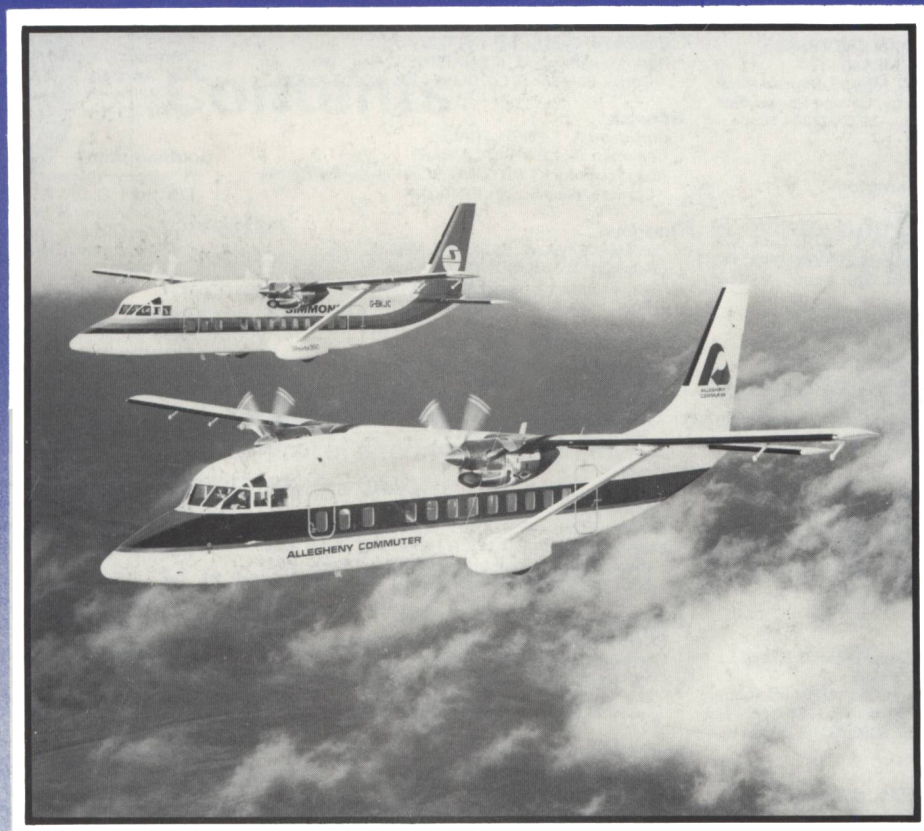


The AERONAUTICAL Journal



Directory of heavier-than-air
machines 850 BC — AD 1783
Cost control of aircraft manufacture

DIVISIONS AND BRANCHES OF

THE ROYAL AERONAUTICAL SOCIETY

Australia Branches at: Canberra, Sydney, Melbourne and Adelaide.

President: Professor R. D. ARCHER, FRAeS. *Hon. Secretary:* B. A. J. SCOLES, MRAeS, 191 Royal Parade, Parkville, Victoria 3052.

Zimbabwe Branches at: Bulawayo, Gweru and Harare

President: H. M. DOWELL, AMRAeS. *Hon. Secretary:* Mrs. MARGARET HEAP, Assoc RAeS, 84 Broadlands Rd, Emerald Hill, Harare.

New Zealand Branches at: Auckland, Wellington, Palmerston North, Christchurch, Hamilton and Blenheim.

President: Ben NEW, DFC, MRAeS. *Hon. Secretary:* M. MILSOM, BP New Zealand Ltd, 20 Custom House Quay, Wellington.

Southern Africa *President:* Wg. Cdr. A. W. BOWER, MRAeS. *Hon. Secretary:* Wg. Cdr. N. F. HARRISON, MRAeS, PO Box 27335, Sunnyside 0132, RSA.

Bedford

President: Air Vice Marshal D. W. RICHARDSON.

Chairman: A. M. McVITIE.

Hon. Secretary: G. I. PAULEY, Aircraft Research Assoc. Ltd., Manton Lane, Bedford. MK41 7PF. Tel: 0234 50681.

