

# The JOURNAL of NAVIGATION

---

VOL. 25, NO. 1

JANUARY

1972

<b>International Cooperation in Hydrography</b>	2
PRESIDENTIAL ADDRESS BY G. S. RITCHIE	
<b>Time Data and Navigation</b>	13
H. M. SMITH	
<b>The New System of Coordinated Universal Time</b>	32
D. H. SADLER	
<b>Navigating the <i>Osterley</i>, 1758–1760</b>	43
W. E. MAY	
<b>The Case for Fully Automatic Plotting Radar</b>	51
F. J. WYLIE	
<b>The Economics of Traffic Circulation</b>	60
L. OUDET	
<b>Port and Terminal Navigation and Control</b>	67
H. J. BRANDENBURG	
<b>Low Light Television and its Application to Navigation</b>	73
R. J. CORPS AND A. G. HICKS	
<b>Sir William Thomson and the Intercept Method</b>	91
C. H. COTTER	

## FORUM

<b>The Rotterdam Approach Control</b>	99
R. B. RICHARDSON	
<b>Navigational Discipline at Sea</b>	100
P. A. THOMPSON	
<b>Collisions Involving Very Large Ships</b>	103
J. WATT	
<b>A Manœuvring Diagram for Avoiding Collisions at Sea</b>	105
A. N. COCKCROFT	
<b>Historical Hyperbolae</b>	107
C. POWELL	
<b>Distance by Vertical Angle</b>	109
C. H. COTTER	
<b>The Determination of Distance at Sea by Vertical Angle</b>	112
V. L. BOSAZZA	
<b>Collisions and Groundings</b>	113
A. G. DUNNE	
<b>Lateral Error on Airways</b>	121
J. D. PROCTOR	
<b>The Knife as a Compass</b>	122
F. HEINESEN	
<b>Record</b>	124
<b>Reviews</b>	126

---

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

---

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

---

PRICE ONE POUND FIFTY (£1.50)

---

THE ROYAL INSTITUTE OF NAVIGATION

*Patron*

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

*OFFICERS AND COUNCIL 1971-72*

*President*

Rear-Admiral G. S. Ritchie, C.B., D.S.C., F.R.I.C.S.

*Vice-Presidents*

Group Captain D. F. H. Grocott, C.B.E., A.F.C., R.A.F.

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

*Other Members of Council*

J. H. Beattie

Captain C. H. Cotter

S. S. D. Jones

Captain F. L. Main

Captain R. Maybourn

Colin Mudie

Captain F. Ormonroyd, D.F.M.

