LONDON:
HARRISON AND SONS, PRINTERS IN ORDINARY TO HER MAJESTY.
ST. MARTIN'S LANE.
CONTENTS.

VOL. LXIII.

Meeting of March 3, 1898, and List of Candidates for Election .......... 1

List of Papers read ...................................................... 2


Meeting of March 10, 1898, and List of Papers read ......................... 25

On the Modifications of the Spectra of Iron and other Substances radiating in a strong Magnetic Field. By Thomas Preston, M.A. Communicated by Professor Geo. Francis FitzGerald, F.R.S. .............. 26

Note on the Connection between the Faraday Rotation of Plane of Polarisation and the Zeeman Change of Frequency of Light Vibrations in a Magnetic Field. By Geo. Fras. FitzGerald, F.R.S., F.T.C.D. ........................................ 31

On Artificial Temporary Colour-blindness, with an Examination of the Colour Sensations of 109 Persons. By George J. Burch, M.A. Communicated by Professor Gotch, F.R.S. .................................. 35

On the Connection between the Electrical Properties and the Chemical Composition of different kinds of Glass. By Professor Andrew Gray, LL.D., F.R.S., and Professor J. J. Dobbie, M.A., D.Sc. ............... 38


Upon the Structure and Development of the Enamel of Elasmobranch Fishes. By Charles S. Tomes, M.A., F.R.S. .................................... 54


Experimental Observations on the Early Degenerative Changes in the Sensory End Organs of Muscles. By F. E. Batten, M.D. Communicated by Professor Victor Horsley, F.R.S. .......................... 61
No. 391.

Meeting of March 17, 1898, Croonian Lecture, &c. ........................................... 63
Meeting of March 24, 1898, Bakerian Lecture, &c. ........................................... 63

On the Relation between the Diurnal Range of Magnetic Declination and Horizontal Force and the Period of Solar Spot Frequency. By William Ellis, F.R.S., formerly of the Royal Observatory, Greenwich ................................................................. 64

On the Relative Retardation between the Components of a Stream of Light produced by the Passage of the Stream through a Crystalline Plate cut in any direction with respect to the Faces of the Crystal. By James Walker, M.A. Communicated by Professor R. B. Clifton, F.R.S. ........................................................................................................ 79


Bakerian Lecture.—Further Experiments on the Action exerted by certain Metals and other Bodies on a Photographic Plate. By W. J. Russell, Ph.D., V.P.R.S. ........................................................................................................ 102

No. 392.


No. 393.

the Rotation of Plane of Polarisation of Electric Waves by a Twisted Structure. By Jagadis Chunder Bose, M.A., D.Sc., Professor of Physical Science, Presidency College, Calcutta. Communicated by Lord Rayleigh, F.R.S. ......................................................... 146


The Relations between Marine Animal and Vegetable Life. By H. M. Vernon, M.A., M.B. Communicated by Professor Burdon Sanderson, F.R.S. ......................................................... 155

No. 394.

Report of the Kew Observatory Committee for the Year ending December 31, 1897................................................................. 161
On the Calculation of the Coefficient of Mutual Induction of a Circle and a Coaxial Helix, and of the Electromagnetic Force between a Helical Current and a Uniform Coaxial Circular Cylindrical Current Sheet. By Professor J. Viriamu Jones, F.R.S. ................................. 192

Meeting of March 31, 1898 ........................................................................... 205

No. 395.

Meeting of April 28, 1898, and List of Papers read ................................. 206


Meeting of May 5, 1898, and List of Papers read ......................................... 212


On certain Structures formed in the Drying of a Fluid with Particles in Suspension. By Catherine A. Raisin, B.Sc. Communicated by Professor T. G. Bonney, F.R.S. (Plate 2)..................................................... 217

The Relations between the Hybrid and Parent Forms of Echinoid Larve. By H. M. Vernon, M.A., M.B. Communicated by Professor E. Ray Lankester, F.R.S. .................................................. 228

No. 396.