Belfast

President: Sir PHILIP FOREMAN, CBE, FRAeS.

Chairman: T. E. MORRISON, MRAeS.

Hon. Secretary: W. GORDON, MRAeS, Dept. of Mech. Eng., College of Technology, College Square East, Belfast BT1 6DJ. Tel: Work—0232 227244. Home—0232 710370.

Birmingham and Wolverhampton

President: J. LENHAM, MRAeS.

Chairman: E. ALBRECHT, MRAeS.

Hon. Secretary: W. G. MORRIS, 16 Benson Ave, Goldthorn Park, Wolverhampton WV4 5HB. Tel: Work—W'ton 783361. Ex. 328. Home—W'ton 330139.

Boscombe Down

President: Air Cdre. R. G. SPIERS, OBE, FRAeS.

Chairman: B. RAMSDALE, BSc.

Hon. Secretary: Wg. Cdr. C. T. B. PEILE, MRAeS, RAF, O/C RAF Handling Squadron, Boscombe Down, Salisbury SP4 0JF. Tel: 09802 3331. Ex. 2840.

Bristol

President: H. METCALFE, FRAeS.

Chairman: J. M. HAHN, CEng, MRAeS.

Hon. Secretary: D. C. GREENMAN, MRAeS, Aerodynamics Dept, No 7 Drawing Office, British Aerospace Aircraft Group, Filton House, Bristol BS99 7AR. Tel: 0272 693831. Ex. 464.

Brough

President: L. W. MILSOM, CEng, MIMechE, FRAeS.

Chairman: E. J. SOLMAN, AMRAeS.

Hon. Secretary: C. ROE, TEng(CEI), AMRAeS Future Projects Dept, British Aerospace, Brough, N. Humberside HU15 1EQ. Tel: 0482 667121. Ex. 5116.

Cambridge

President: Professor W. A. MAIR, CBE, FRAeS.

Chairman: N. A. J. HARRY, FRAeS.

Hon. Secretary: J. MOSELEY, AMRAeS, 6 Cooks Drove, Earith, Huntingdon, Cambridge PE17 3QG.

Chester

President: R. GRIFFITHS, FRAeS.

Chairman: V. W. CLARKSON, MRAeS.

Hon. Secretary: J. R. YOUNG, AMRAeS, British Aerospace, Hatfield Chester Division, Broughton, Chester. Tel: 0244 535333.

Christchurch

President: M. COBHAM, FRAeS.

Chairman: R. C. GODWIN, MRAeS.

Hon. Secretary: C. H. GOOM, MRAeS, British Aerospace, Weybridge Bristol Division, Bournemouth (Hurn) Airport, Christchurch, Dorset. Tel: 020-16 3201.

Coventry

President: A. H. POPE, FRAeS.

Chairman: A. J. WEBBER, MRAeS.

Hon. Secretary: A. J. EAGLES, 30 Lupton Ave, Coventry CV3 5BQ. Tel: 0203 415412.

Cranwell

President: Air Vice Marshal B. BROWNLOW, FRAeS.

Chairman: Wg. Cdr. P. N. HILLER

Hon. Secretary: Flt. Lt. M. S. MASON, RAF College, Cranwell, Sleaford, Lincs NG34 8HB. Tel: 0400 61201.

Derby

President: D. A. HEAD, FRAeS.

Chairman: J. BUSH, FRAeS.

Hon. Secretary: D. P. HARPLEY, AMRAeS, Rolls-Royce Ltd, East Midlands Airport, Derby DE7 2SA. Tel: 0332 811216

Dublin

President: R. W. O'SULLIVAN, FRAeS.

Chairman: Capt S. J. P. LYTTLE.

Hon. Secretary: J. CONNERNEY, Eng. Wing, Air Corps, Baldonnell, Co. Dublin. Tel: 592493. Ex. 28.

Gatwick

President: A. T. PUGH, FRAeS.

Chairman: T. J. PATRICK, MRAeS.

Hon. Secretary: G. BOYLING, BCal, Caledonian House, Crawley, West Sussex RH10 2XA.

