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Mitteilungen / Notes

Early Maps of the Arctic Coast of Russia

by Eugen Seibold[1]

Summary: The attempt, from the 16th century on, to open up the Northeast Passage for marine trade in East Asian textiles and exotic spices was a driving force behind the exploration of the Russian Arctic coast. The aim in doing this was to break the Portuguese and Spanisch trade monopoly. Until the late Middle Ages there existed antique notions of a ring-like ocean surrounding the Earth's land mass. These formed part of the background to the quest for the passage. In addition there was vague information garnered from Pliny the Elder that was used for cartographical purposes until the beginning of the 18th century. According to Pliny the coast of North Siberia was formed by a vast bay flanked by two promontories, the Scythian Cape and Cape Tabin. Following some fairly unsuccessful British attempts, Dutch explorers succeeded in drawing up maps which reached the western coast of the island of Novaya Zemlya. These maps were produced before the end of the 16th century. However, because of ice conditions, the Dutch did not manage to find their way into the Kara Sea at the island's southern end.

It was not until the 18th century that new progress was made. The progress resulted from Peter the Great's re-orientation of Russia towards the west which entailed extending invitations to western specialists. He also initiated the "Great Northern Expedition" (1733-1743) during which large parts of the coast east of Novaya Zemlya were mapped for the first time. It is interesting that climatic conditions in Siberia made it necessary to explore downriver, in contrast to normal mapping procedures during the Age of Discovery, these normally involved exploring continents in the opposite direction, i.e. upriver from the coasts. One of the results of the Great Northern Expedition was that Vitus Jonassen Bering confirmed that Asia is not physically connected to America. In addition, improved astronomical positioning allowed him to prove that in approximately 70 degrees North Siberia comprises roughly 130 degrees of longitude, as opposed to the 90 degrees given in all previous maps. This meant that Siberia, and thus also the voyage through the Northeast Passage, was in fact about 1600 km longer than they had been previously thought to be.

Scientific progress, in this case in cartography, was thus driven by the economic interests of Western Europe and by the economic and political interests of Peter the Great, as well as by methodological innovations.

Zusammenfassung: Der Versuch, den Schiffshandel mit den exotischen Gewürzen und Textilien Ostasiens auch über die Nordostpassage zu betreiben, war seit dem 16. Jahrhundert ein wesentliches Motiv für die Erkundung der russischen Arktisküste. Dadurch sollte das portugiesisch-spanische Handelsmonopol gebrochen werden. Im Hintergrund standen dabei bis in das späte Mittelalter hinein auch antike Vorstellungen, wonach das kompakte Festland der Erde durch einen ringförmigen Ozean umgeben war. Noch zu Beginn des 18. Jahrhunderts bezog man sich zudem in Karten auf vage Angaben von Plinius dem Älteren. Danach wurde die nordsibirische Küste durch zwei Vorsprünge gegliedert, Kap Scythia und Kap Tabin, mit einer tiefen Bucht dazwischen. Nach wenig erfolgreichen britischen Versuchen gelang es holländischen Seefahrern bis zum Ende des 16. Jahrhunderts, Karten bis zur Westküste der Insel Novaja Semlja und deren Nordspitze zur Verfügung zu stellen. Der Durchbruch an ihrer Südspitze in die Karasee gelang aber wegen der Eisverhältnisse nicht.

Erst mit dem 18. Jahrhundert wurden mit der Öffnung Russlands nach dem Westen durch Zar Peter den Großen und dessen Einladung von ausländischen Spezialisten Fortschritte erreicht. Er initiierte die "Grosse Nordische Expedition" (1733-1743), wodurch große Teile des Küstenlandes östlich Nowaja Semlja erstmalig kartiert wurden. Interessanterweise geschah dies nicht wie sonst im Zeitalter der Entdeckungen bei der Erkundung der Kontinente von der Küste her flussaufwärts, sondern aus klimatischen Gründen flussabwärts. Dabei bestätigte Vitus Jonassen Bering, dass Asien nicht mit Amerika zusammenhängt. Er konnte zudem durch verbesserte astronomische Ortsbestimmungen nachweisen, dass die wahre Ausdehnung Sibiriens auf rund 70 Grad Nord etwa 130 Längengrade beträgt und nicht rund 90°, wie in bisherigen Karten angenommen. Das bedeutete, dass dadurch Sibirien und damit die Nordostpassage um rund 1600 km nach Osten zu verlängern war.

Der Fortschritt der Wissenschaft, hier der Kartographie, wurde in unserem Fall vorangetrieben durch ökonomische Interessen Westeuropas und ökonomisch-politische Peters des Großen, aber auch mit Hilfe methodischer Neuerungen.

INTRODUCTION: THE NORTHEAST PASSAGE AS A CHALLENGE

Scientific progress does not normally happen linearly: it happens instead in a stepwise fashion. The same is true in the history of mapping. Progress in mapping may result from using new techniques such as photogrammetry, satellite geodesy, or systemtic astronomic positioning. It may result also from the use of different projections or different ways to illustrate relief. But the most important incentives for mapping coasts of foreign countries more exactly are generally political or economic ones, as will be demonstrated in this article.

With the opening of the seaway to India and the Far East and with the discovery of the two Americas in the late 15th and 16th centuries, navigational seacharts and coastal maps became of fundamental importance both to naval and to merchant naval shipping. Up until then, maps had been only needed to illustrate routes on land and in seas as the Mediterranean. The Portolano charts focussed on the coast lines that had safe harbours or prominent coastal features, and gave sailing directions that could be used with a magnetic compass.

World maps date back into antiquity. Some of the primitive ones, for instance the world map produced in 160 AD by Ptolemy (c 90-168 AD), were replaced during the Middle Ages by more or less schematic circular figures based on the idea of a flat, disc-shaped Earth. In some of these maps, those known as "T-O Maps", the three continents Europe, Asia and Africa were shown surrounded by a circular ocean (Fig. 1). Normally these maps showed the East at the top, pointing to the Holy Land, to the Paradise and to sunrise. They are "oriented" toward the Orient. In some of these maps, however, it was the

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Fig. 1: Medieval T-O Map from the 11th century. East oriented, therefore Northwest Europe at the lower left hand side. Circular ocean (after KUPCIK 1980: 11).

Abb. 1: Mittelalterliche T-O-Karte aus dem 11. Jahrhundert. Nach Osten orientiert, deshalb Nordwesteuropa unten links. Kreisförmiger Ozean (nach KUPCIK 1980: 11).

North that was on the top, and on these particular maps climatic zones are also shown. The cold zone in the North and the hot zone in the South are both described as "inhabitable".

It is interesting to note how long these ideas persisted. There is a medieval map from c 1500 that, less than fully satisfactory for Scandinavia with the Baltic, gives a relatively correct impression of Europe including the Mediterranean (Fig. 2). But there is also a circular world map of Russian origin that dates from as late as 1620 (BAGROW 1954b: 46). In the legend of this latter map are scarce remarks that are relevant to the challenge of the North East Passage. For instance (No. 94): "The ships from western countries to Russia go to the port of Archangel on their navigation route. The Northern Siberian Sea is cold. There is ice floating even in summer." And (No. 96): "The Great country of Siberia was formerly a kingdom and now belongs to Russia. There are sables, martens, foxes, bears, squirrels and other beast. It is cold and rich in forests". Fur merchants were for a long time among the most influential explorers of Siberia, and the reference to them is just one of the many geographic and ethnologic details that this map gives its readers. As a map however, it is completely confusing.

The idea of the "circular ocean" is significant in the context of the challenge of the North East Passage. It was this idea that gave rise to the belief that it would be possible to reach China and the Far East by a northerly route as well as by a southerly one. As is well known, the Turkish conquest of Byzanz / Constantinople in 1453 led to the closure of the overland route from Europe to the luxuries and spices of the Far East. This led in turn to Portuguese and Spanish explorers attempting to find an alternative sea route, and to Portugal and Spain eventually achieving a monopoly in trade by this. This sea route was a southerly one, however, and the English and the Dutch were consequently motivated to search for a northerly route by which that monopoly could be broken. The fall of Constantinople had another result: refugees came to Italy who brought with them Greek manuscripts. These manuscripts included Ptolemy's Geography which was first printed with maps in Bologna in 1477. Figure 6 is partly based on these maps.

One of the principal problems in early map-making was the problem of estimating real distances. The revival of antique ideas that the Earth is a globe, as was so convincingly done in 1492 by the "Earth apple" of Martin Behaim (1459-1507), served to stimulate new interest in distances.

On this globe Eurasia covered some 230 degrees of longitude from west to east. This left only 130 degrees for the ocean between Gibraltar and China, the "New Cathay". That was one of Christopher Columbus' most productive errors. On this globe are also shown at up to about 80 °N the "wilde Lapeland, inhabited only in summer" and the "frozen Northern Sea". Lapeland, together with some islands are shown forming a polar continent which is separated from Asia by a continuous seaway.

From the 16th century onwards more and more large-scale maps contained grids. Maps produced by different authors generally agreed with each other on latitudes much better than on longitudes. The measurement of longitudes at sea improved considerably only after Harrison's invention of the marine chronometer in 1765.

The development of fixing positions on land also took considerable time; this applies both to astronomical methods and to systematic triangulation surveys. Distances in northern parts of Eurasia tended initially to be underestimated, as will be shown later in this article.

Fig. 2: Medieval circular Map, c 1500. Scandinavia forms a peninsula together with Greenland ("Engrovelant"), as in many other maps based on Ptolemy. Hyperborei mountains in Siberia (after WOLDAN 1954).

Abb. 2: Mittelalterliche Weltkarte, ca. 1500. Skandinavien bildet zusammen mit Grönland ("Engrovelant") eine Halbinsel wie in vielen andern Karten, die auf Ptolemäus zurückgehen (nach WOLDAN 1954).

The knowledge of the interiors of countries outside Europe remained modest for a long time. Maps of these countries were filled with few observations but many sailors' stories. The gaps in these maps had to be filled in order that the maps could be sold, and illustrations were therefore drawn, green forests, brown hills, indigo lakes and rivers or red towns together with colourful flags and armorial bearings. Human figures, sometimes exotic, filled the remaining unknown or empty space. Areas of open sea were shown with seamonsters, ships or wind roses and instead of fabulous rivers there were drawn fabulous islands. Several of these islands were mapped in the North Atlantic from the island "Brasil" west of Ireland to "Frisland" south of Iceland (Fig. 3). These maps nevertheless contained a lot of cartographic details, even though the interior of both the oceans and the continents were left open for speculation. Exploration of hinterlands often followed rivers upstream, of course, but many important features remained undiscovered for a long time. The River Nile was mentioned even in many T-O maps (Fig. 1), but its sources were finally discovered and mapped in the 19th century!

Siberia is exceptional in that even its coasts were first explored "downstream" by climatic reason. And its linear coastline without any bays has a total length of some 5000 km, from Novaya Zemlya to the Bering Strait. This exploration was an enormous achievement particularly bearing in mind the loneliness, the climatic conditions and the logistic poblems that characterize this huge area. It was political will that, coupled with economic factors, pushed this exploration ahead, the will of Tsar Peter the Great. And it was in the 18th century therefore that the second phase of real cartographic progress in Northem Siberia began.

In this article "early maps" are defined as maps published up to the first half of the 18th century. Some remarks about later exploration are added. A detailed account of all the scientific, trading, hunting, and military expeditions to the Arctic is given by HOLLAND (1994).

The article covers the coasts of the Barents Sea, to the Chukchi Sea leading to Bering Strait. Administratively, Siberia begins east of the Urals and at the western coast of Yamal Peninsula (Fig. 4).

Fig. 3: MÜNSTER; Regiones Septentrionales-Scandinavia (Section, Basle 1544). Icy Sea up to Pechora, fabulous islands in the Atlantic Ocean.

Abb. 3: MÜNSTER; Regiones Septentrionales-Scandinavia (Basel 1544, Ausschnitt) Eismeer bis Petschora, Fabelinseln im Atlantik.

WESTERN APPROACHES

As mentioned, some optimistic ideas evolved even from antique misconceptions. In addition to the T-O maps with their circular ocean, the world map of Ptolemy and its many modified editions in the late Middle Ages were influential up to the 16th century. Two examples are given in Figure 5: the primitive map of Asia from 1544 in Sebastian Münster's "Cosmographia" with the "Oceanus Hyperboreus" as a gateway to the east, and the world map in Abraham Ortelius' "Theatrum orbis terrarum" from 1570 (Fig. 6). In this later map there exists too an open ocean between Northern Scandinavia and "Cathaio". North of this spreads a polar continent, with some straits and with a peninsula "Nowa Zemla" to the south. In his 1595 atlas, Gerard Mercator published a similar map, with an island "Veigats" at about 72°N near Novaya Zemlya.

Pessimistic opinions also existed. During the 4th century BC, the Greek explorer Pytheas had sailed northwards up to about middle Norway. There, in "Thule", he supposed was "the end of the Earth, shrouded in fog". There where places "where there was neither land, nor sea nor air, but a mixture of all three" (NORDENSKIÖLD 1897: 80).

Human curiosity nevertheless drove sailors, fishermen and finally cartographers northward. In one of the first "modern" maps (Rome 1427) the Danish geographer Claudius Clavus (Claus Claussen Swart) mapped the Norwegian North Cape at 68 °N (now at 71°10'N, 25°45'E) (NORDENSKIÖLD 1897: Fig. p. 90). In Zeno's Atlas (Venice 1558) it is situated at 71°N. East of it is marked "Mare et terre incognite" (NORDENSKIÖLD 1889: 58). In the first volume of NORDENSKIÖLD'S (1882) classical report, he describes the history of this exploration in great detail. A short modern overview was published by DUNBAR (1985).

An illustration of further progress is given by Münster's map of Scandinavia from 1544, a wood cut in the best of Nuremberg's tradition (Fig. 3). The "White Sea" is added there with the island monastry Solofki, the mouth of the Dvina ("Pinegofe", the most important harbour area for exchanges with western countries) and the coast up to Pechora. The map shows sketchy degrees of longitude with a prime meridian around the western end of Iceland, and also a single 80° line of latitude. South of this line a polar continent is marked, populated only "by pigmei". Similar fantastic features are marked in Greenland, known from Viking times on, and in several non-existing Atlantic islands. With the growing importance of the traffic with Archangelsk, founded in 1584 at the Dvina mouth, detailed portolanos and sea charts of the Pechora Sea were produced.

In the background were always circulating noises about the Northeast Passage. In 1525 Paulus Jovius assumed that Cathay could be reached from the mouth of the Dvina along the coast (MICHOV 1884: 29). This optimistic opinion lasted. In his Cosmographia MÜNSTER (1628: 1370) mentions the two possible ways to Cathay, the Northwest Passage and the way

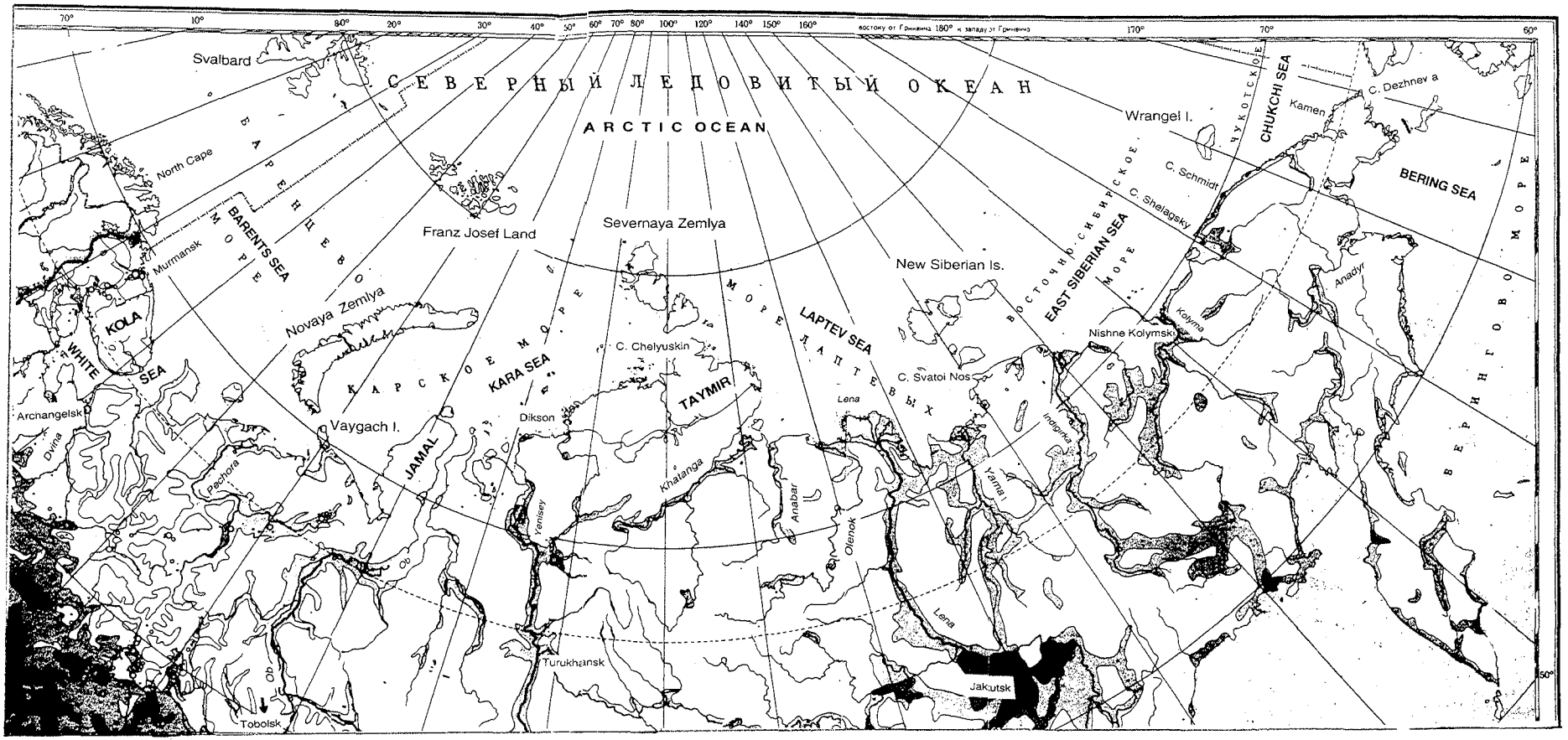


Fig. 4: Reference map of the Arctic coasts of Europe and Asia. North of the Polar Circle (66°30'N, dotted line) tundra vegetation is widespread, generally characterised by absence of trees, mainly because of short and cool summers. Parts of the Arctic Islands are even situated in the nival zone. From the northern part of Yamal Peninsula to the East continuous permafrost is common. The original atlas map (from 1962) illustrates the density of population. It shows the importance of the river valleys with 1-10 inhabitants per square kilometer. Near Jakutsk and at the southwestern corner 10-25 inhabitants per square kilometer are reached (after BARANOV & SCHUROV 1962).

