

The JOURNAL of THE INSTITUTE OF NAVIGATION

VOL. 16, NO. 2

APRIL

1963

The Automation of Ships' Navigation Systems	145
C. T. CLAYTON AND C. G. KURZ	
The Navigation of a Communication Satellite	163
J. E. CLEGG	
Some Oceanography from the Past	180
J. N. CARRUTHERS	
The Mathematical Approach to the Collision Problem	189
A DISCUSSION	
Navigation and Communication in Project Beacon	206
H. GIESECKE	
Telecommunications and Identification of Radar Information	212
L. GÉRARDIN	
An Experimental Airborne Computer	216
W. R. PAYNE	
High-Level Turbulence over Europe and the Mediterranean	220
J. BRIGGS	
Service Area Calibration of Hyperbolic Navigation Systems	227
J. E. SULLIVAN AND W. A. PORTER	

FORUM

Hovercraft and the Collision Regulations	243
A Theoretical Note on System Malfunctioning	244
The Sextant and Precision Celestial Navigation	246
The Use of the Planetarium in Navigation Instruction	249
Radar Simulator Courses	253
Record	256
Reviews	259

THE INSTITUTE OF NAVIGATION
AT THE ROYAL GEOGRAPHICAL SOCIETY
1 KENSINGTON GORE LONDON SW7

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

PRICE FIFTEEN SHILLINGS

THE INSTITUTE OF NAVIGATION

Patron

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

OFFICERS AND COUNCIL 1962-63

President

Dr. G. E. R. Deacon, C.B.E., F.R.S.

Vice-Presidents

Dr. D. F. Adams

Rear-Admiral E. G. Irving, O.B.E.

Hon. Treasurer: Mr. J. E. D. Williams

Chairman of the Technical Committee

Wing Commander E. W. Anderson, O.B.E., D.F.C., A.F.C.

Chairman of the Membership and Fellowship Committee

Captain A. J. R. Tyrrell

Other Members of the Council

Captain R. C. Alabaster,
D.S.O., D.F.C.

Mr. G. E. Beck

Captain M. E. Butler Bowdon,
O.B.E., R.N.

Mr. F. G. G. Carr, C.B.E.

Mr. Francis Chichester

Captain W. R. Colbeck, R.N.R.

Wing Commander D. F. H. Grocott,
A.F.C.

Lieut. Commander J. H. Hardwick,
R.N.

Air Vice Marshal W. E. Oulton,
C.B., C.B.E., D.S.O., D.F.C.

Captain G. S. Ritchie, D.S.C., R.N.

The directors of navigation at the Admiralty, the Air Ministry and the Ministry of Transport and Civil Aviation attend meetings of the Council as *ex-officio* members.

Executive Secretary: M. W. Richey

The Journal of the Institute 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.

The *Journal* is free to all members of the Institute. It is sold to the public at fifteen shillings per copy or, by subscription, at sixty-two shillings per annum (post free) and may be obtained through all booksellers and John Murray (Publishers) Ltd., 50 Albemarle Street, London W1.

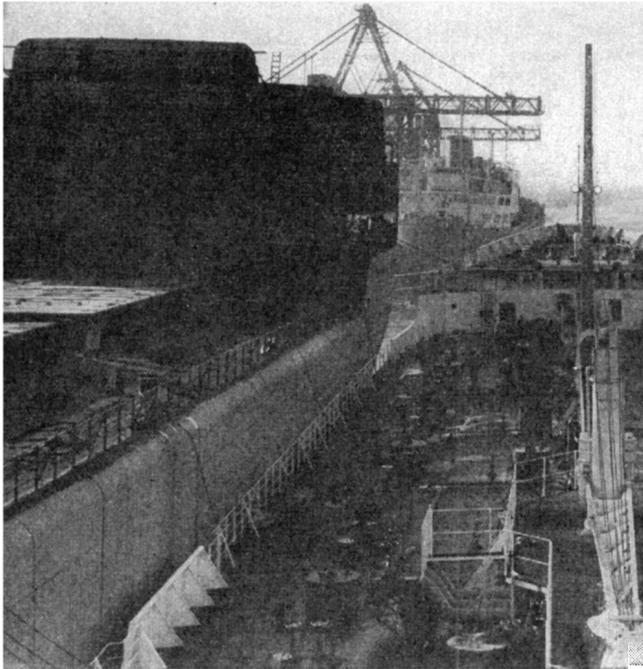
Contributions, which are welcomed from both members and non-members should be addressed to the Editor.

