

*Proceedings of the*  
CAMBRIDGE PHILOSOPHICAL  
SOCIETY

(MATHEMATICAL AND PHYSICAL SCIENCES)

VOLUME 57

CAMBRIDGE  
AT THE UNIVERSITY PRESS  
1961

PUBLISHED BY  
THE SYNDICS OF THE CAMBRIDGE UNIVERSITY PRESS  
Bentley House, 200 Euston Road, London, N.W. 1  
American Branch: 32 East 57th Street, New York 22, N.Y.

*Printed in Great Britain at the University Press, Cambridge  
(Brooke Crutchley, University Printer)*

## CONTENTS

	PAGE
<b>Adams, J. F.</b> A finiteness theorem in homological algebra . . . . .	31
<b>Adams, J. F.</b> On Chern characters and the structure of the unitary group . . . . .	189
<b>Afzal Ahmad and Lakshminikanth, V.</b> On self-reciprocal functions for Fourier-Bessel integral transforms . . . . .	778
<b>Åkerberg, B.</b> A variant on the proofs of some inequalities. ( <i>Research note</i> ) . . . . .	184
<b>Åkerberg, B.</b> Proof of Poisson's formula. ( <i>Research note</i> ) . . . . .	186
<b>Albasiny, E. L.</b> The use of associated Legendre polynomials for interpolation . . . . .	288
<b>Arthurs, A. M.</b> The mathematical equivalence of the Born approximation and the method of impact parameters. ( <i>Research note</i> ) . . . . .	904
<b>Atiyah, M. F.</b> Bordism and cobordism . . . . .	200
<b>Atiyah, M. F. and Hirzebruch, F.</b> Bott periodicity and the parallelizability of the spheres . . . . .	223
<b>Bagley, R. W.</b> A characterization of compact regular spaces. ( <i>Research note</i> ) . . . . .	430
<b>Baines, M. J.</b> Transport properties of thin metallic films . . . . .	606
<b>Bartlett, M. S.</b> Equations for stochastic path integrals . . . . .	568
<b>Bassali, W. A. and Hanna, N. O. M.</b> Bending of curvilinear and rectilinear polygonal plates symmetrically loaded over a concentric circle . . . . .	166
<b>Bastin, E. W.</b> The idea of size in large-scale physics . . . . .	848
<b>Bennett, B. M.</b> On a certain multivariate non-normal distribution. ( <i>Research note</i> ) . . . . .	434
<b>Besicovitch, A. S.</b> On diagonal values of probability vectors of infinitely many components . . . . .	759
<b>Bhargava, R. D.</b> ( <i>Joint author</i> ). Two-dimensional elastic inclusion problems . . . . .	669
<b>Bickley, W. G. and McNamee, J.</b> Eigenvalues and eigenfunctions of finite-difference operators . . . . .	532
<b>Birch, B. J.</b> Waring's problem in algebraic number fields . . . . .	449
<b>Brearley, M. N.</b> The motion of a biased bowl with perturbing projection conditions . . . . .	131
<b>Brearley, M. N.</b> The number of real zeros of the solution of a linear homogeneous differential equation. ( <i>Research note</i> ) . . . . .	693
<b>Browder, W.</b> Some additive cohomology operations which are not suspensions . . . . .	50
<b>Burgess, D. C. J.</b> Note on the preceding paper (McFadden, R. and Schneider, H. Completely simple and inverse semigroups.) . . . . .	237
<b>Burkill, H.</b> On Riesz and Riemann summability . . . . .	55
<b>Caldow, G. L. and Coulson, C. A.</b> Lower-bound energies and the virial theorem in wave mechanics . . . . .	341
<b>Capildeo, R.</b> The kinematics of inertial frames . . . . .	321
<b>Cassels, J. W. S.</b> On the equation $a^x - b^y = 1$ . II. ( <i>Corrigendum</i> ) . . . . .	187
<b>Cassels, J. W. S.</b> Note on quadratic forms over the rational field. ( <i>Addendum</i> ) . . . . .	697
<b>Clemmow, P. C.</b> An infinite Legendre integral transform and its inverse . . . . .	547
<b>Cohen, D. E.</b> On the Adem relations . . . . .	265
<b>Cohen, M. and Coulson, C. A.</b> Single-centre expansions for the hydrogen molecular ion . . . . .	96
<b>Cohn, P. M.</b> On a generalization of the Euclidean algorithm . . . . .	18
<b>Cole, A. J. and Swierczkowski, S.</b> On a class of non-measurable groups . . . . .	227

