

# The JOURNAL of NAVIGATION

---

VOL. 29, NO. 1

JANUARY

1976

<b>Navigation and Technology</b>	1
PRESIDENTIAL ADDRESS BY G. E. BECK	
<b>Nautical Astronomy and the Mercator Principle</b>	14
CHARLES H. COTTER	
<b>Route Finding by Desert Aborigines in Australia</b>	21
DAVID LEWIS	
<b>Manœuvres in Fog Compatible with the Collision Regulations</b>	39
O. I. MITROFANOV	
<b>The Course of Navigation</b>	49
DOUGLAS J. LINDSAY	
<b>Navigation for the Fishing Industry</b>	57
GREGORY HAINES	
<b>On Error Distributions in Navigation</b>	69
O. D. ANDERSON	
<b>Misalignment Angle and Calibration of a Two-component Electromagnetic Log</b>	76
M. J. R. FASHAM	
<b>An Automated Integrated Ship's Bridge Layout</b>	82
C. ABRAMOWSKI	

## FORUM

<b>Rate and Ratio in Radar Collision Avoidance</b>	90
J. VENDRELL	
<b>Education and the Sea</b>	93
L. W. J. FIFIELD	
<b>Automatic Radar Plotting Systems</b>	94
F. J. WYLIE	
<b>Multiple Sun Sights with One Reduction</b>	95
JOHN P. BUDLONG	
<b>Further Comments on the Calculation of Position Line Data with a Computer Calculator</b>	97
JOHN A. READ	
<b>Record</b>	100
<b>Reviews</b>	106

---

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

---

SCOTTISH ACADEMIC PRESS LTD., 25 PERTH STREET, EDINBURGH EH3 5DW

---

PRICE TWO POUNDS FIFTY (£2.50)

---

# THE ROYAL INSTITUTE OF NAVIGATION

*Patron*

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

*OFFICERS AND COUNCIL 1975-6*

*President*

Sir Edward Fennessy, C.B.E.

*Vice-Presidents*

Captain B. J. Calvert

Mrs. Mary Pera

*Honorary Treasurer*

Lieut-Comdr. R. B. Richardson,

*Chairman of the Technical Committee*

Captain R. Maybourn

*Chairman of the Membership and Fellowship Committee*

Captain C. H. Cotter

*Other Members of Council*

Prof. A. N. Black

Rear Admiral D. W. Haslam, O.B.E.

A. H. Jessell

Dr. J. F. Kemp

S. Ratcliffe

Group Captain H. L. Sheppard, R.A.F.

F. S. Stringer

Captain R. J. Turner

Captain A. J. R. Tyrrell

Lieut.-Comdr. D. W. Waters

---

*Director* M. W. Richey, M.B.E.

*Secretary* D. Nicolson

---

## 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 fifty per copy or, by subscription, at ten pounds fifty per annum (post free) and may be obtained through all booksellers and Scottish Academic Press Ltd., 25 Perth Street, Edinburgh EH3 5DW. 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.

