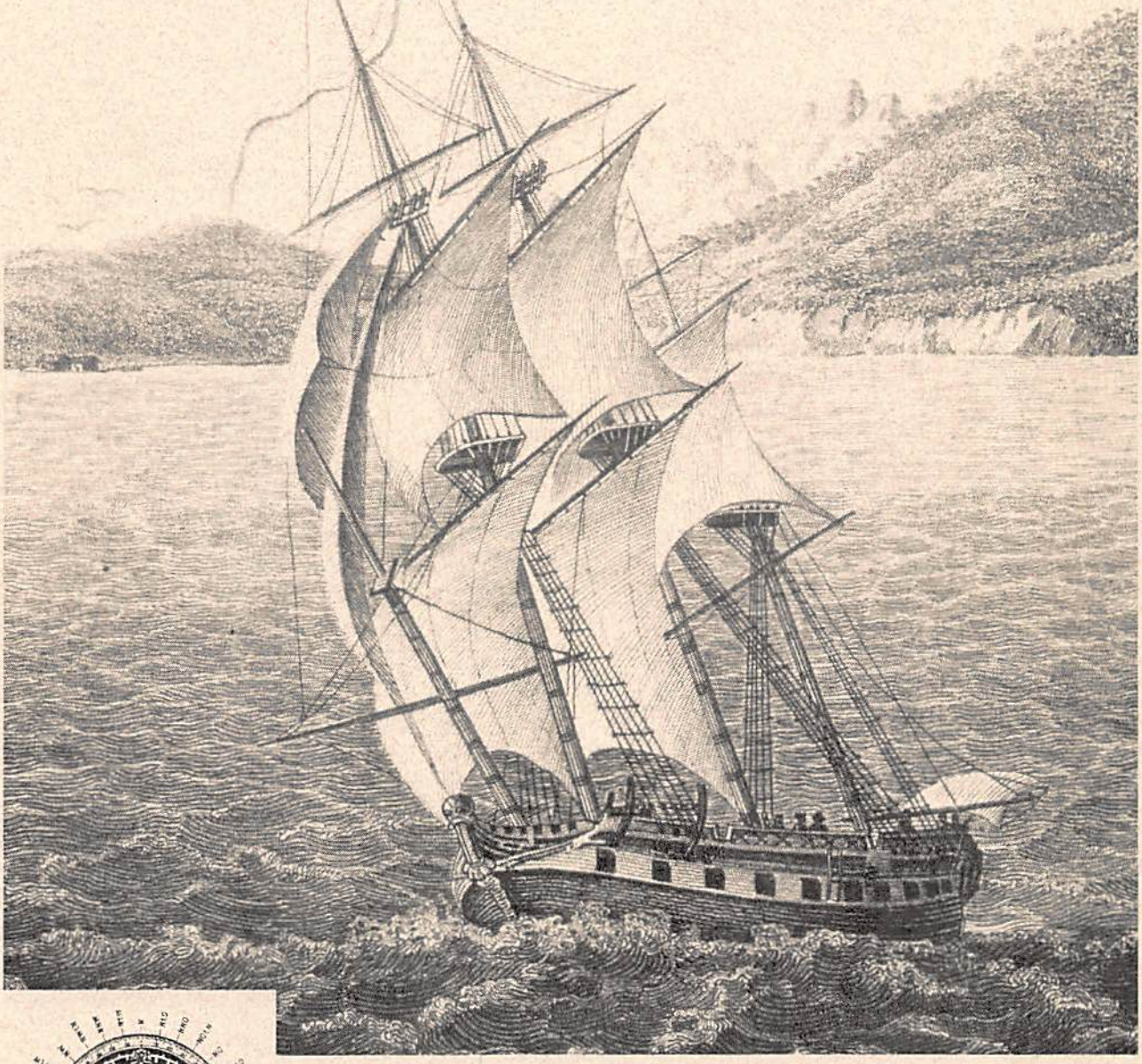
Science Under Sail

Russia's Great Voyages to America, 1728–1867



Instructional Guide

Science Under Sail: Russia's Great Voyages to America, 1728-1867
Instructional Guide
by Donna Matthews &
Barbara Sweetland Smith

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Instructional Guide by Donna Matthews and Barbara Sweetland Smith

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We hope you enjoy this expedition. Our gratitude to all who contributed to launching it.

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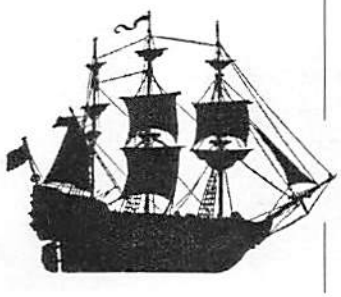

INTRODUCTION TO THE INSTRUCTIONAL GUIDE

To The Teacher

Herein begins a journey of discovery for you and your students. As you follow the adventure through this instructional guide and visit the exhibition—*Science Under Sail: Russia's Great Voyages to America 1728-1867*—**you will be among the first ever to experience this story.** Never before assembled in one place, this is the story of the sailors, naturalists, ethnographers, astronomers, cartographers, geographers, and artists who originally described Siberia, Japan and the northwest coast of America to the rest of the world. Much of what we know about the peoples and places on the shores of the North Pacific Ocean, we know because the Russians provided brilliant maps, reports, and art.

In this instructional guide you will find these highlights:

- The intellectual woman who became the ruler of Russia and inaugurated schools for women, vaccinations for smallpox, and magazines for Russians to read.
- The captain who is credited with finding America and the ones who really did, but are not credited.
- The difference a tin can makes in a sailor's life (or the disease that can be cured by cabbage).
- The mysteries of missing and found journals and atlases.
- The deadly risks of dead-reckoning.
- The challenge of taking the ocean's temperature.
- The powers of observation and record-keeping.
- The wonder of scientists who are poets, and artists who are scientists.
- The serf who became one of the most important artists to picture the first people of Alaska and California.
- The massive animal that became extinct a few decades after being scientifically identified.

This instructional guide accompanies the exhibition, *Science Under Sail*, but is designed also to be a "stand-alone" unit of study.

When you visit this first exhibition of Russia's maritime exploration of the North Pacific, you and your students will see:

- a scale-model of Bering's ship, the first European ship to land in Alaska;
- a life-sized recreated ship's cabin and shore camp;
- sextants and chronometers used by the mariners;
- original watercolors of botanical, and animal species;
- actual plants collected more than 175 years ago;
- wood, ivory, grass and gutskin artifacts from the era of first European contact with northwestern North America; and
- original paintings of Native Alaskans and Californians.

