"NOTES & QUERIES"

IS IT POSSIBLE TO TRANSMIT CARTOGRAPHIC DRAWINGS BY TELEGRAPH.

Numerous attempts have been made during recent years to send drawings and photographs by telegraph either by wireless or by wire or cable.

Successful experiments, carried out in America, France, Germany and Great Britain, show that, under certain conditions, this might very well be done in practice.

In principle, a sensitized receiving surface is swept by a very narrow pencil of light which passes successively over closely adjacent parallel bands on the surface. The relative intensity of this pencil varies in proportion with the intensity of the radio or cable current emitted and this is governed by the intensity of light after passing through or reflected from similar parallel bands on the picture or drawing which it is required to transmit.

In practice a photographic film of the picture or drawing is rolled round a cylinder which is rotated on a screw thread which causes it to advance in the direction of its axis. The pitch of the thread is equal to the width of the pencil of light which is directed on the film. This pencil, after passing through the film, acts on a photo-electric cell in proportion to the lights and shades of the picture. The varying intensity of the light when it reaches the cell causes the variations in the current transmitted.

At the receiver a similar arrangement is used ; a cylinder turns and advances in synchronism with the sending cylinder, the synchronism being maintained by electrically-operated tuning fork governors. A so-called "light valve", actuated by the intensity of the current received, controls,

by means of a movable diaphragm, the light which falls on the sensitized receiving film; this diaphragm opens and closes an aperture onto which a pencil of light is directed, thus making a close reproduction of the original picture or drawing.

There are two methods:

If an image of the aperture be thrown onto the sensitized film, the light passing through will record the length of the aperture as governed by the light-valve. This gives the result shown in Figure 1.

If a diffused light is allowed to fall on the aperture the lines will always be of the same width as the aperture, but the intensity of the light will vary in accordance with its length as it is covered and uncovered by the diaphram. Fig. 2 shows a picture received by this method.

These two figures are reproduced by the courtesy of "*The Military Engineer*" (810 Mills Building, Pennsylvania Av. at 17th Street, N.W., Washington, D. C.) from an article, in the November-December 1925 number of that journal, entitled "Transmission of Pictures over Wires" by T. T. Cook of the American Telephone & Telegraph C°.

In the "*Rivista Marittima*" (July-August 1925, pages 390 to 396) there is a discussion of a work entilted "Vision by Radio; Radiophotographs and Radio-Photograms" by C. G. JENKINS, in which attention is directed to the great value of the transmission of parts of charts, as demonstrated experimentally at Fort Leavenworth.

Regular services of telegraphic transmission of autographs and drawings are now being used in France by means of the Edouard BELIN method or "Otautograph" which reproduces the lines of the drawing with a certain degree of accuracy.

Telephotography should eventually be capable of being applied to nautical and hydrographic purposes (*e. g.* for accurate reproduction of parts of charts, insets or other small plans and charts, or chart correction slips).

The attention of readers is called to this possibility and they are requested to supply the Bureau with any information which they may have on this subject.

With reference to this subject, and for information, the figure opposite which is reproduced from the „ Annalen der Hydrographie und Maritimen Meteorologie ", Heft V, Berlin, 1916, page 206, shows a sketch of a daily meteorological map of the North Atlantic as it was transmitted at sea to the German ship „ Westphalia ", by means od Dr. Dieckmann's process, tested by the Deutsche Seewarte in April 1926.

Fig. 1

Portion of Variable Width Line Type, Enlarged.

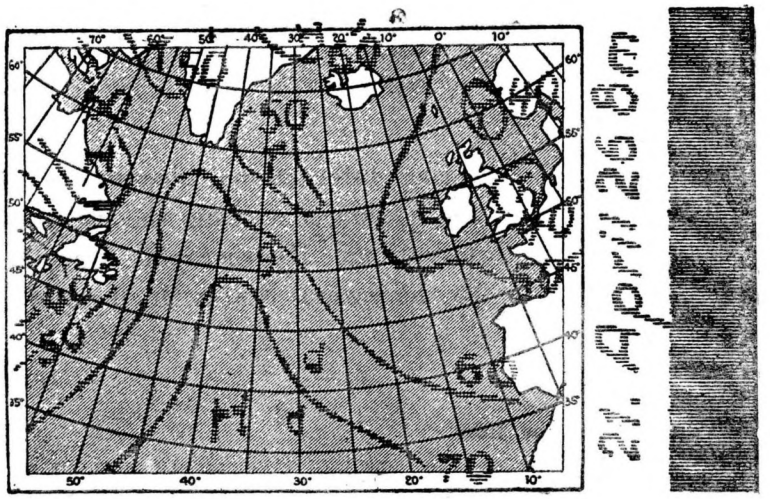
Fig. 2

Portion of Variable Density Line Type, Enlarged.

