session by Sir John Lubbock.

FRIDAY.

Department of Zoology and Botany.

The members of the Section assembled to hear the introductory address of the President of the Department of Anatomy and Biology. This having been delivered, the regular business was commenced by a description, by Dr. SCLATER, of a new species of rhinoceros, *R. lasiotis*, captured near Chittagong, and distinct from *R. Sumatrensis*. Six species of the genus were therefore now known. The animal was living in the Zoological Society's Gardens.—In answer to General STRACHEY, Dr. SCLATER said that nothing was known of the Rhinoceros which within the historic period existed on the Indus; but the examination of caves might bring some of its remains to light.

Mr. GWYN JEFFREYS read a paper 'On the Mollusca of Europe and East and North America.' Comparing the molluscan Fauna of Europe with

THE

ATHENÆUM

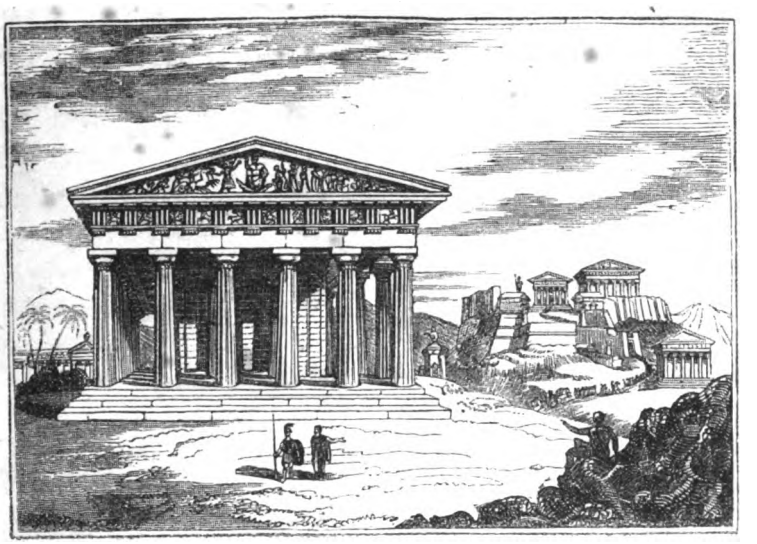
JOURNAL

OF

LITERATURE, SCIENCE, THE FINE ARTS, MUSIC, AND THE DRAMA.

JULY TO DECEMBER,

1872.



LONDON:

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MDCCCLXXII.

THE ATHENÆUM

Journal of English and Foreign Literature, Science, the Fine Arts, Music and the Drama.

No. 2339. SATURDAY, AUGUST 24, 1872. PRICE THREEPENCE REGISTERED AS A NEWSPAPER

India Office, 27th Sept., 1871.

BY ORDER of the SECRETARY of STATE for INDIA in COUNCIL.

NOTICE is HEREBY GIVEN, that Appointments to the Indian Public Works Department of Assistant-Engineer, Second Grade, Salary Rs. 4,200 (about £421) per annum, will be available in 1874, for such Candidates as may be found duly qualified.

For further particulars apply, by letter only, to the Secretary, Public Works Department, India Office, S.W.

NOTICE.—The ARCHIEPISCOPAL LIBRARY at LAMBETH PALACE will be CLOSED for the Vacation, from the 30th of August, for SIX Weeks.

Lambeth Library, 24th August, 1872.

ROYAL ACADEMY of ARTS.—A MASTER is REQUIRED who shall undertake the duties of Curatorship in the Upper and Preliminary Schools of Painting. In the latter School, in which oil paintings and objects of still-life will be placed as models before the Students, he will be expected to Teach the Technical Processes of the Art, and to give general information as to the practice of the various Schools of Painting. The salary will be 200l. rising.—Applicants are requested to send in their names, together with evidences of their ability, on or before the 16th of November.

JOHN PRESCOTT KNIGHT, R.A., Secretary.

ANDERSON'S UNIVERSITY, GLASGOW.—The Trustees invite Candidates for the Chairs of NATURAL PHILOSOPHY and MEDICAL JURISPRUDENCE.—Applications to be lodged on or before the 28th of August with the Secretary, who will furnish information regarding the duties and terms of the appointments.

J. B. KIDSTON, Secretary.

90, West Regent-street, Glasgow, 7th August, 1872.

TEACHER OF FOREIGN LANGUAGES WANTED.

ROYAL BELFAST ACADEMICAL INSTITUTION.

A VACANCY now occurs in the FOREIGN LANGUAGE DEPARTMENT of the Royal Academical Institution, Belfast. The Teacher must be competent to give instruction in FRENCH and GERMAN. The Remuneration of the Teacher arises from the Fees of the Pupils, which, at the present time, amount to about 300l. per annum. He will be expected to commence his duties, if possible, on the 1st of November next.—For the other conditions, application to be made to Mr. WILLIAM STRAIN, Assistant-Secretary, Linen Hall, Belfast, to whom Testimonials must be forwarded, not later than the 16th of September.

W. J. C. ALLEN, Secretary.

Belfast, August 15, 1872.

GUILDHALL COMMERCIAL SCHOOL, BURY ST. EDMUND'S.

SCHOOLMASTER FOR 150 BOYS WANTED.

The Master, who must be a Member of the Church of England, is to teach Reading, Writing, English Grammar, Arithmetic, Geography, History, and the Elements of Mathematics and of the Latin and Greek Languages. Salary, 150l. per annum, and 5s. per Quarter from each Boy. The Master will not be allowed to take Boarders. 10l. for Coals and Forms for the School-room will be allowed by the Trustees of the School.

An Under Master will be appointed by the Trustees to assist the Head Master in the duties of the School.

The Master will be expected to enter upon his duties at the close of the next Christmas Holidays.

Applications to be made to JAMES SPARKE, Esq., Solicitor to the Trustees, Bury St. Edmund's, of whom further particulars may be had, and at whose Office the Charity Commission Scheme for the Regulation of the School may be seen. Testimonials, sealed and post paid, and directed to the Trustees of the Guildhall Feoffment, to be forwarded, under cover, to him on or before the 1st day of November next.

JAMES SPARKE, Solicitor to the Trustees of Guildhall Feoffment.

Bury St. Edmund's, August 15, 1872.

THE OWENS COLLEGE, MANCHESTER.

The next Session commences on the 7th October.

Candidates for Admission must not be under fourteen years of age, and those under fifteen will be required to pass a preliminary examination in English, Arithmetic, and the Elements of Latin.

Prospectuses of the several Departments of the Day Classes, the Evening Classes, and the Medical School, and of the Scholarships and Entrance Exhibitions tenable at the College, will be sent on application.

J. G. GREENWOOD, Principal.
J. HOLME NICHOLSON, Registrar.

KING'S COLLEGE, LONDON.—The PROSPECTUS for the ensuing ACADEMICAL YEAR is now ready. The College is close to the Temple Station of the Metropolitan Railway, and there is an entrance to it from the Thames Embankment.—Apply, personally or by postage-card, to J. W. CUNNINGHAM, Esq., Secretary.

FOUNDED 1849. INCORPORATED 1869.

BEDFORD COLLEGE (for LADIES), 48 and 49, Bedford-square, London.—The SESSION, 1872-73, will BEGIN on THURSDAY, October 10.

Two ARNOTT SCHOLARSHIPS, giving free admission for two years to five classes, will be OPEN for competition by examination at the beginning of next October. Candidates are requested to send their names to the Secretary before September 1. Prospectuses, with particulars of scholarships, boarding, &c., may be had at the College.

JANE MARTINEAU, Hon. Sec.

THE LONDON INTERNATIONAL COLLEGE.

Founded under the auspices of the late Richard Cobden; inaugurated 16th July, 1867, by H.R.H. the Prince of Wales.

Principal—Dr. L. SCHMITZ, F.R.S.E. (late Rector of the High School, Edinburgh).

Vice-Principal—M. S. FORSTER, B.C.L. M.A. Oxford.

The aim of this College is to afford an Education of the highest order, harmonising with the wants and spirit of the age. Unfettered by traditional usages, this College assigns a prominent place in its curriculum to Modern Languages and the Natural Sciences.

The AUTUMN TERM will COMMENCE on WEDNESDAY, 18th SEPTEMBER, 1872.

Applications for Admission should be addressed to the Secretary, at the College, Spring Grove, near Isleworth, Middlesex.

DERBY SCHOOL.—An EXHIBITION (52l. 10s. per annum), tenable at Cambridge for three years, will be offered for COMPETITION in June, 1873. Boys entered next Michaelmas Term will be eligible.

THE COLLEGE, WESTON-SUPER-MARE.—The ensuing TERM will COMMENCE on THURSDAY, 12th of September.

A Prospectus will be sent on application to the Rev. the HEAD MASTER.

LADIES' COLLEGE, DUFFIELD HOUSE, LOWER NORWOOD, SURREY. *Principals*—Mrs. and Miss RICHARDSON.—The NEXT TERM will commence (D.V.) the 17th September. Fees, 61, 85, or 100 Guineas, the latter including Riding Lessons and Crystal Palace Ticket. Examinations at the end of each Term.

BRIGHTON COLLEGE.—*Principal*—The Rev. C. BIGG, M.A., Late Senior Student and Tutor of Christ Church, Oxford.

The NEXT TERM will COMMENCE on TUESDAY, September 24.

The College is liberally endowed with Scholarships, tenable both at the College and at Oxford and Cambridge.—Full particulars may be obtained from the Rev. the SECRETARY, Brighton College.

DOVER COLLEGE.

President—The Right Hon. Earl Granville, K.G.

Head Master—Rev. Wm. Bell, M.A. Christ College, Cambridge.

Terms—Tuition fees from Ten to Fifteen Guineas per Annum, according to age. Charge for Boarders in Head Master's House, 40l., in addition to School Fees.

The College will RE-OPEN on WEDNESDAY, September 18.

WIMBLEDON SCHOOL, SURREY, S.W. *Head Masters.*

Rev. JOHN M. BRACKENBURY, M.A., of St. John's College, Cambridge.

Rev. CHARLES J. WYNNE, M.A., of Jesus College, Oxford.

Assisted by Nine Resident Masters and other Professors.

The chief aim of this School is to combine the tone and discipline of the great schools with especial means of advancement in all the different studies that have been introduced into the competitive examinations for Military, Naval, and Civil Appointments.

The School, which is limited to one hundred boys, is divided into small classes, so that each boy receives much attention individually.

The Honours obtained during the last ten years include eighty successful Candidates for the competitive examination for Woolwich and ninety for Sandhurst, and of these six have at different times obtained the first place on the Lists.

The NEXT TERM commences on TUESDAY, the 3rd of September.

For further particulars apply to either of the Head Masters.

BELSIZE COLLEGE for LADIES, 43, Belsize-park-gardens, Hampstead, N.W.

The COLLEGE will RE-OPEN on WEDNESDAY, September 25th.

The Course of Study embraces all the branches of a solid High-class Education, including the English, French, German, Italian, Latin, and Greek Languages, Lectures on Literary and Scientific Subjects, Writing, Arithmetic, Mathematics, Drawing, Singing, Pianoforte, Calisthenics. Pupils not desirous of attending the Course may select two or more studies. A Junior Class is formed for Pupils from Five to Twelve Years of Age. The Lectures are open to adults. Classes are formed in any of the Languages on the entry of six names. Professors in attendance—W. Hughes, Esq., F.R.G.S., A. Bernard, Esq., M.A., of the University of Paris, Prof. Buchheim, Ph.D., T. H. Wright, Esq., Prof. Voipe, J. Tennelli Calkin, Esq., from the Conservatoire, Milan, Walter Macfarren, Esq., Herr Althaus, Frederic Nash, Esq., W. Henry Fisk, Esq., London University College, Claude Heyes, Esq. —Prospectuses, with full particulars of Board, Fees, &c., may be had on application to Miss HASWELL, at the College.

EDUCATION in BERLIN.—Fräulein GOERING receives a LIMITED NUMBER of YOUNG LADIES. Especial care is devoted to the study of Music and Languages. House and Garden situated in the healthiest part of Berlin. Fräulein Goering was some years in England, and the family in which she lived will be most happy to give her the highest recommendations. German references can be had on application to Miss Goering, Neu-Schoenberg 1, Berlin. English references:—Laura Lady Peyton, Stratton Audley, Bicester; and Mrs. H. B. Hankey, Aldingbourne House, Chichester.

EDUCATION.—SCHOOL for the DAUGHTERS of GENTLEMEN, in the best part of BRIGHTON. Established more than twenty years. Resident Foreign Governesses and the first Professors. Reduced terms arranged for Children of Clergymen and Professional Men of good family.—For Prospectus and References, address R. S. T., care of Messrs. Treacher, North-street, Brighton.

EDUCATION in the LAKE DISTRICT.—The Rev. JOHN RUSSELL desires to receive ONE or TWO PUPILS to Board and Educate.—10, Cliff-terrace, Kendal.

BRIGHTON.—A VACANCY offers after the Vacation for a YOUNG LADY to be received into a select and long-established SCHOOL on eligible terms. The Instruction embraces English in all its branches, with the use of the Globes, Music by an eminent teacher, French and German by native ladies. The highest references given to several parties who have had Daughters educated and finished in the Establishment, as well as to the Pupils themselves. Terms, with Laundress, Fifty Guineas per annum, without any extras of any kind.—Letters addressed to Mrs. HONINGTON, Post-Office, Hornsey-road, will be forwarded.

INDIAN CIVIL ENGINEERING COLLEGE, COOPER'S HILL.

Candidates for Admission are specially prepared by the Rev. Dr. WRIGLEY, M.A., M.D., F.R.A.S., formerly Professor of Mathematics, Addiscombe, and late Examiner of Candidates for Appointments in the Indian Civil Engineering Service. Pupils may be Resident or Non-resident.—Address 67, High-street, Clapham, S.W.

TRAVELLING TUTOR.—An English Gentle- man, who has graduated with honours at the Dublin University, and acquired in Berlin a thorough knowledge of German, wishes for an ENGAGEMENT as above—B.A., L.L.B., care of Mr. Gammell, Bookseller, 35, High-street, Camden Town, London, N.W.

MISS GLYN'S SHAKSPEARIAN READINGS. —Arrangements are now being made for AUTUMN and WINTER READINGS, and Mrs. Dallas-Glyn will Teach Reading and Elocution during her leisure from public engagements. Letters to be addressed to Mrs. Dallas-Glyn, care of Mr. Carter, 6, Hanover-square, W.

READINGS by F. KEMPSTER, M.A. Oxon.—Mr. KEMPSTER will be glad to arrange for his DRAMATIC and HUMOROUS READINGS.—For Terms and Opinions of the London and Provincial Press, address Mr. KEMPSTER, Mr. Goodwin's, 15A, Leicester-place, Leicester-square, London.

TO LITERARY INSTITUTES.—Madame RONNIGER will be happy to enter into Arrangements with the above for her "Shakespearean and Miscellaneous Readings."

Also for her Lectures on "Macbeth," with Illustrative Readings; "The Great German Composers," "The Songs of Scotland," and other Subjects.—For Opinions of the Press, &c., address Madame RONNIGER, 1, Abingdon Villas, Kensington, London, W.

Madame R. will Lecture at the EDINBURGH LITERARY INSTITUTE, on January 29th, and for the PETERHEAD YOUNG MEN'S CHRISTIAN ASSOCIATION, on February 4th, and can accept engagement *en route*.

(Organized 1866.) (Capital, 50,000 dollars.)

AMERICAN LITERARY BUREAU, an Agency for Lecturers, Readers, Singers, Authors, &c.

Chief Office—COOPER INSTITUTE, NEW YORK CITY.

Solicits Correspondence with persons meditating a Professional Visit to America.

References in England: J. A. Froude, Edmund Yates, Justin M'Carthy, S. Phillips Day, Mrs. Scott-Siddons, Mrs. Dallas-Glyn, Wilkie Collins, James M. Wehli, Henry Nichols, &c.

CABINET COLLECTION of PICTURES, including some fine Examples by Old Crome, Müller, The Carracci, Breughel, &c., and a *chef-d'œuvre* by Jan Molenaer, representing a Village Fête, containing nearly 100 Figures, this and several others being signed and dated.

On View at MATTHEW THOMPSON'S, 25, Wigmore-street, Cavendish-square.

Admission by private address card, between the hours of 10 and 5 o'clock.

HIGH-CLASS PICTURES of the British and Foreign Schools, and a Collection of choice WATER-COLOUR DRAWINGS, selected with the greatest care from the Easles of the different Artists, always ON VIEW at T. M'LEAN'S New Gallery, 17, Haymarket (next door to the Theatre).

J. C. STEVENS'S SCIENTIFIC, NATURAL HISTORY, and HORTICULTURAL SALE ROOMS, 38, King-street, Covent-garden, London. Established 1760. Sales by Auction nearly every day. Catalogues on application.

NEGLECTED CLASSICS.—Gentlemen (Adults) wishing to commence, or to complete, the Study of GREEK or LATIN, are invited to apply to a Teacher of much experience, whose Books and System of Teaching have been reviewed and highly recommended by the late Rev. Sydney Smith, Macaulay, and other great Authorities.—Address ZETA, 2, Ballarat-terrace, Richmond, S.W.

A GENTLEMAN, who has a SON about entering Cambridge next year, wishes to place him in the mean time in the FAMILY of a CLERGYMAN, or Gentleman of religious principles, with whom he could read.—Address H. B., care of Barker & Co., 1, Castle-court, Cornhill, E.C.

A GENTLEMAN, well-acquainted with MS. and RECORDS, is prepared to MAKE SEARCHES, &c. and TRANSLATIONS from the Public Records, or any other Repository of MS.—Address SCRUTATOR, 115, Cornwall-road, Westbourne Park, London.

TO AUTHORS, &c.—INDEXES carefully com- piled, MSS. prepared for the Press, and Proof-Sheets corrected, by a Printer's Reader of many years' experience. Terms moderate.—INDEX, 49, Gibson-square, Islington, N.

PARTNERSHIP.—A Gentleman having capital may connect himself with a First-class Literary Publication.—Principals may address in confidence to M. E. S., care of Mr. Todd, Percy Chambers, Northumberland-street, Strand.

THE PRESS.—The Advertiser, who has had Twenty-five Years' Practical Experience in Newspaper Work as Printer, Reporter, Sub-editor, &c., is open to an ENGAGEMENT.—Address ARGUS, 8, St. James's-street, Ashley-road, Bristol.

TO EDITORS, &c.—PARIS CORRESPON- DENCE.—A Journalist of experience is at liberty to contribute a DAILY or WEEKLY PARIS LETTER to a First-class London, Provincial, or American Paper. Entrée into Society. Published specimens forwarded.—Address EDITOR, Poste Restante, Paris.

PUBLISHER.—A Gentleman will be shortly DISENGAGED. He has for nine years been Publisher to a First-Class Literary Journal, and has a large Advertising Connexion with Publishers and General Advertisers. Could accept the Agency of an American or Provincial Newspaper.—Address W. A., 17, Royal Exchange, E.C.

THE PRESS.—WANTED, an efficient RE- PORTER for a Local Journal. Must be a Verbatim Shorthand Writer and a good Paragraphist.—Apply to Messrs. BRAGG & SON, Taunton.

TO BOOKSELLERS and STATIONERS.—Wanted, at Michaelmas next, an efficient ASSISTANT as MANAGER under the Principal in a first-class business in the West of England, to board and lodge in the house. He must be well up in Modern Books, and be a Churchman. A good address and manners indispensable. To a respectable and energetic young man, a comfortable home and liberal salary is offered.—Letters, stating age, experience, salary required, with references, &c., addressed LIBER, to the care of Messrs. Hamilton, Adams & Co. Paternoster-row, London.

Ex uno disce omnes. Mr. Robinson is a smart enough theatrical writer, but in the present volumes has shown no turn for anything of more lasting value.

LIST OF NEW BOOKS.

Theology.

Davies's (J.) Notes on 2nd Samuel, 12mo. 1/6 cl. swd.
Foster's (Rev. R. S.) Christian Purity, 12mo. 1/6 cl.
Jesus Christ's Way or My Own Way, 12mo. 1/ cl. swd.
Vernon's (Rev. J. E.) Catholic Sermons for Children, 1st series, cr. 8vo. 2/ packet.

Music.

Hiles's (H.) The Wesley Tune-Book, roy. 16mo. 3/ cl.

History.

Hunter's (W. W.) Annals of Rural Bengal, Vol. 1, 5th edit. 18/
Lawrence's (Sir H.) Life, by Edwardes and Merivale, 2nd edit. 2 vols. 8vo. 32/ cl.

Geography.

Black's (G. B.) Paris and Excursions from Paris, 12mo. 2/6 cl.

Philology.

Nugent's French and English Dictionary, by Brown and Martin, 2 vols. 32mo. 1/6 each, cl.

Science.

Dunster's (Rev. H. P.) Young Collector's Handbook of Recreative Science, 12mo. 3/6 cl.

General Literature.

Churchman's Shilling Magazine, Vol. 11, 8vo. 7/6 cl.
Elijer Goff, his Travels, &c., cr. 8vo. 1/ swd.
Fenton's (E. D.) Military Men I have Met, 8vo. 7/6 cl.
Fonblanque's (A. De) How We are Governed, new edit. 2/6cl.
Grant's (J.) Jack Manly, new edit. 12mo. 2/ bds.
Hook's (T.) Ramsbottom Letters, 12mo. 1/ swd.
Innocents (The) Abroad, by Mark Twain, Author's English Edit. 12mo. 1/ swd.
Lee's (H.) Wortlebank Diary, 12mo. 2/ bds.
Loudon's (Mrs.) The Mummy, a Tale, 12mo. 2/ bds.
New Pilgrim's Progress, by Mark Twain, Author's English Edit. 12mo. 1/ swd.
Our Farm of Four Acres, 5th edit. 12mo. 2/ bds.
Practical Jokes with Artemus Ward, by Mark Twain, 12mo. 1/
Prior's (R. C. A.) Notes on Croquet, 8vo. 3/6 cl.
Spry's (Capt. F.) Guide to Schools of Instruction for Officers of the Auxiliary Forces, 18mo. 2/ roan limp
Talmage's (Rev. T. de W.) Abominations of Modern Society, with Portrait, cr. 8vo. 4/ cl.
Thackeray's Works, Pop. Edit. Vol. 12, 'Christmas Books,' 5/ cl.
Weylland's (J. M.) The Man with the Book, 3rd edit. 12mo. 3/6

Literary Gossip.

THE title of the novel on which the author of 'The Caxton Family' is engaged is 'Kenelm Chillingly: his Adventures and Opinions.'

THE world is likely to get an answer to Mr. Browning's question, which so many have echoed,—

> What's become of Waring
> Since he gave us all the slip,
> Chose land-travel or sea-faring
> Boots and chest, or staff and scrip,
> Rather than pace up and down
> Any longer London-town?

Mr. Alfred Domett, to whom the poem referred, is announced as the author of 'Ranolf and Amohia: a South Sea Day-Dream,' just published. Possibly, as it is, alas! so many

> Years ago when he was young,

the new poet may be a son of him who was last heard of on board the felucca which overhauled the "English brig" while "sailing by Triest" not less than thirty years ago. However this may be, for the sake of the friend who has delighted so many, we promise *this* Mr. Alfred Domett

> A clear stage and a crowd to see.

WE hear that a novel by the author of 'The Coming Race' will commence in the October number of *Blackwood*.

MAJOR FRANCIS DOYNE DWYER is engaged upon a Life of Charles Lever, including extracts from his correspondence. Lever was a charming letter-writer.

THE great preliminary Class Catalogue of Manuscripts in the British Museum approaches completion. It will probably be finished by Christmas, and is the result of seven years' hard work on the part of the Keeper, Mr. E. A. Bond, and his able staff. The next step will, we believe, be the re-examination of all the manuscripts imperfectly described in the old catalogues, and a re-classification of the whole by languages, in addition to the present classification by subjects. Is it too much to hope that the Printed Book Department will some day follow the good example of the Manuscript one?

