The available records appear to show definite relations of storm intensity and movement to the period and direction of swells, as follows :

1. Within the tropical cyclone, the winds turn to the left of the swell in the Northern Hemisphere, to the right in the Southern Hemisphere.

2. The progressive movement of the tropical cyclone results in differences in the amount of deviation of wind from swell in the different parts of the cyclone.

3. In the tropical cyclone, the length of fetch of the winds is insufficient to develop waves of the maximum length and period theoretically possible under favorable conditions with winds of hurricane force acting upon long stretches of deep sea.

4. The period of storm swells is indicative of the intensity of the storm and is not dependent upon the distance between the storm center and the point of observation.

5. There is a line of discontinuity in the movement of swell, along the line of progression to the rear of the storm center.

6. When storm swells move into shallow water along the shore, a turning movement results, so that the direction of swell tends toward the normal to the coast line.

7. Waves do not deviate from the wind in the absence of a cyclonic storm or other unusual weather conditions.

8. As a storm increases in intensity the period of the swell increases.

9. The size of waves caused by winds depends upon the extent of the water surface over which the winds blow. Waves along the southern Atlantic coast of the United States are much larger under average weather conditions than waves during ordinary weather in the Gulf of Mexico.

10. The winds over a considerable part of the storm field to the right of the center of a traveling cyclone (in the Northern Hemisphere) are directed continuously forward, roughly along the line of progression. The progressive movement of the cyclone increases the force of these winds upon the water, hence the largest swells are developed there. They run far ahead of the cyclone.

DIFFERENT MEANS OF LIGHTING AND THE RANGE OF LIGHTS WITH REFLECTORS.

(Information abstracted from a pamphlet issued by the *Anciens Etablissements* SAUTTER-HARLÉ, 16-26, Avenue de Suffren, Paris 15^e, 1936).

(Translated from the French).

I. *THE DIFFERENT METHODS OF LIGHTING :*

1. *Incandescence by vaporized petroleum :* For a long time the most commonly employed means of lighting in the most important lighthouses was the incandescent petroleum vapour lamp.

The burners are easily kept in condition owing to the facility with which they may be assembled and taken apart. Use is made of soft mantles which may be transported without danger of breakage and which may be kept in storage for several years. When being put in service these mantles are incinerated on the burner itself. In most cases the intrinsic brightness exceeds 30 candles per sq. cm.

These mantles are 55 or 85 mm. in diameter. The hourly consumption of petroleum is 0.700 kgs. for the 55 mm. mantle and 1.300 kgs for the 85 mm. mantle.

2. *Electric Incandescence :* Wherever there is available in the vicinity an electric power distribution station or where there is an electric generating plant, the use of incandescent electric lighting is much more advantageous. The lamps used have twisted tungsten filaments and operate in an inert atmosphere similar to the "half-watt" lamps, but the filaments which are specially developed for the lighthouse service are particularly well concentrated. Lamps of the following powers are used, viz. — 1,000, 1,500 and 3,000 watts. The lamps designed especially for use in aerial beacons have vertically protracted filaments.

The mean intrinsic brightness of the incandescent body used in these lamps reaches as much as 800 candles per sq. cm. and the energy radiated amounts to about 0.6 watts per candle.

This high brilliancy, for a given power permits a great reduction in the dimensions of the optical system.

In fact, as will appear from the following tables giving the range of these lights, an apparatus with electric lamp and reflector has the same range as an apparatus fitted with oil lamps supplied with a reflector four or five times greater in diameter.

In the case where a petroleum lamp is used, the apparatus fitted with a reflector of 2.25 metres diameter, with a petroleum vapour burner, consumes 1,300 grams/hour for a luminous intensity 1 × 0.4 of 270,000 candles. With incandescent electric lamps and reflectors of 1.1 metres supplied by an electric generating plant, for the same expenditure of petroleum as fuel there results a luminous intensity 1 × 0.4 of 760,000 candles. This is practically three times as much lighting and insures in addition the illumination of all parts of the lighthouse. Further, if the electric generating plant burns heavy oil as fuel, costing about one-fourth as much as petroleum, the expense can be still further reduced while the power of the light is augmented.

