

THE MARITIME SURVEY OF DENMARK

Extract from a lecture delivered in "Kartografiska Sällskapet", Stockholm

by

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As far as is known the oldest chart of Danish waters (1) in existence is that of the southern part of the Sound dating from 1653; it is due to Bagge WANDEL, who in 1647 was appointed Director of the Nautical College founded by CHRISTIAN IV at the Royal Dockyard, Copenhagen.

WANDEL was working here until he died in 1684. At that time shipping in Danish waters had to be content with bad foreign charts, mainly Dutch.

A memorial, which CHRISTIAN V sent to the Admiralty on the 1st May 1688, shows that the want of good charts was making itself felt. In this memorial the King gave orders that the necessary personnel and material be placed at the disposal of the Director of the Nautical College for producing charts of the Sound from Kullen to Falsterbo and Stevns, of Grönsund and its approaches, and of the Great Belt.

The first result of this survey, an unsigned chart of the Sound, dating from 1688, is still at the "Sökort-Arkivet" (2). Up till now this chart has been referred to as being made by Valentin LORENZ, who was appointed Director of the Nautical College in January 1685 as successor of Bagge WANDEL.

By investigation in the State Archives, however, Candidate Johannes KNUDSEN has found that the chart cannot be due to Valentin LORENZ for he died in 1687; it is due to Jörgen DINESEN his successor. It is a fact that the survey carried out by order of CHRISTIAN V was conducted by the latter, from 1681 to 1687 he had been in charge of a general survey of estates all over the country, which survey became the basis of the registration carried out by Ole RÖMER.

It is therefore beyond doubt that it is due to Ole RÖMER that Jörgen DINESEN was appointed Director of the Nautical College and thus had charge of the maritime survey, although he had done no service at sea before.

Looking at these charts it is obvious that those of Bagge WANDEL, dating from 1653, are extremely imperfect and must be considered free-hand drawings not based on any particular survey. In Flinterenden, where no buoys were found, numerous land-marks are mentioned. To memorise these, several of their names were introduced into rhymes.

Looking at Jörgen DINESEN'S charts dating from 1688 great progress will be noticed, but unfortunately nothing has been preserved as to the manner in which he made this survey. He says himself that the survey was done by a "new and geometrical method". On it lines are drawn lengthwise in the

(1) The chart of the Faeroes by Bagge WANDEL dates from 1650.

(2) The Danish name for the "Hydrographic Office".

waters and other lines at right angles to them. This is better seen in a chart drawn by Andreas LOUS in 1763 probably from Jørgen DINESEN's original chart. It appears from the chart that it is purely the principles of land-surveying which he used for the maritime survey, so that the line of direction forms the line of connection between the two surveying-ships and all lines of soundings are at right angles to the line of direction. I cannot tell how he was able to do this. Probably the survey itself was not quite as accurate as appears from the drawing.

The pure principles of land-surveying were used for making a chart of Copenhagen Road. The survey was done on the ice in January 1689 and every single line was marked by poles ashore. One must admit that Jørgen DINESEN, in spite of his lack of maritime experience, proved able to undertake maritime surveys, at any rate near the coast. In spite of this and his otherwise unquestionable ability, and though he had so able a spokesman in Ole RÖMER, who recommended that the surveys should be continued in the way in which they had been started by Jørgen DINESEN and under his charge, it was not he who had charge of the surveys in Danish waters. The reason for this must be sought in the fact that his method was too slow and, consequently, too costly, and secondly a man turned up who was specially capable of doing the practical maritime surveying that was needed.

This man was Jens SÖRENSEN, born at Sølvesborg in 1646, where his father was a merchant; the son had, from his earliest youth, been to sea in his father's ships, in later years as a captain. During his voyages he noted what was specially wanted in the charting of waters. He had formerly received the King's prize for drawing a chart and from his early youth it had been his heart's desire to make charts of the Danish waters, for he had realized long before how bad the Dutch charts were.

On 30th May 1689 he sent a long report to the Government setting out the necessity of getting all Danish waters surveyed and charted. At a meeting at Copenhagen on 1st June between Jens SÖRENSEN, Jørgen DINESEN and Ole RÖMER, at which the King was present, he is likely to have pleaded his cause very strongly, for on 11th June he was appointed "Director of Charts". It might be interesting to know what were the defects that he pointed out in Jørgen DINESEN's charts, for, looking at the latter's surveys of Drogden, Hol-laenderdybet, Kongedybet and of the shoals along the coasts, one must admit that the survey by Jens SÖRENSEN was not so thoroughly done as the former. It is possible that the Government found the surveys of Jørgen DINESEN too slow and too expensive. Thus in his instructions it was expected that besides the Sound, Grönsund and its approaches and the Great Belt also would have been surveyed in 1688, but he finished the Sound only.

