CARTOGRAPHY OF THE ARCTIC WITHIN THE LIMITS OF THE U. S. S. R. FRONTIERS

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In the first place, let me state that my problem is to make clear the question of the cartography of the Arctic within the frontiers of the U. S. S. R. Even restricted in this manner, the problem is vast and, moreover, unlimited. From this it follows that one's conception of the Arctic itself or, more precisely, of its boundaries cannot be considered as definite. Although for the antipodes of the Arctic — *i. e.* the Antarctic — these boundaries can be represented by a mathematical line, this method of representation for the Arctic is quite useless. Thus, for example, if we take only that part which lies within the Arctic Circle we find regions which are totally different in their climatic conditions, their accessibility, the density of their population and their degree of civilization. It is sufficient, in this respect, to compare Northern Norway with the Bays of Ob and Taz which all lie within the same parallel. It seems to me, then, that one of the problems to which the Aeroarctic should devote its attention is to elucidate the question of the exact limits of the Arctic and to arrive at a definite decision concerning the regions embraced within those limits.

With regard to our own country, the problem of the limits of the Arctic can perhaps be solved with greater facility because, here, the conditions of life everywhere within the Arctic Circle are practically the same. Certainly in Siberia there are regions where similar conditions prevail even South of the Arctic Circle; but in the general character of the cartography this does not play an essential part.

Having limited our problem in this manner, we may say that the cartography of our Arctic is essentially a cartography based on the work of our hydrographers. In fact, if we glance at the charts of the Military Topographical Service, we see that the only charts existing for the European part of the U. S. S. R. are to the scale of 10 kms. to 1 inch and, for the Asiatic portion, to the scale of 100 kms. to 1 inch. From this it will be further noticed that we see large blank spaces on the charts, which show the results of the astronomical, trigonometrical and survey work of the Topographical Service and which are crossed, only here and there, by narrow bands of expeditionary surveys with very sparse astronomical positions.

In their general outline, therefore, the above-mentioned charts are based on data of a few local surveys, supported only by scanty astronomical positions.

If we add to these the results of isolated surveys, carried out by various scientific expeditions and which relate to certain small areas only, we shall have exhausted the whole of the data provided by scientists other than hydrographers.

Without dwelling further on the above-mentioned work, let us pass on to with charts of the whole of our Northern Coast as well as of the seas and bays adjoining it, which is included within the limits fixed above, *i. e.* North of the Arctic Circle.

From the work which has served as the basis of cartography of the whole of this region, we select three fundamental stages which practically correspond to the beginning of the three consecutive centuries: the 18th., 19th. and 20th.

The explorers who took part in the work of the first of these periods undertook it when they had only at their disposal material handed down from the middle-ages such, for example, as the sketches of Siberia by Godounow; they had also a certain amount of material obtained and prepared on the spot without the use of even the most elementary methods of measurement. Besides, as the work was carried out with the most imperfect measuring instruments and by rudimentary methods, they were only able to plot very approximately indeed the wide stretches between the 30th. and 190th. degree of Longitude East of Greenwich, in spite of heroic efforts. At any rate, at this period direct measurements of distance and bearings were

already in use. For distance measurements surveyors-chains were employed and, for hydrographic work, measurements of the routes traversed were made by means of the log. For this latter work astrolabes were of use and, still more frequently, compass bearings. The determination of latitude was checked astronomically by means of octants and sextants; but the longitude was generally estimated. As later observations have shown, local errors even in determining latitude amounted to as much as half a degree; and the longitude positions were in error by several degrees.

For this reason much of the data was found to be insufficient a hundred years later, and new expeditions had to be sent equipped with good compasses, sextants and chronometers, and having at their disposal perfect methods of observation. This time the work embraced only a part of the coast: actually, the Murman Coast, that of the White Sea and the Barents Sea, the greater part of Nova Zembla, the coast of Kara and the West Coast of the Yamal Peninsula in the Bay of Ob. Then there followed a gap as far as the mouth of the Olenek, at which point the area of work carried out in the course of this period recommenced; this included the coast of the Siberian Sea and the neighbouring islands as far as the Bay of Kaljutschinskaia. The same bay together with the coast as far as Cape Dejneva was defined shortly before this. The work at this period showed a much greater degree of accuracy. On comparing the latitude observations of that time with existing data, it is found that they agree to within a few minutes. Regarding the longitudes, in cases where they were not obtained merely by dead reckoning, these are certainly comparable with later data even though they deviate considerably from the truth. This last fact is not surprising, for the observers had often only one chronometer at their disposal and there was a lapse of time of several months between observations for longitude. As regards the absolute longitude positions, they could not be carried out very frequently so that the degree of accuracy attained was only from two to five minutes of arc.

Towards the end of the 19th. century, the development of navigation and of civilization in general in the different adjacent regions called pressingly for greater perfection in the charts which were projected in the second half of this century. Consequently, new work was undertaken employing the most modern methods. Naturally, it was impossible to extend such work over the whole of the North and they had to be content, in the first place, with continuing it only in the most important regions. Thus work based on triangulation was executed in the region of Murmansk and in the Bay of Kola. The West Coast of the Peninsula of Kanin was included in hydrographic work, based upon numerous coastal astronomical positions. Work in the Bay of Petschora was begun again. The straits leading into the Kara Sea were once more explored, as also were some parts of the coast of Nova Zembla. Similarly on the coast of Kara and in the Bays of Ob and Yenissei new exploration was undertaken. Finally a survey was made of the whole region between Cape Tcheliuskin and Cape Dejneva, when new islands and new territories were discovered and charted.