Glasgow

President: Dr. A. W. BABISTER, MRAeS.

Chairman: T. J. GOODWIN, AMRAeS.

Hon. Secretary: F. FRENCH, MRAeS, 27 Bourtree Road, Hamilton ML3 8QA. Tel: 03552 20200. Ex. 163.

Gloucester and Cheltenham

President: Sir ROBERT HUNT, HonFRAeS.

Chairman: K. BEST, FRAeS.

Hon. Secretary: R. W. WHITE, MRAeS, c/o Smiths Industries Ltd, Bishops Cleeve, Cheltenham, Glos. Tel: 024-267 3333. Ex. 2516.

Halton

President: Gp. Capt. M. J. EVANS, ADC, CEng, MRAeS, RAF.

Chairman: Wg. Cdr. J. A. CHARLETT-GREEN, RAF.

Secretary: Sqn. Ldr. P. G. HISCOCK, RAF, Electrical Training Squadron, RAF Halton, Bucks HP22 5PG. Tel: 0296 623535. Ex. 234.

Hatfield

President: M. J. GOLDSMITH, FRAeS.

Chairman: F. W. VANN, FRAeS.

Hon. Secretary: K. GREEN, MRAeS, Repair Drawing Office, British Aerospace, Hatfield — Chester Division, Hatfield, Herts. Tel: 07072 62345. Ex. 89.

Isle of Wight

President: M. J. BRENNAN, FRAeS.

Chairman: R. L. WHEELER, MRAeS.

Hon. Secretary: N. MAY, Technical Office, British Hovercraft Corporation Ltd, East Cowes, Isle of Wight. Tel: 098-29 4121.

London Airport

President: Sir JOHN KING, Assoc. RAeS.

Chairman: P. J. CRAWFORD, MIMechE, AFSLAET.

Hon. Secretary: J. D. BROWN, MRAeS, British Airways, Room 512, Viscount House, PO Box 10, London (Heathrow) Airport, Hounslow, Middx TW6 2JA. Tel: 01-750 4449. Ex. 3340.

Loughborough

President: Professor D. J. JOHNS, FRAeS.

Chairman: F. G. MACCABEE, MRAeS.

Hon. Secretary: L. E. WOODFIELD, AMRAeS, Transport Technology Dept, Loughborough University of Technology, Loughborough, Leics. LE11 3TU. Tel: Loughborough 63171. Ex. 470.

Manchester

President: C. E. FIELDING, OBE, FRAeS.

Chairman: D. L. RAFFLE, CEng, MRAeS.

Hon. Secretary: J. H. MANGAN, MRAeS, Assit. Sec., W. JAMES, Aerodynamics Dept., British Aerospace, Manchester Division, Woodford, Stockport, Cheshire. Tel: 061-439 5050. Ex. 278

Medway

President: P. A. HEARNE, FRAeS.

Chairman: M. MOULTON, MRAeS.

Hon. Secretary: F. H. WOOD, MRAeS, c/o Marconi Avionics Ltd, Airport Works, Rochester, Kent. Tel: 0634 44400.

Preston

President: F. E. ROE, FRAeS.

Chairman: A. G. BARNES, MRAeS.

Hon. Secretary: J. R. HUNTINGTON, MRAeS, British Aerospace, Warton Division, Warton Aerodrome, Preston. Tel: (0772) 633333. Ex. 60.

Prestwick

President: R. McINTYRE, FRAeS.

Chairman: I. McDONNELL, FRGS, AMRAeS.

Hon. Secretary: V. B. M. McLEONARD, MBE, AMRAeS, 21 Hillhouse Gdns, Troon, Ayrshire KA10 6SZ. Tel: 0292 311351.

Southampton

President: Professor G. M. LILLEY, FRAeS.

Chairman: G. DAVIES, CEng, FRAeS.

Hon. Secretary: S. W. D. WOLF, BSc, AMRAeS, Dept. of Aeronautics and Astronautics, The University, Southampton, Hants. SO9 5NH. Tel: 0703 559122. Ex. 2303.

