

The JOURNAL of NAVIGATION

VOL. 26, NO. 2

APRIL

1973

Collision Avoidance in a Traffic System	137
E. S. CALVERT	
Obstacles to the Establishment of Mobile Satellite Communications	145
D. O. FRASER	
Aquino's Short-method Tables	152
C. H. COTTER	
Navigation in the Vertical Plane	167
B. J. CALVERT	
Jester's Transatlantic Passage, 1972	176
MICHAEL RICHEY	
Manœuvring Large Ships in Shallow Water—I	189
J. P. HOOFT	
Collision Avoidance Systems	202
I—A Mariner's View	202
K. D. JONES	
II—Some Navigation Radar Problems	205
P. J. HOUSELEY	
A New Approach to the Presentation of Marine Radar Information	218
S. R. PARSONS AND J. P. STEWART	
Voyage Delay Decisions	230
A. WEPSTER	

FORUM

Time-Scales	235
D. H. SADLER	
Errors of Some Sextant Sights with a Bubble, from the <i>Queen Elizabeth 2</i>	236
F. W. WRIGHT	
The Leap-Second of 31 December 1972	238
D. H. SADLER	
Henry Raper's Spherical Traverse Table	240
C. H. COTTER	
Progress in Port Approaches	244
R. B. RICHARDSON	
A Cautionary Tale	245
P. R. J. REYNOLDS	
Marine and Air Traffic Control	247
J. D. PROCTOR	
Review	250

THE ROYAL INSTITUTE OF NAVIGATION
AT THE ROYAL GEOGRAPHICAL SOCIETY
1 KENSINGTON GORE LONDON SW 7

JOHN MURRAY (PUBLISHERS) LTD., 50 ALBEMARLE STREET, LONDON W1

PRICE TWO POUNDS (£2.00)

THE ROYAL INSTITUTE OF NAVIGATION

Patron

H.R.H. THE PRINCE PHILIP DUKE OF EDINBURGH, K.G., K.T., O.M.

OFFICERS AND COUNCIL 1972-73

President

G. E. Beck

Vice-Presidents

Captain V. A. M. Hunt, C.B.E.

Captain A. J. R. Tyrrell

Honorary Treasurer

F. A. Haworth

Chairman of the Technical Committee

H. E. Smith, O.B.E.

Chairman of the Membership and Fellowship Committee

Captain C. H. Cotter

Other Members of Council

Air Commodore B. Hamilton,

O.B.E., D.F.C., A.F.C.

S. S. D. Jones

Captain I. S. S. Mackay, R.N.

Captain R. Maybourn

Colin Mudie

Captain F. Ormonroyd, D.F.M.

P. G. Reich

R. B. Richardson

Captain P. A. Thompson

Captain R. J. Turner

Executive Secretary M. W. Richey, M.B.E.