The accuracy of this work — if once again we take astronomical positions as our criterion — is already characterized by their probable error. For latitudes the error is of the order of 1 to 2 seconds or fractions of a second; in longitudes the error also amounts to 1 or 2 seconds of time, *i. e.* a quarter or a half minute of arc, for ships usually carried several chronometers kept under favourable conditions. Under certain special circumstances the error might be only half a second of time, Recently, by using W/T, the error has been reduced to some tenths of a second of time, that is to say, a small number of seconds of arc.

If we add to this information the results of the numerous expeditions, both Russian and foreign, which were sent out at the end of the last century and the beginning of the present one, we shall have exhausted the whole of the material relied upon in the cartography of the Arctic within the limits of the U. S. S. R. frontiers. As can be seen, all this data consist of the most heteroclite elements, some of it dating back a century or even more. There can be, then, no question of uniform accuracy in this cartography, regarded in its entirety; rather must we examine each individual region. We will obtain the best solution of the question by examining the existing charts relative to the Arctic and establishing their degree of accuracy. This can be done by taking them in order from West to East and, for this purpose making use of the catalogue of the Hydrographic Service corrected to the 1st. January 1927. (*)

(*) *This catalogue contains* 65 *charts of the region under examination, their scale being not more than* ½ *verst to* 1 *inch,* i. e. 1: 21,000. (1 *verst* - 1.067 m.)

These can be divided into two groups, according to their date of publications: the first group, from 1833 to 1871, consists of only 10 charts; and the second group, beginning in 1892 and continuing to the present day, includes a further 55 charts. But, if we consider the years of work on the territory, which serve as the basis of these charts, the question becomes far more complex. We observe that a fairly large number of charts, which have been prepared during the last few years, in some places rely solely upon data collected in the first twenty years of last century; two of the charts even rely upon the work carried out during the first forty years of the 18th. century. On the other hand, if we subdivide all the charts into various sections, the following groups appear to be the most important: a first group based on the work of the years 1822 to 1833, comprising 10 charts; a second group dealing with the work from 1889 to 1902, with 8 charts; a third group containing 35 charts appertaining to the period commencing about 1900; and finally, a last group of 12 charts, based on data existing since the 18th. century.

Such, in general terms, are the characteristics of the existing charts. We will now analyse the charts individually and, first of all, those which surround the larger land-spaces. Starting from the West, let us commence with chart Nr. 1279 of 1839, scale 2.7 miles to 1 in., which represents the Murman Coast from Vardö to about half the Rybatschi Peninsula. It includes the whole of the Varanger Fjord, the Petschenga and other bays. This chart is based on the work of 1826. It has been partially corrected, as far as the old Russian frontier, in accordance with data supplied by the Murman hydrographic expedition.

The next chart is Nr. 989, scale 3 miles to 1 in., of 1917, which relates to the stretch of coast between the Rybatschi Peninsula and Kildin. It is based on the accurate work of the Murman hydrographic expedition of 1905 to 1907. For each of the six regions included in this chart, we find separate charts and plans on a larger scale; the coastal zone has a width of 3 to 5 Kms. and is indicated by hachures and hypsometric data.

Then follows chart Nr. 1891, scale about 6 versts to 1 in., dated 1904, appertaining to the stretch of coast from Kildin to the Seven Isles. It is based on the work of 1822-26, 1897 and 1903; the latter relies upon astronomical positions fixed about 1900. The character of the coast is only defined by means of conventional signs.

And finally, we have the chart Nr. 1276 from the Seven Isles to Sviatoi Nos, scale 2.8 miles to 1 in., established in 1839 following the work of 1822. This chart terminates the series relative to the Murman Coast. It is also the oldest one and has only been corrected later in the region of the Jokanka Islands as a result of more recent surveys. For the latter region there is a plan on a scale of $\frac{1}{2}$ verst to 1 in., projected in 1916.

For the whole Murman region there is yet another chart Nr. 1518, scale 8 miles to 1 in.; however, this chart was made in 1855 from the work of 1822 to 1832 and, although fundamental corrections have been made to it from the hydrographic point of view, it is completely out-of-date and should be replaced. Details of the coast are almost totally lacking, and only the positions of certain lakes and rivers are indicated, partly by means of dotted-lines.

Let us now pass on to the next region, namely, that of the White Sea. There are four charts in existence, numbered 1179, 1176, 1177 and 1178, one following the other and which comprise the Bay of Kola, and also chart Nr. 1068 pertaining to the Bay of Murmansk; all these charts were drawn up in 1833-34, based on the work undertaken from 1827 to 1832 to the scale of 2.8, 3 and 3.1 miles to 1 in., respectively. These charts are quite out-of-date and, from the point of view of accuracy, leave much to be desired as they are based on a small number of astronomical positions and on surveys made by sailing ships. The relief is indicated by hachures. The corrections made recently are of very little importance and concern soundings principally. Moreover, the region of the Three Islands has been corrected and a small chart of the Island of Morjovets prepared to the scale of 2 versts to 1 in., and numbered 952.