Jens SÖRENSEN, on the other hand, being a practical sailor, knew what was specially wanted for navigation and on which tasks he need not spend so much time.

Jens SÖRENSEN now started the surveying of the waters and continued for many years with untiring energy and industry; he drew more than 100 charts. These were sent to the Admiralty and kept there to be used in the Navy. Although he repeatedly tried to have them reproduced and published he never

succeeded, so that private shipping could not benefit by them. Here, as in other countries, the Admiralty's fear that the enemies of the country might profit by the better charts, asserted itself. If Jens SÖRENSEN's charts be compared with those now existing it is amazing to see how good were the results that he attained with the primitive resources at his command. All directions were determined by compass, long distances were measured by mean of what he called a "mile-carriage" which he constructed. In this carriage after a certain number of rotations the wheel sounded a bell. By means of the circumference of the wheel and the number of rotations between two strokes of the bell he obtained the distance (thus a primitive odometer). The lesser distances he measured by chain or rod. He had to determine all contours of the coast in this way and the accuracy attained is surprising. All determinations at sea were made by course and distance.

When looking at Jens SÖRENSEN's charts it will be seen that his method of surveying differs widely from that of Jörgen DINESEN. On his chart of Aarhus Bugt the contours of the coast are remarkably good; the shoals Mejlgrund (Middelgrund), Norsminde, Flak and others, are well surveyed and their positions fairly accurate, but in places where he thought that no shoals would be found very few soundings have been taken. All his charts are without graduation and all his surveys are plans.

Jens SÖRENSEN probably thought that the main thing would be to determine the contours of the coast as accurately as possible and fix the relative distances and directions between the various parts of the country as well as possible, and at sea to locate the shoals and find the depths on them. By means of his own knowledge of the waters and information which he got from people having local knowledge, he learned of the existence of the shoals and then by repeated voyages he located them by means of actual courses and distances. By this method, of course, many shoals escaped notice.

From a chart of the Kattegat it appears that he determined the contours of the coasts remarkably well, but this chart shows relatively few soundings.

However he did not confine himself to the Danish coasts solely. He gathered information concerning the Swedish and German coasts as well, and it is of interest to study a chart of "Stockholms Skaergaard fra Landsort", of which he made his first records in 1664 and improved on them during his later voyages, until he drew it in 1712.

After the death of Jens SÖRENSEN, which occurred in 1725, a period follows in which but a few occasional maritime surveys were made.

I should like to mention one of these as it gives some information as to the method used, at any rate with regard to the survey along the coast.

After the death of Jens SÖRENSEN it would seem that the Director of the Nautical College, or the "Director of Navigation" as he was now called, again had charge of the maritime survey and that the pilotage authorities made surveys of their own. Further it looks as if a record of the methods adopted by Jörgen DINESEN had been deposited at the Nautical College and now came into use again. The survey in question extends from Kronborg to Copenhagen and consists of 7 plans and 1 ordinary chart, it was carried out in 1752 by three

Naval Officers who, according to a letter from the Admiralty, had to report themselves to the Director of Navigation to undertake this survey in order to "ascertain where the best place might be found for a harbour to hold a flotilla of galleys". All the charts have been bound into an atlas and the log of the survey has been inserted on the front pages of the atlas.

A line of direction was determined from one point to another, the direction of which was found by means of a compass. The direction was verified from one line of direction to another by means of an astrolabe. The length of a line of direction was found by measuring special lines along the shore. The directions of these lines were also found by means of a compass and verified by astrolabe. By means of the directions and lengths of these special lines the length of the line of direction was computed. The soundings were taken in lines at right angles to the lines of direction, the distances between the lines varying from 60 to 100 fathoms and the distance between the soundings was 10 fathoms. The distance between the lines of soundings, reckoned on the line of direction, was found by measuring on the special lines a distance equal to the required distance on the line of direction divided by the cosine of the angle between the lines.

It does not appear from the explanation how the boats managed to keep on these lines, but as far as I can see the lines were determined by means of two poles, as the lines are called *aa*, *bb*, *cc*, and so on. However, it does not appear from the explanation how the distance of 10 fathoms between the soundings was obtained.