The lines indicate the isobars with the pressure in numerals above 700 millimeters.

H signifies Hoch, *T* signifies Tief, and the small Latin Characters indi'cate the force of the wind: *a* - calm; *b* - force 1; *c* - force 2, *etc*,

The thin lines which appear on the right hand side of the figure refer to the suncrhonisatiof device.



ERRORS OF RADIO BEAMS AND OF RADIO COMPASSES

(REQUEST FOR INFORMATION).

With the object of collecting international documents which may furnish useful information to Navigation concerning the use of radio beams and radio compasses, the International Hydrographic Bureau addressed the following Circular Letter to the various States Members of the Bureau and others :

CIRCULAR LETTER N° 3-H. OF 1926.
RADIOGONIOMETRY.
REQUEST FOR INFORMATION.

MONACO,
30th January 1925.

Sir,

At the meeting of the Buoyage Committee of the League of Nations held in Monaco in November 1925, an enquiry was made for information on the subject of errors of radio-beams and of radio-compasses.

2. The Bureau is aware that experiments and measurements on this subject have been carried out in several countries, by using light vessels, *etc.*, and that the results, which are of such great interest to the navigator, have been issued occasionally by means of Notices to Mariners and have been inserted in various other nautical documents.

3. It was requested by the Buoyage Comittee that the International Hydrographic Bureau should collate more data in connection with the subject. A list of publications containing such information, and of which the Bureau is aware, is given below.

4. I have the honour, therefore, to request you to be kind enough to supplement this list by informing the Bureau of any works which, to your knowledge, deal with the question and also by forwarding all other information you possess concerning the following points and any others which may bear on the subject in its connection with navigation :

(*a*) Limits of errors in bearings taken from land or ship stations by day, by night, *etc.*, under various conditions.
(*b*) Process of calibration.
(*c*) Distortion due to various causes such as the presence of antennae in operation, of the metallic mass of the ship or rigging, *etc.*
(*d*) Influence or change due to the wave length used or to the system of emission.

5. New information received will be published in the *Hydrographic Review* for the benefit of its readers.

The information contained in paragraphs (*a*), (*b*), (*c*) and (*d*) given above, lays particular emphasis on the following:

1.— Errors when bearings run approximately parallel with the coast line, or pass alternately over land and sea.

2.— Influence of temperature and of changes of temperature met with in the track of the beam.

3.— Polar curve of the beam, or revolving beam with reflector.

4.— Process of checking: adjustment and correction of apparatusses used for taking radio bearings.

5.— Distortion due to the presence of buildings, electric power cables or wires, antennae tuned or not, in operation, isolated or grounded.

6.— Influence of the hull and metallic mass of the ship or rigging, *etc.* with respect to the approaching wave front; also unsymmetrical location of receiving apparatus on board, and correction required.

In accordance with the statement made in paragraph 5 of the above Circular Letter, we give below a list of publications relative to the subject, containing important information which has been received in answer to the Circular Letter mentioned above, or which has been received by the International Hydrographic Bureau since that date.

