was found to be not uncommon in deep water at Oban—on the strand at Red Bay, county of Antrim, I found an example of this shell. *Trochus papillosus* and *Eulima polita*, dredged by Capt. Beechey, were not procured at the more northern localities, Sana Island † and Oban—of the latter species, a single living example was taken in the course of the Ordnance Survey in Belfast Bay. The most northern locality on the Irish coast, in which it had hitherto been obtained, was Dublin Bay.

Many observations are suggested by these catalogues, and others of a similar nature in my possession, but to my friend Mr. E. Forbes must be left the treatment of a subject in which he of all men possesses the most ample and important data.

MEDICAL SCIENCE.

On the Construction and Application of Instruments used in Auscultation. By C. J. B. Williams, *M.D., F.R.S., Professor of Medicine in University College, London.*

The acoustic examination of the chest having been so profoundly as well as generally studied, it is not surprising that the instruments used in it should have needed modifications to make them exhibit better the phænomena which increased experience and skill have discovered. To make these improvements, some knowledge of acoustic science is necessary; and it might seem to be the province rather of the natural philosopher than of the physician to suggest them. But it must be borne in mind, that a good knowledge of the ends in view, as well as of the instrument, is required. To suggest what a stethoscope ought to be, a knowledge of acoustics is not more necessary than an acquaintance with disease and experience in its investigation. A want of these latter qualifications, in my opinion, renders some recent suggestions of the Professor of Natural Philosophy at Edinburgh of little value to practical men. An imperfect acquaintance with all the purposes and ends of the stethoscope seems to me also apparent in other late proposals for its improvement.

I now beg to offer a few remarks on the acoustic principle of the stethoscope, and on the best mode of applying this principle to obtain an efficient and convenient instrument for auscultation.

Laennec, the inventor, had no accurate views with regard to the principles of the construction of the stethoscope. He declared that the instruments which he found to be the best were not constructed according to the commonly received laws of natural philosophy. Experiment taught him that the solid cylinder does not convey the sound of the breath or voice so well as the cylinder perforated or excavated at its pectoral end. Many years ago I pointed out that this fact, which is unquestionable, is in perfect accordance with a law of acoustics, that sounds are best conducted by bodies of an elasticity or tension resembling that of the sonorous body. On the other hand, bodies differing in elasticity become bad recipients of each other's vibrations. Thus wood, although an excellent conductor of sounds generated in itself or in other solids, receives but imperfectly those produced in air. But by thinning wood, and bringing a large surface in contact with air, it is more readily affected by the vibrations of air, and becomes an excellent medium for transferring to air sounds of denser solids; and this is the principle of sounding-boards of musical instruments.

* This species was dredged in Belfast Bay by the collectors attached to the Ordnance Survey.

† In June 1842, Mr. Hyndman dredged a full-grown *Trochus papillosus* near Sana Island.

The view which I have always given of the principle of the stethoscope, represents its operation as varying with the source of sound; that sounds produced in air (vocal and breath sounds) are best transmitted by an enclosed column of air; those produced by solids (those of the heart, bronchi, friction) are better communicated by rigid solids of moderate density. This view I still hold, and I proceed to show how the principle may be brought into the best operation.

I shall first point out the conditions by which the stethoscope may conduct aërial sounds. It has been lately questioned, that the air contained in the central canal and excavation in any degree assist in conducting sound. This doubt has arisen chiefly from the observation first made by Dr. Cowan, that plugging the central canal with cork or putty does not much impair the power of the instrument. Professor Forbes has repeated the same remark.

I have made many experiments on this point, and will now state some of the results. Corking the pectoral end of the instrument decidedly impairs its conducting power, but stopping the ear-end does so in a much slighter degree. But in any way stopping the tube does impair the passage of sound; and, to be assured of this, it is necessary to try a test sound (as opticians use a test object), a sound just within the bounds of audibility, such as the sound of expiration, or a very faint cardiac murmur. But the impairing effect of such a stoppage is most obvious in the flexible stethoscope, in which, if used near the pectoral end, a cork in great measure stops the sound. That the stethoscope really conducts sound by its closed column of air, as well as by its solid walls, is further proved by the following facts:—Loud pectoral sounds, particularly of the heart and its murmurs, may be heard by bringing the ear end close to the ear, without touching it; the sound is then conveyed exclusively by the air, and may be totally intercepted by a plug. If a hole be made in the side of a stethoscope, its conducting power is greatly impaired, especially for aërial sound; and it is at once restored by closing the aperture with the finger. This depends not only on the accession of extraneous sounds through the orifice, but chiefly on the much lower power of conduction which an open column of air possesses.

The closed state of the column of air is the chief condition necessary to give air a high conducting power. Following the assertions of acoustic writers, that the pulses of sound pass through air in straight lines like rays of light, I formerly recommended that the pectoral end of the stethoscope, instead of being made with a parabolic hollow as directed by Laennec, should open by a very tapering cone, and that the whole interior should be made as smooth as possible to promote the most direct reflexion of the waves of sound. But this principle is more applicable to ear-trumpets, which receive sounds from the open air, than to the stethoscope, which receives vibrations from a solid surface. Air confined in a close tube vibrates as a whole, and its vibrations pass over angles and through the coils of a flexible tube with a facility which supersedes the idea of straight reflexion; and although they must be more freely transmitted through a straight smooth tube than through a crooked and rugged one, the difference is less than might be expected without a knowledge of the properties of close tubes.

The chief object in the formation of the hollow part of the stethoscope is to bring into closed contact with the walls of the chest a surface of air as large as possible, and to convey the pulses of this air as directly as possible to the ear. It is at the same time desirable to avoid a large hollow within the instrument, because such a hollow causes a conchal or tinkling echo, from the repeated transverse reflexion of the vibrations. For this reason the parabolic cavity is bad. The conical cavity is much better, and for the aërial vibrations is perhaps the best; but the trumpet or bugle-end does not appear to be inferior, and answers better than the conical end for transferring the vibrations of solids.

We now proceed to consider the office of the solid walls of the stethoscope. I have before noticed the inferiority of the solid stethoscope. Those who consider the stethoscope to conduct only by its solid walls, ascribe this inferiority to the weight of its mass, and suggest that, if its weight be reduced by hollowing, the simple solid is still the best instrument. On this principle I had an instrument constructed, closed at the pectoral end with a thin plate of wood, but it proved to be much inferior to the open kind.

But finding the considerable share which the solid walls have in communicating the sounds, I have devised a form for the pectoral end of the instrument which qualifies it for this office better than any now in use; this is the bugle or trumpet-end, the edges of which being made very thin, and fitting flat on the walls of the chest, are most readily affected by their vibrations. The instrument thus constructed, if tried with a test-sound, will be found for most purposes superior to those now in use.

But most stethoscopes are provided with a perforated stopper, the object of which is to shut out diffused sounds, and transmit by the central canal the sound from a spot only. I find that the same object can be pretty well attained with the new stethoscope by reversing it, applying the ear-end, which is made of dense wood, to the chest, and the hollow end to the ear; and, from its flatness, this pectoral end fits the ear very well, without hollow enough to give the conchal sound.

An inconvenience early found in this instrument was its fragility in the pocket. This was readily obviated, and a convenient portability obtained, by taking off the ear-end and fitting it into the hollow end, which is thus supported in its thin part.

Percussion.

Since I explained the principle of percussion in 1835, I have had almost daily opportunities of proving its accuracy, and of deriving advantage from the varied modes of percussion which a clear understanding of that principle suggested. So delicate do I now find this test, that in many instances it discovers disease when other signs are negative.

The principle is briefly this, that the sound on percussion is derived from the bodies which the impulse of the stroke reaches; and the character of the sound depends on the conjoint vibration of these bodies. Thus gentle and flat percussion reaches, and is toned by, superficial parts only; forcible percussion reaches, and is toned by, deep-seated parts also.

The character of the stroke-sound differs not only in loudness and clearness, but also, and most remarkably, in pitch; the deepest tones being the healthiest in all cases except a few of pneumothorax and flaccid emphysema. In some instances the stroke-sound is much louder on the diseased than on the healthy side. This is remarkably the case where the sound is tubular, from condensation or compression of the upper lobes of the lungs from pneumonia, pleurisy, or tubercle; but in all these cases the morbid character of the sound is proved by its note being higher than on the healthy side.

In percussion of the abdomen, different degrees of pressure with the pleximeter or the hand struck on, will often afford useful results. The gentlest filliping percussion without pressure may sometimes detect the superficial dulness of a layer of serum, too thin to be discoverable by fluctuation: strong pressure, on the other hand, displaces the superficial parts, and brings the pleximeter within striking distance of the deep-seated parts.

For general purposes I consider the fingers the best instruments for percussion; and the various ways in which they may be used constitute one of their best recommendations. There are, however, a few cases in which a little instrument for percussion will give more accurate indications; and I will mention one which is very simple as well as efficient. Percussion plates generally are too large to be applied closely between the ribs: when made of hard materials they cause too much clacking on their own surface. The hammers recommended by Drs. Burne and Bennett are liable to the objection, that their strokes may not fall in the same direction; and thus the sound may vary from the mode of the stroke.

To obviate these objections, I have a firm narrow slip of whalebone slightly bent, so that one end forms a handle, while the other is applied to the chest: this last is covered with leather and velvet, to deaden the clack of the surface. The hammer is made of a lenticular spheroid of lead, also covered with leather and velvet, with a small rod of whalebone for its handle. The pleximeter fits like a finger between or on the ribs: the hammer head being circular, *can* scarcely vary in the direction of its stroke, and both being elastic as well as firm in their handles, they may be used with much ease and precision.

Observations on the Therapeutic Application of Air-Tight Fabrics. By Professor Williams.

The use of oiled silk the author stated to be now of frequent practice, as a preventive of evaporation in water-dressing. This valuable addition to therapeutics was chiefly to be ascribed to Dr. Macartney, who was really the first, and not the Germans, to point out its utility, and to explain its pathological action; but, independent of water-dressing, oiled silk proved, simply by itself, of great value as a therapeutic agent, by preserving parts to which it is applied from changes produced by the atmosphere, by preventing evaporation, and thereby promoting perspiration and a return to healthy action. This was found to be particularly the case in dry scaly affections of the skin, which in mild cases its use completely removed, as in slight attacks of psoriasis, lepra, and scaly affections of the scalp. He had also found it useful as a derivative, removing, when worn on the head, obstinate chronic ophthalmia and protracted coryza. Its use in water-dressing was well known, and extensively practised; but he found it equally valuable where it was necessary to use more active agents, metallic salts, in solution for different purposes; these lotions it materially improved in cases of severe eczema and prurigo.

He had found another application of air-tight textures of great use, to assist the operation of derivants or revulsives applied to the external surface. For this purpose Mackintosh's India-rubber cloth answers best. Flannel or cotton cloths dipped in hot water, when covered with a piece of this cloth, act as a poultice or fomentation, and are very beneficial in slight inflammations of the chest or abdomen. By adding salt, mustard, ammonia, turpentine, or various other stimulants to the water, a counter irritant operation is added, which the superimposed air-tight cloth renders more equal and durable than that resulting from any common counter irritant. Such applications Dr. W. has found very serviceable in phthisis and other chronic affections of the chest.

A third therapeutic use of air-tight cloth was one invented and lately made with success by Dr. Arnott, as a means of applying equal pressure to parts: this was by using a slack air-cushion or bladder containing a little air between the bandage or compress and the part to be pressed on. This interposed a layer of air, which diffused the pressure equally and softly.

On the Influence of the Coronary Circulation on the Heart's Action. *By* J. E. Erichsen.

The influence of arterial blood on the voluntary muscles, the author stated, was acknowledged by physiologists; and surgeons were familiar with the fact, that when the main artery of a limb, as the femoral or axillary, was tied, the contractility of the muscles of the extremity was much impaired, and was not restored until the complete reestablishment of the circulation. We ought then, *à priori*, to expect that a similar influence would be exerted over the involuntary muscles, particularly over the heart. Dr. Marshall Hall, in his Gulstonian Lectures, attributes sudden death frequently to an interruption of the coronary circulation. From the importance of the subject, in a pathological view, Mr. Erichsen undertook a series of experiments to demonstrate, as far as possible, the influence of the coronary circulation on the heart's contractility. These were numerous and varied. The coronary vessels were tied after killing the animals, artificial respiration was kept up, and the time the heart, in its several parts, continued to contract was accurately noted; each experiment was detailed, and the following conclusions Mr. Erichsen deems fully established:—First, that an arrest of the coronary circulation produces a speedy, although by no means instantaneous, cessation of the heart's action. Second, that an increase in the quantity of blood sent into or retained in the muscular fibre of the heart, produces a corresponding increase in the activity of the organ. The latter deduction was made from experiments in which the aorta was tied, thus causing a greater quantity of blood than natural to be forced into the coronary artery; artificial respiration was not kept up; the right ventricle continued acting for a much longer time than it would do, under similar circumstances, when no ligature was applied to the aorta. In connexion with this experiment the following fact was observed:—that the order of cessation of the different cavities of the heart was reversed. In it the order of cessation was as follows:—First, the left ventricle; second, the right auricle; third, the left auricle; fourth, the right ventricle. It has been established by Haller and subsequent physiologists, that the right auricle acts longest in ordinary death, and was therefore denominated the "*ultimum moriens.*"

On some Peculiarities in the Circulation of the Liver. By ALEXANDER SHAW, *Surgeon to the Middlesex Hospital.*

The object of this paper is to treat of the influence of the actions of respiration upon the circulation of the blood in the liver. Former writers have shown that, during the act of inspiration, the cavity of the pericardium undergoes a dilatation; a disposition for a vacuum to take place in the space around the heart, therefore, occurs at that time; and the consequence is, that the blood in the venous trunks is drawn with increased velocity to the right auricle. Sufficient attention, however, has not been paid to the effect of this auxiliary power in promoting the free discharge of blood from the hepatic veins, and thereby facilitating the circulation of the liver generally. To prove that the blood is sent with increased velocity from this gland to the heart during the act of inspiration, the author directs especial notice to three principal points,—first, to the place at which the venæ cavæ hepaticæ join the inferior cava; secondly, to the structure of the hepatic veins; thirdly, to the mode in which the opening in the tendon of the diaphragm through which these veins pass is enlarged or contracted, in correspondence with the motions of respiration. With regard to the first point, as the hepatic veins join the cava inferior just where it has entered the cavity of the pericardium, it follows that their mouths will be exposed directly to the influence of the vacuum described as occurring at inspiration in that cavity; secondly, as to the anatomical characters of the venæ cavæ hepaticæ, the peculiar structure of these veins corresponds with the view that the blood is subject to be drawn out of them by the force of suction. It is a law in physics, that for fluid to be propelled along a tube by atmospheric pressure, it is a necessary condition that the tube communicating with the cavity in which the vacuum takes place should be of a rigid structure, otherwise its walls will become collapsed. The author first refers shortly to the mechanism described by Sir Charles Bell*, as provided in the neck for protecting the veins in that situation from the effects of the atmospheric pressure while the vacuum is forming in the chest during inspiration, and then proceeds to point out that a provision for the same object exists in the veins of the liver. He shows that, owing to these veins being contained in canals, the boundaries of which consist of the firm substance of the liver, and to the coats of the veins adhering closely to the interior of the canals, whereby they are prevented from collapsing, they may be regarded as rigid tubes, capable of resisting the atmospheric pressure. He considers, therefore, that when there is a disposition for a vacuum to be formed in the cavity of the pericardium during inspiration, and the liver is subjected to compression, the venæ cavæ hepaticæ are enabled, by this peculiarity of their structure, to maintain their calibres of the natural size; and the blood is consequently drawn, or pumped out of the depths of the gland with accelerated velocity at that time †. Lastly, the author directs attention to the difference in the relative dimensions of the opening in the tendon of the diaphragm, through which the hepatic veins pass, according as the muscular fibres of the diaphragm are in a state of contraction or of relaxation; and he likewise points to the change in the direction of this opening, as compared with the orifices of the veins of the liver, dependent on the shifting of the position of the parts in these two conditions. During inspiration, not only is the opening in the diaphragm dilated, owing to the tension of the tendon at that time, but, from the protrusion of the liver, the veins are elongated, and their course made straighter and more favourable for the escape of the blood; whereas in expiration, the opening in the diaphragm is contracted, owing to the relaxed and flaccid condition of the tendon; and from the change of position of the liver, the course of the veins from the point where they emerge from the gland to that where they pass through the diaphragm, is rendered oblique, or a kind of valvular obstruction takes place between the two openings. By these means it follows, that while the force of suction is in operation during inspiration, the channel for the transmission of the blood is both wide and direct; but that during expiration, when from the contraction of the chest there is danger of the blood regurgitating from the heart into the open canals within the liver, their mouths are partially closed.

* Practical Essays, Part I.

† See the same subject treated of by M. Berard, Arch. Gen. de Med. 1826; also by Dr. Carson, 'Inquiry into the Causes of the Motion of the Blood.' 2nd edition.

On the Relation of the Season of Birth to the Mortality of Children under two years of Age, and on the probable duration of Life, as it is affected by the Month of Birth solely, and by the Months of Birth and Death conjointly. By Mr. Catlow.

Mr. Catlow drew his inferences concerning the mortality of children from a table of 10,700 deaths under two years of age, from 1821–1838, extracted from the registry of the Rusholme Road Cemetery, in Manchester, whose natal month was determinable from the stated age. Following the estimate of the average number of births in each month by M. Quetelet, as an index to the debit number of deaths to be furnished from the births of each month severally, the average result is, that the winter births, or those of January, February, and March, supply 2·1 per cent. less than their debit quota of the mortality; and the autumnal births 2·7 per cent. less; while, on the other hand, the spring births supply 2·4 per cent., and the summer births 2·5 per cent. more than their debit quota of the mortality. It thus appears that summer and spring births have a less probability of arriving at the age of two years than winter and autumnal births. If we estimate the relation to the debit quota of mortality half-yearly, we find the general result to be a deficiency of 4·6 per cent. in the winter quota, that is, for births in the rising part of the year, or winter and spring, and of course a corresponding excess in the summer quota, that is, for births in the falling part of the year. A second inference, then, appears to be, that children born in a *generally* increasing temperature have a greater probability of life up to two years than children born in a generally declining temperature. It may be inferred, thirdly, that the season of birth is one of the necessary elements in the estimate of the causes of infantile mortality in general, or at any particular period. From another table, exhibiting the quota of mortality furnished by each month of birth, we learn the remarkable fact, that the June and July births furnish the *largest quota* of mortality under two years, while, according to M. Quetelet, they are *less* numerous than the births of any other month. It was inferred by Mr. Catlow from these and other facts and tables submitted, that the tendency to death in a certain month is as inherent in the animal economy as is the tendency to a certain duration of life. Moreover, since death in a certain month does not produce the same effect on the average duration of life with respect to every month of birth, but raises it in one case and depresses it in another, it seems fair to infer the existence of a special and fixed relation between the anniversary season of birth and that of death. Again, we may with reason consider that the seasons of birth and death are equally characteristic elements in the constitution of man, and are equally correlative with all his periodical changes. Nay, it is not difficult to foresee that the different combinations of these two constitutional elements must be, on the one hand, promoted, and on the other hand prevented, by similar combinations in both parents.

On the Uses of the Muscular Fibres of the Bronchial Tubes. By James Carson, *jun., M.B.*

The object of this paper is to assign a use to the muscular fibres of the bronchial tubes, whose existence was first pointed out by Russessen, but the really contractile power of which was not established until it was made the subject of investigation by Dr. Williams, whose report was laid before the British Association at the Glasgow meeting. The author of the present paper maintained, in opposition to the previously-received opinions on this subject, that the object of the muscular apparatus was to cooperate with the external inspiratory muscles dilating the cavity of the chest, in extending the superficies of the peculiarly organized membrane lining the air-vesicles, at which surfaces the change produced in the blood by the air is effected. This they effect by contracting during inspiration, and by thus determining in the air-cells or vesicles an increase of dimensions at least equal to the whole increase of volume of the chest arising from an inspiration. To illustrate the effect of this contraction of the tubes on the superficies of the vesicles, the following calculations, based on the supposition that after an ordinary expiration there remain 100 cubic inches of air in the vesicles, and that the average diameter of the air-vesicles is $\frac{1}{100}$th of an inch, were submitted to the Section. There are 190,985,000 such vesicles in the lung.

The contents of each of these vesicles is 0·000,000,523,599 cubic inches.
Superficies ... ... is 0·000,314,181 square inches.
The aggregate superficies of the whole is 60,000 square inches.

The increase of superficies arising from the additional quantity of one cubic inch equally distributed through the whole, is 40·347 square inches, equal to 2·8 square feet.

That arising from 5 cubic inches is	1987	... ...	13·79	...
... ... 20 ...	7621	... ...	52·9	...

The correctness of these views was also inferred from stethoscopic phænomena in health and disease.

On a general Law of vital Periodicity. By THOMAS LAYCOCK, *M.D., M.R.C.P., London, F.R.M.C.S., Physician to the York Dispensary.*

The object of this paper is to establish, by induction, a law of periodicity, with a term of *seven days*, pervading the entire animal kingdom, and influencing the manifestations of disease in man. The facts brought forward for this purpose are derived from periods of gestation, or of hatching, in fishes, reptiles, birds, and mammals; from the transformations and habits of insects; from the effects of morbid poisons on the animal economy, as more particularly exhibited in malarious, exanthematous, and infectious fevers; and from the phænomena of gout and the mutations of chronic diseases. In all of these classes of facts a periodical movement is found, with a strict reference to seven days, or its submultiple or multiple. Of the numerous facts stated the following are examples: of 129 species of birds and mammals, whose period of utero-gestation or incubation was examined, in 67 the period was a definite number of weeks or months, 24 were within one day of being so, and in the remaining 39 the period was so loosely stated as not to be of much weight for or against the accuracy of the measure of time adopted by the author. As special examples, it is stated that the period of incubation in the Grallidæ, Tetraonidæ, and other birds of about the same size, is three weeks; in the Anatidæ four weeks; the Cygnidæ six weeks; but in small birds, as the Musciparæ, only two weeks. The period of hatching in the salmon is exactly twenty weeks; in the wasp, common bee, and ichneumon, half a week, or seven *lunar* days; in other insects a week and a half, as in the *Tenthredo capræa*, or gooseberry gnat; while in the mole-cricket it is four weeks, and in the glow-worm six weeks. The author states, that the most remarkable confirmations of the law are to be found in insects by observing the periods regulating—first, the development of the ovum; second, the duration of the larva state, and the moults which take place in this stage of development; third, the duration of the pupa, or chrysalis period; and fourth, of the imago state, or puberty, and of the vital manifestations then developed. Numerous examples from these conditions in many species are given, in all which a period of seven days, or its simple multiple, is traced. The phænomena of disease in man are next examined in the order previously mentioned; and the author endeavours to show that the stages, the duration, and the principal changes of the whole class of febrile diseases, are governed by the same law, which really afforded the grounds for the establishment of the critical days of Hippocrates; of these days, the most important being the seventh, fourteenth, and twenty-first, and the next in importance the fourth, seventh, and eleventh, the half-periods. The law is next traced through a paroxysm of gout, and through chronic diseases; and it is observed that the doctrine of "septenaries," which prevailed among the ancient physicians, was founded on similar observations, by whom the fact of vital periodicity was assumed, as if it were too well known to be doubted.

By extending this law to health and the performance of healthy functions, the author shows how it explains some hitherto inexplicable facts in pathology; as, for example, the latent periods of fever, and the limitation of them to a period of twenty-eight days. The extension of an epidemic amongst an entire population is also regulated by it; and, according to the author's views, the individuals of a single family, that is, of those born of a common mother, will be attacked at intervals of time regulated by the measure he has developed in the general law. It is remarked that those fevers, one attack of which affords immunity from a second, exhibit invariably the quartan type; or, in other words, are measured by the half-period; and that this general fact must be considered of some importance in discussing the vexed question of contagion. The inquiry into the efficacy of remedial agencies may be rendered more satisfactory than it has been hitherto, by remembering that, by the operation of this law, the return to health, as well as various functional changes, may be altogether independent of any remedies whatever. In short, the author insists that the knowledge and observation of this law is necessary to carry on all pathological inquiries with scientific accuracy.

A further investigation of the law is recommended to naturalists, meteorologists, veterinary surgeons, and medical practitioners. Upon the naturalist is impressed the importance of accurately noting all vital changes or habits in animals which occupy a limited portion of time. The vast field presented to the entomologist is mentioned. The period also of moulting, in all animals, is instanced as worthy of notice, and so also the time occupied by birds in pairing, nest-building, and egg-laying, as well as in incubation. All observations, the author suggests, should be made with reference to known meteorological phænomena, so that the relations of the law may be ascertained and its regulating cause detected. This, it is supposed, will be finally found in the moon's motions round the earth, or in the combined movements of the earth and moon. The time of the day at which periodic phænomena occur is in evident relation with the diurnal variations of the barometer and of the electric tension of the atmosphere, as well as with the diurnal deviations of the magnetic needle. For example, it is stated that the barometer is at its minimum variation when the fits of quotidian and quartan agues begin, and at its maximum when they end. The silk-worm moth, and the hawk-moth of the evening primrose, constantly break forth from the pupa about the hour when the magnetic needle is at its minimum variation east, while the hawk-moth of the lime appears when the needle is at its maximum variation west, and the death's-head moth at the hour of minimum variation east. The paroxysms of agues exhibit similar relations to the earth's magnetic state.

The author remarks, that it is of much less importance to observe the moon's *changes* in connexion with periodic vital phænomena than to observe her apogee and perigee, her equinoxes and solstices; in short, rather her relations to our planet than to the sun. In accordance with these views, the author suggests the division of the year into lunar seasons, of which he thinks there are six; or at least that the solar seasons be more accurately defined, and according to meteorological phænomena. Of these, the intermediate point should be at the equinoxes and solstices, so that mid-autumn would be about the 21st of September, mid-spring about the 21st of March, &c. The author concludes his paper by remarking, that it is only widely-extended and accurate observations of this kind which can form the foundation of a science of *vital proleptics*; a science the most important of all, as having for its object the prevention or amelioration of social and individual suffering, by foretelling its occurrence and foreseeing its causes.

*** This communication is published at length in the first volume of "The Lancet" for 1842–3, pp. 124, 160. At p. 423 of the same volume is a second communication from Dr. Laycock, in which his views are further developed.

On the Period of Puberty in Negro Women. By JOHN ROBERTON, *Manchester.*

The object of this paper is to prove, from a large body of well-ascertained facts obtained from three of the Moravian Mission stations in the West Indies, that there is no truth whatever in the common notion that the period of puberty is earlier in black than in white women; in a word, that the notion in question is no better than a vulgar error.

The data concerning the period of puberty in negro women in the West Indies are furnished by three independent witnesses; two of them superintendents of Moravian stations in Jamaica, and the third a medical gentleman long resident in the Island of Antigua, employed by the Moravian superintendent in that island to conduct the inquiry. The result is a body of facts of an unexceptionable kind, consisting of tables of the ages of a number of negresses, with the age when puberty occurred. As a whole, the evidence goes to prove that negro females reach this period of life neither earlier nor later than the women of Europe.

N.B. The paper, in its entire form, will be found in the 'Edinburgh Medical and Surgical Journal' for July 1842.

Notice of Dr. Martin Barry's Researches on Fibre, published in the Transactions of the Royal Society. By Prof. Owen.