The East coast of the White Sea, from Kanin Nos to Intza, was projected on two charts (Nr. 951 and Nr. 950), scale 5 versts to 1 in., and brought up-to-date in 1916. In the same year a hydrographic survey of this region was made and this survey was based on a very large number of astronomical positions on the coast, so that a high degree of accuracy was attained; the portion relating to this last work is shown on the chart by an unbroken line, with indications of the nature of the coast and the most important heights inland. With regard to the Western portion of the coast of the White Sea, this is only drawn in dotted lines without

details of any kind; however, it is based upon observations taken at the beginning of the present century.

The whole of this region, moreover, is included in one chart Nr. 1000, scale 15 versts to 1 in., dated 1924. In its preparation not only the material which had served for the preceding charts was made use of, but also the most recent data; hence the degree of accuracy in this chart varies very considerably from one part to another. Only the contour of the coast and the soundings are shown on it. The relief and the details of the coast are entirely lacking. The towns and villages, lighthouses and land-marks, the mouths of the rivers and the railways are scarcely indicated.

In order to facilitate the analysis, we will now consider the group of charts comprising the whole coast from Kanin Nos to the Taimyr Peninsula. This vast region is dealt with, in the first place, by five charts; in part these are separate charts, but one of them, on the other hand, included the whole of the data collected. The first chart of the group, Nr. 1655, scale 20 versts to 1 in., disposes of the Murman Coast from Sviatoi Nos as far as Yugor Schar, as well as the South-West coast of the Sea of Kara. It was projected in 1871 from material collected between 1821 and 1861 and must be considered as being out-of-date, although it has been corrected from data recently obtained. Rivers, lakes and mountains are shown on the coast, but their position can scarcely have been given with accuracy.

The following chart Nr. 1896 represents Nova Zembla and about one half of the Yamal Peninsula, drawn to the scale of 24 versts to 1 in., It was prepared in 1897 from data collected between 1821 and 1896. The chart is completely out-of-date and must be replaced absolutely, so that the results of the large amount of work undertaken in the last few years may be incorporated. It appears that the details of the relief have been given, in most cases, without instrumental measurements. As we shall see from what follows, for various parts of this region there are still further separate charts on different scales and of more recent origin.

The third chart of the region with which we are dealing is numbered 763, scale 25 versts to 1 in., and gives the whole of the Yamal Peninsula, the Bay of Ob starting from the entrance and the Gulf of Yenissei, together with a part of the river. It was begun in 1910 from the work undertaken between 1828 and 1909, and particularly also from data obtained in the 18th. century.

The Yamal Peninsula is charted in accordance with the hydrographic work of the years 1897 to 1904, and the details given are the results of the partial surveys of 1909. On the other hand, with regard to the coasts of the Bays of Baidarats and Taz, as well as the Southern part of the Gulf of Yenissei, the chart depends upon work dating from the beginning of the 19th. century. It is evident, from the most recent work on the Yenissei and Ob, that the chart ought to be revised. A few other charts must also be considered; they represent isolated portions of the above-mentioned regions and are based on data collected in the course of the last few years.

The fourth and fifth charts of this area Nrs. 681 and 712, scale 5 miles to 1 in., and projected in 1906 and 1908, include the least well-explored portion of the coast which extends from the Gulf of Yenissei to the river Taimyr. The first of these charts is based on 5 astronomical positions and the second on 21, determined for the most part by means of the sextant in 1900 and 1901. In making these charts, information was used furnished by the TOLL expedition and by certain foreign expeditions which crossed this region. For certain particular points, material was employed which was collected by the large Northern Siberian Expedition at the beginning of the 18th. century. On the coast, they show several of the important heights and the mouths of the rivers.

The chart which embodies this whole stretch of coast is numbered 1662. It was projected in 1922, scale 50 versts to 1 in., and all the existing material was used to correct the coast-line. The relief of the coast is not given.

Before analysing the more complete charts contained in the general chart Nr. 1662, we will consider the last three, numbers 986, 985 and 984, which take us to the Eastern limit of the zone in question. The scale is 20 miles to 1 in. and they represent the entire coast to Cape Dejneva together with the adjacent islands of Taimyr. They are projected uniformly in accordance with the results of the Arctic Ocean Expedition of 1911 to 1914, which was made by two torpedo-boats and the object of which was the hydrographic description of the coast; their

data were based on exact astronomical coastal positions. The details of the coast-line are furnished by the work of the coastal expedition of 1909 between the Bays of Iana and Tschaun, as well as by that of the expeditions made towards the mouth of the Kolyma, Lena, etc. In certain places on the coast, the rivers and heights are shown.

It only remains to observe that, for the region which corresponds to chart Nr. 984, there is yet another chart Nr. 1495, the Eastern part of which includes a part of America along the meridian of Cape Ledianoi (Icy Cape). The chart was projected in 1854 and it contains fairly numerous details of the coast-line to the West of the Bay of Tschaun as far as Lat. 67 ½° N. In the other parts, the mountains and rivers are given over a stretch of land 100 Kms wide. However, their positions are not at all certain. For this reason the chart is out-of-date without any doubt, even though various corrections have been made to it.

Now let us return to the more detailed charts. Among the sectional charts comprised in the general chart Nr. 1896, six of them, namely, Nrs. 614, 772, 225, 576, 651 and 694 belong also to chart Nr. 1655. The work of the last thirty years is the basis of these charts, with the exception of Nr. 225. The coasts have been surveyed with the plane-table and besides this a triangulation was made. Among these charts, Nr. 614, scale 5 versts to 1 in., refers to the Gulf of Petschora; Nr. 772, scale 4 versts to 1 in., covers the region of the Gulf of Petschora as far as Yugor Schar; Nr. 576 gives Yugor Schar in the scale of 1 mile to 1 in.; Nr. 651, the Bay of Ljamtschina in the scale of 1 verst to 1 in.; and Nr. 694, scale 1 mile to 1 in. the Bay of Dolgaja. The two latter concern the Island of Vaigatsch.