	PAGE
<b>Collins, W. D.</b> On some dual series equations and their applications to electrostatic problems for spheroidal caps . . . . .	367
<b>Collins, W. D.</b> Note on an electrified circular disk situated inside an earthed coaxial infinite hollow cylinder . . . . .	623
<b>Coppel, W. A.</b> Note on an equation of boundary-layer theory. ( <i>Research note</i> ) . . . . .	696
<b>Corner, A. L. S.</b> A note on rank and direct decompositions of torsion-free Abelian groups . . . . .	230
<b>Coulson, C. A.</b> ( <i>Joint author</i> ). Single-centre expansions for the hydrogen molecular ion	96
<b>Coulson, C. A.</b> ( <i>Joint author</i> ). Lower-bound energies and the virial theorem in wave mechanics . . . . .	341
<b>Croft, H. T.</b> A problem on tangents to a sphere. ( <i>Research note</i> ) . . . . .	685
<b>Croft, H. T.</b> and <b>Fowler, M.</b> On a problem of Steinhaus about polygons. ( <i>Research note</i> ) . . . . .	686
<b>Curtis, M. L.</b> Shrinking continua in 3-space. ( <i>Research note</i> ) . . . . .	432
<b>Diananda, P. H.</b> On a theorem of Mordell. ( <i>Research note</i> ) . . . . .	682
<b>Douglas, A. J.</b> A homological characterization of certain Abelian groups . . . . .	256
<b>Elliott, D.</b> A method for the numerical integration of the one-dimensional heat equation using Chebyshev series . . . . .	823
<b>Erdős, P.</b> and <b>Taylor, S. J.</b> On the Hausdorff measure of Brownian paths in the plane	209
<b>Fisher, M. E.</b> and <b>Zucker, I. J.</b> On a non-linear differential equation for the zero-point energies of the rare gas solids . . . . .	107
<b>Fowler, M.</b> ( <i>Joint author</i> ). On a problem of Steinhaus about polygons. ( <i>Research note</i> )	686
<b>Fox, C.</b> Power series with non-integral exponents which are Fourier kernels . . . . .	274
<b>Foxley, E.</b> Testing the independence of a system of axioms, using a logical computer	443
<b>Friedman, B.</b> Eigenvalues of composite matrices . . . . .	37
<b>Gabriel, J. R.</b> On the construction of irreducible representations of the symmetric group . . . . .	330
<b>Ganea, T.</b> ( <i>Joint author</i> ). Topological embeddings of lens spaces. ( <i>Research note</i> ) . . . . .	688
<b>Gangadharan, K. S.</b> Two classical lattice point problems . . . . .	699
<b>Garstang, R. H.</b> Mutual magnetic interactions and oscillator strengths in the first spectrum of oxygen . . . . .	115
<b>Gheorghita, St. I.</b> The marginal stability in porous inhomogeneous media . . . . .	871
<b>Gillis, J.</b> Stability of a column of rotating viscous liquid . . . . .	152
<b>Godwin, H. J.</b> The determination of the class-numbers of totally real cubic fields . . . . .	728
<b>Greve, W.</b> A geometrical model for the real number field . . . . .	722
<b>Hammersley, J. M.</b> The number of polygons on a lattice . . . . .	516
<b>Hammersley, J. M.</b> A short proof of the Farahat-Mirsky refinement of Birkhoff's theorem on doubly stochastic matrices. ( <i>Research note</i> ) . . . . .	681
<b>Hanna, N. O. M.</b> ( <i>Joint author</i> ). Bending of curvilinear and rectilinear polygonal plates symmetrically loaded over a concentric circle . . . . .	166
<b>Hannan, E. J.</b> A central limit theorem for systems of regressions . . . . .	583
<b>Hardie, K. A.</b> Note on the Hopf-James invariants . . . . .	746
<b>Helliwell, J. B.</b> Unsymmetrical flow patterns past a finite wedge profile in a high subsonic stream . . . . .	401
<b>Hilton, P. J.</b> Note on the Jacobi identity for Whitehead products. ( <i>Research note</i> ) . . . . .	180
<b>Hilton, P. J.</b> and <b>Rees, D.</b> Natural maps of extension functors and a theorem of R. G. Swan . . . . .	489

