

# The JOURNAL of THE INSTITUTE OF NAVIGATION

---

Volume 3

Number 4

October 1950

## Marine Radio Position Fixing Systems

<b>Systems in Use Today</b>	319
H. E. HOGBEN	
<b>The Use of d.f. at Sea</b>	332
F. P. BEST	
<b>Decca as an Aid to Navigation at Sea</b>	336
E. FENNESSY	
<b>The Use of Consol in the Fishing Fleet</b>	347
D. H. HARPER	

## Interplanetary Travel

<b>I—The Dynamics of Space-Flight</b>	357	
A. C. CLARKE		
<b>II—Some Problems of Interplanetary Navigation</b>	365	
R. d'E. ATKINSON		
<b>The Effect of Changes in Altitude and Azimuth</b>	378	
J. B. PARKER		
<b>An Altitude Correction Computer</b>	385	
J. BARTELSKI		
<b>An Instantaneous Fix on Two Bodies</b>	389	
P. L. NIGHTINGALE		
<b>The Development of the Automatic Radio Compass</b>	393	
J. H. MOON		
<b>The Air Accuracy of Compasses</b>	404	
J. L. NUNN		
<b>The Reduction of Consol Bearings for Plotting</b>	412	
R. E. G. SIMMONS		
<b>The Double Altitude Problem</b>	416	
W. E. MAY		
<b>Record 422</b>	<b>Reviews 427</b>	<b>Correspondence 430</b>

---

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

---

JOHN MURRAY, 50 ALBEMARLE STREET LONDON W1

---

PRICE SIX SHILLINGS

## THE INSTITUTE OF NAVIGATION

OFFICERS AND COUNCIL, 1949-50

President: Sir Robert Watson-Watt, C.B., F.R.S.

*Vice-Presidents*

Air Commodore C. E. Chilton, C.B.E.    Captain G. C. Saul

Chairman of the Technical Committee: R. F. Hansford

Treasurer: F. G. G. Carr

Chairman of the Executive Committee: L. P. Kirwan

*Council*

Dr. D. E. Adams	Commander C. E. N. Frankcom, R.N.R.
Captain E. Brook Williams, M.M.	Commander W. E. May, R.N.
Francis Chichester	D. H. Sadler, O.B.E.
Captain W. H. Coombs, C.B.E.	Sir Harold Spencer Jones, F.R.S.
Group Captain E. Fennessy, O.B.E.	Captain G. W. Wakeford

The Director of Navigation and Direction at the Admiralty, the Director of Navigation and Control, Air Ministry, and the corresponding members in the Ministry of Civil Aviation and the Ministry of Transport will be invited to attend meetings of the Council as ex-officio members.

---

*Executive Secretary:* M. W. Richey

---

## Journal of the Institute of Navigation

THE *Journal* is published quarterly by the Institute and is edited by the Executive Secretary. It contains papers read at meetings of the Institute together with the following discussion. Besides papers in the nature of original scientific contributions to navigation, the *Journal* contains a record of current navigational work, reviews of important books, and other matters of concern to those interested in navigation.

The *Journal* is sent free each quarter to members of the Institute. It is sold to the public at 6 shillings per copy or by subscription at 25 shillings per annum and may be obtained through all booksellers and John Murray, 50 Albemarle Street, London W.1.

*Contributions* should be sent addressed to the Editor; it is advisable that diagrams should not be prepared in their final form for publication without prior consultation with the Editor.

*Advertisements.* Enquiries for space should be addressed to the Editor.

The postal address is:

The Institute of Navigation,  
at The Royal Geographical Society,  
1 Kensington Gore, London S.W.7.

*Telephone:* Kensington 5021.

# The Institute of Navigation

## Form of application for membership

Name in full (including title)  
(Please use block letters)

Permanent Address

Class of membership for which you wish to be considered\*

Membership

Student Membership

Corporate Membership

*\*Delete as necessary*

Branch of navigation or related science in which you have particular interest

Profession or Occupation

Professional and/or Academic qualifications

Summary of experience

Date of Birth

“ If accepted for membership of the Institute of Navigation, I hereby agree to abide by its Constitution and By-Laws and to advance the objects of the Institute as far as shall be in my power.”