Meeting of May 12, 1898, and List of Papers read....................................... 231

A Calorimeter for the Human Body. By William Marcey, M.D., F.R.S. .................................................................................. 232


Preliminary Note on the Liquefaction of Hydrogen and Helium. By James Dewar, M.A., LL.D., F.R.S., Fullarian Professor of Chemistry in the Royal Institution................................................................. 256

Effects of Prolonged Heating on the Magnetic Properties of Iron. By S. R. Roget, B.A. Communicated by Professor Éwing, F.R.S........ 258


A Study of the Phyto-Plankton of the Atlantic. By George Murray, F.R.S., Keeper of Botany, British Museum, and V. H. Blackman, B.A., F.L.S., Hutchinson Student, St John's College, Cambridge, and Assistant, Department of Botany, British Museum... .................................. 269
No. 397.
Meeting of May 26, 1898, and List of Papers read.......................... 270


No. 398.

Aluminium as an Electrode in Cells for Direct and Alternate Currents. By E. Wilson. Communicated by Dr. J. Hopkinson, F.R.S. ............ 329

Contributions to the Study of “Flicker.” By T. C. Porter, Eton College. Communicated by Lord Rayleigh, F.R.S. ................................. 347


Note on the Complete Scheme of Electrodynamical Equations of a Moving Material Medium, and on Electrostriction. By Joseph Larmor, F.R.S., Fellow of St. John’s College, Cambridge .................. 365

No. 399.
Annual Meeting for the Election of Fellows .................................. 373

Meeting of June 9, 1898, and List of Papers read ......................... 373


On Photographic Evidence of the Objective Reality of Combination Tones. By R. W. Forsyth, A.R.C.S., and R. J. Sowter, A.R.C.S. Communicated by Professor Rücker, Sec.R.S. (Plates 6, 7)............. 396

On the Cytological Features of Fertilisation and Related Phenomena in *Pinus silvestris*, L. By Vernon H. Blackman, B.A., F.L.S., Hutchinson Student, St. John's College, Cambridge, and Assistant, Department of Botany, British Museum. Communicated by Francis Darwin, F.R.S. ................................................................. 400


On the Heat dissipated by a Platinum Surface at High Temperatures. By J. E. Petavel, 1851 Exhibition Scholar. Communicated by Lord Rayleigh, F.R.S. .................................................................................. 403

On a New Constituent of Atmospheric Air. By William Ramsay, F.R.S., and Morris W. Travers................................................................. 405


No. 400.

Meeting of June 16, 1898, and List of Papers read............. ............... 412

Observations on Stomata. By Francis Darwin, F.R.S. ......................... 413


The Nature of the Antagonism between Toxins and Antitoxins. By C. J. Martin, M.B., D.Sc., Lond., Acting Professor of Physiology, and Thomas Cherry, M.D., M.S., Melb., Demonstrator and Assistant Lecturer in Pathology in the University of Melbourne. Communicated by D. Halliburton, F.R.S. .......................................................... 420

On the Source of the Röntgen Rays in Focus Tubes. By Alan A. Campbell Swinton. Communicated by Lord Kelvin, F.R.S. ............... 432


Summary of the Principal Results obtained in a Study of the Development of the Tuatara (*Sphenodon punctatum*). By Arthur Dendy, D.Sc., Professor of Biology in the Canterbury College, University of New Zealand. Communicated by Professor G. B. Howes, F.R.S. .... 440

The Stomodæum, Mesenterial Filaments, and Endoderm of *Xenia*. By J. H. Ashworth, B.Sc., Demonstrator in Zoology, Owens College, Manchester. Communicated by Professor Hickson, F.R.S. ............ 443


On the Detection and Localisation of Phosphorus in Animal and Vegetable Tissues. By A. B. Macallum, Associate-Professor of Physiology, University of Toronto. Communicated by Professor Sherrington, F.R.S. ................................. 467

Falmouth Magnetic Observatory. Note ........................................ 480

Obituary Notices:—

Prof. Hubert A. Newton ................................................................. i
Sir Richard Quain ..................................................................... vi
James Joseph Sylvester (with Portrait)................................... ix
Alfred Louis Olivier Le Grand Des Cloizeaux ...................... xxv
John Carrick Moore ................................................................. xxix
Baron Ferdinand von Mueller ................................................... xxxii

Index........................................................................................................ xxxvii
Erratum ............................................................................................... xliii
March 3, 1898.

SIR JOHN EVANS, K.C.B., D.C.L., Treasurer and Vice-President, in the Chair.

