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THE BACKGROUND TO IALA BUOYAGE SYSTEM "A"

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This paper formed the subject of a lecture by Captain Bury on 22 April 1977 at the XIth International Hydrographic Conference, Monte-Carlo.

In 1967 a Sub-Committee of the International Association of Lighthouse Authorities (IALA), that had for some years been studying Port Signals under the chairmanship of Mr. Otto GREDAL of Denmark, reported that it was becoming increasingly obvious that the "Buoy System leading to the port" warranted study prior to "port signals", and that because this study involved navigation they thought it proper that it should be chaired by a mariner.

On 2 June 1967 this Sub-Committee was re-constituted by IALA with the following terms of reference :

"To prepare a recommendation to supplement the existing agreements for a Uniform System of Maritime Buoyage".

The object of this task was to bring up to date the present regulations — the Lisbon Agreement (1930) and the Geneva Agreement (1936) — bearing in mind all new aids to navigation and new marking systems adopted since 1936, and eventually to standardise them internationally. These regulation concerned :

Sea lanes for tankers
Oceanographic buoys
Channels for fishing and pleasure craft
Harbour Entrance and Exit lights
Channels for hovercraft.

The members of this Sub-Committee were :

Captain R. N. MAYO, Trinity House, UK (*Chairman*)
Mr. O. GREDAL, Denmark (*Deputy Chairman*)
Herr W. HARTUNG, Germany (later Herr BRAUN)
M. J. F. LEVY, France
Captain G. TARAMASSO, Italy

Captain J. G. MARTINEZ, United States Coast Guard
Captain J. van RIJN, Netherlands
Mr. N. F. MATTHEWS, Trinity House, U. K. (*Secretary*).

Each member of the Committee reported on the present practice and provisions in his country, and a questionnaire was prepared, approved and circulated.

This Sub-Committee worked under these Terms of Reference for six years, and identified all the changes since Geneva 1936. Their proposals on ODAS (*) were accepted by IMCO and implemented world-wide.

They obtained agreement among the European members that pleasure beaches could be zoned off by a local authority, using white buoys to define bathing areas and limits for pleasure craft to operate off those beaches.

Then came the Varne disasters, and at their Maritime Safety Committee of 10-24 March 1971 IMCO requested IALA to give urgent consideration to the study of the Unification of International Buoyage Systems with special reference to Wreck Markings.

The IALA Sub-Committee that met on the 30 April 1971 to consider IMCO's request comprised the following :

Captain R. N. MAYO, Trinity House (*Chairman*)
Mr. O. GREDAL, Denmark (*Vice-Chairman*)
Mr. W. GERLACH, Germany
Captain H. D. MUTH, U.S.C.G.
Mr. J. F. LEVY, France
Captain L. CAPELLARI, Italy
Captain J. van RIJN, Netherlands
Admiral V. D. CHANDABYLOV, U.S.S.R.
Mr. J. N. BALLINGER, Canada
Mr. G. SMITH, Canada
Captain Z. N. SDOUGOS, IMCO Observer
Mr. N. F. MATTHEWS, Trinity House (*Secretary*).

Considerable discussion took place between the members as to the system used in each of their countries, and Captain SDOUGOS pointed out that IMCO wanted an indication of the best system — not necessarily the easiest or quickest to implement, but one which would stand the test of time.

It emerged from discussion that the European members of the Sub-Committee followed more or less the 1936 Geneva Systems (**) with local variations, which meant that both Lateral and Cardinal Systems were in use.

It was emphasised by their member that the United States would on no account change their buoyage, a stance they have maintained since 1892 following the Washington Agreement of 1889 — an agreement that was embraced by all maritime nations because of its simple "Red to Starboard" Lateral System, only for it to fall foul of political intrigue and two world wars.

(*) Ocean Data Acquisition Systems.
(**) Agreement for a Uniform System of Maritime Buoyage, signed at Geneva, 13 May 1937. Owing to World War II, this was never ratified and officially introduced.

