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OF THE

ROYAL SOCIETY OF LONDON.

From January 17, to June 20, 1901.

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CONTENTS.

VOL. LXVIII.

No. 442.

Meeting of January 17, 1901, and Proceedings .............................................. 1


Wave-length Determinations and General Results obtained from a Detailed Examination of Spectra photographed at the Solar Eclipse of January 22, 1898. By J. Evershed. Communicated by Dr. Bambaut, F.R.S. ................................................................. 6

The Thermo-Chemistry of the Alloys of Copper and Zinc. By T. J. Baker, B.Sc., King Edward's School Birmingham. Communicated by Professor Poynting, F.R.S ................................................................. 9


Meeting of February 7, 1901, and Proceedings .................................................. 14

List of Papers read .................................................................................................. 15

Further Investigations on the Abnormal Outgrowths or Intumescences in Hibiscus vitifolius, Linn.: a Study in Experimental Plant Pathology. By Elizabeth Dale. Communicated by Professor H. Marshall Ward, F.R.S ................................................................. 16


On the Proteid Reaction of Adamkiewicz, with Contributions to the Chemistry of Glyoxylic Acid. By F. Gowland Hopkins, M.A., M.B., University Lecturer in Chemical Physiology, and Sydney W. Cole, B.A., Trinity College. (From the Physiological Laboratories, Cambridge.) Communicated by Dr. Lanyon, F.R.S .... 21
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Boiling Point of Liquid Hydrogen, determined by Hydrogen and Helium Gas Thermometers. By James Dewar, M.A., LL.D., Professor of Chemistry at the Royal Institution, and Jacksonian Professor; University of Cambridge</td>
<td>44</td>
</tr>
<tr>
<td>Meeting of February 14, 1901, and Proceedings</td>
<td>55</td>
</tr>
<tr>
<td>On the Functions of the Bile as a Solvent. By Benjamin Moore and William H. Parker. Communicated by Professor Schäfer, F.R.S.</td>
<td>64</td>
</tr>
<tr>
<td>Meeting of February 21, 1901, and Proceedings</td>
<td>78</td>
</tr>
<tr>
<td>An Attempt to Estimate the Vitality of Seeds by an Electrical Method. By Augustus D. Waller, M.D., F.R.S.</td>
<td>79</td>
</tr>
<tr>
<td>On a New Manometer, and on the Law of the Pressure of Gases between 1.5 and 0.01 Millimetres of Mercury. By Lord Rayleigh, F.R.S.</td>
<td>92</td>
</tr>
<tr>
<td>The Mineral Constituents of Dust and Soot from various Sources. By W. N. Hartley, F.R.S., Royal College of Science, Dublin, and Hugh Ramage, A.R.C.Sc.I., St. John's College, Cambridge</td>
<td>97</td>
</tr>
<tr>
<td>Notes on the Spark Spectrum of Silicon as rendered by Silicates. By W. N. Hartley, F.R.S.</td>
<td>109</td>
</tr>
<tr>
<td>Some Additional Notes on the Orientation of Greek Temples, being the Result of a Journey to Greece and Sicily in April and May, 1900. By F. C. Penrose, M.A., F.R.S.</td>
<td>112</td>
</tr>
<tr>
<td>Meeting of February 28, 1901, and Address to the King</td>
<td>115</td>
</tr>
<tr>
<td>His Majesty's Reply</td>
<td>116</td>
</tr>
<tr>
<td>List of Papers read</td>
<td>116</td>
</tr>
</tbody>
</table>

On the Theory of Consistence of Logical Class-frequencies and its Geometrical Representation. By G. Udny Yule, formerly Assistant Professor of Applied Mathematics in University College, London. Communicated by Professor K. Pearson, F.R.S. ........................................ 118


No. 444.

Meeting of March 7, 1901, and List of Candidates .................................. 124

List of Papers read .................................................................................. 125


Some Physical Properties of Nitric Acid Solutions. By V. H. Veley, F.R.S., and J. J. Manley, Daubeney Curator, Magdalen College, Oxford ................................................................. 128

The Anatomy of Symmetrical Double Monosporosities in the Trout. By James F. Gemmill, M.A., M.D., Lecturer in Embryology and University Assistant in Anatomy, University of Glasgow. Communicated by Professor Cleland, F.R.S. .................................................... 129


On the Composition and Variations of the Pelvic Plexus in Acanthias vulgaris. By R. C. Punnett, B.A., Gonville and Caius College, Cambridge. Communicated by Dr. H. Gadow, F.R.S. .................................................... 140

Further Observations on Nova Persei. By Sir Norman Lockyer, K.C.B., F.R.S. (Plate 1) ................................................................. 142

Meeting of March 14, 1901, and List of Papers read .................................. 146

The Action of Magnetised Electrodes upon Electrical Discharge Phenomena in Rarefied Gases. By C. E. S. Phillips. Communicated by Sir William Crookes, F.R.S. .................................................... 147

The Chemistry of Nerve-degeneration. By F. W. Mott, M.D., F.R.S., and W. D. Halliburton, M.D., F.R.S. .................................................... 149


On the Preparation of Large Quantities of Tellurium. By Edward Matthey, A.R.S.M. Communicated by Sir George Stokes, Bart., F.R.S. .................................................... 161
The Transmission of the *Trypanosoma Evansi* by Horse Flies, and other Experiments pointing to the probable Identity of Surra of India and Nagana or Tsetse-fly Disease of Africa. By Leonard Rogers, M.D., M.R.C.P., Indian Medical Service. Communicated by Major D. Bruce, R.A.M.C., F.R.S. .................................................. 163

Meeting of March 21, 1901, and Lecture delivered ........................................ 170

Meeting of March 28, 1901, and List of Papers read ........................................ 170

No. 445.

On the Results of Chilling Copper-Tin Alloys. By C. T. Heycock, F.R.S., and F. H. Neville, F.R.S. (Plates 2–3) ........................................ 171


A Preliminary Account of the Development of the Free-swimming Nautilus of *Leptodora hyalina* (Lillj.). By Ernest Warren, D.Sc., Assistant Professor of Zoology, University College, London. Communicated by Professor Weldon, F.R.S. ........................................ 210


No. 446.