The Journal of Navigation

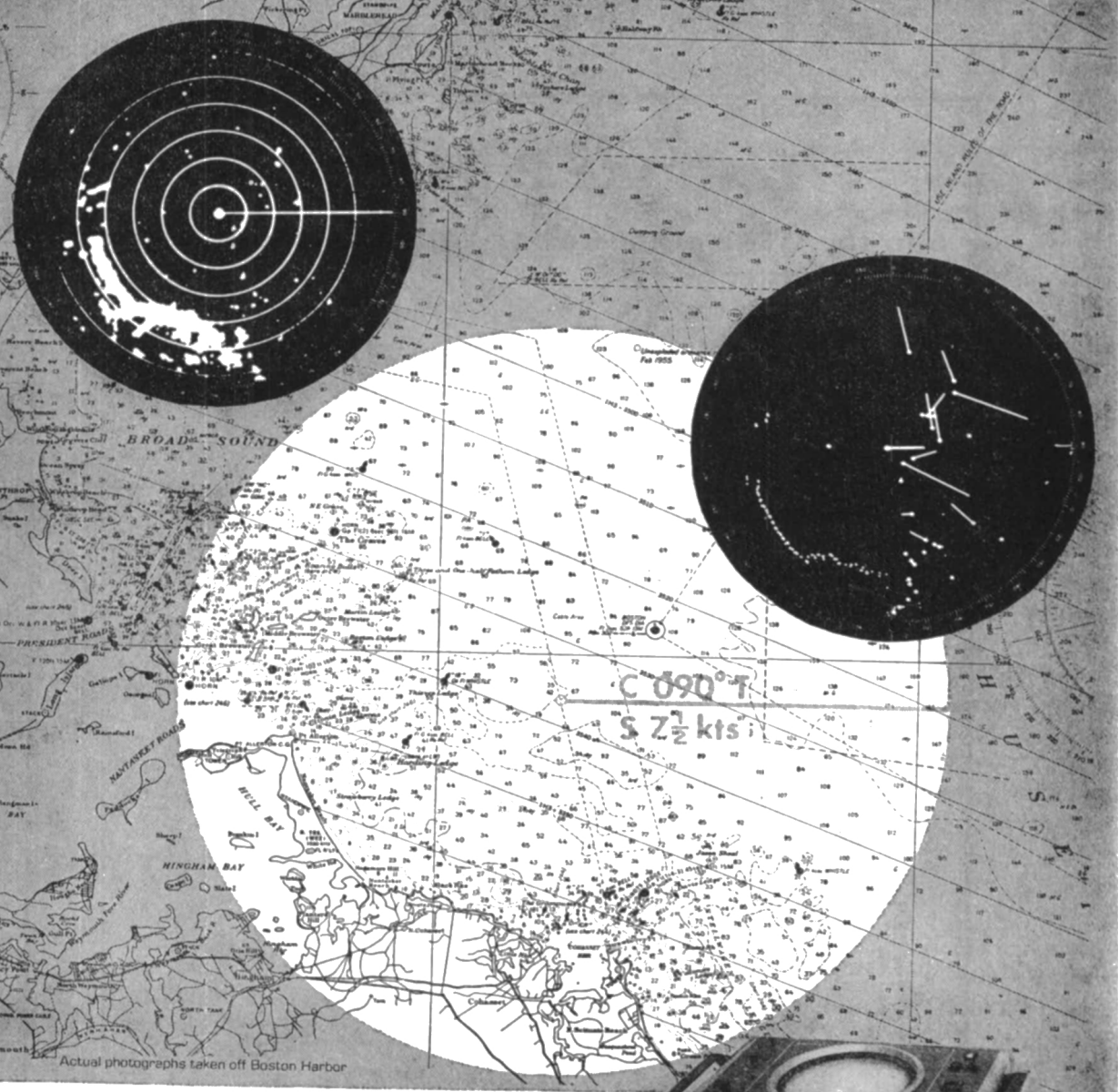
THE *Journal* is published quarterly by the Institute and is edited by M. W. RICHEY. It contains original papers contributing to the science of navigation, including those presented at meetings of the Institute together with the ensuing discussion. In addition the *Journal* includes a record of current navigational work, reviews of important books, and other matters of concern to those interested in navigation. The views expressed in the *Journal* are not necessarily those of the Institute, or of any organization or department to which the authors may belong. Crown Copyright may be reserved.

The *Journal* is issued free to all members of the Institute. It is sold to the public at two pounds per copy or, by subscription, at eight pounds thirty-five per annum (post free) and may be obtained through all booksellers and John Murray (Publishers) Ltd., 50 Albemarle Street, London W1. Back numbers dated two years prior to the current volume may be obtained from William Dawson & Sons, Ltd., (Back Issues Department), Cannon House, Folkestone, Kent.

Enquiries for advertising space should be addressed to the Institute offices.

The postal address of the Institute is The Royal Institute of Navigation, at The Royal Geographical Society, 1 Kensington Gore, London SW7. (Telephone: 01-589 5021).

Volumes of the *Journal* can be bound for two pounds. The parts should be sent to William Clowes & Sons Ltd., 15 Cavendish Square, London, W1M 0HT.



iotron
DIGI PLOT[®]
FULLY AUTOMATIC MARINE RADAR PLOTTER
tested at sea

- Automatic acquisition and tracking
- Chartlike presentation on bright 16" CRT display
- Highest performance at lowest cost
- Immediate delivery

IOTRON CORPORATION • 5 ALFRED CIRCLE • BEDFORD, MASSACHUSETTS U.S.A. • CABLE: IOTRON BOSTON

Institute Publications

In the Wake of the Torrey Canyon: Reflections on a Disaster

by L. Oudet.

'... should be essential and compulsory reading for every navigator of every ship under every flag'. (*Nautical Magazine*.) (Hollis & Carter, £1.00. Members 75p.)

The Haven Finding Art

by E. G. R. Taylor.

'A better book on the art of navigation down to Captain Cook's days has not been written in the English language.' (*Mariner's Mirror*.)

This new edition contains an appendix by Joseph Needham, F.R.S., on the history of navigation in China. (Hollis & Carter, £2.50. Members £2.00 plus postage.)

The Use of Radar at Sea

A Handbook on Marine Radar. (Hollis & Carter, £3.50)

Observational Errors

An elementary account of the ideas behind the statistical theory of errors, by E. W. Anderson & J. B. Parker. (John Murray, 25p)

The Geometrical Seaman

An illustrated work on early navigational instruments, by E. G. R. Taylor & M. W. Richey. (Hollis & Carter, £1.50)

The Mathematical Practitioners of Tudor and Stuart England

by E. G. R. Taylor. (Cambridge University Press, £5.90
Members £4.43 plus postage.)