It cannot be denied that, in this manner, the shoals along the coast were determined quite well, but the whole distance from Elsinore to Copenhagen was found by means of a measuring tape and thus, of course, it was not very accurate. Though I cannot prove it, I hold the opinion that this explanation throws light on the method of surveying used by Jørgen DINESEN and that it is really this method that was taken up again after more than 60 years rest in the archives of the Director of Navigation. I am further confirmed in my opinion by seeing a list, belonging to the State Archives, written by Jørgen DINESEN and mentioning the material required for his survey. In this list 100 long poles for divers land-marks are mentioned. It is possible that these poles were to be used for indicating the lines on which the boats should run when sounding.

During this period a few persons obtained the privilege of publishing certain charts. Thus for instance C. C. LOUS was allowed to publish a chart of the Kattegat. One of these, published by him and A. LOUS in 1769, shows a decline compared with the charts of Jens SÖRENSEN, at any rate with regard to the drawing of the contours of the coast. It looks as if these were taken directly from the old Dutch charts; at this same time the charts of Jens SÖRENSEN were hidden and forgotten at the Admiralty.

During the latter half of the 18th century the first systematic survey of Denmark began, when in 1760 the "Scientific Society" started a triangulation and mapping which were finished in 1840. Thereby, moreover, the basis for a rational maritime survey was formed. This was an enormous step from nothing at all and the work must be considered extraordinarily good for that time.

In 1784 the Government took a step that has been of the greatest importance to the maritime survey by establishing the present "Sökort-Arkiv". The name, which is still used, is somewhat incorrect now, the office ought to be called "Sökotvaerket" as in Sweden and Norway, though the name fitted quite well when it was founded, for its original work was to collect foreign charts and from these to make the best possible charts for use in Danish ships. The first Director of the Sökort-Arkivet was the then Lieutenant-Commander (later Rear-Admiral) Paul LÖWENÖRN. From 1790 to 1807 surveys were made that were continued after the war with England, but no complete plan was adopted and the surveys were not based on the right principle, *viz.*, that maritime surveys should be based on trigonometrically determined positions ashore.

Unfortunately LÖWENÖRN held the opinion, as did most people at the time, that the publication of good charts might be an advantage to the enemies of the country and, therefore, many charts remained unpublished. At LÖWENÖRN'S death, in 1826, the then Lieutenant (later Vice-Admiral) ZAHRTMANN was appointed Director. He held the opposite opinion, but he had to wage a long conflict with the Admiralty for this reason. Thanks to FREDERIK VI he won, but not till 1848 was it finally settled that the Sökort-Arkivet was entitled to put on charts and publish everything that the Admiralty had not expressly forbidden.

During the years 1829 to 1840 the greater part of Danish waters was surveyed, but it was not till 1847 to 1858 that a survey was made of the Kattegat, during which the deep channels and the shoals between them were located.

These surveys constitute an enormous progress. They were made according to a fixed plan laid down beforehand and based on trigonometrically determined positions ashore. As the maps of the Scientific Society contained relatively few fixed points the Sökort-Arkivet had to fix quite a number of points and a great part of the measurement and calculations was made by ZAHRTMANN himself.

Comparing the chart of the Kattegat of 1831 with the existing chart it is seen that the contours of the coast are remarkably good in the former, whereas the soundings are rather scarce, specially in the deeper parts, but the coast-line, for instance round Laesö, is well determined.

Since the Topographical Section of the General Staff started a new survey of the country in 1842, so many fixed points have been determined that it is but occasionally that the "Sökort-Arkivet" must determine further points.

The result of the surveys made by the "Sökort-Arkivet" was a complete set of charts of all Danish waters on a scale of 1:120,000, which scale was reduced later on to 1:130,000 for practical use, and this scale has been maintained ever since.

We have now come so near to the present time that I will give an account of the Danish Maritime Survey as it is actually being carried out in practice.

A GENERAL DESCRIPTION OF DANISH SURVEYING METHODS.

All surveying along the shores is carried out from boats. As the coast nearly everywhere in Denmark consists of an even, slowly rising sandy bottom the lines of soundings are laid out at intervals of 200 metres. In narrow waters, or where the depths are more uneven, the distance between the lines is reduced to 100 or 50 metres according to circumstances. The different positions are determined by simultaneous measurement of angles in the boat and the ship; from the boat the angle of altitude of the ship's mast-head is measured and on board the ship a horizontal angle is taken between the boat and a fixed point on shore.