Southend

President: A. J. BROOKE-WALDER, MRAeS.

Chairman: P. R. GROUT, AMRAeS.

Hon. Secretary: D. M. GLADSTONE, MRAeS, 36 Brooke House, Town Square, Basildon, Essex SS14 1HX. Tel: Basildon 284621; Work: 22861. Ex. 290.

Stevenage

President: T. G. KENT, CBE, CEng, MRAeS.

Chairman: C. H. MARTIN, CEng, FRAeS.

Hon. Secretary: M. F. RICKETT, AMRAeS, British Aerospace, Dynamics Group, Gunnels Wood Rd, Stevenage, Herts. SG1 2AS. Tel: 0438 3456. Ex. 325.

Swindon

President: W. GILLESPIE, MRAeS.

Chairman: W. H. BUNTING, MRAeS.

Hon. Secretary: R. J. WESTMACOTT, MRAeS, 45 Hesketh Crescent, Swindon SN3 1RZ. Tel: 0793 823815.

Thames Valley

President: E. N. MOBBS.

Chairman: J. L. FAREHAM, MRAeS.

Hon. Secretary: A. G. FOSKETT, MRAeS, M.L. Aviation Co Ltd, White Waltham Aerodrome, Berks. Tel: 062-882 3361.

Weybridge

President: J. T. STAMPER, FRAeS.

Chairman: M. W. SALISBURY, MRAeS.

Hon. Secretary: A. M. DOBSON, MRAeS, British Aerospace, Weybridge Bristol Division, Weybridge, Surrey. Tel: 97 45522. Ex. 6945.

Yeovil

President: B. D. BLACKWELL, FRAeS.

Chairman: V. A. B. ROGERS, FRAeS

Hon. Secretary: S. J. LOVE, MRAeS, Development Instrumentation, Westland Helicopters Ltd, Yeovil, Somerset. Tel: 0935 75222. Ex. 2402.

OVERSEAS BRANCHES

Hong Kong

Chairman: Dr. K. L. LEGG, FRAeS.

Hon. Secretary: R. L. AYERS, Civil Aviation Dept., Hong Kong International Airport, Kowloon, Hong Kong.

Malaysia

Chairman: Lt. Col. Yeoh Kiat BOON.

Hon. Secretary: R. H. STEVENS, 3 Jalan, 22-55 Petaling Jaya, Selangor.

The AERONAUTICAL Journal

Volume 87 Number 861 January 1983

Incorporating The Institution of Aeronautical Engineers
and The Helicopter Association of Great Britain



Editor: Jay Wolff,
Assoc. Member RAeS

Assistant Editor: Michèle Didyk

Secretary of the Society:
N. A. M. Eastwood, MA, CEng,
MRAeS
4 Hamilton Place, London W1V 0BQ
Tel: 01-499 3515
Telegrams: Didaskalos,
London W1

Advertisements:
Harris Associates,
15 Studlands Rise,
Royston, Herts SG8 9EZ.
Tel: 0763 42890

Reproduction of any of the papers
published in this journal is not
permitted without the written
consent of the Editor.

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

Printed by
Manor Park Press Ltd,
Unit 7, Highfield Industrial Estate,
Edison Road, Hampden Park,
Eastbourne.

Subscriptions: £88 per annum,
post free.
RAeS members: £9 per annum.

Single copies, including back
numbers: £9.

All foreign currency rates on
application.

Published by
The Royal Aeronautical Society,
4 Hamilton Place,
London W1V 0BQ, England
ISSN: 0001-9240

**PUBLISHED MONTHLY
EXCEPT JUNE AND
AUGUST**

Contents

- 1**
Clive Hart
A directory of heavier-than-air flying
machines in western Europe,
850 BC-AD 1783
- 9**
E. T. Jackson
Cost control of aircraft manufacture.
A modern approach
- 21**
M. B. Snell and P. Bartholomew
Initial design of stringer stiffened
bend boxes using geometric
programming
- 26**
K. G. Winter and L. F. East
The design of a 'jet catcher'
- 31**
**Library reviews, additions and
reports**



Cover picture

The Shorts 360 is now in operation with three airlines, two in the USA and one in the UK. The picture shows aircraft of Suburban Airlines of Pennsylvania and Simmons Air of Michigan. Suburban have already carried over 3000 passengers on revenue earning operations. A second aircraft entered service with Simmons Air in mid-December 1982. The UK operator Genair, of Humberside, has taken delivery of the third Shorts 360 to leave the Belfast assembly lines. This aircraft is being used to open up a new route linking Humberside with Esbjerg in Denmark.