Abb. 4: Indexkarte der arktischen Küsten Europas und Asiens. Nördlich des Polarkreises (66°30'N, gestrichelt) ist Tundra weit verbreitet. Sie ist im allgemeinen gekennzeichnet durch die Abwesenheit von Bäumen, was auf die kurzen und kalten Sommer zurückgeht. Teile der Arktischen Inseln gehören sogar der nivalen Klimazone an. Vom Nordteil der Jamal-Halbinsel nach Osten herrscht weitgehend Permafrost. In der unterlegten Atlaskarte von 1962 ist auch die Bevölkerungsdichte dargestellt, was die Bedeutung der Flusstäler (mit 1-10 Einwohnern km-2) unterstreicht. Um Jakutsk und in der Südwestecke werden 10-25 Einwohner km^{-2} erreicht (nach BARANOV & SCHUROV 1962).

Fig. 5: Asia (MÜNSTER 1544, after an italian edition 1575). Continuous "Oceanus Hyperboreus" from the Dvina Mouth and the Ural mountains to the East and Cathai, with Quinsai, the modern Hang chou, southwest of Shanghai.

Abb. 5: Asia (MÜNSTER 1544, nach einer italienischen Ausgabe von 1575). Durchgängiger "Oceanus Hyperboreus" von der Dvina-Mündung und dem Ural nach Osten bis Cathai mit Quinsai, dem heutigen Hangtschou, südwestlich Schanghai.

from Norway and the frozen sea to the promontory of Tabin and the Anian Strait in the east. He further reports that Dutch ships had penetrated into the area 60 miles from Vaygach Island to the East and "It may well be that Tabin is not far away" (MÜNSTER 1628: 1371). In 1540, in his "Briefe Summe der Geographie", Roger Barlow even stated, that "the shortest route, the northern, has been reserved by Divine Providence for England" (MITCHELL 1985: 863).

And English initiatives did indeed begin. In 1553 three ships sailed north. One of these, under Sir Hugh Willoughby, did not survive in the arctic winter, but another, under Richard Chancellor, reached the area near Archangelsk. Chancellor himself then even reached Moscow. In 1556 Stephen Borough saw the southern end of Novaya Zemlya along with many Russian fishing boats. His ship, the "Search Thrift", was stopped by fog and ice, however, and he could not enter the Kara Sea through the 33 km long and up to 45 km wide Kara Strait. Arthur Pet and Charles Jackman finally succeeded in 1580 in being the first westerners to do this, in their ships "George" and "William". However, the English lost interest after the failure of Henry Hudson to pass to the Kara Sea in 1608 and in 1609. and focussed their efforts on the Northwest Passage. Nevertheless, it was furtheron discussed e.g. in MOXON (1674; 1676 translated into German).

The challenge to open the Northeast Passage was taken up by the Dutch. Wealth of the New World and the Indies was reaching Western Europe during the 16th century via Lisbon and the Spanish ports. But the distribution to the north was mostly taken over by the Dutch. Compared at least with the Mediterranean one needed better charts in the sometimes dangerous northern seas. It is not surprising that the famous first collection of sea charts, the "Sphiegel der Zeevaerdt" was published in Leyden by WAGHENAER (1584/85). And it became a best seller (MORELAND & BANNISTER 1989). Waghenaer's chart initially imcluded only southem Norway, but his later "Thresoor der Zeevaerdt" (WAGHENAER 1592) contained detailed information around Norway and the White Sea and Pechora Sea, up to Novaya Zemlya (HACQUEBORD 2001: 19). In later editions (1596-1601), there was even included a detailed map of the Archangelsk coast.

As mentioned above a Dutch Northeast Passage expedition with Oliver Brunel (1584/85) had reached southwest Novaya Zemlya. The Yugorski Strait between the Vaygach Island and

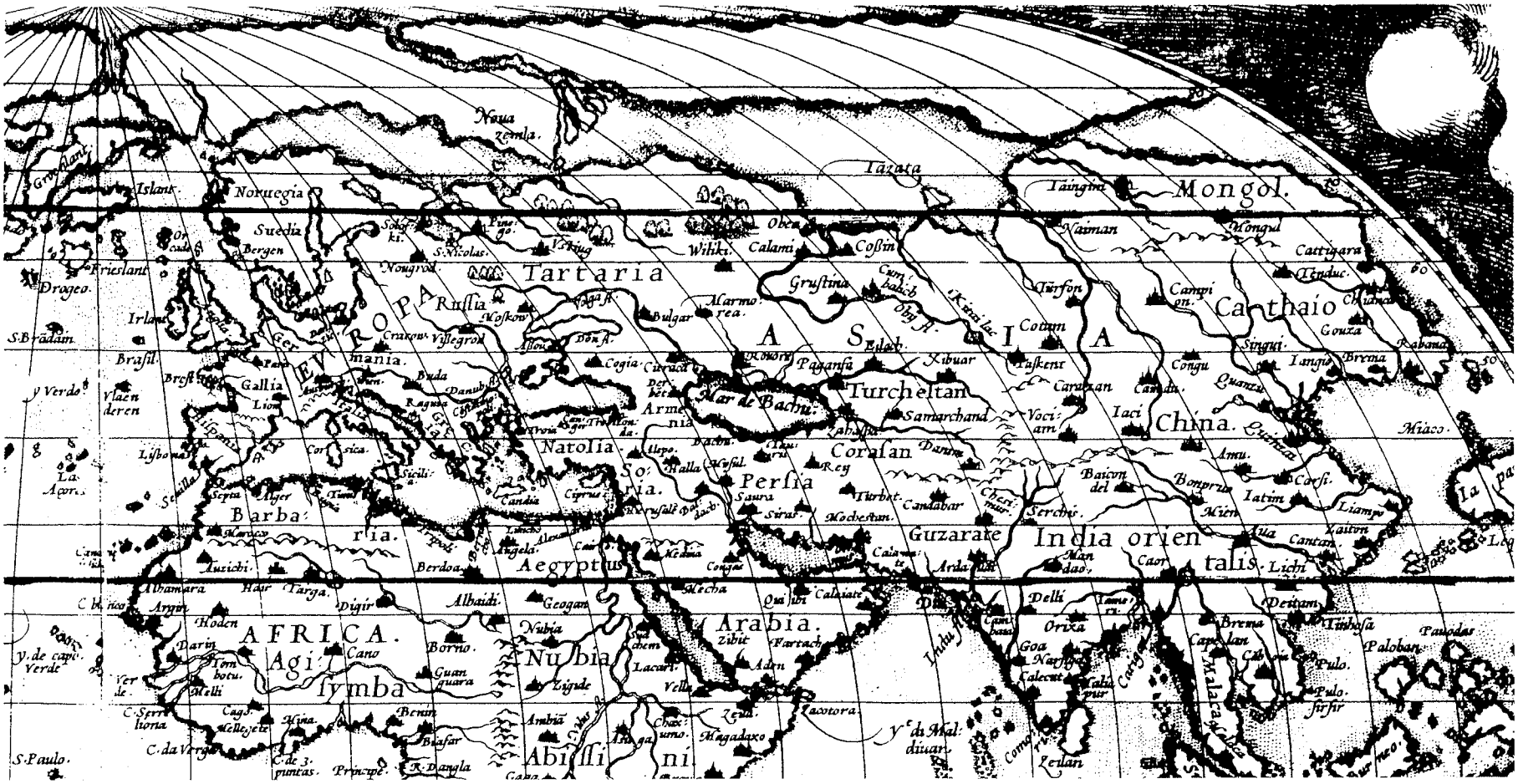


Fig. 6: World map from ORTELIUS' Atlas "Theatris Orbis Terrarum" (Section, Antwerp 1570). Based on Ptolemy's Geography. Arctic gateway between a polar continent with straits and Novaya Zemlya as a promontory, and northern Siberia. Distance between Novaya Zemlya and the Bering Strait only 90 degrees longitude instead of the real 130 degrees.

Abb. 6: Weltkarte aus dem ORTELIUS'schen Atlas "Theatris Orbis Terrarum" (Antwerpen 1570, Ausschnitt). Auf die Geographie des Ptolemäus zurückgehend. Duchgängige arktische Meeresstraße zwischen einem Polarkontinent mit Meerengen und Novaja Semlja als Landvorsprung und Nordsibirien. Die Entfernung zwischen Nowaja Semlja und der Beringstraße beträgt nur 90 Längengrade anstatt der richtigen 130 Längengrade.

the mainland was explored in 1594 by a land expedition. It set out from the Archangelsk trading post, under him. A wider gateway separates Vaygach Island and Novaya Zemlya, the Kara Gate. These pieces of coast were also explored on land from the Russian side.

Legations from Western Europe had repeatedly visited Moscow since the 16th century and these returned with new reports and sometimes also with maps. One example is Ritter Sigismund von Herberstein's map of Russia in 1549 (MICHOV 1884: 8). Another example is the map of "Russia, Moscovia et Tartariae" from the first English ambassador to Moscow, Anthony Jenkinson (used by ORTELIUS 1570 and others); this reached from the Kola Peninsula up to the Ob estuary and described numerous localities (YEFIMOV 1964). A third example is Anton Wied's map of Moscovia from 1555; this ran from the coast north of the White Sea, again with its monastery of Solofki and the mouth of the Dvina to a locality named "Sybir" on the Ob, and warned against "wild beasts" (MICHOV 1884). Sybir was the capital of the Khanat Siber which was included into Russia at the end of the 16th century. Since 1587 Tobolsk (Fig. 4) at the Irtysh River became the capital of the enlarged Siberia.

The real breakthrough resulted from the expeditions of Willem Barents (1550-1597). Under Comelius Rijp he approached the west and north coast of Novaya Zemlya in 1594. A second expedition followed in 1595 and in 1596 he discovered the Bear Island (T'veer Eyland at about 75°N in Fig. 7) and Spitsbergen (Het Nieuve Land, at about 80°N). Near the northem end of "Nova Zembla" he was forced to spend the winter at "winter hoek" (Fig. 8). On the way back to the Kola Peninsula he died. The Arctic Sea west of Novaya Zemlya was named after him in 1835.

Barents was a pioneer in map making because he based his map exclusively on observations and left out the legendary islands around the North Pole on previous maps. Unfortunately, this example was not generally followed. Even a century later, in a map by RENARD (1715), Greenland is part of a continent "Terres inconnues" between North America and Northern Asia. Nevertheless, a Northeast Passage is open on the map.

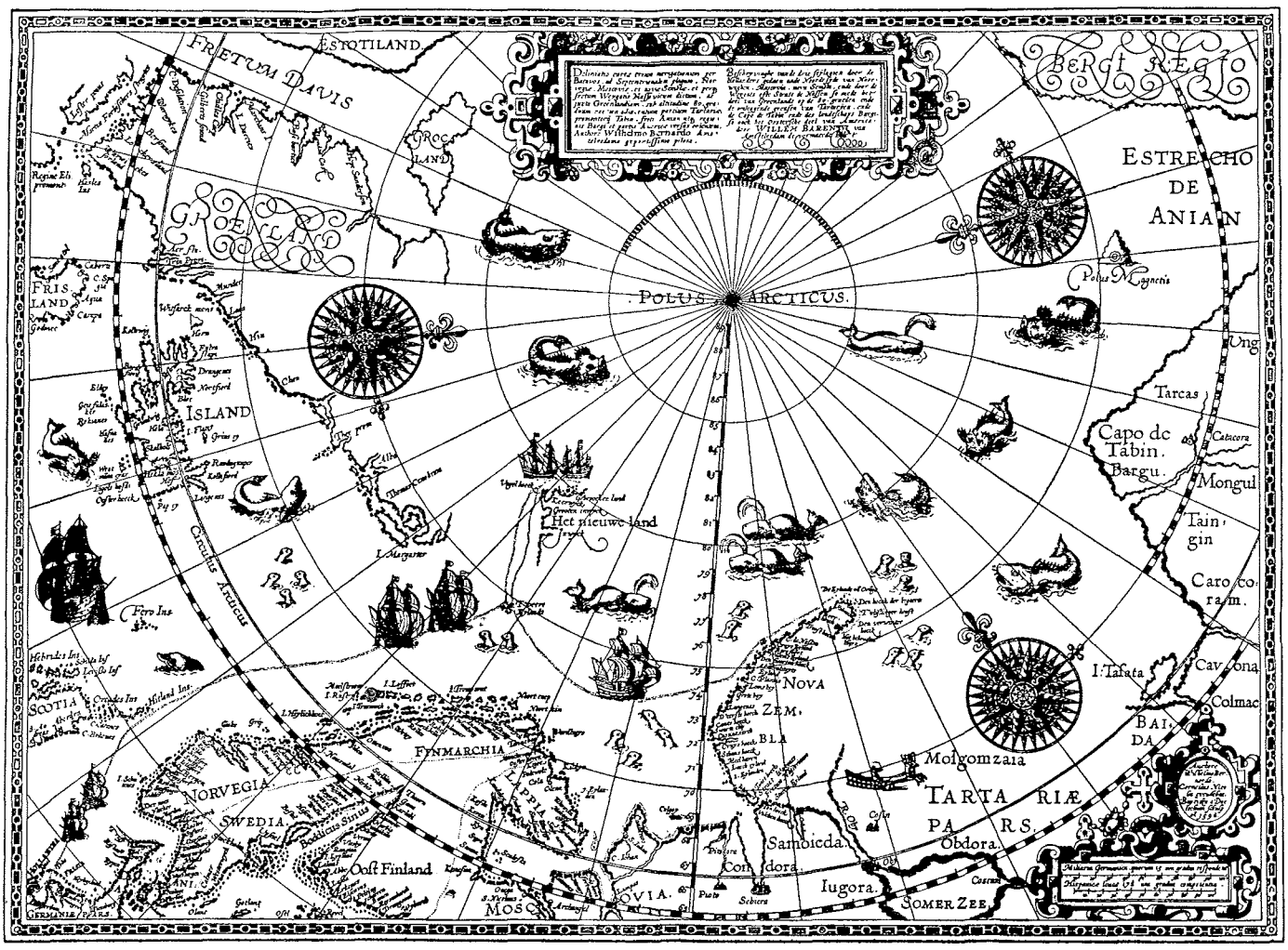


Fig. 7: Map of the European Arctic (BARENTS 1595) Printed post mortem in 1598 in Jan HUYGEN VAN LINTSCHOTEN's Itinerarum, Amsterdam.