Elastic Solids at Rest or in Motion in a Liquid. By C. Chree, Sc.D., LL.D., F.R.S. ........................................ 235


Meeting of May 2, 1901, Names of Candidates recommended for election, and List of Papers read ........................................ 248

Ellipsoidal Harmonic Analysis. By G. H. Darwin, F.R.S., Plumian Professor and Fellow of Trinity College in the University of Cambridge ........................................ 248


Meeting of May 9, 1901, and Proceedings ........................................ 261
Meeting of May 23, 1901, and List of Papers read ..................... 262


No. 447.


A Comparative Crystallographical Study of the Double Selenates of the Series RM(SeO₃)₆H₂O—Salts in which M is Magnesium. By A. E. Tutton, B.Sc., F.R.S ........................................... 322

On the Presence of a Glycolytic Enzyme in Muscle. By Sir T. Lauder Brunton, M.D., F.R.S., and Herbert Rhodes, M.B ................... 323

Annual Meeting for the Election of Fellows .................................. 326

Meeting of June 6, 1901, and List of Papers read .......................... 327

Vibrations of Rifle Barrels. By A. Mallock. Communicated by Lord Rayleigh, F.R.S. ......................................................... 327


Thermal Adjustment and Respiratory Exchange in Monotremes and Marsupials.—A Study in the Development of Homothermism. By C. J. Martin, M.B., D.Sc., Acting Professor of Physiology in the University of Melbourne. Communicated by Professor E. H. Starling, F.R.S. ......................................................... 352

On the Elastic Equilibrium of Circular Cylinders under certain Practical Systems of Load. By L. N. G. Filon, M.A., B.Sc., Research Student of King’s College, Cambridge; Fellow of University College, London; 1851 Exhibition Science Research Scholar. Communicated by Professor Ewing, F.R.S. ......................................................... 353


No. 448.

Meeting of June 13, 1901 .......................................................... 360


Meeting of June 20, 1901, and List of Papers read .................................................. 366

On the Mathematical Theory of Errors of Judgment, with Special Reference to the Personal Equation. By Karl Pearson, F.R.S., University College, London .................................................................................. 369

Mathematical Contributions to the Theory of Evolution.—X. Supplement to a Memoir on Skew Variation. By Karl Pearson, F.R.S., University College, London ................................................................. 372


The Nature and Origin of the Poison of Lotus arabicus. By Wyndham R. Dunstan, M.A., F.R.S., Director of the Scientific and Technical Department of the Imperial Institute, and T. A. Henry, B.Sc., Salters’ Company’s Research Fellow in the Laboratories of the Imperial Institute .................................................................................. 374

The Pharmacology of Pseudoaconitine and Japaconitine considered in Relation to that of Aconitine. By J. Theodore Cash, M.D., F.R.S., Regius Professor of Materia Medica in the University of Aberdeen, and Wyndham R. Dunstan, M.A., F.R.S., Director of the Scientific Department of the Imperial Institute ................................................................. 378

The Pharmacology of Pyraconitine and Methylbenzaconine considered in relation to their Chemical Constitution. By J. Theodore Cash, M.D., F.R.S., Regius Professor of Materia Medica in the University of Aberdeen, and Wyndham R. Dunstan, M.A., F.R.S., Director of the Scientific Department of the Imperial Institute ................................................................. 384


Preliminary Statement on the Prothalli of Ophioglossum pendulum (L.), Helminthostachys zoyleiana (Hook.), and Psilotum, sp. By William H. Lang, M.B., D.Sc., Lecturer in Botany, Queen Margaret College, University of Glasgow. Communicated by Professor F. O. Bower, Sc.D., F.R.S. ........................................................... 405
No. 449.

The Mechanism of the Electric Arc. By (Mrs.) Hertha Ayrton. Communicated by Professor Perry, F.R.S. ......................................................... 410

Report of Magnetical Observations at Falmouth Observatory for the Year 1900 .......... ................................................................. 415

The National Physical Laboratory. Report on the Observatory Department for the Year ending December 31, 1900 ........................................ 421


Croonian Lecture.—Studies in Visual Sensation. By C. Lloyd Morgan, F.R.S., Principal of University College, Bristol ........ 459

The Yellow Colouring Matters accompanying Chlorophyll and their Spectroscopic Relations. Part II. By C. A. Schunck. Communicated by Dr. E. Schunck, F.R.S. (Plates 5, 6) ......................... 474

No. 450.

On Skin Currents.—Part I. The Frog’s Skin. By Augustus D. Waller, M.D., F.R.S. .............................................................................. 480

Virulence of Desiccated Tubercular Sputum. By Harold Swithinbank. Communicated by Sir James Crichton Browne, F.R.S. 495

Effect of Exposure to Liquid Air upon the Vitality and Virulence of the Bacillus Tuberculosis. By H. Swithinbank. Communicated by Sir James Crichton Browne, F.R.S. ......................................................... 498

On the Behaviour of Oxy-haemoglobin, Carbonic-oxide-haemoglobin, Methaemoglobin, and certain of their Derivatives, in the Magnetic Field, with a Preliminary Note on the Electrolysis of the Haemoglobin Compounds. By Arthur Gangee, M.D., F.R.S., Emeritus Professor of Physiology in the Owens College, Victoria University.... 503


Index ........................................................................................................ 519
PROCEEDINGS
OF
THE ROYAL SOCIETY.

January 17, 1901.

Sir WILLIAM HUGGINS, K.C.B., D.C.L., President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read:—


II. "Wave-length Determinations and General Results obtained from a Detailed Examination of Spectra photographed at the Solar Eclipse of January 22, 1898." By J. EVERSHED. Communicated by Dr. RANBAUT, F.R.S.

III. "The Thermo-chemistry of the Alloys of Copper and Zinc." By T. J. BAKER. Communicated by Professor POYNTING, F.R.S.


(Abstract.)