P. G. Reich

R. B. Richardson

Captain P. A. Thompson

---

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

---

The Journal of Navigation

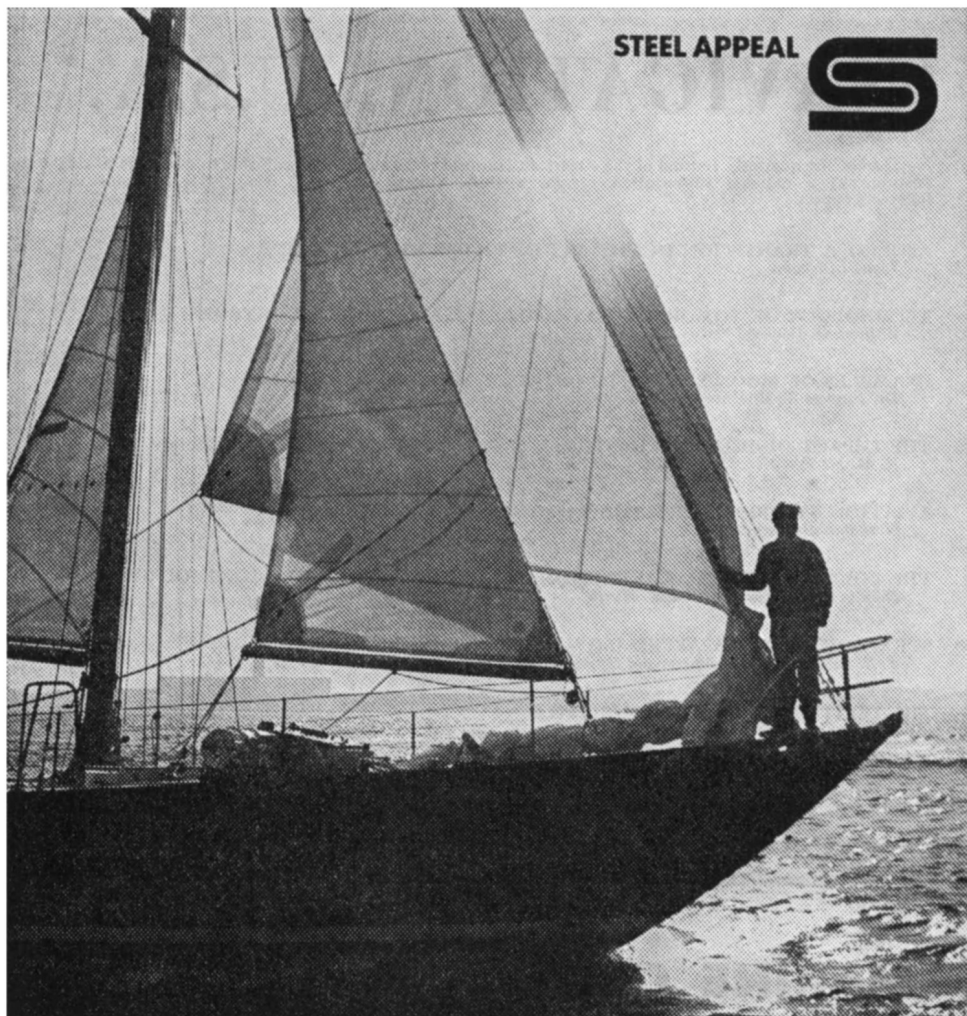
THE *Journal* is published quarterly by the Institute and is edited by M. W. RICHEY. It contains original papers contributing to the science of navigation, including those presented at meetings of the Institute together with the ensuing discussion. In addition the *Journal* includes a record of current 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 one pound fifty per copy or, by subscription, at six 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.



*'British Steel' designed by Robert Clark. Built by Philip & Son, Dartmouth. Length 59 ft. Beam 12 ft. 10 ins. Draught 8 ft. Rig: Bermudian Ketch.*

## "The steel people made it all possible" — Chay Blyth

A 30-year-old ex-paratrooper wanted to build a steel boat to sail round the world single-handed — *the wrong way. Against the wind.*

Chay Blyth believed the odds were against him when he put his proposition to the British Steel Corporation. But BSC saw that a superbly designed and built steel yacht, sailing against some of the most daunting seas in the world, would be a brilliant testimonial for British steel, *and Britain.*

And now, Chay Blyth and his steel yacht have astonished the world. They have made the first-ever solo non-stop circumnavigation from East to West, in the amazing time of 292 days — the longest windward sail in history. And both man and boat have returned as fresh as the day they left.

### What 'British Steel' is made of

**HULL:** Mild steel plate to Lloyd's Grade A specification.

**FRAMES AND DECK BEAMS:** Mild steel sections.

**DECK PLATES:** Mild steel.

**COCKPIT AND 'DOG-HOUSE':** Stainless steel (non-magnetic).

**STANDING RIGGING:** Stainless steel wire rope.

**British Steel Corporation**



# '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 18, No. 3 (Fall 1971), contains the following papers.

APOLLO, A TRANSITION IN THE ART OF PILOTING A VEHICLE  
*James L. Nevins*

TECHNOLOGY OF TOMORROW'S COMMERCIAL AIR TRAFFIC CONTROL  
*William G. Denhard*

EXAMPLES OF MOON SIGHTS TO OBTAIN TIME AND LONGITUDE  
*Dr. Frances W. Wright*

THE IMPACT OF INERTIAL NAVIGATION ON AIR SAFETY  
*R. M. Hershkowitz, D. O'Mathuna and K. R. Briting*

AVIATION SYSTEM DESIGN FOR SAFETY AND EFFICIENCY  
*Nathaniel Braverman*

THE ROLE OF INERTIAL NAVIGATION IN FUTURE AIR TRAFFIC CONTROL SYSTEMS  
*Duncan Mackinnon and John W. Hursh*

STRAPDOWN OR GIMBALED IMU'S FOR THE SPACE SHUTTLE  
*T. S. Bettwy, E. A. Goldberg, and H. A. Irwin*