A PRIVATELY printed volume has just been issued under the editorship of Mr. James Croston, of Manchester, author of 'On Foot through the Peak.' It is 'A History of the Ancient Hall of Samlesbury, in Lancashire,' with an account of its early possessors, and particulars relating to the more recent descent of the manor. Samlesbury is a picturesque old mansion, the residence of Mr. William Harrison, whose taste has rendered it an object of much interest apart from the old associations connected with it; it dates from the time of Edward the Third. The book in question is handsomely printed, and the illustrations are artistically executed.

M. HENRI BORDIER, of the National Library, Paris, has lately utilized the important MSS. relating to the French Protestant refugees, preserved in the Lambeth Library, by making copious extracts, with a view to the preparation of the supplement of MM. Haag's work, 'La Trame Protestante.' M. Bordier has compiled, with M. Charton, an illustrated History of France, 2 vols., 1869, which, with other books, he presented to the Lambeth Library.

WITH the close of the Session of Parliament we receive the monthly list of Parliamentary Papers for July. It contains few of general interest. The Reports and Papers are seventy-two in number, and all for the current year, so that arrears for the first time are made up. Bills are sixty-eight in number, and Papers by Command thirty-one. Of these the most voluminous is the Second Report of the Friendly and Building Societies Commission, with evidence, costing six shillings and eightpence. There is also the Report of the Meteorological Committee of the Royal Society for 1871, the third of the Commercial Reports from H.M. Secretaries of Embassy and Legation, and a Report as to Trade-Marks in Foreign Countries. The Papers relating to the Direction and Management of Kew Gardens are among the Reports and Papers, and we blush for the effect which their perusal is calculated to produce, especially among the cultured classes on the Continent.

DR. ZUPITZA, Professor of North Germanic Philology at the University of Vienna, and editor of several Middle High German poems, &c., is engaged in preparing an edition of the Early English romance of Guy of Warwick, and has, for that purpose, consulted the Advocates' Library of Edinburgh and the various libraries of the University of Cambridge. He is also preparing a most valuable auxiliary for Eddaic students, in the shape of an exhaustive glossary to the poetic or older Edda of Sæmund Sigfusson.

MR. ROACH SMITH, writing to us with reference to the announcement in our last number of a continuation of his 'Collectanea Antiqua,' says, "I do not think I should be warranted, in justice to the subscribers, in reprinting the six volumes; but I contemplate writing a copious review of the whole, which will include the progress of archæology to the present time."

THE *Figaro* announces that a new drama, by M. Victor Hugo, will be finished before the winter.

IN addition to the Monthyon Prizes awarded by the French Académie already mentioned, three prizes of 1,500 francs were given to M. Faure, for his work on 'Antoine de Laval et les Écrivains Bourbonnais de son Temps,'—to M. Imbert de Saint-Amand, for a work entitled 'L'Abbé Deguerry, Curé de la Madeleine,'—and to M. Delpit, for a collection of poems entitled 'L'Invasion.'

IN our paragraph on the manuscripts of the Canterbury Tales last week, we gave the wrong name to the type of MS. from which the Hengwrt MS. was filled in: it should have been Corpus, and not Harleian.

SCIENCE

BRITISH ASSOCIATION.

SECTION A.—MATHEMATICAL AND PHYSICAL SCIENCE.

President—Warren De La Rue.

Vice-Presidents—Prof. G. C. Foster, Prof. F. Fuller, Prof. J. Glaisher, Lord Lindsay, J. N. Lockyer, Prof. Phillips, Prof. H. J. S. Smith, W. Spottiswoode, Sir W. Thomson, Sir C. Wheatstone.

Secretaries—Prof. W. K. Clifford, J. W. L. Glaisher, Prof. A. S. Herschel.

Committee—A. Bennett, G. Bontemps, Prof. Crum Brown, H. Claudet, Prof. Clifton, E. Crossley, Prof. M. Croullebois, G. Dines, Prof. Everett, W. de Fonvielle, G. Forbes, Prof. G. Fuller, J. P. Gassiot, Dr. J. H. Gladstone, Rev. R. Harley, Rev. W. Harpley, Prof. Hilgard, Dr. J. Hopkinson, Rev. F. Howlett, W. Ladd, Dr. Mann, Capt. Maclear, Don Arturo de Marcoartu, C. W. Merrifield, Vice-Admiral E. Ommanney, Prof. Rankine, Admiral Richards, Lieut.-Col. A. Strange, G. J. Symons, C. Talmage, C. V. Walker, F. H. Wenham, Prof. A. Williamson, Prof. Ch. V. Zenger.

THURSDAY.

The PRESIDENT began by stating that he had chosen as the principal subject of his address Astronomical Photography. That the transit of Venus would be recorded by photography might be regarded as certain, as preparations for obtaining photographic records were being made in England, France, Russia and the United States. It was advantageous, therefore, to ascertain the comparative advantages of the photographic and the direct observational methods. The speaker then referred to the results obtained by the late Prof. Bond, at Harvard College Observatory, where stellar photography had been used for some time, to Mr. Rutherford's recent reproductions of stars by photography, and the opinions of Mr. Asaph Hull on the value of the photographic method. With regard to contact observations, Mr. De La Rue conceded that there will attach to the record of the internal contact a certain amount of uncertainty, although not so great as that which affects optical observation. The photograph which first shows contact may possibly not be that taken when the thread of light between Venus and the sun's disc is first completed, but the first taken after it has become thick enough to be shown on the plate; and this thickness is somewhat dependent on incidental circumstances—for example, a haziness of the sky, which, although almost imperceptible, yet diminishes the actinic brilliancy of the sun, and might render the photographic image of the small extent of the limb which is concerned in the phenomenon too faint for future measurements. The speaker then discussed the danger of optical distortion, and the ways of obviating it.

Mr. De La Rue proceeded to point out what had been effected by solar photography. He said, it will be recollected that in 1860, for the first time, the solar origin of the prominences was placed beyond doubt solely by photography, which preserved a faithful record of the moon's motion in relation to these protuberances. The problem of the solar origin of that portion of the corona which extends more than a million of miles beyond the body of the sun, has been, by the photographic observations of Col. Tennant and Lord Lindsay

in 1871, set finally at rest, after having been the subject of a great amount of discussion for some years. The spectroscopic discovery, in 1869, of the now famous green line, 1474 K, demonstrated undoubtedly the self-luminosity, and hence the solar origin of part of the corona. The observations of 1871 have proved hydrogen to be also an essential constituent of the "coronal atmosphere," as Janssen proposes to call it,—hydrogen at a lower temperature and density, of course, than in the chromosphere. Janssen was further so fortunate as to catch glimpses of some of the dark lines of the solar spectrum in the coronal light—an observation which goes far to show that in the upper atmosphere of the sun there are also solid or liquid particles, like smoke or cloud, which reflect the sunlight from below. The speaker then referred to many problems, as yet unsolved, connected with the corona, and to the aid for their settlement afforded by photography.

In connexion with the solution of the most prominent questions connected with the solar envelopes, he alluded to a point conclusively decided during the last annular eclipse of the sun, observed by Mr. Pogson, on the 6th of June of this year, as described by him in a letter to Sir George B. Airy. In 1870, Prof. Young was the first to observe the reversal of the Frauenhofer lines in the stratum closest to the sun. Now, in 1871, doubts were thrown upon the subject. It appears that the reversed lines seem to have been satisfactorily observed by Capt. Maclear at Bekul, Col. Tennant at Dodabetta, and Capt. Fyers at Jaffna. The observations of Pringle at Bekul, Respighi at Paodoxottah, and Pogson at Avenashi, were doubtful, while Mosely at Trincomalee saw nothing of this reversal, which is, according to all accounts, a most striking phenomenon, although of very short duration. Mr. Lockyer missed it by an accidental derangement of the telescope. The reversal and the physical deductions from it are placed beyond doubt by Mr. Pogson's observations of the annular eclipse on June 6th. At the first internal contact, just after a peep in the finder had shown the moon's limb lighted up by the corona, he saw all the dark lines reversed and bright, but for less than two seconds. The sight of beauty above all was, however, the reversion of the lines at the breaking-up of the limb. The duration was astonishing—five to seven seconds; and the fading-out was gradual, not momentary.

After mentioning the promising attempt which has been made by Prof. Young to photograph the protuberances of the sun in ordinary daylight, Mr. De La Rue pointed out some cases where photography has failed. Nebulæ and comets have not yet been brought within the grasp of this art; although, perhaps, no branch of astronomy would gain more if we should hereafter succeed in extending to these bodies that mode of observing them. There is theoretically, and even practically, no real limit to the sensitiveness of a plate. Similarly with reference to planets great difficulties still exist, which must be overcome before their phases and physical features can be recorded to some purpose by photography; yet there is great hope that the difficulties may be ultimately surmounted. The main obstacle to success arises from atmospheric currents, which are continually altering the position of the image on the sensitive plate; the structure of the sensitive film is also an interfering cause for such small objects. A photograph taken at Cranford of the occultation of Saturn by the moon some time ago exhibits the ring of the planet in a manner which holds out some promise for the future. The moon, on the other hand, has been successfully photographed; but no use has hitherto been made of lunar photographs for the purposes of measurement. The photographs of the moon are free from distortion, and offer, therefore, material of value as the basis of a selenographic map of absolute trustworthiness, and also for the solution of the problem of the moon's physical libration. Mr. Ellery, Director of the Observatory of Melbourne, has sent over an enlargement of a lunar photograph taken with the Great Melbourne Telescope, in which the primary image is 3⅛ inches in diameter. Such lunar negatives would be admirably adapted for working out the problem of the physical libration, and also for fundamental measurements for a selenographic map; the more minute details however, would have to be supplied by eye-observations, as the best photograph fails to depict all that the eye sees with the help of optical appliances. On the other hand, selenographic positions would be afforded more free from error than those to be obtained by direct micrometrical measurements. Mr. De La Rue then mentioned the more recent work of Dr. Huggins. Dr. Huggins's results support, in a somewhat striking manner, the views which Mr. Proctor has been urging respecting the distribution of the stars in space.

Passing to the subject of comets, Mr. De La Rue gave an explanation of Prof. Zöllner's views—a theory which, he said, acquired an additional interest from Schiaparelli's discovery of the identity of the paths of certain comets with great meteor-streams, since the meteoric masses must inevitably be converted into vapour on approaching the sun, with exhibition of the characteristic appearances of the comets. The intimate connexion of planetary configuration and solar spots, of the latter and terrestrial magnetism and auroral phenomena, must, the speaker proceeded, tend to establish also a connexion between solar spots and solar radiation. It is demonstrated by the researches of Piazzi Smyth, Stone, and Cleveland Abbe, that there is a connexion between the amount of heat received from the sun and the prevalence of spots—a result clearly in harmony with those derived from recent investigations into the nature of the solar atmosphere. Further, in a paper by Mr. Meldrum, of Mauritius, to be read during the Meeting, most remarkable evidence is given on the close connexion of these phenomena. It appears that the cyclones of the Indian Ocean have a periodicity corresponding with the sun-spot periodicity; so that if an observer in another planet could see and measure the sun-spots and cyclones (earth-spots), he would find a close harmony between them. Such a connexion will probably be found to exist over the globe generally; but with reference to the Indian Ocean, it may be stated, as a matter of fact, from Mr. Meldrum's discussion of twenty-five years' observations, that in the area lying between the equator and 25° south latitude, and between 40° and 110° east longitude, the frequency of cyclones has varied during that period directly as the amount of sun-spots. Mr. Meldrum, in order to place the deductions on a still broader foundation, proposes to investigate these laws on a plan perfectly in agreement with the method of determining the areas of solar disturbances, the results of which have been published from time to time during the last ten years. Moreover, the observations on the periodic changes of Jupiter's appearance, and the observations of Mr. Baxendell, that the convection-currents of our earth vary according to the sun-spot period—all these results, seemingly solitary, bnt truly in mysterious harmony, point to the absolute necessity for establishing constant photographic records of solar and terrestrial phenomena all over the world. There is every hope of the photographic method as applied to sun-observations being joined to the work of the Greenwich Observatory; but what is further wanted is the erection of instruments for photographic records and of spectroscopes in a number of observatories throughout the world, so as to obtain daily records of the sun and to observe magnetical and meteorological phenomena continuously in connexion with solar activity. Meteorological observation is storing up useful facts; but they can only be dealt with effectually if investigated in close parallelism with other cosmical phenomena. The time has really come, not only for relieving private obervers from the systematic observation of solar phenomena, but for drawing close ties between all scattered scientific observations, so as to let one grand scheme embrace the whole; and no method seems to be so well adapted to bring about this great achievement as the method of photographing the phenomena of nature, which in its very principle carries with it all extinction of individual bias.

Col. Strange, in moving a vote of thanks, complimented the President on his success in rendering photography available for purposes of astronomical measurement, and thus accomplishing what the most eminent astronomers had believed to be impossible.—Sir W. Thomson, in seconding the motion, passed some remarks on Zöllner's theory of comets. It reminded him forcibly of a discussion which took place at a meeting of workmen at Millwall. One of them brought forward a glass tube, drew an iron wire through it, and laid it down, and after a few minutes the glass tube cracked. This is a curious phenomenon, and not easily explained. A discussion took place as to its cause, and many explanations were proposed; but the conclusion finally adopted was that it was electrical. *Omne ignotum pro electrico* expresses the whole foundation of Zöllner's theory.

The 'Report of the Eclipse Committee,' by Mr. Lockyer and Dr. Thomson, was then read.—In response to the request of the British Association, the Government had given 2,000*l.* to aid in the work. The Melbourne Expedition failed from bad weather, but the Indian Expedition was successful. The observers selected various stations in Southern India along the line of totality, and at one place only was the eclipse obscured by clouds. It was demonstrated that hydrogen exists at 8′ or 10′ at least above the sun. It was also proved that there was strong radial polarization of the corona. Some photographs were taken, chiefly at the expense of Lord Lindsay, and these proved the corona to be higher than seen by the spectroscope.

Prof. Clifford explained that the radial polarization settles the fact of there being floating clouds of solid or liquid matter in the corona.

The 'Report on Lunar Objects suspected of Change' was read by Mr. Birt.—As the last Report dealt with the observations of the spots on the floor of the Crater Plato, from which it appeared that changes within the area of the crater had been in progress during the two years of observation, so the Report presented to this meeting dealt with the observations of the streaks and the colour of the floor. The principal result of the second discussion appeared to be that changes in the appearance and luminosity of the streaks had been detected, and these changes were of such a character that they could not be referred to changes of illumination, but depended upon some agency connected with the moon itself, while the colour of the floor was found to vary as the sun ascended in the lunar heavens, being darkest with the greatest solar altitude. The Report was accompanied with curves from which the relation of the sun's altitude to the various degrees of tint observed on the floor as of cause and effect was readily deducible. These Reports on the appearances of the spots and streaks indicate the strong probability that if further observations are undertaken, definite changes of an interesting character on the moon's surface are likely to be discovered.

A paper, by Mr. A. Schuster, of Owens College, 'On the Spectrum of Hydrogen,' described observations, the result of which was to confirm Angström's view, that the so-called second spectrum of hydrogen is due to the presence of impurities, such as the effluvium from the tubes, and grease from the greased stoppers.

Mr. G. Forbes, son of the late Principal J. D. Forbes, read a paper 'On Astronomical Refraction,' the object of which was to prove the necessity of applying a correction for the barometric difference between the place of observation, and places in the direction of the star whose zenith distance is observed. If these places have a higher barometer than the place of observation, the amount of refraction will be increased. This result may be arrived at, either by supposing a homogeneous atmosphere, whose height at any place is given by the barometer, or by supposing a plane of equal density drawn through the place of observation, and supposing the refraction to be that due to

altitude above this plane instead of above a horizontal plane.

FRIDAY.

A paper, by the Hon. J. W. STRUTT, 'On the Application of Photography to Copy Diffraction Gratings,' described the successful attempts of the author to produce copies of a grating by Nobert an inch square. They are taken by putting a dry tannin plate of worked glass in contact with the original. In this way excellent gratings can be produced at a price of 10s., whereas the price of the original was 20*l*. Several of the gratings thus obtained, having 3,000 lines to the inch, were exhibited by Mr. Ladd in the Section, and also at the Soirée, on Thursday evening, one of them being mounted in a spectroscope, so as to serve the purpose of a prism. Diffraction spectra have the advantage of giving always the same relative distances between the fixed lines, but are greatly inferior to prismatic spectra in brightness.

Mr. T. GAFFIELD, of Boston, U.S., read a paper 'On the Action of Sunlight on Colourless and Coloured Glass.'—He showed that most samples of glass, especially those containing manganese, become coloured more or less by the action of light, and referred to the fact that the glass in the stained-glass windows of cathedrals has changed somewhat from the original colours: these colours, however, could be restored by subjecting the glass to the action of heat.

M. BONTEMPS said that he had found glass containing manganese useless for lighthouse lenses, but that glass containing lead did not change colour.—Mr. WENHAM said that traces of carbon would colour glass, but the mixture of a little nitre with the materials would get rid of this colouration. He believed Mr. Gaffield's discovery of the restoration of the original colour by heat to be new.

Dr. HOPKINSON read a paper 'On a Nautical Photometer.'—It consisted of a pair of Nicol's prisms, mounted in a tube, and the intensity of the distant feeble light was deduced from the amount of rotation of one of the prisms necessary to quench it.

A paper, by Prof. J. THOMSON, was read, entitled 'Relations between the Gaseous, the Liquid, and the Solid States of Matter.'—One of its most prominent points referred to the condition of water in contact with steam at temperatures below the normal freezing point. The author maintained that the pressure of the steam in such circumstances was greater than the pressure of steam in contact with ice at the same temperature, and gave an elaborate demonstration, based on the impossibility of creating energy.

SECTION B.—CHEMICAL SCIENCE.

President—Dr. J. H. Gladstone.

Vice-Presidents—F. A. Abel, Dr. Crum Brown, Prof. Williamson, Dr. J. H. Gilbert, Sir B. Brodie, Bart., Prof. G. C. Foster.

Secretaries—Dr. Mills, W. C. Roberts, Dr. W. J. Russell, Dr. T. Wood.

Committee—A. H. Allen, Dr. J. Attfield, G. Bishop, H. B. Brady, A. Crum Brown, W. Lant Carpenter, M. Carteighe, Dr. W. Corfield, Dr. C. Calvert, H. Deane, J. Dewar, Warren De La Rue, Dr. J. Baker Edwards, A. Fletcher, G. Gladstone, J. P. Gassiot, D. Hanbury, W. E. Heathfield, Dr. G. D. Longstaff, G. Lemoine, Dr. J. W. Mallet, A. P. Marreco, H. Matthews, Prof. Maxcoe, H. M'Leod, Prof. Nicholls, A. Oppenheim, W. H. Perkin, Dr. B. H. Paul, H. D. Pochin, Dr. Price, Prof. Victor Von Richter, G. F. Rodwell, G. F. Schacht, W. W. Stoddart, F. Sutton, J. Smyth, E. C. C. Stanford, R. D. Silva, Dr. E. Smith, T. E. Thorpe, A. Tribe, J. Williams, C. R. A. Wright, Prof. Wayne, W. Weldon, C. J. Woodward, J. A. Wanklyn.

THURSDAY.

Dr. GLADSTONE, in his opening address, dwelt upon the importance of Chemistry as a branch of science. He regretted that original chemical research was neglected in England in favour of practical inventions, and that little was done by fresh endowments to promote the progress of the science. He dwelt on the good example set by Mr. Lawes in this respect.

The business of the Section commenced with the reading of the 'Report of the Committee for Investigating the Chemical Constitution and Optical Properties of Essential Oils used for Perfumes,' which elicited some discussion, in which Mr. D. HANBURY pointed out the necessity of obtaining precise information respecting the origin of the oils used for the experiments. It is extremely rare to meet with perfectly genuine samples of many of the essential oils, and their chemical and physical properties must be largely influenced by the nature of the oils used in the sophistication. Even the oils prepared from the same plant exhibited marked differences when unmixed with foreign oils. The Report, the chemical portion of which was prepared by Dr. Wright, the purely optical portion by the President, Dr. Gladstone, was of a purely technical character, but the results were considered of sufficient scientific interest to warrant the Committee requesting a continuance of the grant.

Prof. MALLET (of Virginia, U.S.) exhibited some fine specimens of fused arsenic, obtained by fusing this body under pressure. The fact that arsenic can be thus fused has already been shown by Landolt and Bettendorf, who have investigated the physical properties of the metalloid. The tubes in which the arsenic was fused were modified in a remarkable manner by the action of the sand in which they were heated, and Dr. Mallet threw out the suggestion that the study of the manner in which the aggregation of the siliceous particles was brought about might throw light upon the formation of sandstones. Prof. Mallet also exhibited two knife-blades forged from meteoric iron. The character of the forging was remarkably modified by preliminary heating. The original meteorite could be readily obtained in the form of a perfect blade, but on heating the body *in vacuo*, so as to expel the occluded gases, the metal could only be forged with extreme care. The alteration in the physical character of the blade was generally ascribed, in the discussion which ensued, to an alteration in the schreberite, or phosphide of nichel-iron, contained in the body.

Mr. W. C. ROBERTS (Chemist of the Mint) read a short paper, illustrated to the Section by a curve showing the very constant composition of the alloy used in the present gold coinage of this country. The divergence from the standard prescribed by law is remarkably slight.

Mr. W. L. CARPENTER made a short communication 'On the Methods of collecting Samples of Deep-Sea Water.' He described the various difficulties in the use of the present processes, of which he had had experience in the recent dredging expeditions.

Prof. CRUM BROWN described the method about to be employed in the Challenger Expedition, and stated that it had been found to work satisfactorily under the conditions in which it had hitherto been tried: experience in deep-sea work must prove whether it was generally serviceable.

Prof. THORPE exhibited a modification of a new fill-pump, recently described by Mendelejeff, which promises to come into general use in laboratories. It is based upon the principle of the hydraulic ram. It consists of a tube about 3 feet in length, fitted with a side tube containing a small valve, and leading to the vessel to be exhausted. The upper end of the longer tube is cut off slantwise, and is connected, by means of a moderately flexible tube, with a water supply. As the water flows the flexible tube rapidly pulsates, and the valve in the side tube rapidly opens and shuts. The instrument exhausts very quickly: by means of it a vacuum, equivalent to 0·7 mètre, may be readily obtained. As the instrument requires no alteration in the arrangements of a laboratory, and is cheap and portable, it will probably be of general service.

A short discussion followed the reading of a paper, communicated by Dr. MOFFATT, 'On the Results of Observations made by the Tube Ozonometer.'—The members of the Section very generally condemned the use of potassium iodide paper as a means of registration, but no useful facts were elicited as to any better methods of using the liberation of iodine as the basis of a quantitative method.

Mr. WOODWARD exhibited a simple and cheap modification of Hofmann's apparatus for showing the electrolysis of water.

FRIDAY.

Prof. G. C. FOSTER presented the 'Report of the Committee appointed to investigate the Trustworthiness of Siemens' Electrical Pyrometer.'—The Committee had mainly confined themselves to the determination of the constancy of the resistance in the platinum coil, and it was found that only after repeated heating was the resistance constant. As it is contemplated to make some further modification in the apparatus, the re-appointment of the Committee was recommended.

Prof. WILLIAMSON summarized the main statements contained in the 'Report of the Committee for Superintending the Monthly Report on the Progress of Chemistry.'—The work of the Chemical Society in furthering the diffusion of chemical knowledge, by the publication of their series of abstracts of chemical and physical memoirs published in the home and continental journals, was generally appreciated by the meeting. Prof. Williamson gave the cheering assurance that the work was already a fixed institution, and would doubtless, in a very few years, become self-supporting. In the mean time it would be necessary to request the Association to continue their grant of 100*l*. to supplement the funds already at the disposal of the Chemical Society.