In pursuance of the Statutes, the names of the Candidates for election into the Society were read, as follows:—

Allen, Alfred Henry, F.C.S.  Gray, Professor Thomas, B.Sc.
Baker, H. Brereton, M.A.  Haddon, Alfred Cort, M.A.
Baker, Henry Frederick, M.A.  Hamilton, Professor David James, M.D.
Barrett, Professor W. F., F.R.S.E.  Harmer, Sidney Frederic, M.A.
Binnie, Sir Alexander Richardson, M.Inst.C.E.  Head, Henry, M.D.
Bovey, Professor Henry T., M.A.  Hiern, William Philip, M.A.
Bridge, Professor Thomas William, M.A.  Kanthack, Professor Alfredo A., M.D.
Brown, Professor Ernest William.  Lansdell, Rev. Henry, D.D.
Bruce, Surgeon-Major David, M.B.  Lewes, Professor Vivian B., F.C.S.
Buchan, Dr. Alexander, M.A.  Lewis, W. Bevan, M.R.C.S.
Burch, George James, M.A.  Lister, Arthur, F.L.S.
Callaway, Charles, D.Sc.  Lister, Joseph Jackson, M.A.
Cardew, Major Philip, R.E.  MacArthur, John Stewart, F.C.S.
Corfield, William Henry, M.D.  MacGregor, Professor James Gordon, D.Sc.
Crookshank, Professor Edgar March, M.B.  McMahon, Lieutenant-General Charles Alexander.
David, Professor T. W. Edge- Mallock, Henry Reginald Arnulph.
dworth, B.A.  Mance, Sir Henry C., C.I.E.
Dixon, Professor Alfred Cardew, M.A.  Mansergh, James, M.Inst.C.E.
Dixon, Professor Augustus Edward, M.D.  Marsh, James Ernest, M.A.
Gamble, James Sykes, M.A.
List of Papers read.

Matthey, Edward, F.C.S.
Mill, Hugh Robert, D.Sc.
Morgan, Professor Conwy Lloyd, F.G.S.
Muir, Thomas, M.A.
Muirhead, Alexander, D.Sc.
Notter, Surgeon-Lieut.-Col. James Lane.
Oliver, Major-Gen. John Ryder, R.A.
Osler, Professor William, M.D.
Parsons, Hon. Charles A., M.A.
Perkin, Arthur George.
Preston, Professor Thomas, M.A.
Rambaut, Arthur A., M.A.
Reid, Clement, F.G.S.
Reid, Professor Edward Waymouth, M.B.
Salomons, Sir David, Bart., M.A.
Scott, Alexander, M.A.
Seward, Albert Charles, M.A.
Shenstone, William Ashwell, F.I.C.
Smith, Professor William Robert, M.D.

Smithells, Professor Arthur, F.C.S.
Spencer, Professor W. Baldwin, B.A.
Starling, Ernest Henry, M.D.
Stockman, Professor Ralph, M.D.
Swinton, Alan Archibald C., Assoc. M.Inst.C.E.
Symington, Professor Johnston, M.D.
Tanner, Professor Henry William Lloyd, M.A.
Taylor, Henry Martyn.
Thomas, Michael Rogers Oldfield, F.Z.S.
Threlfall, Professor Richard.
Tutton, Alfred E., F.C.S.
Walker, Professor James, D.Sc.
Waterhouse, Colonel James.
White, William Hale, M.D.
Whymer, Edward, F.R.G.S.
Wimshurst, James.
Windle, Bertram Coghill Allen, M.D.
Woodhead, German Sims, M.D.

The following Papers were read:—

I. "The Relationship of Variations of the Ground-water Level to the Incidence of Malarial Fevers in Chotta Nagpur, Bengal." By Dr. L. Rogers. Communicated by Dr. Lauder Brunton, F.R.S.


III. "On Apogamy and the Development of Sporangia upon Fern Prothalli." By W. H. Lang. Communicated by Professor Bower, F.R.S.

IV. "Experimental Observations on the Early Degenerative Changes in the Sensory End-organs of Muscles." By Dr. F. E. Batten. Communicated by Professor V. Horsley, F.R.S.
diastase than the distal. This cannot be the true explanation, since we find that the pre-existent enzymes of the endosperm practically play no part in the self-depletion.