It was also stated by the representatives from Canada and the U.S.A. that there was full unification as far as the North American continent was concerned; both countries having a Lateral-only system which differed completely from the European system and which was much simplified, having fewer light characters and no cardinals.

In an effort to pave the way for a world-wide system acceptable to the Americans, the Sub-Committee proposed to abolish Cardinal Buoys and evolve a Lateral-only system, but this did not find favour with many European and Baltic Authorities. It was agreed to set up a small Working Group to examine the possibility of either introducing a completely new system or modifying existing systems to achieve this unification.

The Sub-Committee evolved the "Expanded Cardinal System" for the marking of wrecks, and this was accepted by IMCO, but was never implemented on the later advice of IALA because it appeared probable it would be overtaken by further work on the overall problem.

In June 1971 the Working Group presented to the Sub-Committee an outline plan which basically provided :

By day : Green or Black conical buoys to starboard;
Red can buoys to port;
Combination of Red, White and Black spherical buoys for mid-channel marks; and no cardinals.

By night : Green flashing light to starboard;
Red flashing light to port;
White flashing light for mid-channel;
Quick flashing White, Red or Green light as appropriate for marking special dangers.

After some discussion it became quite clear that it would be unrealistic to expect the United States and Canada to reverse their already simple system, and equally it would be unrealistic to expect Europe to adopt the American system. It was decided then to divide the world into two regions and to set out the buoyage on a regional basis having as far as possible a similar basic philosophy, but the marking of special dangers was to have a completely universal concept. It was felt that if these new dangers were marked by a quick flashing light (White, Red or Green as requisite), this could well be common to both regions. An Interrupted Quick Flash could then be used to mark important turns, landfall, mid-channel, special purpose and transition buoys.

In North America and Canada a previously determined direction of buoyage is laid down, and the Sub-Committee decided to press for a single Lateral system of buoyage and for a "conventional direction of buoyage" to be decided on a world-wide basis.

Research into the use of a Racon coded "W" was considered for fitment to a mark on a new danger to supplement the visual warning if it was so required, and the idea was passed to the IALA Committee on Microwave Aids to Navigation for technical evaluation.

In brief the Sub-Committee concluded that it had only three real choices :

1. to accept the "American" System;

2. to adopt a simplified Geneva Agreement Lateral System;
3. to adopt a new Lateral system, with the world divided into a number of zones.

Study continued until April 1973 but unification seemed as far away as ever, so the Sub-Committee asked for revised Terms of Reference. As Captain MAYO was retiring, it was recommended that I should take his place as Chairman, and the following were the new Terms of Reference :

a) To investigate the philosophy of buoyage systems at present in use throughout the world;
b) To try and identify the common ground existing in the philosophies of the present systems;
c) To attempt to harmonise existing rules into one unified set of rules (including inland waterways), commencing with the European situation;
d) To propose a unified set of rules, at least in European waters, utilizing existing equipment as far as possible;
e) To investigate port and harbour lighting in conjunction with the Permanent International Association of Navigation Congresses (PIANC) and the International Association of Ports and Harbours (IAPH);
f) Generally, to review the various problems arising in connection with the provision and operation of visual aids to navigation.

All practical hydrographers will certainly know what I mean when I say there are occasions when you want to turn a ship round short the conventional way, and she just won't budge; yet when you take her round the other way she will fly round, contrary to the natural laws of transverse thrust and everything else.

When I thought objectively of the 6 years of dedicated effort by this highly competent team trying to build upon the *wreckage* of Washington and Geneva, I questioned the merit of the foundations upon which those systems were built. From my reading of the historical records over 150 years the systems appeared to be founded upon current practice at the time and upon the strongly held views of the protagonists, rather than upon logic.

So I decided we must cut our losses and start at the very beginning again — to "take her round the other way" instead.

At Trinity House I had long advocated the use of Cardinal marks where Lateral marks were ambiguous, so I went to see Admiral van der GRAAF of the Netherlands, Dr. WIEDEMANN of Germany and Mr. PRUNIERAS of France to find out why they were so wedded to the use of Cardinal. Their usage confirmed my views that Cardinal had a part to play in any new system.