Mr. DEWAR made a communication 'On the Specific Heat of Bodies at High Temperatures, with particular Reference to that of Carbon,' which he showed, from the results of a very carefully-conducted series of experiments, increased in a very rapid manner with the increment of temperature. His observations were made at the temperature of boiling zinc, and of the oxyhydrogen blowpipe. The temperature of the former he found to be 1040° C., that of the latter, by the method of Pouillet and Deville and Troost, to be 2200° C. The discrepancy between this result and that obtained by Bunsen (2800° C.) for this temperature, was doubtless due to the difference of pressure under which the combination of the mixed gases occurred. From these determinations of the specific heat of carbon, and of the amount of heat evolved in the union of carbon and oxygen to produce the two oxides of carbon, with an assumption respecting the latent heat of carbon, Mr. Dewar concluded that the boiling-point of carbon could not exceed 8000° C.

The PRESIDENT briefly summarized the results contained in a paper prepared in conjunction with Mr. Tribe, 'On the Mutual Helpfulness of Chemical Affinity, Heat and Electricity, in producing the Decomposition of Water.' He commenced by remarking on the differences observed in the behaviour of various metals towards water, and he roughly classified them in accordance with their power of decomposition. He showed that zinc, for example, which, when perfectly free from foreign metals, is entirely without action on water when brought into contact with copper, which is even further removed in the classification from those metals which eliminate hydrogen, causes, at ordinary temperatures, a very sensible decomposition of water, but that, as the temperature increases, the rate of decomposition is very rapidly augmented, nearly 500 cubic centimètres of perfectly pure hydrogen being evolved, in presence of an excess of the metals, in the course of one hour. The reaction will doubtless admit of general application, and will be especially serviceable in various processes of reduction, both in analytical and general chemistry.

Mr. WELDON gave an account of his method of preparing chlorine on a large scale by the decomposition of manganite of magnesium. A compound of magnesium and manganese chlorides is obtained by neutralizing carefully the ordinary chloride of manganese liquor by Greek stone, concentrating the liquid until its temperature is about 300° F., and evaporating to dryness in a blind furnace, in which the residue, piled up in thin cakes, is heated in a current of air. A mixture of chlorine and hydrochloric acid is thus obtained, and manganite of magnesium is reproduced. By the reaction of hydrochloric acid upon this compound, chlorine and the double chlorides are reproduced, and these double chlorides may again be shut up, and thus the process rendered continuous—a definite quantity of manganese and magnesium

being able to eliminate an indefinite amount of chlorine from hydrochloric acid.

SATURDAY.

The Section did not sit.

SECTION C.—GEOLOGY.

President—R. A. C. Godwin-Austen.

Vice-Presidents—T. Davidson, Prof. P. M. Duncan, Rev. T. Wiltshire, Prof. J. Phillips, J. Prestwich.

Secretaries—H. Woodward, L. C. Miall, G. Scott, W. Topley.

Committee—Dr. Adam, J. Brigg, W. Carruthers, Dr. Collingwood, Prof. W. M. Cornfield, Rev. W. H. Crosskey, W. Boyd Dawkins, Prof. G. Dewalque, J. Evans, Prof. J. Hall, Capt. Douglas Galton, Prof. Harkness, Prof. Hébert, H. Hicks, J. Hopkinson, J. M'K. Hughes, Prof. E. Hull, J. Gwyn Jeffreys, W. Jolly, Prof. T. Rupert Jones, J. B. Jordan, G. H. Kinahan, J. E. Lee, G. A. Lebour, Capt. A. F. Lendy, J. Logan Lobley, G. Maw, W. S. Mitchell, C. Moore, W. Molyneux, R. W. Mylne, Prof. H. A. Nicholson, J. Plant, I. Roberts, W. Pengelly, H. G. Seeley, S. Sharpe, W. Sanders, W. W. Stoddart, R. G. Symes, J. Thomson, Rev. Canon Tristram, Henry Willett, Rev. H. H. Winwood, R. Wood, J. W. Woodall, J. Wyatt.

There was generally a good attendance in this Section, the large lower hall being nearly filled during the reading of the more important papers. Of the foreign visitors who were invited to the Association Meeting this year, we noticed that M. Hébert, M. A. Gaudry, and Prof. J. Hall, of New York, frequently attended this Section, where they were cordially received.

THURSDAY.

The meeting opened with an address from the President, Mr. R. A. C. Godwin-Austen, of which we here give an abstract:—It might perhaps be a fitting preliminary to the local communications which we may expect in the course of this Meeting, should I here give a summary of what has been already done with reference to the geology of the south-east of England; but to many who meet now in this Section very much of such a survey would be familiar. Instead of this, I propose to call attention to what is the peculiar feature of our local geology—namely, its great Wealden formation,—the product of that vast lake or sound which, at a time before a particle of the chalk hills of Sussex had been formed, covered an area larger than the whole of the south-east of this island. What I shall endeavour to put before you—a point not generally understood—is with reference to the place of formations akin to our Wealden in the records of past time, to enable you to realize what were then the geographical conditions of the northern hemisphere, what the distribution and extent of other areas of fresh water, the equivalents of our Wealden.

When a general view is taken of the successive physiographical conditions of bygone geological periods, which all represent distinct periods of past time and are all the products of purely marine conditions, we see that what is at present terrestrial surface was at those times to a great extent covered by water, and that the great geological formations are merely old sea-beds.

On a projection of the northern hemisphere, we see that at those times the area of water exceeded what it is at present: at each of these great periods the northern hemisphere must have presented just such a preponderance of water as the southern hemisphere does at present; and it is further to be remarked how closely the area of one period of northern geological submergence corresponds with the others, as the Nummulitic with the Cretaceous, and the Cretaceous with the Jurassic. Whatever the cause, there is to be seen in this a recurrence of like conditions at enormously long intervals of time. If next the internal evidence to be derived from these Mesozoic formations be taken, we arrive at the result familiar to most geologists, that each, when most complete, presents a like order of change from its older to its newer portions.

With respect to none of these marine geological formations is there any indication whatever that one passed into, or was in continuous sequence with, another, either stratigraphically or geologically; on the contrary, wherever there is apparent continuity, either upwards or downwards, it is by change or transition from one set of conditions to another wholly different. The purely marine Upper Silurian beds of the Welsh border are followed conformably by the Old Red Sandstone, which last is now universally accepted as a lacustrine formation, the place of which, in time, was intermediate between the middle Palæozoic group and the upper or Carboniferous, which commenced with the so-called "Devonian." The positions and extent of the "Old Red" lacustrine beds in all parts of the British Islands indicate, even at this day, to what extent Silurian sea-bed had become terrestrial surface, to which the lacustrine basins were subordinate.

These evidences of successive physical conditions over the northern hemisphere indicate an order of recurrence of corresponding conditions, and, as already noticed, of a progress of change which, in the course of each period, came about in a corresponding order. Great periods, during which wide marine conditions prevailed, alternated with others of wide terrestrial surfaces. The marine periods, as we measure them by the products of the agents which seas and oceans call into action, must have been of vast duration. In like manner we may feel assured that the great freshwater formations are not, as some geologists have supposed them, mere subordinate parts of the great marine groups, as our "Wealden" of the "Cretaceous," but rather true intermediate groups, of equal geological value with them in the estimate of past time.

The freshwater strata, known as the Wealden, extend for seventy miles from east to west, and with a breadth from north to south of thirty-five miles. Over the whole of this area the freshwater depositions attain a great thickness; the lower sandy group may be taken at 800 feet, and the Weald clay at 450 feet at least.

To realize the conditions under which these accumulations were formed, the now upraised central sandstone ranges must be put back to their original horizontal position, and the whole series must be regarded as the infilling by freshwater rivers of what was an area of depression with reference to the terrestrial surface of the time. In a northerly direction, several sections about Oxford, of thirty miles, show Purbeck beds and freshwater ferruginous sands passing beneath Cretaceous beds.

These are indications that changes in the area surrounding the Wealden formation took place in the progress of that series; the lower and earlier sandy deposits indicate only inconsiderable depths of water. Yet the vertical thickness of the series may be estimated at nearly 2,000 feet: for that area, at least, progressive depression must have been going on, but not uninterruptedly.

Such changes as these seem to imply change in the physical geography of the land region to which this great freshwater area was subordinate—such, for instance, as would give rise to larger rivers, greater influx of fresh waters, and stronger currents.

The successive conditions indicated by the great Wealden group as a whole are, for the first stage, that of an extensive shallow lake, or sound, at the sea-level of the time, the inflowing waters to which were largely charged with lime derived from the surface of Portland Oolite, from which they came. This is the Purbeck stage, which commenced with a long period of purely fresh water conditions. Brackish water conditions followed, with a change of Fauna. Mollusca, such as Corbula, Cardium, Modiola, Rissoa, appear, presenting, as was observed by the late Edward Forbes, the change of character which the Caspian Sea molluscs have at present in adapting themselves to brackish water.

During the Middle Purbeck series the alternations from fresh to brackish water conditions were frequent and apparently of short duration, till finally it was closed as it commenced by a thick set of purely freshwater depositions.

The changes in the Purbeck series are readily accounted for, by reference to areas of water such as occur on the American coast at present, and which may be salt or brackish, according to the extent to which the sea-waters are excluded by sand-bars from mixing with the fresh waters flowing from the land. The south and east coast-line of our Wealden lake must be looked for beyond the area of our island.

In the Boulonnais there occur ferruginous sands like those of Shotover, full of freshwater shells (Unio) overlying Purbeck limestone, and passing beneath the Cretaceous formation, just as happens in this country. These Wealden beds are not now of any considerable thickness, having been reduced by the denudation of the district. They are so mixed up with pebble-beds in places as clearly to indicate a marginal line, which may safely be placed to the north of the Boulonnais denudation. These beds were formed beneath the waters of the same lake as our own.

Sixty miles to the south of the Boulonnais is a district known as the Pays de Bray, which is an elliptical valley of elevation and denudation, like our own Wealden on a small scale, extending from Beauvais to Neufchatel, a distance of forty-five miles. In this denudation the lowest beds exposed belong to the marine Jurassic series (Portland Kimmeridge). Next above the Portland stone is a Wealden formation.

Neufchatel is seventy miles south of Boulogne; the Wealden beds, as we have seen, indicate that the series extended southwards from Marquise; and it is no unreasonable supposition that the deposits of the Pays de Bray were formed under the waters of the same lake as were those of our own Wealden.

Such, then, were the dimensions of the Wealden lake or sound. It extended from parts of Buckingham on the north, half across the English Channel on the south, a breadth of 160 miles; in the contrary direction it reached from Wiltshire far into France, beyond Beauvais for 250 miles.

In another part of France, Département de l'Aube, M. Cornuel has described a fluvio-lacustrine formation between the Jurassic and Cretaceous formations at Vassy, containing Iguanodon, several species of Unio and Planorbes. The lacustrine formation at Cimey is in a corresponding geological position.

In the Jura, the Portland beds are followed by hard bluish marls, calcareous marls, and gypsum, the whole very like our Purbeck series. These lacustrine formations are interesting, as they seem to show the existence of a chain of lakes stretching across France into Switzerland for 260 miles, with a general direction parallel to the axis of Artois, and thus connected as part of one great lake-system with our Wealden.

In France, Département des Deux Charentes, some 350 miles due south of our Sussex coast, there occurs a great freshwater formation in intermediate position between the Portland Oolite, and what were then the lowest beds of the Cretaceous series. This formation has engaged the attention of many French geologists, more particularly of M. Coquand, who has determined its age and purely lacustrine character, and who puts it as the equivalent of the Purbeck beds of England. The feeders of this lake are more easily accounted for than in the case of our own Wealden. Such a lake would necessarily have received all the streams descending from the western slopes of a terrestrial surface of very ancient date, namely, the granitic district of Central France.

In North Germany there is a well-exhibited Wealden formation, extending from Bentheim by Rheine, with a breadth from north to south of twelve miles. From Ibbenhüsen it reaches on the south side of the Triassic and Palæozoic axis of Osnaburg for many miles. It is everywhere in an intermediate position betwixt the Upper Jurassic and Lower Cretaceous formations. On the north of the axis it spreads for seventy miles to Minden, certainly as far north as the Steinhuder Meer to near Hanover, and as far south as the Hils district. From west to east the ascertained extent of this lake is upwards of 120 miles.

These large lacustrine areas imply that there was at that time a corresponding extent of terrestrial surface. There occur over parts of Belgium the remains of such a terrestrial condition of surface beneath the lower Cretaceous beds there (Tourtia), consisting of variegated sands and clays, with much diffused vegetable matter, and occasionally with beds of lignite. Such surfaces can be traced along the line of the Belgian coal-field (Mons), and overlying parts of the Palæozoic

series. Such-like evidence of terrestrial conditions recur over a wide European area: such are the sub-cretaceous beds of pisiform iron ore, of sub-aerial origin, and the wide area over which freshwater sands with Pterophyllum, Pecopteris, Cycadites, &c. of our Wealden are found.

Did time allow, I might call attention to the results of the labours of the distinguished palæontologists who have described the forms of life of the Wealden period, both of animals and plants. From them we know that crocodiles and chelonians, referable to many genera, abounded in the Wealden waters. These, with the Cycadeæ of the land, sufficiently mark the temperature of that time as being much higher than it is here at present. With respect to the numerous large terrestrial Dinosaurs, it is observable that as yet they are nearly all peculiar to our Wealden lake. The relative level of this lake seems throughout to have been such as to have admitted of easy communication and interchange with the waters of the sea; and this condition may serve to account for some of the peculiarities which its Fauna presents.

The first paper was by Prof. E. Hull, 'On the Raised Beach of the North-East of Ireland.'—The author referred to the evidences of a very modern raised beach, first appearing along the shores of Dublin Bay, becoming more prominent, and rising to a higher elevation, as it is traced northwards, till, in the neighbourhood of the Giant's Causeway and Rathlin Island, it attains an elevation of about twenty feet above the sea-level. The phenomena along the shores of Antrim consist of gravel-beds, with blanched shells of existing species and rudely-worked flint-flakes, which were first described by the late Mr. Du Noyer. The caves, containing bones of animals now extinct in this district, were many years since described by Mr. Andrews and Dr. Bryce. The whole of these littoral phenomena, consisting of gravel-beaches, sea-caves, and sea-stacks, the author considered to be referable to one period of elevation, corresponding to that of the well-marked "twenty-five feet raised beach" of the coast of Scotland.

Prof. Harkness remarked, that the observations of Prof. Hull and the officers of the Irish Geological Survey were adding greatly to our knowledge of the superficial geology of Ireland, and stated that the beach described might also be traced in places along the west and south coasts of the island. He did not see that the evidence of flint-flakes alone was sufficient to justify the inference as to the palæolithic age of this beach. Prof. Harkness thought that the beach showed indications of varying level. He stated that many changes of level had taken place since the formation of the beach, especially in a downward direction, as was indicated by the presence of peat-bogs, which were of a subsequent age to the raised sea-beach, below the present sea-level; and these subsequent depressions did not seem to be equal in amount over the area of Ireland.—Mr. Pengelly had observed that, where the coast was composed of hard rocks, there are often found old beaches; but where the rocks were soft, they did not often occur. Submarine forests he regarded as more recent than raised beaches, and these prove a submergence of more than sixty feet. He further remarked that contemporary beaches were not necessarily all at the same level, as we know that varying tides make varying beaches.—The Rev. W. H. Crosskey remarked that on the west coast of Scotland there is every variety of level of old beaches, and these certainly cannot represent only one period. He insisted upon the necessity of following these beaches inland where they range in that direction, and not confining ourselves to the coast.—Prof. Hull, in reply, said that old beaches often occur where the rocks are soft. This is especially the case with the twenty-five feet beach of the west coast of Scotland, where caves and sea-stacks abound along this line. The oscillations of level which Ireland has undergone in recent times have had their least development in the centre of Ireland. As we go to the north or the south, the beaches rise in level; and Prof. Hull contended that the low beaches of the central area are the exact equivalents of the higher beaches of the north and south, and these again of the well-marked twenty-five feet beach of Scotland.

Mr. J. Howell followed with a paper 'On the Super-Cretaceous Formation in the Neighbourhood of Brighton,' in which these deposits were minutely described, many of the author's facts having been obtained during recent excavations for draining the town of Brighton. The deposits of this district were classed by the author as follows, in ascending order:—1, Chalk, with flint, upon the crests of the hills and their abrupt descents; 2, Plastic clay (lower eocene), constituting Furze Hill; 3, Temple field deposit, formed of the wrecks of the eocene and chalk strata; 4, Brighton cliff formation, Coombe rock or elephant bed, chiefly east of Brighton (post-pliocene); 5, Brick earth, resting on Coombe rock or sand, the western parts of Brighton and Hove (post-pliocene); 6, Silt of the Brighton Valley (recent). These deposits were described in detail; and with regard to the second, or plastic clay it was stated, "the soil upon the South Downs is generally but a few inches thick, yet, from the fact that there are patches of rich loam several feet in thickness interspersed with a few tertiary pebbles upon Seaford heights, Castle Hill, Newhaven, Chanctonbury, Cissbury, and many other places, besides Greyweathers or Druid sandstone scattered over the surface in every direction, we are reasonably led to conclude that sub-aerial and aqueous action have stripped these grand old hills of the rich tertiary clays that once reposed upon them."

Mr. W. Topley's paper 'On the Sub-Wealden Exploration' was next taken. The author, who had been requested to prepare an account of this undertaking for the Section, first briefly described the structure of the Wealden area, and the lines along which the lowest-known beds were brought to the surface. Especial reference was made to the formations exposed along the London and Brighton Railway; and then the lowest rocks of the Weald, the Ashburnham beds, were more minutely described. It was shown that a ridge of palæozoic rock existed beneath the London basin, the continuation of the axis of Artois; and that this axis is variable again in the West of England, where we find the valuable coal-fields of Bristol and South Wales. Along this axis in the East of England there would probably lie productive coal-fields, as Mr. Godwin-Austen had shown. It was pointed out that there was very great uncertainty as to the existence of coal-measures beneath the Weald, although of the existence of Palæozoic rocks beneath that area there could be no doubt whatever. The depth at which these old rocks would be reached might vary between about 700 and 1,600 feet. It could hardly be much less than the former, nor would it be likely to exceed the latter. The author acknowledged his indebtedness to the works of Mr. Godwin-Austen, Mr. Prestwich, and other writers, for many of the facts and inferences advanced.

Mr. Godwin-Austen then addressed the meeting. He described the area of Western Europe over which the old coal growths had spread, and explained that our present coal-fields were but small remnants of a vast deposit; these had been preserved in "basins," whilst the larger part had been entirely swept away. He traced the old axis from the South of Ireland eastwards into Central Europe, and stated that this was perhaps the most remarkable line of disturbance known, as it could be traced half round the globe. Through Belgium and the North of France a large fault runs along this axis, which cuts off the coal on the south, whilst on the north the coal occurs in basins. Carboniferous limestone had been found at a small depth in the Pays de Bray, and somewhere between this and the fault it is possible there may be coal. He expressed his doubts as to there being productive coal-fields beneath the Weald, and cautioned his hearers against being misled by newspaper reports as to the exploration now commencing being one in search of coal. Mr. H. Willett, with whom the undertaking originated, had never given any countenance to this idea: his only object was to explore the Sub-Wealden Rocks, whatever they might be. Mr. Godwin-Austen felt confident that the palæozoic rocks would be reached at a much less depth than 1,600 feet.—Mr. H. Willett, who was loudly cheered by the meeting, gave an account of the origin and progress of the enterprise, and stated that nearly 1,900*l.* had already been subscribed.

The last paper read this day was one by Mr. G. A. Lebour, 'On the Geological Distribution of Goitre in England.' The author had carefully collected a vast number of facts bearing upon this subject, and this was a work of some labour, inasmuch as no information was given upon this subject in the Registrar-General's Reports. He traced in detail the distribution of this disease over the various rock formations, noting that it was common on the chalk (in places), on the carboniferous limestone, and on the Hastings beds. Near Speldhurst it was more common than elsewhere in the Weald; whilst Stoney Middleton enjoyed the distinction of being the head-quarters of goitre in England. As a rule it was rare on coal-measures and on igneous rocks. It had generally been believed that this disease was very common along the magnesian limestone, but the author had been unable to find any confirmation of this. The cause to which goitre was generally attributed was the water of limestone districts, which is almost always *hard*. It was, however, shown that this assumed cause was insufficient, inasmuch as over many limestone districts goitre was absent, whilst in others it abounded. The cause suggested by Mr. Lebour was the metallic impurities in the water; and it was shown that goitre prevailed most where ferruginous water occurred, particularly where the iron was derived from the decomposition of iron pyrites.

This communication was subsequently forwarded to the Biological Section, to be there read again.

FRIDAY.

The 'Report on Kent's Cavern, Torquay,' which is yearly presented to this Section, and for which an annual grant is given by the Association, was read here, by Mr. Pengelly, this morning. The Report was supplemented by a note, also by Mr. Pengelly, 'On the Occurrence of *Machairodus latidens* at Kent's Cavern.' This "find" is the chief result of the year's exploration, confirming, as it does, the accuracy of M'Henry, who years ago professed to have found it there. This was not generally accepted, it being surmised that specimens from different localities had been mixed together in M'Henry's collection. Some remarkable flint implements have also been found during the past year, upon which Mr. Evans made some remarks.

M. A. Gaudry, who addressed the meeting in French, spoke of the characters of the various species of Machairodus; after which Prof. Phillips congratulated the meeting upon the fact that the Association had, for some time past, devoted its grant to the thorough exploration of one particular area, instead of distributing its strength over various districts.—Mr. Boyd Dawkins asserted that this species was an early pleistocene animal, and remarked that this fact was not inconsistent with its co-existence with man. He thought that the animals of Kent's Cavern invaded Europe before the minimum temperature of the glacial period was reached. Afterwards they were pushed southwards during the extreme period of glacial cold, to return again as post-glacial animals. In answer to a question by the President, Mr. Dawkins said that the so-called Machairodus from the Forest Bed of Norfolk certainly belonged to that genus, but that its specific position was doubtful.

The most interesting paper of the day was that by Dr. Carpenter 'On the Temperature and other Physical Conditions of Inland Seas, considered in reference to Geology.'—The author first briefly went over some points as to deep-sea conditions as an introduction to his after remarks, affirming that old observations as to deep-sea temperature were untrustworthy, in consequence of the employ-

ment of faulty or unprotected thermometers. In the open sea, if we went deep enough, we should everywhere find the temperature descend to 32°; but in enclosed seas, such as the Mediterranean, the deeper and colder water of the open sea, circulating from the Poles, could not enter; therefore, the lowest bottom temperature was determined by the lowest winter temperature of the surface. The large rivers entering the Mediterranean brought down large quantities of organic matter, which robbed the water of its oxygen to such a degree, that whilst in the Atlantic there was generally 20 per cent. of oxygen and 40 per cent. of carbonic acid in the bottom water of the Mediterranean, there was often only 5 per cent. of oxygen, and over 65 per cent. of carbonic acid. To this cause the author attributed the scarcity of life in the deeper parts of the Mediterranean. The Red Sea and its neighbourhood is the hottest area of the world, the temperature of the surface water rising to 85° or 90°; the bottom temperature is about 71°, corresponding to the greatest winter cold; but outside this sea, in the Arabian Gulf, the bottom temperature is 33°. It has long been known that reef-building corals do not live at a greater depth than twenty fathoms, and Dana has observed that they do not live where the temperature sinks below 68°. Dr. Carpenter surmised that in the Red Sea, where corals abound, and where the lowest bottom temperature is only 71°, we should find them living at greater depths than anywhere else in the world. The author gave other illustrations, and remarked upon the evident bearings of these researches upon geological inquiries. It was mentioned incidentally that submarine telegraph cables give less trouble over deep seas, where the temperature is low, than in shallower seas, where the temperature is higher and the conducting power of the wire increased.

In the discussion which followed, Mr. Godwin-Austen, Prof. Phillips, Mr. T. M'K. Hughes, and others, took part, dwelling chiefly upon the bearings of Dr. Carpenter's paper upon geological research.—Dr. Carpenter remarked that his theory of deep-sea temperature was not a new one. It was adopted by Pouillet as an expression of facts then known. Then came Sir J. Ross's observations, made with imperfect thermometers. These led to the erroneous opinions which until lately were universally accepted.