Abb. 7: Karte der Europäischen Arktis (BARENTS 1595, nach dessen Tod in Jan HUYGEN VAN LINTSCHOTEN's Itinerarum 1598 in Amsterdam gedruckt).

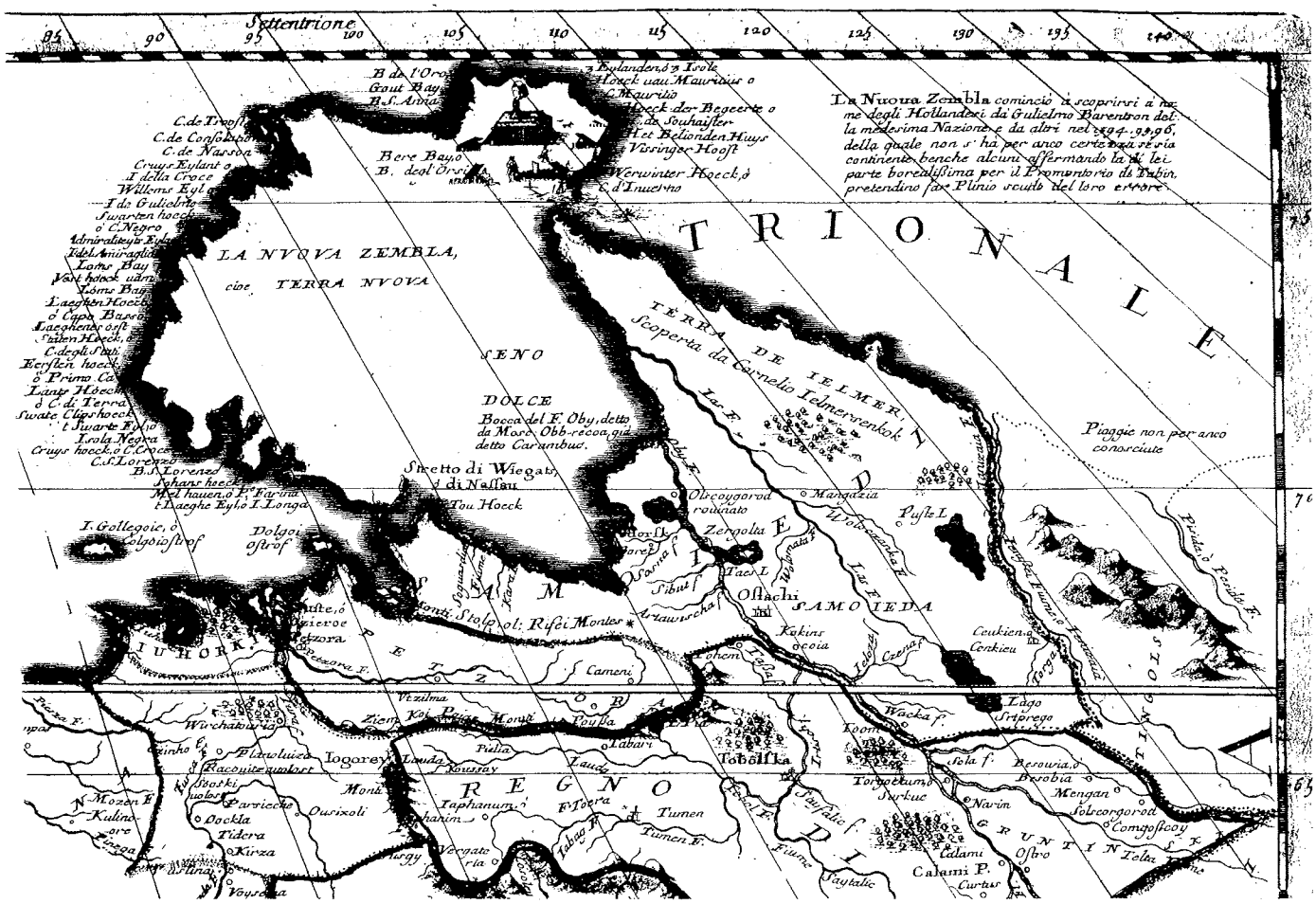


Fig. 8: Novaya Zemlya and Terra de Ielmer (CORONELLI Section, Venice, c. 1690). Winter quarters of Barents in 1596, "Unknown coast" to the East.

Abb. 8: Nowaja Semlja und Terra de Ielmer (CORONELLI Venedig, c. 1690, Ausschnitt). Winterquartier von Barents im Jahre 1596. Nach Osten hin "unbekannte Küste".

NOVAYA ZEMLYA - THE WESTERN BARRIER FOR THE SIBERIAN COAST

Barents' map depicts many details of the island. The latitude given for its northern end is correct (about 77°N); by contrast, he gives 69°N for its southern end, as opposed to the correct latitude 70°30'N.

Along the west coast of Novaya Zemlya, at about 72°N, Barents observed a narrow and long bay. This was the opening of a 100 km long channel, the "Matochkin Shar", which crosses the whole island. It was discovered only in 1768 by Ltn. F.F. Rozmyslow and it was scientifically investigated by the expedition of F.P. Litke (1821-1824), along with the west coast. With the discovery of this channel a second gateway to the Kara Sea was established.

It is curious that on the old maps of PLANCIUS (1594) as well as on those of MERCATOR (1595), the island seems to be bisected. The channel can also be seen as a somewhat sketchy feature near the "Lomsbay" in the "Charte des Russischen Reiches" of GÜSSFELD (1786). In the 1805 edition of this map the island is clearly separated into two. The Strait also appears as a very distinctive feature that cuts the island on the very low quality map of VON LICHTENSTERN (1806) (Fig. 9). In the map of MASSA (c 1612), two possible channels are recorded, one at 72 °N and one at 74 °N.

The most urgent problem was the one whether Novaya Zemlya was really an island at all. For more than a century, the 1000 km long hook in Barents' map became a characteristic "landmark". It is found on global and on polar maps, including the first one specifically devoted to the area around the North Pole (MERCATOR 1595), on which this area was shown as a rocky island, on maps of Europe and Russia, and on maps from all the publishing houses. The hook was also adopted by LOMONOSSOV (1763) (Fig. 11). It was only three years before, in 1760, that Savva Loshkin had in fact circumnavigated the island, but his reports had been lost (HOLLAND 1994).

Several authors had nevertheless already mapped Novaya Zemlya as an island, for instance the afore mentioned PLANCIUS (1594), MERCATOR 1595) and MASSA (1612), and also BERTIUS (1618) and HALLEY (1728) (Fig. 10). But we owe by far the most colourful portrayal of this island to SEUTTER (c 1723). The "Montes Glacialis" mark a completely wrong eastern coast (Fig. 12). But of course it was tempting to convert the line of this provoking open hook into an island.

Novaya Zemlya is sometimes pictured as a projection or a

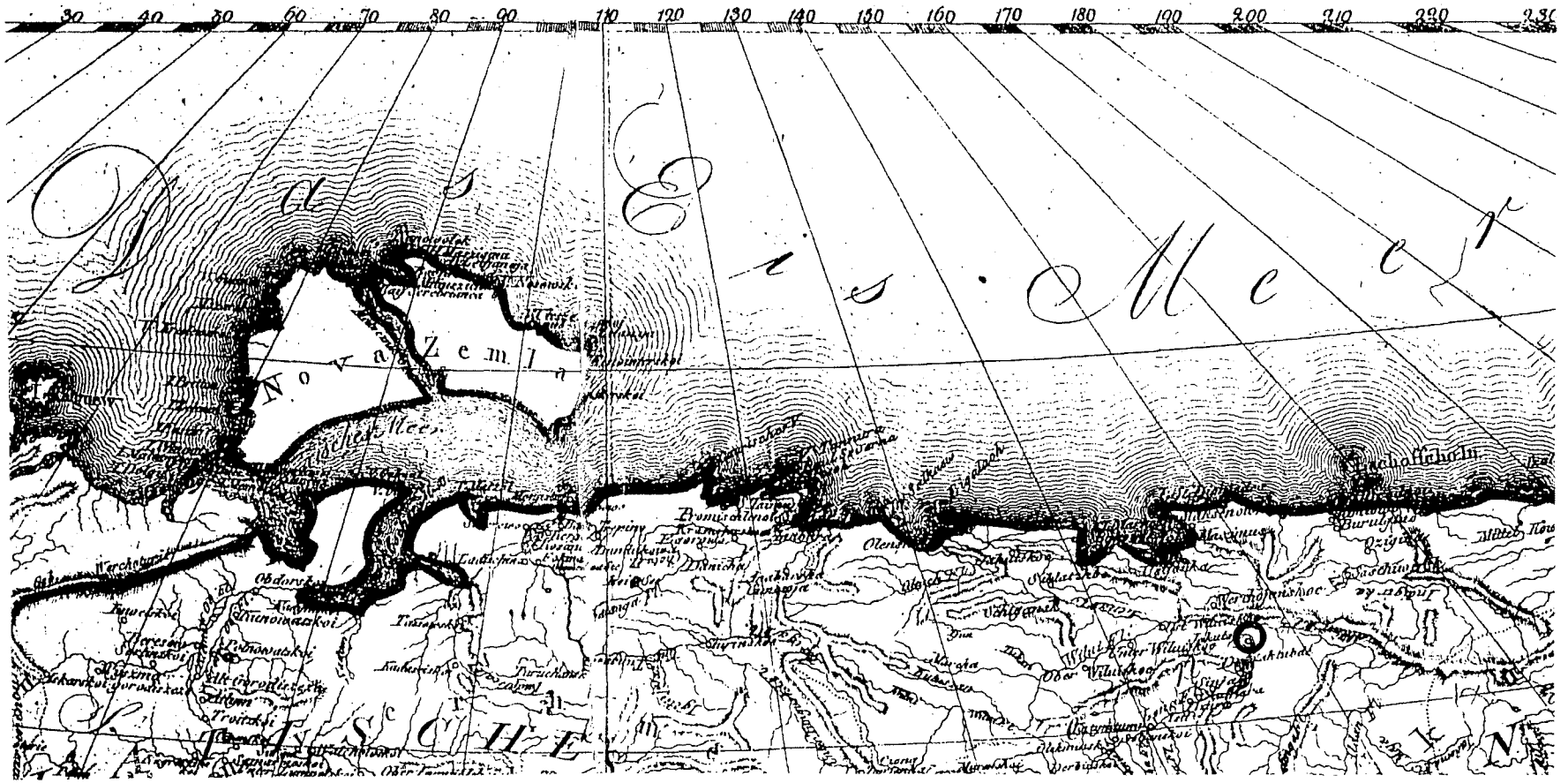


Fig. 9: Novaya Zemlya split by Matochkin Shar. Section of a map from LIECHTENSTERN (1806) as an example for bad quality with regard to the Siberian coasts and rivers. Even the river Lena can hardly be identified. Jakutsk/Lena = O.

Abb. 9: Nowaja Semlja, durch den Kanal "Matochkin Shar" durchschnitten. Ausschnitt aus einer Karte von LIECHTENSTERN (1806) erschienen, daher von schlechter Qualität, was die Sibirischen Küsten und Flüsse betrifft. Sogar die Lena ist schwer zu erkennen. Jakutsk/Lena = O.

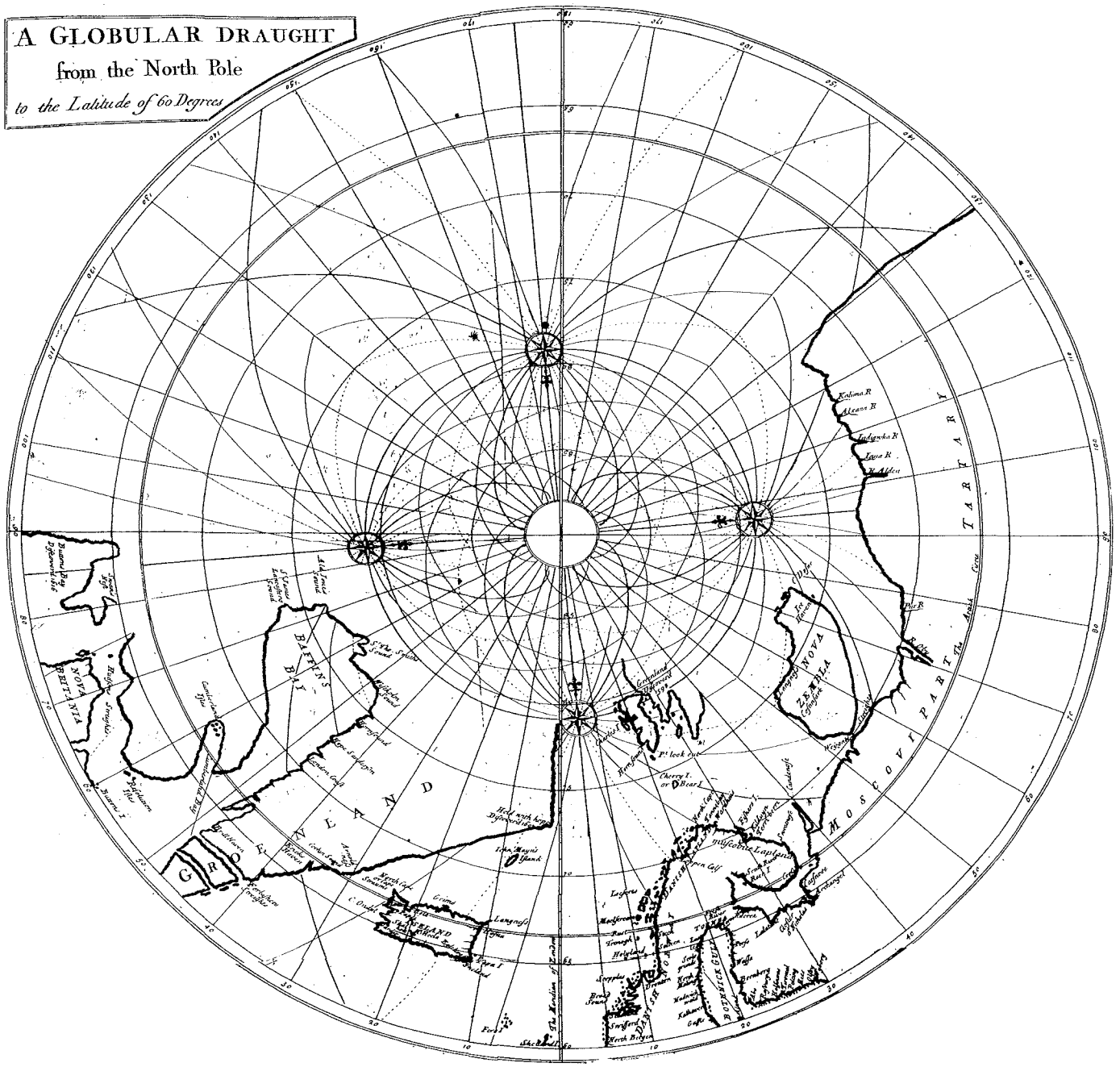


Fig. 10: Polar Map (HALLEY, London 1728). An interesting rare map by the famous English astronomer, after whom the comet is named and whose work on magnetic variations, ocean currents and winds brought new dynamism to European cartographers. Former degrees of longitude at the northern Siberian coast.

Abb. 10: Polarkarte (HALLEY, London 1728). Eine interessante, seltene Karte des berühmten englischen Astronomen, nach dem der Komet benannt ist und dessen Untersuchungen und Darstellungen der magnetischen Deklination, der Meeresströmungen und Winde eine neue Dynamik in die Europäische Kartographie brachte. Noch die alten, falschen Längengrade für die nordsibirische Küste.

peninsula, too. In the Ptolemy type maps of ORTELIUS (1570) (Fig. 6) and MERCATOR (1587) it is attached to the polar continent in the north. In Mercator's double cordiform map of 1538, the North Atlantic ends with "Corelia" and "Permia". East of "Permia" a wide landbridge connects Siberia with a huge polar continent. The Polar Map of DE JUDAEIS from 1593 is similar: A polar continent is divided by three straits, "euripi", and east of them a seaway leads directly to Japan.

But the open hook stimulates to tie it to the mainland, too. Examples can be found in the maps of ORTELIUS (1604) (Fig. 13), VAN DER KEERE (1614), HONDIUS (1618) or PITT (1680). In the map of SELLER (after 1667) Novaya Zemlya is a peninsula with the Kara Sea as a bay ("Sinus dulcis"). During the 18th century we find in maps indications of a fabulous "Terre Jelmer", sometimes even "discovered in 1664", as a bridge between Novaya Zemlya and the mainland east of the Yenisey estuary (e.g. DELISLE 1723, HAAS 1744 (Fig. 14), LE ROUGE 1744). In CORONELLIS's map (c. 1690), Terra di Ielmer "discovered by Cornello Ilmersenkok" nearly joins onto the hook at the place where Barents was forced to winter (Fig. 8).