The Royal Aeronautical Society

FOUNDED 1866

INCORPORATED BY ROYAL CHARTER 1949

Patron: HER MAJESTY THE QUEEN

COUNCIL

President: CAPTAIN E. M. BROWN, CBE, DSC, AFC, MA, FRAeS, RN(Ret'd)

President-Elect: PROFESSOR M. G. FARLEY, HonCGIA, CEng, FIMechE, CBIM, FIProdE, FRAeS

Vice-Presidents:

J. W. FOZARD, OBE, DCAe, BSc(Hons), CEng, FIMechE, FAIAA, FRAeS
G. K. C. PARDOE, BSc(Eng), DLC, CEng, FBIS, FRAeS
T. H. KERR, BSc, FRAeS

Past Presidents:

P. A. HEARNE, MSc, DLC, CEng, FRAeS
J. T. STAMPER, MA(Cantab), FEng, FRAeS

Members:

AIR CDRE M. K. ADAMS, AFC, FRAeS
C. ABELL, OBE, CEng, HonFSLAET, HonFRAeS
M. W. ANDERSON, MA(Cantab), CEng, MICE, MSAE, AFAIAA, FRAeS
PROFESSOR R. D. ARCHER, CEng, FRAeS (*President — Australia Division*)
A. F. ATKIN, CBE, BSc(Hons), DipAe(Hull), FEng, FIMechE, FRAeS
R. G. AUSTIN, MSc, CEng, MAIAA, FRAeS (*Chairman, Rotorcraft Section*)
AIR CDRE F. R. BANKS, CB, OBE, HonCGIA, CEng, HonFAIAA, HonFRAeS, RAF (Ret'd)
A. E. M. BARTON, DFC, CEng, MRAeS
A. L. BLACKMAN, OBE, MA, FRAeS
WING CDR A. W. BOWER, OBE, DFC, MRAeS (*President — South Africa Division*)
DR P. H. CALDER, OBE, BSc, ACGI, PhD, CEng, FRAeS
I. B. CRIPPS, MRAeS (*Chairman — Branches Committee*)
J. L. CROWDER, MA, CEng, FBIS, AFAIAA, HonMIED, FRAeS (*Chairman — Astronautics and Guided Flight Section*)
H. M. DOWELL, AMRAeS (*President — Zimbabwe Division*)
N. FALCONER, BSc, MEcon, FISTat, MRAeS
DR G. S. HISLOP, CBE, HonDSc, PhD, BSc, ARCST, FEng, FIMechE, FRSA, FRSE, FRAeS
G. C. HOWELL, MA, MSc, CEng, FRAeS
D. J. KNIGHT, BSc(Eng), AMRAeS
B. P. LAIGHT, OBE, MSc, FEng, MIMechE, FRAeS
F. J. LOW, MRAeS
B. NEW, DFC, MRAeS (*President — New Zealand Division*)
AIR MARSHAL SIR CHARLES PRINGLE, KBE, MA, FEng, FRAeS, FBIM, RAF(Ret'd)
D. J. RICHER, MSc, BSc, CEng, MRAeS
M. RYLAND (*Chairman — Graduates' and Students' Section*)
P. R. SAMPSON, TEng(CEI), AMRAeS
PROFESSOR J. L. STOLLERY, DSc(Eng), DIC, ACGI, CEng, AFAIAA, FRAeS

Officers:

Hon. Treasurer: C. F. HUGHESDON, AFC, FRAeS
Secretary: N. A. M. EASTWOOD, MA, CEng, MRAeS