In this way the direction and distance of the boat from the ship is obtained, the position of the latter being determined by horizontal angles between fixed points on shore. The position of the ship is computed and so many fixed points are used that it is possible to make the necessary check of the calculations. Whilst the boat is moving along the lines soundings are taken constantly and later on the different soundings are distributed equally — between positions determined at intervals of 200 or 300 metres — by means of the time being noted. Unless it is impossible to avoid it, the furthest line run by the boat should not be more than 800 metres from the ship, whereby the maximum distance between boat and ship will not exceed 1000 to 1100 metres. Taking the altitudes of the mast-heads of our ships into consideration and allowing an error of 0.5' in the angle of altitude measured, an error of 6 meters is possible. This gives an error of 0.3 $\frac{m}{m}$ on the plotting-sheet (on a scale of 1:20,000) which is considered the limit of permissible error.

That we have retained this somewhat old-fashioned method is mostly due to the nature of the Danish coasts. The latter are covered with forests for long distances or end in low but steep cliffs, so that near the shore it is impossible to see the necessary number of fixed points and, unlike the coasts of Sweden, no outlying islands and rocks are found where the necessary fixed points might be established. Moreover, over long distances the coasts are straight and without protrusions, so that it would be quite impossible everywhere on the coast to see three different marks, and besides the fixing of such marks would require a personnel greater than our Maritime Survey has at its disposal.

Outside of the coast area the surveying is carried on from the ship itself and here the distance between the lines is from 300 to 400 metres unless conditions require it to be less. The positions are determined by horizontal angles between fixed points and are plotted by station-pointer. The lead is kept going constantly and the revolutions of the engine are noted together with the positions and soundings and the depths are plotted as described above.

On board, the whole survey is drawn on the plotting-sheet and this is redrawn during the next winter at the "Sökort-Arkivet".

In several places outside the coastal-banks Danish waters are strewn with shoals on which stones may be found. These shoals are searched for by means of "Trallen" which consists of a spar 18 metres (59 feet) long that can be

kept horizontal and be towed at any depth to 10 metres (33 feet) by means of a vertically placed mast to the lower end of which the spar is fastened by a hinge. The mast passes through a hoop and thus can either move freely up and down or be kept at a certain depth. The hoop is fastened to a boom which forms the connection between two heavy pieces of timber. These are joined by a bolt at the fore-end and the whole forms a triangle floating on the water.

Below the fore-part of the two pieces of timber an oblique wooden plank is attached to give the fore-part a suitable lift to counteract the downward pressure caused by the horizontal spar being towed through the water. The apparatus is towed by a launch and we make sure that the whole area in question is searched by means of small buoys.

Another apparatus used is the wire-drag that consists mainly of a bottom-wire which, by a system of weights and buoys placed at certain intervals can be towed horizontally at various depths by regulating the length of the uprights (wires between the weights and buoys). The wire-drag is towed between two motor-launches and the length of it, as used in our waters, is 200 metres