(1.) If we take two offspring from the same parental pair, we find a certain diversity and a certain degree of resemblance. In the theory

VOL. LXVIII.
portion of clay. That this is the case, as compared with sodium salts, is beyond doubt (see paper by the late Dr. A. Voelecker, “On the Composition of the Waters of Land Drainage,” ‘Journal of the Royal Agricultural Society of England,’ 1874); but the series of analyses of the Broadbalk subsoils that has now been made by means of weak citric acid solution, shows that potash, though “fixed” relatively to soda, is far more migratory than phosphoric acid, and descends much lower into the subsoil. At the same time it appears probable that a portion of it passes into a fixed and stable form of combination, from which weak citric acid fails to dislodge it.

The results yielded by the samples of soil and subsoil taken from the same plots at the different periods afford instructive comparisons, notwithstanding the age of the earlier samples at the time of their examination, which might have been expected to be responsible for considerable modifications in the condition of the less stable chemical compounds contained in them.

In consequence of the death of Her Most Gracious Majesty Queen Victoria, which took place on the 22nd of January, the meetings of the Society were suspended, by order of the President, until after the funeral of Her late Majesty, which took place on the 2nd February.

February 7, 1901.

Sir WILLIAM HUGGINS, K.C.B., D.C.L., President, in the Chair.

The President, in moving that a dutiful Address of Condolence and Homage be drawn up and presented by the Council of the Society to His Most Gracious Majesty the King, said:—

“The ebrace upon our Mace would remind us, if indeed we needed to be reminded, of the sorrow which is uppermost in every heart. We mourn to-day the greatest Queen the world has known—truly great by the supreme example She set, in Her own person, of sustained nobility of purpose, and of devotion to duty, and by the influence of Her wise and understanding heart, for the world’s good, upon the councils of the Empire. We mourn more than a great Queen—a gracious Lady who by the brightness of Her domestic virtues, and Her rare power of kindly sympathy with Her subjects in all their joys and sorrows, had in a real sense become the Mother of Her Peoples. As Fellows of this Society, we mourn further a Sovereign Patron, who by Her enlightened encouragement and protection, has made possible through the sixty-
Proceedings and List of Papers read.

three years of Her reign, an 'improvement of natural knowledge,' not only unprecedented, but even beyond the wildest dreams of the most enthusiastic of the Fellows who welcomed Her at Her accession—so much so, indeed, that the Victorian Age has become synonymous with the Scientific Age.

"But, though dead She yet speaketh to us through His Gracious Majesty the King, Her Son, a Fellow of this Society, whose words of yesterday are still in our ears, 'that it would be his constant endeavour to walk in Her footsteps.' We join in most loyal and heartfelt wishes that His Majesty may long reign over a united and prosperous Empire; and that under His fostering care Science may continue to advance with even accelerated steps."

The motion was seconded by Lord Lister and carried in silence, the Fellows present rising from their seats.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read:—

"The Boiling Point of Liquid Hydrogen, determined by Hydrogen and Helium Gas Thermometers." By Professor Dewar, F.R.S.

"On the Brightness of the Corona of January 22, 1898. Preliminary Note." By Professor H. H. Turner, F.R.S.

"Preliminary Determination of the Wave-lengths of the Hydrogen Lines, derived from Photographs taken at Ovar at the Eclipse of the Sun, May 28, 1900." By F. W. Dyson. Communicated by the Astronomer Royal, F.R.S.

"Investigations on the Abnormal Outgrowths or Intumescences on Hibiscus vitifolius, Linn.: a Study in Experimental Plant Pathology." By Miss E. Dale. Communicated by Professor Marshall Ward, F.R.S.

"On the Proteid Reaction of Adamkiewicz, with Contributions to the Chemistry of Glyoxylic Acid." By F. G. Hopkins and Sydney W. Cole. Communicated by Dr. Langley, F.R.S.

"The Integration of the Equations of Propagation of Electric Waves." By Professor Love, F.R.S.
February 14, 1901.

A. B. KEMPE, M.A., Treasurer and Vice-President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read:—

I. "Some Additional Notes on the Orientation of Greek Temples, being the Result of a Journey to Greece and Sicily, in April and May, 1900." By F. C. PENROSE, F.R.S.

II. "The Transmission of the Trypanosoma Evansi by Horse Flies, and other Experiments pointing to the Probable Identity of Surra of India and Nagana or Tsetse-fly Disease of Africa." By Dr. LEONARD ROGERS. Communicated by Major D. BRUCE, R.A.M.C., F.R.S.

III. "On the Influence of Ozone on the Vitality of some Pathogenic and other Bacteria." By Dr. A. RANSOME, F.R.S., and A. G. R. FOULERTON.

IV. "On the Functions of the Bile as a Solvent." By B. MOORE and W. H. PARKER. Communicated by Professor SCHÄFER, F.R.S.

V. "On the Application of the Kinetic Theory of Gases to the Electric, Magnetic, and Optical Properties of Diatomic Gases." By G. W. WALKER. Communicated by Professor RÜCKER, Sec. R.S.

VI. "Heredity, Differentiation, and other Conceptions of Biology: A Consideration of Professor Karl Pearson's Paper 'On the Principle of Homotyposis.'" By W. BATESON, F.R.S.


The influence of ozone on the vitality of bacteria is a matter which has received the attention of several investigators. But, on reviewing the records of the results which have been arrived at, it is obvious that such results have not always been consistent.

VOL. LXVIII.
The optical properties are next considered, and the amount of refraction produced by free atoms and molecules calculated. The calculations on the free atoms are of interest, inasmuch as it is shown that they accelerate the velocity with which waves are transmitted. With regard to the molecules, it is shown that the optical control may be regarded as due to $\omega^2$, the mean value of $\omega^2$ for the molecules, where $\omega$ is the angular velocity of rotation of the two atoms about their common C.G. Dispersion is also accounted for, and depends essentially on the distribution law of velocities. The effects of radiation from the molecules are also considered in the course of the work.

The rate of rotation of the plane of polarisation in a magnetic field is also calculated, and the sign of the rotation shown to depend on which atom has the larger mass. If the masses are equal no rotation is produced. The work borders in some ways with Professor W. Voigt’s investigations.