Date

Signature  
(See note below)

Received

Proposed

Elected

*Note.—In the case of applications for Student Membership this form should be countersigned by the Principal of the Educational Establishment at which the applicant is studying.*

**Copies of this form can be obtained from the Executive Secretary.**

# THE INSTITUTE OF NAVIGATION

**T**HE OBJECT of the Institute is to unite in a scientific body those who are concerned with or who are interested in the science and art of navigation. Membership is not restricted to those who hold professional qualifications but is open to others who wish to further the aims of the Institute.

By co-ordinating the knowledge and achievement of marine and air navigators, scientists and those associated with the development and production of navigational equipment, the work of the Institute is directed towards raising the standard of navigation. In the field of education it is the aim of the Institute to encourage uniformity of practice and, by bringing practical navigators into contact with teachers and research workers, to increase the mutual appreciation of the issues involved.

It will be an object of the Institute to encourage research in navigational equipment and methods.

The activities of the Institute include the holding of meetings to discuss specific problems, the publication of a *Journal* and such other activities as the Council may deem necessary to promote knowledge in navigation and its associated sciences.

By means of an International Committee, the work of the Institute is co-ordinated with that of other Institutes and Societies abroad who are interested in similar problems.

**Membership.** There are five classes of membership of the Institute :

(i) *Honorary Members*, who shall be distinguished persons upon whom the Council may see fit to confer an honorary distinction.

(ii) *Fellows*, who shall be Members—

(a) who have held the recognized certificate of proficiency in navigation in the Royal Navy, Royal Air Force, Merchant Navy or Civil Aviation for not less than five years, and who, in the opinion of the Council, have been responsible for a contribution of value to the science of navigation ; or

(b) who, in the opinion of the Council, have made an outstanding contribution to the science of navigation.

(iii) *Members*, who shall be persons over twenty-one years of age who satisfy the Council that they are interested in the advancement of the science of navigation.

(iv) *Student Members*, who shall be persons under twenty-five years of age who are studying at one of the universities, colleges or schools recognized by the Institute preparatory to entering on a career as navigator or in other responsible positions closely allied to the science of navigation.

(v) *Corporate Members*, who shall be universities, manufacturers, operating companies or other organizations interested directly or indirectly in the science of navigation.

**Subscriptions.** Every Fellow, Member, Student Member and Corporate Member shall pay an annual subscription in advance, as follows:

Fellow	. . . . .	Two guineas
Member	. . . . .	Two guineas
Student Member	. . . . .	Half a guinea
Corporate Member	. . . . .	Twenty guineas

The Institute of Navigation,  
at The Royal Geographical Society,  
1 Kensington Gore, London, S.W.7

By Order of the Council.  
M. W. RICHEY,  
*Executive Secretary.*

*a great advance  
in Marine Radar*



# MARCONI RADIOLOCATOR IV



Range scale as well as screen is visible with visor attached.

**THE WORLD'S BEST AND MOST ECONOMICAL MARINE RADAR**

The Marconi Marine Company is actively engaged in bringing marine radiolocation to its highest point of practical development. The new Marconi Radiolocator **IV** is designed to combine small bulk and economical operation with the greatest efficiency.

- ★ Improved performance, lower cost, and considerably reduced bulk.
- ★ No decrease in the size of the picture.
- ★ Built to conform with Ministry of Transport requirements for marine radar.
- ★ Scanner can be fitted on elevated mounting to give 40 miles range on suitable targets.

- ★ Automatic change of pulse length for short and long ranges means higher discrimination and clearer painting of targets.
- ★ Remote display units, up to two in number, may be fitted.
- ★ Positive drive of magslip from scanner motor — no creeping of heading marker.
- ★ Scanner has performance indicator built in and is fitted with de-icing apparatus.