The relief of the coast is shown by hachures, over a width of one to two miles, with local hypsometric data.

Chart Nr. 225, scale 675 fathoms to 1 in., shows the Southern part of Nova Zembla. It is based on the Hydrographic description of 1833 and, as the voyages of the last few years have demonstrated, its accuracy is very doubtful. This chart must be replaced by one brought more up-to-date.

The remaining five charts comprised in chart Nr. 1896 were compiled from the work of the last few years. They are based on a survey made with the planetable. It is only in chart Nr. 1023, which gives the whole of Matotschkin Schar to the scale of 3 versts to 1 in., that the material of 1823 has been partly made use of; this, however, is of a very high degree of accuracy as has been proved by the numerous voyages of latter years. The relief is shown in the form of contour lines, with numerous hypsometric data. The anchorages marked on the chart of 1912 are in some cases derived from old data. The chart Nr. 806, scale 1 mile to 1 in., shows the Bay of Krestovaia from the records of 1910; whilst of the two charts Nrs. 583 and 1017, the latter, to the scale of 1 mile to 1 in., comprises a part of the first which is projected on the scale of 3 miles to 1 in. Both these charts relate to the Western entrance to Matotschkin Schar and its environs, from Sukhoi Nos in the North to Northern Cussini in the South. Both are based on the records accumulated between 1922 and 1924. The relief of the coast is shown by contour lines with hypsometric data.

As has already been mentioned, the vast area represented on chart Nr. 763 is to-day the subject of a series of new regional charts. For the Bay of Ob, for example, four provisional charts were prepared in 1925, scale 5 miles to 1 in., and two others on a scale of 5 versts to 1 in., which show the Northern, Central and Southern parts, respectively. They rely on recent work, during which the coast was surveyed with the plane-table to the scale of 2 versts to 1 in. and the observations verified with extreme accuracy by means of coastal astronomical positions, taken at points from 40 to 60 miles apart. The longitudes were determined by W/T. These charts have not yet been numbered as work on them will be continued and, also, a part of the coast has not yet been surveyed. In addition, a chart has been prepared, scale 1 verst to 1 in., for a recently discovered bay which has received the name of "Novi Port".

The entire Gulf of Yenissei is shown on a special chart, scale 10 versts to 1 in., which is not yet numbered; for the Yenissei River, there are three charts, scale 2 ½ versts to 1 in. (Nrs. 996, 998 and 999), based on the work of 1911 to 1921, which define the river from Cape Sopotschnaja Korga to the Port of Ienissei. Chart Nr. 1001, scale 1 verst to 1 in., has been prepared from the same data for certain anchorages in the Gulf of Yenissei and in the Yenissei River. Along the coast, altitudes are indicated by means of hachures and their character shown by conventional signs.

Also it should be mentioned that an atlas of the Yenissei River, from the town of Yenisseisk to the Gulf, appeared in 1900; this atlas is based on data of the expedition of 1893-96, thereby verifying the more detailed parts of chart Nr. 763.

For the vast region from Taimyr to Cape Dejneva, there are three more detailed charts other than those already mentioned. The first of these charts is numbered 679 and gives some anchorages off the Taimyr Peninsula and in the neighbouring archipelago; the second, Nr. 687, gives similar information for the New Siberian Islands and Nerpitschja Bay. Finally, chart Nr. 1021 shows the mouth of the Lena, with the Bay of Tiksi, on a scale of 1 mile to 1 in. The latter was prepared in 1925 from the work of 1903 to 1920. The first was drawn up in 1909 and the second in 1906, both from the records obtained between 1900 and 1906; the scales employed for different details are from 200 fathoms to 5 versts to 1 in. It should also be noticed that on one of the sheets of chart Nr. 984 we find insets showing, separately, the Bay of Kaljutschinskaia and the Bay of Nolde, the first to the scale of 5 miles to 1 in., and the second to the scale of 3 miles to 1 in.