Papers by Dr. Hicks, 'On Ramsey Island, St. David's; by Mr. Hopkinson, 'On Graptolites'; and by Mr. H. Seeley, 'On a Zeuglodon from Barton,' occupied the remainder of the meeting.

Though not part of the business of the Section, we should notice the excursion to the East Cliff in the afternoon. A very large party assembled there, and examined the ruined beach and elephant bed which have been made so famous by Dr. Mantell's writings. Addresses were given by Mr. G. Scott and Mr. Topley (Secretaries of the Section), and by Prof. Rupert Jones. The party was afterwards joined by Mr. Godwin-Austen and Prof. Phillips. By this time many had returned to Brighton, but those who remained received a sufficient reward in listening to the remarks of these two distinguished geologists.

SATURDAY.

The meeting was occupied this morning with the reading of a paper by Prof. E. Hébert 'On the Upper Cretaceous Formation of France and England.'—The paper was read by the author in French, but Mr. Davidson subsequently gave a brief account of the author's views in English. M. Hébert gave a detailed classification of the French chalk, each division being characterized by special groups of fossils; and he believed that a similar classification might be adopted in England. The point upon which English geologists might be most disposed to disagree with the author was his placing the upper greensand with the grey chalk,—he apparently not sufficiently appreciating the fact that over wide areas in England the former bed has well-marked and important characters, wholly distinct, lithologically, from the overlying beds.

Mr. Godwin-Austen made some remarks upon the area of original deposition of the Cretaceous beds, which were interesting as supplementing his able presidential address.—Prof. Phillips, Mr. Seeley, and others, also took part in the discussion.

SECTION D.—BIOLOGY.

President—Sir John Lubbock, Bart.

Vice-Presidents—Prof. Balfour, J. Ball, Dr. J. Beddoe, G. Bentham, Dr. J. C. Burrows, Dr. T. S. Cobbold, Prof. Flower, Col. A. L. Fox, Dr. J. D. Hooker, J. G. Jeffreys, Dr. J. B. Sanderson, Prof. W. Thomson.

Secretaries—Prof. Thiselton-Dyer, H. T. Stainton, Prof. Lawson, F. W. Rudler, J. H. Lamprey, Dr. Gamgee, E. R. Lankester, Dr. Pye Smith.

Committee—Dr. Leith Adams, Prof. Allman, J. Bateman, Prof. Van Beneden, A. W. Bennett, H. G. Bohn, Dr. Boycott, E. W. Brabrook, H. B. Brady, H. Buckley, Dr. Campbell, C. Collingwood, J. F. Collingwood, Prof. R. O. Cunningham, Hyde Clarke, J. Clarke, Prof. Dickson, Dr. A. Dohrn, R. Dunn, T. Davidson, W. Boyd Dawkins, H. E. Dresser, M. E. Grant Duff, Dr. Martin Duncan, Dr. Edwards, Sir Walter Elliot, J. Evans, Dr. M. Foster, P. Gervais, Sir Duncan Gibb, Bart., A. Grote, G. Harris, H. H. Howorth, T. M'K. Hughes, Prof. Rupert Jones, Dr. King, J. Lee, R. M'Lachlan, J. M'Lelland, M. Moggridge, Prof. Alleyne Nicholson, Prof. A. Newton, Dr. O'Callaghan, J. S. Phené, Capt. Bedford Pim, M. R. Pryor, Dr. Radcliffe, Dr. Sclater, Carl Semper, Dr. E. Smith, Dr. J. L. Stewart, Dr. T. Thomson, Rev. Canon Tristram, J. Van Voorst, A. R. Wallace, C. Staniland Wake.

THURSDAY.

Department of Zoology and Botany.

Sir J. Lubbock commenced the work of the Department with an address. Adverting to the introduction of natural science into our great public schools, he was glad to say that the regulations which are being drawn up under the Public Schools Act by the new governing bodies, contain a provision that natural science shall be taught to all boys in their passage through the schools. There was little probability of opposition to this being carried out in practice, and it would only then remain to devote a fair proportion of the scholarships and exhibitions to natural science. It was only fair to say, with regard to private schools, that they had little choice of action until the universities and great schools led the way. A deputation of the Council had waited on Mr. Forster, to urge the importance of the introduction of natural science into the elementary schools also of the country. The Government had distinctly abandoned the principle that primary education should be confined to reading, writing, and arithmetic; but little had been effected as yet for the practical introduction of scientific instruction. The experience of Dean Dawes and Prof. Henslow had shown that the aptitude of the children opposed no obstacle, and he rejoiced to see that the School Boards of London and Liverpool had determined on the introduction of science into all schools under their control. If it was objected that this could only amount to a smattering, it might well be asked, who has more? Those who are most advanced in knowledge know best how slight this knowledge is. Indeed, every fresh observation opens up new lines of inquiry. Every biologist would admit, for example, the impulse to research which had been given by the publication of Mr. Darwin's 'Origin of Species.' Yet it was surprising how much fundamental misapprehension still surrounds Mr. Darwin's views. Thus Browning, in one of his most recent poems, said:—

> That mass man sprung from was a jelly lump
> Once on a time; he kept an after course
> Through fish and insect, reptile, bird, or beast,
> Till he attained to be an ape at last,
> Or last but one.

It was hardly necessary to point out that Mr. Darwin would be the first to repudiate such a theory. These types of structure might be derived from one origin; they were certainly not links in one sequence. It was one thing to recognize in natural selection a *vera causa*; it was another to assume that all animals were descended from *one* primordial source. As to the first alternative, he could not himself feel any doubt; and whatever conclusion might be come to as to the latter, the publication of the 'Origin of Species' would not the less have constituted an epoch in biology. How far the present condition of living beings was due to natural selection,—how far, on the other hand, the action of natural selection has been modified or checked by other natural laws, by the unalterability of types, by atavism, &c.,—how many types originally came into being,—whether they had arisen simultaneously or successively,—these and many other similar questions remained to be solved, even if we admitted the theory of natural selection. All this, indeed, had been clearly pointed out by Mr. Darwin himself, and would not have needed repetition but for the careless criticism by which, in too many cases, the true question had been obscured. Without, however, discussing the argument for and against Mr. Darwin's conclusion, we so often meet with travesties of it like that which he had quoted, that it might be worth while to consider the stages through which a group—say that of insects—had come to be what they were, assuming them to have developed from simpler organisms under the influence of natural laws. The question was one of great difficulty. It was hardly necessary to say that they cannot have passed through all the forms of animal life, and the true line of development would not be agreed upon by all naturalists. One would, however, admit that embryology and development were our best guides. The various groups of Crustacea, however different the mature conditions, were for the most part very similar when they quitted the egg.

So again in the case of insects—the differences between the different groups of insects were indeed great. The stag-beetle, the dragon-fly, the moth, the bee, the ant, the gnat, the grasshopper; these, and other less familiar types, seemed at first to have little indeed in common. They differed in size, in form, in colour, in habits, and modes of life. Yet, following the clue of the illustrious Savigny, it had been shown, not only that they were constructed on one common plan, but that other groups, such as Crustacea and Arachnida, could be shown to be fundamentally similar. If we compared the larvæ, this fact became much more evident. It had been pointed out by Brauer and also by himself, that the two types of larvæ which Packard had proposed to call the eruciform and leptiform, ran through the principal groups of insects. This was obviously a fact of great importance. If individual beetles were derived from a similar form, it was surely no rash hypothesis to suggest that beetles as a group might be so. If he were asked to describe the insect type, he would say it was an animal composed of head with mouth parts, eyes, and antennæ; a thorax made up of three segments, each with a pair of legs; and a many-segmented abdomen, with anal appendages. This would describe the larva of a small beetle named Sitaris; and, speaking generally, it might be said that (excepting the weevils) all coleoptera were derived from larvæ of this type. The same was also true of Neuroptera, Orthoptera, and Trichoptera. The larvæ of Lepidoptera, from the large size of the abdomen, had been generally, and as he thought wrongly, classed with the maggots of flies, bees, &c. The three thoracic segments were still marked by legs, and, excepting greater clumsiness in general appearance, it essentially agreed with the type already described. No Dipterous larvæ belonged, however, to this type. The larvæ state then of insects widely different in their mature state closely agreed. Was there any mature form which also corresponded to it? We need not have been surprised if this type, through which it would appear that insects must have passed so many ages since (for winged Neuroptera have been found in carboniferous strata), had long ago become extinct. But the genus Campodea still represented it. It seemed to him also highly significant that its mouth parts were intermediate between the haustellate and mandibulate types. There were good grounds, therefore, for considering the various types of insects as descended from ancestors more or less resembling the genus Campodea.

This ancient type may have been possibly derived from one less highly developed, resembling the modern Tardigrades, such as Macrobiotus. Further, this closely resembled the vermiform type of larva general in Diptera, and occurring in other groups. There was reason to think that amongst insects the segments preceded the appendages in appearance, which was the reverse of what was the case in Crustacea, although this stage of development might have eluded observation from its transitoriness. Fritz Müller and others considered the vermiform type of larva as more recent than the hexapod. Considering, however, that the vermiform type was altogether lower in organization and

less differentiated than the Campodea (hexapod) form, he considered that the latter was derived from vermiform ancestors; and Nicolas Wagner had shown, in the case of a small gnat allied to Cecidomyia, that these vermiform larvæ might still retain reproductive powers. Such a larva very closely resembled some of the Rotatoria, such as Lindia, in which both cilia and legs were altogether absent. This vermiform type he agreed with Herbert Spencer in thinking the result of a modified segmentation. For the next descending stage, we must look amongst the Infusoria. Other forms of Rotatoria, such as the very remarkable Pedalion discovered last year by Mr. Hudson, seemed to lead to Crustacea through the Nauplius form. (The true worms appeared to constitute a separate branch of the animal kingdom.)

Probably, however, in some such forms as Haeckel's Magosphæra and Protamœba, the primitive ancestors of even such lowly-organized types as Macrobiotus and Lindia must be looked for. And if it were said to be incredible that even the lapse of geological time should have been sufficient to bridge over the immense interval between such creatures as these and Campodea, or even Tardigrades, we might consider what happened under our eyes in the development of each one of these creatures in the proverbially short space of an insect's individual life. The development of the egg of a Tardigrade went through the same course as the Magosphæra; and from the cells which were the result of the process of yolk-segmentation, the body of the Tardigrade was built up. This same similarity between the development of Magosphæra and the earlier stages of that of other animals occurred, as shown by Van Beneden, in *Filaria mustelarum*, a small worm, and in allied species, as well as in the Rotifera, Echinida, Mollusca, and the Vertebrata, as was illustrated by the diagrams which were shown. It was true that yolk-segmentation was not universal in the animal kingdom, but its absence might be attributed to that suppression of stages of embryological development which might be illustrated from many cases both in zoology and in botany.

Of course it might be argued that these facts have not really the significance which to him they seemed to possess. It might be said that when the Divine power created insects they were created with these remarkable developmental processes. So it had been said that when God created the rocks he created the fossils in them. Probably no one would now maintain such a theory; and he believed the time would come when the contents of the egg and its developmental changes would be held to teach as truly the course of organic development in ancient times as the contents of the earth told us the past history of the earth itself.

In conclusion, there was one matter which he could not but touch upon, but which he yet could not properly treat at length. Great anxiety had been felt during the last few months lest changes should be made at Kew which would prove prejudicial to its scientific work, and lead to the retirement of Dr. Hooker. He felt sure that he only expressed the feeling of the scientific world when he said that such an event would be a misfortune to science, and when he stated his hope that the Government would do nothing to retard or impede the valuable scientific work now going on at Kew.

Dr. Carpenter, in proposing a vote of thanks, to the President, was satisfied that classical and mathematical knowledge did not give a complete education, for the mind required also to be trained to properly apprehend natural phenomena. There was some danger, however, that the changes in schools might be too rapid. He disagreed with the President's view of natural selection as a *vera causa*. He thought the true cause really lay in the developmental powers of nature. Dr. Carpenter then spoke of the debate in the House of Commons about Kew. Dr. Hooker, who was present, had been most warmly received on reaching the platform, and the Meeting expressed their emphatic approval of the allusions which the President and Dr. Carpenter made to the matter. Kew, the last speaker said, was now the centre of the world of botanical science, and if we might believe the formerly expressed opinion of a great scientific man, whose name had been most unhappily introduced into the discussion, Dr. Hooker was *facile princeps botanicorum*, and the worthy successor of Robert Brown.

After an adjournment to the Anthropological Department to hear the President's address, Mr. Spence Bate read a fourth Report 'On the Fauna of South Devon.' He described the formation of a deep-sea pond at Plymouth, in which animals were stored for the Crystal Palace Aquarium, and in which they could also be studied. Different fish did well in this except those, like the mackarel, of erratic habits. These roamed about seeking an outlet, and finally died. He also dwelt on the decrease in the number of the edible species of Crustacea. This arises from the uncontrolled destruction of the females, the spawn of the lobster being especially in demand for culinary purposes. He thought the capture of the lobster should be interdicted from February till May, and that of the female crab altogether.

Prof. Newton read a 'Report on Further Researches respecting the recently Extinct Birds of the Mascarene Islands.' These had resulted in more perfect remains being obtained of many species, besides proof of the continued existence of one of them (*Palæornis exsul*).

Dr. Dohrn's 'Report on Zoological Stations' was next read. The Zoological Station at Naples will be in working order at the beginning of January, 1873. It has been built and organized almost entirely at the expense of Dr. Dohrn, who has expended 7,500*l.* out of his own pocket for the purpose. It is intended to have on the ground-floor an aquarium, to which the public will be admitted. The upper story will be entirely devoted to scientific purposes, including a library, for which gifts of scientific books are earnestly desired. The existence of this station will give opportunities such as have never before existed to persons anxious to prosecute zoological research.

Mr. Robertson read a paper 'On the Perforating Instrument of *Pholas candida*.' He believed that this mollusc excavated by the rasping action of its shell.

Prof. Allman said, that he thought the late Mr. Bryson, of Edinburgh, had shown that the "foot," laden with silicious particles, acted like a lapidary's leaden-wheel charged with emery in effecting the operation.—Mr. Gwyn Jeffreys said that in all excavating molluscs the foot did the work. Sellius had shown this, in 1733, in the case of the Teredo. Deshayes had given up himself the chemical theory which he at one time advocated.

Department of Anthropology.

It was not until after Sir John Lubbock had delivered his opening address to the Department of Zoology and Botany, in the Banqueting-Room in the Pavilion, that the anthropologists began to assemble in the magnificent apartment appropriated to their use at the other end of the building. A large ethnological map of the world, showing the distribution of the chief modifications of man according to Prof. Huxley's views, was suspended in front of the organ, while the walls were covered with a series of diagrams illustrating certain parts of Col. Lane Fox's inaugural address on Anthropology. During the delivery of this address, the chair was occupied by Sir John Lubbock, Bart., who was supported by Dr. Carpenter.

After briefly referring to some of the great questions of anthropological science,—such as the theory of the development of man from some lower forms of life, and the probability of the monogenesis rather than the polygenesis of our species,—Col. Fox proceeded to discuss at length certain points relating to the development of civilization. It may be fairly assumed that where savage races are now found employing implements corresponding with those of prehistoric age, these existing races present us with fair pictures of general prehistoric culture. Among modern savages, the Australians are undoubtedly the best representatives of a primitive people. The speaker called attention to the close resemblances between the different forms of weapons and implements used by the Australians. From Col. Fox's long and careful study of the weapons of primitive and savage warfare, he is peculiarly fitted to speak with authority on such a subject. He has observed that the Australian spear, the club, the malga, the boomerang, and the heileman, or rudimentary shield, all pass one into another, by transitional forms, serving as connecting links; in short, all their forms are derived, with slight modifications, from the forms of the stems of trees and other natural objects. The Australian, like the palæolithic man, has not advanced even to the conception of boring a hole through his stone axe for the insertion of a handle. If he sees a hole in an axe of European manufacture, he has no notion of its use, and has been known to stop it with gum as useless, and then proceed to haft the axe according to the primitive traditional customs of his race. Yet this rudimentary state of culture is far from being due exclusively to racial incapacity, for the Australian, when properly instructed, is by no means slow in receiving new ideas.

It is interesting to learn that Col. Fox has traced the Australian boomerang and the rudimentary parrying shield to the Dravidian races in Central India and to the ancient Egyptians—a fact which tends greatly to support the views of Prof. Huxley, who, from studying the physical characters of the Australians, the hill tribes of India, and the old dwellers in the Nile Valley, has traced so close a connexion between these peoples, as to lead him to group them together under the term of the *Australioid* stock. Nor should it be forgotten that philologists have detected numerous resemblances between the Australian and Dravidian languages.

Col. Fox pointed out the geographical distribution of many other weapons, and showed that similar forms are often found in widely-separated localities; thus, the throwing-stick is now used only by the Australians, the Esquimaux, and the Purrus-Purrus Indians of South America. Two theories have been brought forward to explain such coincidences in the culture of peoples at present dwelling in distant regions. Either the culture has descended from some original source, and the people now separated were once connected, or the culture has originated independently in distant centres. On the latter hypothesis, the customs and arts will be similar in consequence of the similarity of conditions under which they arose. Like causes produce like effects; hence, it is said, different peoples placed under similar circumstances will have like wants, and consequently similar customs will be developed. Neither of these theories, however, should be exclusively applied to the interpretation of the phenomena of civilization; both theories may admit of application in certain cases. But as a staunch supporter of the doctrine of continuous development, Col. Fox guards us against supposing that coincidences in culture among peoples living at present in widely-separated localities necessarily prove the independent origin of such culture in distinct centres. It is true there may be no evidence of connexion known at present, but it may fairly be expected that, as our knowledge increases, we may eventually be able to trace connexions unknown to-day, and perhaps unsuspected.

As culture was continuously and slowly developed, it seems safe to conclude that, wherever an art or an institution is now found in an advanced or in a conventionalized form, it has been the result of gradual growth; for it is difficult to imagine that it originated in an advanced state, though the evidence of its primitive condition and gradual development may be lacking. On the other hand, where the arts are now only in a low state, it may be assumed that they are indigenous in that locality.

In seeking to trace the history and sources of human culture, we may rely on evidence derived from the study of the religions, myths, institutions, and language of a people; or we may turn to the

evidence afforded by the relics of its ancient material arts. Col. Fox proceeded to discuss the relative value of these two classes of evidence, and, as might be supposed, decided in favour of the material; maintaining that the evidence derived from a study of ancient weapons, implements, and other relics, carried us much further back in time and possessed greater stability than that derived from any branch of culture which depended for its transmission on memory and oral communication. As an illustration of the stability of the arts of a savage people compared with the fluctuations in its language, Col. Fox stated that in Australia the simple weapons are the same throughout the continent, whilst the names for these weapons are different in almost every tribe—the *thing* has remained, but its *name* has changed.

An amusing illustration of the theory of variation and continuity, as applied to the implements of a savage people, was afforded by the exhibition of a collection of ornamented paddles from New Ireland, one of the Papuan group, adjacent to the island which recently witnessed the murder of Bishop Patteson. These paddles are ornamented with the figure of a man, painted in red and black, and carved on the face of the blade. For many generations the form of the paddle appears to have remained unchanged; but the ornamentation varies within certain limits. Nevertheless, when a sufficiently large number of specimens are placed side by side, the continuity between the several forms of ornament may often be instructively traced. The first specimen exhibited to the meeting presented the characteristic head of a Papuan; but in passing along the series the form of the figure became gradually simplified and conventionalized, until finally nothing was left but a crescent, representing the chin of the original face. Without the intermediate forms, no one could have suspected the origin of this moon-like ornament. And if these intermediate forms had represented connecting links between myths, customs, religions, or languages, or, indeed, anything not embodied in material forms or committed to writing, it would have been impossible to establish this connexion.

From a discussion of the value of anthropological evidence, Col. Fox was led to a consideration of the best means of collecting the evidence, and of digesting it when collected. True to his profession, he strongly advocated the introduction of greater order, discipline, and organization in the numerous existing institutions for the encouragement of studies bearing upon anthropology. There is no end to the number of societies, associations, and institutions for such studies; but they work with so little co-operation, that the same subjects are often discussed at several societies, and a great amount of working power is thus wasted. The archæological bodies came in for the lash severely. To remedy the existing unsatisfactory state of things, the speaker warmly advocated co-operation between the several anthropological and archæological institutions, and the specialization of the functions of each body. Anthropology presents so vast a field of study, that it requires, more perhaps than any other science, to be judiciously subdivided. Col. Fox suggested that the several branches of anthropology might be distributed under five heads:—*Protohistoric Archæology* (a term proposed by Mr. Hyde Clarke), *Prehistoric Archæology*, *Philology*, *Biology* (including psychology, and comparative anatomy in so far as it bears upon man), and *Descriptive Ethnology*, or original reports from travellers on the races of man. It is to be hoped that the seed sown by this suggestive address may eventually bear much fruit.

After ten years' diligent application to a special subject, one ought assuredly to attain results well worth recording. Canon Greenwell has, for the last ten years, devoted himself in great measure to the exploration of the barrows or tumuli scattered over the Wolds of Yorkshire; and the general results of these diggings have been thrown into the shape of a paper, which certainly is one of the most valuable that was read in this Department. The memoir contains a vast mass of information respecting the barrows and their contents. The barrows are constructed of the materials which come readiest to hand—more commonly of earth than of chalk. Animal bones are scattered through the mounds, and appear to be the remains of feasts held either at the time of the burial or subsequently, perhaps at its anniversary. Flints and potsherds also occur indiscriminately mingled among the materials of the barrows, and Mr. Greenwell suggests that they may have symbolized some religious idea, and quotes a passage in 'Hamlet,' where the priest, answering Laertes relative to the burial of Ophelia, says—

> Shards, flints, and pebbles should be thrown on her.

And though this relates to the burial of a suicide, it is known that rites accounted pious in one religion may be regarded as unholy in another. In some cases, the burials in these barrows were by inhumation; in others, after cremation—the former being by far the more frequent custom on the Wolds. Where the burial has been by inhumation, the skeleton is always found in a contracted position, with the knees drawn up towards the head—a position evidently not due in all cases to the requirements of space, but one which must have originated in some settled idea. Mr. Greenwell suggests that where the sleeping-place was not well protected against the cold, and where covering for the body was but scanty, the contracted posture was that best adapted for securing warmth and comfort—the position, in fact, in which the person usually slept, and in which he may have died. Weapons and implements of stone and bronze, and rarely of bone or horn, are found in the tumuli. It is notable that the articles in flint, found in immediate connexion with the bodies, appear in most cases to be perfectly new, as if manufactured expressly for the occasion of the burial. Ornaments and objects of personal decoration are rare; indeed, the whole of the evidence afforded by the barrows seems to show that they were the burial-places of a people not possessed of much wealth of any kind, and having but limited intercourse with other parts of the country.

Fitly following Canon Greenwell's paper, was one by Mr. Spence Bate, 'On some Tumuli on Dartmoor.' Mr. Bate has been actively engaged in the exploration of the prehistoric monuments of Devonshire, and reported upon them some time ago to the late Ethnological Society. The present communication related to a continuation of these researches. The author believes that he is justified in concluding from some of these investigations that the Norsemen visited Dartmoor at a very early stage of the bronze period, perhaps for the purpose of obtaining the tin, so essential an ingredient in the manufacture of their bronze.

Several examples of stone and bone implements, bearing curiously suggestive marks, have been brought to light in exploring the caves or rock-shelters in the valley of the Vezère, in Dordogne. It is well known that the late Messrs. Christy and Lartet explored these caves, and that an exhaustive work on the subject is in course of publication, under the title of 'Reliquiæ Aquitanicæ.' Prof. T. Rupert Jones, the accomplished editor of this serial work, having had occasion to study the marked implements in question, read a paper of much interest on this curious subject. Many of the specimens bear notches, scorings, and dottings, whilst others are ornamented with carvings of fishes, horses, deer, and other natural objects. The author described especially a blade-like piece of ivory, bearing three kinds of markings,—marginal notchings, groups of scorings and patches of systematic dottings. In comparing these with analogous specimens, chiefly in the Christy Collection, and with implements bearing somewhat similar markings, Prof. Jones referred some to the category of owners' marks, such as Esquimaux harpoons frequently bear; some he regarded as tally-sticks, made by the savage hunter for his game-score or for other numerical marking; and others he thought to be analogous to the gambling-tools used by both savage and civilized man. On two harpoons he found linear series of angular cuts, distinctly resembling letter-strokes. He further alluded to Mr. W. Morris's exquisite appreciation of savage life and notions in his 'Jason,' where Medea congratulates the hero on having escaped the enemy's arrow, "scored as by a sharp-edged knife .... with what seem'd written words," and charged with the cruel charms of the wizard.

