THE INTRODUCTION OF AERONAUTICAL BEACONS INTO COASTAL MARINE BEACONAGE

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A comparatively recent news item tragically illustrates the problems of applicability and identification which may confront the mariner when lighted aids to air navigation are set up in coastal areas.

The answers to such problems appear initially to be as simple as those permanently afforded the mariner by the equipment and signals of a system of marine beacons whose characteristics and positions fully meet landfall requirements in surface navigation. The difficulties become apparent, however, as soon as the principle of air beacon applicability emerges. Designed as a guide for air navigation, with an optical system and characteristics more readily suited to observations of a vertical and transitory type, such lights do not necessarily meet observational requirements at horizon level, or satisfy the need for continuity and permanence consistent with a ship's slower approach. Even when they do, they may well interfere with marine beacons; moreover, whenever direction or proximity so lend themselves and characteristics are indistinct or difficult to separate, they may, instead of contributing additional assistance, often introduce an element of confusion or error during landfall.

Even if the coexistence of both types of lights has been wisely planned and the characteristics and positions of aeronautical lights — recently developed and increasingly numerous — have been carefully selected, will the information, warning or potential advantage to the mariner be adequately ensured by the radical solution of including in the Light Lists all aeronautical lights visible from seaward? Publication No. 1 of the French Navy Hydrographic Office: *Information relating to Nautical Documents and Navigation* (1), prudently warns the navigator (page 45) that « only aeronautical lights located near the coast and likely to be seen offshore are inserted in the Light List ».

It is well known that on a geometrical earth the visibility offshore of the light itself depends on:

(1) Its distance inland;

(2) The height of the optical apparatus;

(3) The luminous intensity;

(4) The clearness of the atmosphere and refraction conditions.

Average information can of course be readily supplied on the basis of average conditions of propagation, i.e. by indicating a light range, in average weather, corresponding to a fifty per cent probability level of visibility. But

(1) Renseignements relatifs aux documents nautiques et à la navigation.

if the optical apparatus is sufficiently elevated, as in the case of certain airway lights located on hills or even on high towers, and if the luminous intensity is high, the geometrical range in average weather will be so considerable that the mariner will no longer merely require information regarding « aeronautical lights located near the coast ». Thus, the theoretical range of the horizontally beamed double-light of the Eiffel Tower limits its useful range to 180 Km in the case of low-flying aircraft proceeding towards the mouth of the Somme, but if the focus were raised an additional hundred metres or so, the light would unquestionably have to be included in the group of lights seen by the navigator making a landfall in the Channel. It would therefore have to be included in the List of Lights, in spite of its distance; and yet, a screen of low-lying hills, at the range-limit of the beam in the coastal area, would suffice to mask it in a more or less extensive sector. It is not possible, therefore, to arrive at a decision concerning the advantage of an aeronautical light to the mariner through consideration of its range factors alone, while it is imperative that a local and experimental type of discrimination be carried out and the mariner supplied with actual and effective information following methodical observations as to distance and direction.

To sum up, the inclusion of an aeronautical light in a list of lighted aids to marine navigation can be accepted and maintained only after a series of checks, the basis for which has a twofold aspect. After an aeronautical light has been planned and its characteristics and position have been so chosen as best to fit air requirements, its influence on marine beaconage must be investigated, first by checking the offshore range resulting from its height and position, and secondly, by making a practical analysis of its behaviour along the coastal strip involved, by determining the masked sectors, and finally by verifying the fact that its appearance in directions adjacent to marine lights will be no possible cause for confusion. The mariner must moreover be supplied with accurate information as to schedules of operation and extinction: whereas it may be discouraging, when making a landfall, to wait in vain for a light which is destined to serve either as confirmation, or as the sole evidence as to the course to be followed, nothing is worse than a light which appears unexpectedly. And if the position of the aeronautical light, especially one designed for long-range navigation, need only be accurate to within a few minutes of arc for aircraft purposes, it must be given in nautical documents and on charts to within the accuracy that has always been standard for marine lights, i.e. one second of arc. It will readily be apparent that at intervals of a few tens of metres, the aspect of two lights located at widely different distances inland may change rapidly. An analysis of this type, which in its latter stages can be but empirical, will ultimately result in a classification of the aeronautical lights which interfere with the mariner's field of view but which are located at largely variable depths inland; it will not always be easy to prick them off on the marine chart. An eventual choice will have to be made among the group: first, the useful lights which contribute something to the marine lighting system, and secondly those which, unless closely identified and recognized, may, without actually hindering navigation , become under certain difficult sailing conditions a definite source of trouble and confusion. The aeronautical lights may moreover on occasion be more powerful and have a longer range than the marine lights. Any navigator knows from experience that it is more troublesome to land in a roadstead lit up by anchorage lights or by those of numerous ships lying at anchor, and have to pick out its small pier-head light, than to land in a lifeless port in the dead of night, where at any rate the faint harbour-entrance lights show up eventually.

It is of corresponding importance, therefore, that commanding officers receive accurate information regarding lights, and the more so as the latter are likely to interfere with their navigation. The analysis of lighted areas should be carried out by trained observers from seaward at various ranges, and should cover the entire landfall horizon. It may well be asked which organization on a national basis should be made responsible for carrying out a task that is fast becoming inevitable. As regards areas located beyond the nation's boundaries, this same question must remain unanswered in the absence of any strictly enforced international convention. The users themselves can of course be asked to make the necessary investigations, but, even though the volume of observations would guarantee their average value, this would too often dangerously retard the emergence of the actual facts, and would cause reliance to be placed on an occasionally fallible and untrustworthy source of information. Parenthetically, the opinion may here be ventured that ship masters are insufficiently called upon to submit information to hydrographic, lighthouse and coast-guard establishments, although the latter have all been set up for the mariner's benefit and he relies upon them for his safety. This a period in which new methods are emerging, in which local or permanent anomalies require delimitation for the mariner's increased welfare, and in which unvarying radar landscape profiles should be defined and publicized; from among the vast numbers of ships plying their trade in certain areas, there is a wealth of information available from which it is possible to sift facts that it would take years for a solitary observer to obtain.

