Technical and Bibliographic Notes / Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming are checked below.

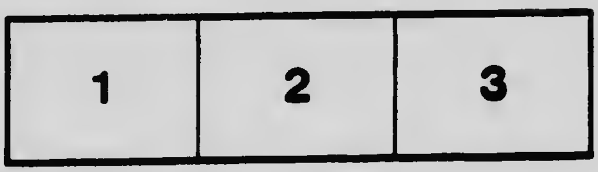
L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

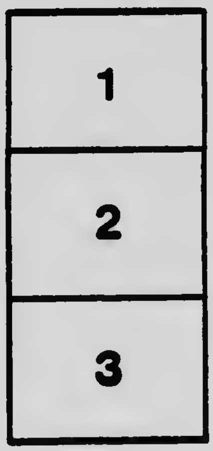
- [x] Coloured covers / Couverture de couleur
- [ ] Covers damaged / Couverture endommagée
- [ ] Covers restored and/or laminated / Couverture restaurée et/ou pelliculée
- [ ] Cover title missing / Le titre de couverture manque
- [ ] Coloured maps / Cartes géographiques en couleur
- [ ] Coloured ink (i.e. other than blue or black) / Encre de couleur (i.e. autre que bleue ou noire)
- [ ] Coloured plates and/or illustrations / Planches et/ou illustrations en couleur
- [ ] Bound with other material / Relié avec d'autres documents
- [ ] Only edition available / Seule édition disponible
- [ ] Tight binding may cause shadows or distortion along interior margin / La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure.
- [ ] Blank leaves added during restorations may appear within the text. Whenever possible, these have been omitted from filming / Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.
- [ ] Additional comments / Commentaires supplémentaires:

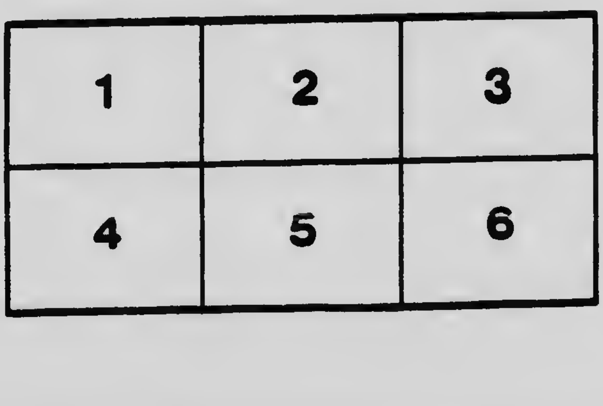
- [ ] Coloured pages / Pages de couleur
- [ ] Pages damaged / Pages endommagées
- [ ] Pages restored and/or laminated / Pages restaurées et/ou pelliculées
- [x] Pages discoloured, stained or foxed / Pages décolorées, tachetées ou piquées
- [ ] Pages detached / Pages détachées
- [x] Showthrough / Transparence
- [ ] Quality of print varies / Qualité inégale de l'impression
- [ ] Includes supplementary material / Comprend du matériel supplémentaire
- [ ] Pages wholly or partially obscured by errata slips, tissues, etc., have been refilmed to ensure the best possible image / Les pages totalement ou partiellement obscurcies par un feuillet d'errata, une pelure, etc., ont été filmées à nouveau de façon à obtenir la meilleure image possible.
- [ ] Opposing pages with varying colouration or discolourations are filmed twice to ensure the best possible image / Les pages s'opposant ayant des colorations variables ou des décolorations sont filmées deux fois afin d'obtenir la meilleure image possible.

This item is filmed at the reduction ratio checked below /
Ce document est filmé au taux de réduction indiqué ci-dessous.

10x	12x	14x	16x	18x	20x	22x	24x	26x	28x	30x	32x
							✓				

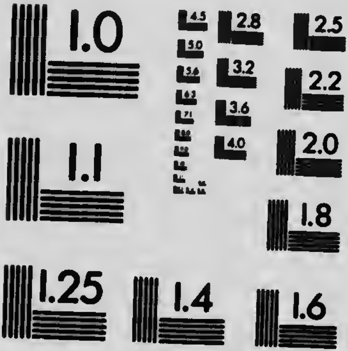

1
2
3


1
2
3


1
2
3
4
5
6

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



Modern Types of Danger Warnings on the Sea Coast.