Observations on the best Mode of expressing the Results of Practice in Therapeutics. By Dr. Fowler.

The tabulating and recording all observations in accordance with some recognized physiological laws were strongly urged for this purpose.

Further Particulars respecting a Young Woman Deaf, Dumb and Blind, of whom a full Account was given last Year at Plymouth. By Richard Fowler, *M.D., Salisbury.*

In consequence of Mr. Tyrrel's attention to her eyes and syringing her ears, she can now get a glimpse of shining objects on the floor (a shilling), can sometimes catch a ball on its cup, be made sensible of the return of Sunday, by counting her fingers and putting her hands and knees in the attitude of prayer. She starts at loud sounds, and expresses pleasure at the sound of a Jews'-harp between her teeth. By such exercises of the senses and constant communications by touch with two young girls, both her intelligence and comfort have been improved.

Now, as our thoughts are expressed by muscular adjustments, and as these reciprocally excite thoughts (ideas) similar to those they express, is there not reason for hope that, by the frequent exercise of the muscles, some pleasurable thoughts may be excited even in minds as torpid as this poor girl's?

Cases of enormous Hydropic Distension of the Abdomen, and of sudden Death from the Rupture of an Aneurism of the Thoracic Aorta. By Sir David J. H. Dickson, *M.D., F.R.S.E., F.L.S.*

Mr. James Frazer, superannuated boatswain, aged 65, stated that he had been affected with general dropsy for nearly two years, and that the disease had supervened on a severe attack of rheumatism. He had only returned from Jersey within the previous week. He was received into the hospital on the 16th of April, at three o'clock p.m., and died early next morning. Besides the great distress, dyspnœa and cough, &c. resulting from the enormous distension of the abdomen, the lower extremities also were so loaded with serous effusion, that the integuments of the left leg (which from the knee to the ankle were of a fiery-red colour, in some places very dark and fast running into gangrene and sloughing) had given way, and thus somewhat relieved the turgescence of the limb by a very profuse discharge of serum.

The following are the principal morbid appearances elucidated by dissection, twenty-three hours after death:—

The abdomen contained fifty-nine imperial pints of very viscid straw-coloured serum, which coagulated firmly on being heated. The visceral peritoneum was of a deep red or livid colour, and much thickened; the intestinal canal was dilated. The liver was about the natural size, but dense, indurated, and so much altered in shape as to resemble a very large kidney. The spleen and kidneys were nearly normal. The heart was considerably enlarged, and the pericardium was universally adherent; the left ventricle was hypertrophied, and the mitral valves were thickened and cartilaginous, so as to narrow the corresponding aperture, reducing it to a transverse slit. The lungs were congested and slightly œdematous. This is supposed to be the largest accumulation on record.

Mr. John Anderson, boatswain, aged 64, who had been admitted for obstinate constipation a few days previously, and whom I had left sitting on his bed a few minutes before, suddenly became faint, fell back and expired.

Sectio Cadaveris, twenty-four hours post-mortem.—The cavity of the right pleura was found to be almost filled with blood, which had separated into serum and crassamentum; the former amounted to three pints, and the coagulated portion, which was exceedingly firm, weighed about three pounds. The hæmorrhage had proceeded from a large aneurism of the thoracic aorta, and the tumour, which resembled a cocoa-nut both in size and shape, corresponded to the three last dorsal and first lumbar vertebræ, the bodies of which were carious and deeply eroded, while the intermediate fibro-cartilages were, as usual, sound, and projected into the interior of the sac. The œsophagus, which adhered closely to the anterior wall, was much flattened and thickened. The sac contained a fibrinous coagulum, distinctly laminated at the circumference, together with a quantity of semi-fluid blood in the centre. The orifice leading into the right pleura had a lacerated appearance and was situated close to the spine, and capable of admitting the little finger. The left ventricle of the heart was hypertrophied and its cavity diminished, but the valves were sound. The aorta was generally dilated, the lining membrane thickened and puckered, and numerous calcareous deposits existed between it and the middle coat. The stomach, liver and kidneys were natural, but the spleen was very small, and the intestines, especially the colon, were much dilated.

Abstract of the Case of a Diver employed on the Wreck of the Royal George who was injured by the bursting of the Air-pipe of the Diving Apparatus. By JOHN RICHARDSON, *M.D., F.R.S., &c., Inspector of Hospitals at Haslar.*

In the operations that have been carried on at Spithead for two years past, for the removal of the wreck of the Royal George, under the superintendence of General Pasley, the divers are clothed in a water-tight caoutchouc dress. The legs of the dress are of one piece with the body and end in close feet, like stockings; the arms are open at the wrists to admit of the passage and free use of the divers' hands, but are rendered air-tight there also, by the application of bandages. The diver enters the dress at the neck, which is then gathered into folds and closely secured to a brass collar, on to which the capacious helmet that incloses the head is screwed. This helmet is furnished with a window of thick glass in front of the eyes, a valve behind to permit the escape of air, and an aperture near the crown through which, by the intervention of a flexible tube of a length proportionable to the depth of water, atmospheric air is propelled by a forcing-pump. An external coarse canvas frock protects the dress from injury, and thick woollen shirts and trowsers, worn next the skin, suffice for warmth. The shoes are heavily loaded with lead, and weighty plates of the same metal are hung over the shoulders and tied to the back and breast. The last act of the diver's toilet generally consists in the screwing on of the glass window; the forcing-pump instantly begins to play, the dress is distended by the air, balloon fashion, and the diver, having a signal or safety-line tied to his waist, passes over the ship's side, and descends leisurely into the sea by a rope ladder which reaches to the bottom. There he remains working on the wreck from half an hour to an hour and a half or more at one time. The forcing-pump, which is fitted with three pistons, is worked by double cranks manned by four labourers, and throws in a constant stream of air from the time that the helmet is closed before the diver descends until it is opened after his ascent. The heat generated in the air-pump by friction is abstracted by a stream of water which flows round the chambers, and the air is thus kept cool. The gauge, which stands at 15 under the pressure of one atmosphere, generally marks 34 when the diver is below—about equal to two atmospheres and a quarter. The dress loses its balloon shape and is pressed pretty closely to the limbs before the diver reaches the bottom. The helmet weighs 17½lbs., the leaden weights 80lbs., and the whole dress, these included, 130lbs.; but the weight is not felt as an incumbrance at the proper depth, which in the operations is from 13 to 15 fathoms, according to the time of the tide. The diver generally takes about a minute and a half to ascend from the bottom, but can be drawn up in somewhat less than a minute when an alarm of danger is given. Six divers are constantly employed; they perform their work with much cheerfulness and alacrity, and they are very seldom known to suffer any inconvenience. Some persons, however, who have attempted to descend so dressed, always bleed at the nose and spit blood after they reach the bottom.

On the 14th of October 1841, Roderick Cameron, a private in the Royal Engineers, a well-made, tall, active and intelligent man, who had been trained for some time as a diver, descended to the bottom in 13 fathoms, and in a few minutes afterwards the air-pipe burst close to the pump. The air escaping with a loud rushing noise, which was heard at the distance of 50 fathoms, instantly made the accident known, and the workmen commenced immediately to haul the man to the surface by the safety-line, the air-pump being kept in action all the time. Cameron himself imagines that he became aware of the accident sooner than those upon deck, and he had time to make the signal of danger before he felt that they were pulling him up. His first sensation was that of suffocation, from a want of air, and he felt the collar of the helmet, the leads on the back and breast and the dress on the body generally pressing upon him, as if he were about to be crushed, after which he lost all perception. It is supposed that he was brought to the surface in less than a minute, and air was immediately admitted into the helmet by unscrewing the eye-piece. No water had entered within the caoutchouc dress. In less than a quarter of an hour he recovered his consciousness and was soon afterwards able to speak. He was immediately removed to Haslar Hospital, three miles distant from the scene of the accident. When first examined at Spithead, the face, neck and breast were discoloured, and the tint became darker before he reached the hospital. When he arrived there, his face was considerably swollen, his neck more so; both had a dark purple hue, and large patches of extravasated blood separated the conjunctiva from the sclerotica of both eyes. He felt no uneasiness in the chest or head, but had much pain in the larynx, and considerable difficulty in swallowing. P. 65, rather full. Leeches were applied to the throat, and he was placed in a warm hip-bath.

He passed a comfortable night; next day he felt giddy, the pupils were dilated, the eyes were pained by light, and objects were seen double, though his vision was less hazy than on the preceding evening. The pain in the larynx and difficulty of swallowing were almost gone, the swelling of the face and neck had greatly subsided, and parts of the face were resuming their natural hue. The conjunctiva of both eyes was punctured, and the more fluid portion of the extravasated blood allowed to escape. The discoloration of the face and neck went entirely off in a few days, with the exception of the upper and under eyelids, which retained their dark purple tints for above a week, and the blood extravasated beneath the conjunctiva was not absorbed for a month. The natural vision was restored on the fourth day from the accident, and after that time till his discharge from the hospital he had no uneasy sensations. He was anxious to return at once to his duty as a diver, but was not permitted to do so again that season. The principal question of interest excited by this case is, repecting the cause of the crushing sensation experienced by the diver, and the extensive discoloration of the chest, neck and face. As the air must be propelled into the helmet with a force superior to the pressure of the water at any given depth to which the diver may descend, it appears obvious that the bursting of the pipe must have produced a sudden diminution of pressure. An accident of a similar nature occurred in the operations carried on by Captain Dickenson for the recovery of treasure from the Thetis, wrecked off Cape Rio. Two men were employed in the diving-bell, in 15 fathoms of very clear water, when the air-pipe burst. They both dived under the edge of the bell, and one of them, named Haynes, reached the surface in from 11″ to 15″, but perceiving that his companion, named George Davies, lingered below, he dived again and assisted him up. This was witnessed by John Leary, armourer, who was also present at the operations of the Royal George, and, in his opinion, Davies was more swelled about the neck, and blacker from the waist upwards than Cameron *.

On a Case of unusual Paralysis. By Dr. Carson.

I have taken the opportunity of the meeting of the British Association to lay before the Medical Section a case of peculiar partial paralysis, which occurred at the Northern Hospital of Liverpool, in the practice of my friend Mr. Banner, and which he kindly afforded me an opportunity of observing, with permission to present it to the meeting. The patient, Mark Barnes, aged 23, has all his life enjoyed good health,

* Since the meeting of the Association an accident of a precisely similar nature to Cameron's has occurred to another of the divers employed on the Royal George, named John Williams. The discoloration of the face and neck was of a darker purple than in Cameron's case, but did not extend to the hairy scalp; his eyes were much blood-shot, the neck swelled, and blood flowed from his nose, mouth and ears. This case has been published in detail by Dr. Liddell, Deputy Inspector of Hospitals at Haslar. Subsequent to the occurrence of the last accident a valve has been fitted to the termination of the air-pipe, by which, in the event of the tube again bursting, the air will be retained in the helmet, to serve for respiration while the diver is ascending to the surface.

with the exception of the inconvenience arising from the paralysis, which was not preceded by, nor is it accompanied with, any pain in the head or spine, nor any diseased sensations in the skin or extremities indicative of cerebral or central nervous lesion by which the paralysis might be explained. He is a joiner by trade, and about ten years ago he first experienced a loss of power in the right arm and an inability to bring into exercise all its movements. The principal inconvenience arose from the difficulty, amounting to inability, of raising the arm above the head to more than a right angle with the body. The loss of power gradually increased, and at the end of twelve months the base of the scapula on the right side was noticed to stand out from the back, and at the expiration of three years it assumed its present appearance. At the same time from the commencement of the attack the right lower extremity began to fail him, his gait becoming rather unsteady, and when in the bent position he experienced a little difficulty in raising himself. About four years ago, being six from the commencement of the attack, the arm of the left side became similarly affected, the scapula being displaced and the lower extremity being affected as on the right side, although he has retained more power in the left arm than in the right. The circumstance which more prominently strikes the attention in the present case, is the appearance of the scapulæ, more especially when the man attempts to raise and make use of the arm. In the quiescent position, the base of this bone, instead of lying parallel to the spine, is approximated to it at the lower angle, and stands out from the ribs a distance of an inch and a half, leaving between the scapula a deep hollow channel, the upper angle being drawn high up into the neck, appearing on both sides to the observer in front midway between the shoulder and ear. The clavicle in front is in its natural position, as is also the acromion process of the scapula to which it is articulated. The acromion process stands considerably forward. When the patient attempts to raise the arms all these appearances are much exaggerated. The base of the scapula approaches nearly to a right angle with the spine, forming with the base of the scapula on the opposite side a very obtuse angle, and they both stand out on their whole length nearly three inches from the ribs. The arm cannot be raised beyond the horizontal position; after stooping at a right angle to the lower extremities he is quite unable to recover the erect position without help, and there is an evident lateral curvature of the spine; both which I conceive to be consequences of the loss of power in the longissimus dorsi and sacrolum bales, and the deep-seated extensors of the spine. In his ordinary position the upper part of the body is thrown back, evidently to balance the weight of the head and upper part of the body, which in the healthy person is supported in the completely erect position by the above muscles. In analyzing the actions of the muscles attached to and influencing the movements of the scapula, we found that he could raise and approximate to each other and to the spine, the upper angles of the scapula, showing a complete freedom of the trapezius and of the levator anguli scapulæ; he can also approximate to each other the bases of the scapula, showing power in the rhomboidei. He can put his arm behind him freely and with force, showing that the latissimus dorsi is not involved. It is however doubtful, from the tilted-up position of the lower angle of the scapula, I conceive, that the slip of the latter muscle passing over the angle and assisting to bind down the scapula to the ribs, has lost its power, and do not pass beneath it. There is no reason to suppose any paralysis in the teres muscles, as the action of drawing the arm to the side and backwards is performed with ease. The sub- and supraspinous muscles are very much developed, and the deltoid is of moderate size and retains complete power. The condition of the subscapula muscle can only be conjectured, yet it appears to be healthy and in good condition. The only remaining muscle connected with the scapula is the serratus magnus, whose function in the motion of the scapula is, along with the deltoid, to raise the arm above the horizontal position, and, making the insertion into the scapula the fixed point, co-operates with the pectoralis major in those more energetic dilatations of the chest which are on occasions required for respiration. The power of this muscle on both sides is completely destroyed; and this appears to be the most prominent lesion in the case. In elevating the arm above the horizontal position, this muscle takes up the action which has been carried so far by the deltoid, the supra and infra spinatus and the subscapularis. In the present case this action so far is perfectly performed; but the further action in the elevation of the arm, to effect which the subscapularis is absolutely necessary, is in the present case impracticable. The muscle, in consequence of its paralysis, is wasted and can scarcely be distinguished. In both arms, in some degree, but in the right arm more particularly, the biceps, triceps, and coraco brachialis appear to be completely atrophied, and for some time I was puzzled to know how the contractions of the fore-arm, whose muscles are well developed, could be effected, in the complete absence in both of any evidence of action in the biceps. It appears, however, that this motion altogether depends on the combined actions of the pronators and supinators, which are well developed. The study of the variety of partial paralysis appears to me one of the most fruitful means of examining the functions of different parts of the nervous centres, and the present case is one, the record of which may at some future time illustrate a community of source on the nerves proceeding to the muscles affected. The serratus magnus is supplied with a nerve originating in the brachial plenus, which Bell has classed among his respiratory nerves.

Observations on the Evils arising from the Use of Common Pessaries. By Charles Clay, *M.D., Manchester.*

In this paper the author shows how very far removed from true mechanical principles all the contrivances hitherto in use to support the uterus *in situ* have been, and how very contrary to the structural arrangements of the parts to which such contrivances are applied; that these remarks not only apply to mechanical means, but to the various operations suggested of late by home and continental writers, which the author endeavours to prove are cruel and uncalled for.

Finally, the author recommends a new pessary, frequently applied by himself and others with every success that could be desired, constructed on true mechanical principles, and in accordance with the structural arrangements of the parts concerned in its application; a circumstance hitherto singularly neglected in the construction of pessaries.

Case of Monstrosity, By Dr. Bardsley.

Dr. Bardsley presented a drawing of a case of monstrosity, which was born in 1837, and was alive in 1840. He had not heard of its death since, which he thinks he should have done if it had taken place. In addition to a well and full-grown male child, there were a pair of additional arms connected with the ensiform cartilage, and an additional pair of lower extremities connected with one of the lowest ribs near the transverse process of the corresponding vertebra.

On Diabetes mellitus. By C. Clay, *M.D.*

The author endeavours to show that this disease arises from debility, and recommends the tonic and astringent treatment of it.

On Lithotomy and Lithotripsy. By Mr. Wilson.

The author contrasted the advantages and disadvantages of both operations for removing calculus. Lithotripsy, he said, had not fulfilled in practice the hopes which its first advocates held out from it. Many circumstances rendered the practice of it not only formidable but fatal. The statistics of lithotomy were stated at large, and the views entertained by the author supported by numerous cases, which he detailed at length to the Section.

On Mr. Fleming's Plans for Ventilation. By Robert Chambers, *F.R.S.E.*

STATISTICS.

On the Vital Statistics of Manchester, by a Committee of the Manchester Statistical Society.

The report on this subject consisted of abstracts and classifications of the registration of births, deaths and marriages in the years 1840 and 1841, and was prefaced by observations on the growth and population of the district, on the peculiar influences to which the population is subjected, on the geological character of the country as connected with the subject of drainage, and on the climate. It was illustrated with maps. The entire district, called in popular language the *town of Manchester*, comprises eight different townships, the peculiar circumstances of which were separately detailed. The following are extracts:—

Population.

Townships.	Census.	Numbers.	Increase.
Manchester	1801	70,409	about $2\frac{1}{3}$ times in 40 years.
	1811	79,459	9,050, or 12·85 per cent. in 10 years.
	1821	108,016	28,557, or 35·94 ....
	1831	142,026	34,010, or 31·49 ....
	1841	163,856	21,830, or 15·37 ....
Salford	1801	13,611	about 4 times in 40 years.
	1811	19,114	5,503, or 40·43 per cent. in 10 years.
	1821	25,772	6,658, or 34·83 ....
	1831	40,786	15,014, or 58·25 ....
	1841	53,200	12,414, or 30·44 ....
Chorlton-upon Medlock	1801	675	about 42 times in 40 years.
	1811	2,581	1,906, or 282·37 per cent. in 10 years.
	1821	8,209	5,628, or 218·06 ....
	1831	20,569	12,360, or 150·57 ....
	1841	28,336	7,767, or 37·76 ....
Hulme	1801	1,677	about 16 times in 40 years.
	1811	3,081	1,404, or 83·72 per cent. in 10 years.
	1821	4,234	1,153, or 37·42 ....
	1831	9,624	5,390, or 127·30 ....
	1841	26,982	17,358, or 180·36 ....
Pendleton	1801	3,611	about 3 times in 40 years.
	1811	4,805	1,194, or 33·07 per cent. in 10 years.
	1821	5,948	1,143, or 23·79 ....
	1831	8,435	2,487, or 41·81 ....
	1841	11,032	2,597, or 30·79 ....
Ardwick	1801	1,762	about $5\frac{2}{3}$ times in 40 years.
	1811	2,763	1,001, or 56·80 per cent. in 10 years.
	1821	3,545	782, or 28·30 ....
	1831	5,524	1,979, or 55·85 ....
	1841	9,906	4,382, or 79·33 ....
Cheetham with Crumpsall	1801	1,204	about $7\frac{1}{2}$ times in 40 years.
	1811	1,798	594, or 49·34 per cent. in 10 years.
	1821	2,937	1,139, or 63·25 ....
	1831	5,903	2,966, or 100·99 ....
	1841	8,827	2,924, or 49·54 ....
Broughton	1801	866	about $4\frac{1}{2}$ times in 40 years.
	1811	825	
	1821	880	55, or 6·67 per cent. in 10 years.
	1831	1,589	709, or 80·57 ....
	1841	3,794	2,205, or 138·77 ....
Total of these eight divisions.	1801	93,815	about $3\frac{1}{4}$ times in 40 years.
	1811	114,426	20,611, or 21·96 per cent. in 10 years.
	1821	159,541	45,115, or 39·43 ....
	1831	234,456	74,915, or 46·96 ....
	1841	305,933	71,477, or 30·48 ....

Tables were given of the monthly mean height of the barometer at Manchester from 1794 to 1840, as recorded by Dr. Dalton; of the average monthly maximum, minimum and mean height of the thermometer at Manchester from 1819 to 1840 inclusive, the mean being 50·1 Fahr.; of the mean monthly and annual quantities of rain during forty-seven years, ending 1840, the mean being 35·518 inches.

General state of Weather (exclusive of Temperature) for the Twelve Months, on the average of the five years ending with 1841.

	WIND. Number of Days.								WEATHER. Number of Days.					
	North.	North-East.	North-West.	South.	South-East.	South-West.	East.	West.	Fair.	Cloudy.	Rain.	Snow.	Sleet.	Hail.
January	1·2	4·4	5·0	4·4	4·4	4·8	1·4	5·4	9·0	4·0	11·4	4·2	0·8	1·6
February	1·6	1·4	1·4	4·8	7·6	5·8	3·2	2·4	12·0	2·2	10·8	2·4	0·6	0·2
March	1·6	8·0	5·4	3·2	3·4	4·0	3·2	2·2	10·6	3·6	12·0	3·8	0·2	0·8
April	1·8	4·8	7·6	1·2	3·2	5·8	1·8	3·8	13·8	1·0	11·6	2·0	0·2	1·4
May	2·0	7·0	5·6	0·8	3·6	5·8	2·8	3·4	13·4	1·4	15·0	0·6	0·2	0·4
June............	1·4	4·6	7·8	1·2	3·2	8·0	1·0	2·8	11·4	1·8	16·8			
July	0·8	1·4	8·2	2·6	2·2	8·2	0·6	7·0	6·8	0·6	23·4	...	...	0·2
August	0·8	2·0	8·4	1·4	1·8	9·6	2·2	4·8	1·0	0·6	20·2	...	...	0·2
September	0·6	2·8	3·2	2·8	3·8	11·4	1·4	4·0	8·2	3·2	18·6	...	...	0·2
October	1·2	3·6	5·8	3·0	4·2	6·4	1·0	5·8	6·8	4·2	19·6	...	...	0·2
November	0·8	2·2	3·2	4·4	5·0	9·0	4·0	1·4	5·8	4·4	18·6	0·6	...	0·6
December	0·6	3·0	3·0	6·2	6·4	5·8	2·4	3·6	6·0	4·6	19·0	1·2		
	14·4	45·2	64·6	36·0	48·8	84·6	25·0	46·6	113·8	31·6	197·0	14·8	2·0	5·8

Average number of days on which rain fell in each quarter of the year, during a period of five years, ending with 1841 :—

1st quarter	34·2 days	77·6 days.
2nd quarter............	43·4 days	
3rd quarter............	62·2 days	119·4 days.
4th quarter	57·2 days	

Selection from the Tables of Mortality, &c. &c., for the years 1840 *and* 1841.

Population of the Townships of Manchester, Salford, Chorlton-upon-Medlock, Ardwick, Hulme, Broughton, Pendleton, and Cheetham with Crumpsall, according to the Census for 1841.

Townships.	Males.	Females.	Total.
Manchester	79,236	84,620	163,856
Salford	26,024	27,176	53,200
Chorlton-upon-Medlock	12,567	15,769	28,336
Hulme	12,970	14,012	26,982
Pendleton	5,185	5,847	11,032
Ardwick.......................................	4,586	5,320	9,906
Cheetham with Crumpsall	3,967	4,860	8,827
Broughton....................................	1,554	2,240	3,794
Total in the above eight Townships	146,089	159,844	305,933

Marriages in the eight Townships.

In the year 1840............2984, being one in 102·52 of the population.
...... 1841............2988, ... 102·38 ....

Per-centage.	1840.	1841.
Of the Males married who cannot write...	26·40	25·90
Of the Females married who cannot write	59·45	57·46

Births in the Eight Townships.

Births.	1840.	1841.
Male	6070	6569
Female	5731	6066
Total	11801	12635

Twin Births.

Classification.	1840.	1841.	Proportion to the total Number of Births,	1840.	1841.
Total Number of Twins	115	139	Being as one in	102·61	90·90
Viz.—			Proportion to the total Number of Twins,		
Male Twins	34	44	Being as one in	3·38	3·11
Female Twins	34	49	... ...	3·38	2·83
Twins, being one of either sex	47	46	... ...	2·42	3·02

Proportion of Births to the Population.

1840.		1841.	
Hulme	one in 23·32	Ardwick	one in 21·30
Salford	... 23·58	Hulme	... 22·00
Ardwick	... 24·27	Salford	... 22·43
Pendleton	... 25·77	Manchester	... 24·75
Chorlton-upon-Medlock	... 26·06	Pendleton	... 25·07
Manchester	... 26·82	Chorlton-upon-Medlock	... 25·25
Cheetham with Crumpsall	... 34·75	Cheetham with Crumpsall	... 31·63
Broughton	... 36·83	Broughton	... 33·57
In the above eight Townships	25·92	In the above eight Townships	24·21

Proportion of Births to the Female Population, 1840, 13·54; 1841, 12·65.
Proportion of Illegitimate Births in total Births, 1840, 21·26; 1841, 20·47.

Proportion of Births to Deaths.

1840.	Births. Deaths.	1841.	Births. Deaths.
Manchester	as 100 to 94·58	Manchester	as 100 to 78·35
Salford	100 ... 72·60	Salford	100 ... 66·80
Ardwick	100 ... 69·36	Hulme	100 ... 66·72
Chorlton-upon-Medlock	100 ... 67·70	Ardwick	100 ... 65·37
Cheetham with Crumpsall	100 ... 64·96	Chorlton-upon-Medlock	100 ... 64·26
Hulme	100 ... 61·19	Pendleton	100 ... 62·50
Broughton	100 ... 58·25	Cheetham	100 ... 53·40
Pendleton	100 ... 56·77	Broughton	100 ... 48·67
The above eight Townsh.	as 100 to 81·43	The above eight Townsh.	as 100 to 71·95

Proportion of Male Deaths to Male Population, ...1840, 29·17; 1841, 31·90.
Proportion of Female Deaths to Female Population, 1840, 34·73; 1841, 35·41.

Proportion of total Deaths to total Population.

1840.		1841.	
Manchester	one in 28·36	Manchester	one in 31·59
Salford	32·47	Ardwick	32·58
Ardwick	34·88	Hulme	32·98
Hulme	38·11	Salford	33·58
Chorlton-upon-Medlock	38·55	Chorlton-upon-Medlock	39·30
Pendleton	45·39	Pendleton	40·11
Cheetham with Crumpsall	53·49	Cheetham with Crumpsall	59·24
Broughton	63·23	Broughton	68·98
In the above eight Townships	31·83	In the above eight Townships	33·64

Comparative per-centage of Deaths at different ages in 706 Spinsters, 1746 Wives, and 993 Widows, for the years 1840–41.

NOTE.—Besides the above 3445 Women, there were 382 entered as "unknown;" with reference to their designation as Spinsters, Wives, or Widows. These, therefore, have been omitted in the following Table.