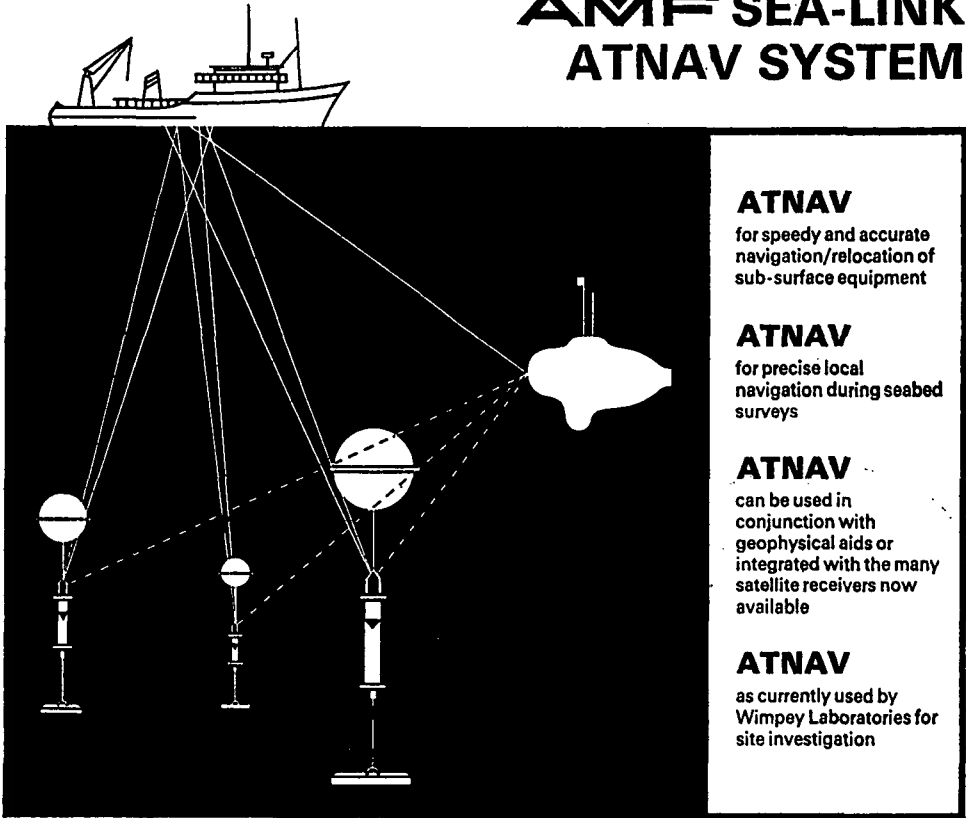
Enquiries for advertising space should be addressed to the Institute offices.

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 5011).

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.

# Key to exploration

## AMF SEA-LINK ATNAV SYSTEM



**ATNAV**  
for speedy and accurate navigation/relocation of sub-surface equipment

**ATNAV**  
for precise local navigation during seabed surveys

**ATNAV**  
can be used in conjunction with geophysical aids or integrated with the many satellite receivers now available

**ATNAV**  
as currently used by Wimpey Laboratories for site investigation

ATNAV is obtainable from Marconi Space and Defence Systems Limited, specialists in underwater systems, and sole UK Distributors and European Servicing Agents for AMF Sea-Link Equipment.

Marconi Space and Defence Systems Limited  
Naval and Ocean Engineering Division  
Chobham Road, Frimley, Camberley, Surrey.  
Telephone: Camberley (0276) 63311 Telex: 85289  
Telegrams: Spadef, Camberley.



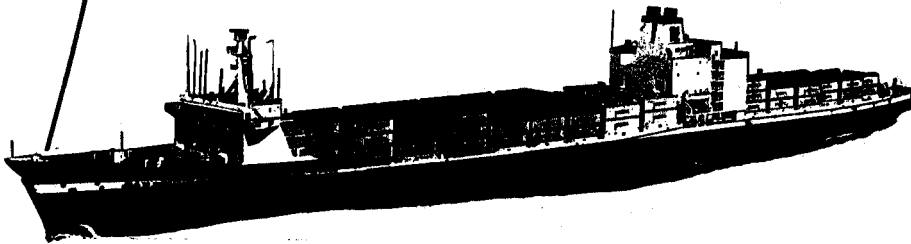
A GEC-Marconi Electronics Company

LTD/S23A

# SEA-LAND SELECTS DIGILOT

COLLISION AVOIDANCE  
FOR 12 CONTAINERSHIPS

One of 155  
INSTALLATIONS  
throughout  
the world



## DIGILOT®

FULLY AUTOMATIC MARINE RADAR PLOTTER

- Chartlike presentation on bright 16" CRT display.
- Automatic acquisition and tracking.
- Automatic plotting continuously updated without manual assistance.
- Potential collision threats assessed at a glance at all times.
- Automatic CPA Alarm and trial maneuver facilities.
- World-wide installation and service.