I also went to Finland where the Finnish Board of Navigation took me by ship from Turku to Helsinki. Every one of their channels throughout this archipelago has its sides marked by Cardinals, proving beyond all doubt the versatility of this type of mark.

The next step was to analyse the function of a buoy, its method of giving information and the limitations thereof. We arrived at the "pitch

black night" situation when all a buoy has to offer is the colour and the rhythm of its light, so *that* was the point from which we started.

A study of IHO Special Publication 38 revealed that in the present world-wide systems rhythm and colour have no significance, since the same colour and rhythm can be found to mean anything and everything : lateral, axial and cardinal. So this mixture had to be "unscrambled" if the mariner was to receive consistent information in all situations.

Green had been used for the marking of wrecks since 1823, but since then it had also been adopted for other purposes as well. Why should a wreck be marked as such, anyway ? We can appreciate that in those days the tall, well-stayed masts of a sailing ship sitting upright on the bottom could be a new and very serious hazard indeed in what was otherwise quite deep water, but viewed in the light of today's radio warning services it is no more a hazard than any other newly discovered obstruction, be it rock, wreck or shoal.

So why waste a distinctive colour like Green on Port, Starboard and Middle Ground Lateral wrecks and East- and West-Cardinal wrecks, when it could be used for instant identification of a Lateral side, irrespective of which persuasion you belong to : "Red to Port" or "Red to Starboard".

Any Red/Green Lateral System governed by flood tides alone would be bedevilled with anomalies; so it was logical to tie it to a conventional direction of buoyage, which we did by confirming the opinion of the earlier committee.

The Lateral mark when out of sight of a reference point or another buoy is at a disadvantage in wide open waters, especially to a vessel crossing the line of tide; but a Cardinal buoy is in its element when it is "lonely". Every sea-going craft has a compass and the meaning is clear, so the inclusion of Cardinal was logical in any new system.

Red and Green lights in themselves are not wholly adequate for the marking of channels, and White light must be used here in some way.

So we hit on the idea of confining White Lights to Cardinal but using them in channels, as does Finland for instance, to convey a compass meaning. It took a bit of "mind-bending" before many of us could accept this hypothesis, but the more we thought about it the more attractive it seemed.

It was agreed at a meeting in Paris on 12 November 1973 that it would be well worth-while to test a combined Lateral (Red/Green) and Cardinal (White only) System, and Trinity House offered to set up a buoyage experiment to evaluate its merits in a "real-life" situation. It was not intended as a test of equipment or engineering skill but as an exercise to be observed by mariners of any nation in order to obtain their reactions to the underlying philosophy of the system.

The planning was started, Notices to Mariners prepared, and by the end of March 1974 twenty-two buoys had been laid in Knock Deep, an unmarked channel in the Eastern part of the Thames Estuary (fig. 1).