Modern Types of Danger Warnings on the Sea Coast.

By Lt.-Col. Wm. P. Anderson, M. Can. Soc., C.E.

Lighthouses. From the earliest dawn of commerce, which is coeval with the dawn of civilization, the necessity for danger warnings on the sea coast has been recognized. 300 years B. C the pharos of Alexandria, the prototype of our modern lighthouse, was one of the seven wonders of the world, but this was crowned by the uncertain and rude light afforded by an open fire. The historic lighthouse of Corduan, at the mouth of the Garonne, built at the close of the sixteenth century, remains to-day, in point of architectural grandeur, the noblest edifice of its kind in the World.. It, too, was first illumined by burning billets of oak in a chauffeur at the top. It was not until 1807 that the feeble light from a chandelier filled with 10 lbs. of tallow candles was supplanted in the [illegible] Eddystone lighthouse by lamps, reinforced by para- [illegible] reflectors, so that improved methods of lighthouse [illegible]ion began less than a hundred years ago.

Argand's accidental discovery that the superposition over an oil flame of a glass cylinder would, by increasing the draught, that is the supply of oxygen, vastly increase the brilliancy and steadiness of the light, was the first step in the improvement of illuminating apparatus.

The direction of a considerable proportion of the beams of light by placing the flame in the focus of a paraboloidal reflector was the next progressive step, but the crowning improvement in the illuminating apparatus of light houses was the utilization by Fresnel of the refractive power of glass, when cut into properly shaped lenses, to direct the light into parallel beams.

Since the days of Argand and Fresnel little has been done to improve the *theory* of lighthouse illumination. The principles adopted by them are still recognized as accurate, and progress has been in the direction of increasing the size and power of the apparatus, without departing from their general principles.

Spermaceti oil obtained from whales, seal oil and various fish oils, as illuminants, gave place to Colza oil, a vegetable product, and it, in turn, has been displaced by petroleum, a much cheaper illuminant, and capable of producing a much larger and more brilliant flame.

The English lighthouses burn petroleum in lamps having as many as ten concentric wicks, with an intensity of 2619 standard candles.

Of late years many experiments have been made with a view to replace oil by coal gas, acetylene gas and electric light, but petroleum is still generally used. It has the advantage over other forms of illuminants of being cheap and easily stored, and of giving a light with a clear yellow colour, which, it is claimed, penetrates fog better than the whiter lights obtained from more modern illuminants. In the endeavour to secure the best possible light producer many very powerful lamps have been invented, including a gas burner made by Mr. Wigham, of Dublin, containing 108 gas jets. He has superposed three such burners in the foci of separate lenses in a single lighthouse. The difficulty of using this apparatus consists in the great heat evolved, as well as in the immense lantern required to contain the superposed lenses, and to give sufficient air for and ventilation to the flames. Mr. Wigham has lately utilized the Auer light principle in his multiple jet gas burners, and must secure very great illumination by this means. Mr. Emmerson of this city has shown me a lamp in which oil in a vapourized form is burned under an incandescent mantle. This promises a brilliant and cheap light, if mantles less fragile than those now in the market can be secured.

Acetylene also promises good results, when a perfect gas generator shall have been invented Heretofore so much practical difficulty has arisen in producing pure gas, in producing it economically in the small quantities required in a lighthouse, and in preventing the mechanism from freezing, that acetylene has not yet supplanted oil in any of our lighthouses

Electric light can only be profitably employed when the supply can be drawn from a commercial source. To instal and run an independent plant at a light station is so expensive, and is accompanied by so many practical difficulties, that even rich lighthouse boards, like those of England and France have extended the installation of electric lighthouses very slowly. In Canada we have a few lighthouses supplied by corporations producing electricity in large quantities Advantage has been taken of the facility with which the electric current can be turned off and on, to make the light at Port Dalhousie occulting, by a simple clockwork; and to alternately light a lamp and operate a fog trumpet on a beacon in Victoria harbour.