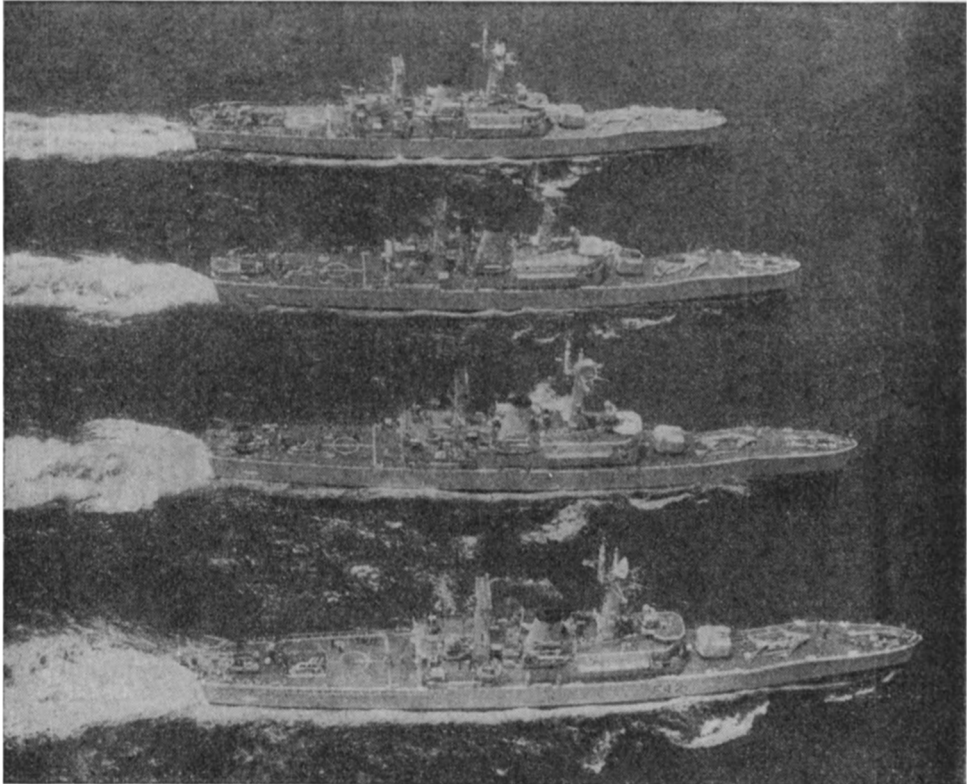
An account of the ideas, instruments and methods in navigation and surveying between 1485 and 1715 with lists of the mathematical practitioners with biographical notes and details of their work.

The Mathematical Practitioners of Hanoverian England

by E. G. R. Taylor. (Cambridge University Press, £6.90
Members £5.17 plus postage.)

This book, a sequel to the earlier volume, takes the story up to 1840, by which time the independent mathematical practitioner had virtually disappeared, absorbed into the large firm or organization as a consequence of industrial and social change.

Marconi complete naval communications



The Marconi comprehensive range of s.s.b/i.s.b naval communications equipment meets all present and foreseeable requirements for voice and automatic telegraphy.

The complete range conforms to Royal Naval standards of resistance to shock, vibration and climatic conditions, and has been NATO codified by the British Ministry of Defence. It is in wide use by the Royal Navy and in the modernization of twenty other navies.

Marconi Communication Systems Limited also has a complete range of communications

equipment available for shore stations; digital transmission, and airborne communications.

In addition the Company is able to assist naval departments and shipbuilders with the planning, fitting, testing and tuning of complete ship communications installations.

Marconi Radio Division, designers and suppliers of h.f and l.f point-to-point systems, line-of-sight and tropospheric scatter microwave systems—part of the total systems capability of Marconi Communication Systems.

Marconi Communication Systems

Complete civil and military static and mobile communication systems

Marconi Communication Systems Limited,

Radio and Space Communications Division, Chelmsford, CM1 1PL, England

A GEC-Marconi Electronics Company

LTD/H94

THE INTERNATIONAL HYDROGRAPHIC BUREAU

Avenue Président J. F. Kennedy, MONACO

publishes

twice a year in January and July,
an English and a French edition of

THE INTERNATIONAL HYDROGRAPHIC REVIEW

This publication contains articles of topical interest on hydrography, hydrographic surveying and related subjects.

Each number contains an average of 160 pages, 18×27 cm., and numerous illustrations.

Price per number 33.50 French Francs, plus postage.

Orders should be sent direct to the Bureau's Headquarters in Monaco, but payments can be made to the Bureau's account at Barclays Bank Ltd., Chief Foreign Branch, 152-156 Upper Thames Street, London, E.C.3. Specify English or French edition when ordering.