By now, the IALA Technical Committee for the Unification of Buoyage

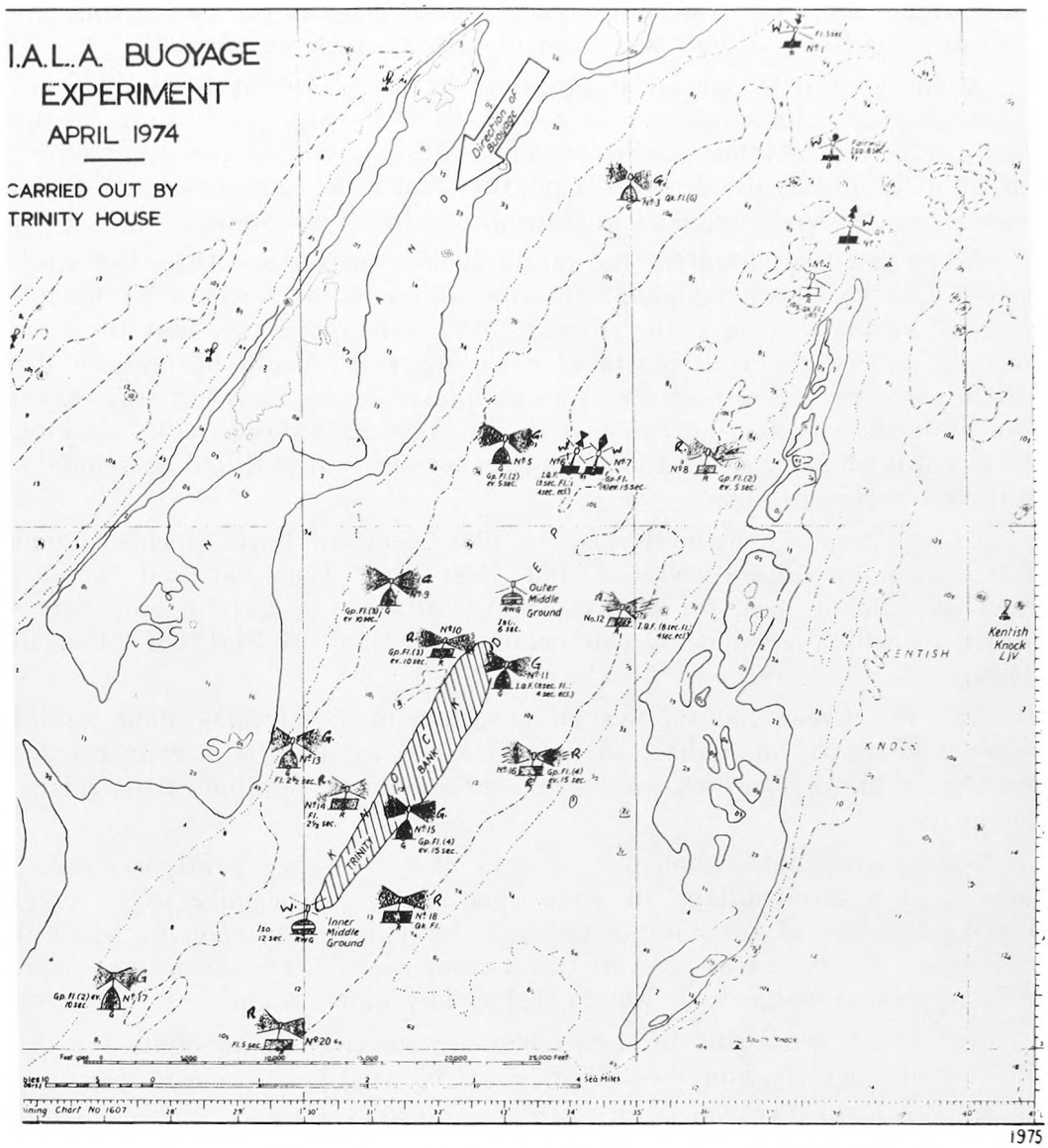

FIG. 1

comprised representatives of Belgium, Canada, Denmark, Finland, France, Germany, Netherlands, Norway, Sweden, U.S.A., and occasionally the U.S.S.R.

Shiploads of delegates from all maritime interests were taken to view the Experiment by day and by night on the 2nd, 3rd, 4th, 5th, 8th and 9th April, 1974. They were all asked to comment, and their impressions gave us the encouragement to continue with the work.

Having established that a Combined Lateral and Cardinal System was a requirement, this was taken to be within the requirement set out in para (d) of the Terms of Reference : "to propose a unified set of Rules, at least in European waters, utilising existing equipment as far as possible".

We now got down to the planning. Various principles were established.

Cardinal Cones must be 3 ft (1 metre) across the base for High Focal Plane Buoys, and 2 ft (66 cm) for standard estuary buoys.

The characters of Cardinals must have an alternative in order to enable two similar buoys near one another to be identified.