Send for full particulars to:

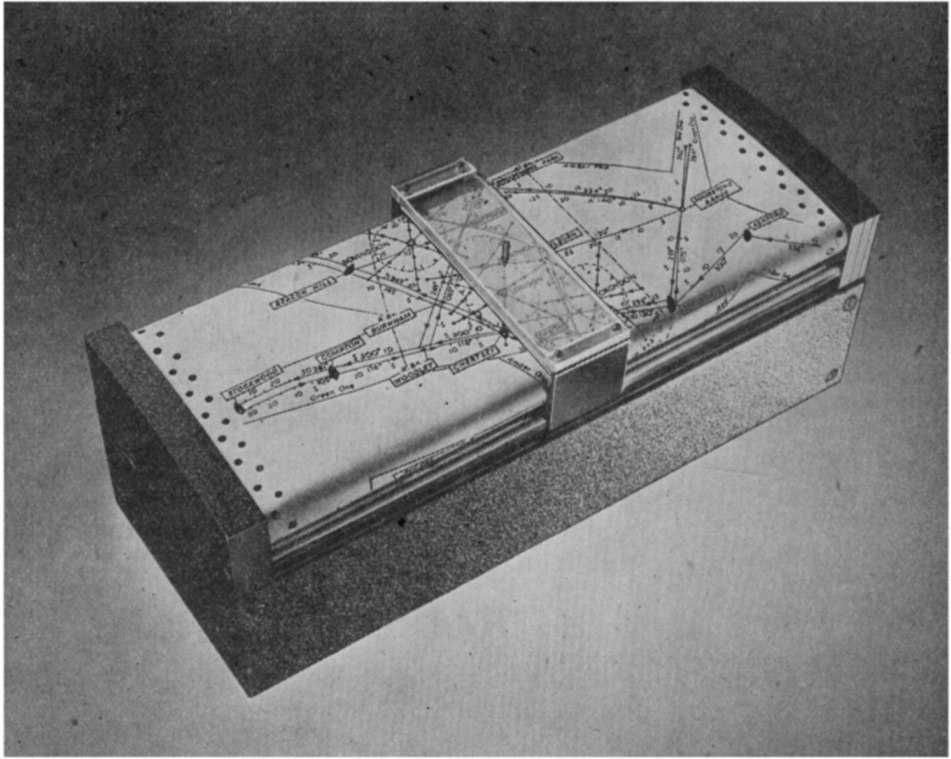
**THE MARCONI INTERNATIONAL MARINE COMMUNICATION CO. LTD.**

Electra House, Victoria Embankment, London, W.C.2.

Telephone: Temple Bar 4321

Telegrams: Thulium, Estrand, London





## THE MAGIC OF THE FLIGHT LOG

The Decca Flight Log presents to the pilot or navigator a continuous plot of the aircraft's position on a chart. The marking stylus automatically traces every movement of the aircraft throughout a flight and enables the pilot to follow, by means of the cockpit-mounted Display Head illustrated, any desired route or traffic pattern. A diversion or change of route can be made at will and the instrument does not limit the aircraft to a pre-determined track. At the end of a flight, the chart forms a detailed record of the track made good, providing a hitherto unobtainable fund of accurate information for traffic analysis. Used in conjunction with the existing Decca Navigator ground and airborne equipment, the Flight Log is an aid so far surpassing all others in precision and flexibility as to make an entirely new contribution to the art of navigation.

If you are interested in the Decca Flight Log, and would like to have further details, please write to us.