## Contents

v

	PAGE
<b>Hirzebruch, F.</b> ( <i>Joint author</i> ). Bott periodicity and the parallelizability of the spheres	223
<b>Hughes, W. F.</b> Relativistic magnetohydrodynamics and irreversible thermodynamics	878
<b>Jaswon, M. A.</b> and <b>Bhargava, R. D.</b> Two-dimensional elastic inclusion problems	669
<b>Johnson, R. E.</b> Ideal extensions in an algebra. ( <i>Research note</i> ) . . . . .	427
<b>Jones, D. S.</b> and <b>Noble, B.</b> The low frequency scattering by a perfectly conducting strip	364
<b>Kelly, G. M.</b> The exactness of Čech homology over a vector space. ( <i>Research note</i> ) . . . . .	428
<b>Kelly, G. M.</b> On manifolds containing a submanifold whose complement is contractible . . . . .	507
<b>Kilmister, C. W.</b> and <b>Newman, D. J.</b> The use of algebraic structures in physics . . . . .	851
<b>Kingman, J. F. C.</b> A mathematical problem in population genetics . . . . .	574
<b>Kingman, J. F. C.</b> The single server queue in heavy traffic. ( <i>Research note</i> ) . . . . .	902
<b>Kshirsagar, A. M.</b> Some extensions of the multivariate <i>t</i> -distribution and the multivariate generalization of the distribution of the regression coefficient . . . . .	80
<b>Kuttner, B.</b> Some theorems on the relation between Riesz and Abel typical means . . . . .	61
<b>Lakshmikanth, V.</b> Some self-reciprocal functions and kernels. ( <i>Research note</i> ) . . . . .	690
<b>Lakshmikanth, V.</b> ( <i>Joint author</i> ). On self-reciprocal functions for Fourier-Bessel integral transforms . . . . .	778
<b>Lebovitz, N. R.</b> The real solutions of a certain non-linear system of equations . . . . .	503
<b>McFadden, R.</b> and <b>Schneider, H.</b> Completely simple and inverse semigroups . . . . .	234
<b>McNamee, J.</b> ( <i>Joint author</i> ). Eigenvalues and eigenfunctions of finite-difference operators . . . . .	532
<b>Meligy, A. S.</b> Expansions of the Poiseuille and the irregular Coulomb functions . . . . .	782
<b>Michael, D. H.</b> Energy considerations in the instability of a current-vortex sheet . . . . .	628
<b>Miller, J. B.</b> On the solution of certain integral equations by generalized functions . . . . .	767
<b>Moran, P. A. P.</b> The survival of a mutant under general conditions . . . . .	304
<b>Moran, P. A. P.</b> Entropy, Markov processes and Boltzmann's <i>H</i> -theorem . . . . .	833
<b>Morris, I.</b> Modular orthogonal groups in four dimensions . . . . .	239
<b>Munn, W. D.</b> Pseudo-inverses in semigroups . . . . .	247
<b>Neuwirth, Lee.</b> An alternative proof of a theorem of Iwasawa on free groups. ( <i>Research note</i> ) . . . . .	895
<b>Newman, D. J.</b> The physical interpretation of entity-structure . . . . .	539
<b>Newman, D. J.</b> ( <i>Joint author</i> ). The use of algebraic structures in physics . . . . .	851
<b>Noble, B.</b> ( <i>Joint author</i> ). The low frequency scattering by a perfectly conducting strip	364
<b>Northcott, D. G.</b> A property of balanced functors . . . . .	268
<b>Northcott, D. G.</b> Simple reduction theorems for extension and torsion functors . . . . .	483
<b>Olagunju, A.</b> A note on closed operators. ( <i>Research note</i> ) . . . . .	426
<b>Olver, F. W. J.</b> Error bounds for the Liouville-Green (or WKB) approximation . . . . .	790
<b>Olver, F. W. J.</b> Two inequalities for parabolic cylinder functions . . . . .	811
<b>Petersen, G. M.</b> Matrices and norms . . . . .	271
<b>Power, E. A.</b> and <b>Saavedra, I.</b> Scattering by a bounded non-linear singularity . . . . .	121
<b>Pringle, G. E.</b> The potential of a circular current . . . . .	385
<b>Radha, T. K.</b> ( <i>Joint author</i> ). Correlation problems in evolutionary stochastic processes . . . . .	843
<b>Ragab, F. M.</b> A series associated with an identity of Orr. ( <i>Research note</i> ) . . . . .	900
<b>Ramakrishnan, A.</b> and <b>Radha, T. K.</b> Correlation problem in evolutionary stochastic processes . . . . .	843
<b>Rankin, R. A.</b> A crystal dislocation problem. ( <i>Research note</i> ) . . . . .	898