A flint-implement station near Sandhurst was described in a short paper by Lieut. Cooper King. Several isolated groups of flint flakes, and a few implements, have been found in a marshy deposit, which may have been the site of an ancient lake-dwelling.

At the conclusion of the day's doings, Col. Fox read a letter which had been addressed to Sir John Lubbock by Mr. Cunnington, relative to the recent injury of the cursus at Stonehenge. The threatened destruction of many of the prehistoric remains in this country shows the necessity for obtaining legislative measures to insure their protection. Such a Bill will be introduced next session by Sir John Lubbock.

FRIDAY.

Department of Zoology and Botany.

The members of the Section assembled to hear the introductory address of the President of the Department of Anatomy and Biology. This having been delivered, the regular business was commenced by a description, by Dr. Sclater, of a new species of rhinoceros, *R. lasiotis*, captured near Chittagong, and distinct from *R. Sumatrensis*. Six species of the genus were therefore now known. The animal was living in the Zoological Society's Gardens.—In answer to General Strachey, Dr. Sclater said that nothing was known of the Rhinoceros which within the historic period existed on the Indus; but the examination of caves might bring some of its remains to light.

Mr. Gwyn Jeffreys read a paper 'On the Mollusca of Europe and East and North America.' Comparing the molluscan Fauna of Europe with that of Massachusetts, the former contained 200 land and freshwater and 400 marine—the latter 110 land and freshwater and 267 marine species. Of the land and freshwater shells, 28 per cent. were European, and of the marine 52 per cent.

In a general discussion which followed this paper, there was a general agreement that the communication by which European land animals and plants had reached America had taken place, not across any imaginary continent in the Atlantic, but by way of North-Eastern Asia.

A paper was read from Mr. J. F. Whiteaves 'On Dredging in the Gulf of St. Lawrence.'—Nearly all the marine invertebrata of the northern part of the Gulf of St. Lawrence are purely arctic. The species belonging exclusively to the deep sea in Canada have a decidedly Scandinavian aspect.

Prof. A. Nicholson gave some account of his Dredgings in Lake Ontario.

Prof. Allman described the structure and development of Mitraria, a curious larval form. It consisted mainly of a transparent dome-like body, from the base of which a process was subsequently developed, at first wholly unsegmented, which became the body proper of the worm.

Mr. A. W. Hayne read a paper 'On the Flora of Moab.'—He had accompanied Canon Tristram at the beginning of the year on his visit to Moab. The eastern shore of the Dead Sea was much more fertile and well watered than the west. The abundance of the date palm was the most conspicuous feature. On the west side of the sea there is only the single clump observed by Canon Tristram near Jericho. Two hundred and fifty species were collected, of which a large proportion belonged to Leguminosæ and Compositæ.

Canon Tristram read the Report of the Close Time Committee. It is feared that the new Act, though far from a general measure, will be a very inefficient check to the destruction of sea birds which, from their yearly decreasing numbers, most require protection. Its restraining power has been greatly weakened for the sake of protecting a

number of birds which do not require protection at all. The Committee believe that small birds are actually on the increase.

Prof. NEWTON gave an animated account of the history of the passage of the Act for the Preservation of Wild Fowl through Parliament, which had been attended with many vicissitudes, from which the Act had not emerged by any means the better.

Mr. MOGGRIDGE described a curious elm in Kensington Gardens, which gives off, at eight feet above the ground, a mass of roots, which reach the ground with no farther attachment to the tree.

The remainder of the sitting was occupied with communications from two distinguished foreigners who are attending the Association.

M. P. GERVAIS described the dentition of Macrauchenia, an extinct animal of South America, of which the Paris Museum has obtained an important collection of remains.

Prof. VAN BENEDEN, of Louvain, followed with an account of the extraordinary accumulation of the bones of small extinct Cetaceans which have been obtained from excavations in the so-called Antwerp crag. These are identical with the rolled fragments otherwise indeterminable from our Suffolk crag. All the species were smaller than those now existing. This was an exception to the general rule. There was, however, a parallel in the small fossil elephant of Malta.

Department of Anthropology.

On Friday most of the papers were on philological subjects, but, in consequence of the great attractions offered in the Geographical Section by the papers relating to Dr. Livingstone, the Anthropological Room was almost deserted in the early part of the day.

Three papers were contributed by Dr. CHARNOCK. Two of these were of much local interest—one being 'On Certain Geographical Names in the County of Sussex,' and the other 'On Sussex River-Names.'

The attractive subject of the 'Origin of Serpent-Worship' was discussed in a paper by Mr. C. STANILAND WAKE, the former Director of the Anthropological Institute. After referring to the existence of this worship in many parts of the world, the author considered the several ideas associated with the serpent among ancient and modern peoples—its supposed power over wind and rain, its connexion with health and good fortune, its symbolic association with life or immortality, and with wisdom. It was then shown that this animal was viewed by many uncultured peoples as the re-embodiment of a deceased ancestor, and that descent was traced from a serpent by the Mexicans and some other peoples. Hence the serpent superstition became a phase of ancestor-worship. When the simple idea of a spirit-ancestor was transformed into that of the Great Spirit, the attributes of the serpent would be extended; and, from its supposed connexion with the atmosphere, the serpent would come to be associated with nature- or solar-worship. Hence the sun was not only a serpent-god, but the divine ancestor or benefactor of mankind. It appears that serpent-worship, as a developed religious system, originated in Central Asia, the home of the great Scythic stock, whence the civilized races of the historical period sprang; and that the descendants of the legendary founders of that stock, the Adamites, were, in a special sense, serpent-worshippers.

Further researches on the classification of the languages of the Caucasus were communicated by Mr. HYDE CLARKE. He identifies the Ude with the ancient Egyptian, or Coptic; the Abkhass with the Agaw, Falasha, &c., of the Upper Nile; the Circassian with the Dravidian; and the Georgian, Lazian, and Swan, with the Caucaso-Tibetan. Mr. Hyde Clarke observed that the Caucasus was not a centre of population for the world, but merely a place of passages; and showed the relations of the Abkhass and Circassian with their congeners in Europe, Africa, Asia, Australasia, and America, illustrating the common population of the New and the Old World, and the knowledge of America by ancient nations, dimly preserved, though not understood, by the old classic geographers.

In discussing Mr. Hyde Clarke's paper, Mr. H. H. HOWORTH took occasion to call attention to a fine series of photographs of various members of the Caucasian family—a series recently received from Tiflis by Mr. Lamprey, one of the Secretaries of the Department.

But the most amusing part of Friday's proceedings was a verbal communication, by Mr. JOHN EVANS, 'On the Origin of Alphabets.' By aid of a large series of diagrams, the speaker was able to exhibit many transitional forms between the characters of our alphabet and those of the Phœnician, tracing them back to the oldest alphabet we possess—that on the Moabite Stone. Those who had the good fortune to attend Mr. Evans's lecture on this subject at the Royal Institution, will readily believe that no small amount of amusement followed the exhibition of his movable diagrams, which surprise every one by suddenly revealing the relation between the old form of the characters and the figures of the objects which the names of the letters originally denoted—the ox-head, the house, the camel, the door, and so forth.

Friday's proceedings were brought to a close by a paper by the Rev. J. C. ATKINSON, the result of a vast amount of labour in examining the local nomenclature of Cleveland, in Yorkshire. The author concludes that upwards of eighty per cent., or four-fifths, of the genuine old forms of place-names in this district, dating back to mediæval times and yet earlier, must unhesitatingly be referred to a Danish as contradistinguished from an English or Anglian source.

Department of Anatomy and Physiology.

This Department did not meet until Friday, when Dr. B. SANDERSON, the Director of the Brown Physiological Institute in London, delivered the introductory address:—The speaker began by asserting that the reason why physiological research is less successfully pursued in England than could be wished, is the general want of scientific education. In considering the subject of education, he proposed to refer, first, to that higher training which is required for the production of scientific workers or investigators; secondly, to what may be called the education of public opinion by the popularizing agency of books and lectures; and, lastly, to the introduction of natural science as an element of education in our great schools and universities. If a man wants to be a physiologist, he must, as things at present stand, study medicine. There is no logical reason for this; for, although medicine ought to be built on physiology, there is no reason why a physiologist should know anything about the art of curing diseases. Practically, however, it is the case, that the kind of education which a man requires in order to be a physiologist is best obtained through a course of medical study. This close relation between medicine and physiology is likely to be a permanent one, on the general ground that any science is likely to be studied with more earnestness by those who have to practise an art founded upon it than by others. It becomes of interest, therefore, to know in how far the existing institutions for teaching are fitted for the training of scientific men. So far as concerns English schools, an ordinary medical education is a poor preparation for a scientific career. The "medical sciences," as they used to be called,—viz., chemistry, anatomy, and physiology,—have developed far too fast for the resources of the medical schools. How rapid that progress has been, may be judged of by any one who chooses to read any of the text-books of twenty years ago in the light of recent researches. In this movement, England has been represented by her medical teachers; but they, possessing neither the men nor the means necessary for prosecuting an experimental science, have been only too readily content to reap the fruits of other men's labours. It would not be agreeable to make this admission were it not possible to look forward with considerable confidence to something better. In the schools of London, in the old universities, and in one or two of the provincial schools, great efforts are being made to provide adequate buildings and appliances for the experimental teaching and study of physiology. Notwithstanding, it will take years for England to regain the position she ought to maintain. The appliances and places for work have been obtained, and this is a great step forwards. But the pecuniary resources necessary for the carrying out of systematic and continuous researches are still lacking, and, above all, workers have to be educated. The difficulties which lie in the way in this respect are very great indeed. The objection always advanced by young men as a reason for not giving up their time to scientific research is, that it does not pay. But it need scarcely be said that the real difficulty is a more general one. It lies in the practical tendency of the national mind, which leads Englishmen to underrate or depreciate any kind of knowledge which does not minister directly to personal comfort or advantage—a tendency which was embodied in the philosophy of Bacon, and has been thought by some to constitute its weakness. There are many in England who would not be deterred by the prospect of comparative poverty, which in every country must be the portion of all those who devote themselves to abstract science, although there are very few who have the courage and the resolution to follow this course, in spite of a public opinion which estimates science on utilitarian principles. The most efficient means that can be adopted to improve the position of our science in England are those which have for their object the enlightenment of public opinion; and this is to be effected partly by diffusing among the public information about labours accomplished, and so inducing a greater interest in them, partly by introducing training in physical science into schools. In the art of exposition, that is, of making difficult subjects plain, England has a master whose powers have been acknowledged not only in England, but in France, and still more emphatically in Germany. His work on 'Elementary Physiology' has been translated and presented to the German public by one of the leading German physiologists, himself a model of clearness of style,—who tells his countrymen in his Preface that no German writer could expound the experimental facts which are the basis of physiological knowledge as Mr. Huxley can. At one time the speaker confessed he was disposed to underrate the value of popularizing science. Now he saw this power of exposition to be a great power for good.

After a few remarks on Faraday as a master of the art of exposition, and on the influence he exercised, Dr. Sanderson passed to the next part of his address, that which related to the teaching of science, and particularly physiology, in schools. The teaching, he remarked, must necessarily be elementary; but if it is thorough and genuine, it is useful. A little bit of Bowdlerized physiology, "something about the structure and functions of the human body," as it is called, thrown into the ordinary course of school education, may be an ornamental addition to it, but can scarcely be really useful as intellectual training. The reform of education must consist, not in adding natural science to the old system of instruction, but in substituting for some of the old drudgeries something better and more substantial. As regards that higher education which may be defined as introductory to the studies of the University, most people are now disposed to recognize that there exists at the present day a tendency to increase its extent at the expense of its thoroughness. On the one hand, a powerful effort is being made by the *laudatores temporis acti* to maintain the old disciplines, while, on the other, a general, though vague, notion prevailed, that no system of education shall be regarded as complete from which science is excluded. To reconcile these antagonistic tendencies, the only method found has been that of addition and accumulation; and an additional load of new subjects has been imposed on the unfortunate examinee in the form of chemistry, physics, animal philosophy, &c. No wonder that,

to the victim who has just passed through one of our modern ordeals, the very names of these sciences are sickening; for, in addition to the disagreeable task of getting them up from text-books (text-books, however excellent, are at best but very poor reading), the competitor, whether successful or not, has the consoling reflection that he has been doing treadmill work after all,—learning a number of facts and laws of great value to the man who is able to possess himself of them, but to him rendered absolutely useless by the mode of study to which the present system of examinations has compelled him. The speaker had already hinted at the way to obviate this: natural science must be introduced into the system of education, not as an ornamental addition or accomplishment, but as part of the groundwork. To serve as a groundwork, physiology is obviously not suitable. The corner-stone must, of course, be mathematics. Side by side with mathematics, the subjects which ought to claim preference are physics and chemistry, and this for several reasons. While chemistry is an indispensable preparation for the acquirement of the other allied sciences, it can itself be taught and understood independently. A second reason is, that the appliances required for teaching it may be easily obtained, and the modes of demonstration are such that it can be taught thoroughly and efficiently, not from books, of course, but in the laboratory. The third and most important reason is, that the study itself is fitted in a remarkable degree to serve as a mental discipline, and particularly as a means of developing at an early period of life that certainty, that convincedness of mind, that clear realization of facts, seen not by the bodily, but by the intellectual eye, which constitutes the scientific spirit. It is clear that physiology could not be recommended on the same ground, yet it may be wisely included in ordinary instruction, not as a discipline or mental drill, but on the ground that it is so usefully applicable to the common affairs of life. It is well that every one should know something of the structure and functions of his own body; he is enabled thereby to take better care of himself, and to understand how to preserve himself by reasonable precautions against some of the well-recognized causes of disease. He is also not so likely, as he would otherwise, to become the dupe of the many quackeries which are afloat. He would be more ready to take the advice of his doctor as regards the regulation of his mode of life, less credulous as to the efficacy of drugs.

In concluding, the speaker urged that the result of the general adoption of a system based on scientific training would be, that the scientific part of a student's education would not, as now, disappear out of his mind as soon as he entered on different studies. The details might fade away from his recollection, but the scientific habitude of mind would be retained.

Prof. Flower exhibited a great number of diagrams of the liver from various mammals, and pointed out the typical structure of the mammalian liver. He recognized right lateral, right central, left lateral, and left central, Spigelian and caudate lobes. The most complex of mammalian livers could be reduced to this type. The simplest form of liver was present in the whales and dolphins, in which that organ is divided into only two nearly equal lobes, a right and left. It was elicited in discussion that this was the form of liver which Prof. Flower would regard as primeval. The two-toed sloth presents three nearly equal lobes by the excessive development of the Spigelian lobe; but though the group of animals to which the sloth belongs are of a low type, and in a certain sense archaic, yet this form of liver does not appear to have any claims to be regarded as the original form among mammalia, since the other sloth and the armadilloes have totally different proportions, resembling the other mammalia.

Prof. Struthers, of Aberdeen, brought before the Section a number of bones and dissections, showing the presence in the human arm-bone of a supra-condyloid process, to which special interest attaches from its mention in Mr. Darwin's recent work. This little projecting spur, just above the elbow, occurs, Prof. Struthers says, much more extensively than has been generally supposed. He finds it in about one case in fifty, and it may be observed in a very rudimentary state in almost every subject. It was impossible, he said, to explain this variation on the old ideas of final cause and type, and it was a strong piece of evidence in support of the doctrine of evolution. In some animals the process had a specific function to fulfil, but in man it served no purpose whatever.

Prof. Struthers next made a communication 'On the Sternum and Pelvic Bones in the Right Whale and in great Fin Whales, showing great variations in Form, even in different Species.'—He mentioned a curious circumstance in the osteology of whales, viz., that these animals are very liable to rheumatism. He had, he said, seen many examples of rheumatic ostitis in whales of different kinds. It had been said that animals were not subject to disease until they were brought into connexion with man; but the fact he had mentioned contradicted the theory. It was the more remarkable, seeing that whales were less liable than man to variations of temperature; and the cold water cure (as a witty friend had observed) did not seem to be efficacious in the cure of the disease in question.

A third communication was made by Prof. Struthers, 'On the Occurrence of Finger Muscles in the Bottle-Nose Whale (*Hyperoodon bidens*).'—A dissection of the fin of a whale of this species (a male 20 feet in length) was exhibited, showing the presence of finger muscles corresponding to those in man, and also the biceps muscle transferred from the scapula to the head of the humerus. A piece of the gum of the lower jaw was likewise shown, in which a concealed tooth was sunk about half-an-inch below the surface. He asked, what could be the use of teeth in such a position? He could only infer, from the existence of such rudimentary structures, that the animal was descended from a species possessing functional teeth.

Prof. Flower attributed the great variations in the pelvic bones and the sterna of the whale to their rudimentary character.

A paper was read by Mr. G. Harris, 'On the Concurrent Contemporaneous Progress of Renovation and Waste in Animated Frames.'—The general object of the paper was to show that certain causes tending to produce renovation and waste are controllable by human skill, and that they would become still more so by increased chemical and pathological knowledge. In the case of animated bodies, the hardening of the cartilages and deterioration of the blood appeared to be the principal causes of preventing renovation and accelerating waste; and there was little doubt that certain artificial appliances would, to a considerable extent, affect those conditions so as to restore waste and effect renovation, and thus greatly prolong the period of human life. Wild animals, he said, are rarely known to die of extreme old age, and he suggested that they might have an instinctive knowledge of the value of vegetable or mineral appliances in increasing renovation and restoring waste.

The paper was sharply criticized by Mr. Lankester and Dr. Gamgee as a mere speculative production and a collection of random assertions; and the Chairman denied the statement of the author that death was materially influenced by the ossification of the cartilages and the deteriorated condition of the blood.

The last communication brought before this Section was a paper by Dr. Radcliffe, entitled, 'Whether the Causes of Vital Movement are yet clearly appreciated.'

Section E.—GEOGRAPHY.

President—F. Galton.

Vice-Presidents—C. R. Markham, Major-General Sir H. Rawlinson, Major-General Strachey, Vice-Admiral Sir E. Belcher, Vice-Admiral Ommanney, J. Arrowsmith, A. G. Findlay.

Secretaries—H. W. Bates, A. Keith Johnston, Rev. J. Newton, J. H. Thomas.

Committee—Sir J. Alexander, W. P. Andrew, J. C. Burrows, Dr. C. T. Beke, Dr. W. G. Blackie, Dr. Brandis, C. L. Buxton, Sir T. Fowell Buxton, Bart., Dr. W. B. Carpenter, Dr. Cuthbert Collingwood, Sir Walter Elliot, Rev. Dr. Ginsburg, Rev. E. Hale, Capt. Griffith Jenkins, Gwyn Jeffreys, R. C. Johnson, Dr. R. King, Prof Newton, Capt. Nolloth, Capt. Nares, Dr. P. O'Callaghan, Rear-Admiral Richards, H. M. Stanley, Dr. T. Thomson, J. A. Tinné, Rev. Canon Tristram, A. R. Wallace, C. White.

THURSDAY.

The President opened the business of the Section with an address, in which he said that the several Sections of the British Association had different functions from those of Societies pursuing corresponding branches of science. The Section he addressed was not simply the Geographical Society, meeting in a hospitable and important provincial town, but a body having a distinct individuality, with purposes to fulfil which were not easily to be fulfilled elsewhere; whilst, on the other hand, Geographical Societies performed many functions which the Section could not successfully undertake. Its peculiarities lay in the briefness of its existence, combined with an extraordinary opportunity for ventilating geographical projects. The lectures were constituents of a great scientific organization, which enabled them to secure the attention of representatives of all branches of science to projects they put forward, and to obtain the support of the whole Association to those which had merit enough to earn their deliberate approval. These considerations indicated the class of subjects which might most profitably engage the attention of the Sections, viz., those which may lead to a definite proposal for the aid of the Association generally, and those of a high and general popular interest. There were many objects of geographical pursuit other than explorations; geographical problems were as numerous and interesting as those of any other science. The configuration of every land, its soil, its vegetable covering, its rivers, its climate, its animal and human inhabitants, act and re-act upon one another, and it was the highest problem of geography to analyze their correlations. The mutual effects of climate and vegetation were an instance of this. Certain general facts are familiar to us, namely, that rain falling on a barren country drains away immediately; it ravages the hill slopes, rushes in torrents over the plains, and rapidly finds its way to the sea, leaving the land unrefreshed and unproductive. On the other hand, if a mantle of forest exist, the effects of the rainfall are far less transient. The water has to soak through much vegetation and humus before it is free to run over the surface, and when it does so the rapidity of its course is checked by the stems of the vegetation; consequently, the rain-supplies are stored, and the climate becomes more equable and humid. We were also familiar with the large differences between the heat-radiating powers and evaporation of the forest and of the desert. We had, however, no accurate knowledge of any of these data, or of the influences of forest and desert on the rate of passage and horizontality of the water-laden winds from the sea. Such were examples of the interesting and intricate problems which geography had to solve. There are tracts in Africa, Australia, and at the Poles, not yet accessible, and wonders may be contained in them; but the region of the absolutely unknown is narrowing, and the career of the explorer, though still brilliant, is inevitably coming to an end. The geographical work of the future is to obtain a truer knowledge of the world, not by accumulating masses of petty details, but by just and clear generalizations. We want to know all that constitutes the individuality, so to speak, of every geographical district, and we have to use that knowledge to show how the efforts of our race may best conform to the geographical conditions of the stage on which we live and labour.

The President then propounded certain reforms, which he hoped would be discussed by the Section, regarding the distribution and production of maps of the Ordnance Survey. Referring to the maps already issued on the one-inch scale, whose accuracy and hill-shading were unsurpassed, although a defect might be pointed out in the absence from the coast maps of the sea data (*i. e.* the depth and character of the sea-bed, its currents and tides), he discussed what he believed to be the defects in the form and manner of their publication—

defects easily remediable. In short, it was to be regretted, he said, that these beautiful and cheap maps (already paid for by the tax-payer) were not more accessible. They are rarely to be found even in the principal booksellers' shops, and are never seen on the bookstalls of railway stations. Many educated persons seldom, if ever, see them, and they are almost unknown to the middle and lower classes; in fact, those interested in local maps are generally driven to use common and inferior ones out of those which have the command of the market. The same may be said of the French Government maps. The obstacles to the general usefulness of Ordnance Maps are caused, first, by their being printed on large and stiff paper, which makes them cumbrous and unfit for use, except after much trouble and expense in mounting and binding; and, secondly, by the circumstance that the agents for their sale are themselves map makers, and, therefore, competitors. The remedy he should propose to the Committee of the Section was to memorialize the Government to cause an issue of the maps to be made in quarter sheets, on thin paper, folded in pocket size, with an index map outside of each to show its contents; and to appoint them to be sold at every "head post-office" in the United Kingdom. Each of the seven hundred offices might keep a stock of the sheet relating to its district and of those of the eight adjacent sections; others not kept in stock to be obtainable by ordering them through any of the offices. These simple reforms would be an immense public boon. For sixpence, the price of a quarter sheet, any one would be able to obtain, without trouble, a beautiful and accurate pocket map of the district in which he resides: such a measure would increase the sale, and enlist the sympathies of the people and of their representatives in Parliament on the side of the Survey. As to the objection that it would interfere with private enterprise, he (the President) could not see why the Government should restrict the sale of its own work in order to give a fictitious protection to inferior productions of the same description. Another proposal he intended to make to the Committee was to memorialize Government to undertake, should the other scheme succeed, the construction of a reduced Ordnance Map, on the scale of five miles to an inch, to be printed in colours. The art of colour-printing has already influenced cartography in foreign countries, and it was found that colours were well calculated to represent the variety of nature on the surface of a country. The Dutch had issued maps of Java in more than ten different colours, and they gave a vivid idea of the state of cultivation in that country. It was understood that the Ordnance Survey Office had favourably considered the question of printing, at some future time, of an edition of the one-inch maps on this principle, but his (the President's) proposal was to suggest that maps be produced on the smaller scale of five miles to an inch, and their sale to the public be facilitated by the same measures as those he had proposed in the case of the already existing plain maps.