A reduction of 25% on the list price is allowed to booksellers. A 30% reduction is granted to government offices and to naval or merchant marine officers of the IHO's Member States who send their orders direct to the Bureau.

Marine Physics

R. E. Craig
*Department of Agriculture and
 Fisheries for Scotland
 Marine Laboratory, Torry
 Aberdeen, Scotland*

February 1973
 viii + 84pp., £1.90

Drawing upon his extremely varied experience of marine science, the author has selected those physical topics most important for engineers and physicists whose interests reach out into the hydrosphere and who may be seeking a general background for their own specialized research.

The volume builds from basic principles an understanding of physical mechanisms at work in the sea, presenting ideas without pursuing them to a point where the results can only be demonstrated by employing high-level mathematics. The author has written for undergraduate and graduate students and research workers in engineering and physics, and all branches of marine science. It will also be of value to fisheries institutes, schools of navigation and university departments of geography and meteorology.

Contents: Density currents in the sea. Diffusion processes in the sea. Wind currents in deep water. Qualitative physical oceanography. Waves in deep and shallow water. The tides. Optics. Acoustics. Appendix: Some physical properties of seawater. Index.



ACADEMIC PRESS London and New York
 24-28 Oval Road, London NW1, England
 111 Fifth Avenue, New York, NY 10003, USA

NEW 'SOLID STATE' CHERNIKEEFF

Accurate and dependable at all speeds from 1-Knot.

Distance run to 1/100th of a Knot.

Suitable for Ship's 'Side' and 'Bottom' Installation, with equal accuracy.

DIGITAL SPEED PRESENTATION.

ANALOG and **SERVO** Systems interface to Navigational Computers available.

Complete Electronics of Equipment is now housed in a Single Display Unit, reducing Installation costs and weight to a minimum.

Radar outputs to all known makes are available as a standard fitting.

Remote Control of Retractable Log Tube can be provided.

The ideal Log for all Types of Vessels backed by over 50 years' experience in design and manufacture of CHERNIKEEFF's Impeller System.

Log makers to the British Navy and Overseas Navies for more than 40 years.

MARCONI-MARINE world wide service available to users.

Sole Makers

The Submerged Log Company (1962) Limited,
565/569 High Road, Chiswick, London, W4 3AW, England.

Telephone: CHISWICK 01-994 6685/6

Telegrams: CHERLOG LONDON W.4

'NAVIGATION—No. 81'

January 1973—TWENTIETH ANNIVERSARY NUMBER

NAVIGATION (Paris), the quarterly Journal of the French Institute of Navigation, is available to Members of the Institute at the preferential subscription rate of £4.00 per annum. The special January 1973 issue contains the following papers.

Avant propos du président: l'Institut Français de Navigation a 20 ans

1. Adresse du Chef d'Etat-Major de la Marine
2. Adresse du Chef d'Etat-Major de l'Air
3. Adresse du Secrétaire Général de la Marine Marchande
4. Adresse du Secrétaire Général à l'Aviation Civile

LES NOUVEAUTES TECHNIQUES

1. Navigation de véhicules marins à plus de 50 noeuds par P. PRABONNEAU (Thomson CSF) et J. BARRIAC (Sagem)
2. Applications de l'Infra-rouge à la navigation par C. LEMONON

CHRONIQUE DU NAVIGANT

1. Commennavigue-t-on actuellement sur les navires français par P.H.
2. Evolution et aspect actuel de la navigation aérienne par P. FOMBONNE
3. La navigation des sous-marins par B. LOUZEAU
4. La traversée de l'Atlantique en solitaire par "Jester" en 1972 par M. W. RICHEY
5. Comment naviguent aujourd'hui les arabes de l'Océan Indien par H. GROSSET-GRANCE

INFORMATIONS

1. Le nouveau règlement international pour prévenir les abordages en mer (Londres 4-20 Octobre 1972)
2. Le Congrès International des Instituts de Navigation d'Europe et des Etats-Unis (Hanovre 2-5 Octobre 1973)

CHRONIQUE DES LIVRES & REVUES

MARINE OBSERVER

A quarterly journal of maritime meteorology prepared by the Marine Division of the Meteorological Office, containing articles on weather, currents, ice conditions, meteorological observing at sea, and the practical use of a knowledge of meteorology to seamen. A large part of each issue is devoted to reports of meteorological and other scientific phenomena which have been contributed by voluntary observing ships.

Published in January, April, July, October, by Her Majesty's Stationery Office. 42½p (by post 46p) per issue ; annual subscription £1.88 including postage

Available from the Government Bookshops in London, (post orders to PO Box 569, SE1 9NH), Edinburgh, Cardiff, Belfast, Manchester, Birmingham and Bristol, or through booksellers



HMSO BOOKS

USEFUL BOOKS ON NAVIGATION AND SHIPPING LAW

NICHOLLS'S CONCISE GUIDE

Vol. I Fundamental Principles and Second Mates

Revised by H. H. BROWN, D.S.C.*, R.D. Extra Master.

