

Journal of THE ROYAL AERONAUTICAL SOCIETY

INCORPORATING THE INSTITUTION OF AERONAUTICAL ENGINEERS AND THE HELICOPTER ASSOCIATION OF GREAT BRITAIN

Published Monthly at 4 HAMILTON PLACE, LONDON W1

Telephone: Grosvenor 3515-9 Telegrams: Didaskalos, London, W1

Subscriptions: £10 10s. 0d. per annum, post free Single Copies: 17s. 6d.

Advertisements only: J. W. Williams, DFC, Magazine Advertising Ltd. 36-38 Whitefriars St., London, EC4. Fleet Street 7539

VOLUME 70

FEBRUARY 1966

NUMBER 662

CONTENTS

	Page
Notices	XI
<p>Centenary Banquet: 12th September 1966—Nomination of Candidates for Council—New Year Honours 1966—19th Louis Bleriot Lecture: in Paris—Royal Aeronautical Society Centenary Congress Combined with the 5th Congress of the International Council of the Aeronautical Sciences—Symposium on Management—Lecture on Dr. A. P. Thurston—Symposium on the Impact of Digital Computers on Engineering—Test Pilots' Group Lecture at RAE, Farnborough—Honours Awarded to Members—Acknowledgments—1965 Dorothy Spicer Memorial Award—Centenary Calendar—Royal Aeronautical Society Prizes in Aeronautics: 1965—Royal Aeronautical Society Prize—Centenary of "Engineering"—The January Journal—Imponere Pelio Ossam Scilicet, atque Ossae Frondusum Involvere Olympum—Back Issues of the Journal—Diary—Other Meetings—Ultrasonoscope School—Symposium on High Temperature Problems in Aircraft Design—Presentation to Sir Vernon Brown—XVIIth International Astronautical Congress: Madrid, Spain: 9th-15th October 1966—Elections—5th International Conference on Non-Destructive Testing—The Alan Cobham Prize—News of Members—Lecture Summaries—One Hundred Years Ago.</p>	
The Branches	XIX
Graduates' and Students' Section	XX
The Plowden Report	303
The Well-Balanced Structure	304
<i>Sir Alfred Pugsley</i>	
On the Aerodynamics of "Hangar" Type Engine Test Facilities	312
<i>R. A. Wallis and N. Ruglen</i>	
An Investigation of Hovercraft Wavemaking	321
<i>N. Hogben</i>	
Private Enterprise in British Air Transport	330
<i>F. A. Laker</i>	
A Century of British Aeronautics	
Flight Refuelling	335
<i>C. H. Latimer-Needham</i>	
Instruments and Equipment for Testing	340
<i>A. E. Bingham</i>	
Experiences of Lighter-than-Air.	344
<i>F. A. Best</i>	
A Trial Flight on HMR 33 1919	345
<i>R. W. Potts</i>	
Naval Aircraft	345
<i>G. E. Petty</i>	
The First Ten Years	346
<i>F. M. Green</i>	
Training	347
<i>A. Eadon</i>	
The Good Old Days	349
<i>C. W. Tinson</i>	
The Centenary Conversazione	351
Technical Notes	357
<p>Transient Vibration by Vector Methods—<i>A. W. Morley</i>. Arbitrary Quadrilateral Spar Webs for the Matrix Displacement Method—<i>J. H. Argyris</i>. The Momentum Equation for a Static Hovercraft at Zero Incidence—<i>A. J. Alexander</i>. The Rates of Change of the Eigenvalues of a Lambda Matrix and their Use in Further Investigations—<i>D. L. Woodcock</i>. Recent Data on the Collapse of Spherical Caps under External Pressure—<i>B. Klein</i>. Initial Flow in the Entrance of a Straight Circular Pipe—<i>J. Gillis and M. Shimshani</i>. A Note on the Static Hole Error Problem—<i>N. Rajaratnam</i>. Integral Axi-Symmetric Nozzle Design—Author's statement—<i>M. J. Cohen</i>.</p>	
The Library	371
<p>Reviews: Thermal Stress Analyses—Probability and its Engineering Uses—Sourcebook on the Space Sciences—Metals for the Space Age—Flight—Handbook of Satellites and Space Vehicles—Theory of Laminar Flows—Physical Chemistry for Metallurgists—Fracture Toughness Testing and its Applications—The History of Rocket Technology—Internationales Lufttransportrecht—Bell and Baldwin: Their Development of Aerodromes and Hydromes at Baddock, Nova Scotia—Dynamics of Rockets and Satellites—The Design of Structures of Least Weight—High-Temperature Compounds of Rare Earth Metals with Nonmetals—Russian-English Aerospace Dictionary—Aeronautics.</p>	
Additions to the Library	Reports