Science Under Sail tells the surprising story of the intrepid explorers who were the first Europeans in the North Pacific.

Opening in May, 2000, *Science Under Sail: Russia's Great Voyages to America, 1728-1867* begins its public viewing at the Anchorage Museum of History and Art. For exhibition locations and schedules, please contact the Museum at 907-343-4326 or the Education Department at 907-343-6187.

This interdisciplinary and integrated instructional guide incorporates science, social studies, language arts, and art.

- For grades 4-8
- Two - four weeks of varied activities
- Ten topical lesson chapters
- Imbedded evaluation
- Detailed glossary
- Extensive resources

This instructional guide accompanies the exhibition, *Science Under Sail*, but is designed also to be a "stand-alone" unit of study.

Teacher input from development through revision has guided its production. Intended as an interdisciplinary instructional guide suitable for grades four through eight, its lessons include two to four weeks of activities that may be expanded or shortened according to the needs of your classes. Arranged in ten topics with glossary, resources and notes about meeting teaching standards, the instructional guide is designed for easy placement in a binder or file folders.

Each of the topic sections contains special information for the teacher. The section begins with the summary and materials needed for the lesson. Suggestions for activity implementation, hints for adaptation to age group and class size, and some optional activities and extensions are included also.

The teacher's pages are followed by an historical narrative—suitable for reproduction—that features information and activities directed to the student.

Instructional goals

1. Students will understand the contributions of the Russian voyages of discovery.
2. Students will place the events of the Russian explorations to America in a timeline.
3. Students will appreciate the rigors of daily life on a Russian voyage to America.
4. Students will read and interpret primary and secondary historical narratives and pictures.
5. Students will keep a log book, using writing and drawing skills.
6. Students will understand the ways contemporary research uses historical scientific records.
7. Students will appreciate the use of objects and collections in developing and understanding the historical record.
8. Students will understand that history begins with present-day events that are subject to historical interpretation.
9. Students will understand the history of science in this period.

The topic titles in quotation marks are from the historical record of Catherine the Great's instructions to Captain Joseph Billings in 1785.

1. **"Expeditions of Discovery"**
   An Exhibition Overview
2. **"Noble Emulation of Such Great Men"**
   The Voyagers and Their Stories
3. **"Journals Relative to Your Expedition"**
   Record-Keeping
4. **"Forming an Exact Chart"**
   Way-Finding and Map-Making
5. **"Vessels of Sufficient Strength & Convenience"**
   Life on a Russian Ship
6. **"In the Eastern Ocean"**
   Understanding the Sea
7. **"Remarkable Places"**
   Pictures of the Voyages
8. **"Natural Curiosities"**
   Plants and Animals
9. **"All the People You May Meet"**
   Cultural Communities
10. **"Such Perfect Knowledge"**
    The Legacy

Log Book

A significant aspect of student work throughout these ten lessons is a log book of their discoveries. **The log book is a written record that may be viewed publicly and perhaps published. It is not a private diary.**

The student's record-keeping replicates an important aspect of the Russian experience in the expeditions. Each Russian ship had record-keepers who wrote and drew the story of the journey. Log books, journals, charts and maps formed the collections of information that guided each expedition. Every expedition added its own records to a growing body of knowledge that was shared among all the mariners and the scientists at sea and at home. And every shred of information that was published or shared was used by the next voyage to simplify and guide its journey.

Beginning in lesson one, students need to have their log books in hand. The physical book may be paper that is stapled together. It may be a bound, school-writing book. It may be a hand-made, hand-sewn, hard-cover book. However elaborate or simple the log book may be, it should be a separate, stand-alone document.

Each lesson's entry should begin with the date, time, and place of the entry. Then a statement about the weather should follow with a notation about the wind, an especially significant ingredient in the sailing community. Continue with the lesson directions for each log book entry.

A significant aspect of student work throughout these ten lessons is a log book of their discoveries.

Writing on a regular basis in these log books provides discipline that will, over time, improve and sharpen writing skills. Students learn to be more discriminating observers and improve their ability to turn their observations into accurate phrases. Some of the log book lessons require drawing or sketching. In those instances, students should write their observations in words, first, and then follow with the sketch. It is easy to become trapped in the details of a drawing experience. Early sketches may seem rough and crude, but like writing, improve with practice.

It may also be a useful review for students—and a reference for absentees—to begin and maintain a class log book. Using large paper, summarize the ingredients of each day's lesson as a group with a "scribe" who records the information for the group.

Before reviewing the material in the "Overview," lesson 1, students should write the first entry in the log book:

> " On this date, this is what I know about Russian exploration in Alaska and the Pacific from 1728-1867, and these questions are what I want to know."

The first entry becomes a front-end evaluation of the content of the student's knowledge at the beginning of the unit of study, and their questions may provoke examination of material not anticipated by this Guide.

When the students visit the exhibition, the log book becomes a guide for evaluation. What do students recognize in the exhibition from the lessons that preceded the visit? What do they find that is new and unusual? Or, if the instructional guide is used following the exhibition visit, what discoveries and expanded information do they discover in the lessons? What do they recall from the exhibition?

For quantitative evaluation strategies, you may wish to develop a four-part matrix for each entry based on (1) Following directions; (2) Describing the material appropriately; (3) Presentation and content, imagination, appearance, and (4) Accuracy in spelling, grammar.

Good luck on your expedition through Science Under Sail, Russia's Great Voyages to America, 1728-1867.

Barbara Sweetland Smith, Exhibition Curator
Science Under Sail, Russia's Great Voyages to America, 1728-1867

THE HISTORICAL OVERVIEW

A small ship travels in a vast unknown, its international crew sent forth to find "What's out there?" This is not today's space shuttle nor tomorrow's starship, but another vessel, called *Enterprise*—a Russian ship in the 1820s, plying the waters of an equally mysterious region: the North Pacific. Commanded by the young Otto von Kotzebue, the *Enterprise* was one of a host of sturdy ships that took on the challenge of the North Pacific in the 18th and 19th centuries for the Russian Empire.

Until 1867, when it sold Alaska to the United States, Russia dominated the North Pacific, sending more than 225 expeditions into the region.

The first explorers and collectors in the region bounded by Japan, Siberia, and Alaska, and even including Hawaii and northern California—were organized by the Russian government. Until 1867, when it sold Alaska to the United States, Russia dominated the North Pacific, sending more than 225 expeditions into the region. Many of these were scientific and carried an international corps of scientists. Their work resulted in important biological, geological, and ethnographic collections which are among the oldest from the northern regions. For many years, these collections were off limits to Russia's enemies in the West. But today, now that the Ice Curtain has melted, the work of these pioneers is coming to light. What is the story behind this story?