£4.00

Per Post £4.25

Vol. II Mate, Master and Extra Master

£2.20

Per Post £2.45

PRACTICAL NAVIGATION FOR SECOND MATES

Revised by Capt. G. C. JOHNSON

£2.10

Per Post £2.20½

A HISTORY OF THE PRACTICE OF NAVIGATION

By J. B. HEWSON, F.R.G.S., R.D., R.N.R.(Retd.)

£2.00

Per Post £2.25

SHIP BROKERS AND THE LAW

By E. J. EDWARD, L.L.B.(Lond.)

£1.50

Per Post £1.63½

LAW AND PRACTICE OF SEA TRANSPORT

By Capt. L. F. H. STANTON, A.M.INST.T.

£3.15

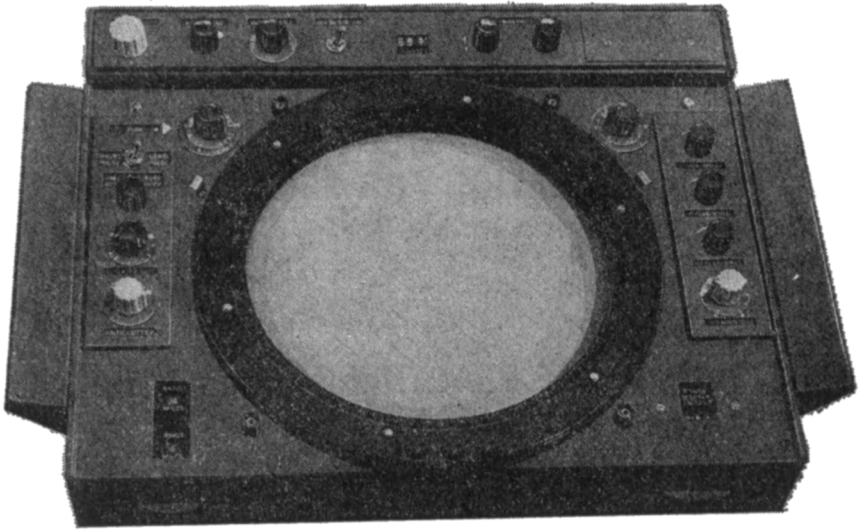
Per Post £3.40

Catalogue "N" free on request

BROWN, SON & FERGUSON, LTD

52 DARNLEY STREET, GLASGOW, G41 2SG

The simple radar



RADIOLOCATOR—radar designed throughout for simplicity and reliability

Conventional . . . yes, but the best of its kind. 'Radiolocator' gives you really dependable, workaday radar at the right price.

Solid-state circuitry. Only two thermionic devices—a long-life magnetron and choice of 12-inch or 16-inch CRT. All normal marine radar facilities, plus true bearing indication, are standard; and options include True Motion, compass stabilisation, reflection plotter, dual displays, and full or partial interswitching of dual installations.

Marconi Marine radar

The Marconi International Marine Co. Ltd.

Chelmsford Essex England

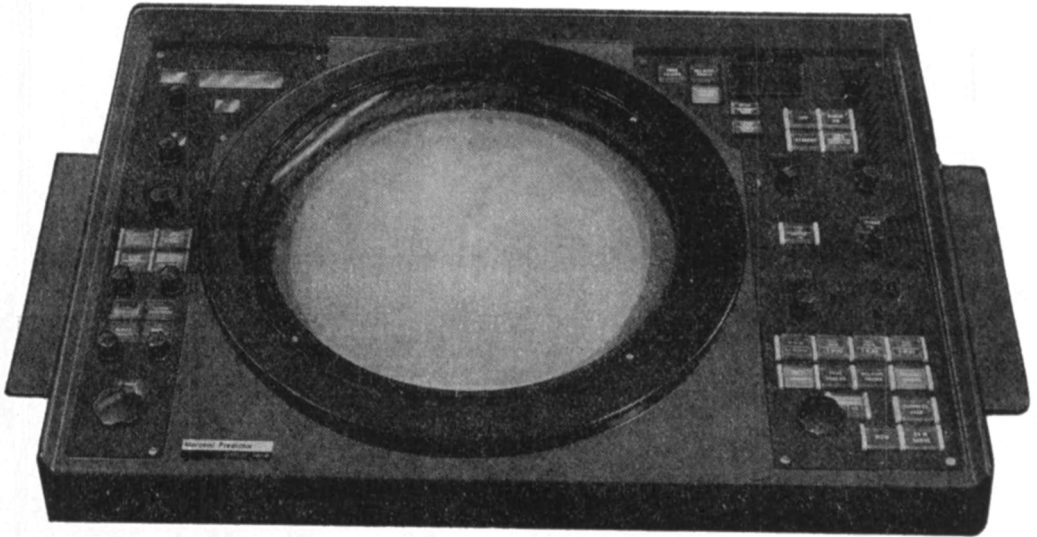
Tel (0245) 61701 Telex 99228 • A GEC-Marconi Electronics Company