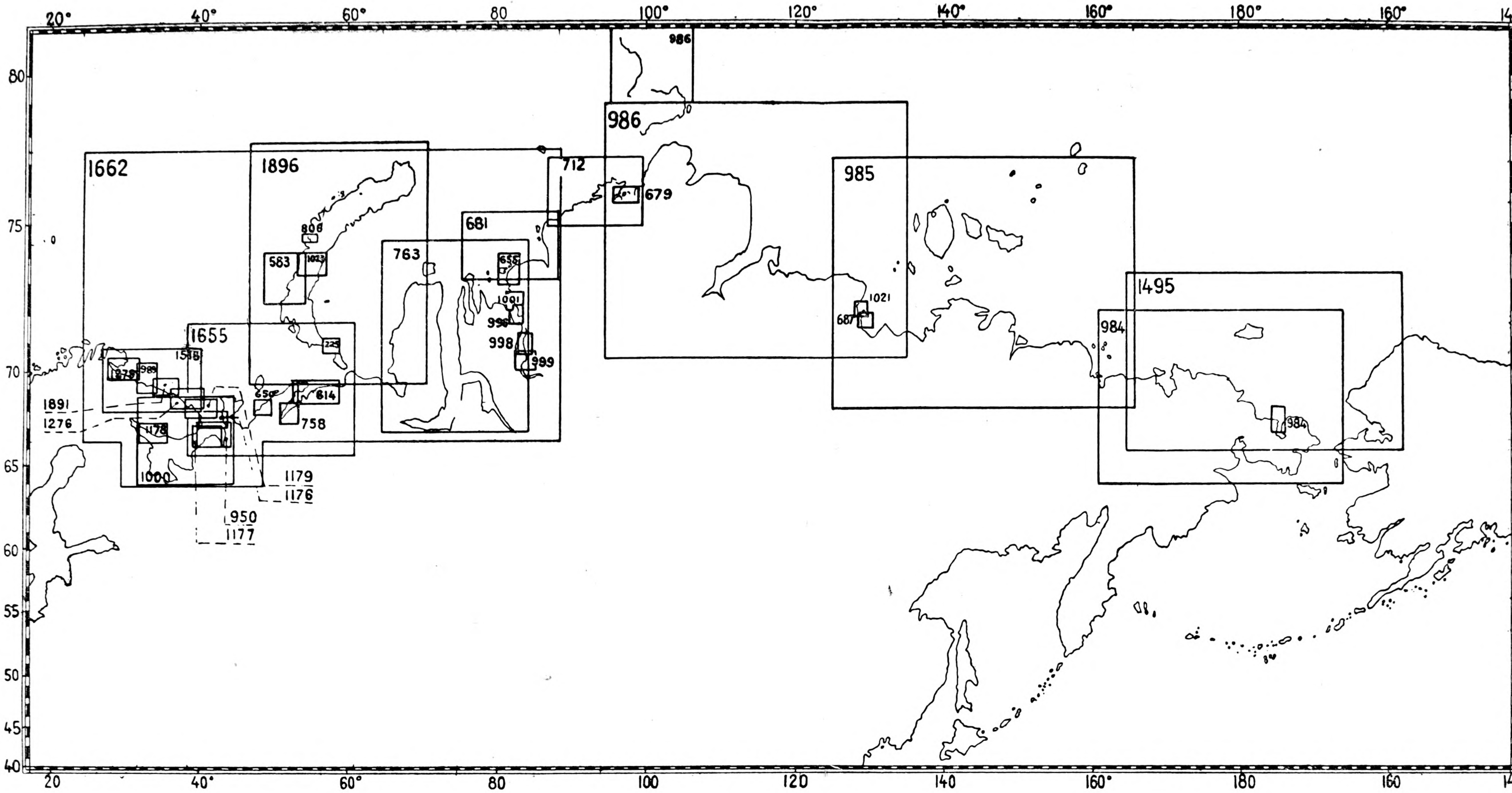
We have now analysed 48 charts relating to the Arctic; among the remaining 17, representing the smaller regions and based on work since 1890, there are only a small number to a scale of less than 1 verst to 1 in. These are: Chart Nr. 758 pertaining to the Petschora River, scale 4 versts to 1 in.; chart Nr. 942 for the Bay of Motowskij; chart Nr. 650, for the Bay of Indiga; and chart Nr. 655, for Port Dickson; all these being made to the scale of 2 versts to 1 in. From their position, only five of them belong to the coast to the East of Kanin Nos; these are Nrs. 758, 650 and 655, already mentioned, and also Nr. 492 (scale of 1 verst to 1 in.) for the Bay of Bolwanskaja and Nr. 323 (scale of 250 fathoms to 1 in.) which represent the access to the Wireless Telegraph Stations of Vaigatsch, Yugor Schar and Maresale.

If we exclude this last group and a few of the detailed charts, which represent only small portions of this region, we can see that there is a possibility of employing the scale of 1: 200,000 for the charts going as far as Kanin Nos. The region between Kanin Nos and the Yenissei is given on the scale of 1 Millionth, so that for certain portions we could employ scales of between 1: 200,000 and 1: 50,000. East of the Yenissei to the Taimyr River the scale of 1: 400,000 would be used and further on, to Cape Dejneva, that of 1: 1,500,000.

An examination of the fundamental scales is sufficient to show that the cartography of the Arctic stands at a very low level. If we consider the individual character of the charts which have been analysed, we find that there is still more ground for the above assertion. The situation regarding the interior of the territory is especially deplorable; if the afore-mentioned scales could be applied to the coast-line, which constitutes a partial proof of the degree of accuracy in the observations taken for determining the longitude, we can safely say that the accuracy deteriorates considerably for most places inland. Naturally, it diminishes in different degrees for various regions, and this degree of accuracy falls lower according to the distance from the coast. As a check, we have great rivers, such as the Petschora, Ob, Yenissei, Lena and Kolyma, the position of which is fairly well defined thanks to the survey-work carried out along their courses. As soon as we move away from these rivers, the conditions become worse.

Thus, for example, it is only at the present time that we begin to have any idea about the region situated between the Ob and the Yenissei, called the Tundra of Gida, and that thanks only to the expeditions of the last few years. However, the position and the outline of the lakes, the direction of the rivers and the altitudes must be corrected in this region by tens and even by hundreds of kilometres. Thus it is, for example, that by comparison with the chart to the scale of 100 versts to 1 in., the astronomic positions of the Khatanga expedition have entailed a displacement of the principal lakes and rivers by hundreds of kilometres from the position which was originally assigned to them, without mentioning the radical divergence in the real position and in the direction of the river-courses and the mountain-chains. Likewise, for example, in the region of the chart of the expedition (10 versts to 1 in.); here, after the Bolsche Zemelskaia Tundra, the River Adzva reaches a length of 365 Kms. instead of the length of 150 Kms. indicated, whilst the number of the Waschutkin Lakes is given as 11 instead of 3. However, the direction of the River Adzva is shown fairly correctly.