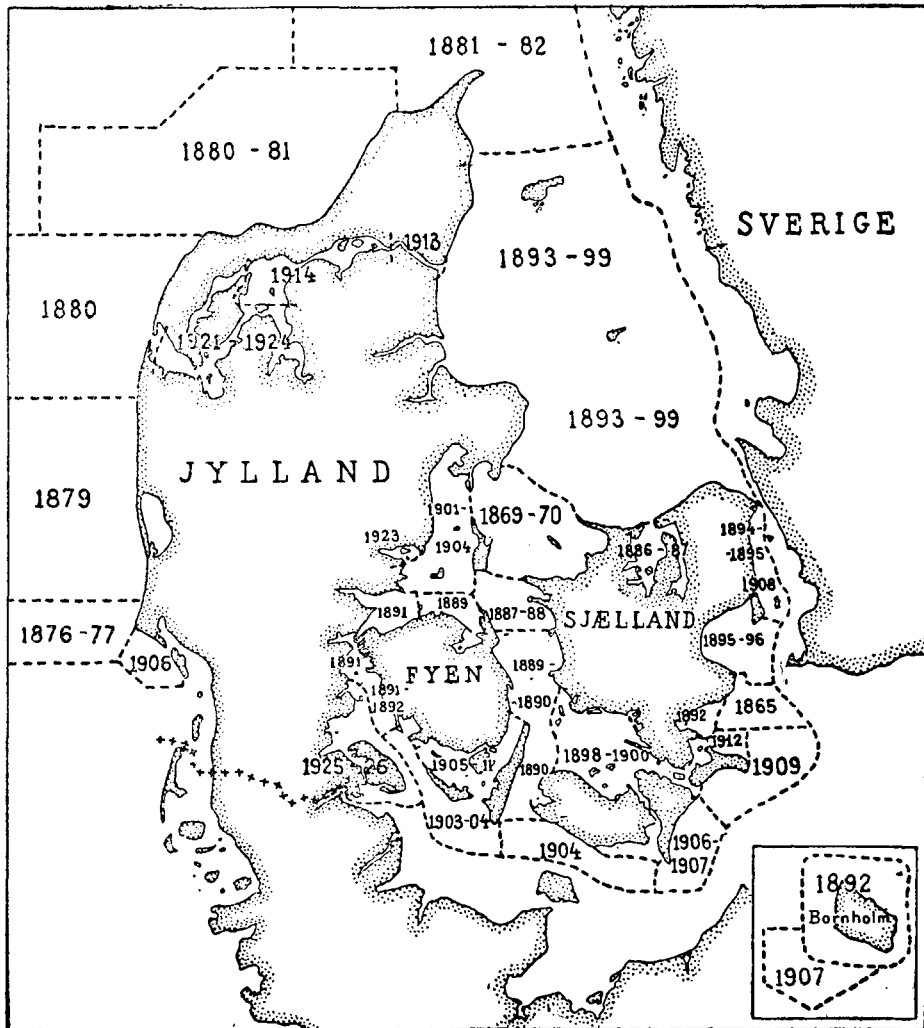


Fig. 1

(219 yards). This length can easily be increased to 400, 600 or 800 metres (437, 656 or 875 yards), or even more, as the bottom-wire consists of lengths of 25 metres (82 feet) which can be shackled together, and at each interval of 50 metres (164 feet) of the bottom-wire a weight and a buoy are attached.

With this apparatus a certain depth in a channel can be comparatively quickly guaranteed, but in our waters it is used, for the present, for locating shoals whose existence is known from earlier surveys; when the shoals have been thus located they are more closely examined by "Trallen".

The dates of the surveys in Danish waters are shown in Fig. 1. The oldest part is a small section between Vejle Fjord and Hov. This section and the section southward of Horns Rev are going to be resurveyed, but for the present work is being concentrated on examining the shoals outside the ordinary buoyage as these have not been examined by any modern apparatus during the years when the surveying was proceeding.

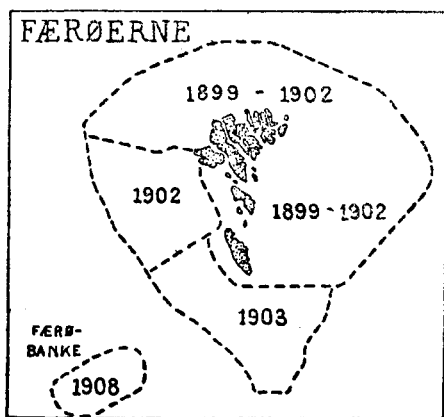


Fig. 2

As for the Faeroes and Iceland the dates of the surveys are shown in Fig. 2. and 3.

With regard to Iceland the Topographical Section of the General Staff commenced a survey of the country in 1900. It has been finished for the southern, western and northern parts nearly as far as Ofjord and the maritime survey here is mainly based on this survey of the land. According to the Law of Confederation of November 1918, Iceland must either pay for land and maritime surveys or cause them to be made of its own accord.