So far as I can ascertain, Canada is the first country that has utilized an alternating current in an occulted light, and Mr. Trudeau of Ottawa is the inventor of the first electric fog alarm

It has always been a question in my mind whether there was any great advantage in multiplying the initial intensity of light in the way in which the superposed burners and other large lamps do multiply it. In clear weather any ordinary good strong light is visible to the horizon of the lighthouse, and this is especially true of the clear atmosphere of Canada. In thick fog the most powerful light is entirely useless at a distance of a few hundred yards, a distance so short that no vessel could get the warning of the light in time to be saved from disaster; consequently it is doubtful if the aim of the inventors of these extraordinarily powerful lights, to secure greater penetration in thick weather, is attained: on the other hand, a very brilliant light in clear weather is a distinct disadvantage, blinding the sailor, and preventing him from judging his distance either from the light or from neighbouring objects.

I believe that the immense sums spent in the maintenance of extraordinarily powerful lights would be utilized to better advantage in increasing the number and power of fog alarms in the same district.

Improvements in the illumination of lighthouses have been forced upon engineers by the growth in the size and speed of vessels. In the days of the old sailing ships, when shore lights were few and feeble, a powerful fixed light was a sufficient guide. In these days of 23-knot vessels, running through narrow, and often through dredged channels, when every city and small town is illuminated by electric light, the fixed light, that was so brilliant under old conditions, is rendered insignificant by comparison, and it becomes necessary to provide a beacon more powerful, and one that by its character can be recognized as soon as seen. The head lights of electrically lighted steamships are to-day as brilliant as many of the old fixed lights; this is another reason why it has been found necessary to adopt the principle of abolishing fixed lights altogether for the more important stations.

To the improvement in lamps I have already referred; the improvement in optical apparatus has been in the direction of varying the character of the light, either by occulting it, or by gathering rays into condensed beams by a suitable arrangement of lenses, thus giving a very powerful flash or groups of flashes followed by an eclipse. This flashing light can be very much diversified in character, but a description of the methods of attaining the results would be tedious if described technically.

The flashes are produced by revolving an arrangement of lenses around the lamp as a centre, and much ingenuity has been displayed in the details for carrying round the heavy machinery with the least possible friction. Today ball bearings are used on small apparatus, while the largest and most quickly revolving apparatus are floated in troughs of mercury. The most perfect development theoretically of this system of concentration of the rays is the French invention know as the *feu éclair*. This light is based on the laws that the time which a flash takes to make an impression varies inversely as its intensity, and that once having made an impression a certain time is necessary to allow a steady light to produce its full effect, and that this time also varies inversely as the intensity of the light. It has been demonstrated that a very powerful beam will produce its full effect on the eye in the space of 1-10 second. Applied to lighthouses, this means that there is no advantage in making a flash of longer duration than 1-10 second, for this will allow it to be seen as a flash at the utmost distance at which it can possibly affect the eye, while as it is approached it will of course appear longer and stronger.

In the *feux éclairs* the lenses are so designed as to gather the whole of the light into one narrow beam, and are revolved so rapidly as to give flashes of about 1-10 second duration at intervals of 10 seconds. The resulting speed of the revolving beam of light is very great. Seventy miles is not an extreme limit of visibility for the most powerful lights, and at that radius the beam is travelling at the rate of about 440 miles in 10 seconds. Its width, therefore, to act on the eye, for 1-10 second, must be nearly 4½ miles. To give the necessary divergence to the beam, an extremely large size of flame is required, and in practice it is found impossible to maintain a flame large enough to give extreme results. The sailor, who usually cares nothing about theories, does not seem to take kindly to the *feu éclair*. He complains that it is impossible to locate a flash before it disappears, and he prefers a light of which he can take a bearing while it remains visible. Therefore he favours less intense and longer flashes, but the general practice today is to greatly reduce the length of flashes and the dark intervals between them; and some of our old-fashioned revolving lights, having a period of two or three minutes, are hopelessly out of date.

Fog Signals. The increase in speed of ships, to which I have alluded, and in the quantity of shipping, as well as the haste insisted upon in these days of close competition, have made it imperative that ships should push on through fair weather and foul, through clear weather and thick, and all our prominent turning points are piled up with the wrecks of the vessels that have cut the corners too closely. In the endeavour to protect vessels under these conditions fog alarms have become more and more necessary, and more and more relied upon as aids to navigation, and are now found upon most salient headlands. These may be classified under four heads, viz:—

(1) Explosive signals.