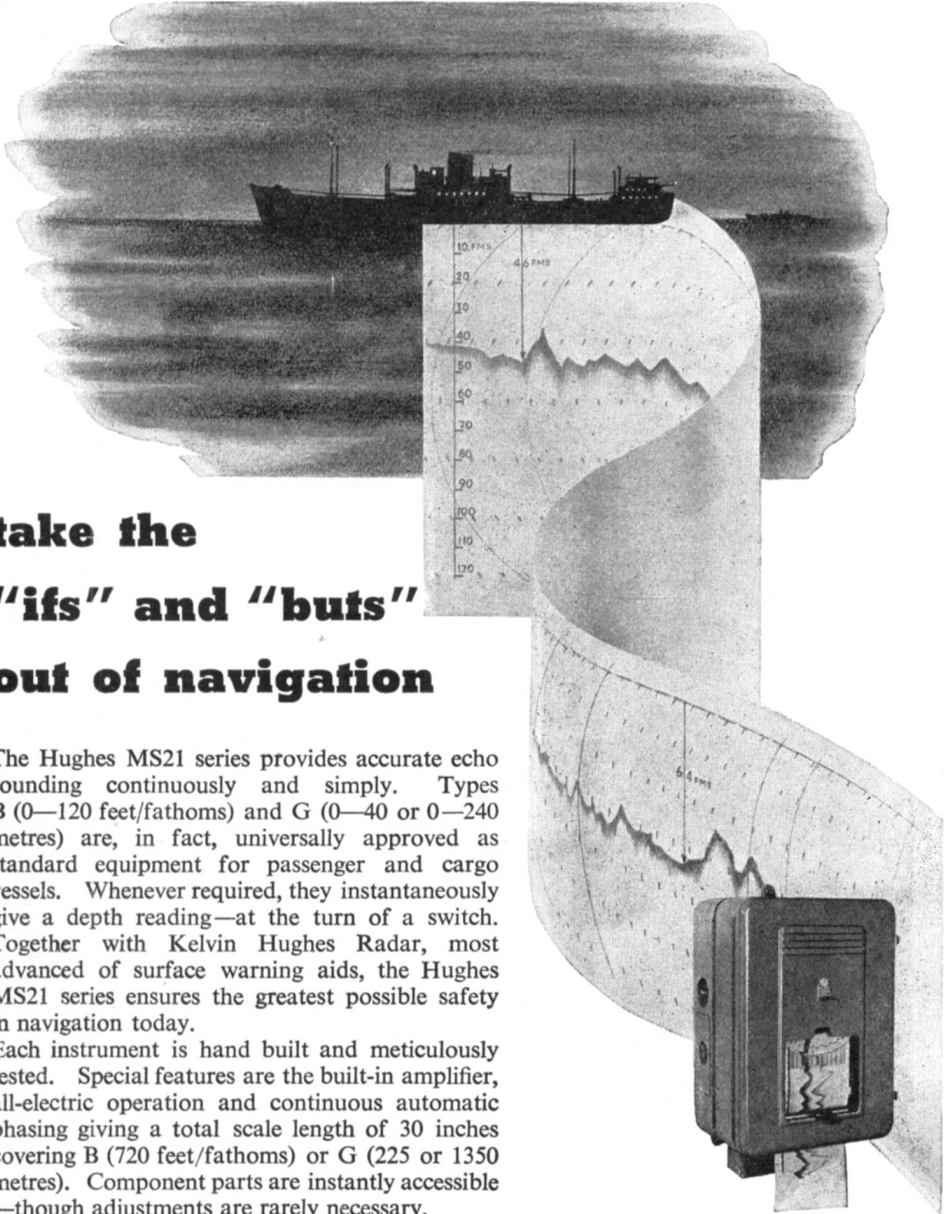
**THE DECCA NAVIGATOR CO. LTD.**

(AIR DIVISION)