IOTRON CORPORATION • 5 ALFRED CIRCLE • BEDFORD, MA. U.S.A.  
CABLE: IOTRON BOSTON • TELEX: 92-3429

# INTRODUCING



# AUTO-MATE®

AUTO-MATE®, Iotron's modular bridge data system, is a complete integrated bridge automation package that applies the most advanced computer techniques to the solution of the demanding problems which confront operators of today's ships. Iotron Corporation, manufacturer of DIGIPILOT, the world's leading marine collision avoidance equipment, has developed AUTO-MATE as an evolutionary extension to the capabilities of DIGIPILOT. This new system will provide the same efficient and easy use as DIGIPILOT.

## DUAL FUNCTIONS - DUAL COMPUTERS

### ANTI-COLLISION

#### DIGIPILOT®

##### NEW FEATURES

- BRIGHT INTRINSIC RADAR PICTURE
- TRUE MOTION-TRIAL MANEUVER
- COMPUTER DRAWN CHART LINES FROM NAV SYSTEM

### NAVIGATION

#### DIGINAV®

- AUTOMATIC WORLD WIDE POSITION FIXING FROM SAT-NAV & SKYWAVE CORRECTED OMEGA
- DECCA-LORAN C CHART LINE POSITIONING FOR COASTAL HAZARD AVOIDANCE
- DIGIPILOT ADAPTIVE AUTOPILOT