Enquiries for advertising space should be addressed to the Institute offices

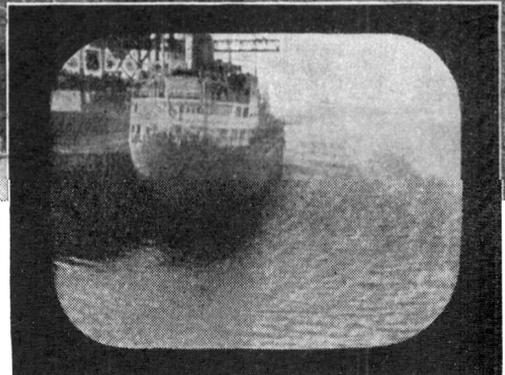
The postal address of the Institute is:

The Institute of Navigation,
at The Royal Geographical Society,
1 Kensington Gore, London SW7

Telephone: Kensington 5021



An EYE in the eyes of the ship



The top picture shows a berthing situation as seen from the pilot's normal point of view. The lower picture of the television screen gives a clear view of the ship lying ahead.

Marconi Marine navigational television stations an eye on the stem head to keep a direct watch ahead when manoeuvring mammoth tankers and similar vessels in confined waters. It gives the bridge a clear view of tugs, other small craft, buoys, etc., hidden by the bows.

Nowadays, when a mere graze of paint may cost dear in cash, delay and vexation, the money spent on the installation represents a positive saving and an inexpensive insurance against risk.

The system consists of a weather-proof camera on the stem head or foremast, a monitor and control unit on the bridge and the necessary cable. Installation calls for little or no structural work on existing or new ships.

The equipment combines Marconi's know-how of shipping needs and experience of designing closed circuit television for tough assignments ashore. Although the equipment is devised as a ship handling aid in port manoeuvres, the principle is applicable to keeping watch on cargo handling, passenger embarkation and any other deck operations which may be screened from the bridge.

An important new aid to ship handling in tankers, bulk carriers and all big ships

Designed and engineered by
**MARCONI'S WIRELESS
 TELEGRAPH CO., LTD.
 CHELMSFORD, ESSEX**

**MARCONI
 MARINE
 TELEVISION**

Sales and Service facilities in all principal ports of the world operated by

THE MARCONI INTERNATIONAL MARINE COMPANY LIMITED
 ELETTRA HOUSE, WESTWAY, CHELMSFORD, ESSEX. TEL: CHELMSFORD 57201

Also at: MARCONI WING, ENGLISH ELECTRIC HOUSE, STRAND, LONDON, W.C.2.

Tel: Covent Garden 1294; and at principal ports.

Cct 1



In
matters
of
FLIGHT
CONTROL
and
SYSTEMS
ENGINEERING

SMITHS

is a name
to look
up to

SMITHS AVIATION DIVISION

The Aviation Division of S. Smith & Sons (England) Ltd.

