PROCEEDINGS

OF

THE ROYAL SOCIETY

 \mathbf{OF}

EDINBURGH.

VOL. XIII.

NOVEMBER 1884 to JULY 1886.

EDINBURGH

PRINTED BY NEILL AND COMPANY.

MDCCCLXXXVI.

CONTENTS.

Election of Office-Bearers,
On the Distribution of Energy between colliding Groups of Molecules. By Sir W. Thomson,
cules. By Sir W. Thomson,
On the Dynamics of Reflection and Refraction in the Wave Theory of Light. By the Same,
of Light. By the Same,
,
On Kerr's Discovery regarding the Reflection of Light from a Magnetic Pole. By the Same,
On an Improved Method of Measuring Compressibility. By Pro-
fessor Tait,
On the Theory of the Tides. Part I. By Edward Sang, LL.D., . 4
On the Nature and Significance of the Structure known as Kupffer's
Vesicle in Teleostean Embryos. By Mr J. T. Cunningham,
B.A., 4
The Relations of the Alveolar form of Cleft Palate to the Incisor
Teeth and the Intermaxillary Bones. By Professor Turner, M.B., F.R.S.
Apparent Lines of Force on passing a Current through Water. By Thomas Andrews, F.R.S.E., F.C.S., Wortley Iron Works, near
Sheffield,
A Proof that the Mean Square Relative Velocity of Two Points
whose Velocities are p and q is p^2+q^2 . By Professor Tait, . 21
Note on a Theorem of Clerk-Maxwell. By Professor Tait, 21
Extraordinary Occurrence at House No. 7 York Place, 23
Remarkable Sunrises on December 6th, 8th, and 11th, 1884.
Described by W. E. M'Intosh, Esq.; Lady Mary Baillie of Pol-
kemmet; and Patrick Dudgeon, Esq., 24
Anatomy and Physiology of Patella vulgata. Part I. Anatomy.
By R. J. Harvey Gibson, M.A. Communicated by Professor
Herdman, D.Sc.,
A Theory of Solution. By W. W. J. Nicol, M.A., B.Sc., 27
On the Salinity of the Water in the Firth of Forth. By Hugh
Robert Mill, B.Sc., F.C.S., Scottish Marine Station, Granton,
Edinburgh,
Notes on the Chemical Composition of the Cobalt and Nickel Ores of New Caledonia with some Remarks on the Properties and

iv Contents.

P	ΛGE
Uses of Metallic Nickel and Oxides of Cobalt. By J. B. Read-	65
man, Esq.,	69
Note on a Singular Passage in the <i>Principia</i> . By Professor Tait,	72
The Graphic Analysis of the Kinematics of Rigid-Bar Mechanisms.	
By Professor R. Smith. Communicated by Professor Tait,	78
Note on the Necessity for a Condensation-Nucleus. By Professor	
Tait,	78
President's Address,	80
On Evaporation and Condensation. By Professor Tait,	91
Note on Ectocarpus. By John Rattray, B.Sc. Communicated by	
John Murray, Esq.,	94
Some Remarkable Concretions, collected in the neighbourhood of	
Philadelphia by the Rev. J. M. Macdonald,	94
Preliminary Report on the Cephalopoda collected during the Cruise	
of H.M.S. "Challenger." Part I. The Octopoda. By William	
E. Hoyle, M.A. (Oxon.), M.R.C.S.,	94
On Energy in Vortex Motion. By Sir William Thomson,	114
The Theory of Determinants in the Historical Order of its Develop-	
ment. Part I. Determinants in General (1693-1800). By Dr	
Thomas Muir,	114
On Bipartite Functions. By Dr Thomas Muir,	114
Note on Galois' Theorem regarding the continued Fraction Represen-	
· tations of the Roots of an Equation. By Dr Thomas Muir, .	114
Letter from Professor Michie Smith on the Zodiacal Light, and on	
the Origin of Atmospheric Electricity,	114
On a New Form of Chromotrope. By John Aitken, Esq.,	116
On the Application of the Atometer. By Professor Tait,	116
An Address on the Recent Progress of the Geological Survey of the	
United Kingdom,	117
Hooke's Anticipation of the Kinetic Theory and of Synchronism.	
By Professor Tait,	118
On the Hexagonal System in Crystallography. By Professor Crum	
Brown, ,	118
On the Effect of Temperature on the Compressibility of Water. By	
Professor Tait,	120
Chemico-Physiological Investigations on the Cephalopod Liver, and	
its identity as a true Pancreas. By Dr A. B. Griffiths, Ph.D.,	
F.C.S. (Lond. and Paris), Lecturer on Chemistry and Physics,	
Technical College, Manchester, &c. Communicated by W. E.	
Hoyle, Esq., M.A.,	120
Chromomictors. By John Aitken,	122
On Chlorophyll from the Deep Sea. By W. W. Hartley, F.R.S.,	
Royal College of Science, Dublin,	-130

