

The **AERONAUTICAL** Journal



Contents

P. R. Ashill and P. D. Smith

An integral method for calculating the effects on turbulent boundary-layer development of sweep and taper

W. R. Quinn and G. F. Marsters

Upstream influence on turbulent jet flows from cruciform nozzles

Arthur Rizzi

Spurious entropy production and very accurate solutions to the Euler equations

Zhou Ming De and L. C. Squire

The interaction of a wake with a turbulent boundary layer

Library reviews, additions and reports

Incorporating
The Aeronautical Quarterly

Volume 89 Number 882 February 1985

DIVISIONS AND BRANCHES OF

THE ROYAL AERONAUTICAL SOCIETY

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

President: R. J. YATES, CEng, FRAeS. Hon. Secretary: R. D. BARKLA, PO Box 573, Mascot, NSW 2020.

Zimbabwe Branches at: Bulawayo, Gweru and Harare

President: D. Panton, MRAsE. 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: A. C. WILLIAMS, MRAsE. Hon. Secretary: P. J. N. O'Callahan, c/o PO Box 892, Wellington.

Southern Africa President: Prof. E. A. BUNT, FRAeS. Hon. Secretary: N. A. H. BARRAUD, MRAsE, PO Box 130774, Bryanston, Republic of South Africa, 2021.

Bedford

President: Air Cdre D. READER.

Chairman: G. W. WOODS.

Hon. Secretary: Dr. P. M. RENDER Aircraft Research Assoc. Ltd., Manton Lane, Bedford MK41 7PF. Tel: 0234 50681.

Belfast

President: Sir PHILIP FOREMAN, CBE, FRAeS.

Chairman: D. J. GRENVILLE, AMRAeS.

Hon. Secretary: W. GORDON, MRAsE, 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. F. W. PRICE, CEng, MRAsE.

Chairman: D. E. HAMMOND, CEng, MRAsE.

Hon. Secretary: W. G. MORRIS, 16 Benson Ave, Goldthorn Park, Wolverhampton WV4 5HB. Tel: Work—W'ton 783361. Ex. 101. Home—W'ton 330139.

Boscombe Down

President: Air Cdre. G. C. WILLIAMS, AFC, MRAsE, RAF.

Chairman: B. W. J. CHILDES, FRAeS.

Hon. Secretary: Wg. Cdr. R. WOOD, CEng, MRAsE, RAF, ATG(A), Armament Division, A&AEE Boscombe Down, Salisbury SP4 0JF. Tel: 0980 23331. Ex. 2403.

Bristol

President: J. D. WRAGG, FRAeS.

Chairman: D. G. ATKIN, FRAeS.

Hon. Secretary: D. C. GREENMAN, MRAsE, Aerodynamics Dept, No 7 Drawing Office, British Aerospace Aircraft Group, Filton House, Bristol BS99 7AR. Tel: 0272 693831. Ex. 2104.

Brough

President: M. EDWARDS, FRAeS.

Chairman: E. J. SOLMAN, AMRAeS.

Hon. Secretary: G. ROE, TEng(CEI), AMRAeS, Technical Dept, British Aerospace, Kingston-Brough Division, Brough, Humberside HU15 1EQ. Tel: Work—0482 667121. Ex. 5531. Home—0482 706610.

Cambridge

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

Chairman: K. WESTLEY.

Hon. Secretary: T. W. CARTER, AMRAeS, 53 Waterside, Isleham, Ely, Cambs CB7 5SH.

Chester

President: R. GRIFFITHS, FRAeS.

Chairman: V. W. CLARKSON, FRAeS.

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

Christchurch

President: M. J. COBHAM, FRAeS.

Chairman: C. H. GOOM, MRAsE.

Hon. Secretary: C. CRUDDAS, MRAsE, Flight Refuelling Ltd, Wimborne, Dorset BH21 2BJ. Tel: 0202 882121. Ex. 654.

Coventry

President: J. B. ROBERTS, FRAeS.