3. *Acetylene :* Acetylene is frequently used in the smaller apparatus owing to the great brilliancy of the flame. In such cases use is made of dissolved acetylene, which one may store in the amounts requisite for operation in the vicinity of the burner for periods of a month, a year, and even longer. For the larger apparatus, use is made of burners with gas-mantles yielding an intrinsic brightness very nearly twice that of the best incandescent petroleum burners. But the great volume of gas required makes the use of acetylene flasks somewhat inconvenient and, further, the control of the gazogene for the production of the gas on the spot makes it more troublesome than the use of the petroleum burners.

4. *Butane-Propane :* Recently gas derived from the distillation of petroleum is being brought out to compete with acetylene; butane, or rather propane, can often be conveniently employed. These gases are available everywhere in flasks which can be easily transported.

5. *Electric Arc :* The incandescent electric lamps designed for lighthouses, with concentrated filaments, may in most cases replace the electric arcs in the lighthouses. Nevertheless, resort must be had to electric arc lights when the maximum range is desired. This is true for certain lights destined especially for aerial navigation. Since aircraft fly at very great altitudes it is necessary that the beacons should have a range of two or three hundred kilometers. In order that a beam may be produced which is visible at such distances, it is necessary to make use of the largest reflectors and the most powerful arcs.

Aside from this particular case, the use of electric arcs for lights does not seem, for the moment at least, to be indicated. The only exception would be the development of carbons having a very long burning period which might again make the use of arcs preferable in practice in many cases.

II. *ILLUMINATING POWER AND RANGES :*

The two tables which follow show, for the possible different cases encountered in practice :—

1. The diameter of the reflectors;
2. The diameter of the incandescent mantles or the type of electric lamp employed;
3. The method of dividing up the reflectors, the different characteristics of the light being given by the use of a single reflector divided into as many segments as there are flashes;
4. The appearance or number of flashes;
5. The duration of a complete revolution of the optical system;
6. The luminous intensity defined by :—

A. The maximum intensity (1 max.) obtained along the axis of each reflector of the apparatus in question according to whether it is illuminated by incandescent mantle (intrinsic brightness of 30 candles per sq. cm.); by filament of electric lamp (intrinsic brightness 800 candles per sq. cm.), or by the crater of an electric arc producing the Beck effect (mean intrinsic brightness of 30,000 candles per sq. cm.).

B. The luminous intensity calculated by the law of Blondel-Rey for a light in which the flash has a duration of 0.4 seconds and the same range. This is the intensity (1 × 0.4) (1), which is utilised in the determination of the range by means of the abacus or any other method.

7. The practical range in atmospheric conditions corresponding to four regions of the French coast. For the Channel, Brittany, and to the south of the Ocean, the ranges indicated correspond to a visibility for 50% of the year. For the Mediterranean three ranges are indicated, one corresponding to a visibility for 90%, another to a visibility for 50% and a third to a visibility for 10%.

All of the ranges are given in nautical miles except those in the last column which are given in kilometres. In fact, owing to the curvature of the earth, these ranges are of interest only to aviators and they do not use the nautical mile but the kilometre.