DESCRIPTION OF PLATE 1.

Fig. 1.—Examples of "sub-scutellar" starch-erosion, showing incipient and advanced forms. Two granules, the one in the centre of the field, the other on the right, show incipient "sub-aleuronic" erosion.

Fig. 2.—Examples of "sub-aleuronic" starch-erosion in incipient stages.

Fig. 3.—Examples of "sub-aleuronic" starch-erosion in more advanced stages.

(For the production of these photographs we are indebted to Mr. Albert Norman.)

March 10, 1898.

Sir JOHN EVANS, K.C.B., D.C.L., LL.D., Treasurer, in the Chair.

The following Papers were read:—

I. "On the Rotation of Plane of Polarisation of Electric Waves by a Twisted Structure." By Professor J. C. Bose. Communicated by LORD RAYLEIGH, F.R.S.

II. "On the Production of a "Dark Cross" in the Field of Electromagnetic Radiation." By Professor J. C. Bose. Communicated by LORD RAYLEIGH, F.R.S.

III. "An Extension of Maxwell's Electro-magnetic Theory of Light to include Dispersion, Metallic Reflection, and allied Phenomena." By EDWIN EDSER, A.R.C.S. Communicated by Captain ABNEY, F.R.S.

IV. "On the Relative Retardation between the Components of a Stream of Light produced by the Passage of the Stream through a Crystalline Plate cut in any Direction with respect to the Faces of the Crystal." By JAMES WALKER, M.A. Communicated by Professor CLIFTON, F.R.S.

V. "On the Relation between the Diurnal Range of Magnetic Declination and Horizontal Force and the Period of Solar Spot Frequency." By W. ELLIS, F.R.S.
March 17, 1898.

The LORD LISTER, F.R.C.S., D.C.L., President, in the Chair.

Professor Wilhelm Pfeffer, who was elected a Foreign Member in 1897, was admitted into the Society.

The Croonian Lecture, “The Nature and Significance of Functional Metabolism in the Plant” (Das Wesen und die Bedeutung des Betriebsstoffwechsels in der Pflanze), was delivered by Professor W. Pfeffer, For. Mem. R.S., of the University of Leipzig.

The following Papers were read:

“On the Intimate Structure of Crystals. Part III. Crystals of the Cubic System with Cubic Cleavage. Part IV. Cubic Crystals with Octahedral Cleavage.” By Professor Sollas, F.R.S.

March 24, 1898.

SIR JOHN EVANS, K.C.B., D.C.L., Treasurer and Vice-President, in the Chair.

The Right Hon. Sir Herbert Eustace Maxwell, a Member of Her Majesty’s Most Honourable Privy Council, was admitted into the Society.

The Bakerian Lecture, “Further Experiments on the Action exerted by certain Metals and other Bodies on a Photographic Plate,” was delivered by Dr. W. J. Russell, V.P.R.S.

The following Paper was read:

\[ = \int_{x_1}^{x_2} \gamma_2 \cdot \gamma dx \cdot dM_x/dx = \gamma_2 \gamma (M_2 - M_1). \]

As special cases, we have equation (11) reducing the calculation of the force between a circular cylindrical uniform current sheet and a coaxial helical current to the calculation of the coefficients of mutual induction of the helix and the circular ends of the sheet; and the simpler case of the force between a circular cylindrical uniform current sheet and a circular current, which is obtained from the calculations of the coefficients of mutual induction of the circle and the circular ends of the sheet.

I hope that equation (11) may be of service in the accurate calculation of the constants of current weighing apparatus. My attention was drawn to the matter from this point of view in consequence of the Report of the Electrical Standards Committee of the British Association made at Toronto, in which mention is made of the importance of re-determining the ampere.

March 31, 1898.

The LORD LISTER, F.R.C.S., D.C.L., President, in the Chair.

Preliminary communications upon the results of the recent Solar Eclipse were made by the following members of the expeditions:


The Society adjourned over the Easter Recess to Thursday, April 28.

* Professor A. Gray has pointed out to me that this result may be deduced from the consideration that the removal of an element from one end of the sheet to the other is equivalent to a small motion of the sheet parallel to its generating lines. — J. V. J., April 21, 1898.
April 28, 1898.