THE INSTITUTE'S PROFESSIONAL FILE

REVIEWS OF RECENT BOOKS

## 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 45p) 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

# at sea you need the confidence Kelvin Hughes inspires

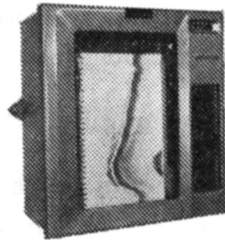
## all round confidence

Kelvin Hughes Radar and Radio Communications equipment give you complete visual and audio information – unfailingly



## confidence in depth

Unerring indication of depth, underwater contours, where the fish are. Kelvin Hughes Echo Sounders help you all the time.



**KELVIN HUGHES**  
A DIVISION OF SMITHS INDUSTRIES LIMITED

New North Road, Hainault, Ilford, Essex, England.

# **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 £2.50 or \$6 (U.S.), 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.



# SPERRY

## MARINE SYSTEMS

The most comprehensive range ever offered

	COMPASSES	UNIVERSAL GYROPILOT & STEERING CONTROLS	NAVAIDS	STABILISERS	ANCILLARIES
INTEGRATED NAV. SYSTEMS					
MAINS	MK37 SR120 SR100 MK23 MK19 MK27	GYRO HYDRAULIC SINGLE CHANNEL STAND PILOT DUAL CHANNEL STAND PILOT SINGLE CHANNEL CONSOLE MOUNTED DUAL CHANNEL CONSOLE MOUNTED TILLER PILOT TILLER STEERER AUTOPILOT 8T	MK16 (X & S-band) 16 in RADAR MK12 12 in RADAR MK10 10 in RADAR MK8 7 in. RADAR MK7 7 in. RADAR COLLISION THREAT ASSESSMENT/AVOIDANCE OMEGA LORAN A/C SATELLITE NAVIGATION BERTHING & NAVIGATION SONARS ECHO SOUNDERS DOPPLER SPEED LOG ELECTRO-MAGNETIC LOG GYROFIN ACTIVATED FIN SYSTEM SPERRY ACTIVATED TANK SPERRY AUTOMATIC LIST CONTROL COURSE RECORDER STEERING REPEATER BEARING REPEATER TAPE TYPE REPEATER RUDDER ANGLE INDICATORS DIGITAL HEADING INDICATOR PILOT WATCH ALARM RATE OF TURN INDICATOR ENGINE MONITOR SYSTEMS		
NAVAL APPLICATIONS					

# SPERRY

MARINE SYSTEMS DIVISION  
BRACKNELL BERKSHIRE ENGLAND

# 'Electronic Chernikeeff'

*Accurate and dependable at all speeds down to 1-knot and distance run to within 1%.*

*Suitable for Ship's Side or Bottom mounting—equal accuracy.*

*Linear Speed Analog Voltage Transmission available direct from Log.*

*Has built-in Transmission for 'True-motion' Radar.*

*Low installation costs—simple maintenance.*

*The Retractable Log Tube can be provided remotely controlled from the Wheel-house.*

The ideal Log for all Mercantile Vessels—backed by over 50 years actual experience in the design and manufacture of Impeller Logs.

Log makers to the British Navy and Overseas Navies for almost 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