If we come back to the scales and note that a millimetre is quite an appreciable dimension in drawing, we may say that in such conditions it is absolutely impossible to represent the interior on the same scale as that adopted for the coast-line. An error of 100 Kms. for a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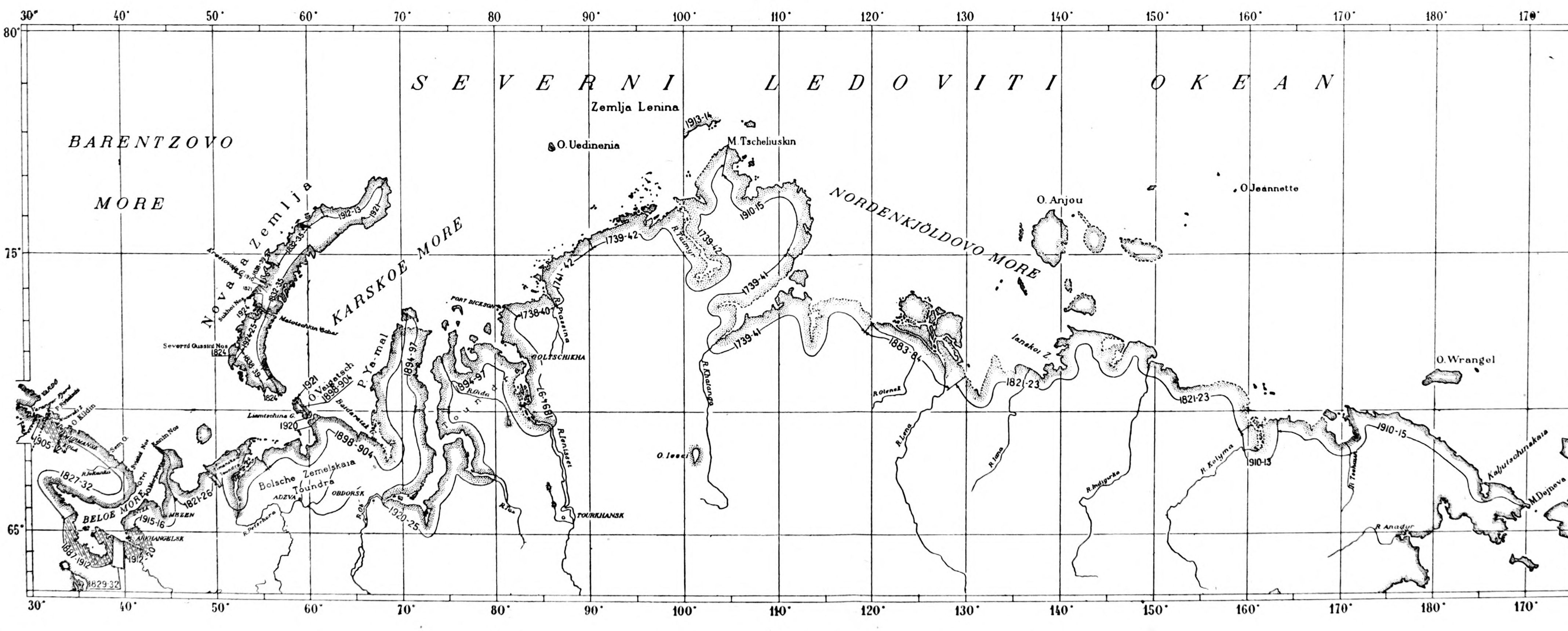
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O. Jeannette
O. Wrangel
Nova Zemlja
P. Ya-mal
O. Vaygatsch
Bolsche Zemelskaia Toundra
BELOE MORE
ARKHANGELSK
OBDORSK
TOURKHANSK
PORT DICKSON
M. Dejneva
R. Anadyr
R. Kolyma
R. Lena
1739-42
1739-41
1910-15
1821-23
1883-84
1898-904
1920-25
1827-32
1829-32
1913-14
1910-13

certain point will produce a displacement on the chart of 10 cms., on a scale of 1: 1,000,000. Naturally, such displacements would lead to complete confusion because they would necessitate a corresponding alteration of all the points which were within the adjacent ten centimetres, when exact data regarding the latter was not always available.

It is easy to understand why we find so few details given in the interior on the charts which we have analysed. We can only insert them in such cases where they agree directly with the points which have served as the basis for drawing the coast-line. One can certainly use the work based upon good astronomical positions but, in that case, one should pay particular attention to the longitudes and, above all, to the points of departure for their determination. The divergence in the position of one and the same point, which was determined from different points of departure and at various intervals of time, can amount to 2 to 3 minutes under unfavourable conditions; and this, in the Southern part of the Arctic, corresponds to 1 or 2 linear Kms. Such a divergence would be scarcely perceptible on a chart to the scale of 1 Millionth and would amount to about 1 to 2 mms.; on the contrary, it would reach a considerable size, even as much as 1 cm., on a scale of 1: 200,000.