1-3 BRIXTON ROAD, LONDON, S.W.9. RELIANCE 4421

KHM3

# HUGHES ECHO SOUNDERS . . .



**take the  
"ifs" and "buts"  
out of navigation**

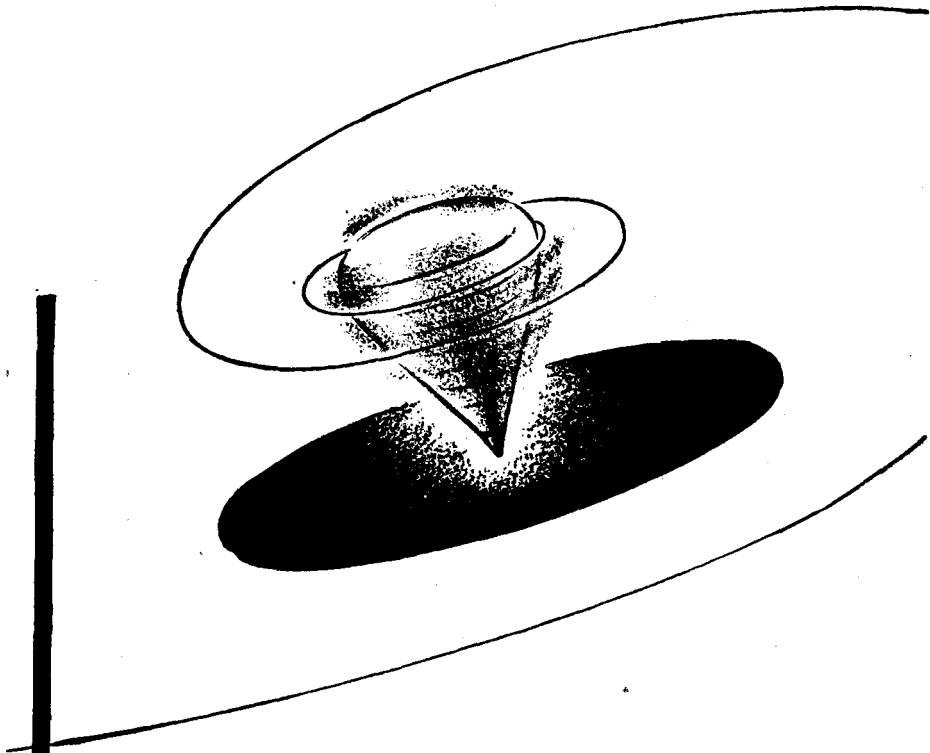
The Hughes MS21 series provides accurate echo sounding continuously and simply. Types B (0—120 feet/fathoms) and G (0—40 or 0—240 metres) are, in fact, universally approved as standard equipment for passenger and cargo vessels. Whenever required, they instantaneously give a depth reading—at the turn of a switch. Together with Kelvin Hughes Radar, most advanced of surface warning aids, the Hughes MS21 series ensures the greatest possible safety in navigation today.

Each instrument is hand built and meticulously tested. Special features are the built-in amplifier, all-electric operation and continuous automatic phasing giving a total scale length of 30 inches covering B (720 feet/fathoms) or G (225 or 1350 metres). Component parts are instantly accessible—though adjustments are rarely necessary.

## **KELVIN HUGHES**

THE TWO GREATEST NAMES IN NAVIGATION

**KELVIN & HUGHES (MARINE) LTD · 107 FENCHURCH STREET · LONDON · EC3**



### **endeavour**

The gyroscope, little more than a child's toy until the middle of the nineteenth century, has since occupied the attention of scientists and engineers attracted by its unique property of independent stability.

### **achievement**

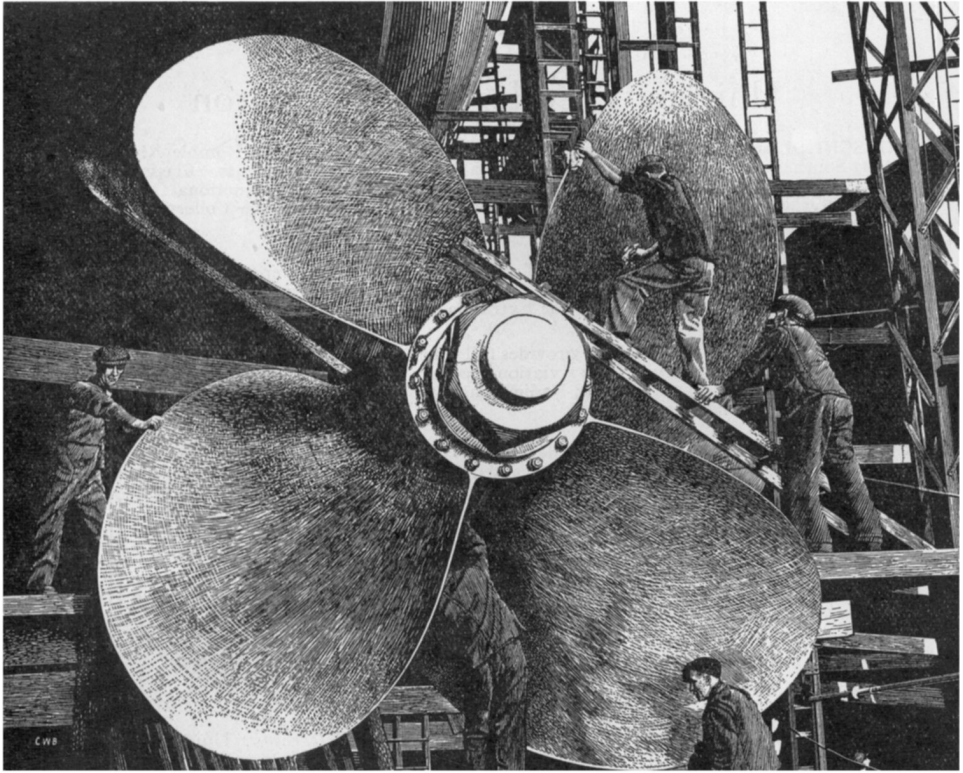
The most important application of the gyroscopic principle has undoubtedly been its use as the basis of the Sperry instruments and navigational aids to be found in the great majority of naval and merchant ships and every military and civil aircraft in the world.