It all begins with Peter the Great.

It all begins with Peter the Great, a man of talent and enthusiasm, who ruled Russia from 1694 to 1725. One of his great passions was the Imperial Russian Navy, which he launched during the first years of his reign. Peter threw much of his prodigious zeal into developing this favorite of his many enterprises. By the end of his reign, Russia had a Naval College, a small fleet in the Baltic, and a significant relationship with the outstanding scientists of the day. This came about through another of Peter's passions, a love for learning and a desire that Russia would leave its medieval ways behind and become a European intellectual power. To achieve this aim, in 1724, he created the Russian Academy of Sciences. Henceforth, except in time of war, Russia's navy would serve science while also flying the flag of the Empire on the oceans of the world.

During the 18th century, Russia launched four major voyages.

During the 18th century, Russia launched four major voyages. The distinguishing feature of all the 18th century expeditions is that they began in the impossibly difficult location of eastern Siberia. At the time, Russia had no ships capable of sailing around Africa or South America to the North Pacific. And secrecy at this stage was a high priority. But Russia had only small military outposts on the Pacific and there were no ports from which to launch an expedition. The ship-building facilities and the community around them, therefore, had to be built by the expeditionary forces. It is no surprise, then, that it might take up to seven years for an expedition to complete its work—with many casualties along the way.

Vitus Bering was the first of these mariners who had to build his ship from scratch on the eastern shores of Siberia.

In 1725, as Peter lay dying, he authorized a northern expedition, launched from Siberia, to explore the northeastern coast and to seek that place "where it is joined to America." He appointed an experienced officer in his navy, a Dane, Vitus Bering to command the enterprise; Bering was one of the many foreigners Peter and other Russian monarchs brought into the service of the empire.

It took Bering three years to reach the Pacific, crossing some 7,000 miles of tundra, rivers and forest, and then to build the ship, *St. Gabriel,* which would travel northward to 67°18'N latitude. His voyage was inconclusive. He sailed along the west side of and named St. Lawrence Island and also sighted one of the Diomede Islands, but he did not find America—that is, "the Great Land" in the east. Some people back in St. Petersburg considered the voyage—and the expenditure—a waste and a failure—even if he had sailed farther north in the North Pacific than anyone known at that time.

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In 1732 Russia sent out another official voyage to try to find America. The fate of this journey and its mariners is a tragic trick of history. M. S. Gvozdev and Ivan Fedorov sailed close to Cape Prince of Wales—the western-most point in mainland North America—and also identified the two Diomede Islands and King Island—forty-five years before Cook. Near King Island, they conversed, using sign language, with a man who came out to their ship in a kayak and identified himself as a Chukchi and told them of the Great Land in the east. Gvozdev was the officer who survived to tell the story but his reports were delayed by a series of unfortunate incidents—including his arrest on spurious charges—until after the Bering voyage of 1741. Thus it was without a doubt that the Gvozdev and Fedorov voyage of 1732 marks the first sighting of Northwest America by Europeans and the first contact with the region's Native Americans. Bering's lieutenants found this out later from Gvozdev's belated report and made a map showing the encounter. It is Bering, mistakenly, who has been given the credit for "First Contact." What, then, did Bering accomplish? It was no small accomplishment: His crew made first landfall on American soil—and some lived to tell the tale.

Thus it was without a doubt that the Gvozdev and Fedorov voyage of 1732 marks the first sighting of Northwest America by Europeans and the first contact with the region's Native Americans

Back in St. Petersburg after his first venture on the Pacific, Bering persuaded the Academy of Sciences to sponsor another, even grander expedition a few years later. This Second Kamchatka Expedition lasted nine years, from 1733 to 1742. Americans identify this expedition with the voyage to America, the brief landing on Kayak Island south of Prince William Sound, the first contact with the people of the Aleutian Islands, in the summer of 1741. But the expedition was much larger than the voyage to America. It was a huge project, involving more than five hundred men and several hundred sledges with supplies. Its work was to explore northeastern Siberia and to chart the waters around northern Japan and the Kuril Islands between Japan and Kamchatka. The first ethnographic study

Back in St. Petersburg after his first venture on the Pacific, Bering persuaded the Academy of Sciences to sponsor another, even grander expedition a few years later.

of the people of eastern Siberia came from this gigantic project, as well as thousands of plant and animal collections, many scientific studies of now extinct species, as well as many new maps and charts.

The expedition to America, however, placed Russia firmly in the Pacific as a major power. During the next 126 years, Russia claimed the islands in the North Pacific and Alaska as its own. It made serious efforts to establish influence in the Kuril Islands and even in northern Japan. And in the 19th century, Russia established a base in California, just north of the limits of Spanish territory. Several voyages in the 18th century expanded a great deal on the Bering legacy, which had included only a few landfalls—one at Kayak Island and another in the Shumagin Islands (named for a sailor who was buried there by the Bering party).

During the next 126 years, Russia claimed the islands in the North Pacific and Alaska as its own.

By the end of the 18th century, Russians had explored all of the Aleutian Islands, Kodiak, the Gulf of Alaska south to Yakutat, and as far north as Norton Sound—not to mention Kamchatka, Yakutia, and Chukotka. One of the most ambitious inter-continental expeditions was the Billings-Sarychev Expedition of 1785-92. During these seven years, an Englishman in Russian Service, Joseph Billings—who had served with Captain James Cook—and Gavriil Sarychev led a remarkable effort to describe the northernmost coast of the Chukotka Peninsula, the Aleutian Islands, and northwestern Alaska. Like Bering, Billings and Sarychev built their ships at Okhotsk on the eastern shore of Siberia.

During the 19th century, Russia began building ocean-going vessels at its ports on the Baltic—or bought such vessels from England. Beginning in 1803, Russia launched forty round-the-world voyages, each of them with duties in the North Pacific. By that time, Russia had established a colonial government in Alaska, with its capital at Sitka. It called its colony Russian America. Most of the round-the-world voyages carried supplies, officials, or instructions for the colonists. But they also carried a complement of scientists who have left us a remarkable legacy.

Most of the round-the-world voyages carried a complement of scientists who have left us a remarkable legacy.