The formulæ obtained are applied to the case of oxygen to obtain estimates of $e/m_1$ and $e/m_2$, $e$ being the charge and $m_1$ and $m_2$ the masses of the two atoms. An estimate of $\omega$, and hence of $2r_0$, the sum of the radii of the two atoms, is also obtained. The value of $e/m_1$ agrees closely numerically with this ratio obtained from electrolytic considerations, while the value of $e/m_2$ agrees closely with the value obtained from considerations of the Zeeman effect.

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February 21, 1901.

Sir WILLIAM HUGGINS, K.C.B., D.C.L., President, followed by The LORD LISTER, F.R.C.S., D.C.L., Vice-President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read:—

I. “An Attempt to Estimate the Vitality of Seeds by an Electrical Method.” By Dr. A. D. WALLER, F.R.S.

II. “On a New Manometer, and on the Law of the Pressure of Gases between 1·5 and 0·01 Millimetres of Mercury.” By LORD RAYLEIGH, F.R.S.

III. “An Investigation of the Spectra of Flames resulting from Operations in the Open-hearth and ‘Basic’ Bessemer Processes.” By Professor W. N. HARTLEY, F.R.S., and HUGH RAMAGE.
IV. "The Mineral Constituents of Dust and Soot from various Sources."
By Professor W. N. Hartley, F.R.S., and Hugh Ramage.

V. "Notes on the Spark Spectra of Silicon as rendered by Silicates."
By Professor W. N. Hartley, F.R.S.


"An Attempt to Estimate the Vitality of Seeds by an Electrical Method." By Augustus D. Waller, M.D., F.R.S. Received January 28,—Read February 21, 1901.

The present observations form part of an extensive series of experiments by which I am engaged in verifying whether or no "blaze currents"* may be utilised as a sign and measure of vitality.

An inquiry of this scope necessitates superficial examination of many varieties of animal and vegetable matter, and the closer study of certain favourable test-cases.

I have selected as such a test-case, the "vitality" of seeds, and have chosen for my purpose beans (Phaseolus) which are anatomically convenient and practically easy to obtain of known age.

But before entering upon the results in this particular test-case, I think it advisable to preface those results by a brief indication of the principle involved in all such experiments.

The method of investigation is similar to that adopted in the case of the frog's eyeball,* the complications of the principle and a tentative explanation of such complications is reserved for future discussion in a more comprehensive memoir.

By "blaze current" (the term which I was led to adopt by the study of retinal effects) I mean to denote the galvanometrical token of an explosive change locally excited in living matter. An unequivocal blaze current electrically excited is in the same direction as the exciting current, i.e., it cannot be a polarisation counter-current. (An equivocal blaze current, in the contrary direction to the exciting current, i.e., not at first sight distinguishable from a polarisation counter-effect, also exists, but is not taken into consideration in this communication.)


Although the theoretical explanation of these currents is not now in question, it may here be remarked that the unequivocal or homodrome blaze current is probably of local post-anodic origin (the previously anodic spot being now strongly electro-positive to the previously cathodic spot), while the equivocal or heterodrome blaze current is probably of local post-kathodic origin (the previously kathodic spot being now strongly electro-positive to the previously anodic spot).
February 28, 1901.

Mr. W. H. M. CHRISTIE, Vice-President, Astronomer Royal, in the Chair.

The Secretary reported that on Saturday, February 23, the President, accompanied by the Treasurer, the Senior Secretary, the Foreign Secretary, Lord Lister, Lord Kelvin, and Sir Joseph Hooker, Past Presidents, and Mr. Christie, Vice-President, had proceeded to St. James's Palace, and, being admitted to the presence of the Throne, had the honour of presenting to His Gracious Majesty an Address of Condolence and of Homage, and that His Majesty had made a gracious reply.

The Address and Royal Reply are as follows:—

To the King's Most Excellent Majesty.

The Humble Address of the President, Council, and Fellows of the Royal Society of London for Promoting Natural Knowledge.

Most Gracious Sovereign,

We, Your Majesty's most dutiful and loyal subjects, the President, Council, and Fellows of the Royal Society of London for Promoting Natural Knowledge, humbly beg leave to offer our deepest and most heartfelt sympathy with Your Majesty in the great sorrow which has befallen You in the death of Your beloved Mother, our late Sovereign Lady the Queen. Your Majesty's loss is our loss also: a loss not only to ourselves, not only to all Your Majesty's subjects throughout the Empire, but to the whole world. During Your beloved Mother's wise and beneficent reign, under Her thoughtful fostering care, that natural knowledge which the Society was founded by one of Your ancestors to promote has been promoted to an extent, and in ways, never known before; and we feel sure that not in our time only, but in the years to come, to the story of the advance of Science in the past century will be most closely linked the memory of the goodness, the wisdom, the peerless worth of the august and beloved Lady, whose death has now plunged us into the deepest grief.

While thus uttering words of sorrow, we ask leave, Sire, at the same time, to lay at Your Majesty's feet our unfeigned and heartfelt congratulation upon Your Majesty's accession to the Throne of Your ancestors, to reign over a people to whom, happily, Your Majesty is no-
stranger, but who have, by many experiences, learnt to recognise Your
great worth, and have been led to the sure hope, that, under Your
gracious rule, the Nation will continue to hold the proud position which
it has gained under the guidance of Your beloved Mother.

That Your Majesty's reign may be long, happy, and glorious, and
that You may ever rule in the hearts as well as over the persons of a
loving, dutiful, and grateful people, is the earnest wish and ardent
prayer of

Your Majesty's loyal and dutiful Subjects,
The President, Council, and Fellows
of the Royal Society of London.

His Majesty's Gracious Reply.

"I am much gratified by the warm expression of your loyalty and
affection, of your profound sympathy with our present grief, and of
your loving appreciation of the goodness and great qualities of my
dearly beloved mother.

"I thank you for your dutiful good wishes, and I share your hope
that my reign also may be blessed by a continuous growth of my people
in enlightenment, refinement, and power for good. The intellectual
attainments and energies which your Society so conspicuously repre-
sents are among the most precious possessions of the nation as aids in
securing those high ends, and I remember with gratification the close
connection of the Society with its Royal Founder and my other prede-
cessors on this Throne, and the fact that I am a Fellow, as was also
my dear Father.