'Report on the Exploration of Moab,' by the Rev. Dr. Ginsburg.—'Report on the Geographical Exploration of Moab,' by the Rev. Canon Tristram.—These two Reports referred to the same journey of exploration, which was supported by a grant from the Association, the Rev. Canon Tristram having continued the Expedition after Dr. Ginsburg had quitted it. The party left Jerusalem on the 30th of January last, entering the country from the south of the Dead Sea; crossing the frontier line of ancient Moab and Edom, they first examined the Ghor es Safieh, which they found very much more extensive southward and eastward than it is marked on the maps. Beyond this, Dráa was visited, generally said to be the ancient Zoar; but nothing is left of it beyond lines of foundations and heaps of sandstone, some of the stones squared and dressed. From Dráa to Kerak the ascent was calculated at 3,720 feet, Dráa being 570 feet below the sea-level. The entrance to Kerak is by an arched natural tunnel, out of which the traveller emerges in the midst of the city. Its fortifications, well adapted to resist mediæval or modern Oriental assault, are in their lower parts of Phœnician or Jewish age, then Roman, and finally surmounted by the work of the Crusaders; they are of vast extent and enormous height. An excellent series of photographs of this singular fortress were taken by Mr. R. C. Johnson, the photographer of the expedition. The party were here held as prisoners of a rapacious chieftain, and not allowed to depart until after the payment of a heavy ransom. Nevertheless, excursions were made in the neighbourhood, and the sites fixed of many ruined places. Near Arar, a messenger reached the party, bringing news of a domestic affliction, which compelled Mr. Klein, who had been of the greatest service, from his knowledge of the language and people, to return hastily to Jerusalem, and Dr. Ginsburg accompanied him. The rest continued their way northward, across a dreary highland plain to Dhiban, near which the famous monolith had been found. No basalt or inscribed remains now exist above ground. The next place visited was Um Rasas. The most interesting ruin here is a Christian mortuary tower, close to the ruins of a Byzantine church, and forming a landmark for miles round. Um Rasas must have been one of the most important cities on these highlands in Roman times, and is on the Roman military road. Several places not hitherto visited, to the east of Um Rasas, were explored. One of these, Khan Zebib, is evidently built on the ruins and with the *débris* of a former great city, and a Doric temple was found to the eastward of it. From Um Rasas the route was north-west, crossing the Wady Themed, and, north of it, a visit was made to Zarafan, with a fort of large squared stones on the top of a *tell*, and the remains of the town below it—probably the Naar Safari of the 'Notitia.' To the north-east lies Um el Weled, one of the most important ruins in the whole country, consisting of three distinct types of buildings, Præ-Roman, Roman, and Saracenic. The forum, surrounded by the bases of columns, is entire, forty-one paces by twenty-eight. Striking eastward, Ziza was visited, mentioned in the 'Notitia' as the head-quarters of the Dalmatio-Illyrican cavalry. The remains are very perfect, and much engineering skill is manifested by the way in which the upper valley has been banked, and a system of sluice-gates arranged for filling the great water-tank. Several acres, full of sculptured ruins, were here seen. A few miles east of Ziza the party made their most interesting discovery, in the ruins of a magnificent palace of the time of Chosroes the Second, A.D. 611-625. Two days were well spent in examining and photographing the richly-decorated façade and walls. Mr. Fergusson, to whom the photographs had been shown, besides fixing their age, had pointed out the indications they afforded of Byzantine art, guided by Persian design. The party returned by the northern end of the Dead Sea, having succeeded in surveying a large tract of this interesting country, and bringing to light some twenty ancient cities hitherto unvisited.

'The Euphrates Valley Route to India,' by Mr. W. P. Andrew.—In the opening portion of his paper, the author dilated upon the many noble objects which the proposed railway to India, *viâ* the Euphrates Valley, would subserve. It would inevitably entail the colonization and civilization of the great valleys of the Euphrates and Tigris, restore the old and renowned productiveness of Mesopotamia, and resuscitate in modern shape Babylon, Nineveh, and Ctesiphon. He argued that no direct route to India, amongst the many which had been proposed, combined so many advantages as the ancient route of the Euphrates. It is the shortest and the cheapest, both for constructing and working a railway,—so free from engineering difficulties, that it appears as though designed by nature for the highway of nations between the East and the West; it is the most surely defensible by England—both its termini being on the open sea—and the most likely to prove remunerative. The other routes proposed, such as those from places on the Black Sea, were open to the fatal objection, that while they *would* be of the greatest service to Russia, they *would* be beyond the control of Great Britain: they were besides excluded from practical consideration by the engineering difficulties they involved. These conclusions had been demonstrated by many eminent witnesses examined before the recent Select Committee of the House of Commons. The author admitted the value of a continuous line from Constantinople to India, but believed it to be too vast a project to be at present undertaken. The moderate scheme which he advocated was a line 900 miles in length, from the Gulf of Scanderoon, *viâ* the *right* bank of the Euphrates to Kowait, in the north-western corner of the Persian Gulf. Should it be found desirable hereafter to construct a through line to India, this portion would form a ready-made and considerable section of it. It was precisely that portion of the route between Constantinople and India from which the greatest benefit would be derived by the substitution of railway for sea transit, whether regard be had to the rate of speed or the economy with which the traffic might be worked. Both the proposed termini possess all the requisites of first-class harbours, and the line, on leaving Alexandretta, would run to Aleppo, and along the Euphrates, by way of Annah, Hit, Kerbela, Nedjef, Somowha, and Sheikh el Shuyukh, to Kowait. The Euphrates would not be crossed, and the line would have the strategic advantage of two great rivers being interposed between it and an advancing enemy on the flank on which there would be the greatest likelihood of danger arising. The cost of the railway was estimated at 9,000,000*l.* sterling. The advantages of the proposed railway to England would be the possession of an alternative route to India and the saving of nearly 1,000 miles in linear distance.

'The Direct Highway to India Considered,' by Capt. Felix Jones.—This paper also advocated the construction of a railway to unite the Mediterranean at Alexandretta with Kowait on the Persian Gulf. The other proposed routes through Asia Minor, Northern Persia, or *viâ* Diarbekr and the left bank of the Tigris, were reviewed by the author, and shown to offer hopeless difficulties in the way of a line of railroad. Aleppo is the key to the entire system of railways in Turkey. A proposed line hence to Mosul would have the advantage of absorbing all the lines of traffic from the north and east, but in its continuation along the Tigris it would entail the bridging of the Euphrates twice and the Tigris once, besides being 300 miles longer than the route along the east bank of the Euphrates. The author spoke also of the more settled habits of the Arab population along this latter route, and of the manifest strategic and political value to England of this line and its two termini.

'On a Through Railway Route to India, *viâ* Russia and the Oxus Valley,' by Gryf Jaxa de Bykowski.—The author had traversed the route he recommended, travelling on horseback a distance of 2,000 miles. He estimated the length of the line at 1,900 miles, whereas the route from England, *viâ* the Euphrates Valley, was 3,185 miles. From the Volga to the Hindoo Koosh extended a plain, traversable even now by wheeled carriages. Crossing the Hindoo Koosh from Inderab to Planshir Valley, there were only a few miles of mountain. It is true there were narrow gorges along the Cabul river, which would entail expensive works, but they were quite practicable.

FRIDAY.

'Discoveries at the Northern End of Lake Tanganyika,' by Mr. H. M. Stanley.—Mr. Stanley prefaced the reading of his paper by an account of the origin of his project of searching for Dr. Livingstone, and of his journey to Ujiji, and his meeting with the great traveller, an account similar to that which has already been made known to the public. He commenced his account of Tanganyika by stating that he was enabled to fill up the south-eastern shores of the lake—at present a blank on our maps—with rivers, marshes, and mountain ranges, and people them with powerful tribes. From Unyanyembe he passed through

Southern Wavinza, Ubha (three marches), the beautiful country of Ukaranga, and then crossed the Linche Valley to the neighbourhood of Ujiji. At the time of his proposing to Dr. Livingstone a journey, in company, to the northern end of the lake, the Doctor was almost sure that the Albert Nyanza and Tanganyika communicated with each other. He had perceived, as he thought, a constant flow northward in the waters of Tanganyika, and all the Arabs and negroes persisted in declaring that the river Rusizi (at the northern end) ran *out* of the lake. As soon as Mr. Stanley mentioned to him the interest and importance attached to a settlement of this question, he lost no time in preparing for the journey. Previously, as he stated, he had not regarded the subject as of any importance, the central line of drainage (*i. e.*, the Lualaba) having absorbed all his time and means. Embarking in a boat, and travelling northward from Ujiji, the two travellers hugged the coast of Ujiji and Urundi, looking sharply into every little inlet and creek for the outlet that was said to be somewhere. About fifteen to twenty miles were travelled per diem, past lofty mountains, rising sometimes 2,000 or 3,000 feet above the level of the lake, and camping ashore for the night. Several times they were in danger from the natives, and their men had to keep watch all night, lest they should be surprised while asleep. It took ten days to reach the head of the lake; on the opposite shore, a mountain range, ever bold and high, limited their western view, and appeared impenetrable. The lake is of very great depth: Mr. Stanley sounded two miles from shore and found no bottom with 620 feet of line; and Dr. Livingstone, further south, while crossing, found no bottom with 1,800 feet of line. The mountains round the northern end fold around so close, with no avenue for the escape of waters, save the narrow valleys and ravines by which tributary streams reach the lake, that were the waters to rise 500 feet above their present level, the configuration of the lake would not be materially altered. The evening before they saw the Rusizi, a freedman of Zanzibar declared (in answer to their questions) that he had been on the river the day before, and that it ran *out* of the lake. This information caused the two travellers to deliberate on their further proceedings, should they find a channel leading into Albert Nyanza; and they decided they would in that case follow it and coast round its shores, in the hope of meeting with Sir Samuel Baker. The mouth of the river was at length found; it was in a little bay about a mile in width, and was masked by a dense brake of papyrus and *matete* cane. The entrance was not visible, and they followed some canoes which were disappearing mysteriously through gaps in the brake. Thus they found the central mouth, and all doubt as to whether it was an effluent or an influent soon vanished, for a strong brown flood met them which tasked all their exertions to pull against. Higher up it widens into lagoons on either side. The alluvial plain through which the Rusizi flows into the lake is about 12 miles wide at the commencement, and 15 miles in length, narrowing upwards to a point. The mountain ranges on either side here approximate to within two miles, the eastern range passing the termination of the western. Further towards the north-west there was a perfect jumble of mountains. The chief Rubinga (near the Rusizi), who was a great traveller, and readily discussed questions of geography with the two explorers, told them that the Rusizi rose in Lake Kivo, a sheet of water 15 miles long by about 8 broad, from which it escaped by a gap in the mountains. About 20 miles from its mouth, the Rusizi is joined by the Luanda, or Ruanda, flowing from the north-west; and there were besides seventeen other tributary streams. Rubinga had been six days to the northward, but had not heard of a large body of water, such as Lake Albert Nyanza. Baker's lake, therefore, could not have the large extension southward which its discoverer had laimed for it. On their return journey to Ujiji, they coasted along the western shore of Tanganyika, visiting Uvira, where they were shown the sandy beach on which the canoes of Burton and Speke had rested. A little south of this rises the lofty peak of Sumburizi, 4,500 feet above the lake-level.

Dr. Livingstone having sent home no map of his discoveries, or any material from which one could be constructed, beyond the descriptions in his despatches, Mr. Stanley, at the request of the President, pointed out, on a map of Africa, the position of the rivers and lakes, as near as he could recollect, from the map he had examined while in Dr. Livingstone's company.

'Extracts from the Official Despatches of Dr. Livingstone.'—The geographical information communicated in these despatches is contained chiefly in that to Lord Clarendon, dated the 1st of November, 1871. In this letter Dr. Livingstone states that he had ascertained that the watershed of the Nile was a broad upland between 10° and 12° S. lat., and lying from 4,000 to 5,000 feet above the sea-level. It is 700 miles in length from east to west, and from it flow innumerable streams, which further north unite to form two main lines of drainage—large "lacustrine" rivers; the exploration of one of which, called the central line, had occupied all the traveller's time and means down to the date of his despatch. The geographical results are stated to be chiefly as follow:—"The great river, Webb's Lualaba, in the centre of the Nile Valley, makes a great bend to the west, soon after leaving Lake Moero, of at least 180 miles; then, turning to the north for some distance, it makes another large sweep west of about 120 miles, in the course of which about 30 miles of southing are made; it then draws round to north-east, receives the Lomame, or Loeki, a large river which flows through Lake Lincoln. After the union, a large lake is formed, with many inhabited islands in it; but this has still to be explored. It is the fourth large lake in the central line of drainage, and cannot be Lake Albert; for assuming Speke's longitude of Ujiji to be pretty correct, and my reckoning not enormously wrong, the great central lacustrine river is about five degrees west of Upper and Lower Tanganyika. The mean of many barometric and boiling-point observations made Upper Tanganyika 2,880 feet high; ... but I have more confidence in the barometers than in the boiling-points, and they make Tanganyika over 3,000 feet, and the lower part of the Central Lualaba one inch lower, or about the altitude ascribed to Gondokoro [nearly 2,000 feet]." The furthest point he reached to the north was stated to be lat. 4° S.

'On Dr. Livingstone's Recent Discoveries,' by Lieut.-Col. J. A. Grant.—The author observed that it was much to be regretted that Dr. Livingstone's despatches and letters contained so few observations of latitude, longitude, and altitude; and that map-makers were consequently unable to lay down his vast discoveries with any degree of certainty. Dr. Livingstone had informed us that his great line of drainage had been traced by him from 12° S. lat. down to 4° S. lat., and that he believed the waters continued to flow beyond that until they joined the Bahr el Gazal, or great western tributary of the Nile. But no such thing could happen. The Bahr el Gazal throughout its course was a system of marshes, stagnant waters overgrown with rushes and ambadj, and supplied very little water to the Nile. Moreover, a recent German traveller, of whose discoveries Livingstone, of course, could not be aware, had passed the sources of the rivers of the Bahr el Gazal system in from 3° to 5° N. latitude. From the facts recorded by Livingstone that pigs were kept by the natives of the Lualaba country, and that the gorilla was found there,—both of which animals are unknown in the Nile-Lake region,—he (Col. Grant) concluded that the great traveller had under-estimated the westing he had made in his longitude, and that he was really on the upper waters of the rivers which flowed west into the Atlantic.

A discussion of some length followed the reading of these papers. Dr. Beke said that the inevitable conclusion from the facts stated by Dr. Livingstone, especially that of the altitude of the Lualaba, was, that the river-system he discovered could not belong to the Nile. It was not an agreeable conclusion to him (Dr. Beke), who had so long advocated the contrary view, but it was forced upon him by the facts brought to light for the first time in Dr. Livingstone's official despatches.—Mr. Petherick stated that it was impossible that the Lualaba could join the Bahr el Gazal, with which he had been, during his travels, so well acquainted. His own observations, and especially those of Dr. Schweinfurth, who had pushed his researches beyond the southern watershed of the Gazal, and found to the south an important river flowing to the north-west, absolutely shut off the Lualaba from any possible connexion with the Gazal.—Sir H. Rawlinson also believed the Lualaba could not be the Nile: he was inclined to the opinion that it formed part of a closed basin, the receptacle being some large lake further to the north.—Mr. Stanley repeated his conviction that Livingstone was correct in his conclusions. In answer to questions, he stated that the water of Tanganyika was perfectly sweet.—The President thought it unlikely that a closed basin existed in that humid part of Africa, where the evaporations from a lake would not equal the amount of water poured into it.—Mr. A. G. Findlay would not admit that the information we had received regarding altitudes was final, and believed it still possible that the Lualaba was connected with Albert Nyanza.

'Explorations in the Gold Region of the Limpopo,' by Mr. E. Button.—The paper gave an account of journeys made by the author in 1869 across the Limpopo and in the neighbourhood of Lydenburg. After crossing the Limpopo in the direction of the Bubyi river, a granitic country was entered, which continued to the furthest point reached, Matiba. The Bubyi has no running water in the dry season, but its banks are clothed with groves of a fan-leaved palm and a fine mimosa, some of the latter trees forty feet high without a branch. The granitic formation of this region possesses very remarkable features; vast flats stretch away for a distance of sixty miles, studded with granite hills, each formed of a single mass of rock rising to a height of 600 to 1,000 feet; the rock is denuded for miles, and the country a waterless desert. The natives build their huts under the shelter of large scales of granite on the sides of the hills, and also on the bare rounded summits. No European could reach these places, but the inhabitants scale the hills with the facility of baboons. The author stated that there was very little hope of the Limpopo ever being rendered a navigable river, or the country settled by a European population. Lydenburg, further south, is situated in a fine agricultural district, and the country to the eastward, on the slopes of the Quathlamba, is very beautiful and fertile for a distance of 100 miles. In 1870 he discovered gold in a mountain range south-west of Lydenburg.

Section F.—Economic Science and Statistics.

President—Prof. H. Fawcett.

Vice-Presidents—Sir J. Bowring, M. E. G. Duff, Sir J. K. Alexander, Right Hon. J. G. Dodson, J. White, R. D. Baxter, W. Newmarch.

Secretaries—J. G. Fitch, B. Phillips.

Committee—Syed Ameer Ali, H. G. Bohn, W. Botly, Rev. I. R. Campbell, Hyde Clarke, Mrs. Fawcett, F. P. Fellows, W. H. Freeland, Jerom Murch, Vice-Admiral Ommanney, Dr. E. Smith, R. Wilkinson.

THURSDAY.

The President opened the proceedings of this Section, and after a few introductory remarks, said—Every one has been saying that we have been for some time past, and that we are at the present moment, enjoying unprecedented prosperity in this country. If the well-being of a nation could be solely estimated by the amount of wealth which is produced at home, and by the quantity of commodities which are imported from abroad, it might be concluded that England was rapidly arriving at a state of perfection, and that all her people were in process of securing an ample supply of the necessaries and comforts of life. Let us for a moment, then, ask whether such a result is likely to be realized by the prosperity which at present prevails. People are beginning to remark that

prices are rapidly rising; and it seems to be discovered that the more prosperous the nation is said to be, the more certainly does an advance take place in the price of many of the first necessaries of life. If we are told that never before was so much wealth produced, that never before were the wages of so many classes of labourers so high, it may be with truth rejoined, that never before were many articles of daily consumption so dear. There has been also a general rise in house-rent. It is at once obvious that unless the increased wealth which is produced is generally diffused throughout the nation, it will of course follow that in consequence of the rise of prices some people may find themselves not more prosperous, but worse off than they were before. There are a great many people whose incomes are either fixed in pecuniary amount or are regulated by customs which, if not unchangeable, require many years to be modified. Nothing is more common than, when a man dies, to leave his widow or his daughters a fixed income. Sometimes the income is derived from property which trustees are ordered to invest in some security such as the funds, in which the rate of interest is fixed; sometimes the income is a fixed pecuniary charge upon some property or business. Then, again, there is a numerous class, such as half-pay officers and superannuated clerks, whose incomes are also fixed. There are also others, such as clergymen, clerks, and others, in the receipt of salaries, whose incomes may ultimately advance if there is a general rise in prices, but after the rise has taken place, a considerable time will elapse before the advance is secured. It must also be borne in mind that although there may be a great increase in trade, yet the increase may not affect every business, and therefore in those branches of industry which remain unchanged, employers and employed may for a considerable time be unable to secure any increase in their remuneration at all commensurate with the augmentation in the cost of living. The operative and the miner have secured an advance of 20 or 30 or 40 per cent. in their wages; but it does not invariably follow that these advancing profits and this increase in wages should be at once accompanied by a corresponding advance in profits and wages in other industries and in other localities. If there is a great increase in the production of wealth, accompanied by a rise in the price of many of the necessaries of life, it does not follow that all are at once benefited; but, on the contrary, many temporarily suffer severely. When trade rapidly increases, it may happen, as it does at the present time, that there is a transfer of wealth, that some people are getting poorer as others are getting richer. In the congratulations which we indulge about national prosperity, let us not forget those who not only do not at once participate in its advantages, but who actually suffer in consequence of it. But it may be asked, is the rise in prices, which is now so marked a feature in the economic condition of England, caused by the general activity of trade, or is it simply an accidental coincidence? If nothing occurs either to increase the supply of the precious metals, or if no change in the method of conducting business enables their use in many transactions to be dispensed with, it is a well-known principle of economic science that an increased production of wealth would cause, not a general rise, but a general decline in prices. It has, however, happened that, contemporaneously with the great development of trade which has occurred during the last twenty years, there has been an enormous increase in the production of the precious metals. It has been calculated that the total yield of gold since the gold discoveries in Australia and California, a little more than twenty years since, is about 500,000,000*l*. This is supposed to be nearly equivalent to the entire quantity of gold existing in the world previously. There has also been a considerable augmentation in the production of silver. The effect which has thus been produced in cheapening the precious metals, or, in other words, in effecting a general rise in prices, has been greatly assisted by an extended use of credit, partly owing to greater facilities in banking. When the gold discoveries in Australia and California first became known, many predicted that there would be a great and almost immediate depreciation in the value of this metal. This prediction was not fulfilled. The gold discoveries occurred just at the time when there was a great development of trade, partly produced by the introduction of free trade, by the extended application of steam to industry, and by the development of the railway system. The additional supplies of gold were consequently for some time absorbed without any decline in its value. It can now, however, be scarcely doubted by any attentive observer that a considerable depreciation has taken place, and that this is indicated by a marked rise in prices, which is erroneously supposed to be due, not to this cause, but to a general activity in trade. The rise in prices which has taken place since 1850 is estimated by eminent authorities as not less than 40 or 50 per cent. This circumstance partly accounts for the fact that the augmentation which has taken place in the production of wealth has not produced a greater and more perceptible influence upon the general well-being of the country. If, for instance, we discover that during the past year 10 per cent. more wealth, estimated in money, was produced than in the previous year; and if during the same period there has been, owing to a depreciation in the value of the precious metals, a rise in prices of 5 per cent.,—it is at once obvious that one-half of this supposed increase of wealth is not real, but simply nominal, because all commodities have advanced 5 per cent. It is not, of course, intended to be implied that there has not been a large and real increase in the production of wealth. It is, however, important not to omit the deduction to which allusion has just been made. But the reason which induced him to refer to the present general rise in prices was threefold. In the first place, he wished to point out the hardship and suffering which it will, at any rate for a time, cause to certain sections of the community. Secondly, to show what precautions should be taken in order, as far as possible, to mitigate the influence of a similar cause in future. And, thirdly, to draw the practical conclusion that at the present time certain classes who are most unfavourably affected by the peculiar economic circumstances of the country, are the very people upon whom the burden, both of imperial and local taxation, falls with peculiar severity and inequality. But it may probably be said, is not the present advance in prices temporary? Is there any possibility that it can continue and increase? In answer to such inquiries, it would be presumptuous to give a positive, dogmatic answer. There is probably no subject on which it is more hazardous to prophecy than on the future yield of the precious metals. Some people may argue that the yield of gold from Australia and California cannot be maintained. On the other hand, it may be urged with equal plausibility that the yield of gold may be greatly increased as labour in these countries becomes more plentiful, and as improved methods of mining are introduced. Without, however, attempting to decide between these two opposite opinions, we will adopt a middle course, and assume that about the present yield will be maintained. If this should be the case, it cannot be doubted that there will be a steady depreciation in the value of the precious metals, and a corresponding advance in general prices; and it is obvious that if the rise in prices should continue, the loss which will be endured by those in receipt of fixed money-incomes will also continue. This being the case, we arrive at the second of the three points enumerated, and we have to seek a reply to the important practical question—What can be best done to mitigate the consequences resulting from such a loss? One or two practical conclusions may be ventured upon. In the first place, it is hazardous to tie down trustees or executors to invest money in some security in which the rate of interest is fixed. If the money is invested in any kind of property, or in shares which represent property, the money value of the property and of the shares will advance with the rise in prices. Workmen and others who can only make very small investments from time to time may, it is thought, have a great difficulty in finding such investments as those just recommended. It is, however, at once evident that if they purchase their dwelling-house by joining a building society, or if they invest their money in shares in some co-operative undertaking, they would avoid the risk of finding the value of their savings depreciated by a depreciation in the value of money; and this risk they would run if they set aside a weekly sum to purchase an annuity to commence some years hence. It may seem that some of these suggestions afford an argument against life insurance; but this is really not the case if a judicious choice of an office is made by those who insure. Many offices divide their profits, over a certain fixed per-centage, among the policy-holders. If, therefore, the money is judiciously invested by the company, the money value of their property will increase with the rise in prices; consequently, the amount to be distributed among the policy-holders will increase, and will afford a compensation for the diminution in the purchasing power of the policy when it is paid. The third point to which he wished briefly to direct attention is the following. In the present circumstances of the country, the possessors of small fixed incomes are those who participate least in the advantages resulting from activity of trade, and are also those who suffer most from the present rise in prices; and there is no class upon whom the burdens of local and imperial taxation probably fall with so much severity. As examples, take a widow, a clerk, a curate, or a half-pay officer, with an income of 200*l*. a year. They are liable to the income-tax. The income-tax is not only made a permanent part of our fiscal system, but a precedent was set last year for defraying exceptional expenditure by means of the income-tax. No class probably has to spend so large a proportion of their income in house rent; and it is, after all, upon the occupiers of houses that by far the most crushing effect of local taxation falls. But the most serious injustice that seems to be done them is associated with our poor-law system. In those branches of industry which are exceptionally prosperous enormous profits are realized, and a great advance in wages is secured. The additional wages are, to a great extent, spent and not saved. They are spent in the purchase of more beer, spirits, meat, butter, or the other articles of daily use. The price of some of these articles advances with this extra demand, and the possessors of fixed incomes suffer accordingly. No one would suppose that he (Prof. Fawcett) did not rejoice in seeing the workman receive a better remuneration for his labour, and have an opportunity of enjoying more leisure. But if his extra wages are all spent, and nothing is laid by, what may happen? Why, trade may become dull. Instead of there being the present demand for labour, tens of thousands of hands may have to be discharged. Nothing having been saved in prosperous days, how will they live without work? They will be able to claim the right to be maintained out of the rates, to no small extent contributed by the very class—the possessors of small fixed incomes—who do not now share in the present prosperity, and who find the cost of living increasing. This is the injustice to which he alluded. Not only does this injustice exist, but there is reason to fear that it may be increased. There is a general feeling at the present day that the burdens of local taxation press unfairly on certain classes. Admitting that some reform is needed, it must be borne in mind that unless we are careful, we shall, in striving after greater equality, secure greater inequality. Some have gone so far as to suggest that there should be a national poor-rate, or, in other words, that the support of the poor should be made an imperial charge. But even if such an extreme proposal as a national poor-rate is not carried out, there is a demand, influentially urged, that many local charges should, in part at least, be defrayed out of the Consolidated Fund. Without now