ROYAL GEOGRAPHICAL SOCIETY

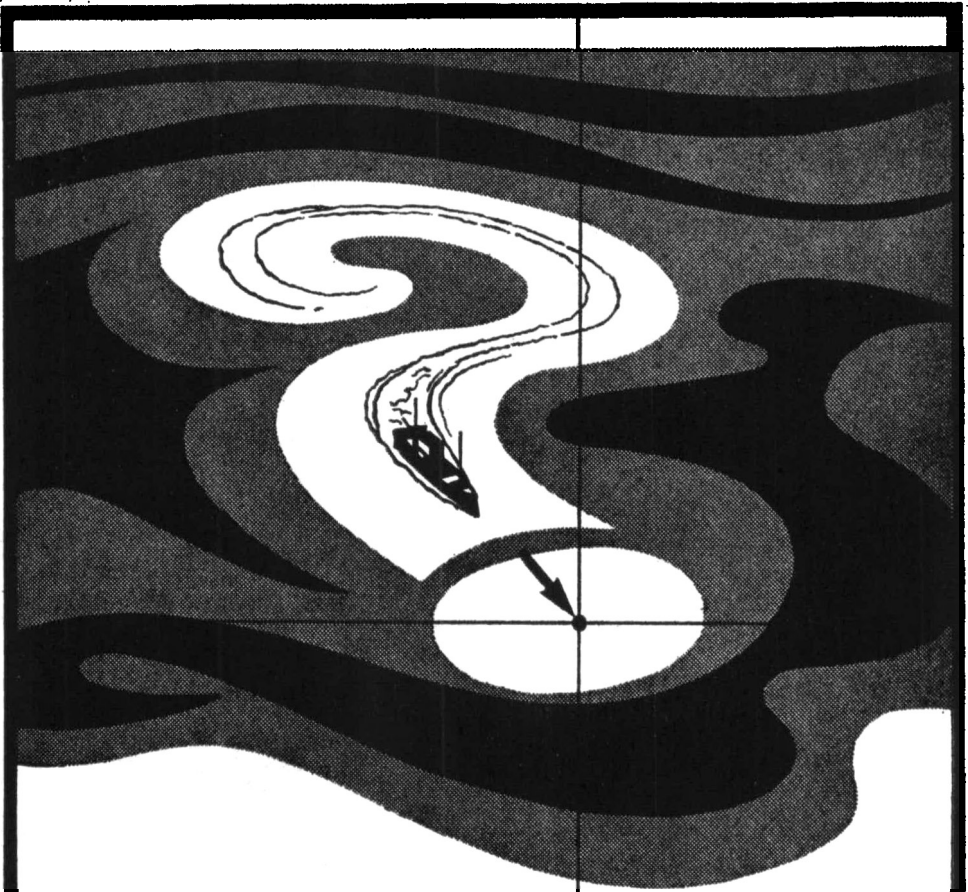
## THE SOURCES OF THE NILE: EXPLORERS' MAPS

A.D. 1856-1891

Price £2.50

Twelve reproductions, including colour, of unique maps by Burton and Speke, Grant, Baker, Stanley and Livingstone, and other British explorers of East and Central Africa. These maps, sent back to the Society, often constituted the first reports on the newly discovered lands and on the gradual discovery of the Nile sources. Included in the handsome green cloth-covered portfolio are colour reproductions of two water colours by Speke, one of Ripon Falls, and a memoir by G. R. Crone, formerly Librarian and Map Curator. This sheds light on the quarrels as well as the mapping of the Nile explorers.