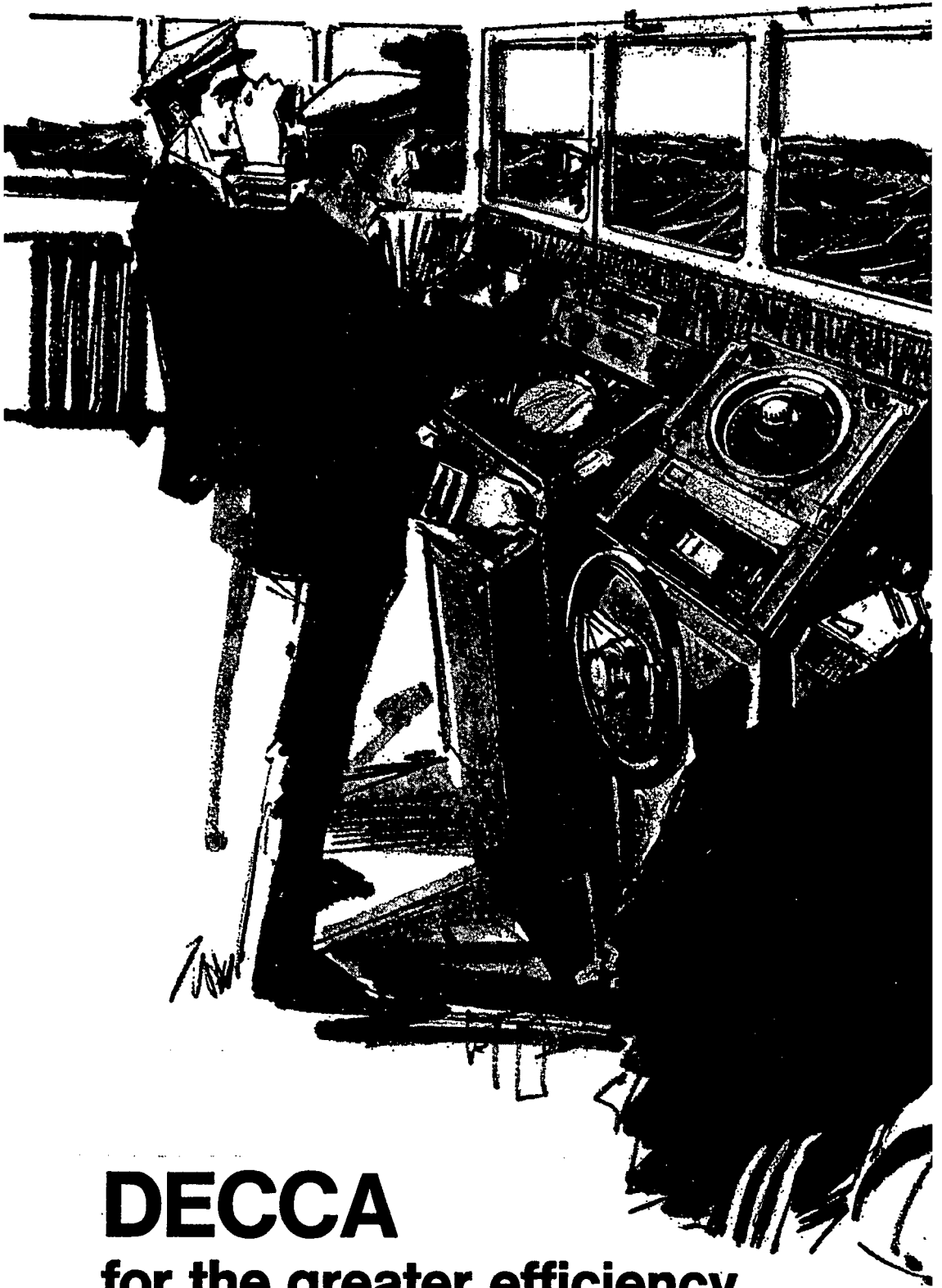
#### DIGIDATA®

- OPTIONAL RECORDING

---

<b>35 Customers bought 165 DIGIPILOTS</b>	
LNG & LPG carriers _____	12
Tankers VLCC's _____	61
50-200 kdwt _____	18
18-50 kdwt _____	38