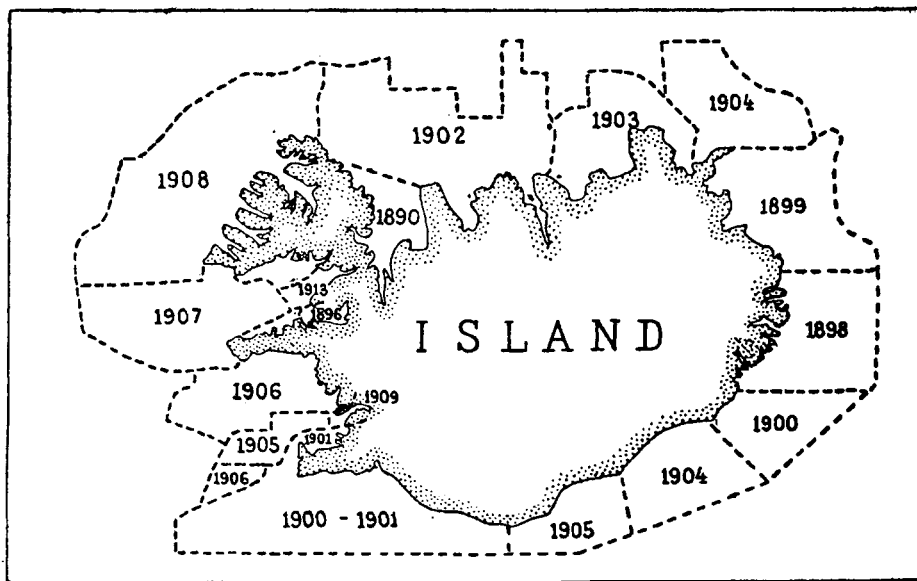


Fig. 3

PROJECTIONS USED.

Charts on CASSINI's projection were formerly used for plotting-sheets but unfortunately the meridian of Copenhagen was used as the tangent meridian so that the distortions of angles and distances on the western coast of Jutland were so noticeable that another tangent meridian had to be chosen for the sheets there. The drawbacks to this, however, were so great that it was resolved to make a change and thus it was decided to use MERCATOR's projection, as the charts had to be drawn on this projection. For charts of Danish waters the cylinder intersecting the earth's surface along the parallel of 56° was chosen, for the Faeroes that of 62° and for Iceland that of 65° .

Tables of longitudinal differences and meridional parts have been computed, in metres, for the three cylinders and by means of these tables the charts may easily be constructed, and in addition all geographical co-ordinates of fixed points are transformed by means of these tables into rectangular co-ordinates of the system chosen on the developed cylinders. Moreover the angular correction has been computed and tabularized so that this can readily be found. Besides, on account of the nature of the country in Denmark, these angular corrections need not as a rule be employed when plotting with a station-pointer, the altitude generally being so small that the longitudinal differences between the points used thereby become very small and thus the correction is often unimportant, but when the positions are calculated the corrections must be employed, of course.

REPRODUCTION OF CHARTS.

This is done either by copper-engraving or by photoalgraphy. The latter method of reproduction is used either for provisional editions or for final editions of charts on large scales. When, in spite of the slowness of this method of reproduction, copper-engraving is used mainly it is due to two reasons, firstly no other method gives so sharp, clear and explicit charts and secondly the continual necessity of keeping the charts up-to-date combined with the relatively small sale of charts has to be taken into consideration. The whole question of correction is very important in connection with charts for in that respect they differ widely from maps, these latter being revised and corrected at intervals of several years whilst a chart should be corrected to the day when it is sold. Omission thereof might prove fatal to shipping.

The photoalgraphed charts which are reproduced in three colours are printed at the Topographical Section of the General Staff (*) and the minimum issue is 200 to 300 charts. Owing to the corrections we can therefore use this method of reproduction for charts of small areas only, where corrections do not occur frequently.

As mentioned above most of our charts are reproduced as copper-engravings and, in order to avoid making too many corrections by hand or being forced to throw away a great number of charts when the corrections are so numerous or important that they cannot be made in this way, 20 to 30 copies

(*) Now the Geodetic Institute.

only of each chart are made at one time. The corrections are therefore continually being inserted on the copperplates, and this special work is increasing so much that more than half the time at the engravers' disposal is spent thereon.

Formerly the corrections were made by hammering the copper up from the back of the plate in the part to be corrected. The hammering was done on an absolutely plain steel block. The area was then polished and the correction engraved on the plate. When the corrections are many and great, for example long lines or large compass roses, the plate will gradually become deformed and buckled, which makes printing difficult and a lot of charts have to be condemned.

If the magnetic compass roses are to be kept within one degree of the actual variation, they must be corrected every ten years and as the plate can only stand being hammered up twice, it will not last more than twenty years. Thus since the "Arkiv" has about 60 copper-engraved charts, it would be necessary to engrave three new plates every year on account of the plates being ruined by hammering.