Age.	Spinsters, 706.	Wives, 1746.	Widows, 993.	Age.	Spinsters, 706.	Wives, 1746.	Widows, 993.
16	7·79	...	...	58	·14	1·43	1·40
17	6·09	·05	...	59	·42	1·71	1·50
18	6·94	...	...	60	·70	1·71	3·82
19	8·07	·34	...	61	·14	1·25	1·50
20	7·08	·51	·10	62	·28	1·89	1·60
21	6·37	·63	...	63	·84	·85	2·11
22	5·94	1·20	·10	64	·84	1·48	3·42
23	3·96	1·14	·10	65	·84	·74	2·41
24	2·97	1·43	...	66	·56	1·14	3·52
25	2·83	1·94	·30	67	·14	·85	2·41
26	2·97	2·06	...	68	·14	1·08	2·71
27	2·40	2·17	...	69	·42	·74	2·21
28	2·97	2·46	·20	70	·99	·85	4·33
29	1·55	2·46	·30	71	·28	·34	2·61
30	2·83	2·11	·40	72	·56	·57	2·92
31	1·27	2·11	·30	73	·28	·68	2·51
32	1·27	3·09	·90	74	·42	·45	3·42
33	·56	2·00	·40	75	·42	·17	3·12
34	·70	2·92	·60	76	·28	·28	3·52
35	1·69	3·26	·20	77	·42	·34	2·92
36	·84	3·15	·50	78	...	·17	2·01
37	·99	1·83	·10	79	...	·34	2·01
38	1·13	2·69	·50	80	...	·05	2·31
39	1·27	2·52	·50	81	·14	·05	1·50
40	1·27	3·66	1·10	82	·14	·05	1·10
41	·42	2·40	·50	83	...	·05	·90
42	·56	2·80	1·10	84	...	...	1·50
43	·70	2·17	·80	85	·14	...	1·07
44	·14	2·11	1·20	86	...	...	1·07
45	1·13	2·63	1·30	87	·14	...	·40
46	·14	1·66	·80	88	...	·05	·90
47	·56	2·06	·50	89	...	...	·80
48	·14	2·52	1·30	90	...	·05	·40
49	·56	1·89	1·60	91	...	·05	...
50	·56	2·40	2·11	92	...	...	·20
51	·56	1·71	1·10	93	...	...	·30
52	·14	1·48	1·10	94	·14	...	...
53	·70	1·48	2·01	95	...	...	·30
54	·56	1·83	1·90	96	...	...	·20
55	·28	2·06	2·01	97	...	...	...
56	·70	1·66	1·70	99	·14	...	...
57	·14	1·77	·90	102	...	...	·20

On the Registers of the Collegiate Church of Manchester. By the Rev. R. PARKINSON, *B.D.*

Mr. Parkinson commenced his observations by giving a brief outline of the various laws which had been enacted for enforcing an accurate system of registration. The registers of the parish of Manchester commence in August 1573, and are continued to the present time, with the following exceptions:—one leaf for the year 1589 is lost, and during the period of the Commonwealth a chasm occurs in the registers for eight years and nearly three months.

The number of Baptisms, Marriages and Burials recorded in the Register-books of the Collegiate Church, Manchester, from their commencement in the year 1573 to the end of the year 1841, showing the total amount every twenty years.

	Baptisms.	Marriages.	Burials.
From 1573 to 1580 (both inclusive)	1,439	367	1,117
1581 ... 1600	3,992	808	4,670
1601 ... 1620	5,145	1,587	4,991
1621 ... 1640	5,654	1,644	5,700
1641 ... 1653	2,681	634	4,032
1654 ... 1661 (missing)			
1662 ... 1680 (both inclusive)	3,533	1,340	4,194
1681 ... 1700	4,135	1,587	5,193
1701 ... 1720	5,105	2,701	5,568
1721 ... 1740	8,144	3,931	8,238
1741 ... 1760	12,866	5,587	11,633
1761 ... 1780	19,750	8,436	13,806
1781 ... 1800	42,995	20,888	24,738
1801 ... 1820	59,823	30,413	20,604
1821 ... 1841	104,592	53,316	26,380
	279,914	133,239	140,864

Baptisms	279,914
Marriages	133,239
Burials	140,864
Total recorded	554,017

Mr. Parkinson observed, that the most complete portion of the registers is that of the marriages, which is perfect for the whole parish up to July 1837. Assuming that a marriage might be taken to represent sixty-five couples, or 130 individuals, which is about the usual proportion in large towns (a number which he stated as closely approximating with the Censuses of 1801, 1811, 1821 and 1831), he had constructed a table of the movement of the population. From this it appeared that the population of Manchester and Salford retrograded from 1570 to 1600, advanced rapidly from 1600 to 1640, fell back by about one-third at or about the period of the Commonwealth, advanced to the point from which it had receded by the year 1700, more than doubled itself in the next forty years, repeated this duplication in the next similar period, nearly trebled itself in the succeeding period of twenty years from 1780 to 1800, advanced in proportion of three to two from 1800 to 1820, and has nearly doubled itself in the last twenty years.

On the Criminal Statistics of Manchester. By Sir CHARLES SHAW.

This paper consisted of a statement and analysis of cases of misdemeanor brought before the police of Manchester on Saturdays and Sundays from the 22nd of January to the 15th of June, 1842.

The total number of prisoners within the period in question was 646, of whom 440 were males and 206 females. Of this number 320 had been out of employment an average of eight months and twenty-five days previous to their apprehension. Of the 326 persons who were in employment, 318 had received their wages on Saturday.

Of the 646 prisoners, there were English 446, Irish 172, Scotch 14, Welsh 14.

With regard to the influence of particular employments in disposing men to intemperance, those engaged in laborious employments, as sawyers, smiths, carpenters, and porters, were much less addicted to intemperance than tailors and others engaged in sedentary occupations. Out of the 646 prisoners there were only seventeen factory operatives.

On the Vital Statistics of the Spinners and Piecers employed in the fine Cotton-Mills of Manchester. By Mr. SHUTTLEWORTH.

Mr. Shuttleworth stated that the tables contained in his communication related to nineteen cotton-mills in Manchester, being the whole of the establishments in that town in which the spinning of fine numbers of yarn was carried on.

The tables were delivered in evidence to the Factory Commissioners when sitting in Manchester, and verified by the affidavits of himself and the agents employed.

The summary of the facts obtained was as follows:—

The nineteen mills worked sixty-nine hours per week. They employed 837 adult spinners, of which there were

8	under 21 years of age.	
184	from 21 to 25 inclusive.	
198	... 26 to 30	......
153	... 31 to 35	......
154	... 36 to 40	......
89	... 41 to 45	......
33	... 46 to 50	......
12	... 51 to 55	......
5	... 56 to 60	......
1	above 60	
837		

The united ages of these spinners was 27,367 years, giving thirty-two years as the average age of each person. They had worked in cotton-mills 19,133 years, which was equal to twenty-two years and ten months for each person. In the year 1832, 255 spinners, or nearly 30½ per cent., were absent from work on account of sickness, an aggregate of 6296⅓ days, or an average of twenty-four and a half days for each sick person, or seven and one-third days for the whole number of spinners employed. Of the 837 spinners,

621, or 74⅕ per cent., reported themselves to have "good health,"
171, or 20½ per cent., reported themselves to have "pretty good health,"
45, or 5⅜ per cent., reported themselves to have "indifferent health."

The 837 spinners employed 3233 boys and girls as piecers, or something less than an average of four piecers to each spinner; and of these piecers 488, or 15 per cent., were relations to the spinners.

The number of spinners married was 707, rather more than 84 per cent. The united ages of the wives when married were 15,376⅓ years, equal to twenty-one years each. The number of years of the marriages was 7907 years and five months, equal to eleven years and two months for each marriage. In this period twenty-six of the wives, or rather more than 3½ per cent., were dead, and 681, or nearly 96½ per cent., were living. Of the living,

422, or 62 per cent., were reported to have "good health,"
151, or 22¼ per cent., were reported to have "pretty good health,"
108, or 15¾ per cent., were reported to have "indifferent health."

The married spinners had had 3166 children, equal to four and a half to each marriage; of these children 1922, or 60½ per cent., were alive, and 1244, or 39½ per cent., were dead.

Of the children alive, 1225, and of those who were dead, 1221 (making 2446, or 77⅓ per cent.), had never been occupied in any kind of work; 640, or about 22 per cent. of the whole, had worked in cotton-mills, and fifty-eight, or near 1⅓ per cent., had worked at other occupations. Out of the 640 who had worked in mills, eighteen, or about 2¾ per cent., were dead; and of the fifty-eight who had worked at other employments, four, or nearly 7 per cent., were dead. The cases of distortion amongst the 640 children were eight, or 1¼ per cent., and there had been seven cases, or something more than 1 per cent., of mutilation from machinery.

On the Increase of Property in South Lancashire since the Revolution. By Henry Ashworth.

Mr. Ashworth commenced his observations by stating that they more particularly related to the Hundred of Salford. The figures on which he proposed to found a comparison of the past and present state of Lancashire were taken from a Parliamentary return of the assessment for the Land-tax in 1692 and the authorized statements of the county assessment for 1841. With respect to the progress of the population he had no returns previous to 1801.

In estimating the assessment value of property in 1692, he multiplied the gross amount of the land-tax, which was then 4*s.* in the pound, by five, which he considered a very close approximation to the real annual value of the property in the county at that period.

The following table, constructed by Mr. Ashworth from the above data, shows the comparative increase in the several Hundreds of Lancashire.

Hundreds.	Value in 1692.	Value in 1841.	Increase per cent.
Lonsdale.........	£8,500	£301,987	£3,500
Amounderness..	10,288	364,454	3,500
Leyland..........	5,774	199,868	3,500
Blackburn	11,131	497,541	4,400
Salford...........	25,907	2,703,292	10,400
West Derby	35,642	2,124,925	5,900
	£95,242	£6,192,067	£6,300

Showing an increase in the agricultural Hundreds of Lonsdale, Amounderness and Leyland, of 3500 per cent., and in the three remaining Hundreds of 7000 per cent.

The following table shows the increase in various Towns and Townships.

Name of Places.	Value in 1692.			Value in 1841.	Increase per cent.
	£	*s.*	*d.*	£	£
Chorlton-on-Medlock..	256	4	2	137,651	53,000
Hulme	152	10	5	75,733	49,000
Ardwick	175	0	0	46,471	26,500
Salford	809	19	7	162,847	20,100
Cheetham	215	18	4	38,933	18,100
Manchester..............	4,025	0	0	721,743	17,900
Heaton Norris	281	15	0	45,175	16,000
Broughton	230	6	8	33,956	14,700
Pendleton	363	12	11	48,150	13,200
Crumpsall	95	6	3	13,237	13,000
Rusholme	146	13	4	15,281	10,400
Moss Side	61	9	2	4,958	8,100
Great Bolton	169	0	0	93,916	54,388
Little Bolton	132	19	7	47,111	35,690
Bury......................	220	14	7	52,882	24,000
Oldham	287	9	7	107,500	37,400
Mayton	91	14	7	16,200	17,800
Heap	265	14	7	41,652	15,700
Kearsley..................	56	4	7	9,035	16,400
Farnworth	141	10	0	17,071	12,700
Edgeworth...............	31	4	2	4,116	13,200
Wardleworth	300	3	9	39,456	13,100
Spotland	524	9	7	58,796	11,200
Ashton-under-Lyne	1,345	0	0	143,803	10,600

In certain other towns, some of which lie contiguous to those contained in the last list, the average increase has not exceeded 2100 per cent., as the following table will show.

Names of Places.	Value in 1692.	Value in 1841.	Increase per cent.
	£ s. d.	£	£
Chorlton-cum-Hardy	236 15 0	4579	1900
Blakeley	364 19 7	7673	2100
Garton	435 11 3	9340	2100
Moston	196 2 11	6743	2900
Burnage	80 15 5	2413	3000
Withington	311 5 5	9565	3000
Ashworth	87 5 0	1428	1600
Longworth	55 2 11	1038	1800
Flexton	290 12 11	5412	1800
Reddish	343 0 0	6503	1900
Denton	378 0 0	7890	2000
Urmston	204 9 7	4174	2000
Lostock	103 4 7	2244	2100
Mivington	111 12 11	2336	2100

As an instance of the increase of the value of land in the vicinity of large towns, Mr. Ashworth cited the township of Chorlton-upon-Medlock (adjoining Manchester). The assessed value of the township was in 1815 19,484*l.*, in 1829 66,645*l.*, and in 1841 137,651*l.*; the increase between 1692 and 1841 is shown in the second table.

To show the advantages arising from a locality becoming the seat of manufactures, the case of West Houghton and Staley Bridge was cited. In 1812 one of the first power-loom factories in England was established in the township of West Houghton, near Bolton, and in the same year destroyed by rioters. That species of manufacture being thus driven from that district, was established at Ashton and Staley Bridge. The assessed value of the parish of Ashton-under-Lyne was in 1815 33,548*l.*, in 1841 143,803*l.* At West Houghton the value of that township was in 1815 7377*l.*, in 1829 9564*l.*, in 1841 10,978*l.* That township was now the poorest of the twenty-four comprised in the Bolton Union.

The Forest of Rossendale, containing an area of about twenty-four square miles, in the early part of the sixteenth century contained 80 souls, it was now increased to upwards of 21,000, and land used exclusively for farming purposes had been recently let for upwards of ten times the rental it fetched a century ago.

With respect to the population of Lancashire, in 1801 this was 672,564, in 1841 it was 1,667,064.

On the Criminal Statistics of Lancashire. By Mr. Hopkins.

Mr. Hopkins stated, that since the year 1782 the number of persons executed in Lancashire was 260; of that number ten were females. The greatest number of executions took place in the years 1801 and 1816, when they amounted to twenty. There were no executions in 1783, 1793, 1823, 1837, and the three last years. In April 1838 one person had been executed at Kirkdale, and this was the only execution which had taken place in Lancashire within the last six years.

The crimes for which the parties had been condemned were, for

Uttering forged notes	54
Forgery	13
Murder	33
Burglary	48
Robbery	53
Horse-stealing	9
Malicious shooting	2
Returning from transportation	2
Seducing a soldier	1
Various offences	45
	260

On the Industrial and Training School about to be erected in the neighbourhood of Manchester. By Mr. GARDNER.

The projected building will be erected at Swinton, in the vicinity of Manchester, for the pauper children in the three Unions contained in the parish of Manchester. The building will accommodate 1500 children. Twenty-three acres of land have been taken in addition to the ground required for the building, in the cultivation of which the children will be employed.

On the Influence of the Factory System in the development of Pulmonary Consumption. By Mr. NOBLE.

Mr. Noble prefaced his observations by a statement that the opinions of medical men were at variance as to the effect of the factory system on the health of the operatives.

In Manchester and Salford, according to the census of 1831, there were resident 49,392 families. The total deaths registered in 1839 amounted to 9223, of which 1454 were recorded as having been from consumption; that is, about one death from consumption to every thirty-four families; and in the total deaths from all causes, three from consumption in every nineteen.

In Essex, with a population of 62,403 families, the deaths from consumption in 1839 were 1201, and the total number of deaths 6352; the deaths from consumption being less by about 250 than in Manchester, although the population of Essex in 1831 was 13,000 families above that of Manchester. The cases of consumption, however, were fewer, relatively, in the factory district than in agricultural Essex, being in the latter as four in twenty-one, in the former three in nineteen.

In a district embracing Cambridgeshire, Huntingdonshire, and the southern parts of Lincolnshire, and comprising a population of 67,351 families, in 1839 the deaths from all causes were 7306, and those from consumption 1308, or nearly one in five, showing, as in the case of Essex, a much lower rate of mortality than that of these districts, but a greater relative proportion of deaths from pulmonary complaints.

Mr. Noble then compared other large towns where there were no factories with Manchester. In 1831 the population of Liverpool and West Derby was 43,026 families; in 1839 the number of deaths registered was 9181, being only forty-two less than the number of deaths in Manchester. The deaths from consumption were 1762, or about 300 more than in Manchester.

In 1831 the population of Birmingham was 23,934 families; in 1839 the number of deaths registered was 3639; those from consumption being 668, being again a smaller relative proportion than in Manchester.

In 1831 the metropolitan districts contained 373,209 families; the deaths were 45,441; those from consumption 7104, being in the proportion of two to 105 families, or three out of nineteen deaths from all causes.

Considering that the township of Manchester contained a fair proportion of the factory population, Mr. Noble had examined the registers of deaths from consumption for the years 1838, 1839, 1840, limiting his inquiry to the ages between fifteen and forty. In these three years he found that, with a population of about 160,000, and with an average of 6000 deaths from all causes annually, there were 1141 registered deaths from consumption; of these 174 were of persons working in factories.

The factory operatives were divided thus:—

Spinners	45
Winders	49
Piecers	28
Rulers	15
Carders	11
Frame-tenders	11
Not specified	15
	174

The ages of the 1141 deaths from consumption were,—

Ages.	Deaths.	
15 and under 20	195	195
20 ... 25	243	503
25 ... 30	260	
30 ... 35	223	446
35 ... 40	220	

A table compiled by Sir James Clarke from certain mortality returns of Berlin, Chester, Carlisle, Paris, Edinburgh, Nottingham and Philadelphia, gave the following proportions:—

Ages.	Deaths.
15 and under 20	99 in every 1000
20 ... 30	285 ...
30 ... 40	248 ...

From these and other facts omitted in this abstract Mr. Noble drew the conclusion, that manufacturing habits do not exert any unusual influence in the production or premature development of pulmonary consumption.

On Vital Statistics, with remarks on the Influence which the Atmosphere exerts over the rate of Mortality. By Dr. Ashton.

After noticing that a great diminution in the rate of mortality had taken place in Europe within the last fifty years, Dr. Ashton called attention to the fact, that, notwithstanding the large town population, the average mortality of England and Wales was much lower than that of most other countries in Europe. He then showed the importance of proper ventilation in dwelling-houses, and the evils arising from a want thereof.

On the Destitution and Mortality of some of the great Towns of Scotland. By Dr. Alison.

Dr. Alison, in confirmation of statements made by him at the Meeting of the Association at Glasgow, stated, that in the early part of last winter it appeared that at Edinburgh 21,600 persons, in a population of 137,200 (excluding the garrison of the castle), were in a state of utter destitution, and were recommended for gratuitous relief to a committee appointed to distribute a charitable fund raised by subscription on the birth of the Prince of Wales. In addition to these, 5000 more, who were not so miserably destitute, were recommended for relief in the way of provisions and fuel at a reduced price. To the 21,600 are to be added the inhabitants of the three workhouses and of the House of Refuge, making a total of above 23,000 persons out of 137,200, or 16·8 per cent., who during at least a part of the year "of necessity must live by alms." Of this number not above 7000 are admitted as paupers to legal relief, so that 16,000, or 11·6 per cent. of the population, during part of the year have no lawful means of subsistence.

In the several epidemics which had taken place in England since the English Registration Act came into force, he could not find that the annual mortality in any of the towns had ever exceeded 1 in 30. In Glasgow the mortality had reached this amount on an average of five years; and in 1837 it had been 1 in 24, exceeding that recorded in any year in Liverpool by 25 per cent.

Dr. Alison stated that in a communication made by him to the London Statistical Society as to the mortality at Edinburgh and Dundee, there had been an error for want of the proper deduction for still-born children, but that after making that deduction, the mortality at Dundee in 1836 (the worst year of epidemic fever there), appeared to be 1 in 30·1, equal to the highest recorded at Liverpool, a town nearly four times larger; and the mortality in Edinburgh in 1837 appeared to be 1 in 27·4, exceeding the highest recorded in Liverpool by nearly 10 per cent., and the highest recorded in London by 19 per cent.

With respect to the greater liability of the Scotch towns to suffer from contagious fever, Dr. Alison stated that the highest mortality from that cause recorded in England was 7·7 per cent. of the whole mortality, and that only in London and Manchester, and only for one year (the general proportion being about 4 per cent.), whilst from documents obtained by Mr. Watt, it appeared that of the whole mortality in Glasgow in 1837 that from fever was above 20 per cent., in Dundee in 1836 15 per cent., in Glasgow on the average of the last five years 13·8 per cent., in Edinburgh for the last three years 9·2 per cent., in Dundee for the last three years 8·4 per cent., in Aberdeen for the last five years 14·2 per cent., and in Edinburgh last year 10·27 per cent.

On the Statistics of Plymouth. By HENRY WOOLLCOMBE, *F.L.S.*

Numerous particulars relating to the progress of population, the municipal government, the progress of crime, and local improvements of Plymouth were stated in this paper. It is a continuation of a paper communicated to the Association by Mr. Woollcombe at the Meeting at Plymouth in 1840, and will form part of a 'History of the Past and Present Condition of Plymouth.'

On Loan Funds in Ireland. By HENRY JOHN PORTER, *F.S.S., Tandragee, Ireland.*

This paper was a continuation of the account of the operation of the Loan Funds in Ireland, read before the British Association at the Meeting at Plymouth in 1841. Since that time the following increase has taken place. There are now of these institutions in Ulster 78, in Leinster 103, in Munster 60, in Connaught 27, in all Ireland 268.

The amount of money lent in 1841 was, in Ulster, 572,000*l.*; in Leinster, 512,000*l.*; in Munster, 262,000*l.*; in Connaught, 90,000*l.* Total, 1,436,000*l.*

The number of loans granted was to Ulster, 149,000*l.*; to Leinster, 142,000*l.*; to Munster, 98,000*l.*; to Connaught, 30,000*l.* Total, 409,000*l.*

The profits, after paying all expenses, were, in Ulster, 5836*l.*; in Leinster, 6791*l.*; in Munster, 2802*l.*; in Connaught, 645*l.* Total, 16,074*l.*

The number of persons who had invested their savings in these societies was, in Ulster, 1528; in Leinster, 1824; in Munster, 941; in Connaught, 235. Total, 4528.

On the Monts de Piété in Ireland. By H. J. PORTER, *F.S.S.*

This paper was a continuation of communications made by Mr. Porter at the Meetings of the Association at Glasgow and Plymouth. Mr. Porter stated that the total capital invested in these establishments was 26,883*l.* The number of articles taken in pledge in 1841 was 351,408, on which the sum of 61,944*l.* had been lent in sums varying from 30*s.* to less than 1*s.*

On the Commercial Statistics of France in 1840. *By the Rev.* H. L. JONES.

From this paper it appeared that the total amount in value of the trade of France (exports and imports included) in 1840 was 2063 millions of francs, an amount greater than in any previous year.

In 1826 the total trade (exports and imports included) was 1126 millions of francs.
In 1836 .... 1876 ......
In 1839 .... 1950 ......
giving an increase for 1840 of 113 millions of francs.

The principal increase was in the imports (which at no former period had exceeded 1000 millions, but) which in 1840 amounted to 1052 millions. The exports exceeded those of 1839 by eight millions. The "*Special Commerce*" of France (that is, the produce of her own soil or manufactures exported, and the articles imported for her own consumption, and included in the 2063 millions) was, in 1840, imports 747 millions, exports 695 millions; total, 1442 millions.

Out of the total trade for 1840 the exports and imports by sea amounted to 1481 millions, or about 71¾ per cent., and those by land to 582 millions, or about 28⅓ per cent. of the 2063 millions.

Of the imports and exports by sea, 705 millions, or 48 per cent., were effected in French bottoms, and 776 millions, or 52 per cent., in foreign bottoms. Of these amounts 757 millions, or 51 per cent., were from or to European countries, 582 millions, or 39 per cent., from or to countries out of Europe, and 142 millions, or 10 per cent., from or to French colonies and fishing establishments.

Mr. Jones concluded his paper by a long series of tables compiled from the published official accounts of the French Custom-House, showing all the details of the general and special commerce of France with England and the United States, and the full details of the silk and cotton trade of France with all nations.

On the Advantages arising from Spade Husbandry and Agricultural Education. By Mrs. DAVIES GILBERT.

In this communication, being a continuation of that made at Plymouth, Mrs. Davies Gilbert stated, that by careful weeding, manuring and cultivation of the land, some of her tenants raised forty bushels of wheat per acre, and were paying double the rent which she had received for the same land when it was in large farms; and that out of one hundred and twenty-four tenants among whom the land was now divided, not one had fallen a single farthing into arrear since 1830.

With regard to an Industrial School founded under her patronage, it appeared that the schoolmaster paid yearly eleven pounds for his dwelling-house and school, and three pounds per acre for three acres of land. His school consisted of twenty boys, of the average age of eight years, who worked for him at out-door labour three hours a day in return for three hours' instruction in reading, writing and accounts. Such labour amply rewarded him for the instruction he gave them.

On the Differences of the Quality of the Milk of Cows for the different purposes of Milk and Cheese, numerically expressed. By G. WEBB HALL.

Mr. Webb Hall stated the result of a number of experiments which had been made with a view to ascertain the relative richness of the milk of different cows, from which it appeared that the variation was much greater than was usually supposed.

On the Comparative Statistics of the Universities of Oxford and Cambridge in the 16*th*, 17*th*, *and* 19*th Centuries. By* JAMES HEYWOOD, *F.R.S.*

Mr. Heywood had compiled part of this paper from a list of the number of persons who had received the degree of Bachelor of Arts at Oxford from 1518 to 1680, in the Ashmolean Library at Oxford, and a list of the number of persons who had obtained a similar degree at Cambridge from 1499 to 1658, in the library of the British Museum.

The number of degrees of Bachelor of Arts conferred in Cambridge,—

In 1500 was	7
In 1530	40
In 1560	60
In 1590	154
In 1600	167
In 1620	271
In 1628	315

From 1628 to 1658 the numbers decreased; the annual average from 1648 to 1658 being 174.

The lists of similar degrees granted at Oxford and Cambridge from 1830 to 1840, showed that during the last ten years the increase had not been above the number of B.A. degrees granted in 1628, and other years in the early part of the first quarter of the 17th century.

The number of B.A. degrees granted at Cambridge in 1630 was 291; in 1635, 275; and in 1640, near the time of the civil wars, only 240: in 1830 it was 324; in 1835, 314: and in 1840, 339.

Contributions to Academical Statistics, continued from 1839. *By the Rev.* BADEN POWELL, *M.A., F.R.S., Savilian Professor of Geometry at Oxford.*

The author in this paper continued the table communicated by him to the British Association at the Birmingham Meeting in 1839, with the addition of a column containing the number of *candidates* for the examination.

University of Oxford.

Year.	Matriculated.	Candidates for Examination.	Passed Examination.	Obtained Honours.		
				Classical.	Mathematical.	Both.
1839	404	374	245	86	26	12
1840	396	419	323	97	22	6
1841	441	399	272	105	27	14
Mean.	413	397	280	96	25	10

Obtained Degrees.

Year.	B.A.	M.A.	Divinity.	Medicine.	Civil Law.	
					Ordinary.	Honorary.
1839	254	179	16	4	7	16
1840	288	177	13	5	11	1
1841	286	179	27	2	13	9
Mean.	276	178	18·6	3·3	10·3	00

The general results are very nearly the same as before.

MECHANICS.

Abstract of a Lecture upon the Atmospheric Railway, *prepared at the request of the Council for the Twelfth Meeting of the British Association, and delivered in the Athenæum of Manchester on the Evening of Monday, the 27th of June,* 1842. *By* CHARLES VIGNOLES, *Civil Engineer, F.R.A.S., M.R.I.A., M. Inst. C.E., and Professor of Engineering in University College, London.*

The system of producing motion on railways by means of the pressure of the atmosphere, had acquired the popular designation of the "*Atmospheric Railway*;" and it was the growing interest felt in the public mind for this new application of one of the very simple powers of nature to the uses of man, which had led the Council of the British Association to suggest the delivery of some public exposition of the principles on which it was based, and which had induced and perhaps justified the Professor in coming forward to attempt an illustration of the very ingenious contrivances which had brought these principles into practical effect. When the enormous cost hitherto incurred in the construction of railways was considered, as well as the heavy daily expenses in working these lines, it was not singular that efforts should have been directed to some means of producing similar useful results in a more economical manner.