RANGES OF LIGHTS WITH REFLECTORS

LIGHTING BY PETROLEUM VAPOUR LAMPS

Diameter of Reflector.	Diameter of Mantle.	Method of Division.	Appearance (Number of Flashes).	Duration of period of Rotation (in seconds).	Intensities in candles decimals.		Range in Nautical Miles or Kilometres					
							Channel	Brittany	In south of Ocean	Mediterranean		
					1. Max	1. x 0.4	50 % of Year Miles	50 % of Year Miles	50 % of Year Miles	90 % of Year Miles	50 % of Year Miles	10 % of Year Kilom.
2 m. 250	85	Entire	1 flash	4	890,000	268,000	20.3	30.5	32	16.8	36.5	137
		1/2	2 flashes	8	445,000	225,000	19.8	30	31	16.4	35.5	134
		1/3	3 »	12	296,000	194,000	19.5	29.5	30.5	16.2	35	131
		1/4	4 »	16	220,000	165,000	19.2	28.5	29.5	16	34	127
		1/6	5 & >	20	148,000	107,000	18.1	26.5	28	15	31.5	120
1 m. 500	85	Entire	1 flash	4	381,000	168,000	19.2	28.5	29.5	16	34	128
		1/2	2 flashes	8	190,000	127,000	18.7	27.5	28.5	15.5	32.5	123
		1/3	3 »	12	127,000	105,000	18.1	26.5	28	15	31.5	120
		1/4	4 »	16	95,000	87,000	17.6	26	27	14.7	30.5	115
		1/6	5 & >	20	63,500	61,500	16.8	25	26	14.1	29.5	108
1 m. 200	85	Entire	1 flash	4	250,000	121,000	18.6	27.4	28.4	15.3	32.3	122
		1/2	2 flashes	8	125.000	93,000	17.8	26.2	27.5	14.8	30.5	118
		1/3	3 »	12	83,000	73,500	17	25.4	26.4	14.3	30	111
		1/4	4 »	16	62,500	61,000	16.8	25	26	14.1	29.5	108
		1/6	5 & >	20	41,000	39,000	15.8	22.7	23.8	13.2	27.1	93
0 m. 750	55	Entire	1 flash	4	95,000	43,500	16	23.5	24.2	13.4	27.5	96
		1/2	2 flashes	8	47,500	32,400	15.4	22.3	23	12.9	26.5	89
		1/3	3 »	12	31,700	26,100	15	21.5	22.5	12.6	25.5	85
		1/4	4 »	16	23,750	21,900	14.5	20.5	21.5	12.1	24.5	82
		1/6	5 & >	20	15,850	15,750	13.8	19.3	20.3	11.6	23	79
0 m. 450	55	Entire	1 flash	4	35,000	19,000	14.3	20.1	20.9	12	24	80
		1/2	2 flashes	8	17,500	14,100	13.7	19.1	20.1	11.4	22.8	78
		1/3	3 »	12	11,600	10,850	13	18.5	19	11	21.5	76
		1/4	4 »	16	8,750	8,750	12.4	17.8	18.2	10.7	20	75
		1/6	5 & >	20	5,800	5,800	11.5	16.1	17.4	10.2	19	73

(1) *It has been realised that a fixed light has no greater range than a flashing light of the same intensity with a duration of only 0.4 second.*

RANGES OF LIGHTS WITH REFLECTORS

ELECTRIC LIGHTING

Diameter of Reflector.	Type of Lamp.	Method of Division.	Appearance (Number of Flashes).	Duration of period of Rotation (in seconds).	Intensities in candles decimals.		Range in Nautical Miles or Kilometres					
							Channel	Brittany	In south of Ocean	Mediterranean		
					I. Max	I. x 0.4	50 % of Year Miles	50 % of Year Miles	50 % of Year Miles	90 % of Year Miles	50 % of Year Miles	10 % of Year Kilom.
					INCANDESCENCE							
1 m. 200	3 kw.	Entire	1 flash	4	6,000,000	910,000	26	38	40	21	48	160
		1/2	2 flashes	8	3,000,000	800,000	25	35	37	19	43	158
		1/3	3 »	12	2,000,000	730,000	23.4	34.5	36.2	18.8	41	156
		1/4	4 »	16	1,500,000	680,000	23	34.1	33.5	18.5	40.6	154
		1/6	5 & >	20	1,000,000	540,000	22.4	33.5	34.8	18.2	40	150
0 m. 750	2 kw.	Entire	1 flash	4	2,600,000	450,000	22	32.5	34	17.8	39	147
		1/2	2 flashes	8	1,300,000	397,000	21.5	32	33.5	17.6	38.5	145
		1/3	3 »	12	860,000	357,000	21.2	31.5	33	17.4	38	142
		1/4	4 »	16	650,000	318,000	20.8	31	32.5	17.1	37	139
		1/6	5 & >	20	430,000	255,000	20.3	30.5	32	16.8	36.5	137
0 m. 450	1 kw.	Entire	1 flash	4	1,000,000	210,000	19.7	30.4	31	16.4	35.5	133
		1/2	2 flashes	8	450,000	180,000	19.4	29.4	30.3	16.1	35	130
		1/3	3 »	12	300,000	160,000	19.2	28.5	29.5	16	34	128
		1/4	4 »	16	225,000	142,000	18.8	28.6	29.8	15.8	33.5	124
		1/6	5 & >	20	150,000	110,000	18.1	26.5	28	15.4	31.5	120
0 m. 300	1 kw.	Entire	1 flash	4	400,000	130,000	18.7	27.5	29.5	15.6	33	123
		1/2	2 flashes	8	200,000	110,000	18.1	26.5	28	15	31.5	120
		1/3	3 »	12	130,000	100,000	18	26.3	27.5	14.8	31	117.5
		1/4	4 »	16	100,000	90,000	17.6	26	27	14.7	30.5	115
		1/6	5 & >	20	65,000	65,000	17.4	25.5	26.5	14.5	30	110
					A R C							
2 m. 000	2 arcs of 300 amp.	2 Ent.	variable as desired	variable between 4 & 12	600 millions	60 - 165 millions according to speed.	—	—	—	—	—	—