It was Empress Catherine the Great who established the orders for the scientific exploration of the North Pacific over the next century. She issued elaborate instructions, through the Academy of Sciences, to the captains and the scientists of her expeditions in the 1760s. Her words reverberated throughout the next one hundred years. In an elegant phrase, she urged her officers "to bring to perfection the knowledge acquired under her glorious reign." To do this, they were instructed to describe in detail "all the remarkable places" and the "natural curiosities" they encountered both on land and sea. They were also to interview, observe, and describe all the peoples they met. The detailed journals kept by the captains and the naturalists reveal how seriously they understood their mission. In a typical passage, Catherine advised the naturalist, Carl Merck:

It was Empress Catherine the Great who established the orders for the scientific exploration of the North Pacific over the next century.

With regard to the people you may visit, you will observe their disposition and different corporeal qualifications; their government, manners, industry, ceremonies, and superstitions religious and profane;

their traditions, education, and manner of treating women; useful plants, medicines, and dyes; food and manner of preparing it; habitations, utensils, carriages, and vessels; manner of life and economy; their modes of hunting, fishing, making war, and treatment of domestic animals; likewise languages...

Artists accompanied many of the major voyages.

In many situations, words were inadequate to describe the practices of the peoples the travelers met. Artists accompanied many of the major voyages and have left indelible impressions and invaluable information about the lands and peoples of the North. Sometimes even ship's officers provided exceptional visual legacies. The first recorded image of an Aleut/Unangan in a skin boat was made by Sven Waxell, an officer on Bering's ship, and even more detailed views of Aleut/Unangan life were recorded in 1768 by the navigator of the first expedition sent out by Catherine the Great.

The scientists who accompanied the voyages were from Europe, primarily from Germany and Estonia. One who is particularly well known is Georg Steller, who accompanied Bering on the voyage of 1741 to America and spent 10 hours on Kayak Island collecting and recording all that he saw in that "remarkable place."

Steller may rightly be called the first naturalist in western North America.

As a result of this and his other studies of marine life, Steller may rightly be called the first naturalist in western North America. He is identified with the ubiquitous Steller's jay, the northern fur seal, and the endangered Steller's sea lion, all of which he described in 1741. His most important work, however, lies in documenting creatures which are now extinct: the northern sea cow [*Hydrodamalis gigas]* and the spectacled cormorant [*Phalocrocorax perspicillatus*]. Both of these natives of the Commander Islands in the Bering Sea were too tasty for their own good and were hunted to extinction by Russians stocking their food lockers en route to the sea otter and seal harvests along the Aleutian Islands. Without Steller's meticulous records of the sea cow, little would be known of how this giant creature looked and lived.

Without Steller's meticulous records of the sea cow, little would be known of how this giant creature looked and lived.

Steller was, however, only the first of a long line of distinguished naturalists who did important work in America. During the 19th century, there were several voyages that had unusually rich scientific aspects, whether recording "remarkable places," "natural curiosities," or the people they met.

The inaugural Russian circumnavigation of the globe, occurred from 1803 to 1806.

The first of these was the inaugural Russian circumnavigation of the globe, which occurred from 1803 to 1806. Like many of these long voyages, there were two ships in the expedition. The *Hope* [*Nadezhda*] was the lead ship, commanded by Captain Johann von Krusenstern; its companion, the *Neva* had Yuri Lisiansky at the helm. It was Krusenstern who revived one of Catherine the Great's ideas. He persuaded the Admiralty that Russia should give up building ships in Siberia and sail to the Pacific by going around the world. Russia purchased two ships in England and outfitted them with the best of British navigational and scientific instruments. Among these was John Harrison's invention, the

chronometer—for determining longitude—which received its first extended test on Krusenstern's voyage, and Troughton's improvement on the sextant, the reflecting circle.

The thermometer invented by James Six and designed to record temperatures at different depths was given a trial run on Krusenstern's ship as well. A distinguished Swiss astronomer and two naturalists were the scientists on board; both Krusenstern and Lisiansky had extensive scientific training as well. Indeed, because of the training provided in the Naval Academy, all officers in service in the North Pacific were well versed in marine science. They often were excellent reporters and even artists, describing the new worlds which they encountered.

This first circumnavigation produced much new information about the density of the waters of the Pacific in different latitudes, about currents, magnetism, and weather patterns.

This first circumnavigation produced much new information about the density of the waters of the Pacific in different latitudes, about currents, magnetism, and weather patterns. A full volume of Krusenstern's journal of the voyage is taken up by the scientific reports. Aside from his purely scientific tasks, Krusenstern also was charged with charting many new areas, particularly around northern Japan. The two naturalists on his ship have left a legacy of more than one hundred illustrations of Japanese people, communities, flora, and fauna—many of them in brilliant color.

Krusenstern's companion vessel, the *Neva,* did not go to Japan but to Kodiak and Sitka. Its captain, Yuri Lisiansky, made meticulous charts of Kodiak Island and Chiniak Bay, the entrance into the port of St. Paul Harbor, present-day Kodiak. Lisiansky is as well known, however, for his ethnographic studies as for his maritime work. His atlas contains drawings of many of the objects which he collected and took back to Russia for the Academy of Sciences. His collections at museums in Russia are among the earliest from Kodiak and Sitka.

Langsdorff made the first collection of artifacts from northern California.

Georg von Langsdorff, a naturalist with Krusenstern left the voyage after Japan. He traveled to Sitka with Nikolai Rezanov, who had hoped to be Russia's first ambassador to Japan. Both Langsdorff and Rezanov spent some time in Unalaska, Kodiak, St. George Island, and Sitka, and then bought an American ship and sailed to San Francisco. The results of this side-trip were important, for Langsdorff made what has proved to be the first collection of artifacts from northern California, as well as notable drawings of the Costanoan and Pomo Indians.

Another round-the-world voyage of special interest is the expedition of Otto von Kotzebue in 1815. A passage across the top of North America to connect the Pacific and Atlantic oceans was an elusive dream for 18th and 19th century mariners for all nations. The futile search for what the Russians call The Northeast Passage inspired many voyages, Kotzebue's among them. Following the return of Krusenstern and Lisiansky in 1806, Russia became embroiled in the Napoleonic Wars. Pacific exploration came to a halt. A wealthy Russian count, with an interest in science, N. P. Rumiantsev, grew impatient with the tsar's neglect of the Pacific and organized his own expedition, Russia's first to have a purely scientific focus. He selected Otto von Kotzebue, who had served with Krusenstern on

the first round-the-world voyage, to command an expedition to look for the Northeast Passage across North America. Kotzebue's travels would take him farther north on the mainland of northwestern America than any mariner before him—although he did not find the fabled passage.