# GET YOUR FIX WITH TORAN

Accuracy between 1 and 10 metres

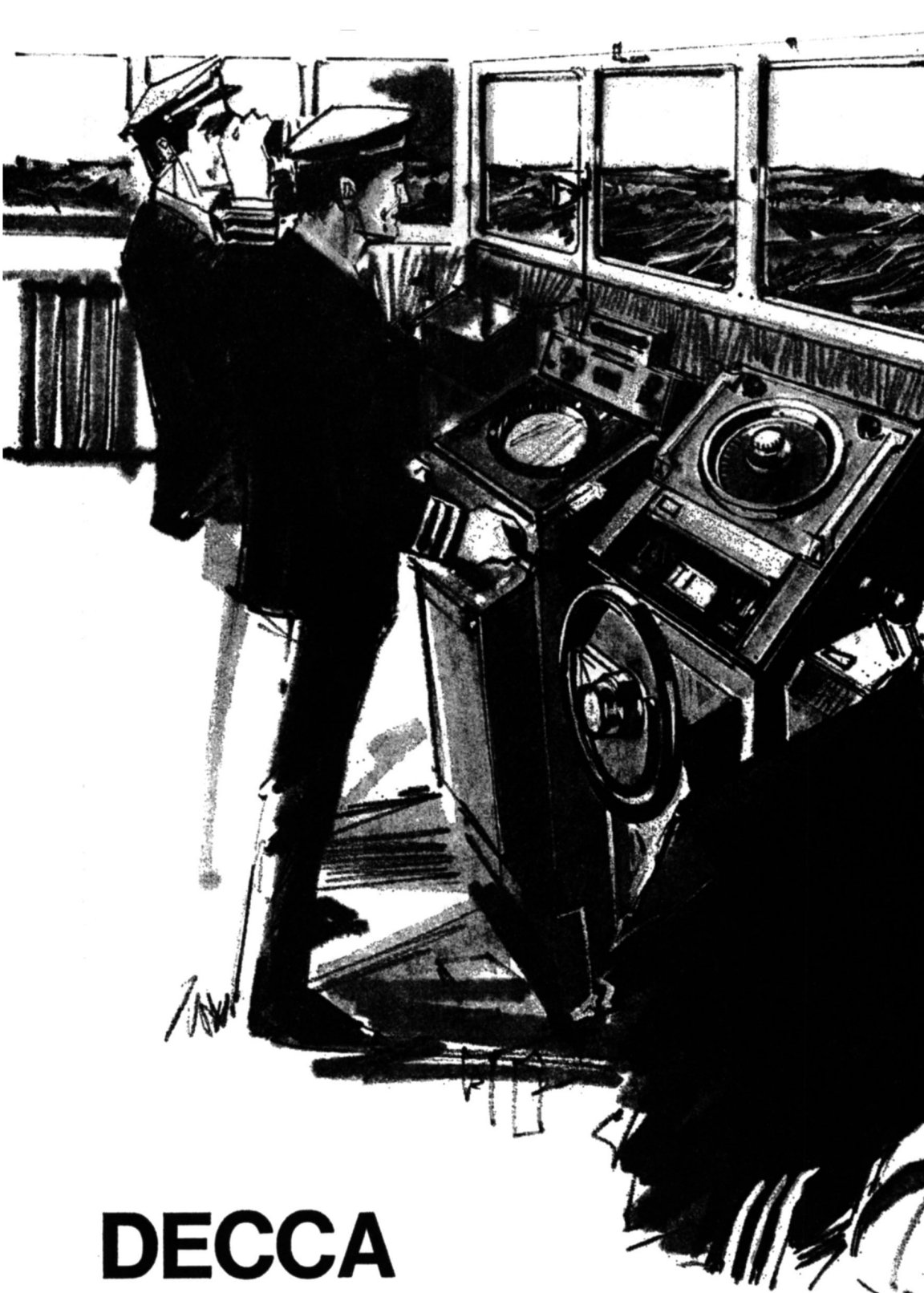
**P. 10 CHAIN** : 50 km range for  
Sounding, Dredging, Port conservancy

**P. 100 CHAIN** : 700 km range for  
Oil exploration, Hydrography, Oceanography

**TORAN "O"** : 1200 km range-range for  
Airborne and Geophysical surveys, Oceanology



Radionavigation Division  
12, rue Léonidas 75 Paris 14<sup>e</sup> - ☎ 273.01.42 - Télex 25.778



# **DECCA**

**for the greater efficiency  
and safety of ships at sea**

**THE DECCA NAVIGATOR COMPANY LIMITED. DECCA RADAR LIMITED. LONDON**





# **Authoritative Sailing-Ship Books**

## **COOLIE SHIPS AND OIL SAILERS**

This book is a record of two special phases of sea life in Sailing Ships

190 Pages 9½" × 7¼" 56 Illustrations £2.10 (per post £2.34)

## **THE COLONIAL CLIPPERS**

The Great Wooden Ships of the Blackwall and other lines

400 Pages 9½" × 7¼" 81 Illustrations, 4 Plans £2.70 (per post £2.94)

## **THE CHINA CLIPPERS**

A History of the celebrated Clipper Ships in the Chinese Opium and Tea Trades

310 Pages 9½" × 7¼" 34 Illustrations £2.50 (per post £2.74)

## **THE LOG OF THE "CUTTY SARK"**

The most authentic work, compiled from her log books and captain's abstracts

344 Pages 9½" × 7¼" 52 Illustrations, 9 Plans £3.50 (per post £3.74)

## **THE LAST OF THE WINDJAMMERS**

Vol. I. The Sailing Ships of the Seventies-Eighties

535 Pages 9½" × 7¼" 126 Illustrations, 17 Plans £3.60 (per post £3.84)

Vol. II. The Deep-Water Sailing Ships, 1888-1928

470 Pages 9½" × 7¼" 174 Illustrations, 17 Plans £3.60 (per post £3.84)

By **BASIL LUBBOCK**

All Lubbock's work is the product of original and comprehensive research. These books are recommended without reserve to the student of the sailing-ship

## **MASTING AND RIGGING**

The Clipper Ship and Ocean Carrier

£3.30 (per post £3.54)

## **SAILING SHIP RIGS AND RIGGING**

With authentic plans of famous vessels.