LIST OF PUBLICATIONS

1.	A. H. TAYLOR.	Variation in direction of propagation of long electromagnetic waves. *Scientific Papers of the Bureau of Standards*, Washington, 1919.
1*a*.	J. ROBINSON.	A Method of Direction Finding of Wireless Waves and its Application to Aerial and Marine Navigation. *Radio Review*, 1920 - 1 - 213 - 219, pp. 265-275.
2.	G. FERRIE, R. JOUAUST, R. MESNY, A. PEROT.	Etudes sur la Radiogoniométrie. *Comptes Rendus*, 172, p. 44 - Paris, 1921. *Radioélectricité* I, p. 477 - Paris, 1921.
2*a*.	J. HOLLINGSWORTH.	Directive Measurement with the R. A. F. System. *Radio Review*, 1921 - 2 - 297.
3.	G. R. PUTNAM.	Annual Report of the Commissioner of Lighthouses. *Government Printing Office*, Washington, D. C. 1921, pp. 24-31.
3*a*.	A. ESAU.	Drahtloses Peilen. *Telef. Zeitung*, IV Jahr, N° 23, Mai/Juni, 1921.
4.	L. H. WALTER.	Directive Wireless Telegraphy. Direction and Position Finding. In 12vo - 124 pages, 57 illustrations. With list of references. Published by Isaac PITMAN & Sons, London, 1921. Price: 2/6 net.

5.	F. A. KOLSTER, F. W. DUNMORE.	The radio direction finder and its application to navigation. *Bureau of Standards: Scientific Paper* N° 428. Washington, 1922.
5a.	C. S. FRANKLIN.	Short wave directional telegraphy. *Journal of Institution of Electrical Engineers*, 60. London 1922.
6.	R. L. SMITH-ROSE.	On the Electromagnetic Screening of a Triode Oscillator. *Proc. Phys. Soc.*, 1922, 34, 127-138.
6b.	R. L. SMITH-ROSE, R. H. BARFIELD.	The Effect of Local Conditions on a Radio Direction-Finding Installation. *Journal I. E. E.*, 1922, 61, 179-191. *Also*: The Effect of Under-ground Metal-work on the Radio Direction-Finders. *Wireless World and Radio Review*, 1922, 11, pp. 165-171.
7.	JOHN S. CONWAY.	The United States Lighthouse Service (Edition 1923). *Government Printing Office*, Washington, 1923, pp. 46-51.
8.	R. L. SMITH-ROSE, R. H. BARFIELD.	A discussion of the Practical Systems of direction-finding by reception. Special Report N° 1, *Radio Research Board*, London, 1923,. Price: 9 d. net.
9.	MARCONI'S WIRELESS TELEGRAPH Co. Ltd.	Revolving Beam Direction Finder, 1923.
10.	F. W. DUNMORE. F. H. ENGEL.	Directive Radio Transmission on a wave-length of 10 meters. *Bureau of Standards: Scientific Paper* N° 469, Washington 1923.
11.	R. L. SMITH-ROSE.	Modern Progress in Direction Finding. *Year Book of Wireless Telegraphy and Telephony*, pp. 77-100. London 1923.
12.	C. E. HORTON.	Wireless Direction-Finding in Steel Ships. *Journal of Institution of Electrical Engineers*, 61, London 1923.
13.	SERVICE HYDROGRAPHIQUE FRANÇAISE.	Liste des Stations des Signaux Radiotélégraphiques. Ouvrage N° 2, Paris, 1924.
14.	G. R. PUTNAM.	Radio Fog Signals and their use in Navigation in connection with the Radio Compass. (Second Edition) - in 8vo - 28 pp. - illus. *Government Printing Office*, Washington, 1924. (Contains an excellent bibliography on the subject).
15.	F. H. ENGEL, F. W. DUNMORE.	Directive Type of Radio Beacon and its application to Navigation. *Bureau of Standards*: *Scientific Paper* N° 480, Washington, 1924.
15a.	R. L. SMITH-ROSE.	The Effect of the Shape of the Transmitting Aerial upon Observed Bearings on a Radio Direction-Finder. *J. Inst. Elec. Eng.*, 1924, 62, pp. 957-963.