Chairman: T. W. HARPER, FRAeS.

Hon. Secretary: R. I. RATCLIFF, Assoc. RAeS, 23 Babbacombe Rd, Styvechale, Coventry CV3 5PE. Tel: 0203 413779. Work—0203 27666. Ex. 237.

Cranwell

President: Air Vice Marshal E. H. MACEY, OBE.

Chairman: Wg. Cdr. T. H. BUSH, MRAsE.

Hon. Secretary: Sqn. Ldr. J. S. PARKER, RAF College, Cranwell, Sleaford, Lincs NG34 8HB. Tel: 0400 61201. Ex. Trenchard 220.

Derby

President: J. O. KEIR, FRAeS.

Chairman: J. F. BUSH, FRAeS.

Hon. Secretary: Vacant. All correspondence to J. F. Bush, Rolls-Royce Ltd, PO Box 31, Derby DE2 8BJ. Tel: 0332 42424. Ex. 726.

Dublin

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

Chairman: Lt. Col. J. L. MOORE, MRAsE.

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

Gatwick

President: A. T. PUGH, FRAeS.

Chairman: T. J. PATRICK, MRAsE.

Hon. Secretary: A. G. SAYCE, MRAsE, 18 Palmers Close, Meath Green, Horley, Sussex.

Glasgow

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

Chairman: C. SNOWDON, AMRAeS.

Hon. Secretary: Dr. A. E. CALDWELL, AMRAeS, Dept of Aeronautics and Fluid Mechanics, The University, Glasgow G12 8QQ. Tel: 041-339 8855. Ex. 329.

Gloucester and Cheltenham

President: Sir ROBERT HUNT, HonFRAeS.

Chairman: K. BEST, FRAeS.

Hon. Secretary: M. D. CHANCE, CEng, MRAsE, Dowty Rotol Ltd, Cheltenham Rd, Staverton, Gloucester. Tel: 0452 712424. Ex. 119.

Halton

President: Gp. Capt. R. H. KYLE, MBE, MRAsE, RAF.

Chairman: Wg. Cdr. J. V. EMERY, OBE, CEng, MRAsE, RAF.

Secretary: Sqn. Ldr. P. G. HISCOCK, RAF, Apprentice Training Wing, RAF Halton, Bucks HP22 5PG. Tel: 0296 623535. Ex. 315.

Hatfield

President: M. J. GOLDSMITH, FRAeS.

Chairman: F. W. VANN, FRAeS.

Hon. Secretary: K. GREEN, MRAsE, 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, MRAsE.

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

London Airport

President: LORD KING of WARTNABY, Assoc. RAeS.

Chairman: LINDA JONES, Assoc. RAeS.

Hon. Secretary: J. D. BROWN, MRAsE, British Airways, Room A123, Technical Block A(S356), London (Heathrow) Airport, Hounslow, Middx TW6 2JA. Tel: 01-750 5603.

Loughborough

President: Professor G. L. WILDE, OBE, FRAeS.

Chairman: Miss D. J. HARGRAVE.

Hon. Secretary: R. H. GILLARD, c/o Transport Technology Dept, Loughborough University of Technology, Loughborough, Leics. LE11 3TU. Tel: Loughborough 0509 263171. Ex. 644.

Manchester

President: C. B. G. MASEFIELD, FRAeS.

Chairman: J. PEDLEY, AMRAeS.

Hon. Secretary: W. JAMES, CEng, MRAsE, 153 Bramhall Lane South, Bramhall, Stockport, Cheshire SK7 2NG. Tel: 061 439 5050.

Medway

President: P. A. HEARNE, FRAeS.

Vice President: M. MOULTON, CEng, MRAsE.

Chairman: I. F. COOPER, CEng, MRAsE.

Hon. Secretary: R. T. TWINE, MRAsE, c/o Marconi Avionics Ltd, Airport Works, Rochester, Kent. Tel: 0634 44400.

Preston

President: F. E. ROE, FRAeS.