A brief history of the discovery and gradual improvements of the first invention was gone into, tracing back the original thought to the celebrated *Papin*; in succession, long afterwards, came Lewis, Vallance, Medhurst, Pinkus, and lastly Clegg, all well known as active inquirers into this subject. But it was shown to have been *Medhurst*, who, about thirty years since, first gave to the world the right idea of connecting the body in the pipe or tube, directly acted upon by the atmospheric power, with a carriage moving along exteriorly; and that to one (already well known to science as the practical applier, economically and on a large scale, of Gas for the illumination of large buildings and towns), viz. to *Clegg*, was due the merit of having worked out the suggestion of Medhurst to practical utility, in a way at once simple, efficient and capable of enduring the rough usage necessarily attendant on constant and rapid motion.

Reference was then made to certain of the drawings and sections representing, drawn to the full size, an atmospheric apparatus equivalent in power to an ordinary locomotive engine, but occupying much less space. It is described to be a cast-iron pipe or tube of twelve inches in diameter, laid, in lengths like water-pipes, between the railway bars, and attached to the same cross-sleepers which support them; on the upper part of this tube is a narrow longitudinal slot or opening, covered by a valve, the peculiar mode of opening and closing down and sealing whereof constitutes the ingenuity of the contrivance. The valve is a simple flap of leather, one edge of which is fastened down, so as to act as a hinge; the upper surface of the leather being plated in successive links with flat bar-iron, and the under surface also plated, but with links of a segmental form, to complete the inner periphery of the tube when the valve is closed down. In the tube moves a piston, made air-tight by one or more leather collars; at the end of the rod of this piston is a counterweight, to keep the rod parallel to the axis of the tube: a connection is made (by one or more plates of boiler-iron of sufficient size and strength, and called the coulter,) between the piston-rod and the perch of a leading carriage or guiding truck, in front of the train moving on the railway. In practice, the piston being in the tube, and at some little distance in advance of the opening of the valve, through which the coulter passes, a vacuum, more or less perfect, is made in that part of the tube in *front* of the piston by an air-exhausting-pump worked by a steam-engine or other stationary power; the air enters by the open valve, and presses at once and directly at the *back* of the piston; the opening through which the coulter passes is raised only for a few feet-length at a time, and the valve is rapidly closed down again, as the piston, carrying forward with it the train, moves on; and being closed, the edge of the valve-opening is hermetically sealed up, and the tube rendered air-tight by a composition of bees'-wax and tallow, varied in certain proportions, according to season and climate: this composition is laid at the valve-edge, in a groove, into which it is pressed by a copper slide, kept just warm by heated charcoal in an attached box. The whole of the mechanical arrangements of rollers, heater, &c. are very far from being complicated, not liable to get out of order, and easily adjusted when deranged; the operation being completely effected when the carriages travel at exceedingly high velocities, as has been repeatedly done, leaving the tube ready to be again exhausted of its air, and allow the next following train to be impelled by the atmospheric pressure. In familiar illustration of the principle on which the piston-rod in the tube connects through the valve with the carriage outside, the movement of an ordinary pencil sliding in its case was referred to.

One leading characteristic of this new system is that of substituting stationary for locomotive power, and in this substitution the advantages will in many cases be great. Even the old system of stationary power, connected with all the obstacles of ropes, sheaves, &c., has still its supporters, both where passenger as well as mineral traffic have to be carried on: but with the numerous economies which might be combined in the atmospheric system, the stationary engine, with steam or water as a prime mover to work the exhausting-pump, may once more take the field against the locomotive. This stationary power is to be erected at long intervals on the line of railway, and may certainly be placed at three or four miles, and probably at five, or even six or seven miles apart, working the exhausting-pump, which will be connected by branches with the main tube lying between the rails.

The air being drawn out by the pump, a certain amount of vacuum is produced in front of the piston, creating a corresponding pressure on the opposite side of it, being about half a lb. on every square inch of surface acted on by the atmosphere, for every inch rise of the barometer. In the ordinary practical working of the apparatus, the usual amount of vacuum obtained may be taken at that corresponding to 16 to 18 inches of mercury, or 8 lbs. to 9 lbs. per square inch; and experiments have fully proved that the whole, or very nearly so indeed, of the pressure due to the degree of exhaustion is obtained.

The measure of the power for producing motion is the product of the transverse sectional area of the tube in square inches, multiplied by the number of lbs. pressure due to the vacuum; various tables of these powers were exhibited, both for horizontal railways and for lines of every degree of acclivity, indicating also the respective corresponding loads, in tons, which may be taken. Thus from a tube of 12 inches diameter, with an 18-inch vacuum, or 9 lbs. pressure per square inch, there is obtained an atmospheric power of fully 1000 lbs.; being equivalent to the *average adhesive* power of a locomotive engine; and this power, with every deduction for friction and resistance of various kinds (all which were specified and tabulated), will propel 46½ tons, or 10 carriages over a horizontal railway; and 9½ tons, or 2 carriages up an inclined plane of so steep a gradient as 1 in 28. With larger tubes and greater pressure more power could be generated, and of course greater loads propelled. These representations were not based on theory only; they were the results of the working on a piece of experimental railway for the last two years and upwards on the West-London line at Wormwood Scrubs, only a few miles from the metropolis. The tube at this place is only nine inches diameter; but there will be a most complete practical demonstration on a larger scale shortly, on the opening of an extension of the Dublin and Kingstown railway to Dalkey, now constructing upon the atmospheric principle; the tube thereon would be 15 inches diameter, the inclination of the railway being about 1 in 110; the stationary steam-engine, exhausting-pump, &c. calculated to propel thereon heavily laden passenger-trains at extremely high velocities.

Reference was made to another peculiarity of this system:—If it were requisite to turn on a lathe with care and scrupulous accuracy the insides of the tubes, the expense would exceed any reasonable limits; but a simple cutter is all that is necessary to pass through the pipes on coming out of the foundry-sand; they are then placed in a proper receptacle and raised to the temperature of melting tallow; in that state a mop dipped in tallow is passed through the tubes, followed up by a wooden piston, which spreads the unguent in a complete coating, producing an even interior surface: by frequent passage of the working piston, this tallow lining, or tinning, as it were, becomes perfectly smooth and nearly as hard as plaster of Paris, and no doubt aids considerably in preventing atmospheric leakage, causing the piston to work, practically speaking, in a tube of tallow, but protected by the iron pipe or casing.

With regard to the velocity attainable by trains impelled by atmospheric pressure, it may be said to be independent of load or gradient; in fact it is almost strictly regulated by the proportion between the area of the tube and that of the exhausting-pump; that is, by the velocity with which the air is withdrawn from the tube by the pump. The exhausting-pump piston will travel at the same speed as the piston of the steam-engine working it, viz. not exceeding three miles an hour; if the trains are required to run at the rate of thirty miles per hour, then the transverse-sectional area of the air-pump must be made ten times that of the tube, and engine power must be provided accordingly; and so of other velocities. This is independent of the load; and gravity being practically an equivalent augmentation of the load to be moved, it is consequently also independent of gradient. The tables exhibited were calculated for various velocities, supposing there was no atmospheric leakage; this must be provided for, and is computed to require additional engine-power to the extent of six-horse for every mile of pipe; the chief leakage being at the longitudinal valve, and therefore nearly constant, whatever the diameter of the tube.

It is evident this is a superior mode of employing stationary power, since there is nothing to be propelled or moved but the carriages, and nearly the full dynamic effect of the force generated is obtained. On the locomotive system, half the load, on the average of all trains, consists of the engine and tender; and in the old stationary system there is the weight of the rope, with the expense and friction of all the attendant mechanism, which is enormous; and of this the Blackwall railway is a palpable example, although the rope-and-pulley system has probably been thereon carried to the greatest perfection of which it is susceptible. On the atmospheric system, there is substituted for a rope of hemp or wire, a rope of air, which, without weight or friction, transfers a power that may be called inexhaustible and boundless; and there is thus obtained the maximum of useful weight carried with the minimum of resistance to be overcome.

In pointing out the table containing the several horse-powers of the stationary engines to work air-pumps of different diameters, and to create and sustain the vacuum in tubes of different sizes, an explanation was entered into of the term horse-power, which was stated to be now generally computed by all makers and purchasers of steam-engines from the diameter of the cylinder and length of the stroke, taking in round numbers each such nominal horse-power as capable of raising 60,000 lbs. one foot high with a given consumption of fuel: Watts's old rule of 33,000 lbs. had long been abandoned, the principle on which it was originally founded being now understood as incorrect, though after all it was but a conventional expression. The Commissioners who had been appointed by the Board of Trade to investigate into and report upon the atmospheric railway, had not even used Watts's rule correctly, and by this, and by reasoning and calculating on the exhausting-pump employed in their experiments as *theoretically perfect*, and by another unintentional misapprehension, the horse-power stated in their report as necessary to work tubes of certain lengths and diameters, was put nearly double the horse-power as understood by the practical engineer. Some of the other opinions and conclusions of the Commissioners were also adverted to and their soundness impugned.

It was then pointed out, that by means of self-regulating valves of a very simple character, drawings and models of which were exhibited, the trains might pass on continuously without necessarily stopping at each stationary engine; and it was also particularly observed, that it did not appear to be either necessary or advisable to vary the diameter of the tubes at each variation of gradient; but that the most convenient arrangement would be to have the tube or main by no means limited in diameter, and to work the different rates of ascent with corresponding degrees of vacuum; and this might conveniently be done, as such variation of pressure scarcely, if at all, affects the speed of the train; this, in fact, is one of the great advantages of the system, as the power expended in obtaining and keeping up the various degrees of exhaustion will be in the direct ratio of the increase of ascent and no more. If it occurs that an inclination intervenes, sharper than could be advantageously managed in this way, a larger tube may be laid down in that particular length of the railway.

A remark was made that the atmospheric system might be applied to any existing railway without interference with the mode of working with locomotive engines during the operation.

A peculiarity of this system was explained by diagrams, to the following effect:—Suppose the travelling load to be fifty tons, the degree of vacuum necessary to obtain a given degree of velocity, producing a pressure of 10 lbs. per square inch on the piston; so long as the load is the same and the line level, the train will move with equal velocity, because the speed is due to the rapidity with which the air is pumped out of the pipe. But if the load be only twenty-five tons starting with the same pressure as with fifty tons, the train then runs faster than the air is drawn out of the pipe; the power behind being so great in the first instance as to force the load forward at an increased rate. But this does not last long; the pump going slower in proportion than the train, the air gets packed up, as it were, in front of the piston, and becoming less rarefied offers greater resistance; the velocity of the train, which is very great at first, gradually diminishes until the amount of vacuum becomes proportionate to the weight behind it, and then the train goes on uniformly. Again, supposing the train to start with a load which is rather heavy, with a pressure of only five or six pounds, the air is then drawn out quicker than the load can follow, and makes the vacuum more perfect; and thus the power increasing gradually, the train increases its velocity until it becomes balanced with the vacuum. To ascend an incline may be called equivalent to adding to the load, and to descend, equal to diminishing it; when the train comes to an ascent it will reach the foot of the plane with a considerable velocity; but its rate will gradually decrease as it ascends, until the power is brought up equivalent to the pressure, that is, until by the exhausting-pump going faster than the train, a power is generated sufficient to drive it up the hill. In coming down hill, the trains will start at the top with very great velocity; but the air will immediately begin to act in front as a buffer until the pressure is reduced. The moment the train comes to the level, its velocity will immediately increase; and thus the speed is nearly uniformly regulated, whatever may be the inclination.

In entering into the question of the cost of the atmospheric railway, several tables were referred to, and it was distinctly and unreservedly stated that from £10,000 to £12,000 per mile was sufficient to construct a line on this principle in most parts of any country. Details were prepared to show this, drawn from actual estimates made for the purposes of determining the expense of the apparatus and railway under several greatly differing circumstances; and the various economies contemplated were mentioned. It was also observed that the recent improvements and simplifications by Prof. Wheatstone of his electro-magnetic telegraph, had very greatly reduced the expense of that invaluable invention; so that for this indispensable accompaniment of the atmospheric railway, no more than £100 per mile would be required. Much stress was laid on the advantage of getting rid of the locomotive engine, which is a constant source of dangers and accidents, and has always been the cause of the most fatal ones; at the same time adding greatly to the unprofitable weight of the train, and requiring everything connected with the present details of railway construction and furnishing to be proportionably large, heavy and expensive. On the atmospheric system, the rails, and upper works generally, the carriages, vehicles, stations, buildings, and establishments, &c., will be all very much less costly. In laying out a line, it may be suited to the undulations of the country, and earth-work greatly reduced; bridges, and all other works of art, will be on a much smaller scale, not simply in the arithmetical proportion of their heights or breadths, but more nearly in proportion to the cubes of those dimensions; and generally a saving in land, damages, &c.

But the great paramount advantage is the perfect safety from collisions and similar accidents, on the single lines of the atmospheric system, which railways worked by locomotive engines, even with double lines, cannot possibly be free from.

Reverting to the stationary power, it was stated that the adoption of other means than steam to work the air-pump and produce a vacuum in the tube, might often be expedient and economical; as water, where abundant, or where it could be collected in reservoirs; or where trains were not constantly passing, a small steam-engine might be continually at work raising water to be used (over and over again if needful) at the stated times when the traffic had to pass, and a short experience would determine the exact quantity of water required to work a wheel for these given periods; and as the time necessary to produce the required exhaustion in any length of tube is probably the same that the carriage would take to travel over the same space, the exact measure of power to create and sustain the vacuum could be calculated. But it is clear that the importance of obtaining the very cheapest method of exhausting the tube would soon attract the attention of scientific and practical men.

Allusion was made to the facilities which this system possessed of disengaging the train from the piston-rod moving in the tube; and also to the very short space in which the train could be stopped, by the ordinary break, and by destroying the vacuum in front of the piston; rendered still more easy by the absence of the vast momentum, which from the weight of the locomotive and the heavier carriages, is always an accompaniment of the present trains.

A summary of the principles of the atmospheric railway concluded the lecture; the Professor observing that the invention was but in its infancy, and that it was scarcely possible to appreciate the results, when further developments, practically brought out on a large scale, should bring this wonderful power still more within the grasp and command of man.

Various models, drawings, tables, and formulæ were exhibited to the meeting, and constantly referred to in the course of the lecture, of which they were intended to be illustrations.

On Straight Axles for Locomotives. By Professor VIGNOLES.

He stated that an unfounded prejudice existed in favour of cranked axles, which, in his opinion, were inferior to straight ones in almost every point of view. With straight axles the cranks were thrown outside the wheels, which gave more room for the arrangement of the working parts; and another great advantage was gained by lowering the boiler nearly fifteen inches, and thereby increasing the safety of the engine, by placing the centre of gravity nearer the rail. The original expense of the engine and of the repairs was also much lessened. These advantages might be shown by a reference to the Dublin and Kingstown Railway. By introducing straight axles and outside cranks the expenses had been greatly decreased, no accident had ever occurred from breakage; and such increase of room had been obtained, that they had placed the tender underneath the engine, thus fixing the centre of gravity as low as possible, and dispensing with the separate tender. By this arrangement they could run fifteen miles without stopping for water. He had found much difficulty in introducing the straight-axled engine on this line; and, in fact, the great obstacle in obtaining a fair trial for different forms of engines arose from the fluctuation in public opinion. Straight axles and cranked axles, four-wheeled and six-wheeled engines, had been used on different lines, not so much from the recommendations of the engineer as in compliance with the opinion of the several railway boards. Just now a prejudice existed against four-wheeled engines, as being less safe than six-wheeled, more liable to run off the line, &c., whereas he contended that the four-wheeled engine *per se* was not open to these objections. He believed that the principal advantage which could be claimed for the six-wheeled engine was in the disposition of the weight on the wheels, and having the third pair of wheels and axle, in case of accident to either of the other pair; and a consideration of the fatal accidents which had lately occurred on the London and Brighton and the Paris and Versailles railways, would show that they arose from other causes, and had no reference to the engine having four wheels or six. He considered that both accidents arose from similar causes: in both cases heavy trains and two engines were coupled together, the smaller one leading; from some cause a check took place, the engine-man shut off the steam of the leading engine, and the following engine, with the immense momentum derived from weight and velocity, struck against it, forcing it off the rails, and causing the overturn of the carriages. It was considered objectionable to use an auxiliary engine behind a train, because, in case of any retardation of the engine in front, it cannot be checked in time to prevent great concussions of the carriages. Similar objections applied to using two engines under any circumstances, especially when of unequal power. Many accidents had taken place in consequence of the breaking of cranked axles; and M. François and Col. Aubert, in their report to the French government, had remarked that the fractures of broken axles, instead of the fibrous appearance of wrought iron, presented the crystallized appearance of cast iron, which they attributed to magnetic or electric changes in the molecular structure of the iron, caused by friction in the bearings and great velocities; and in his opinion it was probable that the continual strains and percussions to which the cranked axle is subjected will account for the changes in the molecular constitution of the iron.

On the Strength of hammered and annealed Bars of Iron and Railway Axles. By James Nasmyth.

In locomotive engines the axle was the chief point of danger; and it was therefore important, both as a scientific and practical question, to determine the nature and habitude of iron when placed under the circumstances of a locomotive axle. Experiment was the only way to discover this, and he would have wished to place iron under exactly similar circumstances; but the short time intervening since the subject had come before the Section had rendered it impossible to do so. One opinion was, that the alternate strains in opposite directions, which the axles were exposed to, rendered the iron brittle, from the sliding of the particles over each other. To illustrate this, Mr. Nasmyth took a piece of iron wire and bent it back and forward; it broke in six bends. He had suggested annealing as a remedy for this defect: in proof whereof he took a piece of annealed wire, which bore eighteen bends, showing an improvement of three to one in favour of annealing. He should therefore advise railway companies to include in their specification, that axles should be annealed; and would moreover most strongly recommend that where any *doubt* existed as to a change for the worse having (from whatsoever cause) taken place in respect to deterioration of the tenacity of the iron of the axle, the simple but effective process of *annealing* should be had recourse to, which would be found to restore its original toughness; he did not like the custom of oppressing engineers with useless minutiæ in specifications, but this was so useful and so cheap, that he thought it ought to be insisted on. To exhibit on a larger scale the effect produced on iron in our workshops, he showed a specimen of iron as it came from the merchant: being nicked with a chisel, it broke in four blows with a sledge, at the temperature of 60°, with a crystalline fracture; by raising the temperature 40° higher, it bore twenty blows, and broke with the fibrous or ligneous fracture; so that the quality of iron was not the only circumstance to be considered as influencing the fracture. Mr. Nasmyth noticed also the injurious effect of cold swaging, as causing a change in the nature and fracture of the iron. Swaging was necessary in many cases; for instance, when an axle had collars welded on, these could not be finished with the hammer alone, certain tools called swages were used, from the action of which great condensation of the iron took place, and a beautiful polish was given to the surface, with what injurious effect he would show by the next specimen, which had been heated red-hot, and then swaged till cold; it broke at one blow without nicking, and the fracture was very close and beautiful, like steel. This showed the fallacy of considering close fine grain a good test of excellence in wrought iron; but moderate swaging was often necessary, and not injurious, unless where an over regard to finish carried it to excess. To prove that annealing restored the toughness and fibrous texture, a portion of the last bar was heated, and swaged till cold as before, then heated dull red, and left to cool gradually; it bore 105 blows without breaking, as was shown by the specimen; this proved that the fibrous structure was restored by annealing, and he therefore thought it should be insisted on in specifications. The effect of heating to welding-heat was very injurious, unless the iron was subsequently hammered to close the texture; a piece of the same iron heated to welding, and left to cool, broke without nicking in one blow, showing very large crystals, especially in the centre. The effect of nicking was also very singular. The strength of iron was generally stated to be proportional to its sectional area; but a nick not removing $\frac{1}{100}$th of the area, took away $\frac{1}{10}$th of the strength. Mr. Nasmyth broke a piece of nicked, or rather scratched wire, to illustrate this point. These and similar things did not prove that science and practice were at issue; but, as Halley reached the great accuracy of his prediction of the return of his comet by taking into account the disturbing forces of Jupiter and Saturn, and the other planets amongst which the body had to pass, so scientific men should seek in the workshops correctional formulæ, by learning there the practical occurrences which would elucidate and correct their theories.

On the best Form of Rails and the Upper Works of Railways generally. By Prof. Vignoles.

He wished to compare the two chief systems of laying down rails, with chairs and without, and to do so he referred to two diagrams:—No. 1, exhibiting the heavy rail and heavy chair used on the South-Eastern Railway, the weight of rail being 80 lbs. per yard, and the chair 20 lbs.: the rail was fastened in the chair, not with iron, but with a longitudinal plug or key of wood: this mode of laying rails was found to answer very well. No. 2 was invented by Mr. Evans; it was rolled with a slot or groove running along its under side; this slot, after coming from the first rollers, was rendered dovetailed by compressing the bottom edges of the rail towards each other, thereby narrowing the slot at the bottom. These rails required no chairs, having continuous bearing on longitudinal wooden sleepers, being fastened down by bolts, with dovetailed heads slid into the groove, and which, passing through holes in the timbers, were secured with a nut and washer at the under side. He had suggested this improvement, as they had been previously fastened with a cotter. By this method all the difficulties attendant on fastening down the chairs were removed. The chairs had been fastened with bolts and screws, but he had found that on the slightest loosening the bolt-heads flew off, from the continual percussions, and the screws very soon allowed vertical play from the yielding of the fibre of the wood. By Evans's rail we secured the rail without the intervention of the fibre of the wood. One inconvenience attending it was, the trouble of scraping away the earth to tighten the nuts when necessary; but this might be partially remedied by placing the bolts as often as possible in the transverse gutters for draining the road, by which at least one-half the bolts might be easily got at; and the difficulty of tightening the remaining bolts would be lessened, if, as he recommended, the timbers were left uncovered. He preferred thus giving a free circulation of air, and disliked burying the sleepers in ballast. The weight of Evans's rail was only 45 lbs. per yard, although quite strong enough, while that of the other with the necessary chair, was 100 lbs. The bevel in No. 2 rail might be given in the wood-bearing: in No. 1 it was arranged in the casting of the chair; this latter rail, from having its top and bottom sides alike, had this advantage, that when it began to wear it might be turned round, or even turned upside down, which was a very great advantage. He had for many years advocated wooden sleepers in preference to stone, from his experience on the Dublin and Kingstown Railway, where he found that the granite sleepers, the more massive they were the more injurious to the rails and carriages. These had all been taken up, and longitudinal wooden sleepers laid down, and the saving in expense of repairs would in a few years reimburse the outlay. The railway only costs now 50*l.* per mile per annum for repairs, notwithstanding the great traffic over it. The rails were the old 42 lb. rails, and, nevertheless, were still used, in consequence of the advantage gained by the continuous bearings. He recommended keeping Evans's rail to the gauge by light iron rods passed through holes in the rails, and secured by nuts: he thought these transverse ties should never be used as supports.

On Combustion of Coal, with a view to obtaining the greatest Effect, and preventing the Generation of Smoke. By William Fairbairn.

The author divided the subject into—1st. The present state of knowledge as to the combustion of fuel, particularly as regarded the boilers of steam-engines. 2nd. The relation and proportion of the furnace and boiler. 3rd. The dimensions and height of the chimney, and its proportion to the boiler and furnace. 4th. The working of the furnace, and the mode of obtaining the nearest approach to maximum effect.

In reference to the combustion of fuel, he observed, that our knowledge was limited; but, from the care of the fire being intrusted to persons of little knowledge or experience, much lamentable waste occurred, from rapid combustion and the overworking of boilers. Great loss also ensued from want of boiler space, and by working the engines to double what was intended by the maker, thus rendering it necessary to force the fires to extract from the boilers sufficient steam. 2nd. With reference to the relation and proportion of the furnace and boiler. It was observed, that in our present boiler furnaces, the ratio of fire-bar to flue surface is about 1 to 11, or 100 square inches of grate-bar to 8 square feet of flue. But the Cornish engines have much more flue surface, and other engines much less. He had always endeavoured to give 12·5 feet of flue surface to 100 square inches of grate, or 1 to 18 nearly; and in marine boilers it is about 1 to 14·28. He found that, in a well-proportioned boiler of 1 to 14, a pound of good coal evaporated 7·46 lbs. of water, which was the maximum effect produced in this district. By increasing the flue surface, the system of slow combustion was established, and the evaporative power increased.

Mr. Fairbairn then read a table of experimental observations respecting ten steam-engines working in Manchester; the mean results were, power of engine nominally 44·5 horses, working up to 57·3 horses; area of grate, 48·2 square feet; area of flue surface, 542·5 square feet; ratio of grate to flue surface, 1 to 11; height of chimney, 117 feet; coal consumed in pounds per horse per hour, 10·5 (the table contained the indicator diagrams of the several engines). Thus it appeared that the ratio of furnaces to flues was of great importance. He had found that a marine boiler, with 100 square inches of grate bar, and 10 square feet of flue (exclusive of the bottom surface of the flue), and having 40 feet of flue length from fire to funnel, generated an ample supply of steam without forcing the fires. He also directed attention to a table in which six different kinds of boilers were shown, with the ratio between their heating or recipient surfaces and their cubic contents, from which it appeared, that the best boiler in these conditions was the cylindrical boiler with internal tubular flues. 2nd. The cylindrical boiler with internal flue. 3rd. Waggon boiler with internal flue. 4th. Waggon boiler without flue. 5th. Cylindrical boiler without flue; and last, the old haycock, or circular boiler.

3rd division. There is no certain rule respecting the dimensions of chimneys. In the Manchester district the custom was to place the chimney in some prominent position at a distance from the furnace, requiring underground flues of sometimes 400 feet long. This custom was injurious; as, from damp, &c., the draft was diminished, and it was necessary to have recourse to descending flues, which were contrary to just principles. The chimneys should be placed near the boilers when practicable;

and descending, and even horizontal flues, avoided as much as possible. With respect to the height of chimneys, we can hardly err in going too high, as the draft is as the height of the column of rarefied air; we thus can always obtain a plentiful supply of air to our fires. Some persons consider that the chimney should be widest at the top, to allow of the free passage of the rarefied air; but this was inconvenient in building, and he had not found it to give any advantage. In general, chimneys, in consequence of their great height, were built broad at the base and tapered towards the top, both externally and internally. This was also disadvantageous, as it throttled the draft. He found parallel flues, well-plastered, to be the best in every respect.

4th. With respect to the best methods of working the furnace, and obtaining the nearest approach to maximum effect, he had endeavoured to obtain, by direct experiment, the comparative consumption of coal, in Mr. Williams's plan, and the common practice. For this purpose he got Messrs. Hetherington and Co. to attach Mr. Williams's apparatus to their boiler in January last. This boiler supplied a 12-horse engine, and gave motion to machinery, tools, &c. During the experiment great care was taken to keep the work steady, and to regulate the firing, so as to give equal chances to each system. The result was slightly favourable to the old plan; but as there was reason to doubt its accuracy, the trial was repeated, when the results showed a saving of $\frac{117}{1000}$ in favour of the new system; or, by taking the average of all the experiments, the consumption on the new system was to that on the old as 292 to 300, or about 4 per cent. in favour of Mr. Williams's plan on the score of expenditure; while, on the point of its abating the nuisance of smoke, no doubt could arise.

