# The JOURNAL of THE INSTITUTE OF NAVIGATION

Vol. 24, NO. 4	October	1971
Error Distributions in Na	avigation	429
E. W. ANDERSON AND		
	ration Standards and Navigation	443
	ration Minima and Navigational Capability	443
A. WHITE		
Mathematical Studies on	Separation Standards	456
D. E. LLOYD	of Navigational Performance Observed at	
Strumble 1969-1970	n Navigational reformance Observed at	458
C. M. BRITLAND		430
The Potential of Existing	y Avionics Technology	469
S. RATCLIFFE		
Polar Navigation—A Nev	w Transverse Mercator Technique	484
G. C. DYER	4	
	osition Fixing Using Earth Satellites	496
T. M. B. WRIGHT	8 8	12-
	ion and its Effect on Navigation in the	
Gulf of St. Lawrence A		512
I. D. BRADFORD		<b>J</b>
<b>Studies in Marine Traffic</b>	Engineering	521
Traffic Surveys in Japan	88	521
A. YAMAGUCHI AND S		
The Analysis of Traffic Ac		534
Y. FUJII AND R. SHIC	DBARA	
Traffic Capacity Y. Fujii and K. Tan	AKA	543
	FORUM	
Controlling Shipping Along	the North European Trade Axis	553
D. J. LINDSAY		
A Note on Manning Reduction	ions and Navigation	556
J. KING 'The Master in Changing Tin	mes'	561
D. BREEDVELD		301
Yaw Angles and Coriolis		563
P. H. TANNER	www.w.l.A	-
Terrain Clearance During De J. D. PROCTOR	escent and Approach	565
Gaussian Logarithms and Nav	vigation	569
C. H. COTTER		
Reviews		(7)
100110110		573

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

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

PRICE ONE POUND FIFTY (£1.50)

#### THE INSTITUTE OF NAVIGATION

Patron

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

OFFICERS AND COUNCIL 1970-71

President Rear Admiral G. S. Ritchie, C.B., D.S.C.

Vice-Presidents G. E. Beck Group Captain D. F. H. Grocott, C.B.E., A.F.C., R.A.F.

> Honorary Treasurer F. A. Haworth

Chairman of the Technical Committee H. E. Smith

Chairman of the Membership and Fellowship Committee Captain V. A. M. Hunt, C.B.E.

Other Members of Council

J. H. Beattie W. J. Charnley Captain C. H. Cotter Captain R. Hart, C.B.E., D.S.O., D.S.C<sup>\*</sup>., R.N. (ret.) S. S. D. Jones Captain F. L. Main Captain R. Maybourn P. G. Reich R. B. Richardson R. Whalley

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

#### The Journal of the Institute of Navigation

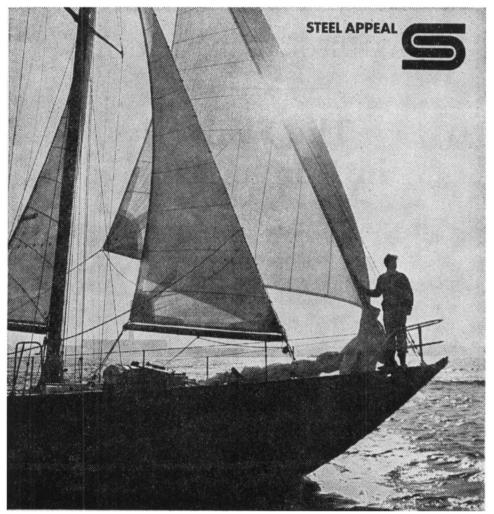
THE Journal is published quarterly by the Institute and is edited by M. W. RICHEY. It contains original papers contributing to the science of navigation, including those presented at meetings of the Institute together with the ensuing discussion. In addition the Journal includes a record of current navigational 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. 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 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 one pound fifty. The parts should be sent to William Clowes & Sons Ltd., Dorland House, 14 & 16 Lower Regent Street, London SW.1.



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 worng way. Against the wind.

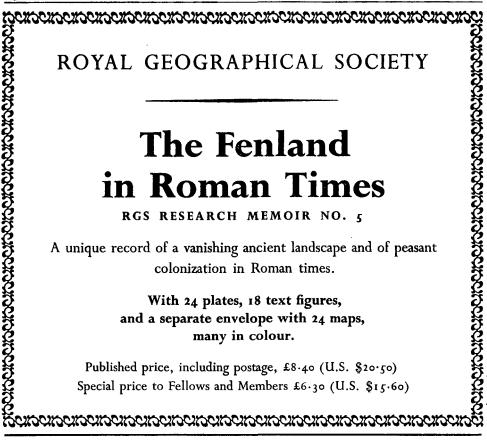
Chay Blyth believed the odds were against him when he put his proposition to the British Steel Corporation. But BSC saw that a superbly designed and built steel yacht, sailing against some of the most daunting seas in the world, would be a brilliant testimonial for British steel, and Britain.