The LORD LISTER, F.R.C.S., D.C.L., President, in the Chair.

The following Papers were read:—

I. "On the Meteorological Observatories of the Azores." By H.S.H. PRINCE ALBERT I OF MONACO. Communicated by J. Y. BUCHANAN, F.R.S.

II. "A Compensated Interference Dilatometer." By A. E. TUTTON. Communicated by Professor CLIFTON, F.R.S.

III. "A Calorimeter for the Human Body." By WILLIAM MARCET, M.D., F.R.S.

IV. "An Experimental Enquiry into the Heat given out by the Human Body." By WILLIAM MARCET, M.D., F.R.S.

"On the Meteorological Observatories of the Azores." By H.S.H. THE PRINCE ALBERT I OF MONACO. Communicated by Mr. J. Y. BUCHANAN, F.R.S. Received April 19, —Read April 28, 1898.

(Translation.)

In 1892 I brought before the British Association, met in Edinburgh, a project which my scientific cruises in the North Atlantic had suggested and preliminary experiments have matured. The importance of meteorological observations is now universally recognised, and a continually increasing number of centres of observation are being created in order to assist the progress of this science.

I proposed to establish on the Azores an advanced post, whose mission should be: 1st, to observe the birth of certain atmospheric disturbances, which appear to be formed in this region of the Atlantic; 2nd, to correct the path of certain others which appear to threaten the coasts of Europe and which are announced from America at too great a distance of time and space for there to be an assurance that more or less considerable modifications may not take place which will affect their strength, their direction, and the date of their arrival on the European coasts.

We should then have, on a point situated almost in the middle of
INDEX SLIP.

MONACO, Prince Albert I. of.—On the Meteorological Observatories of the Azores.


Azores, meteorological observatories in.—Importance of, for storm study and weather prediction, seismology and terrestrial magnetism.

Monaco, Prince Albert I. of.


Protoplasm (Vegetable and Animal), Action of Anaesthetics (Carbon Dioxide, Chloroform, Ether) on.

Farmer, J. B., and Waller, A. D.


RAISIN, Catherine A.—On certain Structures formed in the drying of a Fluid with Particles in Suspension.


Crystallisation, modifications by Mud.


Rock Structures (dendritic, &c.) illustrated by results of drying up of Muddy Fluid.

May 5, 1898.

The LORD LISTER, F.R.C.S., D.C.L., President, in the Chair.

In pursuance of the Statutes, the names of the Candidates recommended by the Council for election into the Society were read as follows:—

Baker, Henry Frederick, M.A. | Preston, Professor Thomas, M.A.
Brown, Professor Ernest William. | Reid, Professor Edward Waymouth, M.B.
Buchan, Dr. Alexander, M.A. | Scott, Alexander, M.A.
Harmer, Sidney Frederic, M.A. | Seward, Albert Charles, M.A.
Lister, Arthur, F.L.S. | Shenstone, William Ashwell, F.I.C.
McMahon, Lieutenant-General Charles Alexander. | Taylor, Henry Martyn.
Osler, Professor William, M.D. | Wimshurst, James.
Parsons, Hon. Charles A., M.A. | |

The following Papers were read:—

I. "Observations on the Action of Anaesthetics on Vegetable and Animal Protoplasm." By Dr. A. D. WALLER, F.R.S., and Professor J. B. FARMER.

II. "On certain Structures formed in the drying of a Fluid with Particles in Suspension." By Miss C. A. RAISIN. Communicated by Professor BONNEY, F.R.S.

III. "On Photographic Evidence of the Objective Reality of Combination Tones." By R. W. FORSYTH and R. J. SOWTER. Communicated by Professor RÜCKER, Sec. R.S.

IV. "The Relations between the Hybrid and Parent Forms of Echinoid Larvae." By H. M. VERNON. Communicated by Professor LANKESTER, F.R.S.
yielded only gastrulae. Finally, hybrids, of a presumably intermediate character, were obtained from the cross *Echinus microtuberculatus* ♀ and *Echinus acutus* ♂. With the ova of *Sphaerechinus* and *Echinocardium*, and the sperm of *Echinus acutus*, only gastrulae were obtained.