Fig. 11: Polar Map (LOMONOSSOV, Moscow 1763/64) "Modern" northern Siberian coast with the new degrees of longitude and distances between Novaya Zemlya and the Bering Strait. A comparison between this map with Halley's map in Figure 10 demonstrates the extraordinary progress of cartography in the Arctic, especially for its American part.

Abb. 11: Polarkarte (LOMONOSSOV, Moskau 1763/64). Nordsibirische Küste mit den modernen Längengraden und Entfernungen zwischen Nowaja Semlja und der Beringstraße. Ein Vergleich mit Abb. 10 zeigt den außerordentlichen kartograpischen Fortschritt, vor allem für den amerikanischen Teil.

A continuation of the island as part of the Uralian fold belt seems geologically obvious. Indeed KHAIN & NIKISHIN (1997: Figs. 501b, 633, 510, 643) suppose that a Mesozoic branch of the foldbelt crosses the subbottom of the Kara Sea east of Novaya Zemlya and joins the mainland just east of the Yenisey estuary. What a nice coincidence with the misinterpreted Ielmer Land!

FURTHER TO THE EAST

Barents's map also looks east, following the Siberian coast. On previous maps the island "Tafata" can usually be recognized in a big bay, further to the East is the cape "Tabin", then Anian Strait leads to the Pacific. The world map of ORTELIUS (1570) seems to show this. South of his polar continent western and eastern Siberia project northwards, leaving between them a bay with "Tazata" island. In the same map collection, however,

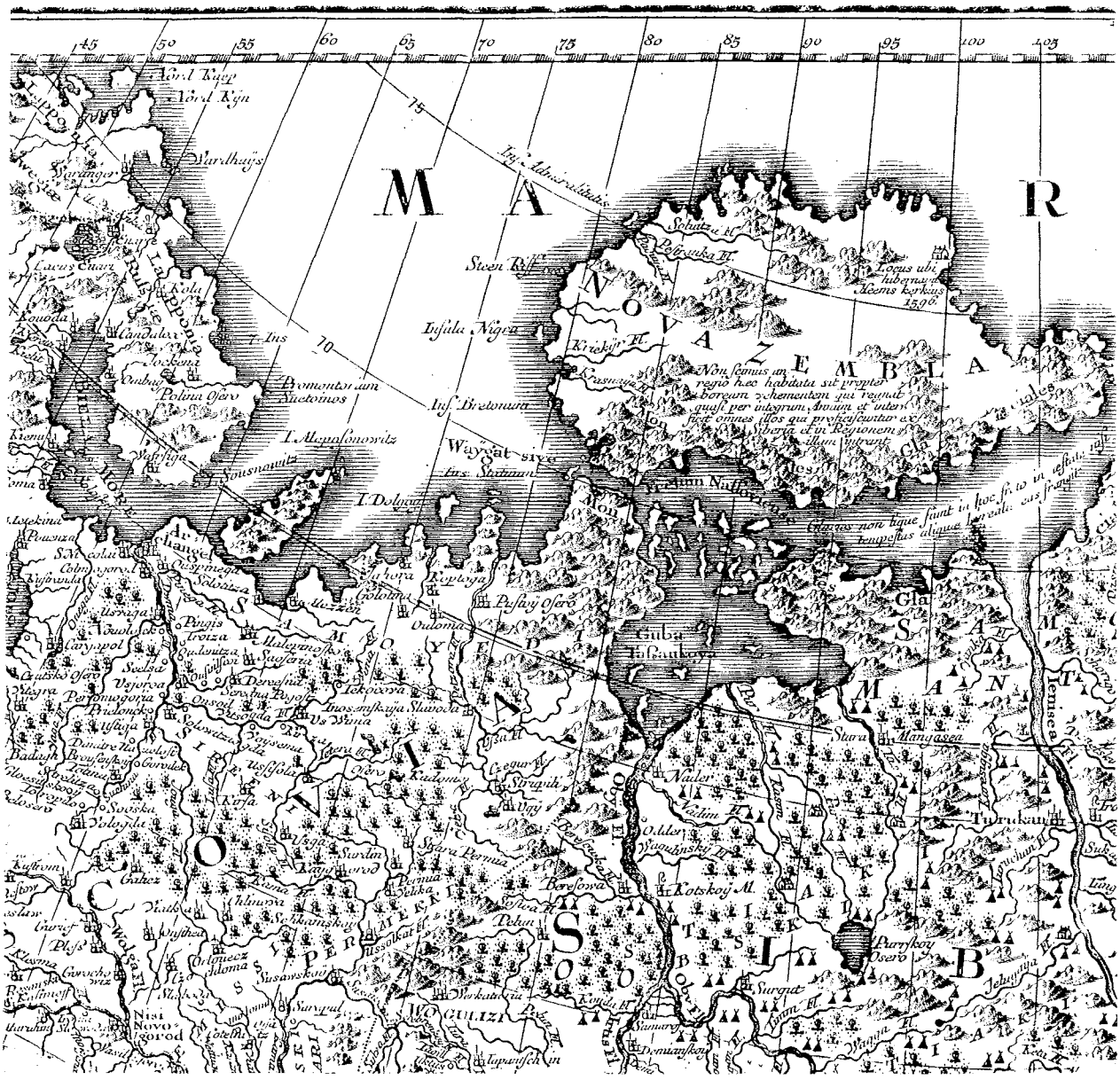


Fig. 12: Map of Russia (SEUTTER, Section, Augsburg c 1723). Novaya Zemlya as a pretty roundish island with southern coastal mountains, and a remark about a warning for passing to the Kara Sea.

Abb. 12: Karte von Russland (SEUTTER, Augsburg 1723, Ausschnitt). Nowaja Semlja als recht rundliche Insel mit südlichen Küstengebirgen und einer Warnung vor den Gefahren einer Passage zur Karasee.

"Tartaria" looks quite different. This illustrates how carelessly maps for atlases were bound together (Figs. 6, 15).

It is astonishing that general features such as these survived since antiquity, for more than 1500 years. Pliny the Elder (c 23-79 AD) mentions in his Historia Naturalis (Liber VI) the north of Asia in a rather general and sometimes unclear way: XIV / 34: "Scyths are living from the uttermost Aquilo up to the area, where the sun rises in summer." (Aquilo = Greek "Boreas", i.e northnorthwesterly winds). "Beyond the Aquilo several people have placed the Hyperboreae" - a mythical tribe at the northern rim of the Earth. XIX / 52: "There are many islands, but well known is only one, Zazata." XX/53: "From the Caspi Sea and the Scythish Ocean one turns round into the Eöic Ocean (i.e. the Pacific). The first part, from the Scythish promontorium is uninhabited because of snow, the next part is not cultivated because of the primitive nature of the tribes. Here, there dwell Scytish anthropophages eating men's flesh. Adjacent are wide deserts and many wild beasts, similar to the wildness of people there. Then again Scyths are there, and again deserts with wild beasts up to the promontorium ending at the sea, called Tabis."

Some of these antique reminescenses are directly included in Figure 15: "According to Pliny and Venetus (one of the many editors of Ptolemy's "Geography", Rome 1507/1508), many islands are situated in the Scythian Ocean, but neither the exact positions nor numbers are reported by them." Most comments on the map are highly speculative. For example, the northernmost "Danorium horda" and the "Naphthalitarium

Fig. 13: Map of Tartaria (ORTELIUS 1604, St.b.M.Mapp. 3-72). Incertainties about a possible land bridge between Novaya Zemlya and the mainland.

Abb. 13: Karte der Tartarei (ORTELIUS 1604, Stb.M.Mapp. 3-72). Unsichere Landbrücke von Nowaja Semlja zum Festland.

horda" make one think of the Israelite tribes Dan and Naphthali, exiled by the Assyrians.

The coasts west of the Ob estuary were fairly well known from about 1600 on. They were mapped by combined exploration from sea and on land, by merchants, sailors and fishermen, and finally by British and Dutch expeditions. But for another one and a half centuries the proper Siberian coast remained a terra incognita. Of course native fishermen and hunters were familiar with their rivers, coasts and some of the offshore islands, but mapping is different: And in mapping the ancient ideas persisted. It is interesting to compare some landmarks, with only approximate coordinates in some of these old maps (Tab. 1).

It has already been mentioned that differences for the positions of Pliny's promontories exist between Ortelius' world map and his "Tartaria" map, but the Lena delta has a remarkably uniform position of about 100°E Greenwich up to HOMANN (1702). WITSEN (1687) got closest to the modern 126°E and with LOMONOSSOV (1763) and HOMANN (1739), the longitude became nearly perfect. This was exactly the period when the real distance between Novaya Zemlya and the Bering Strait became known (133°E and 129°E longitude vs the modern 132°E). Before the 90° distance had "shortened" the Northeast Passage drastically.

RUSSIAN BEGINNING

Why were these drastic corrections made in the middle of the 18th century? Several factors were responsible. The most important was the Russian expansion to the east, that had taken place since about 1582. Repeatedly Russian exploring, hunting, trading and military expeditions reached the Siberian coast beginning in the west, after the 1630s from the Lena to the east, too. Cossack units began to collect tributes for Moscow. Towns, typically at riversides, were fortified: Tobolsk on the Irtysh in 1587, Tomsk on the Ob in 1604, Yenisseysk on the Yenisey in 1619, Jakutsk on the Lena in 1632, and, in the far East of Siberia, Werchojansk on the Yana in 1638 and Nishne Kolymski on the Kolyma in 1644. These towns became exploration centres, especially Jakutsk. The cossacks preferred to use the rivers and then the sea from rivermouth to rivermouth rather than to cross overland. Thus they got to know large parts of the Arctic coast. Their hardiness, courage and love of adventures is praised by NORDENSKIÖLD (1897: 97). It may "justly be compared to that of the Spanish conquistadores". And just like the Spanish, the trading and conquering cossacks were not everywhere welcome.

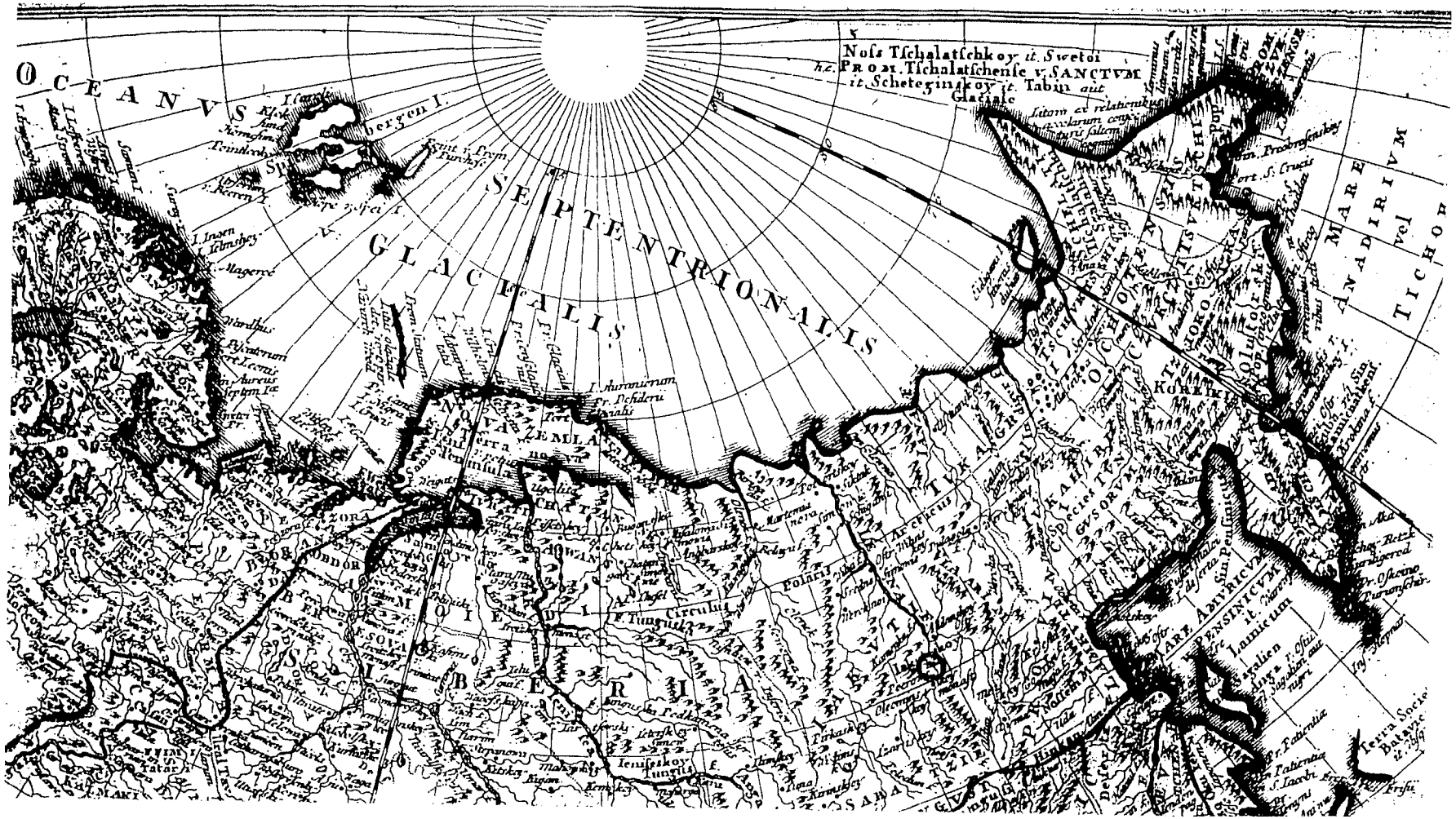


Fig. 14: Map of Asia (HAAS 1744, Section, Nürnberg). Novaya Zemlya as Peninsula attached to the mainland by a Terra Ielmer, "discovered in 1664". Jakutsk/Lena = O.

Abb. 14: Karte von Asien (HAAS 1744, Augsburg, Ausschnitt). Nowaja Semlja als Halbinsel des Festlandes, der Terra Ielmer, "1664 entdeckt". Jakutsk/Lena = O.

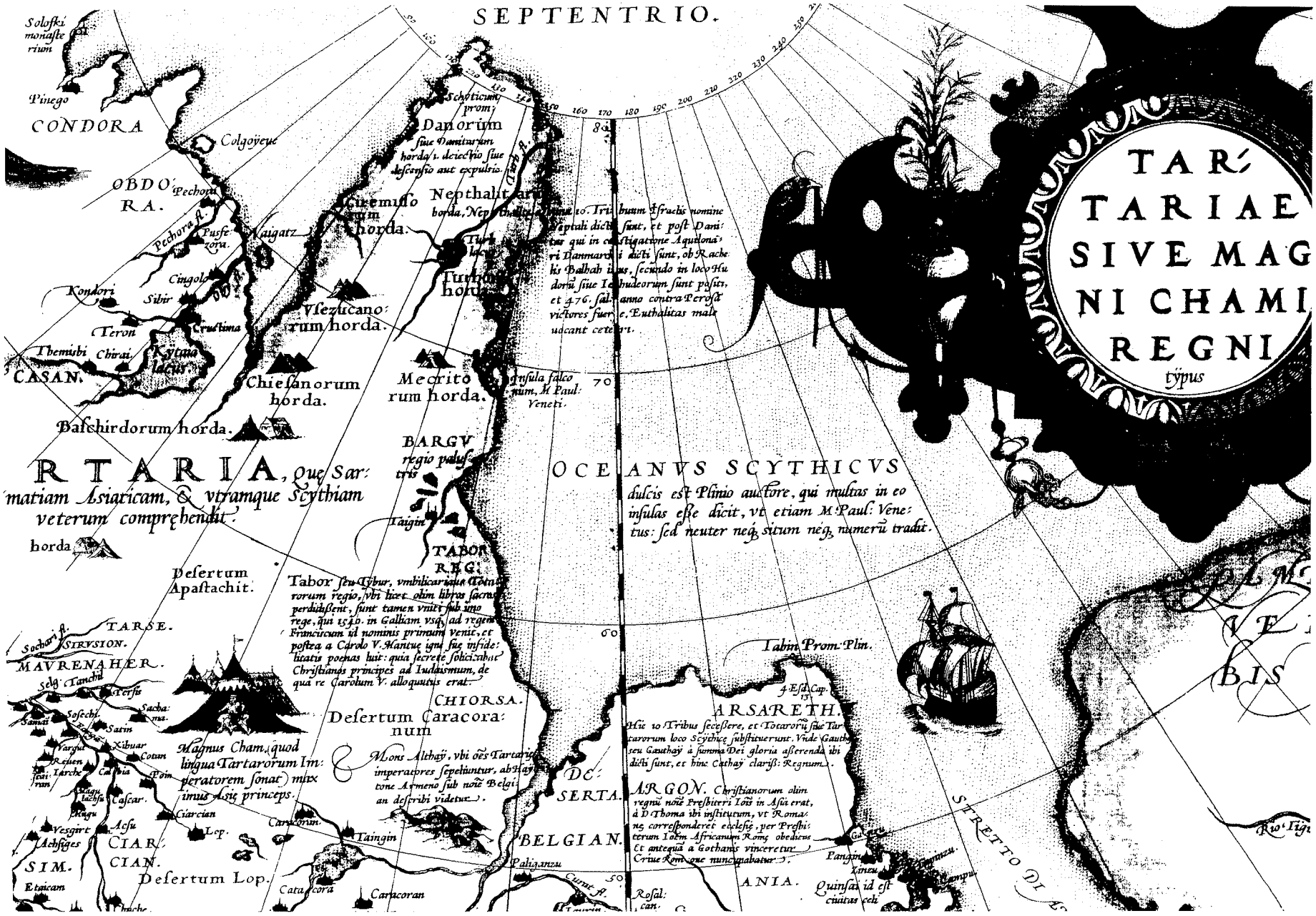


Fig. 15: "Tartarey" Map in ORTELIUS' (1570) Theatris Orbis Terrarum (Section). Novaya Zemlya north of "Vaigats" Island is completely missing. Promontorium Scythicum and Cape Tabin are taken from Plinius, but Tazata Island is misssing. To be compared with Figure 5.