Kelvin House, Wembley Park Drive, Wembley,
Middlesex. Wembley 8 888, Grams: Airspeed,
Wembley. Telex 25388

AV 502

TO ALL MARINE
SUPERINTENDENTS

*There's
something
new in
navigational
aids here!*

... And it warrants your careful examination

If you have not already received information about AEI's NEW RADARS—this new leaflet No. 4321-81 describes them . . . And a note to the address below will bring you a copy by return. The AEI ESCORT RADAR 600 series is a really advanced, integrated range of high quality equipment, employing interchangeable basic units . . . A range of models enabling fleet-operators to meet individual vessels' needs . . . An equipment range giving important benefits to the navigator, too, for all models provide 'Chart Plan' presentation and the many other advanced AEI ESCORT radar features.



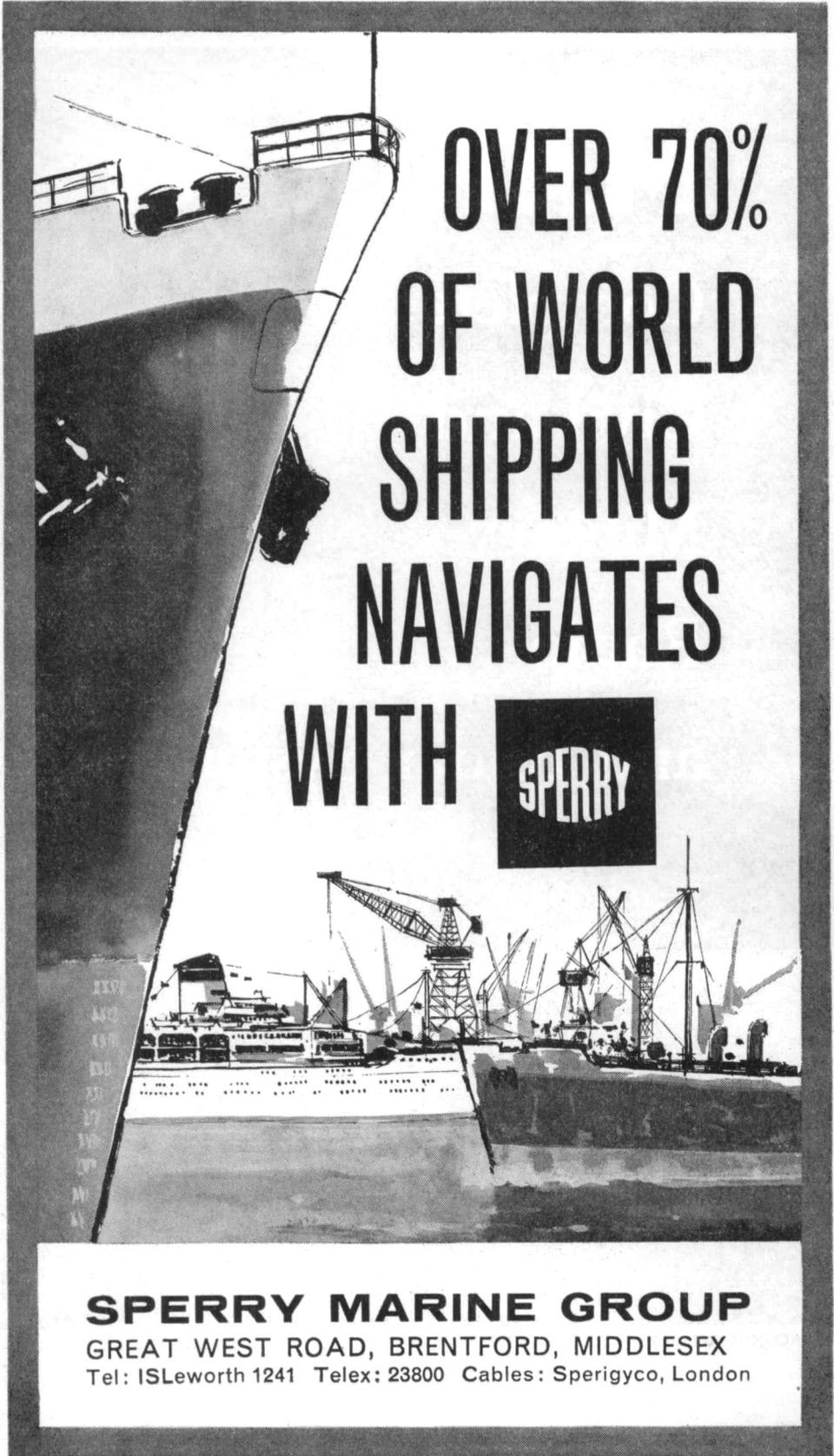
**AEI ESCORT
RADAR**
**600
SERIES**

A5758B

AEI

Associated Electrical Industries Limited
Electronic Apparatus Division

RADAR SALES, BLACKBIRD ROAD, LEICESTER, ENGLAND

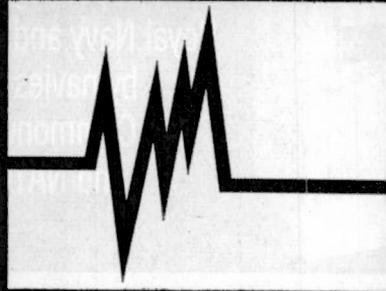


**OVER 70%
OF WORLD