Chairman: A. G. BARNES, MRAsE.

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

Prestwick

President: R. McINTYRE, FRAeS.

Chairman: P. BERRY, MRAsE.

Hon. Secretary: I. McDONNELL, FRGS, MRAsE, Auchairne, Ballantrae, Ayrshire. Tel: 046 583 344.

Southampton

President: Professor G. M. LILLEY, HonFRAeS.

Chairman: C. WISE, MRAsE.

Acting Hon. Secretary: D. R. J. BAXTER, CEng, Dept of Aeronautics and Astronautics, The University, Southampton, Hants SO9 5NH. Tel: 0703 559122.

Southend

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

Chairman: P. R. GROUT, AMRAeS.

Hon. Secretary: D. M. GLADSTONE, MRAsE, 36 Brooke House, Town Square, Basildon, Essex SS14 1HX. Tel: Basildon 284621; Work: 22861. Ex. 265.

Stevenage

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

Chairman: N. MUIR, CEng, FRAeS.

Assistant Hon. Secretary: M. J. M. SMITH, British Aerospace, Dynamics Group, Argyle Way, Stevenage, Herts. Tel: 0438 736501.

Swindon

President: W. GILLESPIE, CEng, MRAsE.

Chairman: G. N. M. GINGELL, CEng, MRAsE.

Hon. Secretary: Sqn. Ldr. J. J. D. RICHARDSON, CEng, MRAsE, Air Force Logistic Command Support Centre Europe, RAF Kemble. Tel: Kemble 261. Ex. 264.

Weybridge

President: J. T. STAMPER, FRAeS.

Chairman: B. W. PAYNE, MRAsE.

Hon. Secretary: A. M. DOBSON, MRAsE, British Aerospace plc, Aircraft Group, Weybridge Division, Weybridge, Surrey KT13 0SF. Tel: 97 45522. Ex. 6945.

Yeovil

President: V. A. B. ROGERS, FRAeS.

Chairman: R. A. DOE, FRAeS.

Hon. Secretary: P. J. BAKER, MRAsE, Programme Directorate Lynx, Westland Helicopters Ltd, Yeovil, Somerset. Tel: 0935 75222. Ex. 2624.

OVERSEAS BRANCHES

Hong Kong

Chairman: S. M. JOHN, FRAeS.

Hon. Secretary: M. J. POMFRET, MRAsE, MME Dept, HK Polytechnic, Kowloon, Hong Kong. Tel: Office: 3-638344. Ex. 765. Home: 3-7213732.

Malaysia

Chairman: Brig. General Datuk Ariff AWANG, MRAsE. Hon. Secretary: Zahari Mohd. NOOR, MRAsE, Malaysian Branch of the RAeS, c/o Malaysian Airline System, Technical Services Dept. E & C Workshop Building, Subang Int'l Airport, Subang, Selangor, Malaysia.

Pakistan

Chairman: M. M. SALIM, FRAeS.

Hon. Secretary: Dr. S. A. HASAN, MRAsE, PAF, College of Aeronautical Engineering, Korangi Creek, Karachi 2002, Pakistan.

The AERONAUTICAL Journal

Incorporating the Aeronautical Quarterly



Head of Publications:
Robert Bryanton

Editor: Jay Wolff,
Assoc. Member RAeS

Assistant Editor: Michèle Didyk

Associate Editor:
Professor L. F. Crabtree,
PhD, CEng, FRAeS

4 Hamilton Place, London W1V 0BQ
Tel: 01-499 3515
Telegrams: Didaskalos,
London W1

Advertisements:
Kevin Shead,
T. G. Scott & Son,
30-32 Southampton Street,
London WC2E 7HR.
Tel: 01-240 2032
Telex: 299181.
(Telecopier facilities available)

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: £116 per annum,
post free.

RAeS members: £10.50 per
annum.

Single copies, including back
numbers: £12.