"Isolated Danger Marks" under the Geneva Rules give no indication as to where the danger lies in relation to the mark. In Scandinavia the Authorities distinguished two types of Isolated Dangers, vertical splinters of granite or else flat boulders. With the former, they clamp the buoy chain to the pinnacle of the rock itself, and so it is known the danger lies within the scope of the mooring. With the flat boulders they place the sinker on top of the boulder, with the same effect. In France, Ireland and Scotland where you have ironbound coasts and off-lying dangers, the Authorities frequently build a structure on isolated outcrops of rock, whether these are under water, half-tide or small islets. Hence the very careful wording of the Rules : "erected on, or moored on or above, an isolated danger which has navigable water all around it". If there is not navigable water all around it then Lateral or Cardinal marks will be used.

The "Sea Lanes for tankers" gave us many, many problems, as did all the other peripheral requirements of buoyage : quarantine, spoil, and many others. In the Isle of Wight area, we in Trinity House resolved the problem of marking the Nab Channel into Fawley for Esso tankers by using "non-navigational" buoys coloured Black and Orange in horizontal bands with Orange lights. Today we can call that colour Yellow, but in those days the term Yellow was unacceptable. So we investigated how a fourth colour — Yellow — could be introduced; and from that grew the Special Mark with Yellow buoys and Yellow lights, to tell the Mariner he must look at his chart to arrive at their meaning.

In future the Nab Channel will be marked by Yellow buoys with the appropriate Lateral superstructure and Yellow light. This means that, henceforth, standard Lateral marks will not funnel unnecessarily all traffic into the deepest water; the Yellow marks will define the deep draught channel for those that need it, and the limit of safe navigation on either side will be Red/Green Lateral or Cardinal, as requisite.

The "Middle-Ground" or "Bifurcation" buoy was retained in our planning for quite a long time, because of its wide use and emotive appeal but, in the end, it failed the test of the "pitch black night". This mark relies upon its spherical shape to convey information, and this of course makes it useless after dark. Gradually the case for using Cardinals instead gained ground. It was argued that the Cardinal cannot indicate the preferred channel — but it can, you know. This is where the skill of a Lighthouse Authority must be exercised in the choice and placing of a mark.

Cardinal marks in the Geneva Rules indicated the bearing of a danger and, for some Authorities, it was difficult to move away from this concept. For instance, a South Cardinal mark indicated a danger to the South and, by implication, said "Pass to the *North*". We changed that

for the more positive terminology, whereby the named side of a mark was the *safest*.

It has always been the practice of Lighthouse Authorities in the past to mark the "Danger" so that Mariners could then navigate past it. With the introduction of IMCO routes, however, marks, when used, would frequently have no "Danger" near them, so marks became "navigational advice" rather than an indication of danger. This change of attitude was exploited by making a Cardinal mark indicate the side on which lay the deepest water, and requiring the mariner to consult his chart before passing on any side other than that indicated.

The choice of rhythm for the four Cardinals gave us many problems. We had to have :

1. alternative characters;
2. a progression for ease of memory;
3. speed of recognition;
4. minimal effect of wave action on recognition.

We took as our basic rhythm the flashrate of 120 flashes per minute as this rate in the old Int Qk Fl was the most distinctive of all rhythms in use anywhere. This could not be attained with propane equipment, but research at Coblenz by the Federal Republic of Germany produced a flasher which could reach 90 fl per min. and, after viewing trials, this was accepted for propane equipment.

The research into the selection and permutation of rhythms was done by the French, and over 10 000 tests were completed. Portable simulators were built by Finland and France, and time and again a promising rhythm failed the "Wave Motion Injection test", or was mistaken by too many observers for something else through atmospheric or other variations.

So we analysed what was available even more carefully than before, and selected :

For North : Continuous Flashing at 120 fl per minute;
For South : Gp Fl 3, at 120 fl per minute, i.e. Morse "S";
For West : Int Qk Fl.

Three very good rhythms, but we could not find a fourth to match them. Finally we tried Int Qk Fl + Isophase, which was highly distinctive but extremely wasteful of fuel.