"You may feel assured of my constant interest in and protection of
your work, and in token of my goodwill I shall be pleased to inscribe
my name as Patron in the Charter Book."

A List of the Presents received was laid on the table, and thanks
ordered for them.

The following Papers were read:

I. "The New Star in Persesus.—Preliminary Note." By Sir
Norman Lockyer, K.C.B., F.R.S.

II. "On the Structure and Affinities of Fossil Plants from the
Palaeozoic Rocks. IV.—The Seed-like Fructification of Lepido-
carpus, a Genus of Lycopodiaceous Cones from the Carboniferous
Formation." By Dr. D. H. Scott, F.R.S.

III. "A Preliminary Account of the Development of the Free-swim-
mimg Nauplius of Leptodora hyalina (Lillj.)." By Dr. E.
Warren.

(Abstract.)

A short account of the new genus *Lepidocarpon* has been given in a note communicated to the Royal Society last August*; the present paper contains a full, illustrated description of the fossils in question, together with a discussion of their morphology and affinities.

The strobilus of *Lepidocarpon Lochinver*, the Coal-measure species, is, in its earlier condition, in all respects that of a *Lepidostrobus*, of the type of *L. Oldhamiius*.

In each megasporangium, however, a single megaspore or embriosac alone came to perfection, filling almost the whole sporangial cavity, but accompanied by the remains of its abortive sister-cells. An integument ultimately grew up from the sporophyll, completely enclosing the megasporangium, and leaving only a narrow slit-like opening, or micropyle, along the top. As shown in specially favourable specimens, both of *Lepidocarpon Lochinver*, and of *L. Wildianeum*, the more ancient Burntisland form, the functional megaspore became filled by a large-celled prothallus, resembling that of the recent *Isoëtes* or *Selaginella*. The whole body, consisting of the sporophyll, bearing the integumented megasporangium and its contents, became detached from the strobilus, and in this isolated condition is identical with the “seed” described by Williamson under the name of *Cardiocarpon anomalum*, which, however, proves to be totally distinct from the Cordaitean seed so named by Carruthers.

The seed-like organs of *Lepidocarpon* are regarded by the author as presenting close analogies with true seeds, but as differing too widely from the seeds of any known Spermophyta to afford any proof of affinity. The case appears rather to be one of parallel or convergent development, and not to indicate any genetic connection between the Lycopods and the Gymnosperms, or other Phanerogams.

will furnish a most convincing proof of the fundamental metallic nature of nebulae.

In conclusion, I wish to express my thanks to Dr. W. J. S. Lockyer and Mr. F. E. Baxandall, of the Solar Physics Observatory, and to Mr. A. Fowler, of the Royal College of Science, who have greatly assisted me in preparing the present note, and who, with the addition of Mr. Butler, of the Solar Physics Observatory, secured the excellent set of photographs and eye observations on the night of the 25th, from which the new knowledge has been derived.

The preparation of the slides I owe to Sapper J. P. Wilkie.

March 7, 1901.

Sir WILLIAM HUGGINS, K.C.B., D.C.L., President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

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

Adeney, Walter Ernest, D.Sc.
Alcock, Alfred William, Major, I.M.S.
Allen, Alfred Henry, F.C.S.
Ardagh, Sir John, Major-General, R.E.
Ballance, Charles Alfred, F.R.C.S.
Binnie, Sir Alexander Richardson, M.I.C.E.
Bourne, Gilbert C., M.A.
Bovey, Professor Henry T., M.A.
Boyce, Professor Rubert.
Bridge, Professor Thomas William, M.A.
Brown, Adrian John, F.C.S.
Brown, John.
Bruce, John Mitchell, M.D.
Budge, Ernest A. Wallis, D.Litt.
Callaway, Charles, D.Sc.
Cardew, Philip, Major, R.E.
Chattaway, Frederick Daniel, M.A.
Clowes, Frank, D.Sc.
Copeman, Sydney Monckton, M.D.
Corfield, Professor William Henry, M.D.
Crookshank, Professor Edgar March, M.B.
Darwin, Horace, M.A.
Davison, Charles, D.Sc.
Dendy, Professor Arthur, D.Sc.
Dixon, Professor Alfred Cardew, M.A.
Dixon, Professor Augustus Edward, F.C.S.
Dyson, Frank Watson, M.A.
Evans, Arthur John, M.A.
Feilden, Colonel Henry Wemyss.
Galloway, Professor William, F.G.S.
Goodrich, Edwin S.
Gray, Professor Thomas, B.Sc.
Gregory, Professor J. W., D.Sc.
List of Papers read.

Hamilton, Professor David James, M.D.
Hardy, William Bate, M.A.
Harker, Alfred, M.A.
Harmer, Frederic William, F.G.S.
Hiern, William Philip, M.A.
Hills, Edmond Herbert, Captain, R.E.
Hopkinson, Edward, M.A.
Jackson, Henry Bradwardine, Captain, R.N.
Jukes-Browne, Alfred John, F.G.S.
Kidston, Robert, F.G.S.
Knott, Cargill Gilston, D.Sc.
Lettis, Edmund Albert, D.Sc.
Lewis, Sir William Thomas, Bart., M.Inst.C.E.
MacArthur, John Stewart, F.C.S.
Macdonald, Hector Munro, M.A.
Maclean, Magnus, D.Sc.
MacMunn, Charles Alexander, M.D.
Mallock, Henry Reginald Arnulphe.
Mance, Sir Henry C., C.I.E.
Mansergh, James, M.Inst.C.E.
Martin, Professor Charles James, M.B.
Masson, Professor Orme, M.A.
Mather, Thomas.
Matthey, Edward, F.C.S.
Maunder, Edward Walter, F.R.A.S.
Meyrick, Edward, B.A.
Michell, John Henry, M.A.
Mill, Hugh Robert, D.Sc.
Newall, Hugh Frank, M.A.
Notter, James Lane, Surg. Lieut.-Col., M.D.
Oliver, John Ryder, Major-General (late R.A.), C.M.G.