SHIPPING
NAVIGATES
WITH**



SPERRY MARINE GROUP
GREAT WEST ROAD, BRENTFORD, MIDDLESEX
Tel: ISLeworth 1241 Telex: 23800 Cables: Sperryco, London

NEW DECCA MARK 12 MULTIPULSE



increases DECCA coverage
and improves performance
at the longer ranges.

The Mark 12 Decca Navigator Marine Receiver offers improved performance and new techniques of position fixing at the longer ranges. These advantages are derived through the introduction of "multipulse" transmissions from the Decca stations.

THE DECCA NAVIGATOR

THE DECCA NAVIGATOR COMPANY LIMITED · LONDON

REVOLUTIONARY NAVAL RADIO TRANSMITTING SYSTEMS



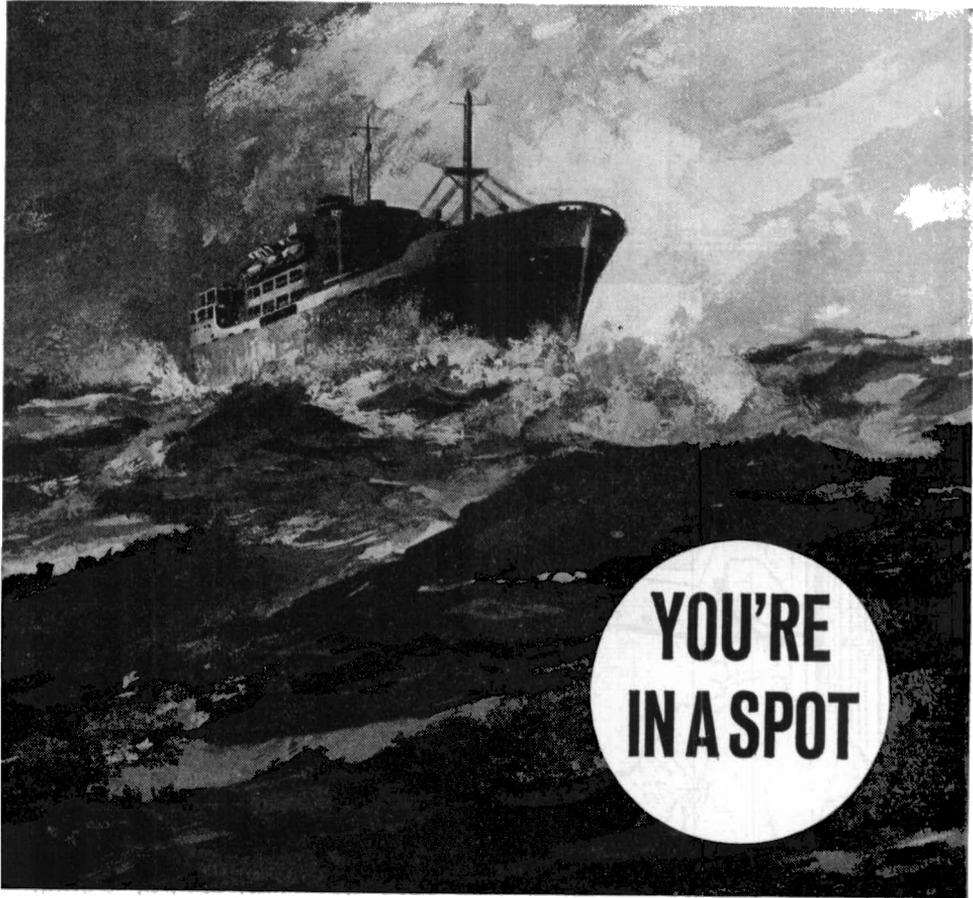
- Precise frequency setting and positive stability allows full advantage to be taken of SSB which provides the most reliable communications under difficult conditions of propagation or interference
- Continuous frequency coverage from 240 Kc/s to 24 Mc/s
- Covers all types of signalling
- Broadband amplifier and synthesizer system provides simplest operation and almost eliminates tuning
- Aerials can be sited for maximum radiating efficiency.