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** 



### 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

Confidently, we invite you to see the brightest, clearest radar display. The Kelvin Hughes Series 19. Ask us to show you its ten range scales, from 1 mile to 64 miles. Its improved clutter suppression. Its 3 cm X band or 10 cm S band operation on 9 or 12 displays – with a range discrimination better than 10 yards (9 metres). For the price, there's nothing to match it. e

### Ask for a demonstration

To Kelvin Hughes, New North Road, Hainault, liford, Essex, England, Please call me to arrange a demonstration of your Series 19 radar.

KELVIN HUGHES &

PUNITION

ADDPIS

NAME

# 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,  $18 \times 27$  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 price quoted is allowed to booksellers. A reduction of 30% is granted to naval or merchant marine officers of IHO Member Governments, provided the order is sent direct to the Bureau. SPERRY INTEGRATED SHIPS SYSTEMS

The most comprehensive range of equipment ever offered

COMPASSES PILOTS STEERING										RADAR LORAN SONAR											\$1 15	AB	S	ANCILLARIES														
SR 100	SR 120	MK37	MK27	MK 23	MK19	GYRO-HYDRAULIC (RATE BNON RATE)	GYRO-ELECTRIC (RATEBNON RATE)	DUPLEX	FACIA PANEL (DUPLEX)	TILLER PILOT	TILLER STEERER	MK12 12in	MK10 10in	MK8 7 in.	MK7 7in.	COLUSION THREAT-MANOEUVRE / AVOIDANCE	BERTHING & NAVIGATION SONARS	OMEGA	LORAN A/C	SATELLITE NAVIGATION	DOPPLER SPEED LOG	ECHO SOUNDERS	FIRE CONTROL RADAR	GYROFIN ACTIVATED FIN SYSTEM	SPERRY ACTIVATED TANK	SPERRY AUTOMATIC LIST CONTROL	COURSERECORDER	STEERING REPEATER	BEARING REPEATER	TAPETYPEREPEATER	ELECTRO-MAGNETIC LOG	RUDDER ANGLE INDICATORS	RE-TRANSMISSION SYSTEM	PILOT WATCH ALARM	RATE OF TURN INDICATOR	ADF	ENGINE MONITOR TUG/TOW	
		•	0	SNA	「二、二、二、二、二、二、二、二、二、二、二、二、二、二、二、二、二、二、二、	•	•	•	•			-	•		and the second	•	•	-	•	•	•	•			• 4	•	•	•	• 翻	• 1	•	•	NS	•	•	•		
	•	•	2	NAVAL APPLICATIONS	0	•		•	•	•	-	•	•	•		•	•	•	•		•	•	<b>MEPLICATIO</b>		•	•	•		•	•	•	•	NAVAL APPLICATIONS	•	•	•		
•	•		1	NAV						•	0	10.1	•	•	•	0	1				10 10 10 10 10 10 10 10 10 10 10 10 10 1	•	NAV		•••		•	•	•	•	•	•	NAVI	•	24 A			
•	•					31	0	1		•	•			•	•	-		~		~				-									-					

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 Wheelhouse.

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.

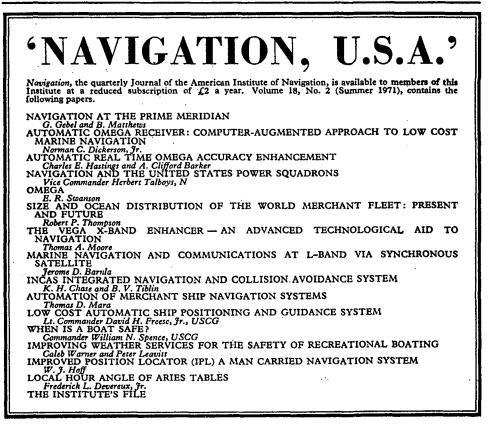
MARCONI-MARINE world wide service available to users.

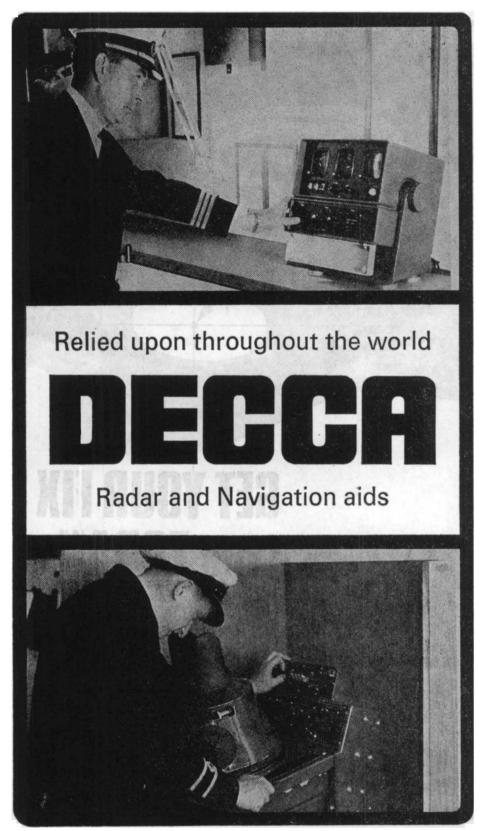
Sole Makers

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





The Decca Navigator Company Ltd Decca Radar Ltd London.