Kotzebue's travels would take him farther north on the mainland of northwestern America than any mariner before him,

Although most of Russia's expeditions had an international flavor, none was more cosmopolitan than the team assembled for Kotzebue's voyage of 1815. A popular French poet, whose family had sought refuge in Germany, was the naturalist; the doctor was Estonian. The artist was a German who had been educated in Russia. Kotzebue himself was a German who had settled in Estonia. And all but the naturalist, Adelbert von Chamisso, were under 30.

Kotzebue himself is identified with charting the north and vividly describing Europe's first contact with the Siberian Yupik and Inupiat of North America. Chamisso, a renowned poet, has left a more profound mark on science, however, through his studies, collections, and identifications. He published the first study of North Pacific whales, using Aleut/Unangan knowledge in his reports.

Chamisso is noted for having conducted the first complete botanical profile in western America.

He is also noted for having conducted the first complete botanical profile in western America. While on Unalaska Island, he took samples of every species of plant and later published his findings. Such data is an invaluable indicator to later scientists of how plant culture has changed over time.

Chamisso and the ship's doctor, Johann Eschscholtz together collected an unprecedented number of plant and animal species from the Aleutian Islands, St. Lawrence Island, Kotzebue Sound, and also in the San Francisco Bay area. In the latter area, Chamisso identified more than thirty new species, including the California Poppy [*Eschscholtzia californica*].

Eschscholtz returned to some of the same areas in 1824 with Kotzebue and produced an outstanding *Zoological Atlas*, which contains his own drawings of some of the more unusual animals he identified—the California coyote and marbled salamander, among them. In his report of this second voyage, he notes that he collected or examined and described more than 2400 animal species in the three years of the voyage, many of them at Sitka and in California.

There was another significant player on the Kotzebue voyage of 1815. Louis Choris, only twenty years old, was the artist who proved an eager associate of the scientists, helping them collect, and painting many of their specimens, both plant and animal. He has also left memorable portraits of men and women of the Aleutian Islands and California, as well as scenes from daily and ritual life. His paintings and lithographs of St. Lawrence Island and Kotzebue Sound provide the earliest European recordings of life among the Siberian Yupik and the Inupiat.

At a small distance from the shore, we were met by a baydar, with ten islanders, who approached us without fear, calling aloud to us, and making the most singular motions, holding fox skins in the air, with which they eagerly beckoned us .... How much did I regret not

understanding their language, as I should then have been able to relate many interesting things concerning these people.

On approaching St. Lawrence Island, June 27, 1816
Kotzebue's Journal, 1821

Two of the Russian voyages are particularly notable for science experiments. In 1823 Kotzebue made a second voyage into the North Pacific, this time at government expense. A young physicist from Tartu University in Estonia, Emil Lenz, traveled on his ship, the *Enterprise*. His mission was to test a new device, an insulated water bottle or "bathometer," to measure the density of water at great depths. Unlike earlier efforts to record the properties of water at various depths, this time the instrument brought the sample safely to the surface. Lenz was able to make recordings of temperature and salinity to 3000 fathoms, a feat unequalled for fifty years.

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Another voyage that produced valuable new scientific information was commanded by Captain Fedor Litke from 1826-1829. Litke was perhaps the most scientific of all the naval officers in the 19th century. He later founded the Russian Geographic Society and was president of the Russian Academy of Sciences. On his voyage, Litke took readings with an invariable pendulum as part of an international effort to learn more about gravity and the shape of the earth. In addition, Litke conducted studies on magnetism and barometric pressure at different latitudes. Aside from such important experiments with physics, he produced an outstanding atlas of the North Pacific, which was a summary of the one hundred years of charting and mapping on both sides of the Bering Sea. His scientific team also included an artist and two naturalists, whose names are well known to biologists through birds and plants they identified — the Kittlitz's murrelet and Alaska's delightful summer wildflower, *Mertensia paniculata*, the common bluebell, among them.

Litke was perhaps the most scientific of all the naval officers in the 19th century.

As one surveys the work of the mariners and scientists who explored the North Pacific during the Russian era, an impression of remarkable energy emerges. The two Kotzebue voyages as well as the Litke voyage produced thousands of specimens for the museums of St. Petersburg. Indeed, the Litke voyage of 1826 returned 1200 illustrations, nearly 4000 specimens, and hundreds of artifacts; it was the largest scientific collection made by any European voyage up to that date.

The Litke voyage of 1826 returned the largest scientific collection made by any European voyage up to that date.

Ten years later, a young Russian scientist, Il'ya Voznesensky, who spent four years in Alaska and California, sent more than twenty-seven trunks with over 5,000 specimens and artifacts to Russia. The naturalists not only described and collected hundreds of plants and animals unknown in Europe, but they also meticulously recorded details of cultural life very different from anything they had known. For their part, the mariners gave shape to the North Pacific, defining its coastlines and islands, charting the harbors and bays with such accuracy that their maps were used well into the 20th century. Some of the voyagers went about their business making

meticulous recordings of weather, currents, water density, all duly noted and reported to the Admiralty. On such "routine" voyages, flashes of brilliance would appear, as on one which sailed round the world from 1817 to 1819. Captain Vasily Golovnin's journal of his encounters with indigenous peoples is notable for its cultural neutrality and sensitivity. And the artist who accompanied him, Mikhail Tikhanov, produced a remarkable series of thirty watercolors of Alaska and California people and places which comprise the entire body of work for this tragic young man, who fell mentally ill near the end of the voyage and never painted again.

Mikhail Tikhanov produced a remarkable series of thirty watercolors of Alaskan and California people and places.

Over the course of 142 years, from Peter's order to Vitus Bering to "go north," until Russia sold Alaska in 1867, Russian chart-makers, navigators, physicists, astronomers, artists, and naturalists worked to achieve Catherine's order to "bring to perfection...knowledge" of the North Pacific.

It must not be forgotten, however, that their writings, their collections, their maps, and illustrations, their scientific data all were conducted within the context of a colonial empire, whose principal interests were commercial and geopolitical. Great social dislocation and cultural losses occurred within the regions of America colonized by Russia. Disease and hard labor devastated the population of the Aleutian Islands and Kodiak in the eighteenth century. In the next century, Russian policymakers tried to mitigate the effects of an imposed economy and western culture. Russians encouraged the use and preservation of Native languages, founded schools with bilingual education, and they did not forcibly prohibit traditional customs, blending many of them with the new Orthodox Christian religion from Russia. They introduced public health programs, including vaccinations for smallpox. Concerned with the declining population of marine mammals, Russian officials introduced conservation practices as early as 1803.