Parsons, Frederick Gymer, F.R.C.S.
Payne, Joseph Frank, M.D.
Perkin, Arthur George.
Pope, William Jackson.
Rose, Thomas Kirke, D.Sc.
Ross, Ronald, Major, M.R.C.S.
Russell, James Samuel Risien, M.I.
Salomons, Sir David, Bart., M.A.
Saunders, Edward.
Schlich, Professor William, C.I.E.
Sidgreaves, Rev. Walter, S.J., F.R.A.S.
Smith, Fred., Lieut.-Col.
Smith, James Lorrain, M.D.
Smithells, Professor Arthur, B.Sc.
Stead, John Edward, F.C.S.
Strahan, Aubrey, M.A.
Swinburne, James.
Swinton, Alan Archibald Campbell, Assoc. M.Inst.C.E.
Symington, Prof. Johnson, M.D.
Tarleton, Professor Francis Alexander, Sc.D.
Tatham, John F. W., F.R.C.P.
Thomas, Michael Rogers Oldfield, F.Z.S.
Wager, Harold, F.L.S.
Walker, James, M.A.
Waterhouse, James, Maj.-Gen.
Watkin, Colonel, R.A., C.B.
Watson, William, B.Sc.
Whetham, William C. D., M.A.
White, William Hale, M.D.
Whitehead, Alfred North, M.A.
Willey, Arthur, D.Sc.
Woodhead, Professor German Sims, M.D.
Woodward, Arthur Smith, F.G.S.

The following Papers were read:—


II. "Some Physical Properties of Nitric Acid Solutions." By V. H. VELEY, F.R.S., and J. J. MANLEY.
"On the Conductivity of Gases under the Becquerel Rays." By the Hon. R. J. Strutt, Fellow of Trinity College, Cambridge. Communicated by Lord Rayleigh, F.R.S. Received December 15, 1900,—Read February 21, 1901.

(Abstract)

This paper gives an account of experiments on the relative conductivities of gases under the action of Becquerel radiation from various radio-active bodies.

It is first explained that in order to determine the constants fundamentally involved, the following conditions must be complied with:—

1. The E.M.F. applied to the conducting gas must be great enough to consume all the ions produced by the rays.

2. The pressure of the gas must be low enough to prevent any appreciable fraction of the radiation being absorbed by it.

If this is not so, then the layers of gas nearer the radio-active surface are exposed to stronger radiation than those further from it. The effective strength of the radiation will thus depend on the absorbing power of the gas at the particular pressure, and the observed ratio of the conductivities of two gases at the same pressure will not represent the ratio of their conductivities under radiation of a given strength.

The criterion applied to test whether the absorption was appreciable, was to examine the conductivity at different pressures. The range was ascertained within which the law of approximate proportionality to the pressure held good. In the experiments, care was taken to keep the pressure well within that range.
is, however, a sufficient reason why at a particular stage in the spectrum of such Novae the enhanced lines of certain substances should predominate. Thus, in $\gamma$ Cygni, titanium is most strongly represented by enhanced lines; in $\alpha$ Cygni, iron, chromium, and nickel; in $\beta$ Orionis, silicium and magnesium, and so on. We may thus expect to find the lines of different substances most prominent at different stages in the history of the star.

In the work above referred to I have been assisted as follows:—
The new photographs have been taken by Dr. Lockyer and Messrs. Fowler, Baxandall, Shackleton, Butler, Shaw, and Hodgson. The detailed examination of the photographs has been made by Messrs. Fowler and Baxandall. The visual observations have been chiefly made by Messrs. Fowler and Butler. The photographs have been enlarged and the illustrations for this paper prepared by Sapper Wilkie. To all, my best thanks are due.

March 14, 1901.

Sir WILLIAM HUGGINS, K.C.B., D.C.L., President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read:—

I. "The Action of Magnetised Electrodes upon Electrical Discharge Phenomena in Rarefied Gases." By C. E. S. PHILLIPS. Communicated by Sir W. CROOKES, F.R.S.

II. "The Chemistry of Nerve-degeneration." By Dr. MOTT, F.R.S., and Professor HALLIBURTON, F.R.S.


IV. "On the Preparation of Large Quantities of Tellurium." By E. MATTHEY. Communicated by Sir GEORGE STOKES, Bart., F.R.S.
hoped to have been able to make arrangements for studying both
diseases side by side, but have not yet been able to do so on account
of the disturbed state of South Africa.

March 21, 1901.

Sir WILLIAM HUGGINS, K.C.B., D.C.L., President, in the Chair.

A List of the Presents received was laid on the table, and thanks
ordered for them.

The Croonian Lecture, "Studies in Visual Sensation," was delivered
by Professor C. LLOYD MORGAN, F.R.S.

March 28, 1901.

Mr. TEALL, F.G.S., Vice-President, in the Chair.

A List of the Presents received was laid on the table, and thanks
ordered for them.

The following Papers were read:

I. "On the Arc Spectrum of Vanadium." By Sir N. LOCKYER,
   F.R.S., and F. E. BAXANDALL.

II. "On the Enhanced Lines in the Spectrum of the Chromosphere."
    By Sir N. LOCKYER, F.R.S., and F. E. BAXANDALL.

III. "Further Observations on Nova Persei, No. 2." By Sir N.
     LOCKYER, F.R.S.

IV. "The Growth of Magnetism in Iron under Alternating Magnetic
    Force." By Professor ERNEST WILSON. Communicated by
    Professor J. M. THOMSON, F.R.S.

V. "On the Electrical Conductivity of Air and Salt Vapours." By
    Dr. H. A. WILSON. Communicated by Professor J. J. THOM-
    SON, F.R.S.

The Society adjourned over the Easter Recess to Thursday, May 2.
May 2, 1901.