On performing cross-fertilisations with the colour varieties of *Sphaerechinus*, there was found to be a distinct diminution of fertility. In the most marked instance, obtained in the experiments made on June 2, it was found that when white-spined varieties were fertilised with white-spined, and violet-spined with violet, 98·5 per cent. of the ova reached the blastula stage, and 73 per cent. the eight days plateus stage. But on cross-fertilising white-spined with violet-spined individuals, only 68 per cent. of the ova developed to blastulae, and 15·6 per cent. to platei. Also these crossed larvæ were 4·5 per cent. smaller than the uncrossed. Other series of experiments were made in July, November, and December, the differential fertility seeming to gradually diminish with the progress of the season. Nevertheless, it was always most distinctly present. On crossing the less definitely marked colour varieties of *Strongylocentrotus*, a small amount of infertility seemed to be present in one series of experiments, but none at all in another.

May 12, 1898.

The LORD LISTER, F.R.C.S., D.C.L., President, in the Chair.

Professor Dewar made a preliminary communication "On the Liquefaction of Hydrogen and Helium."

He prefaced his statement by referring to a letter which he had addressed to the President on the 10th May, announcing to him the fact that he had succeeded in liquefying hydrogen in quantity, and that by means of the liquid hydrogen he had also liquefied helium.

The following Papers were also read:—

I. "On the Magnetic Susceptibility of Liquid Oxygen." By Professor FLEMING, F.R.S., and Professor JAMES DEWAR, F.R.S.

II. "A Study of the Phyto-Plankton of the Atlantic." By G. Murray, F.R.S., and V. H. Blackman.

IV. "Effects of prolonged Heating on the Magnetic Properties of Iron." By S. R. ROGET. Communicated by Professor EWING, F.R.S.

V. "On the Connection of Algebraic Functions with Automorphic Functions." By E. T. WHITTAKER. Communicated by Professor FORSYTH, F.R.S.

The Society adjourned over Ascension Day to Thursday, May 26.

“A Calorimeter for the Human Body.” By WILLIAM MARCET, M.D., F.R.S. Received March 10,—Read April 28, 1898.

(From the Physiological Laboratory, University College, London.)

At the meeting of the Physiological Society held at University College in March, 1897, I exhibited and described a calorimeter constructed for the purpose of determining the heat given out by man. Several members of the Society, in succession, allowed themselves to be shut up in the chamber where they experienced no discomfort whatever. The instrument was also described the same year to the Société de Physique et d’Histoire Naturelle of Geneva, but no full account of it has been published so far.

The first calorimeter for the investigation of animal heat was made by Lavoisier and Laplace,* who enclosed an animal in a chamber surrounded with ice and determined the heat evolved by measuring the amount of ice melted. Crawford, in 1788, placed the air chamber inside a water-jacket, and determined the heat emitted by means of the increased temperature of the water. An objection to this type of calorimeter is the very small rise in the water temperature, and the difficulty of obtaining an uniform temperature in such a large volume of water. J. Rosenthal,† in 1878, introduced a calorimeter in which the heat given out from a small animal was absorbed by a fluid with a low boiling point, such as ordinary ether, the amount of heat was calculated from the volume of the fluid evaporated and its known latent heat of vaporization.

Rosenthal,‡ at a later date, constructed a calorimeter, which consisted of three concentric chambers of sheet copper, and was made in duplicate; the two instruments were connected by means of a U-shaped manometer. The heat given out by an animal, such as a dog, enclosed in the innermost chamber of one of the instruments,

* ‘Mémoires de l’Acad. des Sciences,’ 1780.
May 26, 1898.

The LORD LISTER, F.R.C.S., D.C.L., President, in the Chair.

The following Papers were read:—


II. "The Skeleton and Classification of Calcareous Sponges." By G. P. Bidder. Communicated by Adam Sedgwick, F.R.S.

III. "On Surfusion in Metals and Alloys." By W. C. Roberts-Austen, C.B., F.R.S.

IV. "Note on the Complete Scheme of Electromagnetic Equations of a Moving Material Medium, and on Electrostriction." By J. Larmor, D.Sc., F.R.S.

V. "Aluminium as an Electrode in Cells for Direct and Alternate Currents." By E. Wilson. Communicated by Professor Hopkinson, F.R.S.