Containerships _____	23
Other _____	13

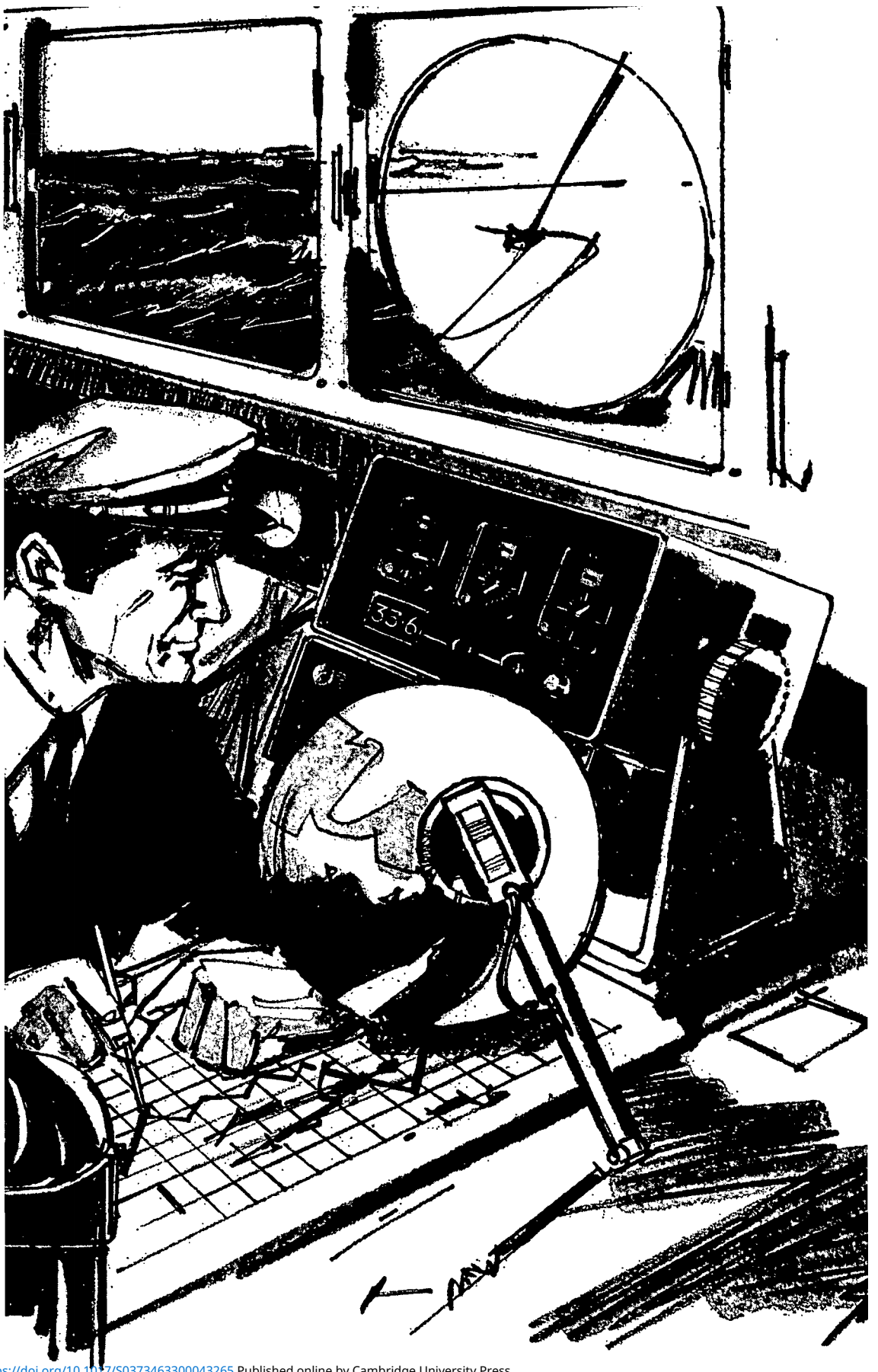
**IOTRON CORPORATION** 5 Alfred Circle Bedford, Mass., U.S.A. Telephone (617) 275-0340 Cable: Iotron Boston Telex: 92-3426.