Sir WILLIAM HUGGINS, K.C.B., D.C.L., President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

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

Alcock, Professor Alfred William, M.B.  
Dyson, Frank Watson, M.A.  
Evans, Arthur John, M.A.  
Gregory, Professor John Walter, D.Sc.  
Jackson, Henry Bradwardine, Captain, R.N.  
Macdonald, Hector Munro, M.A.  
Mansergh, James, M.Inst.C.E.  
Martin, Prof. Charles James, M.B.  
Ross, Ronald, Major (I.M.S., retired).  
Schlich, Professor William, C.I.E.  
Smithells, Professor Arthur, B.Sc.  
Thomas, Michael R. Oldfield, F.Z.S.  
Watson, William, B.Sc.  
Whetham, William C. Dampier, M.A.  
Woodward, Arthur Smith, F.G.S.

The following Papers were read:—

I. “On the Variation in Gradation of a Developed Photographic Image when impressed by Monochromatic Light of different Wave-lengths.” By Sir W. de W. ABNEY, K.C.B., F.R.S.

II. “Ellipsoidal Harmonic Analysis.” By G. H. DARWIN, F.R.S.

III. “On the Small Vertical Movements of a Stone laid on the Surface of the Ground.” By HORACE DARWIN. Communicated by CLEMENT REID, F.R.S.

“Ellipsoidal Harmonic Analysis.” By G. H. DARWIN, F.R.S., Plumian Professor and Fellow of Trinity College in the University of Cambridge. Received March 23,—Read May 2, 1901.

(Abstract.)

Lamé's functions have been used in many investigations, but the form in which they have been presented has always been such as to render numerical calculation so difficult as to be practically impossible. The object of this paper is to remove the imperfection in question by
Meeting for Discussion, May 9, 1901.

1·54 inches. This will perhaps partially explain the slow movement at the end of the experiment.

The curve, Fig. 4, shows the movement due to frost. It is constructed as before, and the ordinates represent the position of the stone magnified 8 times. On February 2, at 12.45 p.m., the thaw was beginning, but the ground was still hard; readings were also taken at 3.25 p.m. and 5.25 p.m. The stone fell 2·37 mm. in 4 hours 40 minutes.

May 9, 1901.

Meeting for Discussion.

Sir WILLIAM HUGGINS, K.C.B., D.C.L., President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

Professor Franz von Leydig was balloted for and elected a Foreign Member of the Society.

The President stated from the Chair that the meeting was convened in pursuance of the following resolution of the Council, passed at their meeting on February 21, viz. :-“That a special meeting of the Fellows be called in order that the President and Council may have an opportunity of hearing the views of the Fellows on the questions raised in the Report of the British Academy Committee, it being understood that no vote will be taken.”

The Report under reference was laid before the meeting, and a discussion ensued, in which the following Fellows took part :-Sir Norman Lockyer, Dr. Johnstone Stoney, Professor A. R. Forsyth, Professor S. P. Thompson, Professor E. Ray Lankester, Sir John Evans, Professor A. Schuster, the Right Hon. J. Bryce, Professor J. D. Everett, Sir Henry Howorth, Sir A. Geikie, Dr. J. H. Gladstone, and Mr. G. J. Burch.
May 23, 1901.

Sir WILLIAM HUGGINS, K.C.B., D.C.L., President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

Professor James Gordon MacGregor was admitted into the Society.

The following Papers were read:—

I. "On the Presence of a Glycolytic Enzyme in Muscle." By Sir LAUNDER BRUNTON, F.R.S., and HERBERT RHODES.

II. "On Negative After-images and their Relation to certain other Visual Phenomena." By S. BIDWELL, F.R.S.


IV. "A Comparative Crystallographical Study of the Double Selenates of the Series R₂M(SeO₄)₂,6H₂O.—Salts in which M is Magnesium." By A. E. TUXTON, F.R.S.

V. "On the Intimate Structure of Crystals. Part V.—Cubic Crystals with Octahedral Cleavage." By Professor W. J. SOLLAS, F.R.S.

VI. "Preliminary Statement on the Prothalii of Ophioglossum pendulum, L., Helminthostachys zeylanica, Hook., and Psilotum sp." By Dr. W. H. LANG. Communicated by Professor BOWER, F.R.S.

The Society adjourned over the Whitsuntide Recess to Thursday, June 6.

"On Negative After-images, and their Relation to certain other Visual Phenomena." By SHELFORD BIDWELL, M.A., Sc.D., F.R.S. Received May 1,—Read May 23, 1901.

I. Preliminary.

In a former communication I described a curious phenomenon due to the formation of negative after-images following brief retinal excitation after a period of darkness.* The effect is conveniently demonstrated by the aid of a disc, partly black and partly white,

June 6, 1901.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read:—


II. “On Skin Currents. Part I.—The Frog’s Skin.” By Dr. A. D. Waller, F.R.S.

III. “Vibrations of Rifle Barrels.” By A. Mallock. Communicated by Lord Rayleigh, F.R.S.


VI. “Thermal Adjustment and Respiratory Exchange in Monotremes and Marsupials: a Study in the Development of Homo-thermism.” By Professor C. J. Martin. Communicated by E. H. Starling, F.R.S.


“Vibrations of Rifle Barrels.”* By A. Mallock. Communicated by Lord Rayleigh, F.R.S. Received May 2,—Read June 6, 1901.

It has long been known that a shot fired from a rifle does not in general start from the muzzle in the direction occupied by the axis of the barrel at the first moment of ignition of the charge.

* The greater part of the notes from which this paper is drawn were made in 1898, but since that time the interesting experiments of Messrs. Cranz and Koch, of Stuttgart, on the same subject have been published, and I have looked through my notes again and put them in their present form, as it may be of some interest to compare results obtained in such different ways.
about by the use of liquid air. A body like sulphide of zinc cooled to 21° absolute and exposed to light shows brilliant phosphorescence on the temperature being allowed to rise. Bodies like radium that exhibit self-luminosity in the dark, cooled in liquid hydrogen maintain their luminosity unimpaired. Photographic action is still active although it is reduced to about half the intensity it bears at the temperature of liquid air. Some crystals when placed in liquid hydrogen become for a time self-luminous, on account of the high electric stimulation brought about by the cooling causing actual electric discharges between the crystal molecules. This is very marked with some platino-cyanides and nitrate of uranium. Even cooling such crystals to the temperature of liquid air is sufficient to develop marked electrical and luminous effects.