MARCONI NT 203/204 SYSTEMS

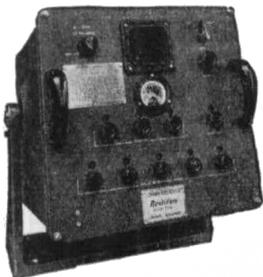


COMPLETE NAVAL RADIO AND RADAR SYSTEMS
 MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED · CHELMSFORD · ESSEX

H2D



AND IT'S EXACT BY LORAN



- *Greater range than any other radio navigation system*
- *Fast, accurate position fixes, day or night in any weather*
- *Simple to install—no DF loops or special aerials are used, and no calibration is needed*
- *Simple to use—no special training is required, and results are plotted instantly*

No other system of radio navigation can compare with Loran for range and usefulness. Chains of shore-based transmitting stations operate 24 hours every day to serve shipping in the North Atlantic and most of the Pacific Ocean; and new transmitters are now being added to serve important shipping lanes in other areas, including the North Sea.

All this is free: the Loran system may be used by any ship equipped to use it, and hundreds of deep-sea vessels—from trawlers to passenger liners—are already fitted with Loran receivers.

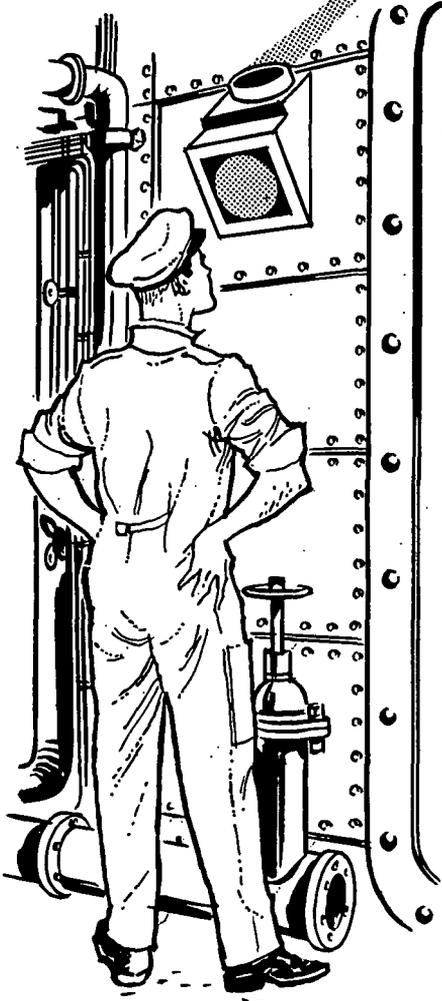
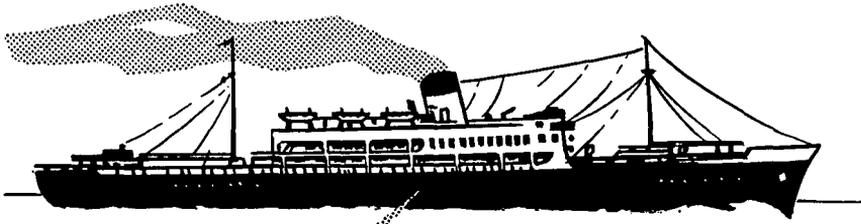
The Redifon type 262A is a new Loran receiver, for use with existing transmitting stations and with the new stations now being built. No special training is needed to use this equipment; an accurate fix can be obtained in half a minute and the results are plotted instantly on Loran lattice charts.