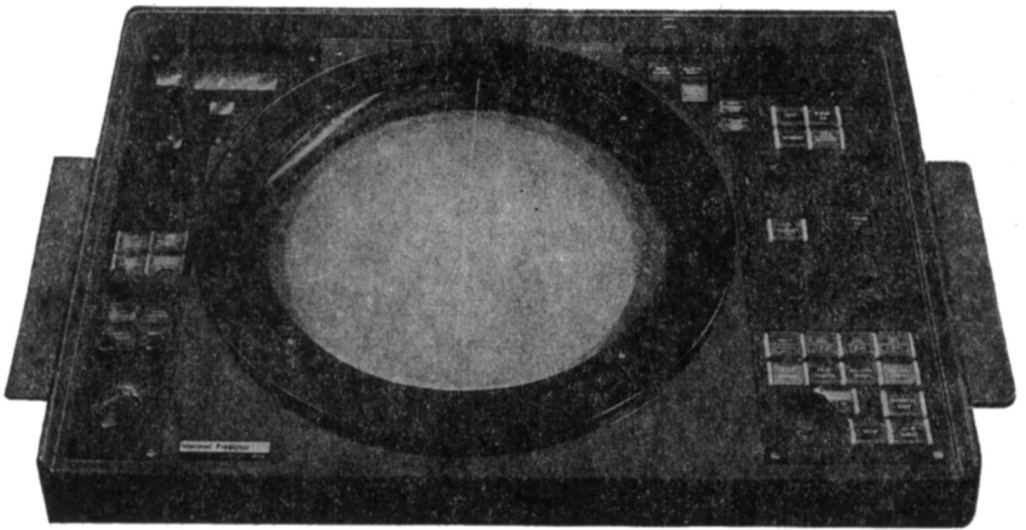
# DECCA

for the greater efficiency  
and safety of ships at sea

THE DECCA NAVIGATOR COMPANY LIMITED. DECCA RADAR LIMITED. LONDON



# INFALLIBILITY



## PREDICTOR II—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

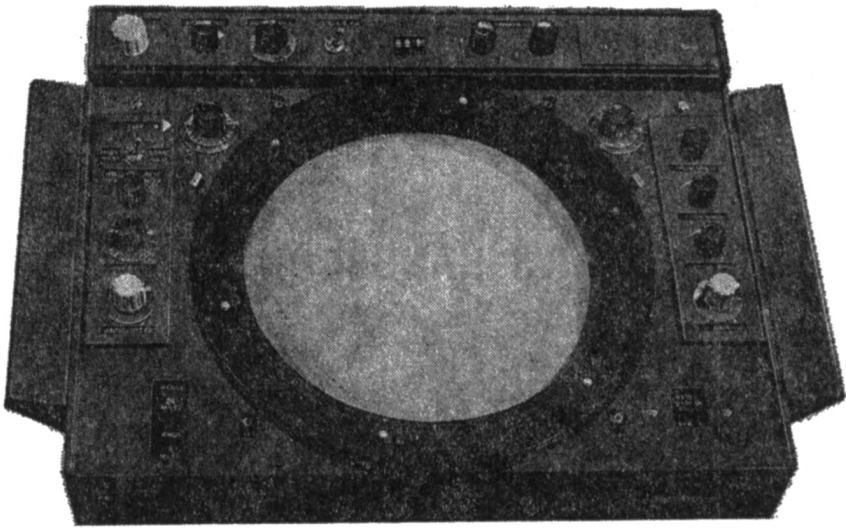
Tel (0245) 61701 Telex 99228 • A GEC-Marconi Electronics Company



COMMUNICATION  
NAVIGATION  
RADAR  
SOUND AND TV



# DEPENDABILITY



## 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

# **USEFUL BOOKS ON NAVIGATION**

---

## **AND SHIPPING LAW**

---

### **NICHOLLS'S SEAMANSHIP AND NAUTICAL KNOWLEDGE**

Revised by H. H. Brown, D.S.C., R.D. Extra Master

£6.75

Per post £7.37

### **RADAR OBSERVER'S HANDBOOK**

By WILLIAM BURGER, M.Sc. (Wales) Extra Master

£4.80

Per post £5.09

### **THE DOCKS REGULATIONS 1934 EXPLAINED**

Revised by CHARLES A. COTTER, B.Sc. Extra Master

75p

Per post 95p

### **SHIPBROKERS AND THE LAW**

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

£1.50

Per post £1.80

### **NICHOLLS'S CONCISE GUIDE VOLUME I**

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

£8.00

Per post £8.62

*Catalogue "N", giving further titles and details, free on request.*

**BROWN, SON & FERGUSON, LTD.,**

**52 DARNLEY STREET, GLASGOW, G41 2SG**

# 'NAVIGATION (U.S.A.)'

*Navigation*, the quarterly Journal of the American Institute of Navigation, is available to Members of the Institute at a reduced subscription of £2.00 a year. Volume 22, No. 3 (Autumn 1975) contains the following papers.