	AGE
On the Termite as the Tropical Analogue of the Earth-Worm. By Professor Henry Drummond,	137
To the state of th	191
On Peroxides of Zinc, Cadmium, Magnesium, and Aluminium. By J. Gibson, Ph.D., and R.M. Morrison, D.Sc.,	146
On Papers by MM. Haas, Clève, and Lecoy de Boisbaudran, on the	
Production of Peroxides by means of Peroxide of Hydrogen. By	
J. Gibson, Ph.D., and R. M. Morrison, D.Sc.,	152
On Supersaturation. By W. J. Nicol, Esq.,	154
Effect of Pressure on the Temperature of Minimum Compressibility	
of Water. By Professor Tait,	155
Note on the Variation by Pressure of the Melting-Point of Paraffin,	
&c. By W. Peddie, Esq. Communicated by Professor Tait,	155
Note on the Thermal Effects of Tension in Water. By G. N.	
Stewart, Esq. Communicated by Professor Tait,	157
On the Temperature of the Water in the Firth of Forth. By Hugh	
Robert Mill, B.Sc., F.C.S. (Plates VIVII.),	157
The Relations of the Yolk to the Gastrula in Teleostean Embryos.	
By J. T. Cunningham, B.A.,	167
Address by R. T. Omond, Esq., on Two Years' Residence and Work	-0.
at the Ben Nevis Observatory,	171
On Detached Theorems on Circulants. By Thomas Muir, Esq., LL.D.,	
On the Hessian. By Professor Chrystal,	172
On the Distribution of Potential in a Thermo-Electric Circuit, open	114
or closed. By Professor Tait	172
On the Volume of Mixed Liquids. By R. Broom, Chemical Labora-	114
tory, Glasgow University. Communicated by J. T. Bottomley,	
Esq.,	172
The Visual, Grating and Glass-Lens, Solar Spectrum, as observed in	
the Year 1884. By C. Piazzi Smyth, F.R.S.E., Astronomer-Royal	
for Scotland,	174
On Knots. Part III. (Amphicheirals). By Professor Tait,	175
On the Chemistry of Japanese Lacquer. By Hikorokuro Yoshida,	
Chemist to the Imperial Geological Survey of Japan. Communi-	
cated by Hugh Robert Mill, B.Sc.,	175
On Atmospheric Electricity at Dodabetta. By Professor C. Michie	
Smith,	191
Recent Photographs of Stars, described by C. Piazzi Smyth, Astrono-	
mer-Royal for Scotland,	191
On Theories of the Formation of Coral Atolls and Barrier Reefs.	
By John Murray, Ph.D.,	199
Observations on Recent Calcareous Formations of the Solomon	
Group, and their bearing on the Theory of Formation of Coral	
Islands. By H. B. Guppy, M.D., R.N. Communicated by John	
Murray Ph D	199

vi Contents.