VI. "Contributions to the Study of 'Flicker.'" By T. C. Porter. Communicated by Lord Rayleigh, F.R.S.

VII. "On the Kathode Fall of Potential in Gases." By J. W. Capstick. Communicated by Professor J. J. Thomson, F.R.S.

The Society adjourned over the Whitsuntide Recess to Thursday, June 9.


The remarkable advance in our knowledge of the constitution of gases that has marked the latter half of this century has immensely strengthened a belief in the doctrine of atoms. It is to this doctrine, therefore, that we naturally turn to assist us in the study of the intimate structure of solids. The solid, however, stands at the opposite pole to the gas; in the one the particles are unrestrained, free to move about any axis, and along paths of comparatively wide
June 9, 1898.

The Annual Meeting for the Election of Fellows was held this day.

The LORD LISTER, F.R.C.S., D.C.L., President, in the Chair.

The Statutes relating to the election of Fellows having been read, Professor Bonney and Mr. R. H. Scott were, with the consent of the Society, nominated Scrutators to assist the Secretaries in the examination of the balloting lists.

The votes of the Fellows present were collected, and the following Candidates were declared duly elected into the Society:—

Baker, Henry Frederick, M.A.
Brown, Professor Ernest William.
Buchan, Dr. Alexander, M.A.
Harmer, Sidney Frederic, M.A.
Lister, Arthur, F.L.S.
McMahon, Lieutenant-General Charles Alexander.
Osler, Professor William, M.D.
Parsons, Hon. Charles A., M.A.

Preston, Professor Thomas, M.A.
Reid, Professor Edward Waymouth, M.B.
Scott, Alexander, M.A.
Seward, Albert Charles, M.A.
Shenstone, William Ashwell, F.I.C.
Taylor, Henry Martyn.
Wimshurst, James.

Thanks were given to the Scrutators.

June 9, 1898.

The LORD LISTER, F.R.C.S., D.C.L., President, in the Chair.

Professor W. Haswell (elected, 1897) and Professor Amagat (elected a Foreign Member, 1897) were admitted into the Society.

The following Papers were read:—


II. "On the Position of Argon, Helium, and Krypton in the Scheme of Elements." By Sir William Crookes, F.R.S.

III. "Experimental Investigations on the Oscillations of Balances." By D. Mendeleeff, For. Mem. R.S.

IV. "Experiments on Aneroid Barometers at Kew Observatory and their Discussion." By Dr. C. Chree, F.R.S.
V. "The Nature of the Antagonism between Toxins and Anti-
toxins." By Dr. C. J. Martin and Dr. T. Cherry. Communicated by Dr. Halliburton, F.R.S.

VI. "Some Differences in the Behaviour of Real Fluids from
that of the Mathematical Perfect Fluid." By A. Mallock.
Communicated by Lord Rayleigh, F.R.S.

VII. "On the Heat dissipated by a Platinum Surface at High
Temperatures." By J. E. Pettavel. Communicated by
Lord Rayleigh, F.R.S.

"An Extension of Maxwell's Electro-magnetic Theory of Light
to include Dispersion, Metallic Reflection, and allied Phe-
nomena." By Edwin Edser, A.R.C.S. Communicated by
Captain W. de W. Abney, C.B., F.R.S. Received
February 18,—Read March 10, 1898.

The Electro-magnetic Theory of Light, as left by Maxwell, gave no
explanation of dispersion, and led to conclusions in some respects
inconsistent with the results of experiments on metallic reflection.
There seems to be little doubt as to the general direction in which it
would be necessary to modify that theory in order to give a satis-
factory account of these phenomena. Electrical conduction has been
considered by many to be inseparably connected with the motion of
charged atoms, whilst the properties of a dielectric have been found
to admit of an explanation on somewhat similar lines; consequently
it would appear necessary, where fluctuations in the electric field of
frequencies as great as those of light are concerned, to expressly
formulate the reactions of the atoms or molecules composing the
medium through which the disturbances are propagated. The
mechanical theories of light, when modified in a similar manner, have
been found capable of giving a more or less comprehensive account of
dispersion and metallic reflection; and it would appear that the
assumptions necessitated in the present case are at least as admissible
as those which have been made elsewhere. No doubt a theory with
any pretension to finality must include a satisfactory account of the
nature of the luminiferous ether and of electricity, perhaps even of
the ultimate constitution of atoms; and Mr. Larmor's investigations
show how far we can even now go in this direction. On the other
hand, a less comprehensive theory, depending only on the known laws
of electrical actions, may prove not without value, if, whilst explaining
the observed phenomena, it enables us to form a clear mental picture
of the processes involved.
June 16, 1898.