Abb. 15: Karte der "Tartarey" in ORTELIUS' Atlas Theatris Orbis Terrarum von 1570, Ausschnitt. Nördlich der "Vaigats"-Insel fehlt Nowaja Semlja völlig. Das skythische Vorgebirge und das Kap Tabin sind von Plinius übernommen, nicht aber die Insel Tazata (vgl. dazu Abb. 5).

	Vaygach Island N Cape	C. Chelyuskin "NW Cape"	Lena Delta "Tazata"	C. Shelagskiy "Tabin"	C. Dezhnewa "NE Cape"	Distance °L
Today	70°28'N 59°05'E	77°43'N 104°15'E	73°54'N 124°30'E	70°10'N 170°30'E	66°10'N 169°30'E	132
ORTELIUS 1570 World map	72°N 90°E	72°N 105°E	67°N 130°E	74°N 155°E	67°N 180°E	90
ORTELIUS 1570 "Tartaria"	69°30'N 110°E	82°N 110°E	55°N 165°E	58°N 190°E	47°N 198°E	88
BARENTS 1595	69°30'N 06°E	- -	67°N 52°E	74°30'N 74°E	? c. 160°E	c. 94
MERCATOR 1607 "Tartaria"	69°N 85°E	? ?	68°N 130°E	75°N 150°E	72°N 174°E	89
BLAEU 1617	69°N ?73°E	72°30'N 93°E	68°N 120°E	76°30'N 148°E	64°30'N 174°E	101
WITSEN 1687	69°N 74°E	74°N 109°E	76°N 127°E	?73°N ?132°E	?63°N ?156°E	?72
HOMANN 1702	69°N 83°E	74°30'N 102°E	74°N 127°E	?74°N ?146°E	? ?150°E	?67
HOMANN 1737 (Heirs)	69°N 82°E	? ?	?72°N 140°E	? ?	? ?210°E	128
HOMANN 1786 (Heirs, Güssefeld)	69°N 75°E	77°30'N 117°E	73°N 136°E	73°N 190°E	66°N 208°E	133
LOMONOSSOV 1763	69°N 76°E	77°N 118°E	73°N 140°E	? ?	?67°N ?205°E	129

Tab. 1: Coordinates of some landmarks of the Siberian coast. Fixpoint is Vaygach Island, because the island has the most exact position in the different maps. The longitudes are not corrected. Prime meridians are either the Azores, Cap Verde Islands or Canary Islands or they were arbitrarily chosen.

Tab. 1: Koordinaten einiger Landmarken der Sibirischen Küste. Vergleichspunkt ist die Waigatsch-Insel, weil sie in den verschiedensten Karten am exaktesten markiert ist. Die Längengrade sind nicht korrigiert. Mittelmeridiane sind entweder die Azoren, die Kapverdischen oder die Kanarischen Inseln oder willkürlich gewählt.

A first map resulting from these activities was initiated by the Govemor of Tobolsk, Pyotr Ivanovich Godunov, and was drawn by Ulian Remetsov "in the year 1776 after the creation of the world", i.e. in 1667/68 (Fig. 16 after BAGROW 1952). During the following years his son Semen improved the map (BAGROW 1954a). These maps are all south oriented, and extend from the Kola Peninsula to the Chinese Wall. Typically the rivers form the skeleton of the maps. Examples are the Ob (with its remarkable estuary just south of Novaya Zemlya which is shown attached to the mainland at the northern end of the Urals), the Yenisey, the Olenek at the NE-corner of the map and the Lena south of it.

This and other information found its way to Western Europe. The most important results were summarized in the map of WITSEN (1687) (Fig. 17). He had been in Moscow in 1664/65 and had made many contacts there; these contacts he later improved by correspondence. Of course his map contains many errors, but it must be remembered that all cartographic information at that time was based only on distances. Additional directional information was not used. It is unfortunate that the compass was not used and therefore latitudes and longitudes are incorrect by several degrees. Witsen knew the antique traditions, but was critical, and placed Tazata Island "chiefly by guess. However I have the authority of Chinese maps, which lay it down in the place where I have put it." (Cartography in China had been promoted by the Jesuit Fathers, and one of them, Martino Martini, had just published his "Novus Atlas Sinensis" as Volume 10/2 in BLAEU'S "Atlas Maior" in Amsterdam 1662. In an appendix to this volume there is even a catalogue of astronomically determined positions).

The coasts were given on Witsen's map in greater detail and were not based only on the legends on which Ortelius and other Dutch map-makers of his period had relied. We can fully

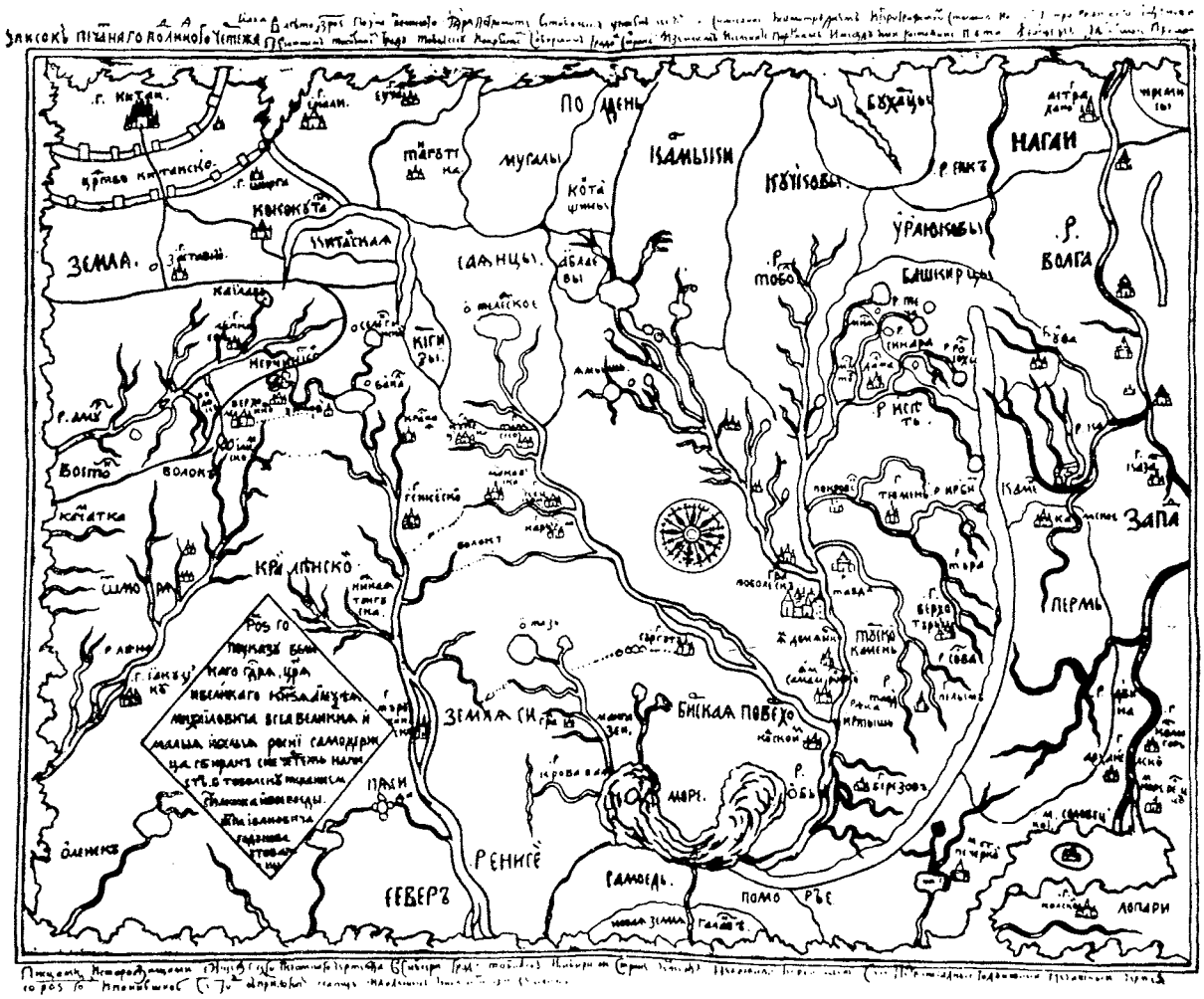


Fig. 16: "Siberia" (REMEZOV 1667). South-oriented, therefore from west to east, from the White Sea and the Dvina mouth to the left with the Urals ending near the Ob estuary, Yenisey, Olenek and from there to the south with Lena and Kolyma rivers. Far in the south the Chinese Great Wall (after BAGROW 1952).

Abb. 16: "Sibiria" (REMEZOV 1667). Nach Süden orientiert. Deshalb folgt auf das Weiße Meer mit der Dwina-Mündung nach links der Ural, der nahe der Ob-Mündung ausläuft. Dann folgen Jenissei, Olenek und von dort nach Süden die Flüsse Lena und Kolyma. Weit im Süden die Große Chinesische Mauer (nach BAGROW 1952).

agree with the comment of Sir Robert Southwell, President of the Royal Society of London, about the Tartary map: "This is Columbus like, the discovery of a New World... But the enterprise being so vast, and the success so unexpected that the Publick are very impatient to be told by what Magick you have been able to master this work. For it looks in one part no less difficult than a Geographical description of the bottom of the sea" (KEUNING 1954).

We owe another pioneering map of Siberia to the Swedish Captain Philipp Johannes von Strahlenberg, born in Stralsund. He had to spend twelve years, 1709-1721, as prisoner of war in Siberia. He even used some astronomical positioning in constructing his map, as did Daniel Gottlieb Messerschmidt (1685-1737) in the same area in 1719-1724 (MIDDENDORF 1867). Strahlenberg's map was printed in Stockholm in 1730. The Lena delta is situated on it at 54° east of Vaygach, not at 124°. A huge island extends over more than 23° longitude off eastern Siberia (NORDENSKIÖLD 1897, Map 38; HINTZSCHE & NICKOL 1996: 66). This was obviously based on vague information. Wrangel looked for this island, unsuccessfully, a hundred years later.

The breakthrough in coastal mapping is due to the initiatives of Tsar Peter the Great (1672-1725). He met Gottfried Wilhelm Leibnitz (1646-1716) in Bad Pyrmont in 1716 who wished to know whether Asia and America were separated and he visited Paris in 1717 and met there the famous Royal Geographer Guillaume Delisle, who had published in 1706 a map of the Tartary and "ad usum Ludovici XV Galliarum regis" in 1723 (DELISLE 1723).

The distance from Vaygach to the Bering Strait is given on this map as 85° longitude, instead of 132°, and the map's general quality is much worse than that of Witsen's map.

France had by this time taken over from Holland as the leader in cartography, and had become the centre of geographical science. Exact ground observations and triangulation had also been given priority there, which resulted in cartography assuming a more scientific and less commercial character. The rise of national states in Europe, each with its own civil and mili-

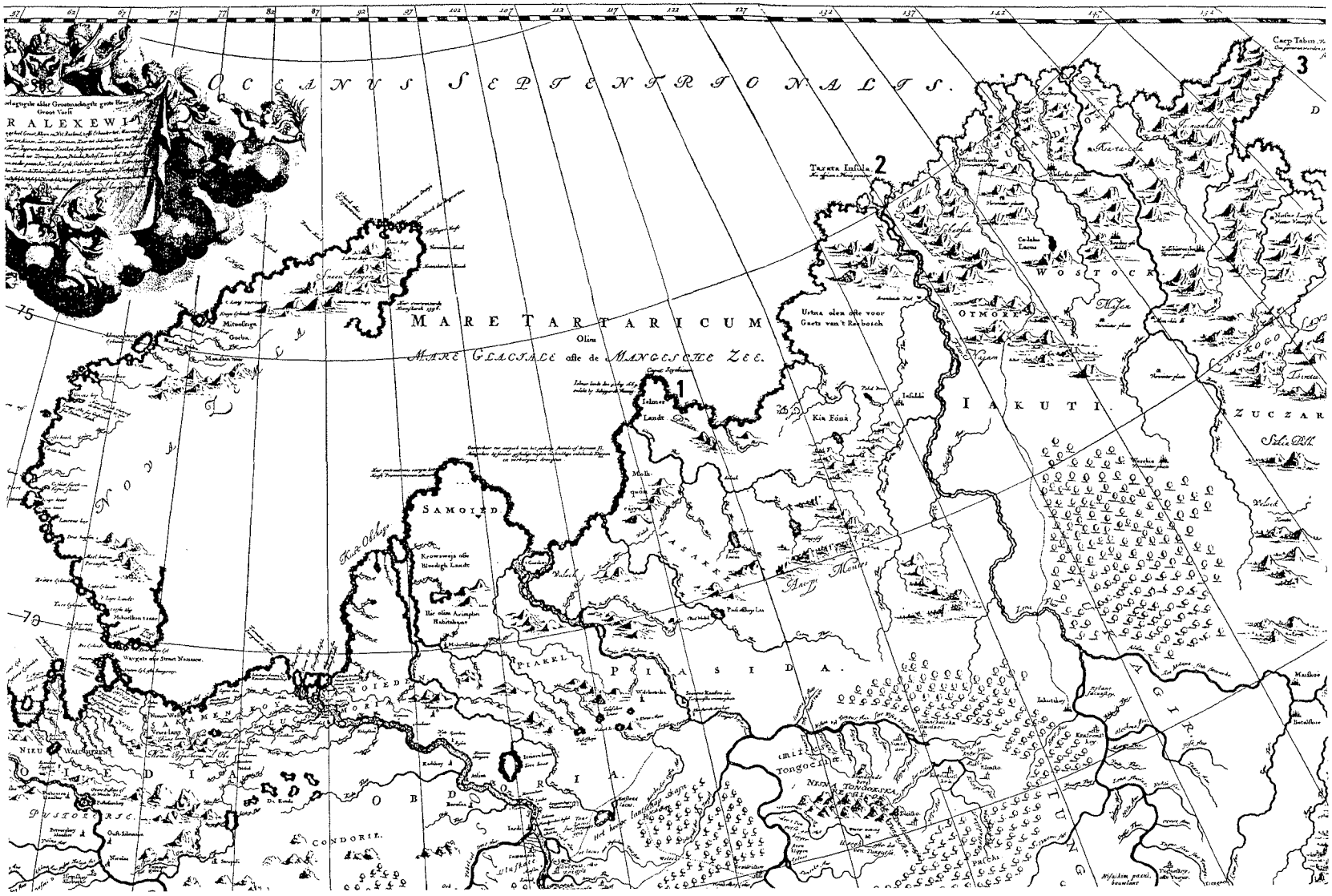


Fig. 17: "North and East Tartary" (WITSEN 1687, Section, Amsterdam). Ancient elements: (1) Caput Scythium, (2) Tazata Insula, (3) Cape Tabin (after KEUNING 1954)

Abb. 17: "Nord- und Ost-Tartarey" (WITSEN 1687, Amsterdam, Ausschnitt). Antike Elemente: (1) Kap Skythium, (2) Tazata-Insel, (3) Kap Tabin (nach KEUNING 1954).

tary needs, stimulated a more precise and systematic approach to mapping. This new mapping was beyond the ability of single map makers acting alone; it required groups of well trained specialists, and so was map making taken over by governmental agencies. Peter the Great quickly realized the importance that this new approach to mapping had for his vast empire, and in 1721 he invited the astronomer and geographer Joseph Nicolas Delisle (1688-1768), the younger brother of Guillaume, to join the newly founded Russian Cartographic Service in St. Petersburg. The production of a first Russian atlas was planned there first by the Senate and later by the Academy of Science (founded in 1725). When Nicolas Delisle arrived, Ivan Kirilow (1689-1737) was already preparing the atlas. He was eager to produce the maps as soon as possible, and used route descriptions of roads and rivers together with distances. He did not, however, use astronomical positions.