On testing the Efficacy of the several Plans for abating the Nuisances from Smoke by effecting a more perfect Combustion. By C. W. WILLIAMS.

The usual mode of measuring combustion, he stated, was the ascertaining the quantity of water evaporated by each pound of fuel; yet this was the most fallacious of all tests, as from the varieties of boilers and the differences in their evaporative powers, their results were so at variance as not to be depended on. As regards the nuisance, the appearance of the chimney was a sufficient test: but when the question of economy was considered, a very different class of tests was required. Economy has reference to two distinct objects; namely, 1st, the obtaining the largest quantity of steam from a pound of coal; and 2nd, obtaining such quantity of steam in the shortest time. Thus economy has reference to fuel and to time; and it is important to observe, that the economy in the one is inversely as that of the other. Mr. Williams observed that economy in fuel, that is, obtaining the highest evaporative effect from each pound of coal, may be the ruin of the manufacturer; for if his engine requires a given weight of water to be converted into steam within a given time, if such quantity be not supplied the engine cannot do the required work. Mr. Williams referred to a variety of experiments made by himself, Mr. Parkes, Mr. Wickstead and others, showing that, by quick or slow combustion of coal, the quantity of water evaporated from the same boiler, and by the same furnace, varied considerably. This view of the question showed the necessity for distinguishing between the boiler and the furnaces; for though heat may be generated by a more perfect combustion in the furnace, yet, if the boiler is not equal to its absorption, the remainder will pass by the chimney and be lost; and Mr. Williams showed that exactly in the degree in which the heat was increased in the flues, was the waste heat also increased by the chimney. If then we look to the quantity of steam generated, we must refer to the boiler and its evaporative faculty; but if we look to the quantity of heat generated, we must refer to the furnace and flues. Mr. Williams then urged the importance, in testing any plan of combustion, of looking as well to the temperature of the escaping products by the chimney as to the quantity of steam generated in the boiler. The true test then is to be found in ascertaining the quantity of heat generated rather than of the steam produced; and without any reference whatever to the boiler. Mr. Williams referred to an ingenious and practical mode adopted by Mr. Houldsworth for estimating the temperature in the flues of a boiler.

Mr. J. Juckes exhibited and explained the model of his furnace for consuming smoke and economizing fuel. His grate bars form an endless chain passing over rollers, and moving forward about an inch per minute. The coals employed are common siftings or screenings, heaped in a hopper (which may be made to hold fuel for an unlimited time) outside the furnace door, which slides upwards. This door is left a little open, and the small coal is spread uniformly over the bars by passing under it. The air is constantly supplied through the bars, directly to the fuel while burning; and in this way perfect combustion is obtained. The bars being slowly moved on, carry the ashes to the ash-pit, which lies at the back of the grate. Clinkers are prevented from encrusting the bars by their passing under a gauge, which effectually removes them; and the burning away of the bars is prevented by their constant motion from the hottest place. The bars or chains, with their rollers and driving wheels, are fixed in a frame, which can be completely drawn out from under the boiler for the purpose of removing injured bars, or any other purpose.

On an Indicator of Speed of Steam Vessels. By J. S. Russell, *F.R.S.E.*

This was a simple application of a well-known principle; it was not novel, but he had applied it successfully, although others had failed. It depended on the hydrodynamical fact, that if a reservoir be filled with water to a certain height, the water will flow from an orifice at the bottom with a velocity proportionate to the height; and conversely, if the reservoir be empty and this orifice turned towards a stream, the water will rise in the reservoir to the height proportionate to the velocity. His plan was to pass a tube through the bow of the vessel, and carry it along the flooring to the centre of gravity of the vessel, where it terminated in a vertical glass tube, exhibiting the weight of water within. To this tube there was attached a moveable scale, the zero of which being placed on a level with the point at which the water stood when the vessel was at rest, the rise of the water in the tube when the vessel was set in motion exhibited the velocity at which the vessel was passing through the water. He had tested the accuracy of this indicator by sailing vessels at least twenty times, over a measured distance of 15⅜ miles, and comparing his tube with Massey's log, the common log, calculations from the number of strokes, &c., he found it more accurate than any. By putting a stopcock in the pipe just under the glass tube, he was enabled to regulate the orifice until the greatest regularity was obtained, and he could now depend on the indications within the twentieth of a mile. From these experiments he had constructed a scale, which he exhibited, and of which the following is an extract; the first column exhibiting the speed in miles per hour, and the second the height of the water in the tube above the zero line, expressed in feet:—

Miles per hour.	Feet on the scale.
15	7·5625
13	5·6800
11	4·067
9	2·722
7	1·647
5	0·84
3	0·3025
1	0·0336

On certain Plans for Ventilation recently adopted in Glasgow. By Robert Chambers, *F.R.S.E.*

The plans described in this paper were suggested by Mr. Joseph Fleming, surgeon, Anderston (a suburb of Glasgow). Mr. Fleming wrote a pamphlet on the subject in 1833. The object of Mr. Chambers's paper was to give an account, illustrated by drawings, of the various modes in which Mr. Fleming's principle had been applied since that period.

The principle is that which has been so well exemplified in other quarters—fire-draught.

Mr. Chambers first described a large house connected with a mill in Anderston, which usually contains about five hundred inhabitants of the humblest class, and which used to be a constant focus of pestilential disease in consequence of the filthy habits and poverty of the people, united with deficient ventilation. There were at one time fifty-seven persons ill at one time with fever in this house, and five had been seen ill in one room. At the end of 1832 a system of ventilation had been established, and since then fever has all but disappeared from the house, although, during five of the years which have elapsed since 1832, there were above fifty-five thousand cases in Glasgow. The plan here adopted is extremely simple, and might be easily introduced in any place where there is a furnace or active flue not far off. A small tube is led from an upper corner of each room containing a family. It joins a main tube in the adjacent gallery. The main tubes of the various floors, four in number, join in one vertical tube descending along the gable of the house, which enters by a channel of brick-work the flue of the mill. Thus a constant draught is kept up in every room of the house, fresh air being liberally enough supplied by chinks in the doors and windows.

A description, illustrated by drawings, was then given of the application of the same plan to the Princess Royal, a steamer recently launched on the Clyde. In this case, each berth in the vessel has a tube for drawing off the used air. These tubes join main ones, which unite in one which supplies a stove upon deck. The exchange of air thus produced in the necessarily small sleeping rooms of the vessel has been productive of a degree of comfort which is felt by every passenger.

The paper also described a washing apparatus for infected clothes, and an hospital bed for fever patients, in both of which cases bystanders are secured from the volatile matter of infection by the drawing off of that matter through tubes towards a fire-place or grate. Finally, there were illustrated descriptions of an application of the plan to the Glasgow Fever Hospital.

Abstract of a Description of a Self-acting Waste Weir and Scouring Sluice. By J. F. Bateman.

The mode of construction here suggested is one for obviating the injurious effects and inconveniences of fixed weirs in rivers, arising principally from the operations of floods in filling or silting up the channels of navigable or other rivers, and in inundating the adjacent country where it is elevated but little above the surface of the water.

The plan proposed is to hang two gates vertically across the stream, one above the other, so adjusted upon horizontal axes that in an ordinary state of the river the pressure of the water will be sufficient to maintain the gates in their vertical position; but that as the water rises in a flood, the pressure will so act upon the unequal portions or leaves of the gates, as to open them, by pressing outwards the upper part or leaf of the upper gate, and the lower leaf of the lower gate, thus opening, in addition to the top, two passages for the escape of the water, a space between the gates and an opening at the very bottom of the weir, which will act as a scouring sluice, and allow all deposit of silt or other matter to be carried away.

For example, suppose a waste weir twenty feet in length and five feet deep, consisting of two gates, the upper one three feet, and the lower one two feet in depth.

If these gates are so hung that in an ordinary state of a river the pressure upon the lower leaf of the upper gate and the upper leaf of the lower gate exceed the weight upon the other two leaves 300 lbs., that will be the closing force exerted in keeping the gates in their vertical position. In this arrangement the area of the leaves against which the closing force is exerted will be only about one-half of the area of the opening leaves, so that in a rise of water above the top of the weir, *two* lbs. are added to the opening force for *one* to the closing force. A foot of rise would add a pressure upon the whole weir of 1250 lbs., say 1200 lbs., 800 of which would be exerted as an opening and 400 as a closing pressure, being a difference of 400 lbs. in favour of the opening force. As this is 100 lbs. more than the original closing pressure of 300 lbs., the gates would open with less than a flood of one foot in height.

By making half the top of the gate rise higher than the level of ordinary water, a flood of under six inches would open the gates, and if so constructed, a partial opening, by which the top of the weir should be depressed only about four inches, the surface in a flood would be but two inches higher than the ordinary level, while the quantity of water discharged over the top and by the openings below, would be equal to a flood over a fixed weir of the same length of upwards of three feet in depth.

The sills against which the gates are made to fit, may be regulated so as to discharge the largest flood of a river without allowing the gates to open further than necessary, or in rivers where it is expedient to remove every obstruction to the current, to prevent inundation, or to pass very large bodies of water, the sills may be so arranged that the gates should assume a nearly horizontal position, opposing little more resistance to the water than the thickness of the material of which the gates may be composed.

On a New Steam-engine worked with three kinds of Pressure, viz. Action of high-pressure Steam, the Expansion of Steam, and the Atmospheric Pressure caused by its Condensation. By Mr. SHAW.

The description was illustrated by models and drawings. The lower part of the piston fits the cylinder and is steam-tight; the upper part or plunger, in the form of a hollow cylinder, is longer than the cylinder, and passes through a stuffing-box in its cover. The piston rod rises through the middle of the plunger, and is connected with the parallel motion; the valve is a modification of the single slide, the upper passage leading to the upper part of the cylinder, the middle to the lower part of the cylinder, and the lowest to the condenser. When the piston is descending, the valve admits steam to the annular space between the plunger and cylinder, when, the middle and lower passages being open, the direct pressure of the atmosphere upon the plunger, the high-pressure steam upon the annulus, and an additional pressure of one atmosphere upon the annulus from the vacuum beneath, concur to produce the down stroke; during this the steam is cut off from the cylinder, and the communication between the cylinder and condenser is shut; the steam, which before occupied the annulus, now acts against the plunger for the ascending stroke with the whole force of expansion, the annular surface of the piston being then passive.

A model and drawings of Mr. Shaw's hydraulic engine were also exhibited. In this engine, the want of elasticity in water, which formed a great objection to the application of that fluid to a piston, is supplied by the elasticity of air in a chamber communicating with the cylinder; it is well fitted for situations where the fall is great, but the supply too small or the space too limited for the use of a water-wheel, as in mines.

On a dry Gas-Meter. By Mr. CLEGG.

It acted on the principle of the differential thermometer, in which a difference of temperature between two bulbs partly filled with alcohol, was shown by the rising of the spirit in one and depression in the other. He had taken advantage of this principle by suspending two little glass vessels, partly filled with alcohol and connected by a tube, and by passing the gas over heaters it warmed one of these bulbs, and the spirit was driven into the other, which, becoming the heaviest, swung to the bottom of the arc in which the vessels vibrate; here it in its turn becoming warm, was emptied of its spirit, and thus becoming lightest, was in turn displaced; the continuance of these oscillations marked the flow of gas, and being registered by the usual train of wheel-work, the number of vibrations had been proved, by many careful experiments at all seasons of the year, to afford an accurate measure of the quantity of gas.

On the Thames Tunnel in its completed Condition. By Sir M. I. BRUNEL.

A representation of the machinery, designated the shield, by the agency of which the excavation had been effected and the structure simultaneously made up, was exhibited.

The shield, standing as it does between the ground and the constructed portion, may be considered as the chief agent, on the functions of which everything essentially depends.

The Thames Tunnel, he remarked, including the shafts at each end, is a quarter of a mile in length, its breadth is 37 feet 6 inches to 38 feet, and the height of the excavation 22 feet 6 inches; presenting therefore a sectional area of 850 feet.

The thickness of the ground over the structure, or over the shield, is 14 feet at the deepest part, and the head of water at the highest tides is nearly 36 feet, and only 12 at the lowest tides.

The shield consists of 12 frames wholly independent of each other: each frame is divided in three stories, thus 36 cells are provided for as many miners in front of the excavation, and for a proportionate number of bricklayers who are to form the structure at the back. The exterior part of the shield at the sides and top is covered with cast-iron sliding plates; and the front, viz. the whole face of the excavation, is covered with small boards (42 in the face of each *cell*), consequently 540 upon the whole: these are kept pressed against the ground by means of 1080 small screws, which admit of being abutted against the front of each frame.

The frames at the back are made to bear against the structure by the interposition and agency of powerful abutment screws resting against capacious plates.

The frames stand upon legs resting upon capacious shoes; and as an auxiliary way, the frames have arms by which each frame may relieve itself upon its neighbour.

The body of the tunnel consists of a substantial square brick structure with two arches. This structure fills the excavated area, and in this way all the mass of the surrounding ground remains undisturbed.

The greatest attention, therefore, is to keep and to maintain the abutting screws in their respective functions, not only to support the surrounding pressure, but to prevent the ground becoming soft for want of resistance.

Sir M. I. Brunel having so far explained his plan of proceeding, concluded by declaring *that the tunnel was accomplished in the manner represented in the drawing and model exhibited.*

On the Use of Béton and Concrete in constructing Breakwaters. By Prof. Vignoles.

The use of béton had greatly increased in France of late, especially in marine works; it was similar to concrete, but not exactly identical with it. Béton, like concrete, was composed of lime mixed with broken stones, gravel and sand; but it required hydraulic lime, while concrete in this country was frequently made of common lime when not to be exposed to the action of water. Béton was first introduced in France by Belidor, and lately much advocated by Vicat; since then it had been much used, and he considered that attention was due to the use that had lately been made of it in the Port of Algiers by M. Poirel, the engineer of that harbour.

On the Construction of a New Rope employed as a Core in the formation of the Patent Stoppers, a Substitute for Corks and Bungs. By William Brockedon, *F.R.S., &c.*

The patent substitute for corks and bungs is obtained by employing an elastic core of fibrous materials of the form required, and covering it with a thin sheet of India rubber. By this combination the tendency of India rubber to harden in these high latitudes is overcome by the elasticity of the fibrous core, whilst the core is preserved elastic by the impermeable quality of the India rubber with which it is covered. But the matter which was more immediately offered to the attention of the Section, is the important improvement which the invention has received by the adoption of cotton cores, mechanically constructed, as a substitute for the felted wool which was originally used; by this improvement greater strength is obtained to resist the hold taken by the entanglement of the cork-screw, and greater precision in roundness and accuracy in size; with these come a train of consequent advantages and facilities in the processes of manufacture, which will now be described. But a very short sketch of the invention itself, prior to these improvements, is necessary.

The idea of such a substitute for cork for stopping bottles and other vessels was suggested to the patentee by Humboldt's researches in South America, wherein he states that the Indians were accustomed to employ plugs made of India rubber for stopping their vessels. The then recent importation of India rubber in large quantities by Messrs. Enderby, and the price at which it could be obtained, suggested to the patentee the idea, that if he could cut cores out of the solid blocks he should obtain a valuable stopper for decanters; he knew enough of India rubber to be certain that in the pure material there was nothing to affect the flavour or odour of common drinks, wine, beer, spirits, &c. The machine was constructed which made the cores, but the first cold weather that set in so hardened them as stoppers in bottles, that he might as well have attempted to withdraw ivory, of the same form, from the bottles: he then directed his attention to the formation of an elastic core, and found felted wool the fittest for his purpose; his first experiments with these were made at the end of the year 1834, and he carried them on for nearly five years before he secured his patents, and it was only when he was seeking to manufacture so cheaply as to compete with the price of common corks that he took out patents. Like most inventions, its progress is a history, but the patentee only described enough to make his improvements understood.

For the attainment of his object he persevered through evil report and good report, and struggled with ignorance and prejudice; the prize was a great one to attain, for a million gross of corks are consumed annually in Great Britain for the bottling of common drinks, and at least £250,000 paid for them. The inventor felt that he was possessed of a better and fitter instrument for closing vessels than such imperfect material as cork could furnish, for his stoppers are air-tight and firm, and will neither fracture nor decay, nor be destroyed by insects; he gave his constant attention to its improvement, and he is now finding his reward in a demand from wine-merchants and others far exceeding the present means of supply; the manufacturers now employ from sixty to eighty men and children, and they will soon be enabled, by their arrangements, to supply the stoppers to any extent, for the patentee has entered into a connexion with Charles Mackintosh and Co. in Manchester, and their means and energies to carry out any manufacture which they undertake require no comment.

When that engagement began the only practicable plan was to form the core of the stoppers of coarse wool yarn, which in a long hank of fifty or sixty feet, and in quantity sufficient for the size required, was fastened at one end and twisted at the other, until it formed a round rope; this was lapped with flax twine to preserve its cylindrical form, until it had, by being beaten in fulling stock for some hours, become felted into a solid rope; the twine was then unwound, and the rope subjected to further fulling until it was felted to the hardness and size required: this rope was manufactured for the patentee by Messrs. Whitehead of Saddleworth.

The rope, when dry, was lubricated with India rubber dissolved in rectified naphtha, and then cut into convenient lengths of about three feet; these were covered with a sheet of India rubber; when they were hard and firm they were again cut into the lengths required for the stoppers; the ends were then charged with some of the same solution on a marble slab, and when dried off to a proper state of adhesiveness, sheet rubber was attached to the ends also; the excess was then trimmed off and the stopper completed. But there was great difficulty in obtaining the wool-rope round, and of an equal or required size throughout; the fulling-stocks produced an imperfect article; nor was it always clean; and dirt was charged as wool; and when inferior material was used, too often the case, the felting, one great means of holding the cork-screw, sometimes failed; cotton was resorted to for the core, and after many attempts and many failures, a core of cotton was combined, which the patentee then described.

He takes a sufficient quantity of the slivers or rovings of cotton to form three strands of the patent rope; these are gathered and drawn through three different fixed holes or nozzles, around which bobbins, charged with strong flax thread, revolve, and lap the threads round the strands as they are drawn out, with about eight turns to the inch; the three strands so lapped are then brought together through another fixed nozzle of the size required for the stopper; around this revolves another bobbin charged with a lighter thread, which binds the rope as it is drawn through and preserves its cylindrical form, by lapping it with twenty or more turns to the inch; this being regulated by the different speed of the bobbins and that of the cylinder to which the rope is fastened, and which draws it through the machine. This machine will make about ten or twelve thousand stoppers per day, and is further capable, if required, of covering the rope with a sheet of India rubber before being removed from the machine.

This rope so prepared exposes on its surface more than one-third of the lapping of the strands of the strong flax thread, and when lubricated and the rubber attached to it, each turn becomes a loop, which cannot be torn from the rubber on the surface without destroying it; and as each strand has eight turns to the inch, and the stopper is three-fourths or seven-eighths long, there are no less than eighteen or twenty such loops in each stopper; and it is almost impossible to insert a cork-screw which will not become entangled in several of these; and the effect is not merely that a greater hold-fast is obtained, but that the strain being oblique towards the centre, the stopper is actually diminished in diameter by the force applied, and easily withdrawn, though its resistance to pressure from within remains the same as to the felted stopper. It is a peculiar property of the patent stopper, that India rubber will not slide on a smooth dry surface, whilst it slides easily on a wet one; therefore, in application, the stopper, which cannot be forced in dry, when wet slides with perfect ease into the mouth of the bottle under the pressure of the thumb, and no more force than this is required in stopping effectually bottled drinks. As rubber has the property of taking up about one per cent. of water, the thin film of moisture between the surface of the stopper, when wetted for application in the liquor to be bottled, and the mouth of the bottle, is soon absorbed, the surfaces come into actual contact, and the stopper cannot be readily drawn out, for its resistance to sliding is so great, that in a few hours the power of a cork-screw is required to draw it: this quality to resist sliding renders unnecessary any wiring or tying of the stoppers, even for effervescing liquors. The advantage therefore of the cotton core, as the stopper is now constructed, is, that whilst it holds with equal firmness, it is more easily drawn by its diminishing under the force of the screw. The roundness obtained by the new core thus made by machinery, now enables the patentee to form the cylindrical sheet, on the surface of the rope itself, without a seam. This again enables him to subject the stoppers to a heat of 150° without bursting; and this heat, whilst it perfectly purifies the stopper, by driving off the naphtha, gives the patentee also the opportunity, of which he avails himself, of putting on the last end of the stopper under this temperature; thus the expanded air at this degree of heat is all that the stopper contains when hermetically closed; as it cools, the atmospheric pressure compels a closer contact of the covering, and no temperature in future purification, or of climate, can affect them.

Notice of Mr. Prosser's Method of making Earthenware or Porcelain from dry Powder of Clay compressed. By Sir J. Robison, *F.R.S.E.*

The advantage was, that no warping or alteration of shape (excepting a little shrinkage) took place in the burning. From the accuracy with which articles formed by compression retained the shape of the mould, they could be fitted together very easily and smoothly. Sir J. Robison showed a piece of tesselated pavement made of these tiles, which, although laid together without cement, was perfectly smooth on the surface. He wished particularly to introduce to their notice a roofing-tile of a construction novel in this country: from the peculiar manner in which these tiles united by imbrication, a little Roman cement rendered them perfectly water-tight; and from their not being absorbent, they were not liable to exfoliate, and would, therefore, be almost imperishable. The old form of tile weighs about 105 lbs. per square yard, while this only weighs 58 lbs. They were manufactured at Stoke-upon-Trent, by Minten and Co.

M. Bergeron, through Prof. Vignoles, explained his method of instantaneously casting loose the locomotive engine from the carriages. It is effected by a contrivance attached to the brake, and worked when necessary by the brakesman. The engine was attached by a large chain, the last link of which was held, not by a hook, but by a bar which could be shot back or forward like a common door-bolt or lock; by drawing this back out of its staple, it was of course drawn out of the chain, which being cast loose, all connexion between engines and carriages was sundered.

Mr. Taylor exhibited some specimens of a new kind of drawing-paper, in which the novelty lay in the cement, by which the paper was mounted on a species of linen or canvas. The advantages offered were, equality of texture, neatness in junctures, and uniformity in expansion and contraction in both directions.

Mr. L. Schwabe explained his method of spinning glass, and brought forward specimens of the glass thread, and also of the cloth woven; he showed the spinning machine with which this was effected, and also displayed many other filamentous substances from which he had succeeded in fabricating cloths—Assam silk, fibres of the Pinna, &c.

On Wigston's Self-Acting Railway Signals. By James Thomson, *C.E.*

On a New Steam-Boiler. By Mr. J. SMITH.

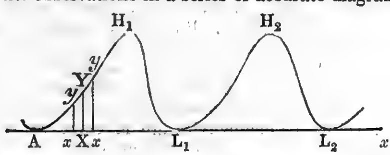
A new and improved safety-lamp was sent for exhibition by Dr. Clanny, but by some error was mislaid till the meeting had separated.

ADDENDUM TO MATHEMATICS AND PHYSICS.

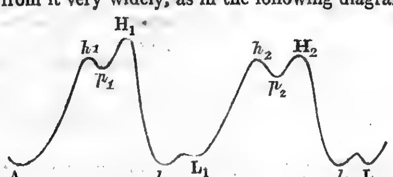
On the Abnormal Tides of the Firth of Forth. By Mr. SCOTT RUSSELL.

HE had on a former occasion presented to the section the result of tidal observations on the Firth of Forth. These observations brought to light the existence of certain very remarkable tidal phænomena, proving the occurrence on some parts of that Firth, of double tides, or rather perhaps of quadruple tides, being four high waters in each day, instead of only two, as usual. When this subject was formerly discussed, Mr. Russell had attributed these anomalies to the great southern tide-wave entering the Firth at a different period from the great northern tide-wave, to which the periods of high and low water on the east coast of Britain are principally due. But other explanations had also been suggested in quarters so high as to entitle them to great respect.

For the purpose of settling this question, and, if possible, reducing these anomalous tides to some law, Mr. Russell had recently instituted a second series of observations on the tides of the Firth of Forth, conducted under very careful observers, the height of the tide being observed simultaneously by different observers, at the different stations, who recorded their observations every five minutes, and continued them unceasingly night and day. They had only as yet extended over a few weeks, but already there had come out of them results of a decided character, so as to set at rest the question of the origin of these tides, and to illustrate some curious points in the history of littoral tides. The tides already observed had, he thought, proved the accuracy of the theory he had formerly advanced on this subject. But it would still be desirable that these observations should be continued and extended. He then proceeded to exhibit the results of the observations in a series of accurate diagrams of the tides.



This diagram represents the two successive tides of a day, as usually observed on the coast of Britain. The line A x, being on the level of a given low water, is divided into equal portions, representing hours, minutes, &c., and lines perpendicular to A x, namely $x y$, X Y, $x y$, proportioned to the successive heights, so that H_1 is high water in the morning, H_2 is high water in the evening, L_1 and L_2 being the succeeding low waters. In this case the tides exhibit the usual form, and at the mouth of the Firth they are in tolerably close accordance with it. In the upper parts of the Firth they deviate from it very widely, as in the following diagram:—



These diagrams exhibit the following changes produced in the tidal course. First of all, we have the tide rising to high water at h_1, falling to a low water at p_1, rising to a second high water at H_1, with a very small low water at p_1, between them;

then we have at the low waters, L_1 and L_2 an elevation, and two depressions of an equally anomalous kind. It also appears that the range or rise and fall of tide *increases* as it travels, instead of diminishing. As these observations were reduced to the same level, it further appeared that the high water-mark at Stirling was higher than high water-mark at Leith by ten to fifteen feet. These diagrams, being compared with the plan of the Firth, serve to show the effect of form of channel on the wave.

Mr. Russell then proceeded to his explanation of these anomalous phænomena. He referred to the very great progress which had recently been made in our knowledge of the laws and phænomena of the tides. Mr. Lubbock had succeeded in deriving all the principal phænomena of the tides most accurately from the equilibrium theory of Bernoulli; Mr. Whewell had constructed, from the discussion of a multitude of simultaneous observations, empirical formulæ by which the progress of the tide-wave had been represented with a high degree of accuracy, and the theory of the tides had attained a high degree of perfection. But there still remained a multitude of anomalous facts for which received theory could not account, and amongst this number were these refractory double tides. Mr. Russell's theory is this: that the tidal wave is a compound wave of the first order; that its phænomena are correctly represented by the wave which he has called the great wave of translation; that this tide's motion along our shores is correctly represented by this type. Now the wave of translation in ascending a channel whose breadth and depth vary, exhibits the following phænomena:—First, a velocity varying as the square root of the depth of the channel; second, an increase of height with the diminution in breadth and in depth of the channel; third, a dislocation of the centre, which is transferred forwards in the direction of transmission according to a simple and well-established law. And these changes exactly correspond to the epoch of high water, the law of rise and fall, and the exaggeration of range in the Firth of Forth.