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

43

P. R. Ashill and P. D. Smith

An integral method for calculating the
effects on turbulent boundary-layer
development of sweep and taper

55

W. R. Quinn and G. F. Marsters

Upstream influence on turbulent jet
flows from cruciform nozzles

59

Arthur Rizzi

Spurious entropy production and
very accurate solutions to the Euler
equations

72

Zhou Ming De and L. C. Squire

The interaction of a wake with a
turbulent boundary layer

82

**Library reviews, additions and
reports**

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

The Royal Aeronautical Society

FOUNDED 1866

INCORPORATED BY ROYAL CHARTER 1949

Patron: HER MAJESTY THE QUEEN

COUNCIL 1984/85

President: Dr. G. K. C. PARDOE, PhD, BSc(Eng), DLC, CEng, FBIS, FRAeS.

President-Elect: T. H. KERR, CB, BSc, CEng, FRAeS

Vice-Presidents:

Dr. J. W. FOZARD, OBE, DSc, DCAe, BSc(Hons), FEng, FIMechE, FAIAA, FRAeS
PROFESSOR J. L. STOLLERY, DSc(Eng), DIC, CEng, ACGI, AFAIAA, FRAeS

Past Presidents:

J. T. STAMPER, MA(Cantab), FEng, FRAeS
CAPTAIN E. M. BROWN, CBE, DSC, AFC, MA, FRAeS, RN (Ret'd)
PROFESSOR M. G. FARLEY, HonCGIA, CEng, FIMechE, CBIM, FIProdE, FRAeS

Members:

AIR VICE-MARSHAL M. K. ADAMS, AFC, FRAeS
M. W. ANDERSON, AE, MA(Cantab), CEng, MICE, MSAE, AFAIAA, FRAeS
R. G. AUSTIN, MSc, CEng, MAIAA, FRAeS
AIR CDRE F. R. BANKS, CB, OBE, HonCGIA, CEng, HonFAIAA, MSAE, FIMechE,
HonFRAeS, RAF(Ret'd)
A. E. M. BARTON, DFC, CEng, MRAeS
A. L. BLACKMAN, OBE, MA, FRAeS
V. W. CLARKSON, FRAeS (*Chairman — Branches Committee*)
J. L. CROWDER, MA, CEng, FBIS, AFAIAA, HonMIED, FRAeS (*Chairman — Astronautics
and Guided Flight Section*)
N. FALCONER, BSc, MEcon, FStat, MRAeS
F. W. FREE, CEng, FRAeS (*Chairman, Rotorcraft Section*)
P. A. HEARNE, MSc, DLC, FEng, FIMechE, FRAeS
G. C. HOWELL, MA, MSc, CEng, FRAeS
PROFESSOR G. J. HANCOCK, BSc, PhD, CEng, FIMA, AFAIAA, FRAeS
N. JACKSON, CBE, CEng, FRAeS
D. J. KNIGHT, BSc(Eng), CEng, MRAeS
F. J. LOW, FRAeS
Ms. M. MANNASSI, BSc(Eng), ACGI, AMRAeS
AIR MARSHAL SIR CHARLES PRINGLE, KBE, MA, FEng, CBIM, FRAeS, RAF(Ret'd)
D. J. RICHER, MSc, BSc, CEng, MRAeS
V. A. B. ROGERS, MSc, FEng, FIMechE, FRAeS
P. R. SAMPSON, TEng, AMRAeS
D. STINTON, MBE, CEng, MIMechE, FRAeS
A. T. WORKER, (*Chairman — Graduates' and Students' Section*)

Overseas Divisions

PROFESSOR E. A. BUNT, FRAeS, (*President — Southern Africa Division*)
M. D. A. van OLST, CEng, MRAeS (*President — Zimbabwe Division*)
A. C. WILLIAMS, (*President — New Zealand Division*)
R. J. YATES, CEng, FRAeS (*President — Australia Division*)

Officers:

Hon. Treasurer: C. F. HUGHESDON, AFC, FRAeS

Secretary: B. P. LAIGHT, OBE, MSc, FEng, FIMechE, FRAeS