It must not be forgotten, however, that their writings, their collections, their maps, and illustrations, their scientific data all were conducted within the context of a colonial empire, whose principal interest was commercial and geopolitical.

Science under Sail examines a part of Russia's legacy in America that is not the usual treatment of a colonial regime—without forgetting the background against which this story is written. It is the story of pioneers and risk-takers, of scientists and poets, of mariners and artists who dared to sail in uncharted waters. The scientific work accomplished by the naturalists and the chart-makers, the information conveyed by mariner's journal and artist's palette, all had real value. The collections of artifacts and specimens were once called "curiosities" in Europe. But we now call them treasures for the information they hold about Native peoples and their way of life two centuries ago, about plants and animals—some now extinct—and about the waters and lands of the North Pacific. These collections and the information from the scientific studies carried out on these early Russian voyages provide today's scientists and policy makers with a deeper and more complex profile of the ecology of the North Pacific. They provide the peoples of America, Siberia, and Japan with a window into their past.

It is the story of pioneers and risk-takers, of scientists and poets, of mariners and artists who dared to sail in uncharted waters.

To All Students Who Embark on These Voyages:
By the Command of Her Imperial Majesty

Her Imperial Majesty, Catherine, extending her maternal and unremitting care for the happiness of her subjects has been graciously pleased to advance their knowledge of science, history, and the arts, in an expedition of discovery to the realms of Russia's Great Voyages to America.

In order to give you a full insight into what is expected from you, Her Imperial majesty has been graciously pleased to approve the following articles, to serve for your instruction.

Article I.
From the day of your setting out till the very conclusion of this expedition, you are to keep a log book accurately, yourself, noting therein all observations and records of your activities. You are to make vocabularies of the strange languages found, endeavoring to express as nearly as possible the meaning of such language. When you complete your endeavors, you will give up your log books and observations and such specimens as described in the articles to the department which Her Imperial Majesty will name for their reception.

Article II.
You are to examine the record of Her Majesty's expeditions of discovery in the great voyages to America from 1728-1867, understanding all accounts of the time and circumstance of said voyages and of such great men as have gone before you in these endeavors.

Article III.
To prevent misunderstanding of our Imperial intentions, you are to examine the journals relative to your expedition.

Article IV.
Whether you shall travel by sea or land, you are to have made instruments for navigation and to form exact charts of these almost unknown parts of the territories and to use them in the successful completion of your journey.

Article V.
You are to occupy a vessel of sufficient strength and convenience for you and your crew-mates and you are to observe in all matters the instructions of your officers. You will take all necessary steps to ward off scurvy.

Article VI.
When you have assembled your materials, you will collect readings of changes of temperature and content of the waters of the vast area you survey, forming tables of these observations.

Article VII.
You are to make descriptions and even drawings of the most curious productions of nature, and of the remarkable places you see.

Article VIII.
You will particularly attend to all natural curiosities you observe, employing your leisure time in making complete descriptions of such specimens. You will be careful in preserving the plants and animals that you may collect and catalog.

Article IX.
With regard to the all the people you may meet, you will inform yourself of their customs and culture, particularly in the manner of their vessels for transport on the seas.

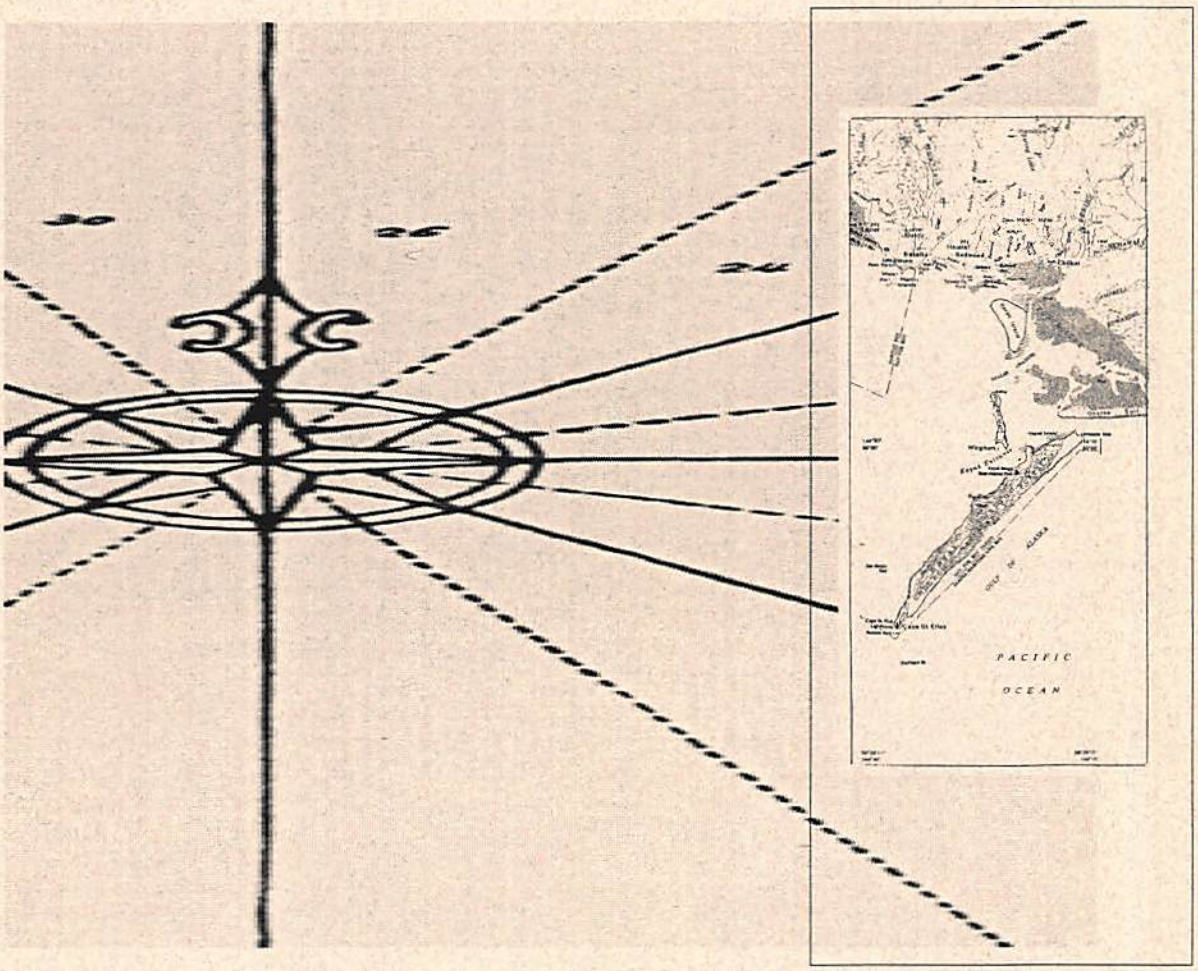
Article X.
You are authorized to make conclusions and observations of such perfect knowledge as has been produced in these voyages and remark on their clear and present import for all who will follow you.