Of the four successive high waters of each day, he has ascertained the latter tide of each pair to be *normal*, and the earlier the abnormal tide. It is well known that the tide which brings high water to the east coast of Britain, as far at least as the Thames, comes round the north of Britain, and bringing high water to Aberdeen about noon, Leith about two, and London about twelve o'clock at spring tides. This wave is the same which brings to the whole of the Firth of Forth the normal high water, and of the double tides the *later* of each pair corresponds exactly with the time as predicted by the excellent tables of Mr. Lubbock. But if we conceive the great southern wave, which comes up the English Channel, to continue its course northwards in the opposite direction to the normal tide, it would enter the Forth at ten o'clock, being two hours previous to the normal tide, due to the succeeding transit of the moon, or the tide E at Leith will consist of the normal tide due to transit B and the abnormal tide due to transit A. Now the double tides are in exact correspondence with these conditions, the abnormal tide being generally about two hours in advance of the normal tide.

But the circumstance which most perfectly fixes the identity of the tides, as due to the successive transits A and B, is found in the character of their diurnal irregularities. If the theory adduced be correct, the normal and the abnormal tides will have opposite inequalities. The observations made exactly correspond with this view; and, so far as they go, establish the soundness of the view which has been adduced for their explanation.

Another remarkable confirmation of this view is derived from the examination of the diurnal inequality of places on opposite coasts at the mouth of the Forth, the diurnal inequality on the south side being that due to the northern or normal tide, and that on the northern coast being that due to the abnormal or southern tide-wave. At Leith both waves meet, and the inequalities nearly neutralize each other, and give only the difference of the inequalities. By the same process, using the wave of translation as a type of the tide-wave, some further anomalies of the tide-wave were explained, and the absence of all tide frequently observed on opposite and adjacent coasts, as at the north of Scotland and the opposite coast of Norway. These are explained by the fact that the lateral transmission of the wave is slower than its transmission in the direction of its amplitude, so that the rapid advancement of one portion of the wave gives divergence to the branches, which thus separate and leave an interval of diminished tide or of no tide.

INDEX I.

TO

REPORTS ON THE STATE OF SCIENCE.

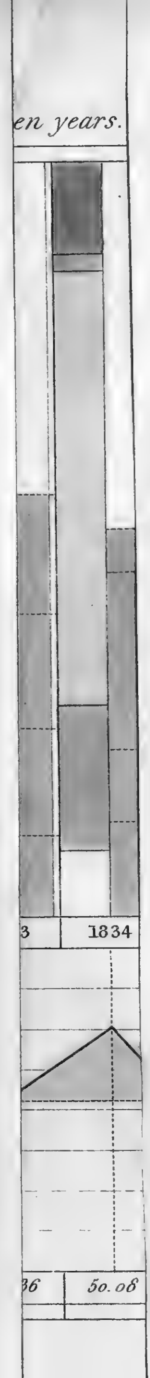
INDEX II.

TO

MISCELLANEOUS COMMUNICATIONS TO THE SECTIONS.

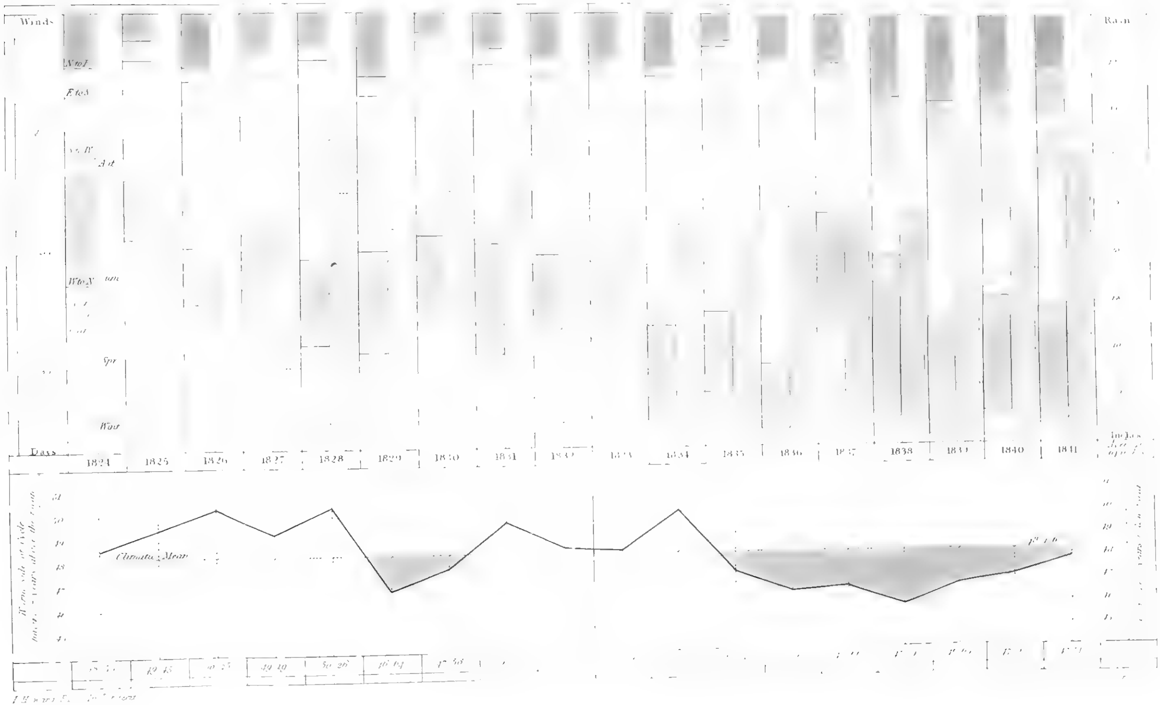
THE END.

PRINTED BY RICHARD AND JOHN E. TAYLOR, RED LION COURT, FLEET STREET.

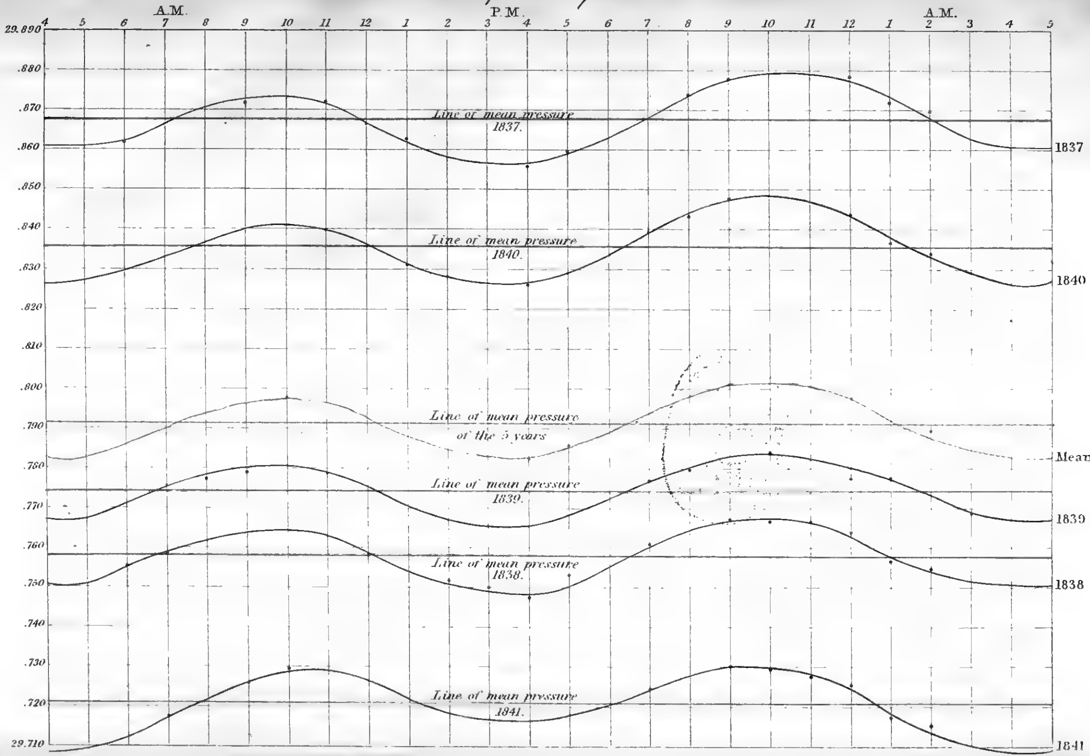


en years.
3
1834
36
50.08

Chart of the Winds, Rain and Mean Temperature over a Cycle of Eighteen years. Observed at Ackworth School, Yorkshire N. Lat. 53° 30′



Shewing the mean hourly pressure for each of the years 1837_38_39_40_41; and the mean of the 5 years reduced to 32°.



J.W. Lowry sculp.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Published Reports of Proceedings at the Meetings of the Association may be obtained by *Members* only, on application to the under-mentioned Local Treasurers, or Agents appointed by them, at the following prices:—

	TREASURER.	DEPOT FOR THE REPORTS.
LONDON	John Taylor, Esq. 2 Duke Street, Adelphi.	Messrs. R. and J. E. Taylor's Printing Office, Red Lion Court, Fleet Street.

	LOCAL TREASURERS.	DEPOTS.
OXFORD	Dr. Daubeny	Ashmolean Museum, Mr. Kirkland.
CAMBRIDGE	Rev. Professor Henslow	House of the Philosophical Society.
DUBLIN	Dr. Orpen	13 South Frederick Street.
EDINBURGH	Charles Forbes, Esq.	Apartments of the Royal Society.
GLASGOW	Charles Forbes, Esq.	Union Bank.
YORK	William Gray, Jun., Esq.	Yorkshire Museum.
BRISTOL	William Sanders, Esq.	Philosophical Institution, Park Street.
LIVERPOOL	Samuel Turner, Esq.	Bank of England Branch Bank.
MANCHESTER	Rev. John James Tayler	Mr. James Orme, Lit. and Phil. Society, Chapel Yard, 9 Cheapside, King St.
BIRMINGHAM	James Russell, Esq.	Philosophical Institution.
NEWCASTLE-ON-TYNE	William Hutton, Esq.	Natural History Society.
PLYMOUTH	Henry Woollcombe, Esq.	Athenæum.

PROCEEDINGS OF THE FIRST AND SECOND MEETINGS, at York and Oxford, 1831 and 1832, 10*s*.

CONTENTS:—Prof. Airy, on the Progress of Astronomy;—J. W. Lubbock, Esq., on the Tides;—Prof. Forbes, on the Present State of Meteorology;—Prof. Powell, on the Present State of the Science of Radiant Heat;—Prof. Cumming, on Thermo-Electricity;—Sir David Brewster, on the Progress of Optics;—Rev. W. Whewell, on the Present State of Mineralogy;—Rev. W. D. Conybeare, on the Recent Progress and Present State of Geology;—Dr. Pritchard's Review of Philological and Physical Researches.

Together with Papers on Mathematics, Optics, Acoustics, Magnetism, Electricity, Chemistry, Meteorology, Geography, Geology, Zoology, Anatomy, Physiology, Botany, and the Arts; and an Exposition of the Object and Plan of the Association, &c.

PROCEEDINGS OF THE THIRD MEETING, at Cambridge, 1833, 8*s*.

CONTENTS:—Proceedings of the Meeting;—Mr. John Taylor, on Mineral Veins;—Dr. Lindley, on the Philosophy of Botany;—Dr. Henry, on the Physiology of the Nervous System;—Mr. Peter Barlow, on the Strength of Materials;—Mr. S. H. Christie, on the Magnetism of the Earth;—Rev. J. Challis, on the Analytical Theory of Hydrostatics and Hydrodynamics;—Mr. George Rennie, on Hydraulics as a

Branch of Engineering, Part I.;—Rev. G. Peacock, on certain Branches of Analysis.

Together with Papers on Mathematics and Physics, Philosophical Instruments and Mechanical Arts, Natural History, Anatomy, Physiology, and History of Science.

PROCEEDINGS OF THE FOURTH MEETING, at Edinburgh, 1834, 10*s*.

CONTENTS:—Mr. H. D. Rogers, on the Geology of North America;—Dr. C. Henry, on the Laws of Contagion;—Prof. Clark, on Animal Physiology;—Rev. L. Jenyns, on Zoology; Rev. J. Challis, on Capillary Attraction;—Prof. Lloyd, on Physical Optics;—Mr. G. Rennie, on Hydraulics, Part II.

Together with the Transactions of the Sections, and Recommendations of the Association and its Committees.

PROCEEDINGS OF THE FIFTH MEETING, at Dublin, 1835, 9*s*.

CONTENTS:—Rev. W. Whewell, on the Recent Progress and Present Condition of the Mathematical Theories of Electricity, Magnetism, and Heat;—M. A. Quetelet, Aperçu de l'Etat actuel des Sciences Mathématiques chez les Belges;—Captain Edward Sabine, on the Phænomena of Terrestrial Magnetism.

Together with the Transactions of the Sections, Prof. Sir W. Hamilton's Address, and Recommendations of the Association and its Committees.

PROCEEDINGS OF THE SIXTH MEETING, at Bristol, 1836, 8*s*.

CONTENTS:—Prof. Daubeny, on the Present State of our Knowledge with respect to Mineral and Thermal Waters;—Major Edward Sabine, on the Direction and Intensity of the Terrestrial Magnetic Force in Scotland;—Mr. John Richardson, on North American Zoology;—Rev. J. Challis, on the Mathematical Theory of Fluids;—Mr. J. T. Mackay, a Comparative View of the more remarkable Plants which characterize the neighbourhood of Dublin and Edinburgh, and the South-west of Scotland, &c.;—Mr. J. T. Mackay, Comparative Geographical Notices of the more remarkable Plants which characterize Scotland and Ireland;—Report of the London Sub-Committee of the Medical Section on the Motions and Sounds of the Heart;—Second Report of the Dublin Sub-Committee on the Motions and Sounds of the Heart;—Report of the Dublin Committee on the Pathology of the Brain and Nervous System;—J. W. Lubbock, Esq., Account of the recent Discussions of Observations of the Tides;—Rev. Baden Powell, on determining the Refractive Indices for the Standard Rays of the Solar Spectrum in various media;—Dr. Hodgkin, on the Communication between the Arteries and Absorbents;—Prof. Phillips, Report of Experiments on Subterranean Temperature;—Prof. Hamilton, on the Validity of a Method recently proposed by George B. Jerrard, Esq., for Transforming and Resolving Equations of Elevated Degrees.

Together with the Transactions of the Sections, Prof. Daubeny's Address, and Recommendations of the Association and its Committees.

PROCEEDINGS OF THE SEVENTH MEETING, at Liverpool, 1837, 11*s*.

CONTENTS:—Major Edward Sabine, on the Variations of the Magnetic Intensity observed at different points of the Earth's Surface;—Rev. William Taylor, on the various modes of Printing for the Use of the Blind;—J. W. Lubbock, Esq., on the Discussions of Observations of the Tides which have been obtained by means of the grant of money which was placed at the disposal of the Author for that purpose at the last Meeting of the Association;—Prof. Thomas Thomson, on the Difference between the Composition of Cast Iron produced by the Cold and Hot Blast;—Rev. T. R. Robinson on the Determination of the Constant of Nutation by the Greenwich Observations, made as commanded by the British Association;—Robert Were Fox, Esq., Experiments on the Electricity of Metallic Veins, and the Temperature of Mines;—Provisional Report of the Committee of the Medical Section of the British

Association, appointed to investigate the Composition of Secretions, and the organs producing them;—Dr. G. O. Rees, Report from the Committee for Inquiring into the Analysis of the Glands, &c. of the Human Body;—Second Report of the London Sub-Committee of the British Association Medical Section, on the Motions and Sounds of the Heart;—Prof. Johnston, on the Present State of our Knowledge in regard to Dimorphous Bodies;—Col. Sykes, on the Statistics of the Four Collectorates of Dukhun, under the British Government;—Eaton Hodgkinson, Esq., on the relative Strength and other Mechanical Properties of Iron obtained from the Hot and Cold Blast;—William Fairbairn, Esq., on the Strength and other Properties of Iron obtained from the Hot and Cold Bast;—Sir John Robison, and John Scott Russell, Esq., Report of the Committee on Waves, appointed by the British Association at Bristol in 1836;—Note by Major Sabine, being an Appendix to his Report on the Variations of the Magnetic Intensity observed at different Points of the Earth's Surface;—James Yates, on the Growth of Plants under Glass, and without any free communication with the outward Air, on the Plan of Mr. N. J. Ward, of London.

Together with the Transactions of the Sections, Prof. Traill's Address, and Recommendations of the Association and its Committees.

PROCEEDINGS OF THE EIGHTH MEETING, at Newcastle, 1838, 10*s*.

CONTENTS:—Rev. W. Whewell, Account of a Level Line, measured from the Bristol Channel to the English Channel, by Mr. Bunt;—Report on the Discussions of Tides, prepared under the direction of the Rev. W. Whewell;—W. Snow Harris, Esq., Account of the Progress and State of the Meteorological Observations at Plymouth;—Major Edward Sabine, on the Magnetic Isoclinal and Isodynamic Lines in the British Islands;—D. Lardner, LL.D., on the Determination of the Mean Numerical Values of Railway Constants;—R. Mallet, Esq., First Report upon Experiments upon the Action of Sea and River Water upon Cast and Wrought Iron;—R. Mallet, Esq., on the Action of a Heat of 212° Fahr., when long continued, on Inorganic and Organic Substances.

Together with the Transactions of the Sections, Mr. Murchison's Address, and Recommendations of the Association and its Committees.

PROCEEDINGS OF THE NINTH MEETING, at Birmingham, 1839, 9*s*.

CONTENTS:—Rev. Baden Powell, Report on the Present State of our Knowledge of Refractive Indices, for the Standard Rays of the Solar Spectrum in different media;—Report on the Application of the Sum assigned for Tide Calculations to Mr. Whewell, in a Letter from T. G. Bunt, Esq.;—H. L. Pattinson, Esq., on some Galvanic Experiments to determine the Existence or Non-existence of Electrical Currents among Stratified Rocks, particularly those of the Mountain Limestone formation, constituting the Lead Measures of Alston Moor;—Sir David Brewster, Reports respecting the two series of Hourly Meteorological Observations kept in Scotland at the expense of the British Association;—Report on the subject of a series of Resolutions adopted by the British Association at their Meeting in August 1838, at Newcastle;—Richard Owen, Esq., Report on British Fossil Reptiles; Edward Forbes, Esq., Report on the Distribution of Pulmoniferous Mollusca in the British Isles;—W. Snow Harris, Esq., Third Report on the Progress of the Hourly Meteorological Register at the Plymouth Dockyard, Devonport.

Together with the Transactions of the Sections, Rev. W. Vernon Harcourt's Address, and Recommendations of the Association and its Committees.

PROCEEDINGS OF THE TENTH MEETING, at Glasgow, 1840, 10*s*.

CONTENTS:—Rev. Baden Powell, Report on the recent Progress of discovery relative to Radiant Heat, supplementary to a former Report on the same subject inserted in the first volume of the Reports of the British Association for the Advancement of Science;—James D. Forbes, Esq., Supplementary Report on Meteorology;—W. Snow Harris, Esq., Report on Professor Whewell's Anemometer, now in operation at Plymouth;—Report on "The Motions and Sounds of the Heart," by the

London Committee of the British Association, for 1839–40;—Professor Schönbein, an Account of Researches in Electro-Chemistry;—Robert Mallet, Esq., Second Report upon the Action of Air and Water, whether fresh or salt, clear or foul, and at various temperatures, upon Cast Iron, Wrought Iron, and Steel;—Robert Were Fox, Esq., Report on some Observations on Subterranean Temperature;—A. Follett Osler, Esq., Report on the Observations recorded during the years 1837, 1838, 1839 and 1840, by the Self-Registering Anemometer erected at the Philosophical Institution, Birmingham;—Sir David Brewster, Report respecting the two Series of Hourly Meteorological Observations kept at Inverness and Kingussie, at the expense of the British Association, from Nov. 1st, 1838, to Nov. 1st, 1839;—William Thompson, Esq., Report on the Fauna of Ireland: Div. *Vertebrata*;—Charles J. B. Williams, M.D., Report of Experiments on the Physiology of the Lungs and Air-Tubes;—Rev. J. S. Henslow, Report of the Committee appointed to try Experiments on the Preservation of Animal and Vegetable Substances.

Together with the Transactions of the Sections, Mr. Murchison and Major Edward Sabine's Address, and Recommendations of the Association and its Committees.

PROCEEDINGS OF THE ELEVENTH MEETING, at Plymouth, 1841, 9*s*.

Rev. Philip Kelland, on the Present State of our Theoretical and Experimental Knowledge of the Laws of Conduction of Heat;—G. L. Roupell, M.D., Report on Poisons;—Mr. Bunt, Report on Discussions of Bristol Tides, under the direction of the Rev. W. Whewell;—D. Ross, Report on the Discussion of Leith Tide Observations, under the direction of the Rev. W. Whewell;—W. S. Harris, Esq., upon the Working of Whewell's Anemometer at Plymouth during the past year;—Report of a Committee appointed for the purpose of superintending the scientific co-operation of the British Association in the system of Simultaneous Observations in Terrestrial Magnetism and Meteorology;—Reports of Committees appointed to provide Meteorological Instruments for the use of M. Agassiz and Mr. M'Cord;—Report of a Committee to superintend the Reduction of Meteorological Observations;—Report of a Committee for revising the Nomenclature of the Stars;—Report of a Committee for obtaining Instruments and Registers to record shocks of Earthquakes in Scotland and Ireland;—Report of the Committee for making Experiments on the Preservation of Vegetative Powers in Seeds;—Dr. Hodgkin, on Inquiries into the Races of Man;—Report of the Committee appointed to report how far the Desiderata in our knowledge of the Condition of the Upper Strata of the Atmosphere may be supplied by means of Ascents in Balloons or otherwise, to ascertain the probable Expense of such Experiments, and to draw up Directions for Observers in such circumstances;—Richard Owen, Esq., Report on British Fossil Reptiles;—Reports on the Determination of the Mean Value of Railway Constants;—Dionysius Lardner, LL.D., Second and concluding Report on the Determination of the Mean Value of Railway Constants;—Edward Woods, Report on Railway Constants;—Report of a Committee on the Construction of a Constant Indicator for Steam-Engines.

Together with the Transactions of the Sections, Prof. Whewell's Address, and Recommendations of the Association and its Committees.

LITHOGRAPHED SIGNATURES of the MEMBERS who met at Cambridge in 1833, with the Proceedings of the Public Meetings. 4to. Price 4s. (To Members, 3*s*.)

List of those Members of the British Association for the Advancement of Science, to whom Copies of this Volume are supplied in conformity with the following Regulation adopted by the General Committee at the Eleventh Meeting in 1841.

"The Volume of Reports of the Association will be distributed gratuitously to every ANNUAL SUBSCRIBER who has actually paid the *Annual Subscription* for the year to which the Volume relates, and to all those LIFE MEMBERS who have paid Two Pounds, as a fixed *Book Subscription.*"

*** It is requested that Members who may perceive errors or omissions in this List will communicate corrections thereof (by letter post paid) to Messrs. R. and J. E. Taylor, Red Lion Court, Fleet Street, London.

LIFE MEMBERS

who have paid the Book Subscription.

Ablett, Joseph, Llanbedr Hall, Ruthin, Denbighshire.
Adam, Walter, M.D., 39, George's Square, Edinburgh.
Adare, Edwin, Viscount, M.P., F.R.S., F.R.A.S., F.G.S., Dunraven, Castle, Glamorganshire.
Ainsworth, Thomas, Egremont, Ulverstone, Cumberland.
Aldam, William, Warmsworth, Doncaster.
Alexander, William Maxwell, Southbarr, near Paisley.
Allecock, Samuel, Arlington Place, Manchester.
Allis, Thomas, York.
Amery, John, F.S.A., Park House, Stourbridge, Worcestershire.
Ashton, Thomas, M.D., 71, Mosley Street, Manchester.
Atkinson, Joseph B., 5, Freemantle Square, Bristol.
Auldjo, John, F.R.S., F.G.S., F.R.G.S., Noel House, Kensington.
Babbage, Charles, M.A., F.R.S. L. & E., Hon. M.R.I.A., F.R.A.S., M.C.P.S., 1, Dorset Street, Manchester Square, London.
Babington, Charles Cardale, M.A., F.L.S., F.G.S., St. John's College, Cambridge.
Backhouse, John Church, Darlington.
Baddeley, Fred. H., Capt. R.E., Fort George.
Bain, John, Portreath, Redruth.
Bain, Richard, Gwennap, Truro.
Ball, William, Rydal, near Ambleside, Westmoreland.
Barbour, Robert, Portland Street, Manchester.
Barker, George, F.R.S., Birmingham.
Barker, Richard, M.D., M.R.D.S., 6, Gardiner's Row, Dublin.
Barnes, Thomas, M.D., F.R.S.E., Carlisle.
Barnett, Richard.
Barton, John, 44, St. Mary Street, Dublin.
Bateman, Joseph, LL.D., Poplar Institution, East India Road, and Excise Office, Broad Street.
Bayldon, John, York.
Beamish, Richard, F.R.S., Sans Souci, Prestbury, Cheltenham.
Beaufoy, Henry, F.R.S., F.L.S., South Lambeth.
Bell, Thomas, Picton Place, Newcastle-on-Tyne.
Binyon, Alfred, Mayfield, Manchester.
Binyon, Thomas, St. Ann's Square, Manchester.
Bird, William, 5, Old Church Yard, Liverpool.
Birks, Thomas Rawson, Watton, near Ware.
Birley, Richard, Upper Brook Street, Manchester.
Blackburn, Charles, B.A., 40, Kensington Sq.
Blackwall, John, F.L.S., Oakland, Llanrwst, Denbighshire.
Blackwell, Thomas E., F.G.S., Foxhangers, Devizes.
Blake, William, Silver Street, Taunton.
Blakiston, Peyton, M.D., F.R.S., Birmingham.
Bland, Rev. Miles, D.D., F.R.S., F.S.A., F.R.A.S., Lilley Rectory, near Luton, Bedfordshire.
Blood, Bindon, M.R.I.A., F.R.S.E., 22, Queen Street, Edinburgh.
Boddington, Benjamin, Burcher, near Kington, Herefordshire.
Bompas, George G., M.D., Fish Ponds, Bristol.
Bompas, G. J., M.D., Fish Ponds, Bristol.
Bond, Walter M., The Argory, Moy, Ireland.
Botfield, Thomas, F.R.S., F.G.S., Hopton Court, Bewdley.
Boughton, Sir W. E. Rouse, Bart., F.R.S., Downton Hall, near Ludlow, Shropshire.
Brady, Antonio, Maryland Point, Stratford, Essex.
Brakenridge, John, Bretton Lodge, Wakefield, Yorkshire.
Briggs, Major-General John, E.I.C.S., F.R.S., F.G.S., M.R.A.S., Cheltenham.
Bright, Benjamin Heywood, F.G.S., Ham Green, near Bristol.
Brisbane, Lt-General Sir Thomas Makdougall, Bart., K.C.B., G.C.H., D.C.L., F.R.S.,