PA	GE
Observations, Morphological and Physiological, on Pitchered Insecti-	
, , , , , , , , , , , , , , , , , , , ,	199
Preliminary Note on Observations with Aitken's Thermometer	100
	199
Notes on the For Tribe of Central Africa. By Dr Robert W.	
Felkin, F.R.S.E., F.R.G.S., Fellow of the Anthropological	อกร
, , , , , , , , , , , , , , , , , , , ,	205
On Bisulphide of Carbon Prisms. By Dr Daniel Draper. Communicated by Professor Piazzi Smyth,	266
Vital Relations of Micro-Organisms to Tissue Elements. By G.	
Sims Woodhead, M.D., and Arthur W. Hare, M.B. Communi-	
cated by Professor Turner,	269
The Resistance during Recrystallisation of Fused Salts of the Halo-	
gens compared with some others and Glass. By Thomas Andrews,	
, , , , , , , , , , , , , , , , , , , ,	275
Notice of a Second Specimen of Sowerby's Whale (Mesoplodon	
bidens), from Shetland. By Professor W. Turner, M.B., LL.D.,	
,	279
Preliminary Report on the Cephalopoda collected by H.M.S.	
"Challenger." Part II. The Decapoda. By William E. Hoyle,	
, ,	281
Some Stereoscopic Photographs, &c., by the Astronomer-Royal for Scotland,	310
	311
On the Unifilar Knots with Ten Crossings. By the Rev. T. P.	
	311
•	311
On the Thermal Effects produced, in Solids and in Liquids, by	
sudden large Changes of Pressure. By Messrs H. G. Creelman,	
B.A., and J. Crocket. Communicated by Professor Tait, 3	311
On a Method of Measuring the Resistance of Electrolytes without	
endeavouring to prevent Polarisation. By W. Peddie,	319
Note on the Contraction of the Auricles of the Pig's Heart. By J.	
MacFadyean, M.R.C.V.S., and G. Sims Woodhead, M.D.,	323
On the Heats of Combination of Zinc and Iodine in Presence of	
Water, as determined by the Measurement of the Electromotive	
Force of the Zinc-Iodine Cell. By A. P. Laurie, Esq., B.A.,	
,	328
On Expressions for the Areas of Rectilineal Figures, By A. H.	
	336
On Pritchered Insectivorous Plants. Part II. By J. M. Macfar-	
,	347
Note on the Salinity of the Tay Estuary and of St Andrews Bay.	
	347
Concluding Address by David Milne Home Vice-President.	351

vii

	AGE
Demonstrations of Theorems A, B, C, &c., page 484 of Transactions, Royal Society of Edinburgh, vol. xxxii. By Rev. T. P. Kirkman,	
M.A., F.R.S.,	3 59
On the Twists of Listing and Tait. By the Rev. T. P. Kirkman, M.A., F.R.S.,	363
Election of Office-Bearers,	369
On the Motion of a Liquid within an Ellipsoidal Hollow. By Sir William Thomson,	370
The Sacral Index in Various Races of Mankind. By Professor Sir	
Wm. Turner, M.B., F.R.S.,	378
On a Case of Interlacing Surfaces. By Professor Crum Brown,	382
On the Foundations of the Kinetic Theory of Gases. By Professor	304
Tait,	386
On the Distribution of Temperature in Loch Lomond during the Autumn of 1885. By J. Y. Buchanan, F.R.S.E. (Plate XI.), .	403
On Oceanic Shoals discovered in the s.s. "Dacia" in October 1883. By Mr J. Y. Buchanan. (Plate XII.),	42 8
On the Phylogeny of the Tunicata. By W. A. Herdman, D.Sc., F.L.S.,	
Professor of Natural History in University College, Liverpool, .	444
On Dew. By Mr John Aitken,	446
Observations on the Structure of Lumbricus complanatus, Duges. By Frank E. Beddard, M.A., F.Z.S., Prosector to the Zoological	
Society of London,	451
On the Physical Conditions of Rivers entering a Tidal Sea; from Observations on the Spey. By Hugh Robert Mill, B.Sc., and T. Morton Ritchie, B.Sc. (Plates XIII., XIV., XV.),	460
The Distribution and Significance of Micro-Organisms in Water.	
By Mr A. Wynter Blyth,	485
Notes on Experiments for the Board of Trade, made at the South Foreland Lighthouse by the Trinity House of London on Lighthouse Illuminants, &c. By Thomas Stevenson, Pres. R.S.E.,	200
M.Inst.C.E.,	494
Glories, Halos, and Coronæ seen from Ben Nevis Observatory. Extracts from Log Book. By Mr R. T. Omond. Communicated	5 00
by Professor Tait. (Plate XVI.),	3 00
On a Model of the "Half-Twist Surface." By Professor Crum Brown. (Plate XVII.),	513
On the Linear Section PR of a Knot M_n , which passes through two Crossings P and R, which meets no Edge, and which cuts away a $(3+r)$ -gonal Mesh of M_n . By Rev. Thomas P. Kirkman, M.A.,	514
F.R.S.,	514
Experiments on the Field of a Helmholtz Tangent Galvanometer. By Messrs R. Ellis, C.E.; R. D. Clarkson; and H. Rainy, M.A.	500
(Plate XVIII)	523

viii Contents.