All communications for publication in the JOURNAL should be addressed to the Editor, JOAN BRADBROOKE, ARAS; all communications on general matters affecting the Society should be addressed to the Secretary, A. M. BALLANTYNE, TD, BSc, PhD, FRAeS, HonFCASI, FAIAA—at 4 HAMILTON PLACE, LONDON, W1.

Reproduction in whole or in part of any of the papers and contributions published in this Journal is not permitted without the written consent of the Royal Aeronautical Society.

None of the papers or paragraphs must be taken as expressing the opinion of the Council of the Royal Aeronautical Society unless otherwise stated.

THE ROYAL AERONAUTICAL SOCIETY

OVERSEAS DIVISIONS

Australia

President: D. B. HUDSON, FRAeS.
Hon. Secretary: W. ISBISTER, FRAeS, Science House, Gloucester & Essex Streets,
Sydney, New South Wales.
Branches at: Canberra, Sydney, Melbourne and Adelaide.

Rhodesia

Hon. President: Sir HUMPHREY GIBBS, KCMG, OBE.
President: Capt. M. O'DONOVAN, AFRAeS.
Hon. Secretary: S. H. GUY, AFRAeS, c/o Central African Airways, Private Bag 1,
Salisbury Airport, Salisbury.
Branches at: Bulawayo, Gwelo and Salisbury.

New Zealand

President: Gp. Capt. W. G. WOODWARD, OBE, AFRAeS.
Hon. Secretary: T. T. N. COLERIDGE, AFRAeS, The Shell Company of New Zealand
Ltd, Box 2091, Wellington.
Branches at: Auckland, Wellington, Palmerston North and Christchurch.

Southern Africa

President: Dr. C. G. van NIEKERK, AFRAeS.
Hon. Secretary: A. W. BENNELL, PO Box 4409, Johannesburg.
Branches at: Johannesburg and Pretoria.

BRANCHES IN THE UNITED KINGDOM

Bedford

President: J. HANSON, FRAeS.
Chairman: F. O'HARA, AFRAeS.
Hon. Secretary: T. E. B. BATEMAN, AFRAeS, Air-
craft Research Association, Manton Lane, Bedford.
Tel: Bedford 67701.

Belfast

President: C. E. WRANGHAM.
Chairman: R. J. FROST, AFRAeS.
Hon. Secretary: D. SAUNDERS, AFRAeS, Short
Bros. & Harland Ltd, Castlereagh, Belfast.
Tel: Belfast 59271.

Birmingham and Wolverhampton

President: H. S. BOTTOMS, AFRAeS.
Chairman: Dr. L. W. J. NEWMAN, AFRAeS.
Hon. Secretary: G. O. FRAMPTON, AFRAeS,
H. M. Hobson Ltd, Fordhouses, Wolverhampton,
Staffs. Tel: Fordhouses 2381.

Boscombe Down

President: Air Cdre. F. R. BIRD, DSO, DFC, AFC.
Chairman: G. MACLAREN-HUMPHREYS, MBE,
AFRAeS.
Hon. Secretary: Sqn. Ldr. H. H. HORSHAM,
MBE, ARAeS, A & AEE, Boscombe Down,
Amesbury, Salisbury, Wilts. Tel: Amesbury
3331, Ext 2143.

Bristol

President: Dr. R. R. JAMISON, FRAeS.
Chairman: G. L. AUTY, FRAeS.
Hon. Secretary: W. O. LEE, ARAeS, BAC (Op) Ltd,
Filton Division, Filton, Bristol 7. Tel: Bristol
693831, Ext 499.

