

**CAMBRIDGE: PRINTED BY
W. LEWIS, M.A.
AT THE UNIVERSITY PRESS**

PROCEEDINGS
OF THE
CAMBRIDGE PHILOSOPHICAL SOCIETY
VOLUME 27

**CAMBRIDGE: PRINTED BY
W. LEWIS, M. A.
AT THE UNIVERSITY PRESS**

PROCEEDINGS
OF THE
CAMBRIDGE PHILOSOPHICAL
SOCIETY

VOLUME 27

1 OCTOBER 1930—30 SEPTEMBER 1931

CAMBRIDGE
AT THE UNIVERSITY PRESS
AND SOLD BY
DEIGHTON, BELL & CO., LTD., AND BOWES & BOWES, CAMBRIDGE
CAMBRIDGE UNIVERSITY PRESS, FETTER LANE, LONDON, E.C. 4

1931

First printed in Great Britain at the University Press, Cambridge
Reprinted by offset-litho
by Lund Humphries and Co. Ltd., Bradford

PRINTED IN GREAT BRITAIN

CONTENTS

VOL. 27

	PAGE
Archbold, J. W. Cremona transformations in four dimensions	502
Arnot, F. L. Note on the angular scattering of electrons in gases	73
Ayres, W. L. Note on a property of continuous arcs	543
Babbage, D. W. A series of rational loci with one apparent double point	399
— Involutions of pairs of points in three dimensions determined by cubic surfaces	404
Bailey, W. N. Some series and integrals involving associated Legendre functions, I, II	184, 381
Brahmachari, I. Some advances towards a purely geometrical justification of the use of unreal elements in projective geometry	306
Bramhall, E. H. Recombination of ions in the normal arc	421
Bruyne, N. A. de and Webster, H. C. Note on the use of a thyratron with a Geiger counter	113
Bullard, E. C. and Moon, P. B. A mechanical method for the solution of second-order linear differential equations	546
Burnett, D. The propagation of radio waves in an ionised atmosphere	578
Coxeter, H. S. M. The densities of the regular polytopes	201
Darwin, C. G. The diamagnetism of the free electron	86
Dirac, P. A. M. Note on the interpretation of the density matrix in the many-electron problem	240
Eddington, A. S. Preliminary note on the masses of the electron, the proton, and the universe	15
Elliott, H. H. and Ellis, C. D. The weak lines in the natural β -ray spectrum of radium C	277
Ellis, C. D. and Elliott, H. H. The weak lines in the natural β -ray spectrum of radium C	277
Feather, N. Concerning the success of the absorption method of investigating the high velocity limits of continuous β -ray spectra	430
Fowler, R. H. and Powell, F. C. A note on ferromagnetism	280
Frame, J. W. On the mathematical equivalence of two ways of regarding the excitation of an atom by a fast moving α -particle	511
Gray, L. H. The photoelectric absorption of gamma rays	103
Haldane, J. B. S. A mathematical theory of natural and artificial selection. Part VII, Part VIII	131, 137