15*b*.	G. R. PUTNAM.	Radio Fog Signals for the Protection of Navigation: Recent Progress. *Proceedings of the National Academy of Sciences*, Washington, D. C., Vol. 10, N° 6, pp. 211-218, June, 1924.
16.	UN FANAL RADIO ÉLECTRIQUE DIRIGÉ.	*L'Industrie Electrique*, Paris, 25th August, 1924, pp. 330-333.
16*a*.	R. L. SMITH-ROSE.	Radio Direction-Finding Observations on Ship adn Shore Transmitting Stations. *Journal I. E. E.* 1924, Vol. LX, p. 701.
17.	A. WEDEMEYER.	Funkortung mit dem Bordfunkpeiler. *Marine Rundschau*, Heft 7, 1924.
17*a*.	E. VELLIN.	Un nouveau radiogoniomètre avec levée de doute. *L'Onde Electrique*, 1924, vol. III, p. 233.
17*b*.	R. L. SMITH-ROSE.	The Reliability of Direction-Finding for Navigation Purposes. *Wireless Year Book*, 1924, pp. 586-591.
17*c*.	J. A. SLEE.	Development of the BELLINI-TOSSI System of Direction-Finding in the British Mercantile Marine. *Journal I. E.-E.*, 1924, Vol. LXII, p. 543.
18.	Dr H. MAURER.	Kompensation der Funkbeschikungen am Bord-Funkpeiler. *Annalen der Hydrogr. u. Mar. Meteor.* IX, 1924, pp. 210-213, and *Rivista Marittima*, Roma, December 1924, pp. 802-805.
19.	G. MONTEFINALE.	Radiofaro transmettente a telai dirigibili incrociati - 6 fig. *Rivista Marittima*, Roma, November 1924, pp. 507-515.
20.	THE PROBLEM OF BEACON STATIONS.	*W. World and R. Review*, 10 December 1924, pp 330-334.
21.	(GREAT BRITAIN).	The Admiralty List of Wireless Signals, including details of Direction-Finding, Fog Signals, *etc.* (published annually), London 1925, p. 6.
22.	R. KEEN, B. ENG.	Direction and Position Finding in Wireless. demi 8vo, 365 p., 250 illust. Price 9/6. *The Wireless Press Ltd.*, London, 1925.
23.	WEDEMEYER.	Genauigheit der Funkpeilungen *Die Komandobrucke*, 2 - 1925. *Seefahrt*, X, 1925.
24.	G. MONTEFINALE.	Il Problema dei Radiofari. *Rivista Marittima*, Roma, Feb. 1925, pp. 599-604.
25.	G. MONTEFINALE.	Sul Radiofaro Marconi. *Rivista Marittima*, Roma, Aprile 1925, pp. 217-221.
26.	(FRANCE).	Phare Tournant T. S. F. Marconi. *La Technique Moderne*, Paris, 15 Mai 1925, pp. 310-311.
27.	(GERMANY).	Funkpeilungen der deutschen Funkpeilstellen an der Noordsee. *Hansa*, Nr. 21, 1925.

27*a*.	R. L. SMITH-ROSE.	The Progress of Radio Direction-Finding during 1924 as an Aid to Navigation. *Wireless Year Book*, 1925, pp. 543-547.
27*b*.		Laws, Regulations and Procedure relating to Direction-Finding. *Wireless Year Book*, 1925, pp. 548-565.
28.	R. MESNY.	Mesures, Radiogoniométrie, Propagation des Ondes, in 8vo - 96 pp. *Chiron*, Paris, 1925.
28*a*.	R. MESNY.	Usage des Cadres et Radiogoniométrie. Publié par *E. Chiron*, Paris, 1925. Prix : 25 francs.
28*b*.	R. MESNY.	Les Ondes très courtes. Publié par *E. Chiron*, Paris, 1925. Prix : Fr. 1.50.
29.	R. L. SMITH-ROSE.	Coastal Errors in Radio Direction-Finding. *Nature*, London, Sept. 19, 1925, pp. 426-427.
30.	EL RADIOFARE DE ONDA CORTE DE SOUTH FORELAND.	*Revista General de Marina*, Madrid, Nov. 1925, pp. 738-743.
31.	A. LIEB und D. NITZSCHE.	Funkpeilungen - *E. S. Mittler u. Sohn*, Berlin, 1925. Price M. 18/50.
32.	R. L. SMITH-ROSE.	Variations of apparent bearings of Radio Transmitting Stations. Part II. Observations on fixed stations. March 1922-April 1924-VIII 107 pages - Special Report N° 3, *Radio Research Board* - H. M. Stationary Office. London 1925. Price : 4 s. 6 d. net.
32*a*.	MASCHKE - SS "WESTPHALIA" Hamburg-American Line	"The Importance of the Radio Compass" (in German) printed as a separate pamphlet from *Der Pilot*, 1925
33.	SIR BERTRAM FOX HAYES.	The value of Wireless Direction-Finding, *Nautical Magazine*, London, Nov. 1925, pp. 390-392.
34.	FALKE.	Uber praktische erfahrungen mit dem Telefunken Bordpeiler. *Annalen der Hydrogr. u. Mar. Meteor.*, Berlin XII - 1925, pages 399-400.
34*a*.	R. A. WATSON WATT.	The Directional Recording of Atmospherics. *Institution of Electrical Engineers*, Dec. 1925.
34*b*.	H. O. N° 205. Hydr. Off. U.S.A.	Radio Aids to Navigation. *Government Printing Office*, Washington, 1925. Price : 90 cents.
35.	JOHN A. SLEE.	Wireless as an aid to navigation. *The Marine Observer*, London, Jan. 1926, pp. 6-10.
36.	U. S. PILOT CHART.	of the North Pacific Ocean for January 1926.
37.	(GERMANY).	Ia. Funkpeilungen. IIa. Funkbaken Signale. *Nautischer Funkdienst, Marineleitung*, Berlin, 1926 edition.