COMMUNICATION
NAVIGATION
RADAR
SOUND AND TV

Come to **MARINEX '73** Exhibition at The Waldorf Hotel, London, 10th to 12th April

The thinking radar



PREDICTOR—the most advanced marine radar in the world

Radar plotting is as easy as pressing a button. 'Predictor' radar tracks and plots every target on the screen continuously, automatically and with infallible accuracy. True or relative tracks are presented as 4 plots equally spaced in time, up-dated every 10 seconds.

And before you alter course or speed, 'Predictor' will work out the new triangle of velocities for every target and plot the *impending* situation—before you alter.

Marconi Marine radar

The Marconi International Marine Co. Ltd.

Chelmsford Essex England

Tel (0245) 61701 Telex 99228 • A GEC-Marconi Electronics Company



COMMUNICATION
NAVIGATION
RADAR
SOUND AND TV

Come to **MARINEX '73** Exhibition at The Waldorf Hotel, London, 10th to 12th April

'NAVIGATION, U.S.A.'

Navigation, the quarterly Journal of the American Institute of Navigation, is available to members of this Institute at a reduced subscription of £2 a year. Volume 19, No. 4 (Winter 1972), contains the following papers.

ON BOARD OPTICAL NAVIGATION DATA FROM MARINER 71

T. C. Duxbury and C. H. Acton, Jr.

NAVIGATING TO AVOID A KNOWN NOISE SOURCE

T. M. Pienkowski

LOCATING DOWNED AIRCRAFT BY GRAN (GLOBAL RESCUE ALARM NET)

W. R. Crawford and W. E. Rupp, Jr.

SIGHT REDUCTION USING THE PORTABLE SEXTANT COMPUTER SYSTEM

S. Feldman, P. K. Seidelmann, E. D. Stephenson and H. C. Ketts

NAVIGATION IN SPACE, THE FUTURE, AND ARTIFICIAL INTELLIGENCE

J. E. Gaffney, Jr.

GYRO DRIFT DETECTION AND ISOLATION FOR A TWO-IMU CONFIGURATION

J. H. Hunter

CELESTIAL FIX—INTERNAL OR EXTERNAL?

Alton B. Moody

UNIQUE CHARTS FOR SPACE MISSIONS

R. W. Carder

INTEGRATED NAVIGATION SYSTEMS AND KALMAN FILTERING: A PERSPECTIVE

R. G. Brown

SECANT, A SOLUTION TO THE PROBLEM OF MID-AIR COLLISION

W. B. Miles

SPACE SHUTTLE LANDING NAVIGATION USING PRECISION DISTANCE-MEASURING

EQUIPMENT

W. S. Widnall and H. R. Morth

ROYAL GEOGRAPHICAL SOCIETY

MAP OF THE MOUNT EVEREST REGION

Scale 1 : 100,000

The Society's map of the Mount Everest region has been reprinted in slightly modified form and stocks are now available. The map, compiled and drawn in the Society's Drawing Office, represents the Society's association with successive Mount Everest expeditions over the last fifty years.

Price £2.00 including postage and packing.

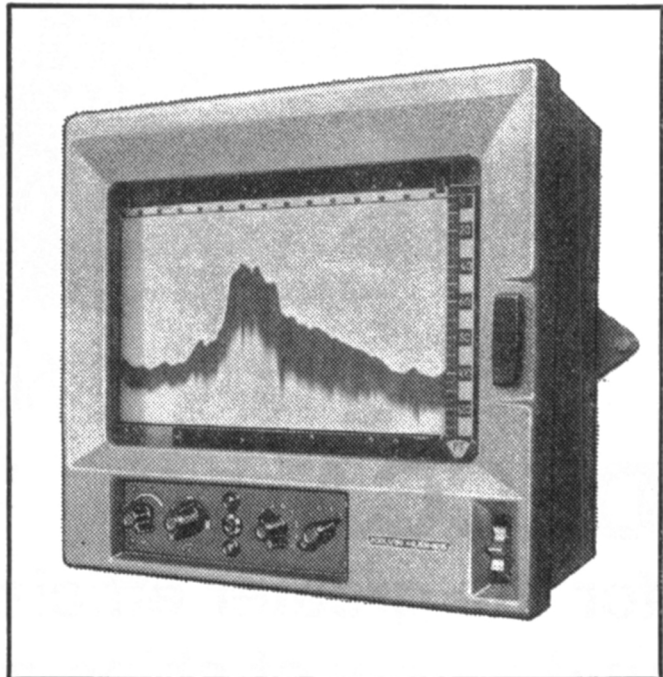
The Kelvin Hughes MS 45 for an accurate picture in depth

