THE RANGE OF FLASHING LIGHTS AND COLOURED LIGHT BEACONS

by

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In this article the author draws attention to the importance of research into the range of light signals with a view to obtaining the greatest efficiency with the maximum of economy. He gives a brief narrative of the successive improvements made in the system invented by Augustin FRESNEL with a view to increasing the photometric luminous strength of flashing lights, and the efforts tending to reduce the number of optical panels while increasing their speed of rotation by floating them in mercury troughs.

The nautical commission which investigated this question in France in 1886 declared, after experiments at sea, that the duration of the flash had no influence on the value of the signal, and could be reduced to a point at which it was no longer appreciable to the navigator so long as the flashes occurred often enough and *at least* on an average once in five seconds.

In any case it does not seem probable that there is any advantage to be gained by giving up very short flashes ; for even if the physiological impression of a light increases when the speed of the rotation is reduced and consequently the duration of the flashes is increased, one would be forced to expend appreciably more energy without any great advantage.

During the International Conference on Maritime Signals held in Paris in June 1933, M. André BLONDEL read a paper on experimental methods of determining the range of flashing lights.

Two sorts of methods were considered :

The first consists in finding experimentally the characteristic curve of a flashing light, either at a distance (several kilometres) or in the laboratory by appropriate methods of concentration. Then a graphic or experimental comparison is made between the flash having these characteristics and (*a*) a fixed light and (*b*) a standard flash. The most up-to-date methods of photogrammetry are used.

The second method consists of a direct comparison, by appropriate photometers and standard flashes, between the visibility of a flashing light and that of a fixed light or a standard flash.

These methods open up a wide field for experiment, which will enable the advantages and disadvantages of various systems of lighting for marine, aerial or even railway use, to be discussed ; the use of coloured lights, again, sets new problems.

One of the principal of these is to attain a *norm for coloured glasses.* At present, the following are used in lighthouses :

(1) Multiple-wick lamps burning the vapour of petroleum, paraffin or kerosine, the spectrum of which varies mainly because the temperature of the concentrated flames increases with the number of wicks ;

(2) Incandescent mantles heated by gas or petroleum vapour ;

(3) Tungsten filament lamps, heated to a greater or less degree according to whether the bulb is vacuum or gas-filled ;

(4) Acetylene burners ;

(5) Arc lamps ; the alternating current arc giving a redder light then the direct current arc with pure carbon and, particularly, than the carbon arc with a metal core of salts of calcium, selenium and other alkaline earth metals. The electric arc, however, is not of very great interest for coloured glasses ; its great power is kept for long-range lights.

The red and green glasses used in lights vary considerably among themselves with regard to their coefficients of optical transmission. The coefficient of transparency of red glass may lie between 0.3 and 0.7 ; green glasses again have widely differing coefficients.

It is also interesting to know how the duration and appearance of a coloured light varies at long range as a result of fog. Artificial fog can be produced in the laboratory.

The first conclusion of this investigation is that all coloured lights with short flashes must be banished from lighthouse practice when they have to be observed at long range !

red lights because there is not time to discover them at long range (for they are only visible on the fovea and are hard to locate); green ones because, although easy to discover, they appear colourless when seen at long range and thus hardly different from white lights. Coloured lights, either fixed or with very closely spaced flashes, or broken by short occultations, can be accepted. But in any case, the diversity of coloured glasses used in tubular, chimney or pane shape makes it necessary to establish a norm to enable the conditions of visibility to be foreseen and, if possible, the range of coloured lights to be increased, notably with the aid of selenium glass. The standards adopted for purposes of comparison must be defined by a spectro-photometric curve, and must also be studied experimentally from the point of view of the visibility of the coloration.

Comparison between points of light coloured by different standard glasses and white points must be made at the limit of the range of visibility in grey tones, which gives a measurement of the liminal coefficient of transparency of each glass, and at the limit of distinguishability of the colour, which allows the chromatic transparency to be defined besides a photochromatic ratio giving a relative figure for the saturation. Those are the three characteristics of coloured glasses in the visual appreciation of points of light.

The same tests must be repeated in a thick atmosphere.

These important questions are now the subject of new investigations which will soon lead to useful conclusions. The sums which can be devoted to light signals in every sphere, notably in that of aeronautics, are necessarily limited; it is essential to have accurate figures capable of guiding engineers and authorities responsible for light signals either for short range or more especially for long range purposes. Lights of the latter category which use enormous quantities of energy are sometimes so expensive that it has been necessary to light them only when specially requested. It is essential to attain a technical and economical performance such that the lighting may be, on the contrary, more extensive and always ready to give information to any airman who may turn up.

I RISULTATI DELLA CROCIERA GRAVIMETRICA DEL R. SOMMERGIBILE "VETTOR PISANI" E LA GRAVITA IN ITALIA

(THE RESULTS OF THE GRAVIMETRIC CRUISE OF THE SUBMARINE *VETTOR PISANI*, AND GRAVITY IN ITALY).

In a lecture reproduced in the *Atti della Società Italiana per il progresso delle Scienze, XXII Riunione, Bari, October* 1933, Vol. II, Professor G. Cassinis gives the results of the gravity measurements resulting from his work in collaboration with Commander M. de Pisa, Assistant Director of the Italian Hydrographic Service, and Professor P. Dore.

In the *Hydrographic Review*, Vol. IX, No. 1, May 1932, p. 148, we have already mentioned the general lines of the Italian gravimetric cruise carried out in the Mediterranean and particularly in the Tyrrhenean Sea between July and October 1931; other information on pendulum measurements relative to gravimetry will be found in the *Rapporti sull' attività del Comitato Nazionale Italiano per la Geodesia e la Geofisica* drawn up by the Italian National Geodetic and Geophysical Committee for the International Conference of Lisbon, 1933.

In the brochure recently published under the direction of Professor Cassinis will be found a concise explanation of the various methods used, and the successive improvements made, especially since 1887, in relative gravity measurements.

The method and the pendulum apparatus used since 1923 by Dr. F. A. Vening Meinesz for eliminating the perturbing influence of the horizontal accelerations of the support of the pendulum are indicated in a few lines, as well as the different measurements at sea taken since that time on board various submarines.

The installation of pendulums of this type and the methods followed by the Italian expedition in the *Vettor Pisani*, for taking measurements and making chronometric comparisons, are described in detail and a list is given of the 88 stations made during the course of the cruise.

The report shows the precautions taken to fix the geographical positions of the stations by means of precise observations at sea. To minimise the error arising on account of unknown currents, it is recommended that the measurements made during a dive on a certain course should immediately be repeated on the opposite course.