It is interesting to notice that divergences of this kind are also quite possible regarding the coast-line. For example, recent work has disclosed the fact that the width of the Bay of Ob was about 1 to 2 cms. too great in its central part, as shown on chart Nr. 763. In other words, the width of the Bay of Ob should be reduced by from 10-20 Kms. in this place.

On the same chart, the shores of the Bay of Taz have undergone similar alterations in recent times ; as a result, this bay has considerably changed its appearance. In the North, the shores of the Gulf of Gydajama have been divided up by the formation of new islands and this has given an entirely different aspect to the coast. However, we must bear in mind that they were drawn with dotted lines, that is to say, as areas of doubtful position.

Consequently, even in the parts in which we can place most confidence, namely, the cartography of the coast, we see that the general cartography of the Arctic is on such a level that the existing data are insufficient even for a scale of 1 Millionth. For the interior, we can only indicate small areas, which have been visited by recent expeditions and the position of which can be represented with sufficient accuracy. In addition to the work carried out along of the water-courses, we may quote the following examples: the survey along the Murmansk Railway, the voyages of exploration in Northern Ural (that is to say, in the region between the Ob and the Kara Sea), the explorations along the River Piassina, on the Peninsula of Tscheliuskin, those in the region of the River Khatanga, the Lakes of Iesei and Wojewoj, the exploration of the River Olenek and of the coast from the mouth of the Iana as far as the Bay of Kolyma and further on to the Bay of Tschaun. It is necessary to add to these examples some regions of Nova Zembla and the work carried out in the Tundras of Bolsche Zemelskaia and Timan. All the expeditions mentioned have made the same survey to the scale of 5 versts to 1 in. and sometimes on a larger scale, or by itinerary surveys. Astronomical positions serve as the basis.

Unfortunately, all this work has not been incorporated in the charts. It is still more regrettable that no one has tried to collect on to one general chart the results of all this work, after making a critical analysis of it.

I think that the composition of such a chart to the scale of 1: 1,500,000 is worthy of being undertaken by the "Aeroarctic". For the reasons indicated above, the employment of a scale would be premature.

Before closing, I would like to say a few words on the employment of aerial photography as a means of improving the cartography of the Arctic. As is well known, it is necessary to have fixed points, connected together into one system, even though the exposures have been made on horizontal plates. Let us suppose that such a survey has been made from a height of 3 Kms. and that the focal length of the apparatus was 0.25 m., the surface embraced by a plate of 50 x 50 cm. would represent an area of 6 Kms. square. It follows from that which has been stated that, even on the coast, we should not find a sufficient number of fixed points. The astronomical positions are at a great distance apart and triangulation points scarcely exist at all; the position of the prominent points such as tongues of land, the mouths of rivers etc., are too vaguely defined for them to be employed. Apart from this, on the scale provided, these points would only be 1/3 cm. distant from each other; that is to say, they would lie so close to one another as to be scarcely distinguishable.

Thus we can scarcely expect at an early date, any improvement in the cartography of the Arctic by means of this method. We can only improve and complete separate detailed charts with the aid of aerial photography. For inaccessible and unexplored regions, we can definitely admit the use of photographic plans which only give a drawing of these areas, without pretending in any way to furnish precise dimensions. Naturally this also is valuable because photography at least gives the exact number of objects such as, for example, the lakes; however, their dimensions and position may certainly be erroneous.

CONCLUSIONS.

1. It is necessary to determine more precisely what is meant by the "Arctic", by fixing the criterions from which we shall be able to judge whether a given region is part of it.
2. The degree of exploration of the Arctic within the U. S. S. R. frontiers does not permit the employment of a scale greater than 1: 1,500,000 for its representation.
3. One of the problems to be solved by the "Aeroarctic" should be the preparation of a general chart of the Arctic on the above-mentioned scale.
4. Under present conditions, no early improvement is to be expected in the cartography of the Arctic by the employment of aerial photography.

NOTE TO FOLLOW THE ARTICLE OF PROFESSOR ACHMATOV.

The Hydrographic Office of Leningrad has communicated the following information to the International Hydrographic Bureau, on the subject of the state of progress of hydrography on the U. S. S. R. coasts at the end of 1921.

COMPLETE SURVEYS.

The complete surveys include those which are based on a triangulation of the 2nd. or 3rd. order, the topography of the coastal belt for a width of 4 Kms. being done with the plane-table, to the scale of 1: 42,000 and above with indications of the relief by contours. Soundings from boats were taken with the line every 50 to 100 sashenes (106 - 213 m.) to a depth of 8 to 10 sashenes (17 to 21 m.); soundings from the ship herself being taken every 200 to 500 sashenes (426 to 1065 m.) as far as the limit of visibility from the coasts. Hydrologic and magnetic observations, as well as current observations, were nearly always made at the same time as the work above enumerated.

Murman Coast. — has been surveyed from 1905 to 1912 in the region which stretches from the frontier of Russia and Finlands, the Bay of Vaida, as far as the meridian of the Western extremity of the Island of Kildine.

White Sea. — from 1887 to 1912, from the Gridine Bay in the Gulf of Onega to the Bay of Ounsky in the Gulf of Dvina; and from 1912 to 1920, in the delta of the Northern Dvina.

Northern Glacial Ocean. — Yougor Char, 1920; Portes de Kara, 1921, and the entrance to the Matotchkin Char in 1924.