attempting to decide whether such a proposal ought to be carried out, it should be remembered that two very serious dangers are associated with it, which ought certainly to be most carefully guarded against. In the first place, local authorities think that public money is no one's money, and consequently localities would vie with each other in getting as much out of the Consolidated Fund as possible. He had felt it his duty, on more than one occasion, to warn people against supposing, as they sometimes seem to do, that the Consolidated Fund is a great source of wealth, kept perennially supplied by the spontaneous bounty of nature. The Consolidated Fund represents taxation. If more money is obtained from the Consolidated Fund for local purposes, what new taxes is it proposed to levy? or which of the existing taxes is it proposed to increase? This question will be answered by the electors, the majority of whom are not the payers of income-tax. They have been encouraged by what has been done in the past to throw the whole extra charge on the income-tax; and the income-tax would fall with the greatest inequality upon the possessors of small fixed incomes, who are placed in the most unfavourable position by the general economic circumstances of the country. Allusion has already been made to a remarkable rise of prices which is going on at the present time. So far as the increasing dearness of commodities is due to such natural causes as the demands of a larger population, it would be neither possible nor desirable to attempt to control it. Indications, however, are not wanting that the cost of producing many commodities may be artificially augmented by the incessant demands which are constantly being put forward for mischievous legislative interference with industry. If we had time to examine the various measures that were introduced into Parliament last year, and the various measures with which we are threatened next Session, it would not be difficult to show that, unless we are very careful, industry will be hampered by State interference much in the same way as a machine would be if sand were thrown among its wheels. Such lessening of industrial efficiency would increase the cost of producing commodities, and the great mass of the people would have greater difficulty than they have now in obtaining either a sufficiency of the necessaries or an adequate supply of the comforts of life.

Sir J. Bowring read the 'Report of the Committee on Uniformity of Weights, Measures, and Coins.'—The Report stated that a further advance had been made by the passing of a law in Austria, in June, 1871, rendering the use of the metric weights and measures permissive from the 1st of January, 1873, and compulsory from the 1st of January, 1876. Two-thirds of Europe, measured by population, have adopted the metric system of weights and measures. The remaining third comprises England and Russia. As regards Russia, there are great difficulties in decimalizing their present weights and measures, and the Imperial Academy has strongly advocated the adoption there of the metric system. In England, a Committee of the House of Commons was appointed to consider the question, and on their recommendation an Act was passed to render permissive the use of metric weights and measures. In the United States of America the system is introduced permissively, and in the other Republics of that continent it has been introduced absolutely. As regards coins, there has been considerable advance made towards unity: France, Italy, Switzerland, Belgium, Greece, Roumania, have already identical coinage secured them by the Coinage Convention. The Committee consider the unification of the weights, measures, and coins all over the world is fraught with immense benefit to science, commerce, and civilization.

A Resolution proposing the reception and adoption of the Report was brought forward, but, on the suggestion of Mr. J. A. Franklin, the resolution was restricted to the reception of the Report only.

A paper, by Mr. H. Burgess, 'On International Coinage,' was then read. The author advocated the issue of gold coin of the value of two pounds sterling, with decimal subdivisions.

In discussion, Sir J. Bowring advocated the pound sterling as the basis of coinage. It was recognized in every part of the world.—Mr. Franklin thought the question was more suitable for discussion among experts than by the general public; and Mr. Newton Fellowes, whilst he agreed with Sir J. Bowring in acknowledging the advantage of the sovereign, thought we were beginning at the wrong end in taking that as the unit. We should take the farthing, and coin a piece equivalent to 1,000 farthings. He further recommended that the standard should be 9/10 fine.

Section G.—MECHANICAL SCIENCE.

President—F. J. Bramwell.

Vice-Presidents—J. Hawkshaw, C. W. Merrifield, C. B. Vignoles, Dr. W. J. M. Rankine, J. Nasmyth, W. Froude.

Secretaries—H. M. Brunel, P. Le Neve Foster, J. G. Gamble, J. N. Shoolbred.

Committee—C. Bergeron, Hyde Clarke, Prof. M. K. Clifford, T. R. Crampton, H. Dircks, E. Easton, Prof. Fuller, Capt. Douglas Galton, F. Galton, R. B. Grantham, J. Clarke Hawkshaw, Chadwyck Healey, W. Hope, J. Hopkinson, J. Head, W. May, R. W. Mylne, Osborne Reynolds, Sir John Rennie, W. Smith, Lieut.-Col. A. Strange G. J. Symons, J. Smyth, Sir W. Thomson, A. Upward, T. Webster.

THURSDAY.

The President opened the proceedings with an address to the Section, in which, after a few introductory remarks, he said, that, however hackneyed the subject might appear, there was none of greater interest to the mechanical engineer, and especially at the present time, than coal. Without going into the geological aspect of the question, or the statistics generally, he observed, that the raisings of coal, which in 1855 were only 64,000,000 of tons in Great Britain, rose to 80,000,000 in 1860, and to 108,000,000 in 1869; and that the price of all kinds of coal has, in the colliery districts, risen about 100 per cent. within the last twelve months. This increase of consumption and this rise in price are startling facts, and force us seriously to reflect upon the use and also upon the abuse of coal. The supply, after all, is but a finite quantity, and unlike the fuel wood, which grows year by year to replace the annual consumption: we are, therefore, dealing with a store that knows no renewal, and if we waste it, the sin of that waste will be visited upon our children; and it thus becomes us to look upon coal as a most precious, valuable, and limited deposit, of which we are the stewards and guardians, justified, no doubt, in using all that we require for legitimate purposes, but most criminal in respect of all that we waste, whether that waste arise from wilful indifference or from careless ignorance—an ignorance culpable as the indifference itself. He then discussed the question of finding sources other than coal for motive power, and pointed to the tide-mill, and suggested that, in the cases of large manufacturing districts within a few miles of the sea, where there is a rise and fall of the tide, coupled, in the outset at all events, with natural indentations of the coast which might be comparatively readily dammed up for the storage of the water, there such storage should be made that the water should be set to work turbines of the best kind (turbines which will work with very nearly the same per-centage of the total power given out by the water at any particular moment, whether they are immersed or whether they are not); that these turbines should be employed in pumping water at a high pressure into Armstrong accumulators; and that pipes should be laid on from those accumulators to the neighbouring manufacturing town, and should there deliver their power to the consumers requiring it, to be used by them in water-pressure engines. Suppose a beginning were made with the city of Bristol, where the rise and fall of the tide might safely be taken at 24 feet. Half a square mile of water enclosed would, after the most lavish deductions for loss, yield, in Bristol at least, 5,000 horse-power,—probably sufficient to replace the whole of the power of the stationary engines now at work in Bristol. Looking at the opportunity which good turbines give of utilizing the power residing in water under constantly varying conditions—looking at the fact that, by Sir William Armstrong's arrangements, this power may be transferred to an extremely small quantity of water under high pressure, and that therefore such water may be transmitted for many miles through pipes at low velocities, even although those pipes be of no great size,—he could not help thinking that there is here open to the talent of the mechanical engineer a new field of enterprise, and one which, if successful, would tend to economize fuel, and to leave more of it for consumption in metallurgical operations, and in other operations requiring heat. He reminded the Section of what has been done in the town of Schaffhausen by a public-spirited inhabitant in the way of utilizing the water-power of the Rhine, and of laying it on, so to speak, to every man's door. This has been accomplished by erecting turbines worked by the river, delivering their power to endless wire-ropes, carried over pulleys placed alongside the Rhine. This rope gives off power at the end of each street abutting on the bank, and that power is conveyed along those streets by a shaft in a channel under the paving. Each manufacturer can make his own communication with these principal shafts, and thus obtains the power he may require. He then adverted to the loss which takes place in the mine, though of late more economic systems of working have come into use. He would not suggest Government interference on this point, believing it would be more mischievous than beneficial; but in the absence of any such interference, it follows, from the ordinary principles which regulate commercial transactions, that a considerable per-centage of coal in many districts will never be brought to the surface, because at the present time it does not pay to bring it. Thus in the very outset we are wasting fuel. But the prevention of this source of waste is a question quite as much for the mining engineer and the political economist as for the mechanical engineer. The question of worth of fuel when brought to the surface may be divided into two branches—the domestic and the manufacturing. First, the domestic use, a highly important branch of the subject. It is believed out of the total of 98,000,000 or 99,000,000 of tons of coal which in 1869 were retained for home use, 18,500,000 tons, about one-fifth of that quantity, were consumed for domestic purposes (about 10,000,000 being exported). Our wasteful treatment of this must be noticed. We put a grate immediately below and within a chimney, and as this chimney is formed of brickwork, by no possibility can more than the most minute amount of heat be communicated from the chimney to the room. On this grate we make an open fire. Fire cannot burn without air, and we seldom provide any means whatever for the air to come in to the fire. The unhappy fire has, as it were, to struggle for existence. In a well-built house especially has it to struggle, for the doors and windows shut tightly. The result is, that the fire is always smoking, or is on the verge of smoking. We breathe the noxious gases, and we spoil our furniture and pictures; nevertheless, happily for us, the fire does succeed in getting supplies of air which, even although insufficient for the wants of the chimney draught, do renew the air of the room. If, to satisfy the demands of the chimney, and to stop its smoking, a window is left a little open or a door is set ajar, we complain of draughts; so that there we are, with an asphyxiated fire, our smoky rooms, and our draughty rooms. Moreover, the fire, being immediately below the chimney, the main part of the conducted heat inevitably goes up it and is wasted, leaving the room to be warmed principally, if not entirely, by the radiated heat; and we do and suffer all this in order that we may see the fire and be able to poke it. He confessed that if there was no cure for the evils just described other than the close stoves of the Continent, with the invisible fire, and with the want of circulation of air in the room, he would rather put up with our present domestic discomforts, and even with the loss of heat, than resort to the close stove as a remedy. But there are modes by which freedom from smoke, freedom from draught, efficient venti-

lation, and utilization of the heat, may all be combined with the presence of the visible pokable fire. He reminded the Section of the paper read before it at the Norwich Meeting in 1868, by Capt. D. Galton, in which he so clearly described his admirably simple invention of fire-grate. This consisted in putting a flue to the upper part of the fire-grate, which flue passed through a brick chamber formed in the ordinary chimney, which chamber was supplied with air from the exterior of the room by a proper channel, and then the air, after being heated in contact with the flue in the chamber, escaped into the room by openings near the ceiling, so that the room was supplied with a copious volume of warm fresh air, which did away with all tendency to draughts from the doors and windows, and moreover furnished an ample supply for the purposes of ventilation and combustion. These fire-places, he regretted to say, have been but little used in England, from a cause to which he would hereafter advert—a cause which, he believed, stands in the way of the adoption of improvement generally. The merits of these fire-places were at once acknowledged by the French, who made the most careful and scientific investigation of their working, and they found that with such fire-places three times the effect was obtained from a given weight of coal that could be got with those of the ordinary construction. No doubt there are many other plans by which the same end as that attained by Capt. Galton may be arrived at, and yet we go on year after year building new houses, making no improvement, exposing ourselves to all the annoyances, and, worst of all, wasting the precious fuel. Assume that we were to set ourselves vigorously to work to cure this state of things, can it be doubted that in ten years time we might halve the consumption per household, and do that not only without inflicting any discomfort, or depriving the householder of any gratification, but with an absolute addition to warmth and an increase of cleanliness—a benefit to health and a saving of expense? Moreover, it must be remembered that, with the imperfect combustion of domestic fires, large volumes of smoke are poured into the air. We know how much freer from smoke town atmosphere is in summer time than it is in winter time, and this simply on account of the smaller quantity of coal that is being burnt. Suppose that we could reduce the total consumption, both in summer and in winter, by 50 per cent., what an enormous boon that would be even in the one matter of a pure atmosphere.

As regards the manufacturing use of coal, this may be divided into two parts, viz., coal for obtaining power, and coal for metallurgical purposes. As an instance of the first he referred to coke-making, where the heat residing in the gases given off is absolutely lost, amounting in some instances to 30 per cent. In our smelting of iron great waste took place in the preliminary process of calcination of the ore—he referred to the black band of Scotland. It has now been in use, however, for many years in our best conducted works; but as a proof of the slowness of its introduction, the furnaces of Scotland are even now almost universally worked upon the wasteful principle of allowing these gases to burn idly away. Take again the melting of steel in crucibles, where the heat issues from the furnace of necessity hotter than the heat of the melted steel (for were it not so it would cool it), and of this issuing heat, as a rule, no use whatever is made. Take again the heating furnace and puddling furnace of our iron-works. Very commonly from these, heat at a greater temperature than that of welding iron escapes up the chimneys disregarded, as though it had cost nothing for its generation. In many works, it is true, a portion of this heat is utilized for generating steam, but far more steam can be obtained than is required, even with the most unnecessary and lavish consumption of it. The speaker then adverted to the utilization of the waste heat from iron blast furnaces. This waste of heat in steel melting, and in furnaces for iron, and for other metallurgical operations, is by no means necessary, although it might be urged that it is, and it might be said, that if a furnace is to heat a body to 300 deg., you must of necessity allow the heat to escape at that temperature, or rather at something above it, or else in lieu of heating the body you will be cooling it; and that you can no more trap escaping heat than you can trap a sunbeam. But Mr. Siemens has shown us that you can trap the heat, and that you can so lay hold of it, and store it up, that the gases as they pass into the chimney from the furnace in which there is, say, even melting steel, shall be lowered in their temperature down to that which will not char a piece of wood; and he has shown us how this stored up heat may be communicated to the separate streams of incoming air and gas of his gas furnaces, that they shall enter the furnace at a high temperature, that temperature to be increased by their union and combustion in the furnace. But although this invention has been before the public for many years, and although it has had the approval of Faraday, and of every other distinguished scientific man who has investigated the question, as well as the approval of the leading minds among the users of furnaces, nevertheless, for the general reason subsequently alluded to, the progress of this invention has been by no means commensurate with its importance, and it is not too much to say that manufacturers would rather waste cheap coal than embark capital in new furnaces, and more than all, be at the trouble of instructing and of watching over their workmen.

He then proceeded to deal with our steam-engines under the four great heads of marine, locomotive, portable, and fixed. Including within the term steam-engine the boiler as well as the engine, the waste may arise in a steam-engine in two ways, in either one of them, or in both combined. It may arise from an imperfect utilization of fuel in the production of steam, that is, a waste due to the boiler and to the firing; or it may arise in an improper use by the engine of the steam provided for it by the boiler. There can be no question that the boiler waste is, as a rule, very large indeed. A pound of fair coal is, theoretically, capable of evaporating from the boiling point 13 pounds of water, and he did not think he was overstating the case in saying that, on an average, not more than from one-third to one-half of this quantity is obtained from the whole of the boilers in use. This poor result varies from a variety of causes: 1st, bad firing, which means bad combustion; 2nd, insufficient surface to absorb the heat; 3rd, an unclean condition of that surface, either from internal or external deposit, or both; 4th, a faulty proportioning of the parts of the boiler to each other, and to the work to be done, which causes heated water to be carried over with the steam—a cause of deficiency of evaporation, which however, so far from being as a rule detected, goes to swell the apparent duty of the boiler. He adverted to mechanical firing and the use of liquid fuel, from which high evaporative duty had been obtained. Crampton's use of powdered fuel was noticed, the powder being blown into the furnace by the very air which is there to enter into combustion with it. Very high evaporative results have thus been obtained. He referred to the temptation to use boilers of inadequate size on the score of expense and room, and pointed out that this was extravagant economy. It may be a saving at the outset, but it is a constant source of loss in the working. He pointed to the great advances made in the saving of fuel already attained in marine locomotive and agricultural engines, but the great class of fixed engines in our manufactories were not in so favourable a condition, and he described these engines as of a most disgraceful and scandalous character. He referred in considerable detail to the various points in which the boilers and engines of the present day are below the standard to which engineering science has already reached, and in which, therefore, there is known opportunity for immediate improvement. There is so little trustworthy information as to the total horse-power at work in the United Kingdom, as is evidenced by the fact that very recently the number of boilers has been estimated before a Parliamentary Committee as low as 50,000, and as high as double, and even close upon quadruple that number, that it would be an unwarrantable waste of the time of the Section to enter into calculations, or rather speculations, as to the exact saving that would be made in the consumption of coal consequent upon improving the whole of our steam-engines up to the present highest standard. It will, however, be sufficient to show the importance of the question, and he felt sure he should be safe in saying that such saving would have to be estimated by millions of tons. This is a saving that might be made with our present knowledge; but when we recollect that an engine burning even as low as 2 lb. of coal per indicated horse-power per hour is still developing only one-tenth of all the power which, according to calculation, resides in that coal, there is manifestly a vast scope for our mechanical engineers in the exercise of their talents for further economy. But let not consumers of coal remain indifferent to savings on their present consumption until those improvements are discovered by scientific men. One is apt, at first sight, to marvel that users of steam-engines should be so blind to their own interest, and should permit waste to go on day after day, and year after year—a waste not only prejudicial to the community at large and to succeeding generations, but a waste causing constant expense to those who commit it; but the fact is, there are several reasons why manufacturers and others permit the waste to go on. In prosperous times those engaged in manufactures are too busy earning and saving money to attend to a re-organization of their plant. In bad times they are too dispirited, and too little inclined to spend the money that in better times they have saved in replacing old and wasteful appliances by new and economical ones; and one feels that there is a considerable amount of seeming justification for their conduct in both instances, and that it requires a really comprehensive and large intelligence, and a belief in the future possessed by only a few out of the bulk of mankind, to cause the manufacturer to pursue that which would be the true policy, as well for his own interest as for those of the community. But there is a further and a perpetual bugbear in the way of such improvements, and that bugbear is the so-called "practical man"; and this was in his mind when, in previous parts of this address, he had hinted at the existence of an obstacle to the adoption of improvement. He did not wish the Section for one moment to suppose that he, brought up as an apprentice in a workshop, and who all his life had practised his profession, intended to say one word against the truly practical man. On the contrary, he is the man, of all others, that he admired, and by whom he would wish persons to be guided; because the truly practical man is one who knows the reason of that which he practises, who can give an account of the faith that is in him, and who, while he possesses the readiness of mind and the dexterity of action which arise from the long-continued and daily intercourse with the subject of his profession, possesses also that necessary amount of theoretical and scientific knowledge which justifies him in pursuing any process he adopts, which in many cases enables him to devise new processes, or which, at all events, will enable him to value the new processes devised by others. This is the truly practical man, about whom he had nothing to say except that which is most laudatory. But the practical man, as commonly understood, means the man who knows the practice of his trade and knows nothing else concerning it; the man whose wisdom consists in standing by, seeing, but not investigating, the new discoveries which are taking place around him, in decrying those discoveries, in applying to those who invent improvements the epithet of "schemers," and then, when he finds that beyond all dispute some new matter is good and has come into general practice, taking to it grumblingly, but still taking to it, because if he did not, he could not compete with his co-manufacturers. It is such a man as this who delays improvement.

For years he delayed the development in England of the utilization of the waste gases of blast furnaces, and he has done it so successfully, that this utilization is by no means universal in this kingdom. It was such men as these who kept back surface condensation for twenty years: who, when semaphores were invented, would have said, "Don't suggest such a mode to me of transmitting messages; I am a practical man, sir, and I believe that the way to transmit a message is to write it on paper, deliver it to a messenger, and put him on horseback." In the next generation, his successor would be a believer in semaphores, and when the electrical telegraphist came to him, he would say, "Sir, I don't believe in transmitting messages by an invisible agency; I am a practical man, and I believe in semaphores, which I can see working." In like manner, when the Siemens regenerative gas furnace was introduced, what said the practical man? "Turn your coals into gas, and burn the gas, and then talk of regeneration! I don't know what you mean by regeneration except in a spiritual sense. I am a practical man, and if I want heat out of coals I put coals on to a fire and burn them." And for fifteen years the practical man has been the bar to this improvement in metallurgical operations. The practical man is beginning to yield with respect to these furnaces, because he finds that men of greater intelligence have now in sufficiently large numbers adopted the invention to make it a formidable competition with the persons who stolidly refuse to be improved. The same practical man for years stood in the way of the development of Bessemer steel; now he has been compelled to become a convert.