£2.00 (per post £2.10½)

## **PLANK-ON-FRAME MODELS and Scale Mastng and Rigging**

Vol. I. £3.00 (per post £3.10½) Vol. II. £2.50 (per post £2.66½)

By **HAROLD A. UNDERHILL**

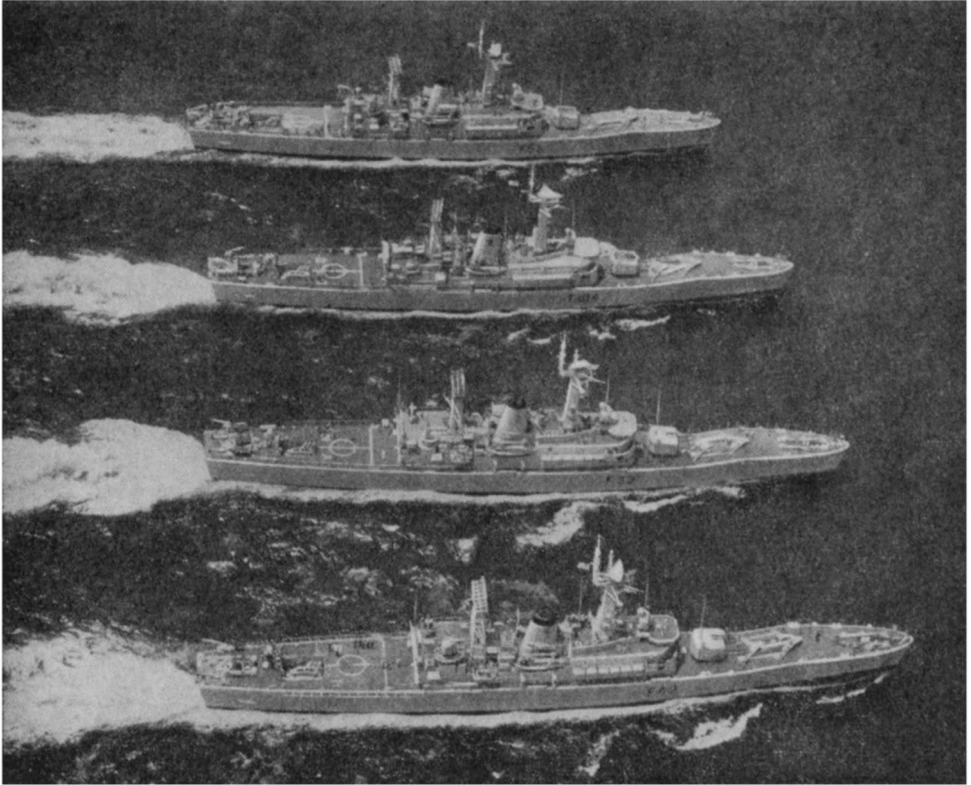
A leading authority on Sail and Ship Modelling

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

**BROWN, SON & FERGUSON, LTD.,**  
52 DARNLEY STREET, GLASGOW, S.1.



# 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 and Space 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

# 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.' (*Martiner'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, 25 p)

## 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, £4.00  
Members £3.00 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, £4.50  
Members £3.37 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.