Considering that both liquid hydrogen and air are highly insulating liquids, the fact of electric discharges taking place under such conditions proves that the electric potential generated by the cooling must be very high. When the cooled crystal is taken out of either liquid and allowed to increase in temperature, the luminosity and electric discharges take place again during the return to the normal temperature. A crystal of nitrate of uranium gets so highly charged electrically that, although its density is 2.8 and that of liquid air about 1, it refuses to sink, sticking to the side of the vacuum vessel and requiring a marked pull on a silk thread, to which it is attached, to displace it. Such a crystal rapidly removes cloudiness from liquid air by attracting all the suspended particles on to its surface. The study of pyro-electricity at low temperatures will solve some very important problems.

During this inquiry I have had the hearty co-operation of Mr. Robert Lennox, to whom my thanks are due, and Mr. J. W. Heath has also given valuable assistance.

June 20, 1901.

Sir WILLIAM HUGGINS, K.C.B., D.C.L., President, in the Chair.

Professor William Schlich and Professor Arthur Smithells were admitted into the Society.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read:—
I. "On the Mathematical Theory of Errors of Judgment, with Special Reference to the Personal Equation." By Professor KARL PEARSON, F.R.S.

II. "Mathematical Contributions to the Theory of Evolution. X.—Supplement to a Memoir on Skew Variation." By Professor KARL PEARSON, F.R.S.

III. "On the Application of Maxwell's Curves to Three-colour Work, with Especial Reference to the Nature of the Inks to be employed, and to the Determination of the Suitable Light-filters." By Dr. R. S. CLAY. Communicated by Sir W. ABNEY, K.C.B., F.R.S.


V. "On the Structure and Affinities of Dipterus, with Notes on the Geological History of the Dipteridinae." By A. C. SEWARD, F.R.S., and Miss E. DALE.


VIII. "The Mechanism of the Electric Arc." By Mrs. H. AYRTON. Communicated by Professor PERRY, F.R.S.

IX. "The Yellow Colouring Matters accompanying Chlorophyll and their Spectroscopic Relations. Part 2." By C. A. SCHUNCK. Communicated by E. SCHUNCK, F.R.S.

X. "Magnetic Observations in Egypt, 1883–1901." By Captain H. G. LYONS. Communicated by Professor RÜCKER, F.R.S.

XI. "A Determination of the Value of the Earth's Magnetic Field in International Units, and a Comparison of the Results with the Value given by the Kew Observatory Standard Instruments." By W. WATSON, F.R.S.

XII. "Virulence of Desiccated Tubercular Sputum." By H. SWITHINBANK. Communicated by Sir H. CRICHTON BROWNE, F.R.S.

XIII. "The Effect of the Temperature of Liquid Air upon the Vitality and Virulence of the Bacillus tuberculosis." By H. SWITHINBANK. Communicated by Sir H. CRICHTON BROWNE, F.R.S.
XIV. "The Fermentation of Urea: a Contribution to the Study of the Chemistry of the Metabolism in Bacteria." By Dr. W. E. Adeney. Communicated by Professor W. N. Hartley, F.R.S.


XVI. "On the Continuity of Effect of Light and Electric Radiation on Matter." By Professor J. C. Bose. Communicated by Lord Rayleigh, F.R.S.

XVII. "On the Similarities between Radiation and Mechanical Strains." By Professor J. C. Bose. Communicated by Lord Rayleigh, F.R.S.

XVIII. "On the Strain Theory of Photographic Action." By J. C. Bose. Communicated by Lord Rayleigh, F.R.S.

XIX. "The Anomalous Dispersion of Sodium Vapour." By Professor R. W. Wood. Communicated by Professor C. V. Boys, F.R.S.

XX. "The Pharmacology of Pseudoaconitine and Japaconitine considered in Relation to that of Aconitine." By Professor J. T. Cash, F.R.S., and Professor W. R. Dunstan, F.R.S.

XXI. "The Pharmacology of Pyraconitine and Methylbenzaconine considered in Relation to that of Aconitine." By Professor J. T. Cash, F.R.S., and Professor W. R. Dunstan, F.R.S.

XXII. "On the Separation of the Least Volatile Gases of Atmospheric Air, and their Spectra." By Professor Liveing, F.R.S., and Professor Dewar, F.R.S.


XXIV. "On the Behaviour of Oxy-haemoglobin, Carbonic Oxide Haemoglobin, Methaemoglobin, and certain of their Derivatives, in the Magnetic Field, with a Preliminary Note on the Electrolysis of the Haemoglobin Compounds." By Professor Gamgee, F.R.S.

XXV. "On the Resistance and Electromotive Forces of the Electric Arc." By W. DuddeU. Communicated by Professor Ayrton, F.R.S.
XXVI. "On the Relation between the Electrical Resistances of Pure Metals and their Molecular Constants." By W. WILLIAMS. Communicated by Professor ANDREW GRAY, F.R.S.

The Society adjourned over the Long Vacation to Thursday, November 21, 1901.

"On the Mathematical Theory of Errors of Judgment, with Special Reference to the Personal Equation." By KARL PEARSON, F.R.S., University College, London. Received April 23,—Read June 20, 1901.

(Abstract.)

In 1896 I, with Dr. Alice Lee and Mr. G. A. Yule, made a series of experiments on the bisection of lines at sight. The object of these experiments was to test a development of the current theory of errors of observation, by which it seemed possible to me to determine the absolute steadiness of judgment of any individual by comparing the relative observations of three (instead of as usual two) observers. As a rule the absolute error of the observer is unknown and unknowable, and I was seeking for a quantitative test of steadiness in judgment to be based on relative judgments. If $\sigma_{01}$ be the standard deviation of the absolute judgments of the first observer, $\sigma_{12}$, $\sigma_{23}$, $\sigma_{31}$ the standard deviations of the relative judgments of the first and second, the second and third, and the third and first observers respectively, then

$$\sigma_{01}^2 = \frac{1}{2} \left( \sigma_{21}^2 + \sigma_{13}^2 - \sigma_{23}^2 \right) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots 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