Delisle nevertheless wanted a skeleton of astronomical positions. He brought with him new methods of astronomical positioning, not only the use of lunar eclipses but also the more exact observation of Jupiter's satellites. In this context it is important to bear in mind the paucity ot the then-existing astronomically measured positions. In 1712, for instance, there were only some 143 of them in the whole world: 90 of these were in Europe, 31 in Asia, 14 in America and 8 in Africa (SANDLER 1882/84). Jesuits had determined the coordinates of Peking, and this was for a long time the only fixed point in the region with which our article is concerned.

The prime meridians used by map-makers had for a long time been arbitrarily fixed. Ferro, 17°40'W of Greenwich, was finally accepted in 1634, but of course even the exact positions of these islands were not known.

Kirilow continued with his efforts, and in 1734 published, privately, the first 15 maps. However, he could not complete his atlas (BAGROW 1937). N. Delisle stayed in St.Petersburg up to 1747 but he had to fight against many intrigues. The "Atlas Russicus" was published in 1745. Nevertheless, it was criticized by M.W. Lomonossov in 1763 for its many gaps and for its overhasty production (see LOMONOSSOV 1961). N. Delisle returned to Paris. He published there many maps and used Russian material, even secret reports of Bering. Therefore, longitudes in a map of the North Pacific from 1750 are correct (BAGROW & SKELTON 1963: 482).

THE GREAT NORTHERN EXPEDITION

During all these years, maps had certainly been improved. But the real progress in obtaining more reliable coastal maps was due to he Great Northern Expedition (1733-1743; Fig. 19). Shortly before his death, in autumn 1724, Peter the Great gave order to map the northern sea route to the east. Vitus Jonassen Bering (1680-1741), a Dane serving in the Russian navy, was asked to plan and organize this historic enterprise.

Bering was active in this from 1725 until his death and concentrated his efforts on exploring the Pacific coast of Siberia. Together with Chirikov, he started out from St. Petersburg in January 1725 to cross the inhospitable country; with him he took sailors, carpenters, blacksmiths etc., and a lot of equipment. Only in April 1727 he arrived at the Kamtchatka River where he constructed a seagoing ship, the 18 m long "Sveti Gavriel", which could carry 45 men (IMBERT 1993). During his first expedition Bering crossed the strait that is now named after him, but bad weather prevented him seeing America. He reached his most northerly position on the Siberian coast (67°18'48"N, at Cape Serzde Kamen) on the 18th August 1728 and then travelled back to St. Petersburg (more details in HINTZSCHE & NICKOL 1996: 70-73). He reported there, in 1730, that he had discovered a strait. Thanks to the influence of N. Delisle, Bering could use better methods of positioning and this resulted in the Russian Empire being extended to the east by some 30 degrees longitude, i.e. some 1600 km. What an excellent present to the late Tsar (Fig. 18)!

In that same year, Bering proposed to the Admirality the exploration of the Siberian coast from the Ob to the Lena. Only in 1733 could the Admirality be convinced to map the coast, from Archangelsk to the Bering Strait. Bering helped to organize this enterprise. He obtained for it some enthusiastic and gifted young naval officers and sailors. The Admirality had by then become very optimistic and it planned to use small boats to cover the coast from the Yenisey estuary to the Lena delta in one single event. This led, however, to a long-lasting and heroic adventure beset with incredible obstacles, ice, storms, fog, illness and often a lack of the food and wood necessary to survive in the cold. It is certainly appropriate to mention at least some of these explorers by name. Details are given in NORDENSKIÖLD (1882), in DUNBAR (1985), and more specifically in LINDEMAN (1879).

The sketchy Figure 19 illustrates the general plan. Parties of two officers had to explore defined coastal sectors:

• From Archangelsk to the Ob, Murav'yev and Pavlov began in July 1734, and were later replaced by Malygin and Skuratov (Fig. 20).

• From the Ob westwards, Golowin was in charge; from the Ob eastwards, Ovtsyn at first, being succeeded by Minin. This latter enterprise is a drastic example of the many difficulties that occured:
Ovtsyn left Tobolsk on the 27th May 1734 and was ordered to map the coast from the Ob and Yenisey estuaries to the Taymyr Peninsula, where he would meet the party starting from the east, from the Lena delta. This was again a very optimistic plan because for three years it proved impossible to get past the Ob estuary. Finally, together with steersman Minin, Ovtsyn was able to map this estuary and succeeded to reach the Yenisey estuary, where the group passed the winter 1737 to 1738.

• Internal frictions resulted in Minin taking command, and he started on the 16th June 1738 to the northeast. Ice stopped the ship on August 28th, but steersman Sterlegov explored another 40 verst (about 43 km) to the north, up to the small island Sjevero Vestotschnyje (Dickson harbor in Figs. 4 & 20). The party had to return to the winter quarters at the Yenisey and, in 1739, they explored the river and its estuary. In 1740, the steersman again reached the same islands as before, by sledge, and then followed the coast. He marked a rocky part of this with a signal, at the Cape Sterlegov (Fig. 21). He had to return, however, because the bright sunshine threatened his eyesight. A last attempt by Minin to explore further to the north failed,

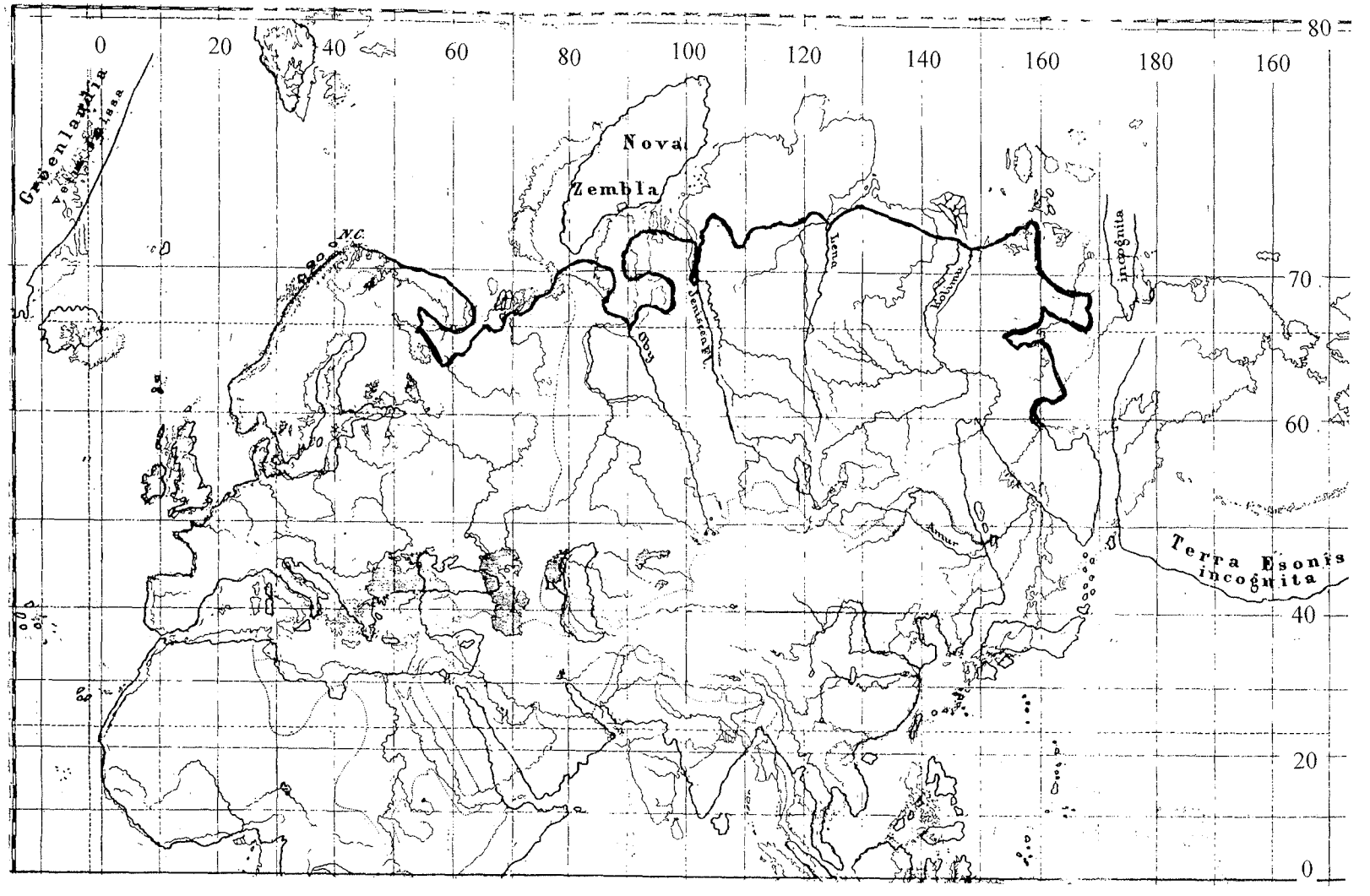


Fig. 18: Modern and former degrees of Longitude. (Ferro, 17°40'W of Greenwich, as prime meridian). Modern outline map (fine lines) compared with HOMANN's maps from about 1700 (distinct lines). Latitudes and Longitudes of Western Europe coincide more or less. In contrast they diverge in Northern Eurasia drastically, in Novaya Zemlya and the western part of the Siberian coast even extremely. From Novaya Zemlya to the Bering Strait the distance was only 90° longitude instead of 132°. Arctic Circle dashed (after SANDLER 1882/84).

Abb. 18: Heutige und ehemalige Längengrade. (Ferro, 17°40'W Greenwich als Mittelmeridian). Moderne Umrisse (feine Linien) verglichen mit denen aus der Karte von HOMANN (1702, kräftige Linien). Die Breiten- und Längengrade in Westeuropa stimmen mehr oder weniger gut überein. Im nördlichen Eurasien weichen sie drastisch ab, um Nowaja Semlja und an der westsibirischen Küste sogar extrem. Von Nowaja Semlja zur Beringstraße betrug die Entfernung bei Homann nur 90 Längengrade statt den heutigen 132. Der Polarkreis ist gestrichelt (nach SANDLER 1882/84).

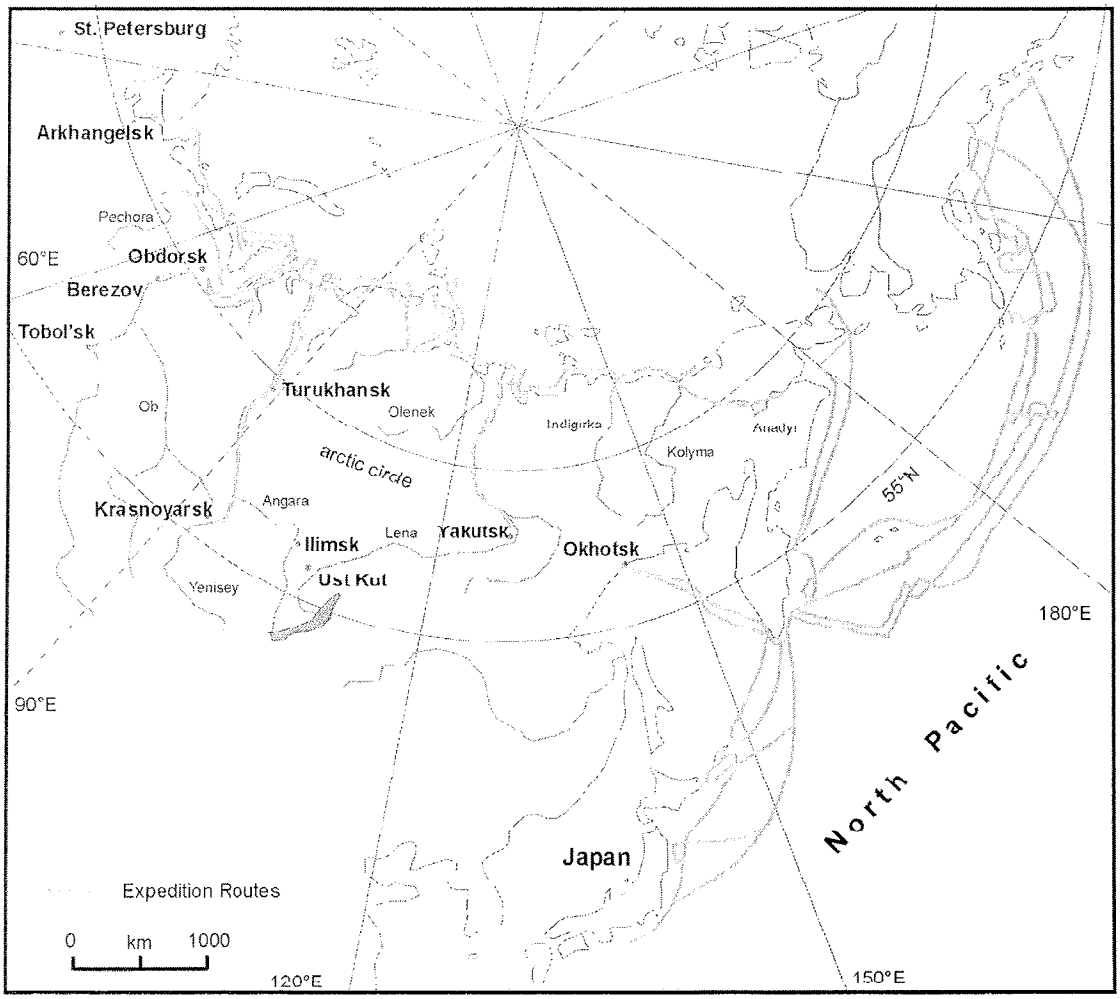


Fig. 19: Great Northern Expedition 1733-1743 (General Plan, in IMBERT 1993, after I. Armstrong, Scott Polar Institute, Cambridge, U.K.).

Abb. 19: Die Große Nordische Expedition 1733-1743. (Übersichtskarte aus IMBERT 1993, nach I. Armstrong, Scott Polar Institute, Cambridge, U.K.).

and he finally returned to St. Petersburg in 1741. He had left Tobolsk in 1734!

All these details illustrate the almost incredible persistency of these men, "sailors of iron on ships of wood"!

A short geological remark may be inserted here: East of the area mentioned above estuaries and fjords are replaced by deltas because the Taymyr Peninsula marks the limit of the iceshield during the last glaciation. Thus, east of Taymyr and the mouth of the Khatanga river vertical land movements were reduced.

• The Lena delta was the starting point for Pronchishchev in 1735/1736 and for Khariton P. Laptev with Chelyuskin in 1739-1743 (Figs. 20 and 21). They were to explore to the west. East of the delta, Lasinius and his cousin Dmitrj Laptev had to explore the coast up to the Kolyma delta.

Pronchishchev started from Jakutsk in 1735. He passed the Lena delta and stayed in winter quarters at 72°45'N, near the Nordwik Bay (Fig. 21). On the 1st September 1736, he and his ship reached 77°29'N. It is a tragedy that ice forced him to return, because Cape Chelyuskin was only some 60 km away to the northwest. He - and his wife - died shortly afterwards, in the same month, of scurvy, in winter quarters at the mouth of the Olenek River.

An attempt of Chelyuskin to go west in 1737 was unsuccessful; he could only observe the area near the Lena delta.

Ch. Laptev then repeated the efforts of Pronchishchev, starting again from Jakutsk. He passed the Lena delta, sailing the same route as before, but only as far as Cape Thaddäus (Fig. 21). On 2nd September 1739 he reached 76°47'N, only some 130 km from Cape Chelyuskin. He was forced to winter in the innermost part of the Khatanga Bay. From there he arranged some exploration parties by sledges in the Taymyr Peninsula. On 11th September 1740 trying to return to the Lena delta, Laptevs ship was destroyed by ice and gales off the Olenek mouth. After overcoming enormous difficulties, his crew of 40 men managed to reach again the winter quarters. New field trips with sledges and with different leaders were arranged in April 1741, for instance around the Taymyr lake up to the Taymyr mouth and the nearby coasts. Finally, all groups moved into winter quarters in Turuchansk at the Yenisey river far to the

south (Figs. 4, 18, 20). What an achievement to manage the logistics of all the different parties and to communicate, and without all our modern facilities!