Her Imperial Majesty has been pleased to order this important trust to be laid on you to complete according to your own interests and judgment the prescriptions of these articles. This trust will doubtless raise in your heart and thoughts a noble emulation of such great learners as have to their honor been employed in like services as you are charged with, and will excite you to think only how you shall begin with zeal, pursue with good sense, and end with honor, this important charge.

Science Under Sail: Russia's Great Voyages to America, 1728-1867

"Expeditions of Discovery"

Overview



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SUMMARY

Students begin their log books and read a brief overview history of Russia's great voyages to America from 1728-1867. Maps, a poster, and a timeline supplement the overview.

MATERIALS

- log book and pencils, pens
- materials upon which to construct a timeline such as string and clothespins
- map of places in the lessons* (Appendix and poster)
- "People and Places" name cards* (Appendix)
- "Timeline"* (Appendix)
- "To All Students Who Embark on These Voyages: By the Command of Her Imperial Majesty," charge to the students in the manner of Catherine the Great*

** included with the Instructional Guide*

ACTIVITIES

1. (Optional) Students read the charge "To All Students Who Embark on These Voyages: By the Command of Her Imperial Majesty."(estimated duration: 10-20 minutes) To introduce the flavor of this series of lessons and activities, the charge "To All Students Who Embark on These Voyages" contains a summary of the activities and lessons that follow.

2. Students begin the log book and record the first entry. (estimated duration: 10-20 minutes) Start with today's date, time, and place. Add a statement about the weather with a notation about the wind, an especially significant ingredient in the sailing community. Continue as directed.

3. Students read the Overview of the exhibition, *Science Under Sail, Russia's Great Voyages to America, 1728-1867*. Students use the "People and Places" cards as appropriate. Students write descriptions of selected people and places. (estimated duration: 40-60 minutes) The names of people and places in the Overview are a rich representation of the period and the Russian language. **Bold lettered words** are found in the glossary with selected pronunciation.

Older students may wish to read the narrative to themselves or with a partner. Younger students may prefer to read aloud in small groups or with a partner.

Suggested ways to use the "People and Places" name cards:

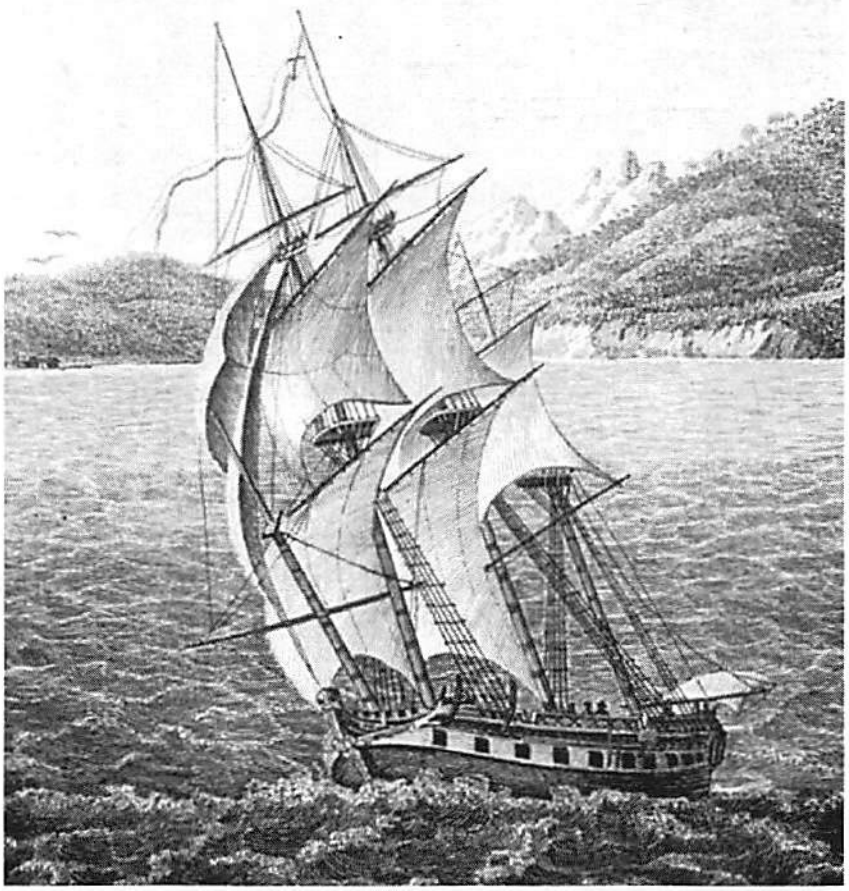
- For some levels, having one or more name cards in hand while reading will focus attention on the details in the overview. For more advanced students, the entire list or a portion may be a useful guide for note-taking. Students write one or two-word descriptions beside each name while reading or listening to someone else read.

4. Students begin constructing a timeline of Russian exploration and related history. (estimated duration: 20-30 minutes) Begin a group timeline. Suggested materials include string lining the area with events hanging from clothes-pins; accordion-fold paper strips, or individual timelines in the log books. Begin with 1700 and continue to 2000. Students post what they know about Alaska/Russia/California currently, and then add Russian exploration events. As students read about the voyages in subsequent lessons, they continue adding to the line. Wherever possible, create a larger context for the events of the Russian expeditions by adding significant world events.