He would not weary the Section by citing any more instances, but one knows, and one's experience teaches one, that this is the conduct of the so-called practical man; and his conduct arises, not only from his ignorance of the principles of his profession, but from another one, and that is, you offend his pride when you come to him and say, "Adopt such a plan; it is an improvement on the process you carry on." It may be said that employers and the heads of manufactories are, as a rule, in these days, educated gentlemen, and that therefore it is wrong to impute to them the narrow-mindedness of the practical man. He admitted that in numerous instances this would be wrong, but the fact is, that in many cases—indeed, he thought he might say, in most cases—the head of the establishment, the monied man, the man who, by his commercial ability (that most necessary element in all establishments), keeps the concern going by finding lucrative orders, is not intimately acquainted with the practice of the business carried on by his firm. He relies upon some manager or foreman, who too commonly is not the real but the so-called practical man. It is to such men as those who simply practise that which they have seen, without knowing why they practise it, that the title of practical man has most improperly been attributed, and it is on the advice of such men that the true heads of the firm too commonly regulate their conduct as to the management of their business, and as to the necessary changes to be made in the way of improvement. The practical man derides those who bring forward new inventions, and calls them schemers. No doubt whatever they do scheme, and well it is for the country that there are men who do so. It also may be true that the majority of schemes prove abortive; but it must be recollected that the whole progress of art and manufacture has depended, and will depend, upon successful discoveries, which in their inception were and will be schemes, just as much as were those discoveries that have been and will be unfruitful. No one now dares to apply the term "schemer" to Mr. Bessemer or "scheme" to his invention; but it is as true now that he is a "schemer" and his invention a "scheme," as it would have been had he failed up to the present to conquer the minor difficulties. It is a species of profanation to suggest, but he must suggest it, for it is true, that Watt, Stephenson, Faraday, and almost every other name among the honoured dead, to whose inventive genius we owe the development that has taken place within the last century in all the luxuries, the comforts, and even the bare necessities of our daily existence, would, in their day, and while struggling for success, have been spoken of as schemers even in respect of those very inventions of which we are now enjoying the fruits. He would be accused of decrying the practical man, and of upholding the schemers. He said most emphatically that he did not decry the practical man. He pleaded guilty to the charge of decrying the miscalled practical man, and he gloried in his guilt, while he readily accepted that which he considered the praise of upholding "schemers"; and he did so for this simple reason, that if there were no schemers there would be no improvement.

In conclusion, could not some means be devised by which consumers of coal may be instructed in, shamed into, or tempted to the economical use of that most valuable material? The Royal Agricultural Society of England, by its judicious efforts for many years past, by the institution of trials, and the giving of prizes for the best engines, has brought the consumption of coal down from 10 lb. per horse-power to a little over a quarter of that quantity. Could not a Society be instituted which should devote itself to the recording and the rewarding of the performances of steamboats and of fixed engines for land purposes? There are implements which record the horse-power exerted from moment to moment, and register it on indices as readable as those of an ordinary counter of an engine, or as those of a gas meter. One of the very greatest incentives to economical working which the owners of steamboats could offer to their engine builders and engineers would be the application of such implements as these. Were they employed, the shipowner would know at the end of the voyage so much horse-power had been exerted as a whole, and that so much coal had been burnt, and that the result, therefore, was a consumption of so many pounds per horse-power per hour. All excuses of head-winds, and all the aid of canvas to the engine-power, would be eliminated from the calculation. The continual indicator would register truly the work the engine had to do, whether that work was made excessive by contending with head-winds, or was rendered light by favourable breezes and the assistance of canvas. In the same way the proprietor of the engine for manufacturing purposes, the cotton-mill, the woollen-mill, the corn-mill, and even the highly irregularly working rolling-mills and saw-mills, would know at the end of the quarter how much power engines had exerted, and had burnt so much coal, and that therefore such and such had been the economic results. Assuming that steamboat proprietors and the owners of fixed land engines would go to the expense of applying such continuous recording implements as these to their engines, and would become members of an association for the purpose of visiting and inspecting and of reporting upon their machinery, and of giving prizes to the men in charge for careful attention; prizes to the manufacturers for original good design and workmanship of the engines; and prizes to the proprietors for their public spirit in having bought that which was good instead of that which was bad and cheap, and for having employed intelligent and careful workmen instead of ignorant and careless ones,—I believe within a few years as great an improvement might be seen among the marine and manufacturing class of engines as has been effected by the laudable exertions of the Royal Agricultural Society of England among the portable ones.

A paper, by M. C. Bergeron, was then read, entitled, 'Transport Rapide et Économique des Marchandises.'—The author proposes to pack his materials for transport in iron spheres of 4 feet to 6 or 7 feet diameter, and to provide a concave roadway of sheet-steel resting on sleepers, or, where necessary for crossing valleys, suspended from pillars or piers, on the principle of the suspension bridge, down which these loaded spheres may roll by their own gravity, the empty spheres being brought back in tubes, on the principle of the pneumatic despatch.

A paper by Mr. P. Le Neve Foster, jun., 'Description of the New Branch Canal leading from the Canal Cavour for Irrigating the Province of Lomellina,' was read.—The author, who had had the direction of the works, described them in considerable technical detail, pointing out their great importance to the productive resources of the district, not only in an agricultural point of view, but as providing considerable water-power, available for manufacturing purposes.

Mr. Merrifield next read a paper, presented by Mr. A. Wylie, of Handsworth, Birmingham, 'On the Progress of Invention in Breech-loading Small Arms during the past Twenty Years.'—All the inventions in breech-loading fire-arms since 1851 presenting any novelty were reviewed and grouped in their natural connexion, so as to trace the development of each system down to the present time. The Reports of the Small Arms Committee were criticized and their conclusions disputed; and it was shown that their decision arrived at three and a half years ago had had the evil effect of putting almost a complete stop to invention in any direction except in that of the chosen arm, the ingenuity of the inventors and manufacturers being now expended in hopeless attempts to improve the Martini.

A paper, by Mr. C. A. Bowdler, 'On Aerial Navigation,' was then read.—The author thought the autumn manœuvres would be an excellent opportunity of trying experiments, and that aerostation would become an important element in military science. Hitherto, captive balloons only had been used, but it was by no means improbable that circumstances would occur where it would be most desirable to pass over the enemy's position, and it would then be important to have the power of severing or deflecting the balloon from the wind course, either to right or left, as required. Captive balloons could not be used in safety in high winds on account of violent rocking of the car. The writer then proceeded to review the elements of aerostation, and to show that aerial navigation was practical only to a certain limit by simple mechanical means. Of the practicability of applying steam-power he had no hope,—the weight of a steam-engine made as light as possible, consistent with due strength, being much too great for any gas balloon to support. The power he proposed was manual, being, he believed, the only power applicable to gas balloons. But propulsion having been secured, the question arose how the power of direction could be acquired, that being of the utmost importance in actual warfare. That was accomplished by rotating the balloon to any required position, and then, holding it from further motion, the rotation was completely under the control of the aeronaut. A rudder was the instrument to be used for that purpose, a vertical disc fixed in a line with the axis of the propeller. By turning the plane of the disc, the current of air forced from the fan on the rudder caused the whole machine to rotate right or left, precisely as the rudder of a ship guided the vessel.

This was followed by a paper 'On the Steering of Ships, in special Relation to a new Form of Rudder,' by Mr. W. Fleming.

Science Gossip.

The Annual Congress of the Association for the Promotion of Social Science will be held at Plymouth, Devonport, and Stonehouse, from the 11th to the 18th of September. The Right Hon. Lord Napier and Ettrick, K.T., will preside, and deliver the opening address. The Presidents of Departments will be—1, Jurisprudence and Amendment of the Law, the Attorney-General, Sir J. D. Coleridge; Repression of Crime Section, J. H. Kennaway, M.P. 2, Education, president not yet chosen. 3, Health, Dr. H. W. Acland. 4, Economy and Trade, president not yet chosen.

At a meeting of the East Kent Natural History Society on the 1st of August, Mr George Gulliver drew especial attention to the hatching of *Ixodes Dugesii* and *Argus reflexus*, and exhibited specimens of their young recently hatched from their

eggs. This ixodes is the tick that causes often so much injury to sheep and young pheasants. Mr. Gulliver having obtained clear evidence of the time required for hatching these parasites, and the manner thereof, says it affords clear proof of how carefully flock-masters should destroy the parent ticks, instead of throwing them, as is too frequently done, on the ground.

A Science College is to be founded in Birmingham, through the liberality of Mr. Josiah Mason, who has already founded the great orphanage at Erdington. The words of the trust-deed are worthy of publicity:—"Being deeply convinced, from long and varied experience in different branches of manufacture, of the necessity for, and benefit of, thorough systematic scientific instruction, specially adapted to the practical, mechanical, and artistic requirements of the manufactures and industrial pursuits of the Midland district, and particularly of the boroughs of Birmingham and Kidderminster," Mr. Mason "hath determined to devote a portion of his remaining property to the foundation of an institution wherein such systematic scientific instruction may be given." With this object, Mr. Mason assigns certain freehold and leasehold property, estimated at not less than 100,000*l*. Instruction is to be provided by means of classes, in mathematics, physics, chemistry, the natural sciences (especially geology and mineralogy with their application to mines and metallurgy), botany, zoology, languages, mechanical drawing, and architecture.

An important contribution to our knowledge of bitumen and its uses, which in these days of asphalte pavement and the like, is important, will be found in the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* for August. The paper, which is by M. Homberg, bears the title of 'Bitumen, and its Application to Public Works.'

The Annual Report of the Institut Impérial de Géologie et de l'Académie Impériale de Vienne, from November 21st, 1870, to November 21st, 1871, has just been issued. The director, M. Fr. de Hauer, who made his first geological field surveys in connexion with the Geological Survey of the United Kingdom, reports a large amount of excellent work completed with the year.

In the *Comptes Rendus* for the 5th of August will be found a paper read at a recent *séance* of the Académie des Sciences, by Prof. J. Dumas, 'On Alcoholic Fermentation.' The long discussed question of the real nature of fermentation is most thoroughly examined, and his conclusions, based as they are upon a most close analysis of ferment, and a searching study of its action, may be received with much confidence. An additional paper by the same eminent chemist, 'On Ferments belonging to the Diastase Group,' is of considerable interest.

FINE ARTS

BRITISH ARCHÆOLOGICAL ASSOCIATION CONGRESS AT WOLVERHAMPTON.

If the object of these annual gatherings of the peripatetic Societies is more to enlist the sympathies of the county families, and encourage the local lovers of antiquities to persevere in the study and preservation of that which remains of the objects of antiquity, and to enlighten the inhabitants of a district in regard to the value, both historically and intrinsically, of their movable and immovable treasures, then, according to the opinions of the officers of the Association, who are perhaps as well able to form a judgment as any outsider, this Congress has been exceptionally successful. One of the Secretaries, at the opening banquet, stated that on his first visit, by direction of the President, to Wolverhampton, he was informed that there was nothing to see, and no one to take an interest in archæological pursuits. A few days showed that there was abundance of matter, and a local spirit and energy in every way encouraging, and, from first to last, the local committee was thrusting forward objects to be visited, and questions to be discussed, which it was utterly impossible for the Association to undertake, and excision became the necessity of each day.

The programmes for the daily excursions included a radius of about fifteen miles, and of course in that radius included part of Shropshire. Boscobel, which, our pages recorded, could not be visited in 1860 (when the Association met at Shrewsbury), was therefore fairly within the excursions, and Mr. Harrison Ainsworth clothed the well-known tale in words telling and forcible. Buildwas Abbey and Wenlock Priory would also have been included, although both are in Salop, but for both having been previously visited in that same Shrewsbury Congress; but for the especial pleasure of the Staffordshire members of the meeting, an extra day was fixed, when, though there was a diminution in numbers, still five-and-thirty could be found to extend the meeting for the purpose of viewing and hearing comments on the two grandest specimens of the Cistercian and Cluniac orders in this country.

The main points to be referred to, for we cannot give detailed reports, are, firstly, those appertaining to Wolverhampton itself. The first of these is what has hitherto been called the Danish Cross. Mr. Gordon M. Hills, who had devoted some time to its examination, expressed a decided opinion on the first day that it was a Christian cross, sculptured in the twelfth century, while Mr. G. Godwin maintained that the *entasis* proved its earlier origin by at least two centuries. Mr. E. Roberts, who subsequently studied the cross, finally agreed with Mr. Hills, but suggested that the sculptures might have been incised in an earlier column—the capital and mouldings showing signs of Late Norman or transitional feeling, while the baluster shape of the shaft indicated a previous date.

A second inquiry made by local antiquaries, as to the etymology of Wolverton and Wolverhampton, was, apparently to their satisfaction, set at rest by the Rev. W. Barnes, who stated that in Wolverhampton we have ton, the Saxon *tun* or farmstead, and ham, a *hemmed* ground, often a British or other earthwork, the "*ham*" has become "*hamp*" before the hard *t*. *Wolver* may be the worn shape of Wulfrun (Wolfcharm), a good Saxon lady, who is said to have founded the church and convent about the end of the tenth century; so Wulfrun-ham-tún is "the farmstead of Wulfrun's home (or enclosure)." Wolverton was probably another "tun" belonging to Wulfrun, but not enclosed.

The papers were numerous—too numerous to be all read, and were entirely devoted to Staffordshire subjects. The inaugural address of Lord Dartmouth, given on Monday, was brief but suggestive, mentioning matters mainly connected with the Civil Wars.

In a paper by Mr. Burgess, 'On the British Remains in the Forest of Arden,' it was incidentally stated that this Staffordshire forest is that in which Shakspeare laid his scene, and not a continental Arden. Mr. J. S. Phené, on the same evening, read a paper 'On the Similarity of Design in Early British and Continental Constructions.' Both these papers tend to show, as was remarked in the subsequent discussion, how universal must have been the intercommunication in prehistoric times.

On the following evening, Wednesday, the venerable Mr. J. R. Planché read a paper 'On the Family of the Giffards'; Mr. Morgan read a paper 'On the Briton, Roman, and Saxon in Staffordshire'; and Mr. E. Levien followed with an exhaustive account of the 'Early Religious Houses of Staffordshire, from unpublished MSS.' A notable paper was one by Mr. J. W. Grover, 'On Iron and the Ironworks of the Romans,' giving a history of the processes adopted for obtaining a blast, either cold or hot, in earliest smeltings.

Mr. W. de Grey Birch had a pleasing task on the last evening, which was wholly devoted to him, because his paper seemed to be highly appreciated, both by the audience and Lord Wrottesley. His paper was 'On the Wrottesley Documents.'

The excursions included everything of interest near the town. Lichfield we need not touch on, for, as Mr. Hills remarked, Prof. Willis had exhausted that subject. Uttoxeter is more fruitful, because untouched. Wall also, the *Etocetum* of the Romans, received well-deserved attention; and one result of the visit is, that subscriptions are being raised for systematic excavations. Dudley Castle was the last place visited, and received attention at Mr. Roberts's hands, such as does not appear to have been paid to it before.

The entertainments were ample and elegant, and it was observed that they were not allowed to interfere with the real work of the meeting: in no case was more than two hours given to these "picnic" receptions, including the drive, alighting, introductions, and departure—indeed, the extensive drives precluded the possibility of a longer stay at any one place. Self-denial had also to be exercised, for the Bishop of Lichfield's proffered luncheon had to be declined as well as several others, and repeated offers of wayside "restorations."

Those who received the Association were Mr. John Neville, of Haselour Hall, the Earl of Dartmouth, at Patshull (the President for the year), and Mr. Richmond Collis, of Stourton Castle, besides light refections of the Bishop, Capt. Shaw Hellier, &c. The brilliant Conversazione given by the Mayor on Saturday evening deserves special mention. The whole of the apartments of the new Town Hall were thrown open, and in order that business might not be sacrificed for pleasure, the several rooms on the upper floor were arranged for exhibition of objects illustrative of local interest, including local industries, and in each room was some one able and willing to throw light on the treasures there collected. Several hundreds of persons availed themselves of the privilege the membership gave them, and of the invitations separately given. Pleasant words are spoken by the Wolverhamptonians of the members, and we trust the hope entertained by the Association of eventual good being caused by the Congress will be realized.

We cannot close our notice without observing on the extreme satisfaction which appears to have been felt at the exertions, geniality, and politeness of the officers, amongst whom were conspicuous Mr. G. M. Hills, Mr. E. Roberts, and Mr. G. R. Wright.

MUSIC

NORWICH MUSICAL FESTIVAL.

The programme of the Seventeenth Triennial Festival, to be held at Norwich, on the 16th, 17th, 18th, 19th, and 20th of September, has been issued. The musical meetings in the East Anglian capital are always more or less interesting, and have, at times, been even important, on account of the remarkable novelties, sacred as well as secular, which have been produced. The early efforts of the late Gresham Professor, Mr. Edward Taylor, the bass singer, even if bearing traces of too sectarian a spirit and too narrow views of Art, tended materially to increase the fame of the Norwich Festival; and if it had done nothing more than introduce Spohr and his oratorios, its high reputation would have been fairly earned. The tide certainly turned against Spohr's works with the advent of Mendelssohn; but the pioneers of Art must not be forgotten with the appearance of new lights. Norwich has always been very serviceable to the musicians born within its boundaries, and even in the present programme there is evidence of strong local feeling. So long as this kind of attachment does not soar beyond reasonable limits, there can be no objection to a slight prevalence of the town epidemic; but when the fever becomes a *furore*, and an attempt is made to put forward an idol who proves after all to be of the earth, earthy, it is, of course, time for intervention and protest on the part of the true lovers of what is great and lasting in compo-

sition. The Festivals are for the benefit of the charitable institutions in the city and in the county at large, and these have at various times largely benefited. As at Birmingham, the performances, sacred as well as secular, take place in a large hall, and so far the Triennial Cathedral Festivals have a marked advantage. The city and county of Norwich is, however, specially favoured in having the music done in St. Andrew's Hall, which was once attached to the Monastery of the Black Friars. There are attractions enough in the city besides the hall to interest the antiquary, and visitors to the Festival will do well to attend the service at the Cathedral on the Sunday of the meeting, as they will hear a performance very superior to that which is generally heard in the metropolitan diocese. The patrons of the forthcoming Festival include the names of the Queen and the leading members of the royal family; the President is the Lord-Lieutenant of the County; and the Vice-Presidents include the names of the city and county dignitaries, the M.P.s for the town and county, &c. As regards the sacred works to be performed, there is no special novelty. On the Monday, Mr. A. Sullivan's 'Te Deum,' conducted by the composer, will be given. As this work was composed in celebration of the recovery of the Prince of Wales, who is a resident in the county, it is natural that the 'Te Deum' should be heard. It will be followed by the first and second parts of Haydn's 'Creation.' On Wednesday, there will be Mendelssohn's 'Elijah'; on Thursday, the 'St. Peter' of Sir Julius Benedict; and on Friday, the 'Messiah.' The essential elements of the week's doings are comprised in the three evening concerts of Tuesday, Wednesday, and Thursday. Thus, on the 17th, Mr. Macfarren's new cantata, 'Outward Bound,' will be heard for the first time, as also a new Festival Overture, and a new song by Mr. F. H. Cowen. On the same evening, the March and Chorus from Mr. W. G. Cusins's 'Gideon' will be executed. On the 18th, a Scena, with Chorus, by Dr. E. Bunnett (formerly a choir-boy in the Cathedral), and an Andante for clarionet solo (Mr. Lazarus), with orchestral accompaniment by Mrs. A. M. White, known as Miss Alice Smith, a lady composer of no ordinary ability, will be the points of attraction. On the 19th, the first *allegro* and *scherzo* of a new Symphony in G minor, by Sir Julius Benedict,—a new overture, 'Endymion,' by Mr. King Hall,—a new song by Mr. A. Sullivan, 'Guinevere,'—will be submitted for the appreciation of the auditory. We take note also that there will be two pianoforte solos, one played by Mr. King Hall, the other by Mr. Kingston Rudd, at two of the concerts. M. Sainton (violin) and M. Paque (violoncello) are also named *obbligati*. A fine band of seventy-four players, nearly all professionals, has been engaged; fifty-four string, and twenty wood, brass, and percussion. Norwich has always been famed for its chorus, the East Anglian voices being excellent in quality, and great pains are taken with the rehearsals. There will be three hundred and eleven voices, of whom eighty-four are sopranos, forty-seven contraltos, twenty-three altos, seventy-five tenors, and eighty-two basses. A great treat may fairly be anticipated from the choral singing. Dr. Bunnett will preside at the organ, and M. Sainton is the *chef d'attaque*. The leading solo singers will be Mdlle. Tietjens, Madame Cora de Wilhorst, and Mdlle. Albani, sopranos; Madame Patey and Madame Trebelli-Bettini, contraltos; Mr. Sims Reeves, Mr. Cummings, and Mr. Kerr Gedge, tenors; and Mr. J. G. Patey and Mr. Santley. The Commander-in-Chief of these autumnal musical manœuvres is Sir Julius Benedict. On the whole, the programme is promising, and if it should prove the means of introducing fresh talent, and of increasing the estimation with which our mature composers are held, there will be reason to rejoice. There is one marked feature attending the selection of the pieces to be performed which is highly commendable, the more so as it is novel, and it may prove infectious. Looking over the names of the composers, we find that three are French, MM. Hérold, Auber, and Gounod; ten Italian, Signori Rossini, Mercadante, Donizetti, Bellini, Verdi, Giordani, Bevignani, Campana, Randegger, and Prince Poniatowski; eleven German, Herren Handel, Haydn, Mozart, Beethoven, Weber, Meyerbeer, Spohr, Mendelssohn, Blumenthal, Offenbach, and Benedict; and, *mirabile dictu*, eighteen English, namely, Messrs. Dibdin, Reeve, Bishop, Balfe, Braham, Macfarren, Pierson, Sullivan, Hatton, Cusins, Cowen, Reay, Harcourt, Goss, King Hall, Bunnett, Clay, and Mrs. White.

Musical Gossip.

THE commissions for new works to be produced at the Birmingham Musical Festival of 1873 are at present for an oratorio by Mr. Arthur Sullivan; a dramatic cantata by Signor Randegger, based on Schiller's poem, 'Den Gang zum Eisenhammer' ('The Walk to the Forge'); and a cantata by Signor Schira.

THE advantages of having National Opera-houses, supported by governmental money and influences, are manifested strongly in France, where a young artist of ability can readily find an opportunity of being heard, and a composer of merit is safe not to be left in neglect. Since M. Halanzier has been Director of the Grand Opera-house in Paris, there has been a succession of *débuts* more or less successful, and now he has found a valuable acquisition in a new tenor, M. Richard, who has enacted Fernando (Signor Mario's great character), in Donizetti's 'Favorita.' M. Richard sang the two romances with intelligence and charm; but it was in the duet finale with Leonora (Mdlle. Bloch) that he distinguished himself so specially as a dramatic singer that the *duo* was encored. Halévy's 'Juive,' which is a popular opera in Italy and Germany, is to be revived, with spectacular attractions. Meyerbeer's 'Africaine' continues to draw large houses to the Rue Lepelletier.

THE drama of 'Don Cæsar de Bazan,' by MM. Dennery and Dumanoir, is being set for the Opéra Comique by M. Massenet, whose poet is M. Chantepie.

M. VERGER has engaged for his next Italian Opera season Madame Volpini and Mdlle. Albani (the Canadian singer), late of Covent Garden Theatre.

THE death is announced of the celebrated contralto, Signora Rosamunda Pisaroni. We shall probably take another opportunity of speaking of her career.

THE works at the new Grand Opera-house in Paris, close to the Grand Hotel, and at the Lyrique, are now progressing, although but slowly.

MANY lady amateurs, owing to revolutionary changes in France and Italy, have adopted the lyric drama, or have taken to the concert-room professionally. To the names which have, perhaps, too often appeared, must be added that of the Marchioness de Santayana, formerly a maid of honour to Isabella, ex-Queen of Spain. The new aspirant for operatic honours has already appeared at Naples, in Hérold's 'Pré aux Clercs,' as Isabelle; and is now engaged for the Apollo Theatre at Rome, where she is to sing in the 'Mignon' of M. Ambroise Thomas, and the 'Ombra' of Herr Flotow, the composer of 'Marta,' 'Stradella,' &c.

As might have been expected, M. Gounod has met with a cordial welcome at Spa. At his first concert in the Redoute, the selections from 'Philemon et Baucis,' 'La Reine de Saba,' &c., were much applauded. Mdlle. Gaetano, Mrs. Weldon, and M. Werrenrath, a tenor, sang compositions by the French composers which were duly appreciated.

SIGNOR PETRELLA's last opera, 'Marco Visconti,' has been successfully produced in Rome.

TO CORRESPONDENTS.—W. B. H.—M. A. B.—B. W.—O. S.—J. M.—T. M.—received.

*** No notice can be taken of anonymous communications.