But the historical task of exploring the northernmost cape of Asia fell to the steersman Chelyuskin. He was asked by Laptev to leave Turuchansk on 16th December 1741 to travel to the far north. Laptev followed him as planned, but returned on 8th July 1742, after an unsuccessful journey. Chelyuskin started with 15 sledges from the Khatanga river in April 1742. His route can be reconstructed from his journal, in which he carefully noted directions and distances. For instance, "five Wersts to NNE 1/2 E the coast has middle heights and a loamy soil ...." and, (on 21st May 1742) he approached "a rocky precipituous promontory of medium height, surrounded by smooth, unbroken ice. I named it Sjewero Wostotschnyi (= Northern Promontory)" and erected a wooden signal at 77°34'N". (The modern coordinates of this cape are 77°43'N, so it is in fact situated some 40 km further to the northwest than Chelyuskin thought (Fig. 21). Unfortunately in Figure 20 the situation is not clear.

Chelyuskin subsequently followed the west coast southwards and reached Taymyr bay end of May 1742.

The predominant problem in this map making was of course the getting of exact astronomically determined longitudes. Some new maps were produced nearly 150 years later, and the "old" distance between the mouth of the Olenek and Khatanga had to be reduced from 17.5 to 4.5 degrees (HANEMANN 1873). But even in 1873 there was not a single astronomical position available between Obdorsk (66°35'E) and Olenek (122°15'E)!

Cape Chelyuskin was finally surrounded by ship only much later. On his famous "Sailing around Asia and Europe" in 1878/79 the ships "Vega" and "Lena", commanded by Adolf Erik von Nordenskiöld (1832-1901) anchored near the cape on 19th August 1878. "We reached a goal that people for centuries had tried in vain to reach. For he first time in history a ship anchored at the northernmost land mark of the Old World. It is not surprising that this event was celebrated by hoisting up the flags and firing salutes. Later, after returning from a land excursion, we enjoyed a celebration aboard with wine and toasts" (NORDENSKIÖLD 1882: 305).

• Mapping the Lena delta is a continuous task because its topography changes continuously. Maps of the Lena and Yana deltas at the end of the 19th century were still based on Anjou's expeditions from 1821/23 (LATKIN 1879). Flash floods in summer raise the waterlevel on the delta by up to 18 m, causing erosion of the sandy, silty and loamy soil, and of the peat bogs and fossilized ice. But at the same time these floods also transport immense loads of suspended matter into the delta and the Laptev Sea. Numerous channels dissect the delta into islands dotted with thermokarst lakes.

On old maps, Pliny's legendary island "Tazata" is often marked at the Lena mouth. In other maps, however, Tazata is represented, without a river mouth opposite it. Tazata is shown in a rather bad map produced by SANSON (1650). WITSEN (1687) may perhaps have had some informations about the Lena delta with its many islands because he placed there the "Tazata insula", together with a smaller island. The first maps with delta channels (these were even named) appeared around 1750 (Figs. 17, 2), i.e. just after the Great Northern Expedition; examples are ANONYMOUS (1745), BROUCKNER (1749) and the huge wall map of D'AANVILLE (1755).

• Exploring eastward of the Lena delta was the task of Lassinius. He started on 2nd August 1735, but was caught in the ice and died in the winter from scurvy. In the same year Dmitrj Laptev also tried and failed, but he repeated his approach in 1739 and mapped the coast around he Yana delta. In September he wintered at the Indigirka delta and explored the land up to the Kolyma delta. In summer 1740, on 8th August, he discovered the first Bear island ("Sv. Antonius") and was stopped by ice further to the east, at Baranov Rock. Winter quarters had to be arranged in Nishne Kolymski, but in 1741 ice again hindered his activities. In 1742 he returned to St. Petersburg (Fig. 4).

Surprisingly, the New Siberian Islands were not discovered during these activities. On many maps up until the late 18th century, however, there is a small island marked as S. Diomit. This island, which is non-existent, is shown east of the "Holy Point", the Svyatoi Nos (72°53'N, 140°40'E), a cape dangerous for sailors.

• Bering reached Cape Serzde Kamen on 18th August 1729, by coming from the east, not from the west. His later expeditions turned eastward, to Alaska (Fig. 19). It may be remembered that the famous navigator James Cook (1728-1779) who tried to explore the Northwest Passage from the Pacific to the Atlantic, was forced by ice to go west and anchored in August 1778 off the "Nordkap" (Cape Schmidt, at 68°53'N, 179°30'W) (Fig. 4).

Cook even assumed that land should exist farther north, because he observed geese and ducks coming from this direction. His skill as navigator needs no better ilustration than his positioning of Cape Dezhnev. He was wrong by only 1' in its latitude and 2' in its longitude (IMBERT 1993).

As a consequence of these different approaches, there remained a gap of about 1200 km between the exploration from the Lena delta to the east and Bering's attempt from the west. But this gap was only a gap in mapping and not a gap in knowledge. For centuries the area had been visited by ships trading with the native tribes that lived there. Moreover, in 1648, the Pacific was reached from the Kolyma delta by a real expedition. After a first unsuccessful attempt in 1647, Gerasim Ankudinov and Semen Dezhnev, two cossacks, started out from the delta an 1st July 1648. They had seven ships, but they became separated. Dezhnev was driven southwards by storms, nearly to the northern end of Kamchatka Peninsula. There his ship was damaged beyond repair. He finally arrived at the mouth of the Anadyr River after a very unpleasant overland joumey.

This was really the first discovery of the Bering Strait, but it unfortunately was forgotten until in 1736 the German historian Gerhard Friedrich Müller (1705-1783), from the St. Petersburg Academy of Science, discovered a description of this journey in the archives of Jakutsk. Only on the basis of a short remark in Strahlenberg's map of 1730 it is possible to speculate that some rumors about this joumey were spreading in Siberia

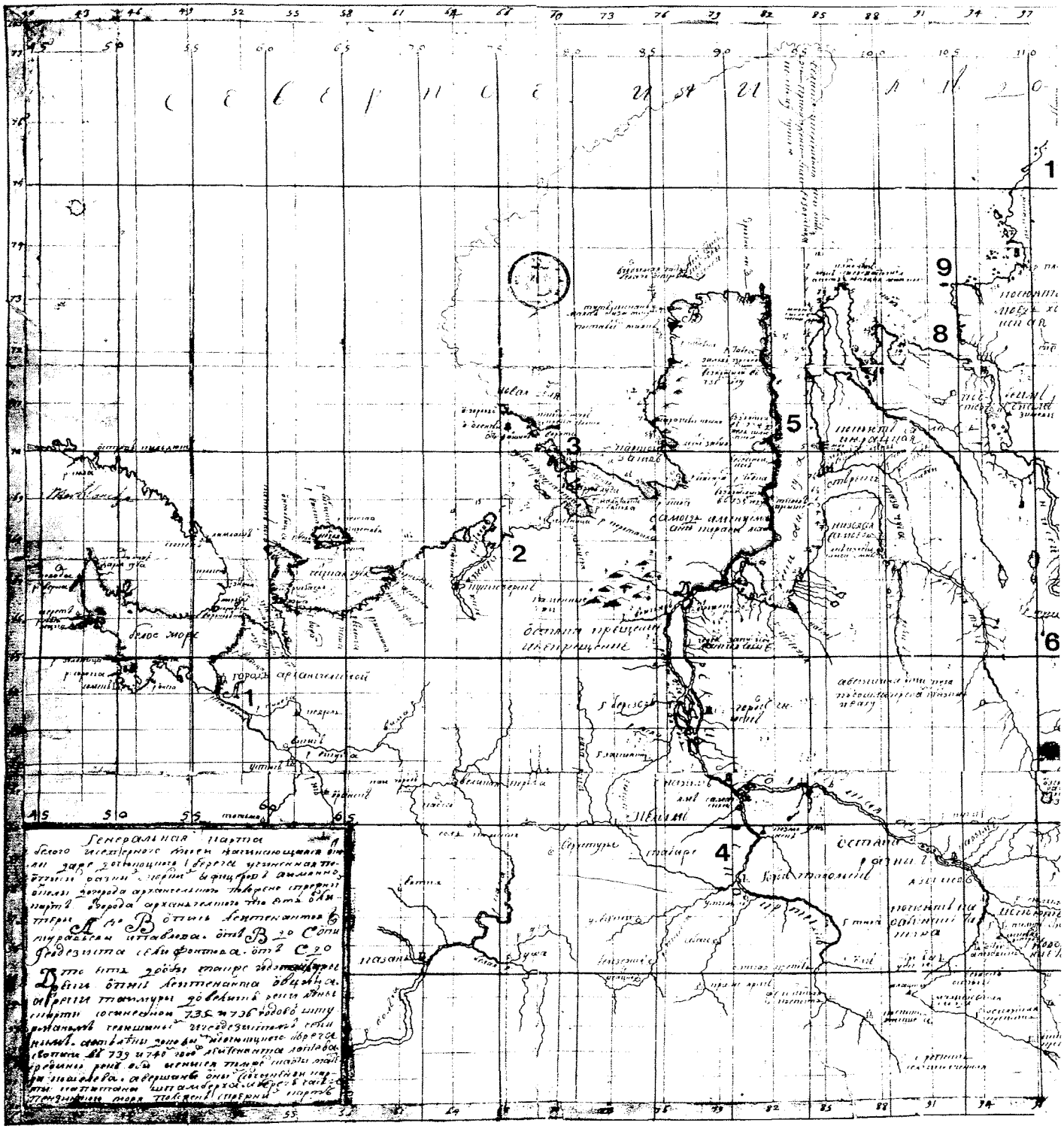
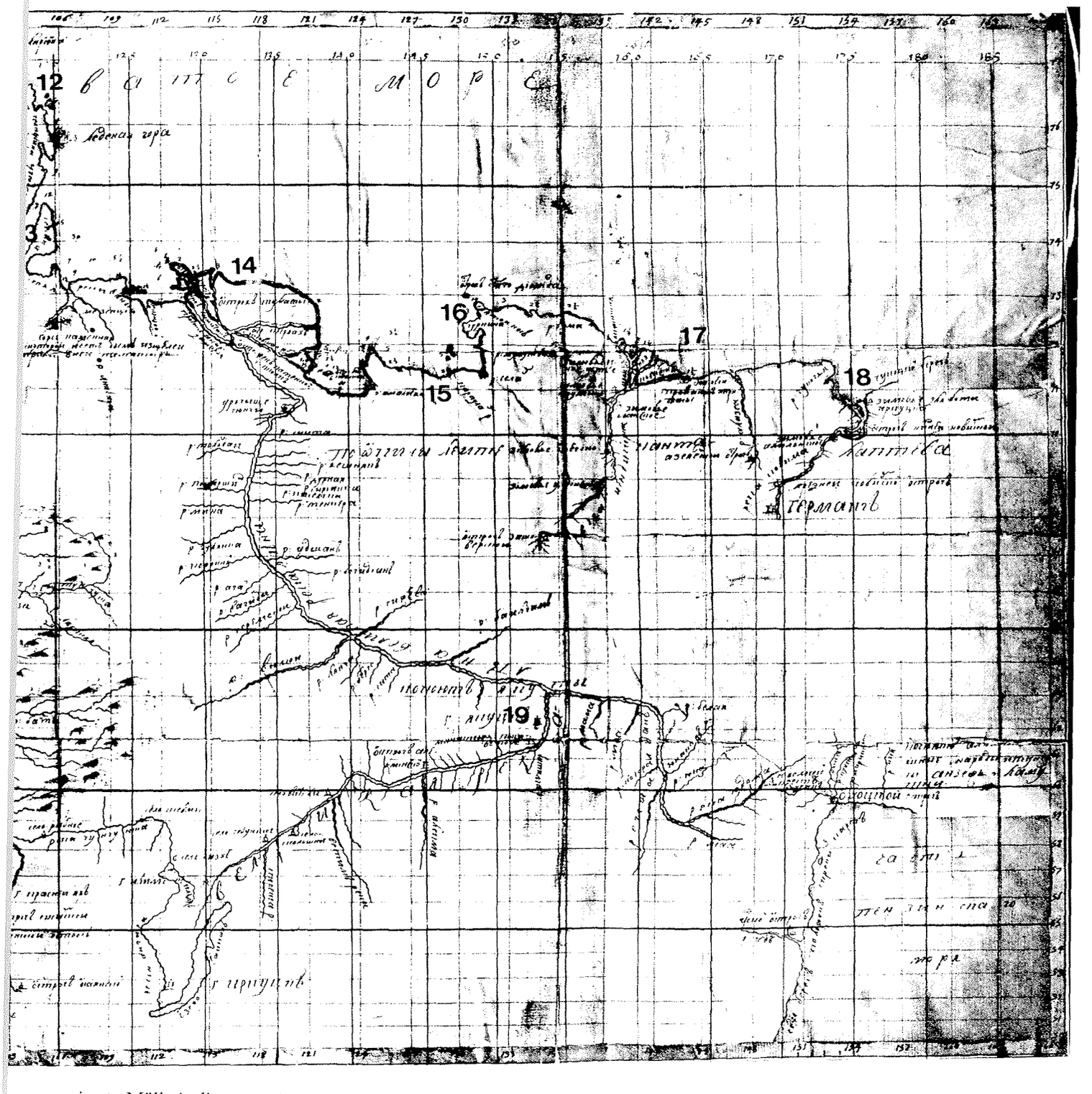


Fig. 20: Map of the Great Northern Expedition, western part (left) and eastern part (right). (1) Archangelsk, (2) Pechora mouth, (3) Vaygach Island, (4) Tobolsk, (5) Ob estuary, (6) Turukhansk, (7) Yenisey, (8) Yenisey mouth, (9) Port Dikson, (11) Taimyr Bay, (12) Cape Chelyuskin, (13) Khatanga mouth, (14) Lena delta, (15) Yana delta, (16) Cape Svatoi nos, (17) Indigirka delta, (18) Kolyma delta, (19) Jakutsk. Lena delta at about 118°E i.e. 6° less than the modern Longitude (after YANIKOV 1952).

Abb. 20: Karte zur Großen Nordischen Expedition, Westteil (links) und Ostteil (rechts). (1) Archangelsk, (2) Petschora-Mündung, (3) Waigatsch-Insel, (4) Tobolsk, (5) Ob-Ästuar, (6) Turukhansk, (7) Jenissei, (8) Jenissei-Mündung, (9) Port Dikson, (11) Taimyr-Bucht, (12) Kap Tscheljuskin, (13) Khatanga-Mündung, (14) Lena-Delta, (15) Jana-Delta, (16) Kap Svatoinos, (17) Indigirka-Delta, (18) Kolyma-Delta und (19) Jakutsk. Das Lena-Delta liegt bei 118°E, das heißt 6° weniger als nach modernen Messungen (nach YANIKOV 1952)



prior to Müller's discovery. But, no matter, all of these activities led to a break-through in the mapping of the northern Siberian coast.

First of all, Bering could finally prove that no land connection existed between Asia and America. He could also demonstrate that Siberia extended much further to the east than had formerly been believed. Secondly, there was completed a programme of nearly continuous exploration and coastal mapping between the White Sea and the Kolyma delta. Thirdly, there were highlights such as the dramatic discovery of the northernmost point of Asia, the Cape Chelyuskin, that resulted from the Great Northern Expedition. Exploration continued, of course, by governmental efforts, by merchants and by trappers, but this exploration is not the subject of this article. Information on it can be found in detailed descriptions of the history of Siberian exploration for instance by NORDENSKIÖLD (1882), by DUNBAR (1985), or for the coasts east of the Lena delta by LINDEMAN (1879).