Pacific Ocean. — Strait of Taftaryn, from the Island of Langr to Cape Surkoum, from 1909 to 1914. Region of the Gulfs of the Amur and Oussouriisk, from 1881 to 1894; and a series of isolated bays on the shore of the Sea of Japan from Cape Povorotny to Cape Surkoum, at various periods.

Caspian Sea. — from the Isthmus of Briansky on the Western Coast towards the South to Cape Bouroutchouk on the Bouzatchi Peninsula, from 1854 to 1874. A part of this work has been revised later, particularly in the region of the town of Petrovsk to Cape Bouinak in 1914, and from the Peninsula of Apcheron to the town of Lenkorani from 1909 to 1912, and in the region of the Gulf of Krasnovodsk from 1912 to 1913.

Black Sea and Sea of Azov. — complete surveys were made between 1871 and 1914.

Gulf of Finland. — has been entirely surveyed from 1828 to 1861.

RAPID SURVEYS.

Rapid surveys are based on astronomical positions. They have been effected by plane-table, to the scale of 2 to 2 ½ versts to 1 in., generally by means of cross-bearings, drawing the relief of the coast by eye and by determining the height of the mountains by measurements either on shore or from on board-ship, by COOK'S method. Soundings from small craft have been only rarely taken and solely on the banks and in anchorages; the soundings taken on board the ship not being made in any systematic manner, consist solely of those taken on the courses during the successive passages of the vessel. The depths have been recorded with varying distances between them, according to the character, depth and importance of the areas. Hydrologic and magnetic observations, and the currents observations have only been made casually.

Murman Coast. — from the Western extremity of the Island of Kildine to Cape Sviatoi Nos, from 1827 to 1832.

White Sea. — from Sviatoi Nos to the Bay of Gridine in the Gulf of Onega, from 1827 to 1832; from Ounsky Bay to the delta of the River Dvina in the North to Cape Kanin, in 1915-1916.

Northern Glacial Ocean. — from Cape Kanin Nos to the liman Petchersky, from 1821 to 1826; from the liman Petchersky to White Island, from 1898 to 1904; from White Island to Cape Lebediny, from 1894 to 1897; from Cape Lebediny to Cape Sapojnikoff, from 1920 to 1925; from Cape Sapojnikoff to Cape Dickson, from 1894 to 1897; from Cape Dickson to the estuary of the River Piassina, from 1738 to 1740; from the estuary of the River Piassina to Tillo Island, from 1741 to 1742; from Tillo Island to Cape Tcheliouskin, from 1739 to 1742; from Cape Tcheliouskin to the Island of Sv. Preobrajenie, from 1910 to 1915; from the Island of Sv. Preobrajenie to the estuary of the Olenek, from 1929 to 1741; from the estuary of the Olenek to Borkhaia Bay, from 1883 to 1884; from Borkhaia Bay to the delta of the Kolyma, from 1821 to 1823; the delta of the River Kolyma, from 1910 to 1918; from the delta of the River Kolyma to Cape Dejneff, from 1910 to 1915; Nova Zembla (Ex-Emperor NICHOLAS II land), the Island of Maly Taimir (Ex-Island of Tzarevitch ALEXIS), from 1913 to 1914.

Nova Zembla. — from the Southern extremity of Nova Zembla to Cape Tcherny, in 1824, from Cape Tcherny to Cape Ioujny Goussiny Nos, from 1838 to 1839; from Cape Ioujny Goussiny Nos to Cape Severny Goussiny Nos, in 1824; from Cape Severny Goussiny Nos to Cape Soukhoi Nos, from 1924 to 1925; from Cape Soukhoi Nos to the Bay of Krestovaia, from 1821 to 1824; the Bay of Krestovaia, in 1910; from Cape Krestovaia to Cape Borissoff, from 1838 to 1839; from Cape Borissoff to the Pankratieff Islands, from 1832 to 1835; from Pankratieff Islands to Cape Gelanie (Cape Desire), from 1912 to 1923; from Cape Gelanie to the Gulf of Blagopoloutchia, in 1921; from the bay which lies to the North of Cape Dalny to the Gulf of Reineke, including the Strait of Matotchkin Char, from 1832 to 1835.

Pacific Ocean. — from Cape Dejneff to the Gulf of Sviatoi Krest, from 1827 to 1828; from the Gulf of Sviatoi Krest to Cape Korobitzine (Latitude 63 deg.), in 1728; from Cape Korobitzine to Cape Olutorsky, in 1885; from Cape Olutorsky to Cape Goven (Hoven), in 1876; from Cape Goven (Hoven) to the parallel of the Island of Karaguinsky, in 1875; from the Island of Karaguinsky to the Island of Langr, comprising the North and East coast of the Island of Sakhaline as far as parallel 50 Deg., from 1811 to 1820; from Cape Surkoum to Cape Pestchany (Sandy Cape) in the Strait of Tartarie, in 1855; from Cape Pestchany to the Gulf of Sv. Vladimir, from 1898 to 1904; from the Gulf of Sv. Vladimir to Cape Povototny, in 1860.

Caspian Sea. — From the Isthmus of Briansky towards the North to Cape Bourountchouk on the Bouzatchi Peninsula, from 1861 to 1873.

The results obtained by these various categories of survey and research are recorded on the Russian charts and in the Russian Sailing Directions, appearing in the catalogue of charts and works published by the General Hydrographic Administration of the U. S. S. R. The catalogue of 1924 gives the sources from which these documents have been compiled.