DIAGRAM FOR THE RANGE OF LIGHTS.

The calculation of the ranges indicated in the two tables of which we have just spoken is based on the law of Blondel-Rey (2) with the aid of a diagram, on the assumption that the minimum perceptible illumination corresponds to an illumination of the pupil given by a light of 0.3 international candle placed at a distance of 1 kilometre from the observer ($\lambda = 0.3$).

The Allard diagram given herewith is a graphic representation of the formula :

$$\lambda = \frac{I \times a^x}{x^2 \times 10^6}$$

(2) *See :* Hydrographic Review, *Vol. III, N° 1, Monaco, November* 1925, *p.* 141.

Addendum to HYDROGRAPHIC REVIEW - Vol. XIV N° 1, May 1937

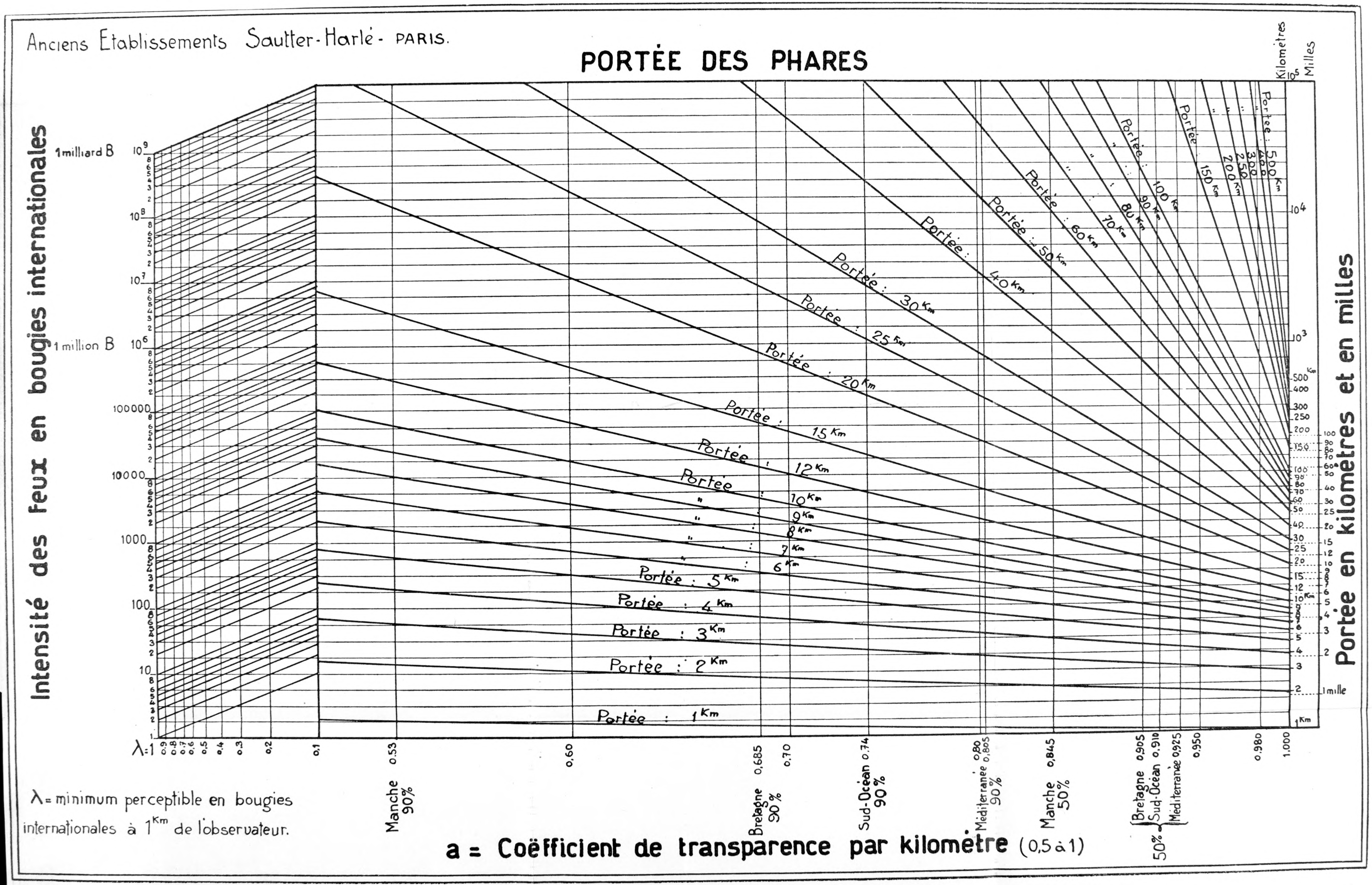
RANGE DIAGRAM FOR LIGHTHOUSES

This diagram is to be inserted to face p. 140.

Addendum à la REVUE HYDROGRAPHIQUE - Vol. XIV N° 1 de mai 1937.

ABAQUE DE PORTEE DES PHARES

Cet abaque doit être inséré en face de la page 146.



in which λ is the illumination of the pupil expressed in candles at 1 kilometre.

I the intensity of the light expressed in candles.

x the distance in kilometres between the lighthouse and observer.

a the coefficient of transparency per kilometre, i. e. the ratio between the luminous energies measured at two places in line with the lighthouse — distant from each other 1 kilometre — taking into consideration the law of the square of distances.

