

THE  
AERONAUTICAL JOURNAL  
VOL.—LXX

THE ROYAL AERONAUTICAL SOCIETY

# *The Journal of the Royal Aeronautical Society*

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

## **VOLUME LXX**

**JANUARY - DECEMBER 1966**

Edited for the Council of The Royal Aeronautical Society

by

Joan Bradbrooke, ARAeS

Printed by the Lewes Press Wightman and Co. Ltd., Friars Walk, Lewes, Sussex  
and Published by the Royal Aeronautical Society, 4 Hamilton Place, London W.1

*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

SEPTEMBER 1966

NUMBER 669

CONTENTS

	Page
Notices	LXV
New Fellows—Royal Flying Corps Memorial—Courses on Air Law—Graduates' and Students' Section Diary—Branches' Centenary Celebrations: September and October—The Council of Engineering Institutions News—Acknowledgments—Library Note—Diary—Elections—Other Meetings—News of Members—Lecture Summaries.	
STOL—Some Possibilities and Limitations	W. A. Mair      825
The Society of British Aerospace Companies Ltd	H. W. Goodinge      836
The U K Polaris Project	Captain C. W. H. Shepherd      843
Economic Space Transportation—Thoughts on Missions, Size and Operational Sensitivity	T. Derbyshire, W. B. Clegg and T. W. Smith      849
Propulsion Controls on the Concorde	P. Young      863
Correspondence	882
Technical Notes	884
A Generalised System for Project Control and Evaluation—G. Mitchell. A Short Proof of the Prandtl-Meyer Expansion Formula—A. R. Collar. The Steady Flow Through a Cascade of Closely Spaced Circular Cylinders—B. W. Roberts.	
The Library	888
Reviews: Roots of British Air Policy—The Invention of the Aeroplane, 1799-1909—The Matrix Analysis of Vibration.	
Additions to the Library	Reports

*All communications for publication in the JOURNAL should be addressed to the Editor, JOAN BRADBROOKE, MBE, ARAS; all communications on general matters affecting the Society should be addressed to the Secretary, A. M. BALLANTYNE, OBE, TD, BSc, PhD, CEng, 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.*

PRINTED BY THE LEWES PRESS WIGHTMAN & CO. LTD., LEWES, SUSSEX, ENGLAND, AND PUBLISHED BY THE ROYAL AERONAUTICAL SOCIETY, 4 HAMILTON PLACE, LONDON, W.1, ENGLAND.

# 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. J. R. ORBELL, 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, Pretoria and Cape Town.

## 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: E. G. COLLINSON, AFRAeS.  
Hon. Secretary: D. SAUNDERS, AFRAeS, Short  
Bros & Harland Ltd, Castlereagh, Belfast.  
Tel: Belfast 59271.

### Birmingham and Wolverhampton

President: H. S. BOTTOMS, AFRAeS.  
Chairman: N. H. SHUTTLEWORTH, 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,  
ARAAeS, 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 449.

### Brough

President: Capt. E. D. G. LEWIN, CB, CBE, DSO,  
AFRAeS.  
Chairman: R. D. BOOT, AFRAeS.  
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: N. A. J. HARRY, 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, Bourne-  
mouth (Hurn) Airport, Christchurch, Hants.  
Tel: Northbourne 3201.

### Coventry

President: J. WRIGHT, CBE, FRAeS.  
Chairman: D. A. WOODLEY, FRAeS.  
Hon. Secretary: G. W. COLLINS, AFRAeS, Rocket  
Dept, Bristol Siddeley Engines Ltd, Ansty  
Aerodrome, P.O. Box 17, Coventry Warwick-  
shire. Tel: Walsgrave-on-Sowe 3211.

### 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. Tel: Cranwell 201.

### Derby

President: Sir DENNING PEARSON, HonFRAeS.  
Chairman: H. PEARSON, FRAeS.  
Hon. Secretary: Y. 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.  
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

President: Air Cdre. F. R. BANKS, CB, OBE, FRAeS.  
Chairman: E. B. ROBINSON, 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  
4121.

### London Airport

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

### Loughborough

President: Professor K. L. C. LEGG, FRAeS.  
Chairman: K. B. AYERS, AFRAeS.  
Hon. Secretary: F. G. MACCABEE, AFRAeS,  
56 Holywell Drive, Loughborough, Leics.

### Luton and Stevenage

President: K. D. MORGAN.  
Chairman: H. E. CURTIS, AFRAeS.  
Hon. Secretary: P. EVERARD, AFRAeS, c/o BAC  
(Op) Ltd, Guided Weapons Div., Technical  
Design Dept., Six Hills Way, Stevenage, Herts.  
Tel: Stevenage 2422.

### 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: K. HOLTAPPEL, Design  
Office, BAC (Op) Ltd, Preston Division,  
Warton Aerodrome, Preston, Lancashire.  
Tel: Freckleton 531.

### Prestwick

President: R. McINTYRE, FRAeS.  
Chairman: T. C. OVEREND, ARAeS.  
Hon. Secretary: J. LOGAN, AFRAeS, Scottish  
Aviation Ltd, Service Dept, Prestwick  
Airport, Ayrshire. Tel: Prestwick 79888.

### Reading

President: E. N. MOBBS.  
Chairman: G. BOYCE, AFRAeS.  
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: P. W. FORTESCUE, AFRAeS, Dept.  
of Aeronautics and Astronautics, The University,  
Southampton. Tel: Southampton 56331, Ext 618.

### Southend

President: J. R. BATT, 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: W. GILLESPIE, AFRAeS.  
Hon. Secretary: E. J. DAVIS, 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, FRAeS.  
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.

SEPTEMBER 1966