Find out more about Loran. An illustrated leaflet showing the present Loran coverage, with full particulars of the new Redifon type 262A receiver, is available from the address given below.

Redifon 262A

REDIFON LIMITED Marine Sales Division, Broomhill Road, London, sw18
 Telephone: vandyke 7281. Cables: Redifon, London, sw18

RED/LG 5



Smoke Indicators

For indicating the density of exhaust smoke passing through the uptake of a boiler.

The smoke appears as a dimming of the illumination on the screen or as a flickering silhouette of the smoke, depending on the density and quantity.

Write for pamphlet 1271/J.

Rangefinders

Used for navigational, station-keeping and other purposes on board ship, and also for observation. Can be supplied with various scales and tripod, belt or rail mounting.

Write for pamphlet 1048/J.

Binoculars

Barr & Stroud make over 20 different types of binoculars. May we send you our 36-page booklet "Choosing a binocular"?

BARR & STROUD LTD

Anniesland, Glasgow, W.3. Telephone : Jordanhill 9601
London Office : 1 Pall Mall East, S.W.1. Telephone : Whitehall 1541

NEW ANTI-COLLISION RADAR SYSTEM

Decca introduce the world's first fully co-ordinated system of simultaneous true and relative motion radar presentation

the Decca Marine Radar system type 969/ ARP

COMPRISING Decca True Motion TM 969 in combination with the new Automatic Relative Plotter Type 50.

PROVIDING High speed automatic plotting from the radar to give simultaneous true and relative motion presentation.

With this system, immediate and automatic transfer of range and bearing information from radar to plotter enables a single officer of the watch instantly and accurately:

- 1 to determine positively the existence of collision risk from any ships within radar range.
- 2 to predict the effect of any proposed change of course or speed before such alteration is made.



A brochure describing the unique Decca Marine Radar System is available on application to:

DECCA RADAR

DECCA RADAR LIMITED

Decca House, Albert Embankment, London, S.E.1

DR217c

PUBLICATIONS OF
THE HAKLUYT SOCIETY



A Regiment for the Sea

WILLIAM BOURNE

EDITED BY E. G. R. TAYLOR

The earliest known technical manual on navigation written by an Englishman. Bourne, a master-gunner at Gravesend, wrote for sailors in clear, forthright English. Professor Taylor introduces the text of the first edition, 1574, and in a General Introduction describes Bourne's life and other writings. *16 plates. Published for The Hakluyt Society, 50s. net*

The Cabot Voyages and Bristol Discovery under Henry VII

EDITED BY J. A. WILLIAMSON

An interpretation by the Vice-President of The Hakluyt Society of the documents relating to the voyages of John and Sebastian Cabot to North America. The evidence is not complete and Dr. Williamson's work contributes to the mental adventure of Cabot studies. The cartographical evidence is fully examined by R. A. Skelton. *14 plates, 5 sketch maps. Published for The Hakluyt Society, 40s. net*

CAMBRIDGE UNIVERSITY PRESS

T A Book of Early **H** Navigational Instruments

E E. G. R. Taylor and M. W. Richey

G **F**ROM earliest times seafarers have had to
E make their way out of sight of land. In
O this illustrated guide the authors first of all
M describe the methods of navigation used, from
E the winds and stars in Antiquity to the pre-
T cursors of modern navigational instruments.
R The instruments and aids are then examined
I separately, from the earliest chart to the
C sextant and the chronometer, each instrument
A being illustrated and accompanied by a text
L in which the authors explain how and why
S it was invented, how it was used and why it
E was superseded.