	PAGE
,	527
On the Effect of Pressure on the Maximum Density Point of Water.	
By Professor Tait,	527
Chemical and Microscopical Studies on the Action of Salicylic Acid	
on Ferments. By Dr A. B. Griffiths, F.R.S.E., F.C.S. (Lond.	
and Paris), Lecturer on Chemistry, Technical College, Man-	
chester, &c.,	527
On the Relations between the Densities and the Atomic Weights of the Elements. By Professor Crum Brown,	53 0
Observations on Earth-Currents in Ben Nevis Observatory Telegraph Cable. By Mr H. N. Dickson (Plate XIX.),	53 0
On the Partition of Energy among Groups of Colliding Spheres. By	000
Professor Tait,	537
On Water-Bottles, with the description of a new form of Slip Water-	
Bottle. By Hugh Robert Mill, B.Sc., Scottish Marine Station.	
(Plate XX.),	539
On a Repetition of Berthelot's Experiment on the Tenacity of Water	
and its Adhesion to Glass. By H. Creelman. Communicated by Professor Tait.	546
The Theory of Determinants in the Historical Order of its Develop-	940
ment. By Thomas Muir, M.A., LL.D.,	547
The Formation of the Germinal Layers in Teleostei. By Mr George	
Brook, F.L.S., Lecturer on Comparative Embryology in the	
University of Edinburgh,	590
Account of a Preliminary Experiment on the Thermal Conductivity	
of Ice. By Mr A. Crichton Mitchell. (Plate XXI.),	592
Chemical Affinity and Solution. By Mr W. Durham,	596
On the Reproductive Elements in Myxine glutinosa, L. By J. T.	
Cunningham, B.A.,	596
The Life-History of the Micro-Organisms associated with Variola	,
and Vaccinia: An Abstract of Results obtained from a Study of	:
Small-Pox and Vaccination in the Surgical Laboratory of the	
University of Edinburgh. By J. B. Buist, M.D., F.R.C.P.	
Edinburgh,	603
On the probable Heats of Formation of Zinc-Copper Alloys. By	
Mr A. P. Laurie,	621
On the Mean Free Paths in a mixture of Two Systems of Spheres	
By Professor Tait,	621
On Two Shrunk Human Heads from South America. By Professor Duns, D.D.,	621
On the Magnitude of the Mutual Attraction between Two Pieces of	î
Matter at Distances of less than Ten Micromillimetres. By Sin	
William Thomson, Hon. V.P.,	625
On a Theorem in the Science of Situation. By Professor Tait,	625
On Radiation from Snow. By Mr John Aitken,	625

Contents. ix

	AGE
Comparison of the Volumes of Saline Solutions with the Sums of	
the Volumes of the Constituents. By J. Holms Pollok, Chemical	
Laboratory, Glasgow University. Communicated by Sir William	
Thomson. (Plate XXII.),	626
On the Increase of Electrolytic Polarisation with Time. By Mr W.	
Peddie,	628
,	632
· · · · · · · · · · · · · · · · · · ·	002
strong Atkinson, M.B., C.M., Assistant to the Professor of Materia	0.40
Medica in the University of Edinburgh,	642
The Absolute Determination of the Strength of an Electric Current	
	650
On the Nature of the Relationship between Urea-Formation and	
Bile Secretion. By D. Noël Paton, M.B., C.M.,	655
Note on the Collision of Elastic Spheres. By Professor Tait,	655
On some Variations in the Structure of Wool and other Allied	
Fibres. By F. H. Bowman, D.Sc., F.R.S.E., F.L.S., F.C.S., &c.	
(Plate XXIV.),	657
	001
On the Comparison of the Intensity of Gravity at different Stations.	2-0
By Professor Tait,	672
On the Reproductive Organs in the Genus Eudrilus, E.P. By	
Frank E. Beddard, M.A., F.Z.S., Prosector to the Geological	
Society of London. (Plate XXV.),	672
On a new form of Portable Spring Balance for the Measurement of	
Terrestrial Gravity. By Sir W. Thomson,	683
Measurements of the Electro-Motive Force of a Constant Voltaic	
	686
Note on the Formation of the Hectocotylus in Rossia. By W. E.	
	686
0 0	686
On Alterations in the Electric Conducting Power of Alloys at their	
Melting Point. By Harry Rainy, M.A., and R. D. Clarkson,	
· //	686
Examples upon the Reading of the Circle or Circles of a Knot. By	
the Rev. Thomas Kirkman, M.A., F.R.S.,	693
Notes on the Waganda Tribe of Central Africa. By Robert W.	
Felkin, M.D., F.R.G.S., Fellow of the Anthropological Societies	
	699
On the Drainage Areas of Continents, and their Relation to Oceanic	
	770
= · · · · · · · · · · · · · · · · · · ·	110
On the Vitality of the Spores of Parasitic Fungi, and the Antiseptic	
1 ,	771
The Action of Benzoylecgonin. By Ralph Stockman, M.D., Assis-	
tant to the Professor of Materia Medica. University of Edinburgh.	771