Brough

President: Capt. E. D. G. LEWIN, CB, CBE, DSO,
AFRAeS.
Chairman: A. G. SMITH, FRAeS.
Hon. Secretary: A. D. HOWARTH, ARAeS, c/o
Hawker Siddeley Aviation Ltd, Brough,
Yorkshire. Tel: Brough 667121, Ext 314.

Cambridge

President: Professor W. A. MAIR, FRAeS.
Chairman: R. O. GATES, AFRAeS.
Hon. Secretary: E. M. J. SCHAFFTER, AFRAeS,
Marshall of Cambridge (Engineering) Ltd,
Aircraft Division, Airport Works, Cambridge.
Tel: Cambridge 56291.

Chester

President: C. B. V. NEILSON, FRAeS.
Chairman: F. G. EVANS, FRAeS.
Hon. Secretary: H. PENDLEBURY, AFRAeS, Electro-
Hydraulics Ltd, Liverpool Road, Warrington,
Lancs.

Christchurch

President: E. W. J. GRAY, FRAeS.
Chairman: H. E. VINCENT, AFRAeS.
Hon. Secretary: J. F. BRENNAN, AFRAeS, c/o
BAC (Op) Ltd, Weybridge Division, Bourn-
mouth (Hurn) Airport, Christchurch, Hants.
Tel: Northbourne 3201.

Coventry

President: J. WRIGHT, CBE, FRAeS.
Chairman: D. A. WOODLEY, FRAeS.
Hon. Secretary: J. G. LUM, AFRAeS, Wind Tunnel
Dept, Hawker Siddeley Dynamics Ltd, Whitley,
Coventry, Warwickshire. Tel: Tollbar 3271,
Ext 111.

Cranwell

President: Air Vice-Marshal I. D. N. LAWSON, CB,
CBE, DFC.
Chairman: Wg. Cdr. J. SANDFORD, AFRAeS.
Hon. Secretary: F. A. BRISTOW, AFRAeS, Dept. of
Engineering, RAF College, Cranwell, Sleaford,
Lincs.

Derby

President: Sir DENNING PEARSON, HonFRAeS.
Chairman: H. PEARSON, FRAeS.
Hon. Secretary: V. R. HAAS, AFRAeS, Rolls-
Royce Ltd, Derby. Tel: Derby 42424.

Glasgow

President: Dr. A. W. BABISTER, AFRAeS.
Chairman: Wm. H. G. FINLAY, AFRAeS.
Hon. Secretary: W. N. ALCOCK, Shenstone,
Dumbuck Crescent, Dumbarton.

Gloucester and Cheltenham

President: Sir GEORGE DOWTY, FRAeS.
Chairman: J. G. RUSSELL, AFRAeS.
Hon. Secretary: C. E. HUTT, ARAeS, c/o Smiths
Industries Ltd, Bishops Cleeve, Cheltenham,
Glos. Tel: Bishops Cleeve 3333.

Halton

President: Air Vice-Marshal B. ROBINSON, CBE,
AFRAeS.
Chairman: Gp. Capt. V. C. G. USHER, AFRAeS.
Hon. Secretary: Sqn. Ldr. J. MACKINTOSH,
Officers' Mess, RAF Halton, Bucks. Tel:
Wendover 2242, Ext 310.

Hatfield

Chairman: F. MARKING, AFRAeS.
Hon. Secretary: G. B. EVANS, AFRAeS, Drawing
Office, Hawker Siddeley Aviation Ltd,
Hatfield, Herts. Tel: Hatfield 2345, Ext 274.

Isle of Wight

President: H. KNOWLER, FRAeS.
Chairman: G. J. THOMPSON, FRAeS.
Hon. Secretary: B. J. SUMMERS, GradRAeS, Design
Office, Westland Aircraft Ltd, Saunders-Roe
Division, Osborne, Isle of Wight. Tel: Cowes
2211.