Sailors, airmen and anyone interested in the problems early explorers had to face will find this book fascinating.

Professor Taylor is Emeritus Professor of Geography in the University of London, Mr. Richey, the Executive Secretary of the Institute of Navigation.

'It is this rare combination — of brief, clear and precise description; of apt references; of factual accuracy, and of brilliant commentary — that make this a book to be read, to be treasured, to be read again and then to be referred to frequently. . . .'

—*Journal of the Institute of Navigation.*

Foolscap 4to, 112 pages, 29 plates, 6 text-figures

N Published for The Institute of Navigation by
Hollis & Carter at 30s.

THE INTERNATIONAL HYDROGRAPHIC BUREAU

Quai des Etats-Unis, MONACO

publishes

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

THE INTERNATIONAL HYDROGRAPHIC REVIEW

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

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

Price per number \$5 (U.S.) excluding 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, 168 Fenchurch Street, London, E.C.3.

A reduction of 30% on the price quoted is allowed to booksellers. The same reduction is granted to government offices and to naval or merchant marine officers of the Bureau's States Members, provided the order is sent direct to the Bureau.

WORLD AVIATION ELECTRONICS

AND CONTROLS

The application of electronic engineering techniques to the solution of aviation problems is one of the most interesting and important branches of electronic technology. *WORLD AVIATION ELECTRONICS and CONTROLS* is a monthly journal devoted to reporting progress in this and allied fields, and to commenting on the political, economic and philosophical problems which are associated with the technical developments.

Editor : Denis Archer

Advertisement Director : Derek Shephard

**4 MILL STREET, LONDON, W.I.
HYDe Park 3936**

BOOKS ON NAVIGATION

A HISTORY OF THE PRACTICE OF NAVIGATION

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

30/-

Per Post 32/3

HARBOARD'S GLOSSARY OF NAVIGATION

Revised by **CAPT. C. W. T. LAYTON**, F.R.A.S., M.I.N., Assoc.I.N.A.

12/6

Per Post 13/6

NICHOLLS'S SEAMANSHIP AND NAUTICAL KNOWLEDGE

By **C. H. BROWN**, F.R.S.G.S., Extra Master

40/-

Per Post 42/3

MAGNETIC COMPASS DEVIATION AND CORRECTION

By **W. DENNE**, Extra Master

25/-

Per Post 26/-

DEVIATION AND THE DEVIASCOPE

By **C. H. BROWN**, F.R.S.G.S., Extra Master

34/-

Per Post 35/-

HOME TRADE NAVIGATION GUIDE

By **CAPT. WILLIAM MACFARLANE**

45/-

Per Post 46/6

Full Descriptive Catalogue "N" Free on Request

BROWN, SON AND FERGUSON, LTD.

52 DARNLEY STREET, GLASGOW, S.1

'NAVIGATION, LOS ANGELES'

Navigation, the quarterly Journal of the American Institute of Navigation, is available to members of this Institute at a reduced subscription of £1 a year. Volume 9, No. 4 (Winter 1962-63), contains the following papers:

PILOT CLASS IN SPACE NAVIGATION AT THE NAVAL ACADEMY: A REPORT
Captain P. V. H. Weems, USN. (Ret.)