38.	Dr H. MAURER, Dr F. FISCHER.	Die vom Schiff hervorgerufene Funkfehklweisung und ihre Kompensation. *Annalen der Hydrogr. u. Marit. Meteor.* Jan. 1926, pp. 13-19.
39.	Dr G. SIMEON.	Su alcuni metodi per la determinazione del punto con rilevamenti radiogoniometrici. *Rivista Marittima*, Gennaio, 1926, pp. 77-107.
40.	R. L. SMITH-ROSE.	The Progress of Directional Wireless Communication. *Nature*, Jan. 16, 1926, pp. 90-92.
41.	H. MAHNKOPF, G. PASSARGE.	Funkpeilversuche auf kurzen Wellen. *Annalen der Hydrogr. u. Marit. Meteor.* Feb. 1926, pp. 36-40.
42.	G. R. PUTNAM.	Use of Radio Compass Fast Extending. *Motorship*, New York, Feb. 1926, pp. 109-111.
43.	R. A. WATSON WATT, J. F. HERD.	An Instantaneous Direct-Reading Radiogoniometer. *Institution of Electrical Engineers*, Feb. 1926.
44.	S. CHAPMAN, Sir HENRY JACKSON.	The Electrical State of the Upper Atmosphere. *Nature*, March 27, 1926, pp. 454-456.
45.	R. L. SMITH-ROSE.	On the Cause and Elimination of Night Errors in Radio Direction-Finding (Lecture). *Institution of Electrical Engineers*, London, May 5, 1925.

Below are given authorized extracts from letters on the subject sent to the International Hydrographic Bureau, and due to the kindness of the Bureau of Lighthouses at Washington, as well as of the United States Hydrographic Office.

DEPARTMENT OF COMMERCE,
Bureau of Lighthouses,
WASHINGTON.
February, 25, 1926.

1. Replying to circular letter No. 3-H of 1926, paragraph 4 (*a*) to (*d*) inclusive

2. (A) *Limits of errors in bearings taken from ship stations by day, by night, etc., under various conditions.*

Assuming that a rotating coil ship type radio compass (the only type manufactured in the United States), has been correctly installed, adjusted and calibrated aboard ship, the bearing errors under normal conditions up to 100 miles distance from the radio beacon should not exceed two degrees. Usually the error at 50 miles from the radio beacon is less than one degree. This accuracy is attained day or night, excepting during abnormal static distrubances, at which time it is necessary to take the average of several bearings in order to obtain the usual accuracy.

(B) *Process of calibration (for radio compasses aboard ship).*

Calibration is usually done by the commercial company supplying the radio compass, and is described in their circulars. In general, whenever possible, the ship, on which the radio compass is installed, is slowly swung in both directions within sight of the lightship transmitting the radio beacon signal, while simultaneous radio compass and pelorous readings are taken. When this method is not feasible, a small craft such as a tug is fitted with a low-powered radio

transmitter, and it circles the ship on which the radio compass is to be calibrated. In either method readings are taken at least every 10 degrees of arc. Off the bow and stern more frequent readings are taken.