# **S P E R R Y**

**instruments that inspire confidence**

THE SPERRY GYROSCOPE CO., LTD., Great West Road, Brentford, Middlesex. Telephone: EALing 6771





## RADAR FOR NEW TONNAGE

With the fitting of the propeller, another important stage is reached in the building of a ship. Just as this development is the outcome of searching tests, skilled design, and faithful adherence to a carefully co-ordinated plan, so is the selection and installation of Radar equipment. For three years CMR has provided conclusive proof of its capabilities by giving invaluable service to shipping in all parts of the world. That is why over 250 ships have been fitted with CMR, and why more and more owners are installing it to help safeguard the future of new tonnage.

**C**ossor  
**M**arine  
**R**adar } **THE GUARDIAN EYE OF SHIPPING**

*Companies who have re-ordered Cossor equipment include Ellerman Lines, Anchor Line Limited, General Steam Navigation Co. Ltd., British Railways, Union Castle Line and British Tankers.*

*Enquiries should be addressed to:* COSSOR RADAR LTD., COSSOR HOUSE, Highbury Grove, London, N.5. (CR31)

## School of Navigation University College, Southampton

THE SCHOOL is situated in pleasant surroundings at the mouth of the Hamble River overlooking Southampton Water. Residence is available for all classes of students. Classes are held apart from those for Undergraduates studying for degrees, but special instructional facilities are offered by the various faculties of the University College, whilst the College Library is available to all students.

THE SENIOR MARINE DEPARTMENT provides full time and preparatory courses for all grades of Ministry of Transport Certificates, and a special preparatory course in Mathematics and Physics for prospective candidates for the Extra Master's Certificate.

THE SENIOR AIR DEPARTMENT provides full time and preparatory courses for all, or specified, subjects for the Ministry of Civil Aviation Licences. Two Link Trainers are provided for training in SBA, GCA, BABS Mk. II, QGH, Radio Range, SCS (ILS) in preparation for the Ministry of Civil Aviation instrument rating.

RADAR OBSERVER COURSES for Merchant Navy Officers are provided, and Ministry of Transport Certificates of Competency are granted to students who have reached a satisfactory standard of proficiency. Refresher Courses of two or three days duration are also provided for both Marine and Air Observers.

GYRO COMPASS COURSES are provided either separately or in connection with other courses.

THE JUNIOR DEPARTMENT provides residential cadet courses of training for boys wishing to enter the Merchant Navy or Civil Aviation as cadets.

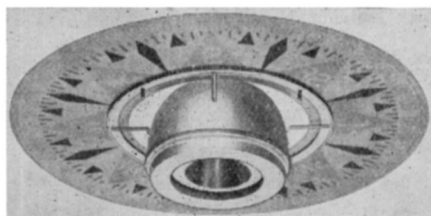
*Full particulars and conspectuses may be obtained from :*

The Director, School of Navigation, Warsash, Southampton.

Tel. : Locks Heath 2161

Telegrams : Uninav, Warsash

### The "CIRCUM" SINGLE RING MAGNET



An outstanding

*"Sestrel"*

advance in  
compass design

For full information apply to :

**HENRY BROWNE & SON, LTD.**  
**BARKING — ESSEX**

Sales & Service Depot :

71 LEADENHALL STREET, LONDON, E.C.3  
Telephones: Sales—AVEnue 6060. Service—AVEnue 2156

### METEOROLOGY FOR SEAMEN

By C. R. BURGESS

15s. (per post 15s. 6d.)