## ACCURACY SPECIFICATIONS FOR AUTOMATIC OMEGA RECEIVERS

*F. C. Sakran, Jr.*

## APPLICATION OF OPTIMAL ESTIMATION TECHNIQUES TO ACOUSTIC TRANSPONDER NAVIGATION SYSTEMS

*H. E. Lee*

## RECENT RESULTS ON PARAMETRIC ANALYSIS OF DIFFERENTIAL OMEGA ERROR

*E. G. Baxa, Jr. and P. V. Piserchia*

## DIGITAL PHASE PROCESSING FOR LOW-COST OMEGA RECEIVERS

*D. B. Cox, Jr., E. V. Harrington, Jr., W. H. Lee and W. M. Stonestreet*

## MAXIMUM LIKELIHOOD ESTIMATION APPLIED TO A FOUR FREQUENCY OMEGA EXPERIMENT

*C. J. Waylan and J. E. Ohlson*

## BINARY PROCESSING AND DISPLAY CONCEPTS FOR LOW-COST OMEGA RECEIVERS

*R. W. Lilley*

## EVALUATION OF REAL-TIME ALGORITHMS FOR OMEGA PROPAGATION PREDICTION

*A. N. Beavers, Jr., D. E. Gentry and J. F. Kasper, Jr.*

## AN EVALUATION OF DIFFERENTIAL OMEGA FOR GENERAL AVIATION AREA NAVIGATION

*W. M. Hollister and S. M. Dodge*

## ALTERNATIVE APPROACHES TO INTEGRATED AIRBORNE OMEGA/INERTIAL NAVIGATION

*D. E. Gentry, J. A. D'Appollo and J. F. Kasper, Jr.*

## THE INSTITUTE'S PROFESSIONAL FILE

# 'NAVIGATION'

*NAVIGATION* (Paris), the quarterly Journal of the French Institute of Navigation, is available to Members of the Institute at the preferential subscription rate of £5.00 per annum. The October 1975 issue contains the following papers.

## I. LES NOUVEAUTES TECHNIQUES—

1. Transformation d'un gyromètre stabilisé en navigateur inertiel par C. REMUZZI & A. LEHRER (Sperry Gyroscope Cy)
2. Le point astronomique sans éphémérides par P.H.
3. La navigation de surface par J. PLAIGNAUD (ITA)
4. Le premier système anti-collision sol, opérationnel pour la navigation aérienne: le GP.W.S. par F. BENOIT (STNA)

## II. CHRONIQUE DU NAVIGANT—

1. La navigation des petits bateaux par M. W. RICHEY (suite et fin)
2. Le service des Phares & Balises par J. PRUNIERAS
3. L'OMEGA et le système hybride "OMEGA-INERTIE" par J. DARVENNE & R. DEBRAS
4. Navigation au plus près des batiments phéniciens par J. C. DEMERLIAC

## III. INFORMATIONS—

## IV. CHRONIQUE DES LIVRES & REVUES—

# THE INTERNATIONAL HYDROGRAPHIC REVIEW

160 pages (approx), 18×27 cm. Price 50 French francs.

Among the papers of navigational interest in the number of  
January 1976 are :

- Developments in narrow-beam echo-sounders (S. B. MACPHEE)
- Identified submerged objects (JAMES DAWSON)
- Satellite navigation in hydrography (R. M. EATON *et al.*)
- Chart design considerations for the navigators of today and tomorrow (A. J. KERR)
- 500 years of graphical and symbolical representation on marine charts (G. S. RITCHIE)

PUBLISHED BY THE

**INTERNATIONAL HYDROGRAPHIC BUREAU**

**Avenue Président J. F. Kennedy, Monte-Carlo, Monaco**

---

The Bureau also publishes monthly

## **THE INTERNATIONAL HYDROGRAPHIC BULLETIN**

A bi-lingual journal—English and French—giving news of hydrographic activities worldwide. Lists in detail all new charts published by Member States of the International Hydrographic Organization, and contains an extensive monthly bibliography on Oceanography, Navigation, etc.

Approx. 30 pages, 21×30 cm

Yearly subscription: 60 French Francs

Individual issue: 6 French Francs

## Institute Publications

### **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, £3.75 plus postage.)

### **The Geometrical Seaman**

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

### **The Mathematical Practitioners of Tudor and Stuart England**

by E. G. R. Taylor. (Cambridge University Press, £10.00  
Members £8.50 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.

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

by L. Oudet

An investigation of all the implications for shipping today of the great oil-spill of 1967. (Hollis & Carter, £1.00. Members 75 p plus postage.)