The Kelvin Hughes MS 45 never leaves you in any doubt about the situation below water. This impressive modern navigation sounder always provides an exceptionally clear and accurate indication of depth. The chart in the large display window is both wide and long; ensuring good magnification of the seabed contour,

and assisting the navigator's appreciation of depth trend. The clear and unambiguous scale, with its bold yellow markings, is positioned so as not to obscure the chart in any way. Clear and accurate depth indication goes hand in hand with reliability - to give you an echo sounder with a truly outstanding performance.

KELVIN HUGHES

masters of marine electronics  internationally

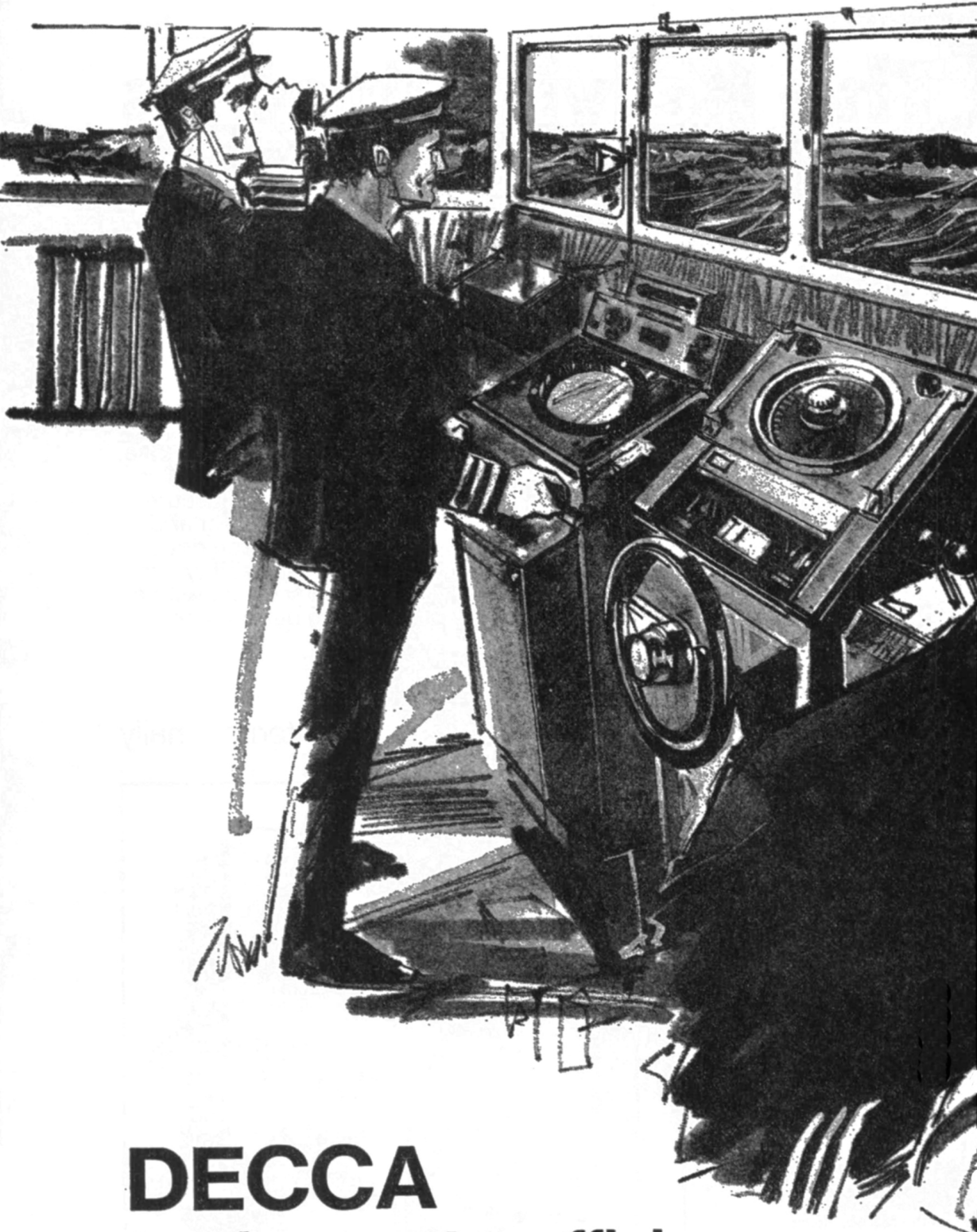


For full details of the MS 45, please write or telephone:



KELVIN HUGHES
A DIVISION OF SMITHS INDUSTRIES LIMITED

New North Road, Hainault, Ilford, Essex, England.
Tel: 01-500 1020

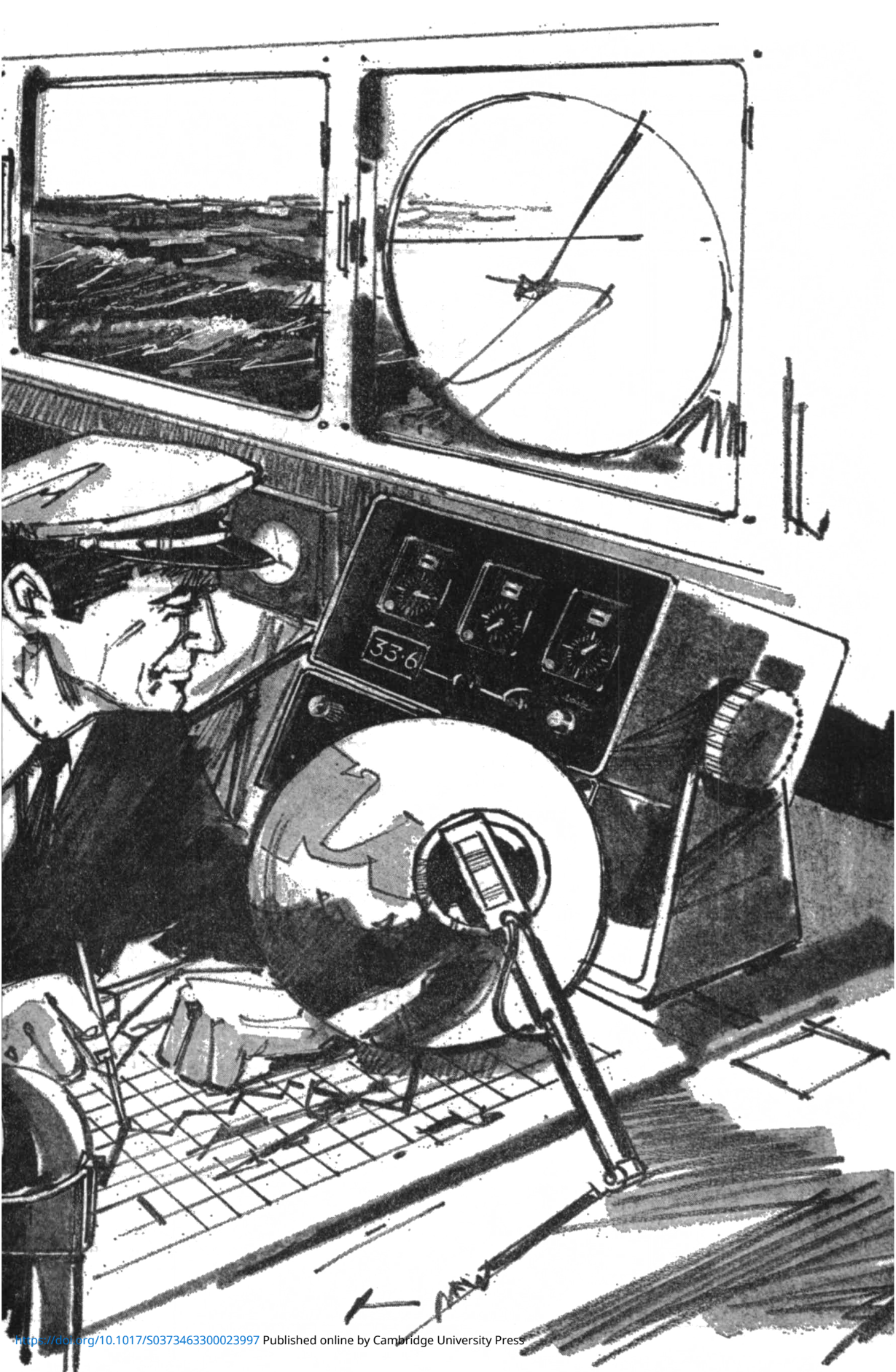


DECCA

for the greater efficiency
and safety of ships at sea

THE DECCA NAVIGATOR COMPANY LIMITED. DECCA RADAR LIMITED. LONDON

<https://doi.org/10.1017/S0373463300023997> Published online by Cambridge University Press



NOW PUBLISHED

**MARINE
TRAFFIC
ENGINEERING**

Proceedings of a Conference
organized jointly by the
ROYAL INSTITUTION
OF NAVAL ARCHITECTS
and the
ROYAL INSTITUTE
OF NAVIGATION
at the
NATIONAL PHYSICAL LABORATORY
MAY 1972

PRICE £6