Leicester

President: Professor K. L. C. LEGG, FRAeS.
Chairman: K. B. AYERS, AFRAeS.
Hon. Secretary: G. J. STURGESS, GradRAeS,
41 Priory Road, Loughborough, Leics.

London Airport

President: Rear Admiral Sir MATTHEW S.
SLATTERY, KBE, CB, FRAeS.
Chairman: J. R. FINNIMORE, AFRAeS.
Hon. Secretary: N. BROWN, ARAeS, BOAC HQ,
Technical Publications Department, London
(Heathrow) Airport, Middlesex. Tel: Skyport
5511, Ext 2883.

Luton

President: K. D. MORGAN.
Chairman: H. E. CURTIS, AFRAeS.
Hon. Secretary: L. A. WILLOTT, AFRAeS, BAC
(Op) Ltd, Luton Division, The Airport, Luton,
Beds. Tel: Luton 31151.

Manchester

President: C. E. FIELDING, OBE, FRAeS.
Chairman: M. J. BRENNAN, FRAeS.
Hon. Secretary: J. A. E. WATERFALL, 56 Manor
Avenue, Ashton-on-Mersey, Cheshire. Tel:
Failsworth 2020.

Merthyr and Treforest

President: E. J. BUSH.
Chairman: E. R. CHAYTOR, AFRAeS.
Hon. Secretary: Dr. G. O. FORESTER, Chief of
Research, Teddington Aircraft Controls Ltd,
Cefn Coed, Merthyr Tydfil, South Wales. Tel:
Merthyr Tydfil 3261.

Preston

President: F. W. PAGE, CBE, FRAeS.
Chairman: E. LOVELESS, AFRAeS.
Hon. Secretary: J. T. FROUD, AFRAeS, Project
Research Office, BAC (Op) Ltd, Preston
Division, Warton Aerodrome, Preston, Lancs.
Tel: Freckleton 531.

Prestwick

President: R. McINTYRE, FRAeS.
Chairman: G. YOUNG, AFRAeS.
Hon. Secretary: Ir. B. J. G. ASBEEK BRUSSE,
AFRAeS, Design Office, Scottish Aviation Ltd,
Prestwick Airport, Ayrshire. Tel: Prestwick
79888.

Reading

President: E. N. MOBBS.
Chairman: J. T. APPELBY, FRAeS.
Hon. Secretary: E. W. C. ANGELL, ARAeS, M. L.
Aviation Co Ltd, White Waltham, Maidenhead
Berks. Tel: Littlewick Green 248.

Southampton

President: Professor E. J. RICHARDS, OBE, FRAeS.
Chairman: F. C. KIRKPATRICK, AFRAeS.
Hon. Secretary: Dr. B. L. CLARKSON, AFRAeS,
Institute of Sound and Vibration Research, The
University, Southampton. Tel: Southampton
56331.

Southend

President: F. A. LAKER, ARAeS.
Chairman: K. A. COLE, AFRAeS.
Hon. Secretary: Wg. Cdr. E. F. PRICE, ARAeS,
Aviation Traders (Eng) Ltd, Southend Airport,
Essex. Tel: Southend 49471.

Swindon

President: Gp. Capt. F. S. HAZLEWOOD, OBE,
AFC.
Chairman: Sqn Ldr. F. H. GRAY, AFRAeS.
Hon. Secretary: D. E. J. TIPPING, AFRAeS, Vickers
Ltd, South Marston Swindon, Wilts. Tel:
Stratton St. Margaret 3241.

Weybridge

President: Sir GEORGE EDWARDS, CBE,
HonFRAeS.
Chairman: J. HEAP, AFRAeS.
Hon. Secretary: A. M. DOBSON, AFRAeS, BAC
(Op) Ltd, Weybridge Division, Weybridge,
Surrey. Tel: Weybridge 45555.

Yeovil

President: E. C. WHEELDON, CBE.
Chairmen: Dr. G. S. HISLOP, FRAeS and Dr. E. W.
STILL, FRAeS.
Hon. Secretary: L. A. LANSDOWN, AFRAeS,
Westland Aircraft Ltd, Yeovil, Somerset.
Tel: Yeovil 5222.

FEBRUARY 1966