Once the light pattern has been obtained and defined under average weather conditions, the problem yet remains as to the immediate and reliable circulation of the information to all users. It is known that as regards all marine lighting data, the operation of *Avurnavs* (1) and Notices to Mariners systematizes both the warning process and correction procedure for nautical documents. On our coasts, through the agency of the beaconage services and the maritime prefectures, the *Avurnav* system operates satisfactorily. A change in aeronautical beaconage is similarly reported by *Notams*, and is reproduced by the Air Pilot department, but although both departments conventionally cooperate in the fulfilment of their parallel duties, it is on a loose basis if only by virtue of the difference in the documents used. The marine Light List is the mariner's Bible, but rare indeed are the aeronautical lights reported therein for correction purposes. The positions of aeronautical lights located inshore are increasingly being added to marine charts, but such positions, although adequate for the aviator, are too inaccurate for marine use. As regards changes made to lights of airports located near the coasts in countries where the information system has not acquired the automatic character of European administrations, it is known that such changes are reported by member-countries to ICAO. Their dissemination, if such does occur, as yet presents an insoluble problem for the hydrographic services.

PRESENT AERONAUTICAL LIGHTS

The lighting of airways and airports tends to increase with the volume of traffic. Airway beacons and airport lights are often located near the shore, and owing to their height and luminous intensity are even more often visible far out at sea in the shape of light projected by their vertical beams. Aeronautical lights include the following:

(1) Urgent Notices to Mariners.

(1) White and coloured group-flashing aerodrome lights. Maximum range in the air reaches 100 to 150 Km.

(2) Vertically beamed, low-powered identification beacons, for recognition purposes at 20 or 30 Km, and emitting a Morse signal-group or a syllable. They generally cause no inconvenience to the mariner.

(3) Horizontally beamed rotating flashing airway lights, which have all the characteristics of marine lights. These lights are not regulated by ICAO. Their considerable range renders them visible from seaward, and their characteristics often include red flashes.

It is known that apart from harbour lights, the optical apparatus of landfall beacons now increasingly avoids the use of coloured lights owing to the absorption of colour by haze on the horizon, sea reflection, and the difficulty in distinguishing at a distance between a green and white light.

Airway beacons are precisely the lights that can either be of valuable assistance or a source of confusion to the mariner, in that they possess all the characteristics of marine lights and in fact are often raised marine lights.

AERONAUTICAL RADIOBEACONS

This departure from the subject of lighted beacons to that of aeronautical radiobeacons seems appropriate in view of the extent to which definite rules are also lacking in this inadequately documented and experimentally uncertain field. Some medium-frequency aeronautical radiobeacons are so powerful as to bellow in the ears of mariners on the look-out for an RDF bearing. The St. Renan radiobeacon, which up to a short time ago was still a valuable aid for landing on the coast of Brittany, is an example.

Their characteristics are well-known and appear in the List of Radio Aids, so that it should suffice to list them in the second volume of Radio Signals, next to the marine radiobeacons which supply bearings. Here too, the problem is a purely local one : some of these radiobeacons are naturally located inland and the path of the radiated medium waves may be affected either upon transmission or when crossing the coast by permanent deviations caused by the adjacent relief or crossing the land/sea boundary. There is consequently some danger in presenting them to the surface navigator as ordinary direction markers, and they too, for discrimination purposes, should be methodically observed from seaward and their deviations determined. A temporary solution consists in including among marine radiosignals those radiobeacons whose positioning involves a relatively short path over the ground and those whose location with respect to the coast or surrounding relief is likely to produce only slight deviations. This solution is the one that has been adopted and it is better than none, since a few of these aeronautical beacons are too powerful to be ignored by mariners.

Finally, on shorter than medium-frequency wavelengths, there are often radio ranges set up along the coast that can be used by shipborne receivers for the ready obtaining of a line of direction by the detection of two complementary letters on either side of the line. Their occurrence is apt to perplex the mariner who is not in possession of the List of Radio Aids issued by Air Pilot department, and they should accordingly be included in the marine publication, provided the beam of the radio range does not extend too far inland.

Generally speaking, the characteristics of such aeronautical radio aids have been so selected as to cause no possible confusion, since the air navigator naturally makes use of marine radiobeacons and these constitute a valuable aid upon which he largely relies. Consol radiobeacons constitute a typical beaconing aid of use to both ships and aircraft: their system of transmission is to a certain extent proof against local short-range deviations owing to the principle involved in the radiation of two waves under similar conditions, in which they are likewise similarly affected by local interference.

It is nevertheless true that as regards both aeronautical radiobeacons and lighted beacons, the information supplied to the mariner should be regulated and supported by practical observations carried out locally at sea in the areas of coverage. All the dangerous aspects of coexistence of air and marine beacons will not only disappear, but a profitable combination result when, after the installations have been coordinated to avoid confusion, the information derived from tests carried out by a responsible and competent organization reaches the mariner promptly and in the form of accurate and unambiguous data.