During analysis of the structure of Int Qk Fl + Isophase we lengthened the eclipse of the Isophase in the interest of economy. We reduced the number of flashes from a random number for 7 sec in the Int Qk Fl to between 9 and 11, which the Engineers confirmed was reasonable. Then, because the simulator showed the Long Flash part of the Isophase was already highly distinctive, we reduced the Flashes from 9-11 to about 6, again in the interest of economy.

Suddenly it was noticed we would have a 3-6-9 situation if we moved the Gp Fl (3) from South to the East, giving us a clock face progression as an aide-memoire, subject to the Engineers being able to give us precisely 6 flashes and precisely 9 flashes with no over-run. The Engineers again confirmed that this was possible; so with a bit more polishing we arrived

at the rhythms you now all know, each with its alternative at half the preferred rate :

For North : Very Quick Flashing (120 or 100 flashes per minute)
or Quick Flashing (60 or 50 flashes per minute)

For East : Very Quick Flashing (3)
or Quick Flashing (3)

For South : Very Quick Flashing (6) + Long flash
or Quick Flashing (6) + Long flash

For West : Very Quick Flashing (9)
or Quick Flashing (9).

These rhythms were tested in the Baltic with a "dummy" channel laid by the Federal Republic of Germany, as for the Knock Deep experiment. The weather was a N W Force 7 gale, with spray and drizzle affecting visibility — yet the pulsing rhythms of the propane Cardinals were identified within seconds of being sighted. We had succeeded beyond our greatest hopes.

The importance of "perspective" when reviewing problems of "marking" cannot be emphasised too strongly. All too often, "planners" create traffic separation schemes and other "solutions", and view them from above as "plans", whereas the mariner who interprets them has to translate them into the horizontal plane. This is why, on two occasions, we carried out full-scale trials to make *quite* sure the mariner would see what we wanted him to see.

System "A" is based upon a logical appraisal of what a mariner requires of a buoy, and *not* upon opinion. Each mark has been tested against this yardstick.

In conclusion, may I pay a tribute to the Hydrographers, both national and international, who took on the formidable task of providing all the new charts and other nautical documents in under a year, so that this new Buoy System would be implemented as quickly as possible in the interests of maritime safety. In the name of IALA, I do thank you most sincerely for your outstanding contribution to this work.

On 16th March 1977, the lighthouse authorities of N. W. Europe gathered in Copenhagen and signed an agreement that they would, each in turn, introduce System "A" into their national waters. They also agreed that if any other nation indicated it would like to adopt System "A", then IALA would assist that nation in any way possible. The Americans and Canadians flew over from North America on many occasions to help us with our work. We in our turn are prepared to help them with their System "B". Mr. Otto GREDAL attended the first of the meetings in Long Beach recently, and we wish them well.

To other countries who would logically look to System "A" for their waters, may I say that any European member of the Buoyage Committee, or myself, would be prepared to travel to assist that country with advice, if required. Please contact the Secretary General of IALA in Paris.

A QUESTION OF LEVELLING

"By the 1920s most of the easily worked gold deposits in New Zealand had been exhausted and covetous eyes were cast at river beds, in particular those with rocky bottoms which could not be dredged but would assuredly hold gold in their crevices.

One obvious site was where the Kawarau River emerged from Lake Wakitipu in the South Island and schemes were made, a company floated and capital raised for the project : to build a dam at the outlet from the lake and so dry up the river for sufficient periods to get the gold.

No question, the site surveys were good, the setting out correct and the dam built according to plan in the right place. Came the great day to stop the flow. Shareholders assembled with their shovels and panning equipment : others were warned off and an armed guard stood ready to rush the gold to the bank.

The gates were shut, the river started to fall, and excitement rose proportionately, shareholders crowded the edge, the river fell just below its lowest recorded level — and stopped falling.

The cause ?

Just 3.5 km downstream the Shotover river joined and, as the Kawarau fell, the Shotover flow compensated and backed the waters up to the gold seekers. Nobody had thought to check the difference in level...".

From the series "Survey Misdeeds" in the *Chartered Surveyor*, Journal of the Royal Institution of Chartered Surveyors, London. (March 1977, p. 267).