ROYAL GEOGRAPHICAL SOCIETY

# Map of Rockall

Scale 1:50 000  
Size 42 x 59.4 cm

From latest hydrographic surveys, with a  
contoured map of the island by G. S. Holland  
from air photographs

Price £1.00 including postage

Further details of this map and other publications and maps  
of the Society are obtainable from

PUBLICATIONS OFFICE,  
1 KENSINGTON GORE, LONDON SW7 2AR



## Blaeu County Maps

The Society has published jointly with John Bartholomew & Sons Ltd,  
a number of county maps in colour, from Blaeu's rare atlas of 1648

*The following counties are available. Size 61 x 45 cm*

- |               |                                  |                 |
|---------------|----------------------------------|-----------------|
| CAMBRIDGE     | CHESHIRE                         | CORNWALL        |
| CUMBRIA       | DERBYSHIRE                       | DEVON           |
| ESSEX         | GLOUCESTERSHIRE                  | HAMPSHIRE       |
| HERTFORDSHIRE | KENT                             | LANCASHIRE      |
| MIDDLESEX     | NORFOLK                          | NOTTINGHAMSHIRE |
| OXFORD        | STAFFORDSHIRE                    | SURREY          |
| SUSSEX        | WARWICKSHIRE &<br>WORCESTERSHIRE | YORKSHIRE       |

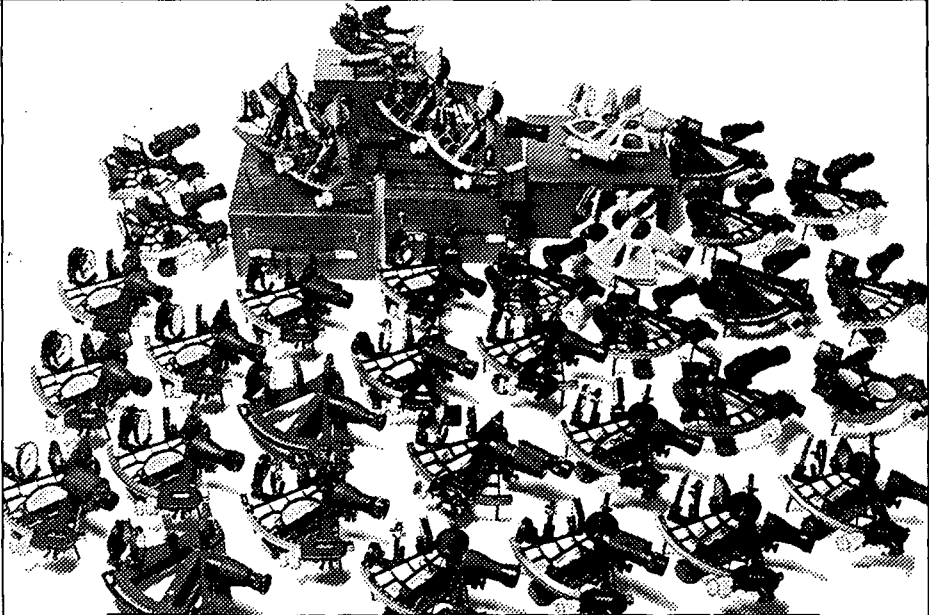
The price of all maps is £1.50 each including postage, they are packed in plastic  
map rolls and are suitable for framing.

From: Publications Department, Royal Geographical Society,  
1 Kensington Gore, London SW7 2AR.

# SEXTANTS FROM THE WORLD'S GREAT INSTRUMENT MAKERS

At Potters you can choose from a range of sextants second to none—Heath—Cooke—Zeiss—C. Plath—Toizaki—Cassens & Plath—for the last three names we are the sole U.K. sales concessionaires—then there are Ebbco for young

navigators and yachtsmen—older sextants which we have recertified—we will re-certify your present sextant or buy it against a new one at a good price. When you are choosing a sextant make sure to visit Potters where you really have a choice...



## J. D. POTTER LTD

The Pure Navigators, Established 1830 145 Minories, London EC3N 1NH. Tel: 01-709 9076 (5 lines)  
Cables: Adcharts London EC3. TeleX: 887386. 24 hour Telephone service.



An encampment in the desert. An article on route finding by desert Aborigines appears at p. 21.