(2) Sounds produced by reed instruments.

(3) Whistles, and

(4) Sirens

The one advantage of explosive signals is the facility with which they can be established. The necessary electrical connections can be made in a few minutes, and their installation costs practically nothing, especially since gun cotton, exploded in the open air at the end of a mast, has taken the place of gunpowder fired from cannons.

A disadvantage of an explosive signal is that the noise is so short in duration that it may be drowned in a local noise, lost in the noise of the waves, or of a storm, or even in the roar of the gale in the rigging; moreover, it is difficult to fire with safety so frequently as modern requirements demand; if fired frequently explosive signals become much more expensive than more powerful and prolonged noises produced at frequent intervals by machinery. Canada is therefore aiming to replace explosive signals by steam or compressed air fog sirens.

The earlier trumpets and horns, operated by steam or air, were reed instruments, but these have been found less powerful than whistles and sirens, and are being rapidly replaced by the latter, although good horns have given surprising results. On one occasion I heard the horn on the Western Islands, in Georgian Bay, distinctly at Cape Croker, 26 miles distant, across a wind.

It is questionable if any sound can be produced superior to the clear blast of a good steam whistle, and many of our best fog alarms are large whistles. The sound can be varied by changing the intervals between the blasts and by the use of various modifications of whistle bells. Chime whistles are used, as well as whistles containing a piston, which changes the length of the bell and consequently varies the note. These variable whistles are known as "Modoc" or "Wild Cat" whistles. You will all remember the distinctive, if disagreeable, sound of the whistle that was on Eddy's factory, previous to the fire of 1900.

In the siren the sound is produced by forcing steam or air through small holes opened and closed very rapidly by the revolution on a perforated metal disk of another similarly perforated disk. By varying the number of openings or the speed of the revolution, the pitch or tone of the siren is changed. At Belle Isle I installed a 6-inch siren in 1899, giving alternately a high and a low note.

The air compressors here are driven by a jet wheel, with water led from lakes on the hills of the island, and the compressed air is piped for 4000 feet to the horns. This alarm is of the largest and most powerful type ever installed at any station, and is the only example of a fog alarm run by water power.

One disadvantage of all fog signals except steam whistles is that the trumpets throw the sound out in one direction, so that it is louder in the axis of the trumpet than in other directions. There seems, however, to be no way of overcoming this difficulty. American inventors have taken advantage of this direction of the sound to equip a siren with megaphones directed to the cardinal points. Through each magaphone it sends a different signal, with the expectation that a vessel can judge the direction from which the sound comes by the relative loudness of the signals. We are now installing one of these Hamilton-Foster sirens at Fame point lighthouse, on the Gaspé coast, the first landfall made by vessels after crossing the Gulf inward bound, to experiment on this principle of judging sound direction. Even though the claim of the inventors, that the siren will indicate its own direction from the vessel, should be unfulfilled, the siginal will give an efficient coast warning, acting as an ordinary siren.

We meet with a good deal of difficulty and disappointment in operating our fog signals. This is because we cannot make mariners understand that sound signals are extremely liable to aerial disturbance. *Theoretically*, sound waves are propagated in straight lines in all directions from their source, exactly as light waves are propagated. *Practically*, these straight lines of sound waves are deflected by any little irregularity in the air through which they pass. If the air is not wholly homogeneous, the sound waves will not pass through it in straight lines, but will be deflected, and whether the deflection is down towards the surface of the water, or up into the air, the effect is the same; the sound does not travel parallel to the surface of the sea, and is lost to the sailor who is listening for it. A small island, a reef, or rocks, or even a shoal lying outside of a fog alarm station, will have the effect of unequally heating the air which covers them, and the air thus separated into strata of unequal densities, causes refraction of the waves of sound, and the fog alarm becomes ineffective. The same thing may happen, though it is not so likely to do so, where none of these natural obstructions are apparent. Times without number complaint has been made that one of our fog alarms was not in operation, when investigation proved that it was sounding as loudly as ever, the trouble being with atmospheric conditions. Some of you may have noticed echoes produced where there was apparently no hill or surface to reflect the sound. These echoes must have been reflected from strata of air differing greatly in density from that at the point of production of the sound, and are one example of the difficulties that fog alarm signals strive in vain to overcome. For these reasons we warn mariners that they must never judge their distance from a fog signal either by the power of the sound or by the absence of sound, because under certain conditions of atmosphere the sound may be heard loudly at long distances from the alarm; under other conditions it may be lost at a very short distance, and these conditions may vary at the same station within very short intervals of time or of space. Unfortunately it seems impossible to convince captains of this, and many wrecks have resulted from their ignorance of these well known aberrations.