SIR JOHN EVANS, K.C.B., D.C.L., Treasurer and Vice-President, in the Chair.

Mr. H. F. Baker, Mr. S. F. Harmer, Mr. Arthur Lister, Lieut.-General C. A. McMahon, the Hon. Charles A. Parsons, Professor T. Preston, Professor E. Waymouth Reid, Dr. Alexander Scott, Mr. A. C. Seward, Mr. W. A. Shenstone, Mr. H. M. Taylor, and Mr. James Wimshurst were admitted into the Society.

The following Papers were read:—

"Observations on Stomata." By Francis Darwin, F.R.S.

II. "Note on the Attenuation and Exaltation of the Virulence of the Organism of Texas Fever." By A. Edington, M.B. Communicated by Professor T. R. Fraser, F.R.S.

III. "Mathematical Contributions to the Theory of Evolution. V. On the Reconstruction of the Stature of Prehistoric Races." By Professor Karl Pearson, F.R.S.


V. "On the Source of the Röntgen Rays in Focus Tubes." By A. A. C. Swinton. Communicated by Lord Kelvin, F.R.S.

VI. "On the Companions of Argon." By Professor Ramsay, F.R.S., and Morris W. Travers.

VII. "Contributions to our Knowledge of the Fucaecæ, their Life-history and Cytology."* By Professor J. B. Farmer and J. Li. Williams. Communicated by Dr. D. H. Scott, F.R.S.

VIII. "On the Detection and Localisation of Phosphorus in Animal and Vegetable Tissues." By Professor A. B. Macallum. Communicated by Professor Sherrington, F.R.S.

* This is the full paper of which the communication entitled "On Fertilisation, and the Segmentation of the Spore, in Fucaecæ," read June 18, 1826, and published in the 'Proceedings,' vol. 60, p. 188, is to be regarded as the 'Abstract.'
IX. "Summary of the principal Results obtained in a Study of the Development of the Tuatara (Sphenodon punctatum)." By Professor A. Dendy. Communicated by Professor Howes, F.R.S.

X. "Tables for the Solution of the Equation

\[ \frac{d^2y}{dx^2} + \frac{1}{x} \frac{dy}{dx} - \left(1 + \frac{h^2}{x^2}\right)y = 0.\]

By W. Stradman Aldis, M.A. Communicated by J. J. Thomson, F.R.S.

XI. "The Stomodæum, Mesenterial Filaments, and Endoderm of Xenia." By J. H. Ashworth, B.Sc. Communicated by Professor Hickson, F.R.S.

The Society adjourned over the Long Vacation to Thursday, November 17th, 1898.

"Observations on Stomata." By Francis Darwin, F.R.S.

Received May 31,—Read June 16, 1898.

(Abstract.)

The method described depends on the fact that in adult leaves transpiration is stomatal rather than cuticular, so that, other things being equal, the yield of watery vapour depends on the degree to which the stomata are open, and may be used as an index of their condition. In principle, it is the same as the methods of Merget* and Stahl.† These observers used hygroscopic papers impregnated with reagents which change colour according as they are dry or damp, and Stahl, who employed paper soaked in cobalt chloride, has obtained excellent results. In my laboratory I have used, for some years, a hygroscope for demonstrating stomatal transpiration, in which evaporation is indicated by the untwisting of the awn of Stipa pennata;‡ my present instrument is of the same general type, but the index is made of "chinese leaf," i.e., shavings of pressed and heated horn.§ If a strip of horn is placed on a dry substance, e.g., the astomatal surface of a leaf, it does not move, but on the stomatal surface, it instantly curves strongly away from the transpiring surface. In the hygroscope the

* 'Comptes Rendus,' 1878.
† 'Bot. Zeitung,' 1894.
‡ Darwin and Acton, 'Practical Physiology of Plants,' 1st edition, 1894.
§ I also use the epidermis of a Yucca—a material which I owe to the kindness of Mr. Thiselton-Dyer.