Weather—Climatology—Forecasting. Illustrated.

### MANUAL OF TIDAL PREDICTION

10s. 6d. (per post 11s.)

Occurrence—Variations—Problems.

### THE LAST OF THE WINDJAMMERS

By BASIL LUBBOCK

Vol. I. 42s. (per post 42s. 9d.)

Vol. II. 36s. (per post 36s. 9d.)

### THE BLACKWALL FRIGATES

By BASIL LUBBOCK

25s. (per post 25s. 9d.)

The Blackwall Yard—The Honourable John Company—The Beautiful Frigate Built Passenger Ships.

Write for Catalogue "N"—Books, Pictures, Prints.

**BROWN, SON & FERGUSON, LTD.**  
**52-58, Darnley St., GLASGOW, S.I.**

# VALVES & TUBES for navigational radar



# Mullard

*Thermionic Valves and Electron Tubes*

INDUSTRIAL POWER VALVES, MICRO-WAVE VALVES, THYRATRONS, INDUSTRIAL RECTIFIERS, PHOTOCELLS, FLASH TUBES, ACCELEROMETERS, CATHODE RAY TUBES, STABILISERS AND REFERENCE LEVEL TUBES, COLD CATHODE TUBES, ELECTROMETERS, ETC.

Mullard Electronic Products Limited

Communications and Industrial Valve Dept., Century House, Shaftesbury Avenue, W.C.2.

## Actual performance details show why



### BTH MARINE RADAR IS PREFERRED

The actual performance details of BTH Marine Radar were measured by the Ministry of Transport and are here compared with the requirements of the M.O.T. United Kingdom Specification of 1948. They show that the experience and skill of the BTH designers and craftsmen provide a handsome safety factor at sea.

MINISTRY OF TRANSPORT SPECIFICATION REQUIREMENT	ACTUAL PERFORMANCE OF BTH MARINE RADAR EQUIPMENT
<b>MAXIMUM RANGE SURFACE OBJECTS</b>	
7 MILES ON TRAMP 5000 g.r.t.	14 MILES ON DESTROYER 1000 g.r.t. Stern on.
2 MILES ON 2ND CLASS BUOY	4½ MILES ON 2ND CLASS BUOY
3 MILES ON FISHING VESSEL 30' LONG	6 MILES ON FISHING VESSEL 50' LONG
<b>MINIMUM RANGE</b>	
50 YARDS	50 YARDS
<b>RANGE ACCURACY</b>	
± 5% of maximum range obtainable on scale in use	RANGE 1. 0-16 CABLES 1.67% of MAX. RANGE 2. 0-4 MILES 0.875% „ „ RANGE 3. 0-10 MILES 1% „ „ RANGE 4. 0-25 MILES 1% „ „
<b>RANGE DISCRIMINATION</b>	
The set shall indicate clearly on the largest scale the presence of two small objects in line when these are 100 yards apart.	A 40 yard gap was visible between two buoys laid on the same bearing spaced 100 yards apart.
<b>BEARING ACCURACY</b>	
Means shall be provided for reading the bearing of an object with a maximum error of 1° at edge of P.P.I. display.	The bearing of an object can be read with an error not exceeding ½° at edge of P.P.I. display.
<b>BEARING DISCRIMINATION</b>	
The set shall indicate clearly the presence of two objects at the same range when the gap between them subtends an angle of 3° provided the distance between them is greater than 200 ft.	A gap subtending an angle of 1½° was visible between the echoes of two buoys at the same range which subtended an angle of 3½°.

THE  
**BRITISH THOMSON-HOUSTON**

COMPANY LIMITED, RUGBY, ENGLAND

A 4174

and

DOBBIE McINNES Ltd., 191-3 Broomloan Road, GLASGOW, S.W.1, & 52/53 Crutched Friars, LONDON, E.C.3

---



---



---

# THE NAVIGATORS

and GENERAL INSURANCE Company Limited

is the obvious and appropriate Company for the insurance of the property and liabilities of all professional and amateur NAVIGATORS.