Lightships. Danger signals that have been greatly improved in recent years are floating aids to navigation, including lightships and buoys. The modern lightship is a reservoir of complicated machinery, containing apparatus for revolving lights at the mast head; powerful fog signal machinery; auxilliary power for propelling the vessel, in case she breaks away from her moorings or is obliged to run for shelter, and mechanical appliances for relieving the strain on the anchor in heavy weather. A lightship however, can in no way be considered as satisfactory an aid to navigation as a solidly founded lighthouse, because the motion of the waves prevents the light from being seen at a great distance, and in our climate a vessel must leave her station when ice forms, and is, therefore, unavailable at the time navigation is closing when an aid is most urgently required; moreover she is liable at any time to break from her moorings, and may therefore not be found at the place expected. The one point in favour of a lightship is that her station may be so located that vessels can run much closer to her than they can to a light on land.

Buoys. In 1899 there was an International conven on the subject of buoyage, which resulted in the adoption of rules to govern the shapes and colours of buoys. Canada has adopted these International regulations, and all our larger buoys have been made to conform in shape as well as in colour to these International regulations. To make the necessary improvements involved the furnishing of a large number of conical buoys.

The ingenuity that has been shown in the development of signal buoys is most interesting. The earliest signal buoy is the old bell buoy. I doubt if this has been much improved since the eighteenth century, when,

The good old Abbot of Aberbrothok
First placed a bell on the Inchcape rock,
On a buoy in the storm it floated and swung,
And over the waves its warning rung.

When the rock was hid by the surges' swell,
The mariners heard the warning bell;
And then they knew the perilous rock,
And blest the Abott of Aberbrothok.

Tempora mutantur. Now the mariners curse a too paternal Government for not having replaced the bell buoy by a lightship or a pile lighthouse!

The bell buoy seems specially to appeal to the imagination of poets, perhaps because later types of signal buoys commend themselves rather to the utilitarian than to the sentimental side of our nature. Rudyard Kipling makes the bell buoy sing, with no lack of imaginative power indeed, and with the vigour that is his chief charm, but emphatically in the spirit of today:—

They christened my brother of old,
And a saintly name he bears;
They gave him his place to hold
At the head of the belfry stairs,
Where the minster-towers stand
And the breeding kestrels cry.

Would I change with my brother a league inland?
("Shoal! 'Ware shoal!") Not I.

* * * *

At the careless end of night
I thrill to the nearing screw,
I turn to the nearing light,
And I call to the drowsy crew:
And the mud boils foul and blue
As the blind bow backs away.
Do they give me their thanks if she clears the banks?
("Shoal! 'Ware shoal!") Not they.

Through the blurr of the whirling snow,
Or the black of the inky sleet,
The lanterns gather and grow,
And I look for the homeward fleet.
Rattle of block and sheet—
Ready about! Stand by!
Shall I ask them a fee that they fetch the quay?
("Shoal! 'Ware shoal!") Not I.

I swoop and I surge and I swing,
In the rip of the racing tide;
By the gates of Doom I sing;
On the horns of death I ride.
A ship-length overside
Between the course and the sand,
Fretted and bound, I bide;
Peril whereof I cry.
Would I change with my brother a league inland?
("Shoal! 'Ware shoal!") Not I.

* * * *

The Courtenay whistling buoy is a most successful, ingenious and original invention. It is fitted with a long cylinder reaching down into the sea below wave action. As the buoy rises and falls on the water this cylinder acts as an air compressor, the compressed air being forced out through a large whistle on the superstructure, and emitting a fitful and distinctive moan. We have now in the Dominion over thirty of these buoys, and are rapidly adding to the number.