(c) *Distortion due to various causes such as the presence of antennae in operation, of the metallic mass of the ship or rigging,* etc.

The presence of ship's antenna, closed and tuned to a frequency near the beacon frequency is undesirable. It is customary to calibrate a radio compass with the ship's antenna either open or grounded and to have it in that state whenever the radio compass is in use. The ship's hull and rigging affect the radio wave, but from experience on commercial ships in this country these effects can be rendered stable and compensated for.

(d) *Influence or change due to the wave length used or to the system of emission.*

The rotating coil type ship radio compass is used interchangeably on spark and modulated continuous wave radio beacons over the frequency range of 300 to 500 kilocycles (1.000 to 600 meters).

3. The practice of the United States Lighthouse Service deals only with radio compasses installed on ships, and radio beacons located on lightships or at lighthouses, and this is considered the only general system of navigation by means of radio bearings.

(Signed): G. R. PUTNAM.
Commissioner of Lighthouses.

HYDROGRAPHIC OFFICE,
WASHINGTON, D. C.

16 March, 1926.

Sir,

Referring to paragraph 4 of International Hydrographic Bureau circular letter No. 3-H of 1926, the following information is furnished.

It is the opinion of the Navy Department that with a proper type of direction finder, which has been carefully calibrated for deviation, it is possible and practicable to obtain bearings accurate to within one degree, under favourable conditions. Sometimes at night it is found impossible to obtain this accuracy. Recent experiments have shown that the rotationg type of direction finder can be used in the day-time at frequencies up to 6.000 kcs. The highest frequency so far tried for shipboard use is 2.100 kcs. Previous experiments have shown that it is impracticable to obtain satisfactory results at night with radio direction finders on frequencies above approximately 2.000 kcs.

Deviation or distortion of received wave direction on ship-board is due in large part to the hull of the ship, but some of the deviation is due to the effects of stays, railings, and other nearby metal structures. The deviation due to the hull does not change, but the deviation due to nearby structures may change; and great care is continuously necessary to prevent such changes, which would cause serious errors in bearings. Similarly, at shore radio compass stations, deviation is due partly to coast line refraction, which changes but little, and partly to the effects of communication lines, etc., which may change considerably. Calibrations provide satisfactory correction for deviations provided the deviations are constant.

The metal structures which may cause deviation changes ar not necessarily of iron. Brass or copper structures are more likely to cause deviation than iron or steel structures, because of their greater electrical conductivity.

Many ship captains and navigators assume, because of the name "radio compass", that deviation is due to the same causes as in a magnetic compass. They, therefore, carefully avoid any changes in iron or steel structures near the direction finder, which actually might have little or no effect, yet permit changes in stays, closed loops, wires, etc., which may greatly affect the

deviation of the direction finder and thereby cause serious errors. Full reliability of the ship direction finder will not be obtained until captains and navigators become thoroughly informed of the precautions necessary to prevent deviation changes.

Under certain conditions, radio bearings are less reliable at night than in the day-time, and the degree of their unreliability varies with the radio frequency on which observations are taken. In general, bearings on frequencies below 200 kcs, and above 1.500 kcs. are much less reliable at night than bearings on frequencies between 200 and 1.500 kcs. Much more data are needed to determine accurately the extent of this effect.

At the present time, to obtain reliable bearings, it is necessary to open or detune all antennae on board ship, (that is, stop the operation of all radio transmitters and receivers except the direction finder).

Future work to increase the serviceability and reliability of the radio direction finder falls under three main headings:

(*a*) Investigation of wave direction variations with time, particularly on frequencies above 200 kcs., for both continuous wave and modulated transmission.

(*b*) Investigation of distortion or apparent direction changes caused by structures near the direction finder, and the preparation therefrom of a standard set of rules giving the precautions necessary to prevent or mimimize errors from such causes.

(*c*) Further refinement of the design, extension of frequency range, and general improvement of direction finding apparatus.

The Navy Department is proceeding, as funds and priority permit, toward the accomplishment of the work outlined in the previous paragraphs. It is believed that if the International Hydrographic Bureau could influence the administrations of other nations to direct investigations along similar lines, and exchange this information, there would be considerable progress made towards the improvement of radio direction finding services.

(Signed): R. A. WHITE,
Acting Hydrographer.