Finally, returning to the beginning, a memorandum from Lomonossov (1711-1765) should be mentioned from 1763

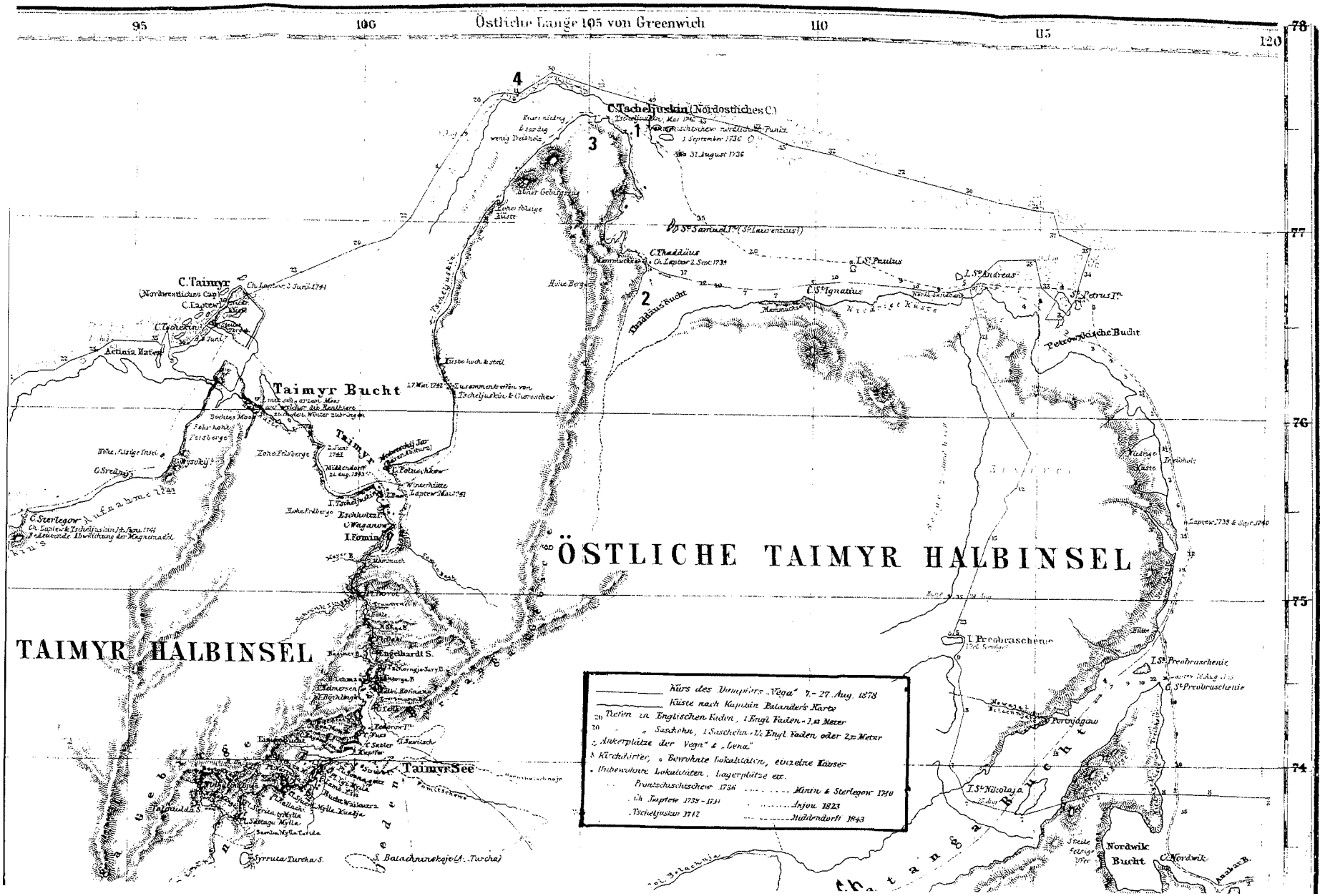


Fig. 21: Exploration of the northernmost Cape of Asia, Cape Chelyuskin. Distinct lines with hachures = Coasts after the Great Northern Expedition. Fine lines = after "Vega" Cruise 1878. Some differences west and northeast of the Taimyr Bay and great differences at the eastern part of the Taimyr Peninsula. (1) Northernmost point of Prontschischtschev, 1st September 1736. (2) Northernmost point of Ch. Laptev, 2nd September 1739. (3) Northern Promontory ("Sjewero Wostotschnyi"), after Chelyuskin, May 1742. (4) Modern coordinates, with "Vega", anchor place in 1878 (section, after ANONYMOUS 1879).

Abb. 21: Erkundung des nördlichsten Kaps von Asien, Kap Tscheljuskin. Kräftige Linien, z.T. mit Bergstrichen = nach der Großen Nordischen Expedition. Feine Linien = nach der "Vega"-Expedition von 1878. Einige Abweichungen westlich und nordöstlich der Taimyr-Bucht, große im Ostteil der Taimyr-Halbinsel. (4) = die heutigen Koordinaten mit dem Ankerplatz der "Vega" im Jahre 1878 (ANONYMOUS 1879, Ausschnitt).

(see LOMONOSSOV 1961). The Russian universal genius in sciences and in humanities became Professor of Chemistry in the St. Petersburg Academy of Sciences in 1745 and Director of the Academy's Geographic Department in 1758. In this latter function he pushed for an official geographic and economic inventory of Russia, for the use of astronomical positioning, and for a better education of geodesists.

In his memorandum LOMONOSSOV (1763) stated that the naval officers of the Great Northern Expedition had explored most of the Siberian coast. But he complained that better preparation would have led to much greater success. Furthermore, "not all of them had tried hard enough because they took their wifes with them on such a tough journey" (LOMONOSSOV 1961 II: 150).

Lomonossow was full of passion and patriotism and a born orator, too, and in this article he pleaded enthusiastically and convincingly for the opening of the Northeast Passage for trade. He compared the situation with that which the Portuguese had to master in order to reach the East Indies. They had to cover 17,000 versts and to cross very different climatic zones with all sorts of difficulties including illness and hostile tribes. They had even had to forego the lack of reliable celestial navigation because of the invisibility of the Pole Star south of the Equator. In contrast there were only some 5000 versts that would have to be covered between Kildin Island (near Murmansk) and the Pacific, and all the journey would happen between 65 and 80°N, without all the various difficulties. Of course there would be ice and cold, but Russians are accustomed to these:

"...let us consider the profit and glory one's country achieves (if this challenge is met) ... In order to win a small piece of land, or indeed for the sake of ambition alone, ...whole armies are sent to death; here, however, it might only take a hundred lives to acquire entire countries in other parts of the world, thus expand navigation and trade, augment the power and glory of the nation and emperor, present Russia's sea heroes to the world, and contribute to the further enlightenment of mankind" (LOMONOSSOV 1961 II: 151).

Shortly after Lomonosov's death W.J. Chichagov tried twice to carry out the passsage. Only in 1878/79 did A.E. Nordenskiöld succeed, and thereby fulfilled this old dream.

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References

Biographical data after R.V. Tooley (1979), maps from
A.C.: Author's collection,
Stb.B.: Staatsbibliothek Berlin,
Stb.M.: Staatsbibliothek München

Anonymous (1745): Pars maris glacialis ostiunque fluvii Lenae cum territorio septentrionali Jakutensi.- Stb.B., GfE Hg, 148),

Anonymous. (1879): Die Fahrt der "Vega" um die Nordspitze von Asien.- Petermanns Geogr. Mitt. 25: 11-23 (Map A. Petermann (Northern Siberia, 1873) with Corrections by Capt. Palanders, August 1878, Table 2).

Anville, Jean Baptiste Bourguignon d' (1803): Sibirie et Tartarie.- Stb.M. Mapp. XIX, 31c.

Bagrow, L. (1937): Ivan Kirilov, Compiler of the first Russian Atlas 1689 - 1737.- Imago Mundi 2: 78-82. Stockholm.

Bagrow, L. (1952): The first Russian maps of Siberia and their influence on the West-European cartography of Northeast Asia.- Imago Mundi 9: 83-93. Stockholm.

Bagrow, L. (1954a): Semyon Remezov - a Siberian Cartographer.- Imago Mundi 11: 111-125. Stockholm.

Bagrow, L. (1954b): An old Russian world map.- Imago Mundi 11: 169-174. Stockholm.

Bagrov, L. & Skelton, R.A. (1963): Meister der Kartogaphie.- Safari Verlag, Berlin.

Baranov, A.N. & Schurov, S.N., Eds. (1962): Atlas USSR, Map 38.- Ministery of Geology, Moscow.

Barents, W. (1595): Map of the European Arctic.- In: I.G. LEITHÄUSER, Mappae Mundi. 290, Safari, Berlin, 402 pp.

Bertius, P. (1618): Tabularum Geographicarum, libri septem.- Amsterdam, Stb.M. Mapp.3, 16.

Blaeu, W. J. (1617): Atlas Noviter delineata, Asia.- Amsterdam. Stb.B. Kart.D2-10. (Reproduction "Tartaria" in: J. GOSS & P. CLARK (1990) Blaeu - Der Große Atlas. Die Welt im 17. Jahrhundert, Neff, Wien, 224 pp.

Brouckner (Bruckner), I. (1749): Arctic Ocean, Nouvel Atlas de Marine, Berlin.- In: NORDENSKIÖLD (1897), Periplus, 97.

Clavus, Cl. also Svart. (1388-?) (1427):- In: A.E.v. NORDENSKIÖLD (1897), Periplus, 90.

Coronelli, V.M. (c 1690): Parte orientale dell'Europa. A.C.

Delisle, G. (1723): Carte d'Asie.- Amsterdam. A.C.

Delisle, J.N. (1740): Mappe Monde.- In: R.V. TOOLEY (1962): Maps and mapmakers, plate 69, London.

Dunbar, M. (1985): Arctic Exploration.- In: THE NEW ENCYCLOPEDIA BRITANNICA 14: 22-24. Chicago etc.

Güssefeld, F.L. (1786): Charte des Russischen Reiches etc. Homann Heirs, Nürnberg A.C.

Haas, J.M. also Hasius, Haase (1744): Atlas, Asia.- Nürnberg.- A.C.

Hacquebord, L. (2001): An archaeological survey in the delta of the northern Dvina in Russia.- Circumpolar Journal 16,2: 16-22.

Halley, E. (1728): A globular draught from the North Pole to the latitude of 60 degrees.- In: N. CUTLER, Atlas Maritimus et Commercialis, London. A.C.

Hanemann, F. (1873): Die Entdeckungsgeschichte der nördlichsten Gebiete von Asien, zwischen Lena und Jenissei, 1734-1866.- Petermanns Geogr. Mitt. 19: 9-21, Tafel 1.

Herberstein, S. von (1546 / 1549): Rerum Moscoviticarum Commentarii etc..-

Hintzsche, W. & Nickol, T. (eds.) (1996): Die Grosse Nordische Expedition – Georg Wilhelm Stelller (1709-1746) – ein Lutheraner erforscht Sibirien und Alaska. – Ausstellung Halle, Perthes Gotha, 347 pp.

Homann, J.B. (1702): Atlas novus terrarum, Map Imperii Moscovitiaris.- Nürnberg. A.C.

Holland, C. (1994): Arctic Exploration and Development c 500 b.c. to 1915.- Garland New York XVI + 704 pp.

Homann, J.B. (1737): Großer Atlas.- Nürnberg. University Library Freiburg, J 8564.

Hondius, J. II (1618): Mineature World Atlas, French edition. Map Tartaria.- Stb.M., Mapp. 3-72.

Imbert, B.C. (1993): Bering et Chirikov, decouvreurs du Pacifique nord.- Oceanis 19(4): 39-63. Monaco.

Judaeis, C. de also C. de Jode (1593): Spectrum Orbis Terrarum, Anwerp.- In: A.E.v. NORDENSKIÖLD (1889). Facsimile Atlas, Table XL VIII.

Keere, P. van der (1614): Asiae nova descrip-tio. Amsterdam. Stb.B. Kart D175.

Keuning, I. (1954): Nicolaas Witsen as a cartographer.- Imago Mundi 11: 95-110. Stockholm.

Khain, V.E. & Nikishin, A. (1997): Russia.- In: M. ELDRIDGE et al., Encyclopedia of European and Asian regional geology, Chapman & Hall, London etc.: 631-652, Fig. 510.

Kupcik, I. (1980): Cartes géographiques anciennes. – Grund, Paris, 240 pp.

Latkin, N. (1879): Die Lena und ihr Flussgebiet.- Petermanns Geogr. Mitt. 25: 91-95.

Liechtenstern, J.M. von (1806): Asien.- Kunst und Industrie Comptoir, Wien. Stb.B. Kart D. 660.

Lindeman, M. (1879): Die Nordküste Sibiriens zwischen den Lenamündungen und der Beringstraße.- Petermanns Geogr. Mitt. 25: 161-175.

Lomonossov, M.W. (1952): Collected publications 6: 418-498 with polar map. Moscow (in Russ.)

Lomonossov, M.W. (1961): Ausgewählte Schriften in zwei Bänden. 2: VII + 317 pp.. Akademie Verlag. Berlin.

Mangerud, I., Astrakhov, V.I., Murray, A. & Svendsen, J.I. (2001): The chronology of a large ice-dammed lake and the Barents-Kara Ice Sheet advances, Northern Russia.- Global Planet. Change 31: 321-336.

Massa, I., Dutch traveller (1612): Novissima Russiae Tabula.- Amsterdam. A.C.

Mercator, G., German cartographer (1595): Atlas, see C. Moreland & D. Bannister 1989, 96.

Michow, W.H. (1884): Die ältesten Karten von Russland, ein Beitrag zur historischen Kartographie.- Meridian Publ. Co. Amsterdam.

Middendorf, A.Th. van (1867): Reise in den äussersten Norden von Ost- Sibirien während der Jahre 1843 und 1844.- St. Petersburg.

Mitchell, I.B. (1985): The history of European overseas exploration and empires.- In: THE NEW ENCYCLOPEDIA BRITANNICA 18: 863. Chicago etc.

Moreland, C. & Bannister, D. (1989): Antique Maps, 3rd edition, IX + 326 pp.- Phaidon Christies. Oxford.

Moxon, I. (1674, in German 1676): Ein kurtzer Discours von der Schiff-Fahrt bey dem Nord-Pol Nach Japan, China usw. – Naumann & Wolff, Hamburg 4 pp.

Münster, S. (1544): Cosmographia. 1752 pp.- facsimile print, 1984, Antiqua Lindau, Basle.

Münster, S. (1575): Novata vola dell'India & quasi di tutta l'Asia etc. Cosmographia, Italian edition.- Venice. A.C.

Nordenskiöld, A.E. von (1882): Die Umsegelung Asiens und Europas auf der "Vega". 2 vols, XIV + 451 pp.- Brockhaus, Leipzig.

Nordenskiöld, A.E. von (1889): Facsimile-Atlas to the early history of cartography etc., 51 tables, 141 pp., Stockholm.

Nordenskiöld, A.E. von (1897): Periplus. An essay on the early history of charts and sailing directions. 60 tables, 207 pp., Stockholm.

Nordenskiöld, A.E. von (1987): Nordostwärts. Die erste Umsegelung Asiens und Europas 1878-1880.- Thienemann. Stuttgart, 331 pp.

Ortelius, A. (1570): Theatrum orbis terrarum. Antwerp. Reprint 1966.- Merian Bibliothek, Hoffmann & Campe, Hamburg.

Pitt,M. (1680): A Map of the North Pole and the Parts Adjoining.- London.

Plancius, P., Cartographer of the Dutch East India Company) (1594): World map. Amsterdam. Stb.B., Kart.B 3262.

Renard, L. (1715): Planisphère représentant toute l'étendue du monde.- In: Atlas de la Navigation et du Commerce. Amsterdam.

Rouge, G.L. Le (1744): Etats de Moscovie. Paris. Stb.B. GFE HG, 21.

Sandler, C. (1882/84): Johannes Baptista Homann, Matthäus Seutter und ihre Landkarten. Ein Beitrag zur Geschichte der Kartographie. 97 pp.- Meridian Publ.Co. Amsterdam.

Sanson, N. (1650): Asia. A.C.

Seller, J. (after 1667): A Mapp of the Regions & Countreyes under and about the North Pole.- London.

Seutter, G. M. (ca 1723): Asia. A.C.

Strahlenberg, Ph.J. von (1730): Der nord- und oestliche Theil von Europa und Asia.- Stockholm.

Tooley, R.V. (1962): Maps and map makers.- 4th edition. B.T. Batsfield, London.

Tooley, R.V. (1979): Tooley's dictionary of map-makers.- XII + 684 pp. - Map collector publications Ltd, Tring, England.

Waghenaer, L.J. (1584-1590): Sphiegel der Zeevaerdt.

Waghenaer, L.J. (1592-1609): Thresoor der Zeevaerdt.-

Witsen, N. (1687): Map of Siberia in 6 sheets. See J. Keuning (1954)

Woldan, E. (1954): A circular copper-engraved medieval world map.- Imago Mundi 11: 13-16. Stockholm.

Yanikov, G.V. (1952): Velikaya Severna Ekspeditsiya (The Great Northern Expedition) 164 pp.- Moscow. Review in Imago Mundi 9: 117-118, with map. Stockholm.

Yefimov, A.V., ed. (1964): Atlas of geographical discoveries in Siberia and Northwestern America 17-18th centuries. 135 pp.- Nauka Moscow.

Zeno, D. (1558): Map of the North Atlantic, Venice. In: A.E.v. NORDENSKIÖLD (1889) Facsimile atlas of the early history of cartography. 58, Stockholm 1889.