Another very successful and original buoy is the Pintsch gas lighted buoy, in which a specially purified gas is compressed to 10 or 12 atmospheres, and supplied to a group of burners through a reducing valve so gradually that a large buoy will burn night and day for three months without attention. An ingenious invention in connection with this buoy is an automatic cut-off that withdraws the supply of gas at short intervals, so as to give the effect of an occulting light. This result is secured by alternately filling and emptying a chamber capped with a piece of flexible leather, and owes its success to the extreme simplicity of the mechanism. With this attachment there are three burners, which are extinguished, grouped about a small pilot burner, not affected by the cut off, and which relights the outer jets as often as the gas resumes its flow.

Pintsch gas is largely used for lighting cars. The brilliant lights on the Canada Atlantic trains between here and Montreal are Pintsch gas-lights, the tanks on the cars being supplied from a gas works in Montreal. This gas is also utilized in many small beacon lights.

Many experiments have been tried in maintaining electrically lighted buoys, and a dredged channel entering New York harbour, Gedney channel, is equipped with electrically lighted buoys, but the system has not proved an unqualified success, as any damage to the cable extinguishes all the lights, and the cost of maintenance has been excessive.

A proposition has lately been made to safeguard the River St. Lawrence, between Montreal and Quebec, by a similar system of electrically lighted buoys. Any electrician will tell you how extremely expensive the installation would be, and how precarious the maintenance. The Department sent the proposer of the scheme out on our steam tender this winter, when we were saving our ordinary buoys from the running ice, and I expect, after what he saw there, we shall hear nothing more of that scheme.

We have had many interesting experiences with buoys that have gone adrift from our Atlantic shore. It is nothing unusual to hear of them anywhere out in the open Atlantic. One has come back to us from Ireland, and we have heard of others in Spain and Africa. Our last prodigal was returned to us from Turks Island, in the West Indies, after being absent for about three years. This buoy must necessarily have made a long journey to have reached its destination. The only way in which it could possibly have reached the West Indies is by following the Gulf stream nearly to the coast of Ireland, down through the Bay of Biscay, past the Azores, the Cape Verde islands, and the African coast, and back to the coast of America through the equatorial ocean.

There are many other aids to navigation, such as hydrographic surveys, surveys of tides and currents, and the connection of lighthouses by telegraph with centres of commerce, which have been of great benefit to mariners, and of which an account might be interesting, but they can scarcely be classed as danger warnings, and are thus foreign to my subject. All the large naval powers are at the present moment experimenting with the Marconi system of aerial telegraphy, which the inventor claims will warn a vessel of the existence of danger more efficiently than any of the methods that are at present in use, but it remains to be seen whether the invention can be utilized in this way.

You may have noticed in the public press, during the year, many vigorous attacks on the lighthouse system of Canada. To read them one would think that all our lights and fog alarms were obsolete. If you make allowance for the immense extent of sea coast that we have to cover, for the youth of the country, and for the fact that all our aids to navigation are absolutely free to shipping, you will admit that Canada has accomplished a wonderful work, and one that should receive praise instead of censure, when I tell you that, since Confederation, the number of our lighthouses has been increased from 227 to nearly 900, and of steam fog alarms from 2 to 64. This large number of aids to navigation, besides thousands of buoys and other minor aids that have not been mentioned, are maintained at an annual expenditure of about half a million dollars.

It is true that many of our lights are not strictly modern, first-class lights, but all of them are good, serviceable lights under ordinary conditions of weather, and our fog alarms are as modern and powerful as any in existence.

We have the testimony of one Commander-in-chief of the North America station after another to the efficiency of our system, and many of the recent attacks on it have been inspired by a few shippers having selfish ends in view. If our lights are not perfect, we are improving them and adding to their number every year, and are also establishing new fog alarm stations, but even in their present condition they are ample to secure safety to a carefully and intelligently navigated ship. What we in Canada require more than improvements in aids to navigation, is education of the sailors and pilots frequenting our waters in modern methods of navigation.