 \mathbf{x}

	AGE
Laws of Solution. By William Durham,	779
On the Fructification of some Ferns from the Carboniferous	
Formation. By R. Kidston, F.G.S. Communicated by Dr	
Traquair,	783
On the Tidal Variation of Salinity and Temperature in the Estuary	
of the Forth. By Hugh Robert Mill, D.Sc., and J. T. Morrison,	
M.A., of the Scottish Marine Station. (Plate XXVIII.) .	790
On a New Method and Reagent for detecting Chlorides, Bromides, and Iodides, in the presence of each other, and also in presence of Nitrates and Chlorides. By John Jas. Barlow, Manchester	799
	100
, 1	803
History and Theory of Spermatogenesis. By Patrick Geddes and J. Arthur Thomson. (Plate XXIX.),	803
On Tungsten. By John Waddell, D.Sc. Communicated by Dr	
Crum Brown,	823
On Certain Theorems mainly connected with Alternants. By A. H.	
Anglin, M.A., LL.B., F.R.S. (Edin.), &c.,	823
The Diurnal Variation in the Direction of the Summer Winds on	
Ben Nevis. By R. T. Omond, Superintemdent, Ben Nevis Obser-	
vatory,	839
The Meteorology of Ben Nevis. By Alex. Buchan, M.A., .	843
On some Algoid Lake-Balls found in South Uist. By G. W. W.	845
The Duration of the Life of Red Blood Corpuscles, as ascertainable	0.20
by Transfusion. By William Hunter, M.D. (Edin.), late President	849
The Electric Resistance of Nickel at High Temperatures. By Pro-	0.10
	856
·	000
Effect of External Forces on a System of Colliding Spheres. By Professor Tait,	856
Notes on the Characters and Mode of Formation of the Coral Reefs	
of the Solomon Islands, being the Results of Observations made in	
1882-84, by H. B. Guppy, M.B., F.G.S., during the Surveying Cruise of H.M.S. "Lark,"	857
The Eggs and Early Stages of some Teleosteans. By J. T. Cunning-	
	904
The Reproductive Organs of Bdellostoma, and a Teleostean Egg from	
the West Coast of Africa. By the same,	904
A Synthetic Outline of the History of Biology. By Patrick Geddes,	
Theory of Growth, Reproduction, Sex, and Heredity. By Patrick	004
Geddes,	911

хi

On the Colours of Thin Plates. By the Right Hon. Lord Rayleigh, 93	
Jeber Algebraische Knoten. By Professor Dr Fr. Meyer of Tübingen. Communicated by Professor Tait. (Plates XXXI	
XXXII.),	31
On Amagat's Manomètre à Pistons libres. By Professor Tait, 94	17
In the Electrical Properties of Hydrogenised Palladium. By Pro-	
fessor Knott,	17
Electro-Chemical Reactions between Metals and Fused Salts. By	
Thomas Andrews, F.C.S.,	7
On the Hygrometry of Ben Nevis and of the Scottish Marine Station. By H. N. Dickson, Esq. Communicated by Professor	
Tait,	0
The Temperature of Loch Lomond and Loch Katrine during Winter and Spring. By J. T. Morrison, B.Sc. Communicated by Dr J.	
Murray,	1
Note on the Surface Temperature near a Tidal Race. By the same, 96	1
Further Remarks on Dew. By John Aitken, Esq., 96	1
The Nature of the Objective Cause of Sensation. Part II., Taste.	
By Professor J. B. Haycraft,	1
Review of the Session. By the Chairman,	5
Donations to the Library,	9
ndex,	1