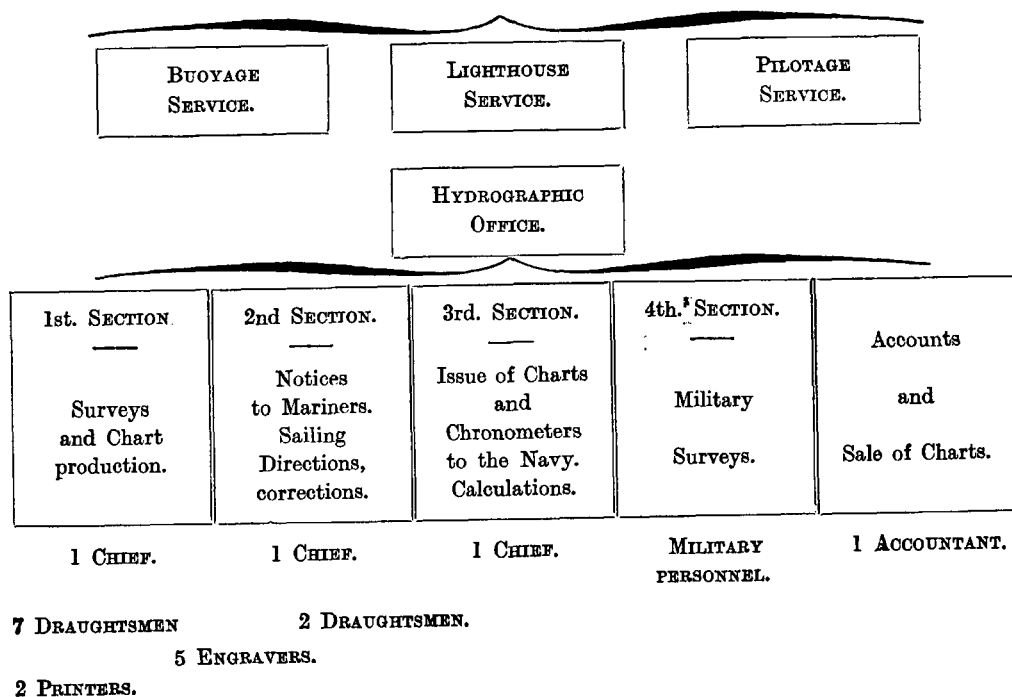
Therefore we have discarded this method and are now using the method of electrolytic deposit. The areas to be corrected are coated with Syrian asphalt and from this coat the places where copper is to be deposited are cut out, the sides and bottom being made somewhat rough so as to make the copper adhere to the plate better. A small vessel, made water-tight with wax and containing a solution of sulphuric oxide of copper, is put on. The current is provided by a small accumulator and acts for 17 or 18 hours from the time when work ceases in the afternoon; thus the whole process is just completed when the work starts next morning. The deposited copper is then scraped and polished, after which the engraving can be done. Three or four plates, with several corrections on each plate, can be dealt with at the same time and it has happened but once that the deposited copper did not adhere sufficiently to the plate. The method is somewhat slower than the method of hammering up but it pays in the long run as the plates will last practically for ever.

ORGANISATION OF THE "SÖKORT-ARKIVET"

The "Sökort-Arkivet" is directly under the Admiralty Department to which Department the Lighthouse Service, the Buoyage Service and the Pilotage Service also belong.

Owing to developments the Director of the "Sökort-Arkivet" (the Hydrographer), besides being in charge of the "Arkivet", is considered a sort of Nautical Adviser to the Admiralty Department. For this reason the Hydrographer gives his opinion on all matters concerning the Lighthouse and Buoyage Services. This method has proved practical, the "Arkiv" thereby being aware of all negotiations concerning these matters and thus nothing can be missed for later publication in "Notices to Mariners". On matters of detail the four organisations correspond directly with one another.

ADMIRALTY DEPARTMENT.



The "Sökort-Arkivet" is divided into four Sections.

The 1st. *Section* in charge of a Commander on active service, is the section for Surveying and Chart-production. During the summer this Officer is chief surveying officer and during the winter he apportions the work of the surveying officers in redrawing the plotting sheets, and is in charge of the work of the Engravers, Draughtsmen and Printers.

In addition he does the proof-reading of all drawings which are to be used for charts and also of the copper-engraved charts before they are ready for printing.

The 2nd *Section*, of which a permanently appointed Chief, who is a retired or a reserve Officer, is in charge, publishes: Notice to Mariners, Sailing Directions, Light Lists and Buoyage Lists. The correction of charts is done by this section.

All information concerning the Lights, Buoyage and Pilotage Services for publication in Notices to Mariners is obtained from the Admiralty, as mentioned above. All information concerning municipal or private harbours, lights or buoyage systems is also obtained from the Admiralty, these harbours not being allowed to lay out new buoys or to alter the existing system without permission from the Admiralty.

Piers and harbours may not be built or harbours and dredged channels leading to them be dredged without permission from the Hydraulic Engineering Service.