	PAGE
Hartree, D. R. The propagation of electromagnetic waves in a refracting medium in a magnetic field	143
Hassé, H. R. The calculation of the van der Waal forces for hydrogen and helium at large inter-atomic distances	66
Ingram, W. H. Note on the operability of a synchronous motor at the end of a transmission line	244
Lennard-Jones, J. E. Wave functions of many-electron atoms	469
Massey, H. S. W. The theory of the scattering of short X-rays by molecular hydrogen	77
— The triatomic hydrogen ion H_3^+	451
— The theory of the extraction of electrons from metals by metastable atoms, II	460
Milne-Thomson, L. M. On the operational solution of linear finite difference equations	26
Moon, P. B. The action of positive ions of caesium on a hot nickel surface	570
— and Bullard, E. O. A mechanical method for the solution of second-order linear differential equations	546
Mordell, L. J. Some applications of Fourier series in the analytic theory of numbers. Corrigenda	25
Mott, N. F. On the influence of radiative forces on the scattering of electrons	255
— On the theory of excitation by collision with heavy particles	553
Newman, M. H. A. On Abelian continuous groups	387
— Intersection complexes, I. Combinatory theory	491
Oppenheim, A. Note on some linear Diophantine inequalities	24
Pocklington, H. C. Two dynamical applications of quaternion analysis	391
Powell, F. C. A note on magnetostriction in single crystals of iron and nickel	561
— and Fowler, R. H. A note on ferromagnetism	280
Pringle, G. E. and Van Praagh, G. On the desorption of gases from the walls of a closed system in which the pressure is independently changing	250
Ratcliffe, J. A. The absorption of energy by a wireless aerial	588
Robinson, G. de B. On the orthogonal groups in four dimensions	37
Room, T. G. Some relations connecting the freedoms of manifolds	518
Roth, L. Some properties of line congruences	190
Steen, S. W. P. The packing of certain sets of cubes	57
Todd, J. A. The groups of symmetries of the regular polytopes	212
— On the determination of plane curves by means of assigned singularities	291
— Some enumerative results for elliptic quartic curves	538
Van Praagh, G. and Pringle, G. E. On the desorption of gases from the walls of a closed system in which the pressure is independently changing	250

Contents

vii

	PAGE
Vedy, L. G. On the rotation of dielectrics in electrostatic fields and related phenomena	91
— and Wilkins, A. F. A portable apparatus for measuring the magnetic field strength in an electromagnetic wave	481
Verblunsky, S. Note on continuous functionals	49
— The symmetric derivative and its application to the theory of trigonometric series	163
— On summable trigonometric integrals	174
— Note on the Gibbs phenomenon, II	393
Webster, H. C. The capture of electrons by α -particles	116
— and Bruyne, N. A. de. Note on the use of a thyratron with a Geiger counter	113
Welchman, W. G. On elliptic quartic curves with assigned points and chords	20
White, E. L. C. A method of continuous observation of the equivalent height of the Kennelly-Heaviside layer	445
White, F. W. G. A theoretical discussion of the electrical properties of the soil	268
Wilkins, A. F. and Vedy, L. G. A portable apparatus for measuring the magnetic field strength in an electromagnetic wave	481
Young, L. C. On the combinatory scheme of analysis	232
Young, R. C. On many-valued Riemann-Stieltjes integration, I, II. 326, 345	
Yule, G. U. In memory of the Rev. William Cecil	1
Proceedings at the Meetings held during the Session 1930-1931	593
Accounts, statement of, for 1930	602

PLATE

Plate I. To illustrate Mr E. L. C. White's paper	450
--	-----

Transactions of the Cambridge Philosophical Society

RECENT PAPERS

Vol. XXII.

- No. XXVI. **The Escape of Molecules from an Atmosphere, with special reference to the Boundary of a Gaseous Star.** By E. A. MILNE, M.A., Trinity College, Cambridge. Pp. 35. Price 5/-.
- „ XXVII. **Some Problems of Diophantine Approximation: The Analytical Properties of Certain Dirichlet's Series Associated with the Distribution of Numbers to Modulus Unity.** By G. H. HARDY, M.A., Savilian Professor, University of Oxford, and J. E. LITTLEWOOD, M.A., Trinity College, Cambridge. Pp. 16. Price 3/6.
- „ XXVIII. **Free Paths in a Non-uniform Rarefied Gas with an Application to the Escape of Molecules from Isothermal Atmospheres.** By J. E. JONES, 1851 Exhibition Senior Research Student, Trinity College, Cambridge. Pp. 22. With Title-page and Index to Vol. XXII. Price 5/6.

Vol. XXIII.