From this one can calculate, for all values of a comprised between 0.5 and 1, the distance at which a light will yield the same value of λ, comprised between 0.1 and 1, as another light located 1 kilometre from the observer.

This diagram may be used for values of λ greater than 1 or less than 0.1; it suffices to find for $\lambda = 1$, the range of light whose intensity is divided by the same value of λ.

The illuminations of the pupil may be expressed in lux; in which case $\lambda = 1$ would be written 10^6 lux.

DIRECTION FINDING BY SOUND.

(Extract from an article by Dr. W.S. TUCKER, O.B.E., Director of Acoustical Research, Air Defence Experimental Establishment, published in *Nature*, London, July 18, p. 111).

....

I will only give one example ......, which ...... deals with the direction finding of fog horns and ships' sirens at sea. The need of supplementing the human ear has been recognized by many navigators, especially as meteorological conditions sometimes baffle the listeners. Situations may also arise when the nearness of the foghorn involves hasty and definite action. The invention of

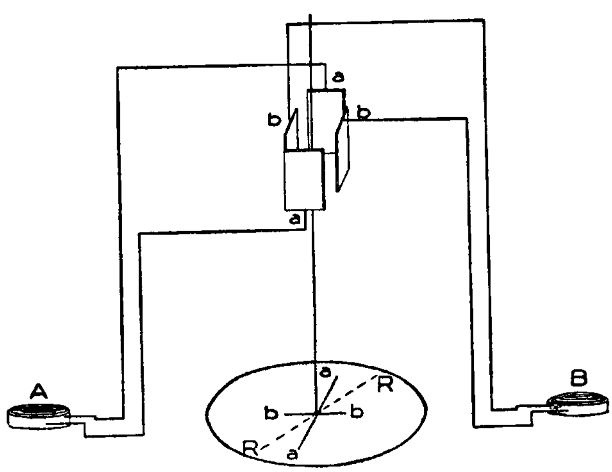


Diagram of Cathode ray oscillograph.

Messrs. W. and T.G. Hodgkinson is directed to the supply of accurate bearings (to half a point of the compass).

The devices tried out were of two types. The first and simpler form of direction finder consisted of a paraboloidal receiver mounted in a drum rotatable about a vertical axis. The axis of the paraboloid was horizontal and coincided with a diameter of the drum. At the