	PAGE
<b>Rao, V. V. L. N.</b> Self reciprocal properties of certain functions . . . . .	561
<b>Rees, D.</b> Degree functions in local rings . . . . .	1
<b>Rees, D.</b> $\alpha$ -transforms of local rings and a theorem on multiplicities of ideals . . . . .	8
<b>Rees, D.</b> ( <i>Joint author</i> ). Natural maps of extension functors and a theorem of R. G. Swan . . . . .	489
<b>Reid, W. H.</b> The effects of surface tension and viscosity on the stability of two superposed fluids . . . . .	415
<b>Saavedra, O.</b> ( <i>Joint author</i> ). Scattering by a bounded non-linear singularity . . . . .	121
<b>Salem, L.</b> Some consequences of bond alternation in long polyenes . . . . .	353
<b>Saxena, R. K.</b> A definite integral involving associated Legendre functions of the first kind . . . . .	281
<b>Schneider, H.</b> ( <i>Joint author</i> ). Completely simple and inverse semigroups . . . . .	234
<b>Sciama, D. W.</b> Recurrent radiation in general relativity. ( <i>Research note</i> ) . . . . .	436
<b>Sim, A. C.</b> An asymptotic expansion for Bessel functions derived with respect to their order . . . . .	284
<b>Simons, S.</b> The interaction of longitudinally polarized vibrations in an isotropic dielectric . . . . .	86
<b>Singh, V. N.</b> Ramanujan's continued fraction and the Bauer-Muir transformation . . . . .	76
<b>Smart, D. R.</b> A fixed-point theorem. ( <i>Research note</i> ) . . . . .	430
<b>Hammond Smith, D.</b> Hyperspaces of a CANR* . . . . .	754
<b>Smith, Russell A.</b> A uniqueness theorem concerning gravity fields . . . . .	865
<b>Stasheff, J.</b> On homotopy Abelian $H$ -spaces . . . . .	734
<b>Stephen, M. J.</b> The interaction of nuclear multipole moments with an external charge distribution in elliptic coordinates . . . . .	348
<b>Stone, A. P.</b> Tensor operators under semi-simple groups . . . . .	460
<b>Stone, A. P.</b> Representations of the $n$ -dimensional rotation group . . . . .	469
<b>Swierczkowski, S.</b> ( <i>Joint author</i> ). On a class of non-measurable groups . . . . .	227
<b>Taylor, J. G.</b> A remark on the proof of dispersion relations in quantum field theory. ( <i>Research note</i> ) . . . . .	694
<b>Taylor, S. J.</b> ( <i>Joint author</i> ). On the Hausdorff measure of Brownian paths in the plane . . . . .	209
<b>Taylor, S. J.</b> On the connexion between Hausdorff measures and generalized capacity . . . . .	524
<b>Teh, H.-H.</b> Construction of orders in Abelian groups . . . . .	476
<b>Trustrum, G. B.</b> The correlations between relatives in a random mating diploid population . . . . .	315
<b>Tyrrell, J. A.</b> The Enriques threefold. ( <i>Research note</i> ) . . . . .	897
<b>Ursell, F.</b> The transmission of surface waves under surface obstacles . . . . .	638
<b>Vranceanu, G. and Ganea, T.</b> Topological embeddings of lens spaces. ( <i>Research note</i> ) . . . . .	688
<b>Wall, C. T. C.</b> Rational Euler characteristics. ( <i>Research note</i> ) . . . . .	182
<b>Wall, C. T. C.</b> Resolutions for extensions of groups . . . . .	251
<b>Wall, C. T. C.</b> On the cohomology of certain groups . . . . .	731
<b>Weir, D. G.</b> A family of exact solutions of one-dimensional anisentropic flow . . . . .	890
<b>Williams, W. E.</b> Waves on a sloping beach . . . . .	160
<b>Williams, W. E.</b> Vertex generated waves outside metallic wedges . . . . .	393
<b>Williams, W. E.</b> Properties of the solution of a certain functional equation. ( <i>Research note</i> ) . . . . .	439
<b>Zucker, I. J.</b> ( <i>Joint author</i> ). On a non-linear differential equation for the zero-point energies of the rare gas solids . . . . .	107
<b>Proceedings</b> . . . . .	906
<b>Statement of Accounts</b> . . . . .	910

The following papers have been accepted for publication and will appear shortly:

- DIANANDA, P. H. On non-negative forms in real variables some or all of which are non-negative.
- DIANANDA, P. H. On rearrangement of series.
- GOOD, I. J. A short proof of MacMahon's master theorem.
- MARTIN, J. L. The exact enumeration of self-avoiding walks on a lattice.
- SCOINS, H. I. The number of trees with nodes of alternate parity.
- SANDER, K. F. Solutions of certain finite difference equations connected with Laplace's equation.
- CROFT, H. T. Two problems on convex bodies.
- MITCHELL, ANN F. S. Sufficient statistics and orthogonal parameters.
- MILNE-THOMSON, L. M. Bounds for the torsional rigidity of isotropic beams.
- EGGLESTON, H. G. On covering a regular polygon with a triangle.
- ASPLUND, E., GROSSWALD, E. and GRÜNBAUM, B. On a measure of asymmetry of convex bodies.
- DOUGLAS, A. S. and GARSTANG, R. H. Transition intervals for Si IV and Ca II.
- KARLIN, S. and McGREGOR, J. On a genetics model of Moran.
- MILLER, H. D. A matrix factorization problem in the theory of random variables.
- MILLER, H. D. Absorption probabilities for sums of random variables defined on a finite Markov chain.

CONTENTS OF BIOLOGICAL REVIEWS

Vol. 36, No. 4. November 1961

R. D. HARKNESS. The biological functions of collagen.

E. FAURÉ-FREMIET. Cils vibratiles et flagelles.

R. B. DRYSDALE and A. R. PEACOCKE. The molecular basis of heredity.

## C O N T E N T S

	PAGE
GANGADHARAN, K. S. Two classical lattice point problems . . . . .	699
GREVE, W. A geometrical model for the real number field . . . . .	722
GODWIN, H. J. The determination of the class-numbers of totally real cubic fields . . . . .	728
WALL, C. T. C. On the cohomology of certain groups . . . . .	731
STASHEFF, J. On homotopy Abelian $H$ -spaces . . . . .	734
HARDIE, K. A. Note on the Hopf-James invariants . . . . .	746
HAMMOND SMITH, D. Hyperspaces of a CANR* . . . . .	754
BESICOVITCH, A. S. On diagonal values of probability vectors of infinitely many components . . . . .	759
MILLER, J. B. On the solution of certain integral equations by generalized functions . . . . .	767
AFZAL AHMAD and LAKSHMIKANTH, V. On self-reciprocal functions for Fourier-Bessel integral transforms . . . . .	778
MELIGY, A. S. Expansions of the Poiseuille and the irregular Coulomb functions . . . . .	782
OLVER, F. W. J. Error bounds for the Liouville-Green (or WKB) approximation . . . . .	790
OLVER, F. W. J. Two inequalities for parabolic cylinder functions . . . . .	811
ELLIOTT, D. A method for the numerical integration of the one-dimensional heat equation using Chebyshev series . . . . .	823
MORAN, P. A. P. Entropy, Markov processes and Boltzmann's $H$ -theorem . . . . .	833
RAMAKRISHNAN, A. and RADHA, T. K. Correlation problems in evolutionary stochastic processes . . . . .	843
BASTIN, E. W. The idea of size in large-scale physics . . . . .	848
KILMISTER, C. W. and NEWMAN, D. J. The use of algebraic structures in physics . . . . .	851
SMITH, RUSSELL A. A uniqueness theorem concerning gravity fields . . . . .	865
GHEORGHIȚA, ST. I. The marginal stability in porous inhomogeneous media . . . . .	871
HUGHES, W. F. Relativistic magnetohydrodynamics and irreversible thermodynamics . . . . .	878
WEIR, D. G. A family of exact solutions of one-dimensional anisentropic flow . . . . .	890
RESEARCH NOTES:	
NEUWIRTH, LEE. An alternative proof of a theorem of Iwasawa on free groups . . . . .	895
TYRRELL, J. A. The Enriques threefold . . . . .	897
RANKIN, R. A. A crystal dislocation problem . . . . .	898
RAGAB, F. M. A series associated with an identity of Orr . . . . .	900
KINGMAN, J. F. C. The single server queue in heavy traffic . . . . .	902
ARTHURS, A. M. The mathematical equivalence of the Born approximation and the method of impact parameters . . . . .	904
PROCEEDINGS . . . . .	906
STATEMENT OF ACCOUNTS . . . . .	910

*Printed in Great Britain at the University Press, Cambridge  
(Brooke Crutchley, University Printer)*