GUIDANCE AND CONTROL OF 24-HOUR SATELLITES
Roger W. Cole

ORBITAL RENDEZVOUS SYSTEMS
Arnold Rosenbloom

CLEAR AIR TURBULENCE AT THE TROPOPAUSE LEVELS
W. Partl

MAPPING RADAR AS AN AID TO AIR SAFETY
Captain Stephen A. Belgau, USAF

THE CENTRAL ELECTRONIC MANAGEMENT SYSTEM: FACTS AND FUTURE FOR THE SST
Donald W. Richardson

NAVIGATION OF GROUND EFFECT MACHINES
Lt. Col. J. L. Wosser, USMC

DESIGN AND MANUFACTURING PROBLEMS PERTINENT TO THE DEVELOPMENT OF SUPERSONIC AIRCRAFT SIMULATORS
Frank B. Crawford

THE USE OF SIMULATORS FOR BIOMEDICAL RESEARCH
Richard G. Pearson

ASSESSMENT OF THE GUIDANCE OF THE LUNIK SPACECRAFT
K. W. Kiser and A. H. Gallas

AIRCRAFT SEPARATION FOR SAFETY AND ITS EFFECT ON NAVIGATION REQUIREMENTS
J. J. Jaglowski

BURTON'S

NAVIGATIONAL PUBLICATIONS LTD.
ALVA, CLACKMANNANSHIRE

THE ART OF ASTRONOMICAL NAVIGATION 18/6

FOUR-FIGURE NAVIGATION TABLES 16/6

(In which the versine is used to secure the necessary accuracy in sight-reduction.)

NAUTICAL TABLES (Sixth Edition) 28/6

THE MASTER AND HIS SHIP

by Charles H. Cotter, B.Sc., Ex.C., M.I.N.

Of particular value to those studying for First Mate's and Master's Certificates. The book deals thoroughly with those vital problems affecting the running and safety of a vessel, including mechanics and its application to seamanship, the ship's equipment, the principle of ship handling, anchor work, the ship in rough sea, fires in ships, collisions, dry docking and grounding, abandoning ship and survival in boats.

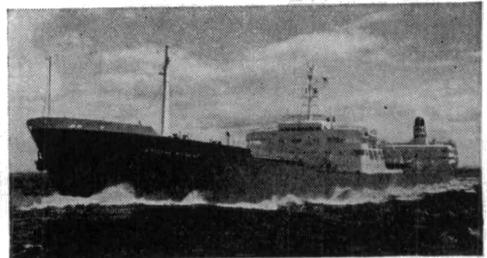
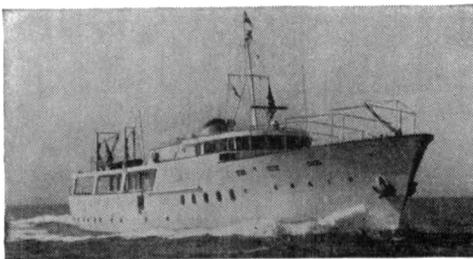
9½ x 6 inches. 256 pages, with 49 line illustrations. 27s. 6d.

If you would like to receive details of other MARITIME PRESS publications, please complete this form and send to the address below.

NAME.....

ADDRESS.....

THE MARITIME PRESS LTD.,
13 Long Acre, London, W.C.2.



Built by Camper & Nicholson Ltd. for Mr. R. Dutton-Forsshaw, Cardigrae VI is an outstanding example of modern ocean going yacht design. Equally outstanding, though in a more utilitarian sense, is the 50,770 ton tanker British Hussar built by John Brown & Co. (Clydebank) Ltd. for the BP Tanker Co. Ltd. Both vessels are fitted with radar equipment from the Kelvin Hughes Unit Radar System, which provides for the operational needs of all vessels, large and small.



S. Smith & Sons (England) Ltd.
KELVIN HUGHES DIVISION

St. Clare House, Minorities, London, E.C.3
Phone: Royal 8741 Grams: Marinst Phone London

MO16