- No. I. **On Approximate Continuity.** By M. H. A. NEWMAN, B.A., St John's College, Cambridge. Pp. 18. Price 3/6.
- „ II. **A Mathematical Theory of Natural and Artificial Selection.** By J. B. S. HALDANE, M.A., Trinity College, Cambridge. Pp. 23. Price 4/-.
- „ III. **On the Form of the Solution of the Equations of Dynamics.** By T. M. CHERRY, B.A., Trinity College, Isaac Newton Student. Pp. 28. Price 4/-.
- „ IV. **On the Motion of Spheres, Circular and Elliptic Cylinders through Viscous Liquid.** By W. J. HARRISON, M.A., Clare College, Cambridge. Pp. 18. Price 3/-.
- „ V. **Researches in the Theory of Determinants.** By Major P. A. MACMAHON, R.A., F.R.S. Pp. 47. 7/-.
- „ VI. **The Optical Constants of Matter.** By C. G. DARWIN, M.A., F.R.S., Christ's College, Tait Professor of Natural Philosophy in the University of Edinburgh. Pp. 31. Price 5/-.
- „ VII. **Some Examples of Trajectories Defined by Differential Equations of a Generalised Dynamical Type.** By T. M. CHERRY, Ph.D., Fellow of Trinity College, Cambridge. Pp. 32. Price 5/-.
- „ VIII. **Some Formulae for Scrolls and Line Systems in Ordinary Space.** By C. G. F. JAMES, Trinity College, Cambridge. Pp. 34. Price 6/-.
- „ IX. **The Aberrations of a Symmetrical Optical System.** By G. C. STEWARD, M.A., Fellow of Emmanuel College, Cambridge. Pp. 29. Price 5/-.
- „ X. **The Linear Invariants of Ten Quaternary Quadrics.** By H. W. TURNBULL, M.A., Trinity College, Professor of Mathematics in the University of St Andrews, and ALFRED YOUNG, Sc.D., sometime Fellow of Clare College. Pp. 39. Price 6/-.
- „ XI. **Mathieu Functions.** By S. GOLDSTEIN, B.A., St John's College. Pp. 34. Price 6/-.
- „ XII. **The Mathematical Theory of the Statistical Methods employed in the Study of Correlation in the case of Three Variables.** By A. A. TSCHUPROW. Translated by L. ISSERLIS, M.A., Christ's College. Pp. 46. Price 7/-.

CONTENTS

	PAGE
<i>Intersection-complexes. I. Combinatory theory.</i> By Mr M. H. A. NEWMAN, St John's College	491
<i>Cremona transformations in four dimensions.</i> By J. W. ARCHBOLD, B.A., St John's College	502
<i>On the mathematical equivalence of two ways of regarding the excitation of an atom by a fast moving α-particle.</i> By J. W. FRAME, B.A., Pembroke College. (Communicated by Mr N. F. MOTT)	511
<i>Some relations connecting the freedoms of manifolds.</i> By Mr T. G. ROOM, St John's College	518
<i>Some enumerative results for elliptic quartic curves.</i> By J. A. TODD, B.A., Trinity College. (Communicated by Professor H. F. BAKER)	538
<i>Note on a property of continuous arcs.</i> By W. L. AYRES, Ph.D., University of Michigan. (Communicated by Mr F. P. WHITE)	543
<i>A mechanical method for the solution of second-order linear differential equations.</i> By E. C. BULLARD, B.A., Clare College, and P. B. MOON, B.A., Sidney Sussex College. (With Two Text-figures).	546
<i>On the theory of excitation by collision with heavy particles.</i> By Mr N. F. MOTT, Gonville and Caius College	553
<i>A note on magnetostriction in single crystals of iron and nickel.</i> By F. C. POWELL, B.A., Gonville and Caius College	561
<i>The action of positive ions of caesium on a hot nickel surface.</i> By P. B. MOON, B.A., Sidney Sussex College. (With Five Text-figures)	570
<i>The propagation of radio waves in an ionised atmosphere.</i> By D. BURNETT, M.A., Ph.D., Clare College	578
<i>The absorption of energy by a wireless aerial.</i> By Mr J. A. RATCLIFFE, Sidney Sussex College	588
Proceedings at the Meetings held during the Session 1930—1931	593
Statement of Accounts of the Cambridge Philosophical Society, from January 1, 1930, to December 31, 1930	602