L. & E., Hon. M.R.I.A., F.R.A.S., Makerstown, Kelso.
Brockedon, Philip N., 29, Devonshire Street, Queen's Square, London.
Brogden, John, jun., Ardwick Place, Manchester.
Brooke, Charles, 35, Keppel Street, Russell Sq., London.
Brown, William, Douglas, Isle of Man.
Bruce, Alexander John, Kilmarnock.
Bruce, Haliday, M.R.D.S., 37 Dame Street, Dublin.
Brunel, Isambard Kingdom, F.R.S., 18, Duke Street, Westminster.
Buck, George Watson, Manchester.
Buckland, Rev. William, D.D., F.R.S., F.G.S., Canon of Christ Church, and Professor of Mineralogy and Geology in the University of Oxford.
Buller, Sir Antony, Pound, Tavistock, Devon.
Bulman, John, Newcastle-on-Tyne.
Burd, John, jun., Mount Sion, Radcliffe, Manchester.
Burke, Francis, 5, Upper Rutland St., Dublin.
Burlington, William, Earl of, M.A., F.R.S., F.G.S., Chancellor of the Uuiversity of London, 10, Belgrave Square.
Campbell, James, Candleriggs, Glasgow.
Campbell, William, 34, Candlerigg Street, Glasgow.
Carew, William H. Pole, Antony House, near Devonport.
Carne, Joseph, F.R.S., M.R.I.A., F.G.S., Penzance.
Carpenter, Rev. Philip Pearsall, B.A., Stand, Pilkington, Manchester.
Carr, William, Blackheath, Kent.
Cartmell, James, Christ's College, Cambridge.
Cayley, Sir George, Bart., Brompton, North Riding of Yorkshire.
Chadwick, Hugo Mavesyn, Mavesyn-Ridware, near Rugeley.
Challis, Rev. James, M.A., F.R.A.S., Plumian Professor of Astronomy and Experimental Philosophy in the University of Cambridge, Cambridge.
Cheetham, David, Staleybridge, Manchester.
Chevallier, Rev. Temple, B.D., F.R.A.S., Professor of Mathematics and Astronomy in the University of Durham.
Chichester, Ashhurst Turner Gilbert, Lord Bishop of.
Chiswell, Thos., 63, Faulkner St., Manchester.
Christie, Samuel Hunter, M.A., Professor of Mathematics in the Royal Military Academy, Woolwich, Sec. R.S., F.R.A.S., The Common, Woolwich.
Clark, Francis, Hazelwood, near Birmingham.
Clay, J. Travis, Rastrick, near Huddersfield.
Coathupe, Charles Thornton, Wraxall, Bristol.
Cocker, Jonathan, 28, Crown Street, Liverpool.
Conybeare, Rev. William Daniel, M.A., F.R.S., F.G.S., Axminster.
Conway, Charles, Pontnwydd Works, Newport, Monmouthshire.
Corbet, Richard, Adderley Hall, Shropshire.
Cottam, Samuel E., F.R.A.S., Brazennose Street, Manchester.
Cotton, Rev. William C., M.A., Windsor, Berkshire.
Courtney, Henry, 27, Upper Mount St., Dublin.
Cox, Joseph, Wisbech.
Crampton, Philip C., Hon. Judge, 50, Lower Baggott Street, Dublin.
Crane, George, F.G.S., Yniscedwyn Iron Works, Swansea.
Crewdson, Thomas D., Dacca Mills, Manchester.
Creyke, Capt. Richard, R.N., 7, Albemarle Villas, Stoke, Devonport.
Crichton, William, Glasgow.
Crompton, Rev. Joseph, Norwich.
Crooke, G. W., Town Hall, Liverpool.
Curtis, John Wright, Alton, Hants.
Dalby, Rev. William, Compton Basset, near Calne, Wilts.
Dalton, Rev. James Edward, M.A., Queen's College, Cambridge.
Daniell, John Frederic, For. Sec., R.S., Professor of Chemistry, King's College, London, and Examiner in Chemistry and Forensic Medicine in the University of London, Norwood.
Darbishire, Samuel D., Manchester.
Daubeny, Charles Giles Bridle, M.D., Aldrich's Professor of Chemistry, Regius Professor of Botany, Oxford, F.R.S., Hon. M.R.I.A., F.L.S., F.G.S., Oxford.
Davenport, Edward Davies, F.R.S., 28, Lower Brook Street, London.
Dawes, Rev. William Rutter, F.R.A.S., 3, Allsop Place, Regent's Park, London.
Dawson, Henry, 14, St. James's Terrace, Liverpool.
Dickinson, John, 67, Stephen's Green, Dublin.
Dilke, C. Wentworth, jun., 118, Sloane Street, London.
Donkin, Thomas, F.R.A.S., Westow, near Whitwell, York.
Downie, Alexander, Crosbastat, Glasgow.
Drury, William, M.D., Garn Gad Hill, Glasgow.
Duncan, James, M.D., Farnham House, Finglass, Co. Dublin.
Dury, Rev. Theodore, Westmill, near Buntingford, Herts.
Ebrington, Lord, 17, Grosvenor Sq., London.
Egerton, Sir Philip de Malpas Grey, Bart., M.P., F.R.S., F.G.S., Oulton Park, Cheshire.
Ellis, Rev. Robert, A.M., Grimstone House, Malton, Yorkshire.
Ellis, Thomas Flower, jun., M.A., F.R.A.S., 15, Bedford Place, London.
Enys, John Samuel, F.G.S., Enys, Cornwall.
Exley, Rev. Thomas, A.M., Bristol.
Fairbairn, William, Manchester.
Faraday, Michael, D.C.L., F.R.S., Hon. Mem. R.S.E., F.G.S., Fullerian Professor of Chemistry in the Royal Institution of Great Britain, 21, Albemarle Street, London.
Fellows, Charles, F.R.G.S., 30, Russell Square, London.
Fisher, Rev. J. M., M.A., 34, South Hanover Street, Edinburgh.

Fisher, Rev. Thomas, A.M., Luccombe, Minehead, Somerset.
Fleming, Colonel James, Kinlochlaich, Appin, Argyleshire.
Fleming, W. M., Baroehan, Renfrewshire.
Fleming, William, M.D., Manchester.
Fletcher, Samuel, Ardwick Place, Manchester.
Flower, Rev. William, jun., M.A., York.
Forbes, James David, F.R.S., Sec. R.S.E., F.G.S., Professor of Natural Philosophy in the University of Edinburgh, Edinburgh.
Forbes, John, M.D., F.R.S., 12, Old Burlington Street, London.
Forrest, William Hutton, Stirling.
Forster, Robert, A.B., Springfield, Dungannon, Ireland.
Forster, William, Ballynure, Clones, Ireland.
Foster, John, M.A., Clapham, Surrey.
Fowler, Robert, 19, Merrion Sq. South, Dublin.
Fox, Charles, Perran Arworthar, near Truro.
Fox, Robert Barclay, Falmouth.
Fullarton, Allan, Greenock.
Gadsden, Augustus William, F.S.A., Hull.
Gibbins, William, Falmouth.
Gilbert, John Davies, M.A., F.R.S., East Bourne, Sussex.
Goff, William, Moat, Ireland.
Goodman, John, Salford, Lancashire.
Gordon, James, 46, Park Street, Bristol.
Gotch, Rev. Frederick William, A.B., Boxmoor, Herts.
Gotch, Thomas Henry, Kettering.
Græme, James, Garvock, Perth.
Graham, Thomas, M.A., F.R.S. L. & E., Professor of Chemistry in University College, London, 9, Torrington Square, London.
Grahame, Captain Duncan, Irvine, Scotland.
Graves, Rev. Charles, A.M., 2, Trinity College, Dublin.
Graves, Rev. Richard H., D.D., Brigown Glebe, Mitchelstown, Ireland.
Gray, John, Greenock.
Gray, John Edward, F.R.S., F.G.S., F.R.G.S., British Museum.
Gray, William, jun., F.G.S., York.
Greenaway, Edward, 9, River Terrace, Islington.
Greenock, Major-General Lord, K.C.B., F.R.S.E., F.G.S., 12, Carlton Place, Edinburgh.
Greswell, Rev. Richard, M.A., F.R.S., Beaumont Street, Oxford.
Griffin, John Joseph, Glasgow.
Griffith, Richard, F.G.S., Fitzwilliam Street, Dublin.
Grooby, Rev. James, B.A., F.R.A.S., Swindon, Wiltshire.
Guinness, Rev. William Smyth, Rathdrum, Co. Wicklow.
Hailstone, Samuel, F.L.S., F.G.S., Horton Hall, Bradford, Yorkshire.
Hall, Rev. T. B., Coggeshall, Essex.
Hallam, Henry, M.A., F.R.S., V.P.S.A., F.G.S., F.R.A.S., Wilton Crescent, London.
Hamilton, Sir William Rowan, LL.D., M.R.I.A., F.R.A.S., Astronomer Royal of Ireland, and Andrews' Professor of Astronomy in the University of Dublin.
Hamilton, Mathie, M.D., Millport, by Greenock.
Hamilton, William John, Sec. G.S., 14, Chesham Place, Belgrave Square, London.
Hamlin, Capt. Thomas, Greenock.
Harcourt, Rev. William Vernon, M.A., F.R.S., Hon. M.R.I.A., F.G.S., Bolton Percy, York.
Hare, Charles John, M.B., 9, Langham Place, London.
Harley, John, Wain Worn, Pontypool.
Harris, George William, London Works, Birmingham.
Harter, William, Broughton, Manchester.
Hartley, Jesse, Trentham Street, Liverpool.
Harvey, Joseph C., Youghal, Co. Cork.
Haughton, William, 28, City Quay, Dublin.
Hawkins, John Isaac, 26, Judd Place West, New Road, London.
Hawkins, Thomas, F.G.S., Sharpham Park, Glastonbury.
Hawkshaw, John, F.L.S., Islington, near Salford.
Haworth, George, Rochdale.
Hawthorn, Robert, C.E., Newcastle-on-Tyne.
Henry, Alexander, Portland St., Manchester.
Henry, William Charles, M.D., Haffield, Ledbury, Herefordshire.
Henslow, Rev. John Stevens, M.A., F.L.S., F.G.S., Prof. of Botany in the University of Cambridge; Hitcham, Bildeston, Suffolk.
Herbert, Thomas, Nottingham.
Herbert, The Rev. William, Dean of Manchester, Manchester.
Heywood, James, F.R.S., F.S.A., Acresfield, Manchester.
Hill, Rev. Edward, M.A., Christ Church, Oxf.
Hill, Rowland, 1, Orme Square, Bayswater.
Hill, Thomas Wright, Bruce Castle, Tottenham.
Hill, Thomas, 28, Ardwick Green, Manchester.
Hindmarsh, Luke, Alnwick.
Hoare, George Tooker, Godstone, Surrey.
Hoblyn, Thomas, F.R.S., F.L.S., White Barns, Buntingford, Herts.
Hodgkinson, Eaton, F.R.S., 17, Crescent, Salford, Manchester.
Hodgson, Adam, Everton, Liverpool.
Holden, Moses, 13 Jordan Street, Preston.
Holditch, Rev. Hamnett, Caius College, Cambridge.
Holland, P. H., 86, Grosvenor St., Manchester.
Hone, Nathaniel, M.R.D.S., 50, Harcourt Street, Dublin.
Hopkins, William, M.A., F.R.S., F.R.A.S., St. Peter's College, Cambridge.
Horner, Leonard, F.R.S. L. & E., F.G.S., 2, Bedford Place, Russell Square, London.
Horsfield, George, 3, George St., Manchester.
Houldsworth, Henry, Newton Street, Manchester.
Hoyle, John, Ducie Street, Manchester.
Hudson, Henry, M.D., M.R.I.A., 24, Stephen's Green, Dublin.
Hull, William D., Fairburn, Rostrevor, Ireland.
Hulse, Edward, All Souls College, Oxford.
Hunter, Adam, M.D., Leeds.

Hutton, Robert, F.G.S., M.R.I.A., Putney Park, Surrey.
Hutton, William, F.R.S., F.G.S., Newcastle-on-Tyne.
Ibbetson, L. L. Boscawen, F.G.S., Polytechnic Institution, London.
Ingram, Thomas Wells, 85, Bradford Street, Birmingham.
Jackson, James Eyre, Tullydory, Blackwater Town, Armagh.
Jacob, John, M.D., Maryborough.
Jardine, Sir William, Bart., F.R.S.E., F.L.S. Jardine Hall, Applegarth, by Lockerbie, Dumfries-shire.
Jee, Alfred S., Dinting Vale, Manchester.
Jenkyns, Rev. Henry, D.D., F.G.S., Professor of Divinity and Ecclesiastical History in the University of Durham.
Jenyns, Rev. Leonard, M.A., F.L.S., F.G.S., F.C.P.S., Swaffham Bulbeck, Cambridgeshire.
Jerrard, George Birch, B.A., West Park, Bristol.
Johnson, Thomas, 24, York Street, Manchester.
Johnstone, Sir John Vanden Bempde, Bart., M.A., M.P., F.R.S.E., F.G.S., 27, Grosvenor Square, London.
Johnstone, James, Aloa, near Alloa, Stirlingshire.
Jones, Christopher Hird, 2, Castle Street, Liverpool.
Jones, Josiah, 2, Castle Street, Liverpool.
Jones, Robert, 59, Pembroke Place, Liverpool.
Jones, Major Edward, Plympton, Plymouth.
Joule, James Prescott, New Bailey St., Salford.
Joule, Benjamin, jun., New Bailey St., Salford.
Jubb, Abraham, Halifax.
Kay, John Robinson, Boss Lane House, Bury, Lancashire.
Kelsall, Henry, Rochdale, Lancashire.
Kenrick, Samuel, Handsworth, Birmingham.
Kerr, Archibald, Glasgow.
Kerr, Robert, jun., Glasgow.
Knox, G. James, 1, Maddox Street, Regent Street, London.
Lacy, Henry C., jun., Kenyon House, Manchester.
Langton, William, Manchester.
Lansdowne, Henry, Marquis of, D.C.L., F.R.S.L. & E., 52, Berkeley Square, London.
Larcom, Captain, R. E., Phœnix Park, Dublin.
La Touche, David Charles, M.R.I.A., Castle Street, Dublin.
Leah, Henry, Byerley Hall, Bradford, Yorkshire.
Leatham, Charles Albert, Wakefield.
Lee, Rev. James Prince, King Edward's School, Birmingham.
Lefroy, Lieut., R.A., Woolwich.
Legh, George Cornwall, M.P., F.G.S., High Legh, Cheshire.
Leinster, Augustus Frederick, Duke of, F.H.S., F.Z.S., Carton House, Maynooth.
Lemon, Sir Charles, Bart., F.R.S., F.G.S., F.H.S., 46, Charles Street, Berkeley Square, London.
Lewis, Capt. T. Locke, R.E., F.R.S., F.G.S., Ibsley Cottage, Exeter.
Liddell, Andrew, Glasgow.
Lightfoot, W. B., Grove Street, Liverpool.
Lindsay, Henry L., C.E., Armagh.
Lister, Joseph Jackson, F.R.S., 5, Tokenhouse Yard, London.
Lloyd, Rev. Humphrey, D.D., F.R.S., M.R.I.A., Professor of Natural Philosophy, Trinity College, Dublin.
Lloyd, William Horton, F.S.A., F.L.S., 1 Park Square West, Regent's Park, London.
Lock, Sir Joseph, Oxford.
Lockey, Rev. Francis, Swanswick, Bath.
Logan, William Edmond, F.G.S., 4, York Gate, Regent's Park, London.
Lubbock, Sir John William, Bart., M.A., V.P. & Treas. R.S., F.L.S., F.R.A.S., 23, St. James's Place, London.
Lucas, William, The Mills, Sheffield.
Lutwidge, Charles, M.A., Hull.
Lyell, Charles, jun., M.A., F.R.S., F.L.S., F.G.S., 16, Hart St., Bloomsbury, London.
M'All, Rev. Edward, Brighstone, Newport, Isle of Wight.
Macartney, James, M.D., F.R.S., M.R.I.A., F.L.S., Professor of Anatomy, Trinity College, Dublin, 35, Upper Merrion Street, Dublin.
MacBrayne, Robert, Barony Glebe, Glasgow.
MacCullagh, James, LL.D., Professor of Mathematics in the University of Dublin.
M'Culloch, George, 6, St. Mary's Street, Mary Square, Lambeth.
MacDonnell, Rev. Richard, Trinity College, Dublin.
M'Ewan, John, Glasgow.
Mackenzie, Sir Francis A., Bart., Kinellan, by Dingwall.
Marshall, James Garth, M.A., F.G.S., Headingley, Leeds.
Martineau, Rev. James, 12, Mason Street, Edgehill, Liverpool.
Mather, Daniel, 58, Mount Pleasant, Liverpool.
Mather, John, 58, Mount Pleasant, Liverpool.
Mayne, Rev. Charles, M.R.I.A., 22, Upper Merrion Street, Dublin.
Meadows, James, Green Hill, Greenheys, Manchester.
Miller, Patrick, M.D., Exeter.
Moilliet, J. L., Hampstead Hall, Birmingham.
Money, Rev. Kyrle Ernle, M.A., Much March Vicarage, Ledbury, Herefordshire.
More, John Schank, F.R.S.E., Edinburgh.
Murchison, Roderick Impey, F.R.S., Pres. G.S., Hon. M.R.I.A., F.L.S., 16, Belgrave Square, London.
Murphy, Rev. Robert, M.A., University of London, Somerset House.
Napier, Johnstone, Dinting Vale, Manchester.
Newman, Francis William, 4, Cavendish Place, Manchester.
Newman, William Lewin, York.
Nicholls, John Ashton, Ancoats Crescent, Manchester.
Nicholson, John A., M.D., Balrath, Kells, Ireland.

Northampton, Spencer Joshua Alwyne, Marquis of, President of the Royal Society, F.S.A., Hon. M.R.I.A., F.L.S., F.G.S., 145, Piccadilly, London.
Northumberland, Hugh, Duke of, K.G., D.C.L., F.R.S., F.S.A., F.L.S., F.G.S., Northumberland House, Strand, London.
O'Reardon, John, M.D., 35, York St., Dublin.
Orpen, Charles Edward H., M.D., 34, Hamilton Square West, Woodside, Birkenhead.
Osler, A. Follett, Birmingham.
Ossalinsky, Count, Chestnut Hill, Keswick.
Outram, B. F., M.D., Inspector of H.M. Hospitals and Fleets, F.R.S., F.G.S., F.R.G.S., 1, Hanover Square, London.
Owen, Jeremiah, Dockyard, Devonport.
Palmer, William, Harcourt Street, Dublin.
Parker, Charles Stewart, Liverpool.
Pasley, Major-General Charles William, C.B., Royal Engineers, F.R.S., F.G.S., F.R.A.S., Board of Trade, Whitehall, London.
Patrick, John Shedden, F.R.S.E., Hessilhead, Beith, Ayrshire.
Patterson, Robert, F.L.S., 3, College Square North, Belfast.
Pedler, Lieut.-Colonel Philip Warren, Mutley House, Plymouth.
Peel, George, Higher Ardwick Lodge, Manchester.
Peile, Williamson, F.G.S., Lowther Street, Whitehaven.
Perigal, Frederick, 33, Torrington Sq., London.
Petus, Edward.
Philips, Mark, M.P., Park, near Manchester.
Phillips, John, F.R.S., F.G.S., York.
Philpott, Rev. Henry, M.A., Catharine Hall, Cambridge.
Pike, Ebenezer, Besborough, Cork.
Pitt, George, 4, Great Portland St., London.
Pontey, Alexander, Plymouth.
Poppelwell, Matthew, Rossella Pl., Tynemouth.
Porter, Hen. John, Tandragee Castle, Armagh.
Porter, G. R., F.R.S., Board of Trade, Whitehall.
Portlock, Capt. Jos. E., Royal Engineers, F.R.S., M.R.I.A., F.G.S., Ordnance Survey, Dublin.
Powell, Rev. Baden, M.A., F.R.S., F.R.A.S., Savilian Professor of Geometry, Oxford.
Pratt, Samuel Peace, F.R.S., F.L.S., F.G.S., Lansdowne Place West, Bath.
Prestwich, Joseph, jun., F.G.S., 10, Devonshire Street, Portland Place, London.
Pretious, Thomas, Royal Dockyard, Pembroke.
Prince, Rev. John Charles, 63, St. Anne Street, Liverpool.
Pritchard, Andrew, 162, Fleet Street, London.
Pumphrey, Charles, New Town Row, Birmingham.
Rance, Henry, Cambridge.
Rawlins, John, Birmingham.
Read, William Henry Rudston, M.A., F.L.S., F.H.S., Hayton, Pocklington.
Reade, Rev. Joseph Bancroft, M.A., F.R.S., Stone Vicarage, Aylesbury.
Renny, H. L., late of the Royal Engineers, Assistant Professor of Practical Engineering, Trinity College, Dublin.
Richardson, John, M.D., F.R.S., F.L.S., Haslar Hospital, Gosport.
Riddell, Lieut. Charles J. B., Royal Artillery, F.R.S., Woolwich.
Roberts, Richard, Manchester.
Robinson, John, Shamrock Lodge, Athlone.
Robson, Rev. John, 193, Renfrew Street, Albert Terrace, Glasgow.
Rogers, Rev. Canon, M.A., Penrose, Cornwall.
Roget, Peter Mark, M.D., Sec. R.S., F.G.S., F.R.A.S., V.P.S.A., 39, Bernard Street, Russell Square, London.
Rothwell, Peter, Bolton.
Roughton, William, jun., Kettering, Northamptonshire.
Royle, John Forbes, M.D., F.R.S., F.L.S., F.G.S., F.R.G.S., Professor of Materia Medica, King's College, London.
Russell, James, Birmingham.
Ryland, Arthur, Birmingham.
Sabine, Lt.-Colonel Edward, Royal Artillery, F.R.S., F.R.A.S., Woolwich.
Sanders, William, F.G.S., Bristol.
Satterthwaite, Michael, M.D., Grosvenor St., Manchester.
Schemman, J. C., at L. Thornton's, Esq., Camp Hill, Birmingham.
Schofield, Robert, Rochdale, Lancashire.
Scholfield, Edward, M.D., Doncaster.
Scoresby, Rev. William, D.D., F.R.S. L. & E., Vicar of Bradford, Yorkshire.
Sedgwick, Rev. Adam, M.A., F.R.S., Hon. M.R.I.A., F.G.S., F.R.A.S., Woodwardian Lecturer, Cambridge.
Semple, Robert, Richmond Lodge, Wavertree, Liverpool.
Shaen, William, 49, Upper Bedford Pl., London.
Shanks, James, 23, Garscube Place, Glasgow.
Sharp, William, F.R.S., F.G.S., F.R.A.S., Bradford, Yorkshire.
Sherrard, David Henry, 84, Upper Dorset Street, Dublin.
Sillar, Z., M.D., Rainford, near Liverpool.
Simpson, Samuel, Lancaster.
Sirr, Rev. Joseph D'Arcy, Kilcoleman Parsonage, Claremorris, Co. Mayo.
Slater, William, Princess Street, Manchester.
Sleeman, Philip, Windsor Terrace, Plymouth.
Smales, R. H., Kingston Bottom.
Smethurst, Rev. R., Green Hill, Pilkington, Manchester.
Smith, Rev. George Sidney, D.D., Trinity College, Dublin.
Smith, Rev. John Pye, D.D., F.R.S., F.G.S., Homerton.
Smith, Rev. Philip, B.A., Cheshunt College, Hertfordshire.
Smith, Robert Mackay, Windsor Street, Edinburgh.
Solly, S. Reynolds, M.A., F.R.S., F.S.A., F.G.S., Surge Hill, King's Langley, Herts.
Solly, Edward, jun., 38, Bedford Row, London.
Sopwith, Thomas, F.G.S., Newcastle-on-Tyne.
Squire, Lovell, Falmouth.
Stanger, William, M.D., Wisbech, Cambridgesh.
Strickland, Charles, Loughglyn, Ireland.

Sutcliffe, William, 4, Belmont, Bath.
Sykes, Lt.-Colonel William Henry, F.R.S., Hon. M.R.I.A., F.L.S., F.G.S., M.R.A.S., 47, Albion Street, Hyde Park, London.
Tayler, Rev. J. J., B.A., Manchester.
Taylor, James, Todmorden Hall, Rochdale.
Taylor, Joseph Needham, Captain R.N., 61, Moorgate Street, London.
Taylor, John, Stronsham Court, Worcestersh.
Taylor, John, F.R.S., F.G.S., F.L.S., 12, Bedford Row, London.
Taylor, John, jun., F.G.S., Coed-Dû, near Mold, Flintshire.
Taylor, Richard, jun., F.G.S., Wood, Penryn, Cornwall.
Taylor, Richard, F.S.A., Assist. Sec. L.S., F.G.S., F.R.A.S., F.R.G.S., Red Lion Court, Fleet Street, London.
Tennant, James, F.G.S., Professor of Mineralogy, King's College, London; 149, Strand, London.
Thicknesse, Ralph, jun., Beech Hill, Wigan.
Thodey, Winwood, 4, Poultry, London.
Thompson, Corden, M.D., Sheffield.
Thompson, David Peter, M.R.I.A., Ballintaggart, Dingle, Co. Kerry.
Thomson, Edmund Peel, Manchester.
Thomson, James, F.R.S., F.G.S., F.L.S., Primrose, Clitheroe, Lancashire.
Thomson, James Gibson, Edinburgh.
Thornton, Samuel, Camp Hill, Birmingham.
Thorp, Rev. Thomas, M.A., Archdeacon of Bristol, F.G.S., Trinity College, Cambridge.
Tidswell, Benjamin Kay, 65, King Street, Manchester.
Tinné, J. A., Briarly Aigburth, Liverpool.
Tobin, Sir John, Liverpool.
Townsend, R. E., Springfield, Norwood.
Trevelyan, Arthur, Wallington, Northumberland.
Turnbull, Rev. Thomas Smith, M.A., F.R.S., F.G.S., F.R.G.S., Caius College, Cambridge.
Turner, Samuel, F.R.S., F.G.S., F.R.A.S., Liverpool.
Tweedy, William Mansel, Truro.
Vallack, Rev. Benjamin W. S., St. Budeaux, Plymouth.
Vance, Robert, Belfast; and 5, Gardiner's Row, Dublin.
Vivian, H. Hussey, Swansea.
Walker, John, Pendleton, Manchester.
Walker, Joseph N., F.L.S., Allerton Hall.
Walker, Rev. Robert, M.A., F.R.S., Reader in Experimental Philosophy in Wadham College, Oxford.
Walker, Thomas, 3, Cannon Street, Manchester.
Wallace, Rev. Robert, 2, Cavendish Place, Grosvenor Square, Manchester.
Ware, S. Hibbert, M.D., F.R.S.E., York.
Warren, Richard B., 35, Leeson St., Dublin.
Waterhouse, John, F.R.S., F.G.S., Halifax.
Watson, Henry Hough, Bolton-le-Moors.
Weaver, Thomas, F.R.S., M.R.I.A., F.G.S., 16, Stafford Row, Pimlico.
Webb, Rev. Thomas William, M.A., Tretire, Ross, Herefordshire.
West, William, Literary and Philosophical Society, Leeds.
Westhead, Joshua Procter, York House, Manchester.
Whewell, Rev. William, D.D., Master of Trinity College, Cambridge, F.R.S., Hon. M.R.I.A., F.S.A., F.G.S., F.R.A.S., The Lodge, Cambridge.
Whitworth, Joseph, Manchester.
Wickenden, Joseph, Birmingham.
Willert, Paul Ferdinand, Manchester.
Williams, Rev. David, F.G.S., Bleadon, Uphill, near Bristol.
Williams, William, Rood Lane, London.
Williamson, Rev. W., Clare Hall, Cambridge.
Wills, William, Edgbaston, Birmingham.
Wilson, Alexander, F.R.S., F.G.S., 34, Bryanstone Square, London.
Wilson, Rev. James, D.D., M.R.I.A., 10, Warrington Street, Dublin.
Wilson, Thomas, Banks, near Barnsley.
Wilson, William, Troon, Glasgow.
Winsor, F. A., M.R.I.A., 57, Lincoln's Inn Fields, London.
Winstanley, Thomas W., Essex Street, Manchester.
Winterbottom, Rev. James Edward, M.A., F.L.S., F.G.S., East Woodhay, Hants.
Wood, George William, M.P., F.L.S., F.G.S., Singleton Lodge, near Manchester.
Woods, Edward, 7, Church Street, Edge Hill, Liverpool.
Woodhead, G., Northam, Manchester.
Woollcombe, Henry, F.S.A., Crescent, Plymouth.
Wormald, Richard, jun., 6, Broad Street Buildings, London.
Wright, Robert Francis, Hinton Blewett, near Bristol.
Yates, Joseph Brooks, F.S.A., West Dingle, Liverpool.
Yates, R. Vaughan, Toxteth Park, Liverpool.
Yorke, Lt.-Colonel Philip, 12, Duke Street, Grosvenor Square, London.
Younge, Robert, M.D., Greystones, Sheffield.