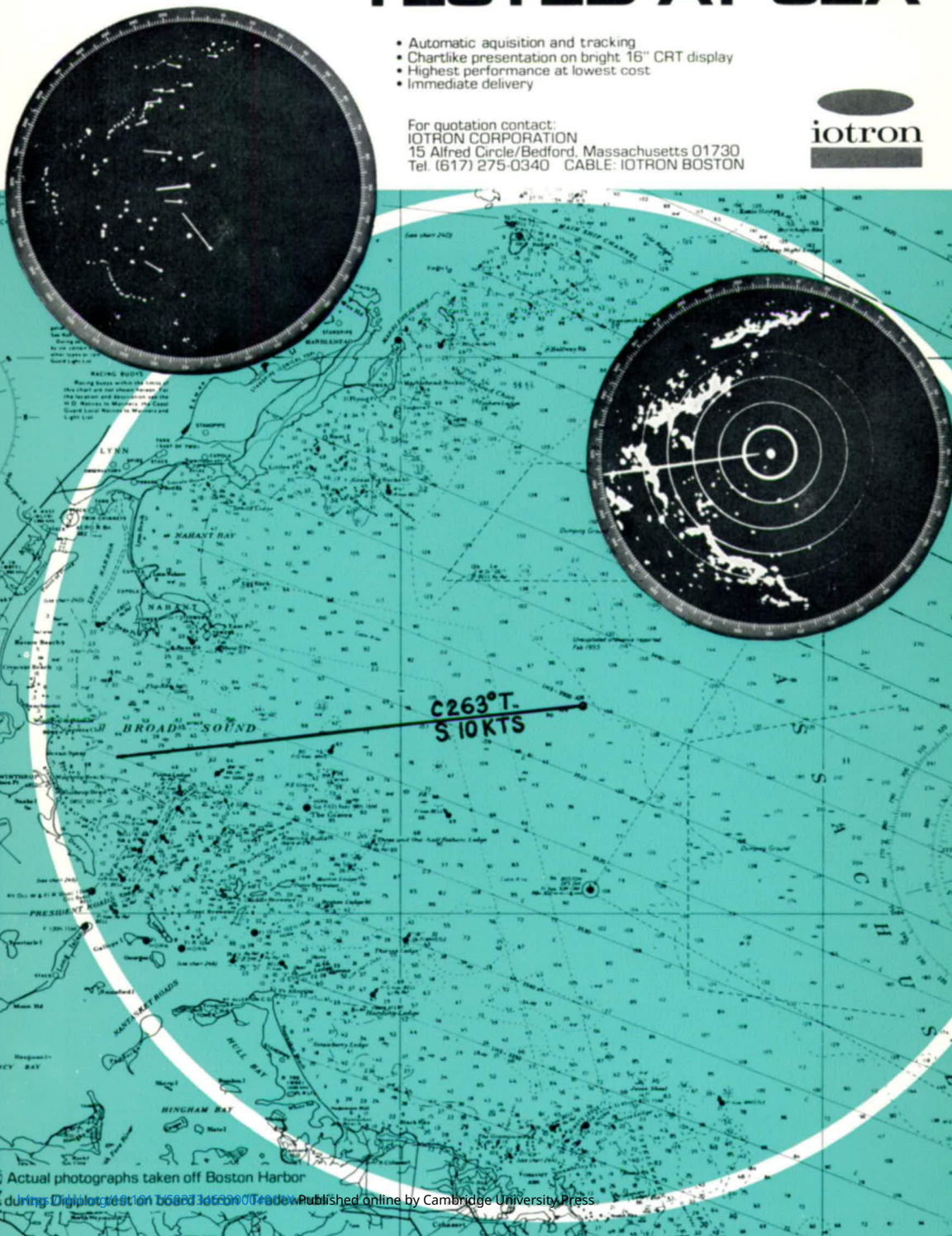
---

from The Royal Institute of Navigation  
1 Kensington Gore, London SW7

# DIGILOT... 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

For quotation contact:  
IOTRON CORPORATION  
15 Alfred Circle/Bedford, Massachusetts 01730  
Tel. (617) 275-0340 CABLE: IOTRON BOSTON



C263°T.  
S 10KTS





The President, Rear-Admiral G. S. Ritchie, presents the Gold Medal to K. Adlard Coles (p. 124)





## The Royal Institute of Navigation

HER Majesty the Queen has been graciously pleased to command that the Institute of Navigation shall be known as

### **The Royal Institute of Navigation**

The distinction coincides with the twenty-fifth year of the Institute's existence.

With the change in the title of the Institute the Council has decided to change also the title of the *Journal*, which with this issue becomes *The Journal of Navigation (J. Navig.)*.

Honorary Members, Fellows or Members who have occasion to designate themselves as belonging to the Institute may now use the following abbreviations:

Hon. M.R.I.N., F.R.I.N., M.R.I.N.

Any amendments to the Constitution and By-laws of the Institute arising from the change in title will be proposed for adoption at the next Annual General Meeting.