# 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 1 700 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° - 🕿 273.01.42 - Télex 25.778



A History of Navigation from Odysseus to Captain Cook

New augmented edition

E. G. R. TAYLOR



In this book the haven-finding art is traced from its first crudities and dangers, through one line of invention or line of advance after another, until at last mathematical precision was reached. This new edition, with an appendix on early Chinese navigation based on the research of Joseph Needham, F.R.S., is published in association with the Institute of Navigation.

'A better book on the art of navigation down to Captain Cook's days has not yet been written in the English language (and I know of none so succinct, authoritative and informative in any foreign language)... It fulfils admirably a long-felt need among all English seafarers.' MARINER'S MIRROR

320 pages. Illustrated. £2.50 (Members £2)

### HOLLIS & CARTER

# SAFETY AT SEA

# AUTRONICA TRANSISTORISED ELECTRONIC BEACONS

These lights are being used all over the world to ensure the safe and efficient movement of goods from origin to destination, marking rocks, headlands, wharves and shipping lanes.

For long endurance, low price and thorough reliability, AUTRONICA beacons are being used extensively either from electrical mains or off batteries with a durability of one to two years.

Full particulars from

## LOSEBERRY ENTERPRISES

Rear-Admiral (Ret.) A. L. P. Mark-Wardlaw,

Loseberry, Claygate, Surrey, England. Telephone : Esher 62882.

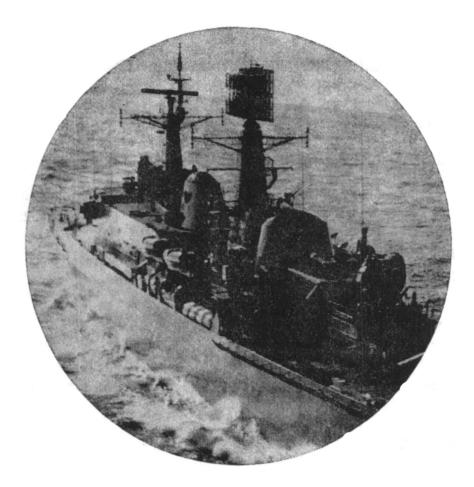
# 'NAVIGATION'

NAVIGATION (Paris), the quarterly Journal of the French Institute of Navigation, is available to Members of the Institute at the preferential subscription rate of £2.00 per annum. Subscriptions should be addressed to the Institute office in London.

The July 1971 number includes a paper by Van Etten on low frequency and very low frequency navigation systems; a description of 'Navstar'; an appreciation by Manuali of the usefulness of satellites for civil aviation and merchant marine navigation; a paper on time routes under sail; an article on Arab navigation in the Indian Ocean; some notes on weather routing; and an article on the discovery of the Jacob's Staff.

In addition there is, as usual, a record of navigational interest, reviews and correspondence.

### 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 Defence Department. It is in wide use by the Royal Navy and in the modernization of ten other navies. Marconi Communication Systems Limited also has a complete range of communications equipment available for shore stations; shipborne, mobile and static space communication earth terminals; 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 installation.

Marconl Communication Systems Limited Radio Communications Division, Chelmsford, Essex A GEC-Marconi Electronics Company

LTD/H88

### AND SHIPPING LAW NIGHOLLS'S SEAMANSHIP AND NAUTICAL KNOWLEDGE By CHARLES H. BROWN, F.R.S.G.S. Extra Master Per post £3.75 £3.50 Supplement 20p Per post 224p BASIC SEAMANSHIP (FOR BEGINNERS AT SEA) By COMMANDER PETER CLISSOLD, R.N.R. (Rtd.) £1.05 Per post £1.12 Per post 221p Supplement 20p **RADAR OBSERVER'S HANDBOOK** By WILLIAM BURGER, M.Sc. (Wales) Extra Master £2.10 Per post $\pounds 2 \cdot 20\frac{1}{2}$ **BUSINESS AND LAW FOR THE SHIPMASTER** By CAPTAIN F. N. HOPKINS, M.I.N., Extra Master £4.50 Per post £4.74 Supplement 25p Per post 27p **MERCHANT SHIPPING ACTS** Revised by CAPTAIN W. V. J. CLARKE, D.S.C. £3.00 Per post £3.24 SHIPBROKERS AND THE LAW By E. J. EDWARD, LL.B. (Lond.) £1.50 Per post £1.60} LAW AND PRACTICE OF SEA TRANSPORT By CAPTAIN L. F. H. STANTON, A.M.Inst.T. £3.15 Per post £3.54 Catalogue "N", giving further titles and details, free on request.

**USEFUL BOOKS ON NAVIGATION** 

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