ANNUAL SUBSCRIBERS.

Agnew, Thomas, Exchange St., Manchester.
Ainsworth, W. Francis, 15, Marylebone Street, London.
Akroyd, Edward, Bankfield, Halifax.
Alcock, John, Gatley Hill, Cheadle, Manchester.
Alcock, Ralph, Milk Street, Manchester.
Alcock, Samuel, Milk Street, Manchester.
Alder, Joshua, Newcastle-on-Tyne.
Alison, W. P., Edinburgh.
Allen, Richard, Oxford Street, Manchester.
Allies, Jabez, 17, High Street, Worcester.
Alsop, John, Darley Dale, Derbyshire.
Antrobus, Thomas, Shepley Hall, Ashton-under-Lyne.

ANNUAL SUBSCRIBERS 1842.

Armitage, Elkanah, Cannon St., Manchester.
Armstrong, Robert, Victoria Arches, Manchester.
Arrott, A. R., London.
Ashton, Richard, 71, Mosley Street, Manchester.
Ashworth, Thomas, Poynton, Stockport.
Atherton, James, Bridgewater Buildings, Manchester.
Bannerman, Henry, Burnage, Manchester.
Barbour, G. F., Portland Street, Manchester.
Bardsley, James Lomax, M.D., Chatham St., Manchester.
Barfoot,——, Lyme Regis, Dorsetshire.
Barlow, John, jun., Manchester.
Barlow, Robert A., Northenden, Didsbury, Manchester.
Barlow, Rev. William, M.A., Northenden, Didsbury, Manchester.
Barnes, Richard Wilson, Cornbrook, Manchester.
Barratt, Joseph, Newton Heath, Manchester.
Barratt, James, jun., Manchester.
Barton, Alfred, Penrith.
Barton, Richard, Cambridge.
Barton, R. W., Mulberry St., Manchester.
Bates, William, M.D., Oakenshaw, Accrington.
Bayley, John Diggles, 4, Basinghall Street, London.
Bazley, Thomas, 4, Acton Square, Salford.
Beamish, William, M.A., Beaumont, Cork.
Beatson, William, Rotherham, Yorkshire.
Beaver, Hugh, The Temple, Cheetham Hill, Manchester.
Beckerleg, Edwyn James, St. John's College, Cambridge.
Bell, Andrew, 35, Scotland St., Edinburgh.
Bell, Richard, Cockermouth, Cumberland.
Bellhouse, James, Victoria Park, Manchester.
Benson, William, Princess Street, Manchester.
Bent, E. S., Manchester.
Bentley, Rev. Thomas Rothwell, M.A., Great John Street, Manchester.
Benyon, Henry, Roundhay Lodge, Leeds.
Besley, William, Manchester.
Bevan, William, M.D., Dublin.
Binyon, Edward, St. Ann's Sq., Manchester.
Birchall, Samuel Jowitt, Leeds.
Birkett, John, F.G.S., 2, Broad Street Buildings, London.
Birley, Hugh, Manchester.
Birley, Thomas Hornby, Manchester.
Birmingham, William, New Market Lane, Manchester.
Black, Donald, Manchester.
Blackburne, Rev. Thomas, M.A., Rectory, Prestwich, Manchester.
Bow, William, Blackfriars Street, Manchester.
Blyth, Dr. William, Church, Accrington.
Boutflower, John, Greengate, Salford.
Bowman, Eddowes, Victoria Park, Manchester.
Bowman, John E., Victoria Park, Manchester.
Bowman, Henry, Princess Street, Manchester.
Bradford, James, York Street, Cheetham, Manchester.
Brandt, Robert, Norfolk Street, Manchester.
Brewster, Sir David, K.H., LL.D., F.R.S., L. & E., Hon. M.R.I.A., F.G.S., F.R.A.S., St. Andrew's, Scotland.
Brideson, Ridgway, Bridge House, Bolton.
Bridson, Henry, Bolton.
Bright, Benjamin, 59, Pulteney Street, Bath.
Bright, Gratton, Rochdale.
Brinsdale, P. A., Consul of the United States to the Sandwich Islands.
Broadbent, James, 42, Church St., Manchester.
Broadhurst, Daniel, Manchester.
Brockedon, William, F.R.S., 29, Devonshire Street, Queen's Square, London.
Brooke, Edward, Hanson's Court, Manchester.
Brooke, Peter, 20, Brazennose St., Manchester.
Brooks, John, jun., Ardwick, Manchester.
Brotherton, Joseph, M.P., Lower Broughton, Manchester.
Brown, Richard, Ardwick Green, Manchester.
Brown, Captain Thomas, Natural History Society, Manchester.
Brown, Thomas, Green Hill, Chorlton-upon-Medlock.
Brown, William, Chester.
Brunel, Sir Mark I., Knt., F.R.S., Thames Tunnel.
Buchannan, Walter M., Glasgow.
Buckingham, ——, 102, Oxford Street, Manchester.
Bull, Rev. W. H., Sowerby Parsonage, Halifax.
Bunting, J. P., Brown Street, Manchester.
Bury, John, Scarborough.
Busk, George, H.M.S. Dreadnought, Greenwich.
Buss, R. W., 68, Warren St., Fitzroy Square, London.
Butterworth, Henry, Rochdale.
Butterworth, John, Messrs. Thomas Hoyle and Sons, Manchester.
Butterworth, Joseph, Manchester.
Byrth, Rev. Thomas, D.D., Wallasey, near Liverpool.
Caid, Nathaniel, 53, Piccadilly, Manchester.
Cairns, Alexander, Oxford Road, Manchester.
Calvert, Charles T. Ardwick, Manchester.
Campbell, Henry Cadogan, Water Street, Manchester.
Capdevielle, Dominic, 103, Piccadilly, Manchester.
Carr, William, Leeds.
Carrington, S. R., Cale Green, Stockport.
Cartwright, Cornelius, Dudley.
Catlow, Joseph P., Sidney Street, Chorlton-upon-Medlock.
Chadwick, Robert, Oakfield, Salford.
Chadwick, James, Oakfield, Salford.
Chapman, John, 17, David St., Manchester.
Charlewood, Henry, Princess St., Manchester.
Chaytor, Gustavus A., M.D., 3, Oxford St., Manchester.
Cheetham, John, Dukinfield.
Christie, David, Edale, Derbyshire.
Christye, Alexander, Fairfield, Manchester.
Christye, Richard, Fairfield, Manchester.
Clark, W. D., Bank Bridge, Droylsden, Manchester.

Clay, Charles, M.D., Manchester.
Clouston, Thomas B., Poolbeg St., Dublin.
Cobden, Charles, Mosley St., Manchester.
Colston, Hungerford, New College, Oxford.
Compton, Joseph, Whalley Range, Moss Side, Manchester.
Compton, Joseph, jun., Whalley Range, Moss Side, Manchester.
Cooke, Thomas, jun., Pendlebury, Manchester.
Cope, Richard, 12, Exchange St., Manchester.
Copinger, John, M.D., Cork.
Corser, Rev. Thomas, M.A., Stand, near Manchester.
Cox, John, Edinburgh.
Coward, Thomas, 66, Upper Brook Street, Manchester.
Crewdson, Robert, Ardwick Green, Manchester.
Critchley, A. W., Upper Brook Street, Manchester.
Critchley, Thomas, Manchester.
Croft, Henry Holmes, 35, Upper Gower St., London.
Crompton, James, Kersley, Bolton.
Crossley, James, Essex Street, Manchester.
Crowley, John, Store Street, Manchester.
Cubitt, Thomas, London.
Cumber, Charles, 13, Dickinson Street, Manchester.
Curtis, Matthew, Manchester.
Daglish, Robert, Orrell Cottage, Wigan.
Dancer, John A., 13, Cross Street, Manchester.
Davies, John, Quay Street, Manchester.
Davies, R. D., Messrs. G. Fraser, Son and Co., Manchester.
Dawbarn, Robert, Wisbech, Cambridgeshire.
Dawbarn, William, Wisbech, Cambridgeshire.
Dean, James Joseph, 17, Grove Street, Ardwick, Manchester.
De Moleyns, F. W., M.A., F.G.S., Killarney, Co. Kerry.
Denny, Henry, Leeds.
Dentith, William, Lime Grove, Oxford Road, Chorlton-upon-Medlock.
Dockray, David, Manchester.
Dockray, Thomas, Manchester.
Dodds, Isaac, Sheffield.
Duck, R. G., Manchester.
Duffy, John, Dublin.
Duncan, John, Lombard Street, London.
Dunn, James, M.D., Kelvin House, Smethwick, Birmingham.
Duppa, Thomas Dupp Lloyd, Cheney Longville, Shropshire.
Dymond, Robert, 20, Southernhay Place, Exeter.
Edgworth, Thomas, Wrexham.
Ebbs, John, Tudor Hall, Dublin.
Edmondson, Thomas, Manchester.
Elphinstone, Sir Howard, Bart., Ore Place, Sussex.
Etchells, James, Gas-works, Ashton-under-Lyne.
Evans, Richard, Manchester.
Evans, Richard.
Eveleigh, Samuel, Plymouth Grove, Chorlton-upon-Medlock.
Ewart, Joseph, Pall Mall, Manchester.
Fairbairn, John, Manchester.
Farmer, John, Cheadle, Manchester.
Fawdington, William, Marsden Square, Manchester.
Felkin, William, Nottingham Park.
Fernley, John, Stanley House, Manchester.
Fleming, John, M.D., Aberdeen.
Fletcher, Thomas, Pendleton, Manchester.
Foster, George, 3, Chapel Square, Manchester.
Fowler, Richard, M.D., F.R.S., F.S.A., Salisbury.
Frost, William, F.R.A.S., 5, Sutton Place, Hackney.
Galloway, John, Knott Mill, Manchester.
Gardiner, Addin, Manchester.
Gardom, George, Salford.
Garnett, Robert, Oak Hill, Cheetham, Manchester.
Garnett, William, Lark Hill, Salford.
Gauthorp, George R., 37, Oxford Street, Manchester.
Gibb, James, 29, Mosley Street, Manchester.
Gibson, Rev. W. N., Ardwick, Manchester.
Gillett, Joseph, 4, Cecil Street, Chorlton-upon-Medlock.
Goddard, John Frederick, 20, London Street, Fitzroy Square, London.
Goodlad, William, 46, Mosley St., Manchester.
Goodwin, F. G., M.A., Wyvill Grange, Derbyshire.
Gourlay, De la Cherois, Madeley, Salop.
Grafton, Joseph Smith, Manchester.
Grantham, John, Liverpool.
Grantham, Richard, Gloucester.
Gray, Rev. David, M.A., Royal Academy, Inverness.
Greaves, George, Egerton Terrace, Hulme.
Greenwood, Thomas, Polefield, Prestwich.
Gregan, John E., 13, Princess Street, Manchester.
Greig, Thomas, Rosebank, Edenfield, Bury.
Grundy, J. C., Exchange Street, Manchester.
Guillemard, John Lewis, F.R.S., 27, Gower Street, London.
Haliburton, Alexander Fowden, Whitley, near Wigan.
Hall, Elias, Castleton, Derbyshire.
Hall, George Webb, Sneed Park, Bristol.
Hall, Joseph, Castleton, Bakewell, Derbyshire.
Hall, Samuel, Basford, Nottingham.
Halley, Rev. Robert, D.D.
Halladay, A. P., Cornbrook, Manchester.
Halse, Wm. Hooper, Brent, Ashburton, Devon.
Hamilton, Dacre, New Park, Coote Hill, Ireland.
Hamilton, Thomas, Princess St., Manchester.
Hamilton, Rev. William, Royal Belfast Institution, Belfast.
Hampson, John Henry, 12, Norfolk Street, Manchester.
Hardey, James, Chapel Street, Salford.
Hardy, Robert, M.D., Manchester.

Hare, Matthias, 98, Lower Baggot St., Dublin.
Harter, James Collier, Chapel Walks, Manchester.
Harter, Rev. G. G., Broughton Hall, Manchester.
Haworth, Edmund, Bolton-le-Moors, Lancashire.
Haworth, George, Church Bridge, Accrington.
Heath, A. M., Manchester.
Henfrey, Charles, Wilmslow, Cheshire.
Héron, Joseph, Princess Street, Manchester.
Hertz, James, Manchester.
Higginbotham, W., M.D., St. Petersburgh.
Higgins, Henry, 1, Mount Pleasant Square, Salford.
Hill, Henry, 13, Orchard Street, Portman Square, London.
Hill, William, Worcester.
Hindle, James, Sabden, near Burnley.
Hodgson, John, London.
Hodgson, W. B., Liverpool.
Hodgson, Steward, London.
Holland, T. C., Loughborough.
Hopkins, R. W., Preston.
Hopkins, Thomas, 5, Broughton Lane, Manchester.
Howard, Luke, F.R.S., Ackworth, Yorkshire.
Howard, Richard Baron, M.D., Princess Street, Manchester.
Howard, George, Church, Accrington.
Howarth, Edmund, Bolton-le-Moors.
Hoyland, William Wheeler, Wood Street, Greenheys, Manchester.
Hulme, James Hilton, Cliffe House, Derbyshire.
Hunter, R. R., Auchterarder, Perthshire.
Huntington, Rev. W., M.A., St. John's, Manchester.
Ibotson, Robert, Kay Street, Chorlton-upon-Medlock.
Irwin, Thomas, Audit Office, Somerset House, London.
Jackson, George, Greengate, Salford.
Jackson, Joseph, Messrs. Jackson, Watson, and Greig, Faulkner Street, Manchester.
Jacson, John, Preston.
Jago, John Sampson, Lieut. R.N., Falmouth.
James, Paul Moon, Manchester and Salford Bank.
Jarman, Francis (solicitor), Bristol.
Jennings, Thomas, Cork.
Jerdan, William, 7, Wellington Street, Strand, London.
Jessop, William, Butterley Hall, Derbyshire.
Johnson, George, Stockport.
Johnson, William, 27, Dale St., Manchester.
Johnston, Edward, 6, Newton Street, Manchester.
Jones, John, Spring Vale Iron Works, Wolverhampton.
Jones, Joseph, Walsham House, Oldham.
Jones, Joseph, jun., Walsham House, Oldham.
Jones, William, Ludlow.
Juckes, John, Putney, Surrey.
Kay, Alexander, Manchester.
Kay, Samuel, Marsden Street, Manchester.
Kay, Samuel, jun., Marsden St., Manchester.
Keith, William, 20, Red Cross St., Manchester.
Kelsall, William Strettell, Halliwell Place, Cheetham, Manchester.
Kennedy, John L., Ardwick House, Manchester.
Kennedy, Matthew, Manchester.
Kentish, Rev. John, Birmingham.
Kenworthy, Charles, Byrom St., Manchester.
King, John, Quay Street, Manchester.
King, John, jun., Quay Street, Manchester.
King, Rev. W. H., Cheetham Hill, Manchester.
Kirkman, Thomas, Salford.
Kissell, George, Booth Street, Manchester.
Knoblock, Dr. Robert, Moscow.
Lankester, Edwin, M.D., F.L.S., 19 A, Golden Square, London.
Lamport, Charles, Manchester.
Leigh, James Heath, Belmont, Cheshire.
Leigh, John, St. John Street, Manchester.
Levyssohn, E. H., Princess St., Manchester.
Lillie, Joseph, Manchester.
Lingard, Thomas Ogden, Water Street, Manchester.
Livesey, John, Douglas, Isle of Man.
Lloyd, William, M.D., Birmingham.
Lockett, John, Stocks, Cheetham, Manchester.
Lockett, Joseph, Higher Broughton, Manchester.
Lockwood, W. J. J., Cleveland Buildings, Manchester.
Lomas, William Melville, Preston.
Lowe, Robert H., Manchester.
Loyd, William Jones, Manchester.
Luney, Rev. Richard, Plymouth.
Lupton, Arthur, jun., Headingley, Leeds.
Lynill, J. P., 29, Faulkner Street, Manchester.
Lyons, Thomas, Cork.
McConnel, James, Manchester.
McConnel, William, Manchester.
McKerlie, Lieut., R.E., Manchester.
McLaren, Duncan, Edinburgh.
McLaren, James, Oxford Road, Manchester.
McLauchlan, Henry, F.G.S., Knaresbrough.
Macdougal, Duncan, Brazennose Street, Manchester.
Malyn, John, 12, James Street, Buckingham Palace, London.
Mann, Robert, Great Bridgewater Street, Manchester.
Marriott, Thomas L., 90, Fountain Street., Manchester.
Marsden, William, 1, Clifford Street, Manchester.
Marshall, John S., Troy, America.
Massey, James, Manchester.
Maude, Daniel, Manchester.
Maule, Rev. T. Carteret, Hulme, Manchester.
Mercer, John, Oakenshaw, Accrington.
Mercer, John, jun., Oakenshaw, Accrington.
Merck, Theodore, Manchester.
Merrick, Josiah, 104, Upper Brook Street, Chorlton-upon-Medlock.
Milne, Joshua, High Crompton, Oldham.
Mitchell, Joseph, Inverness.
Moore, William Cameron, 2, Ardwick Place, Manchester.

Morris, John P., 19, Mosely St., Manchester.
Moseley, Rev. Henry, M.A., F.R.S., Professor of Natural Philosophy and Astronomy, King's College, London.
Murray, Sir James, Merrion Square, Dublin.
Murray, William, Glasgow.
Napier, General, London.
Nasmyth, James, London.
Neild, Alfred, Mayfield, Manchester.
Neild, Arthur, Mayfield, Manchester.
Neild, William, Mayfield, Manchester.
Nelson, George, York Street, Manchester.
Neumark, Joseph, 29, Dale St., Manchester.
New, Antony, Evesham, Worcestershire.
Newton, F., Cheetham Hill, Manchester.
Nicholls, Benjamin, Ancoats Crescent, Manchester.
Nicklin, Edward, Moseley Road, Birmingham.
Nicholson, Cornelius, Cowan Head, Kendal.
Noble, Daniel, 105, Piccadilly, Manchester.
Ogden, James, M.D., Manchester.
Pacey, Jeptha, Strangeways, Manchester.
Parkinson, Rev. Richard, B.D., Higher Broughton, Manchester.
Parry, John, 19, Bank Street, Cheetham, Manchester.
Parsey, Arthur, 2, Spur Street, Leicester Sq., London.
Patchett, Thomas, Shudehill, Manchester.
Pauling, George Clark, C.E., Manchester.
Peacocke, R. A., Slyne Lodge, Lancashire.
Peiser, John, Oxford Road, Manchester.
Petrie, John, Rochdale.
Phillips, Shakespear, Chancery Lane, Manchester.
Phillips, William, Morley Works, Plymouth.
Pickford, ——, jun., Mayfield, Manchester.
Porter, John, 22, Lincoln's Inn Fields, London.
Potter, Edmund, 4, Fountain St., Manchester.
Potter, John, Evesham, Worcestershire.
Potter, Vincent, Manchester.
Pow, Robert, North Shields.
Price, William, Mosley Street, Manchester.
Pringle, Captain, Athenæum, Pall Mall, London.
Procter, Daniel, Manchester.
Procter, James, Manchester.
Pryce, John, York Place, Oxford Road, Manchester.
Purdon, Wellington, Woodhead, Manchester.
Quirk, Richard, Douglas, Isle of Man.
Radford, Thomas, M.D., Higher Broughton, Manchester.
Ransome, J. A., St. Peter's Square, Manchester.
Rattray, William, Aberdeen.
Rawson, Henry, jun., Manchester.
Ray, Andrew, Pendleton, Manchester.
Ray, James, Sheffield.
Reade, Joseph, M.D., St. Patrick's Hill, Cork.
Ree, H. P., 11, Nicholas Street, Mosley St., Manchester.
Reid, John, Bank of England Branch Bank, Manchester.
Remington, Rev. Thomas, Cartmel, Milnthorpe.
Renshaw, James, 4, Crescent, Salford.
Riach, James P., Perth.
Robberds, Rev. C. W., Mansfield, Nottinghamshire.
Robberds, Rev. John, B.A., 18, Park Street, Park Road, Liverpool.
Robinson, Frederick, Mulberry Street, Manchester.
Robinson, Samuel, Dukinfield, Manchester.
Robinson, Thomas, Settle.
Roby, John, Rochdale.
Rooke, John, Akehead, Wigton, Cumberland.
Rooker, Alfred, Plymouth.
Ross, Malcolm, Moston House, Manchester.
Royle, Vernon, Prestwich, Manchester.
Ryland, Rev. John Howard, New College, Manchester.
Sadler, Michael F., Palace Square, Market Street, Manchester.
Salkeld, Rev. Edward, Aspatria, Cumberland.
Satterthwaite, Thomas, Salford, Manchester.
Saull, William D., F.G.S., Aldersgate Street, London.
Schwabe, Louis, Portland Street, Manchester.
Schunck, Edward, Ph.D., 21, Cooper Street, Manchester.
Schunck, Martin, Cooper Street, Manchester.
Schwabe, Salis, 38, Mosley Street, Manchester.
Scott, John Haigh, 4, Liverpool Terrace, Salford.
Sellers, John, Ingleton, Yorkshire.
Sever, Charles, Pool Fold, Manchester.
Sharp, Robert C., Bramhall Hall, Cheshire.
Shaw, Alexander, 23, Henrietta Street, Cavendish Square, London.
Shaw, Sir Charles, 79, Plymouth Grove, Chorlton-upon-Medlock.
Shaw, Benj. L., Honley, Huddersfield.
Shimwell, Isaac, Manchester.
Shuttleworth, J. G., Tiverton Street, Hyde Road, Manchester.
Simpson, William, 69, Market Street, Manchester.
Sleigh, Capt. A. W., Grosvenor Street, Chorlton-upon-Medlock.
Smith, Horatio, Strangeways Hall, Manchester.
Smith, John, Piccadilly, Manchester.
Smith, John, Kingstown, Dublin.
Smith, James, 5, Mosley Street, Manchester.
Southam, George, Salford.
Sowerby, G. B., F.L.S., 50, Gt. Russell St., London.
Spence, William, F.R.S., F.L.S., Hull.
Spence, W. B., Hull.
Spence, R. H., Hull.
Stähelin, Christ., Basle, Switzerland.
Stanger, Joshua, Wandsworth, Surrey.
Statham, Jonathan B., Manchester.
Staunton, John, Talton.
Steel, John H., New Hampshire, America.
Stephenson, James, Market Place, Manchester.
Stevelly, Professor John, M.A., Belfast.
Still, Henry, F.G.S., Ordnance Survey Office, Manchester.
Stone, Daniel, Red Bank, Manchester.

Strickland, H. E., Cracombe House, Evesham.
Surmon, Henry, Red Lion Yard, Aldersgate Street, London.
Swain, Charles, Manchester.
Talbot, William Hawkshead, Wrightington Hall, Wigan.
Taylor, Colonel, Severn, Stoke.
Thistlethwaite, William, Penketh, Warrington.
Thompson, James, Glasgow.
Thompson, James, Kirkhouse, Brampton, Cumberland.
Thompson, John, 14, St. Ann's Street, Manchester.
Thomson, Charles, Primrose, Clitheroe.
Thomson, Henry, Primrose, Clitheroe.
Thomson, James, LL.D., Professor of Mathematics in the University of Glasgow.
Thomson, John, Ardwick, Manchester.
Tootal, Edward, 13, Pall Mall, Manchester.
Tootal, Henry, Manchester.
Townend, Robert, Fountain Street, Manchester.
Townend, William, High Street, Manchester.
Trimmer, Joshua, Putney.
Tunder, F. S., Woodlands, Crumpsall, Manchester.
Turner, George, M.D., Stockport.
Turner, James Aspinall, Cross Street, Manchester.
Turner, Thomas, 67, Mosley Street, Manchester.
Turner, Rev. William, Manchester.
Turner, William, Paris.
Turner, William, Meal Street, Manchester.
Tysoe, Charles, Salford.
Vantini, Zenon, Victoria Hotel, London.
Vickers, William, jun., Nottingham.
Vignoles, Charles, Professor, University College, London; Trafalgar Square, London.
Vignoles, Hutton, C.E., Mill Street, Ancoats, Manchester.
Vivian, John Henry, St. James's Pl., London.
Waddington, David, Rusholme, Manchester.
Waddington, Nathan, Altrincham, Cheshire.
Walker, Ibotson, Altrincham, Cheshire.
Walker, John, Mosley Street, Manchester.
Walker, Samuel H., Horrabridge, Tavistock, Devon.
Walker, William, jun., Manchester.
Warington, Robert, Apothecaries' Hall, London.
Watkin, Absalom, Manchester.
Watson, James, Messrs. Jackson, Watson and Greig, Manchester.
Watt, Alexander, 15, St. Mungo Street, Glasgow.
Watts, Thomas Hodgson, M.D., Manchester.
Wellbeloved, Rev. Charles, York.
Wemyss, Colonel, Manchester.
Wheeler, Daniel, 24, West Clifton, Bristol.
Whitmore, Edward, Bank, St. Ann's Street, Manchester.
Wightman, Alexander, 2, Dover Street, Chorlton-upon-Medlock.
Wilkinson, M. A. Eaton, M.D., 37, George Street, Manchester.
Williams, Cadogan, New Casher, Glamorganshire.
Williams, Richard Thomas, Bristol.
Williams, Thomas Hartley, Manchester.
Williamson, Edward Henry, Holywell.
Williamson, James, M.D., Stretton Hall, Chester.
Wilson, Rev. John, Manchester.
Winkworth, Henry, Polygon Avenue, Ardwick, Manchester.
Winkworth, Thomas, 44, Gutter Lane, London.
Winter, Gilbert, St. Ann's Street, Manchester.
Wood, Charles, Brazennose Street, Manchester.
Wood, Charles Hurd, Brazennose Street, Manchester.
Woodcroft, Bennett, Ardwick Green, Manchester.
Worthington, Edward, Fountain Street, Manchester.
Worthington, John, Brocklehurst Hall, Northwich.
Worthington, Thomas, Manchester.
Wray, Rev. Cecil Daniel, M.A., Seedley, Manchester.
Yates, Joseph St. John, St. James's Chambers, Manchester.
Young, James, Lesmahagow.

PRINTED BY RICHARD AND JOHN E. TAYLOR,
RED LION COURT, FLEET STREET.