Founded in 1921 under the chairmanship of the late Admiral Sir John Franklin Parry, K.C.B.—a former Hydrographer of the Navy—the “Navigators and General” has specialised in the Insurance requirements of Navigators, offers impeccable security, and has built up an enviable reputation for the prompt and generous settlement of claims.

*Classes of Business transacted include :*

**FIRE, ACCIDENT, MARINE**

**YACHTS and MOTOR BOATS**

**PERSONAL EFFECTS**

*(Ashore, Afloat and Airborne)*

**PILOT'S PUBLIC LIABILITY**

**NAVIGATOR'S INDEMNITY (Sea and Air)**

**AIRCRAFT (Hull and Cargo), MOTOR VEHICLES**

*Write for particulars—mentioning this JOURNAL to*

**THE NAVIGATORS & GENERAL INSURANCE COMPANY LTD.**

**15/16 CULLUM STREET, LIME STREET, LONDON, E.C.3**

**TELEPHONE: MANSION HOUSE 2121**

---



---



---



**SEXTANTS**

**BINOCULARS**

**TELESCOPES**

**CHART  
INSTRUMENTS**

**CLOCKS,  
ANEROIDS**

**RULES, Etc.**



**BINNACLES**

**COMPASSES**

**STATION  
POINTERS**

**SOUNDING  
MACHINES**

**AZIMUTHS**

**TAXIMETERS**

Specialists in Meteorological, Temperature Indicating  
and Recording Instruments

Catalogues will gladly be sent upon request, quote (I.N.J.50)

## **HEATH & COMPANY**

(Incorporated with W. F. Stanley & Co., Limited.)

**NEW ELTHAM - LONDON, S.E.9**

Phone : ELTHAM 3836.

Cables : "Polaris, Phone, London."

**NAVIGATIONAL**



**INSTRUMENTS**

## Bound Volumes of the Journal

VOLUME 3 of the *Journal* ends with this issue. Members and subscribers who wish to have the volume bound up by the printers should send the parts with the remittance to Messrs. William Clowes & Sons, Ltd., Little New Street, London E.C.4. The binding is in full cloth boards, blocked on the spine with the name of the *Journal* in gold lettering, and the price per volume is 11s. 9d. post free.

Back copies of the *Journal* can be obtained from John Murray, 50 Albemarle Street, London W.1.

Volumes 1 and 2 can also be bound if required, at the same price.

# Ordinary Meetings

OCTOBER 1950 — MARCH 1951

---

Friday 20 October at 3 p.m.

## ANNUAL GENERAL MEETING

Friday 17 November at 5 p.m. (*Tea at 4.15 p.m.*)

## SURFACE NAVIGATION IN HIGH LATITUDES

Special Problems in Polar Regions

LIEUT. COMMANDER J. D. MOORE, R.N.

(*H.M. Navigation School*)

Compass Problems

COMMANDER A. V. THOMAS, R.N.

(*Admiralty Compass Observatory*)

Friday 15 December at 5 p.m.

## PSYCHOLOGICAL ASPECTS OF INSTRUMENT PRESENTATION

WING COMMANDER H. P. RUFFELL SMITH

(*R.A.F. Institute of Aviation Medicine*)

Friday 19 January at 5 p.m.

## SUBMARINE NAVIGATION

LIEUT. COMMANDER P. G. SATOW, D.S.C., R.N.

(*H.M. Navigation School*)

Friday 16 February at 5 p.m. (*Tea at 4.15 p.m.*)

## THE AMERICAN PLAN FOR AIR TRAFFIC CONTROL

D. O. FRASER

(*Ministry of Civil Aviation*)

Friday 16 March at 5 p.m.

## APPLICATIONS OF OCEANOGRAPHICAL RESEARCH TO NAVIGATION

G. E. R. DEACON, F.R.S.

(*Admiralty Research Laboratory*)

---

AT THE ROYAL GEOGRAPHICAL SOCIETY

(*Entrance in Exhibition Road*)