This Service is directly under the "Ministry of Public Works" and all information is sent at once to the Admiralty.

As soon as a new chart is published it is passed on to the 2nd. Section which makes all future corrections. This Section keeps a register of correction to be entered in each chart. In this register appears the date on which each correction was entered on the existing stock of printed charts, the date on which the correction was engraved on the copper-plate and the date on which the proof-reading of the correction was done. Furthermore the number of the letter dealing with the correction is entered in the register.

The 3rd. Section which is in charge of a permanently appointed Chief, who, like the Chief of 2nd. Section, is a retired naval officer or an officer of the reserve, issues Danish and foreign charts and Sailing Directions to the Navy. Furthermore this Officer is computer and assists in proof-reading of the Notice to Mariners, Sailing Directions and Light and Buoyage Lists.

The accounts of the "Sökort-Arkivet" are kept by an Accountant who has charge of the sale of charts.

At the "Sökort-Arkivet" there are at present 9 Draughtsmen, 5 Engravers and 2 Printers. Of the Draughtsmen two are women who do all colouring work, copying of harbour-plans and the like. Two of the Draughtsmen are constantly occupied with corrections in the 2nd. Section; one of them is called "Registrar" and keeps a register of corrections, wrecks, radiotelegraphic and radiotelephonic navigational warnings, etc...

Of the Engravers two are almost always occupied with corrections and this work takes precedence over all other work. During periods where many corrections have to be inserted other Draughtsmen and Engravers have to leave their work and join in the work of correction.

As will be seen, the administration and organisation of the "Sökort-Arkivet" have nothing in common with those of the Topographical Section of the General Staff, but the co-operation between these two organisations has always been very close so that the want of a more intimate connection has never been felt, on the contrary we have been spared the friction in the accomplishment of the work and the vexations which a connection of that kind might cause.

In the bill now before Parliament, concerning the Defence of the Kingdom, it is proposed that the Institute for Measuring Degrees and the Topographical Section should be merged to form a Geodetic Institute (*), whereas the "Sökort-Arkivet" is to be kept as an independent organisation according to that which in my opinion, is the right view, *viz*:- that maritime surveying is such specialized work that it must be under free and independent direction. Moreover the differences in working methods, surveying material and training of personnel are very great and the advantages which it might be thought would be obtained by joining the two organisations, for example that land and maritime surveys could be made from the same institution, might be rendered impossible by the fact that claims for land and maritime surveys come from widely different institutions in the country.

Institutions on land may possibly wish to have land surveys made at

(*) In accordance with the law of 31st. March 1928 the two organisations have now been fused under the name of "Geodetic Institute".

one place whilst shipping organizations may wish for maritime surveys at another place. In this connection it must be borne in mind that the maritime survey is of international importance and it is very likely that reasonable international claims may be made to the maritime survey with which it might prove difficult or even impossible to comply if, at the same time, due regard be taken of national claims concerning the land survey.

Another advantage which the joining of the organisations might appear to give is a better utilization of the draughtsmen's and engravers' time. But here the question of the continual correction of charts asserts itself. The Hydrographer must, at any time, be able to order all draughtsmen and engravers from their work to join in the work of correction. If all these employees were assembled in a certain section belonging to a large common organisation it could not possibly be done without continual friction with the Chief of such a reproduction section. In stating this view I take it for granted that neither of the two institutions has at its disposal a staff larger than one which can be fully employed. The last question but not the least would be: "Who is to be in charge of the joint organisation?"

It seems to me that, as a rule, it would be very difficult to get a Director who has sufficient knowledge of the two branches of work and, if such Director be not found, one or the other, and most likely both, institutions would suffer.

The work at the various Hydrographic Offices is very much the same but there may be slight differences in the manner in which it is done, besides it is of interest to compare the organisation of corresponding institutions in various countries. I hope that I have been able to give you a notion of how these matters are dealt with at the Danish Hydrographic Office.

Finally I desire from this place to express the thanks of the "Sökort-Arkivet" to the Swedish "Sjökarteverket" for the splendid co-operation which has existed for many years between the two institutions. The "Sjökarteverket" is now — in my opinion — a model institute and being so much more important than the "Sökort-Arkivet" with regard not only to personnel and material but also to work, it has quite naturally been Denmark which has profited by this co-operation. At any rate I can say that the "Sökort-Arkivet" has never applied to the "Sjökarteverket" for advice without this being given after careful consideration.

I express the wish and entertain the hope that this valuable co-operation may be continued in the future.