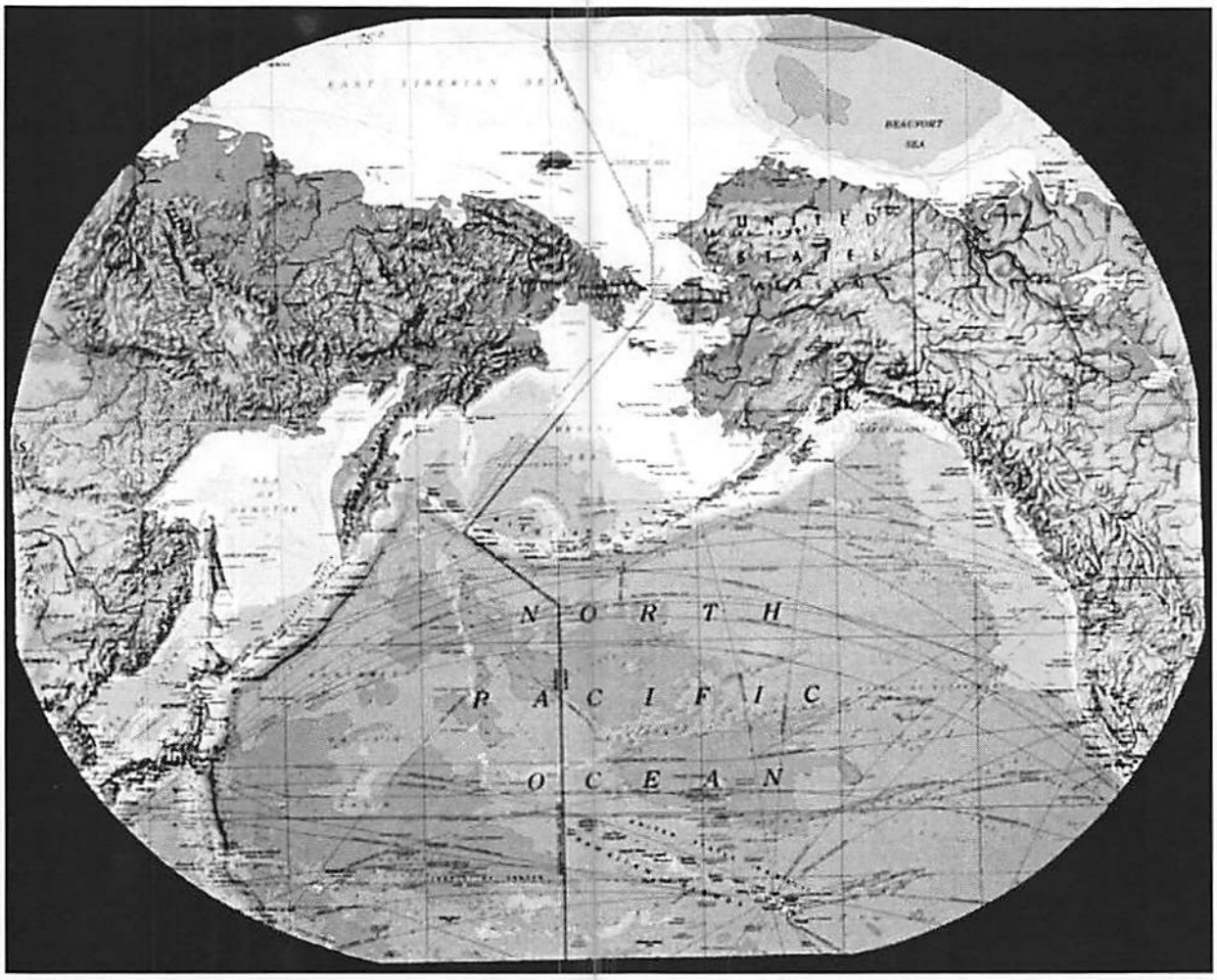
Science Under Sail: Russia's Great Voyages to America, 1728-1867

Expeditions of Discovery

A small ship travels in a vast unknown, its international crew sent to find "What's out there?" This is not today's space shuttle nor tomorrow's starship, but another vessel called *Enterprise*. This is a Russian ship in the 1820's, sailing in the unknown North Pacific. Commanded by the young Otto von Kotzebue, the *Enterprise* was one of the sturdy Russian ships challenging the unknown in the eighteenth and nineteenth centuries.



The *Hope [Nadezhda]*, engraving from drawing by W. G. Tilesius von Tilenau. Detail from Atlas of I. A. Krusenstern. Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks



The North Pacific. Detail from Map of the World. Data as of 1975.
U. S. Department of Defense.

This is a map of the region as we know it today. The North Pacific region is a huge ocean bounded by Japan, Siberia, and Alaska—and Hawaii and California in the south.

This is the way the North Pacific looked on the maps the Russians used for their first voyages—a great blank space covering a large part of North America.

For over 100 years, the Russians sent 225 ships into those mysterious waters, gradually shaping the North Pacific through **charts** and **maps** to the boundaries we know today. Not knowing what they would see or find, many of the expeditions carried scientists and artists to collect objects, write descriptions, and draw pictures. They sent their collections of curiosities back to Russia and Russia's neighbors in Europe.

For many years, these collections and records were off-limits to Russia's enemies in the West. Today, the "**Ice Curtain**" is melting, and the work of these pioneers is coming to light.

Map of the World, Paris, 1744.
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks.

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Peter the Great, oil.
Alaska State Museum

The story of Russia's great voyages to America begins with **Peter the Great**. A ruler with enthusiasm and talent, he founded the Russian Navy, and brought great **mariners** and scientists to serve his country. As Peter lay dying, he ordered an expedition to sail from Siberia and find "where it is joined to America."

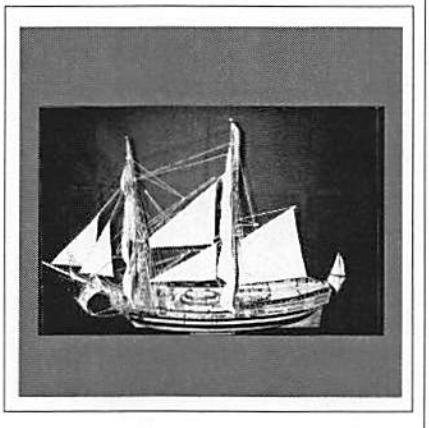
Bust of Vitus Bering, reconstruction from his skeletal remains, 1992 by Dr. Viktor Zviagin, Moscow.
Photograph courtesy Wieland Hintzsche

Peter selected Vitus **Bering** from Denmark to command this expedition. Before Bering could even begin his sailing journey, he had to trek overland for three years across almost 7000 miles of **tundra**, rivers and forest. THEN, when he arrived on the coast of **Siberia**, he had to build his ship.

St. Gabriel, Engraving by I. Pshenichnyi, 1980s.
Central Naval Museum, St. Petersburg, Russia

Bering's ship, the *St. Gabriel,* sailed from Siberia in 1728, north along the coast and then east. But he did not find America. Some people back in **St. Petersburg** considered the cost a waste and the voyage a failure. But Bering had sailed farther north in the Pacific than anyone up to that time.

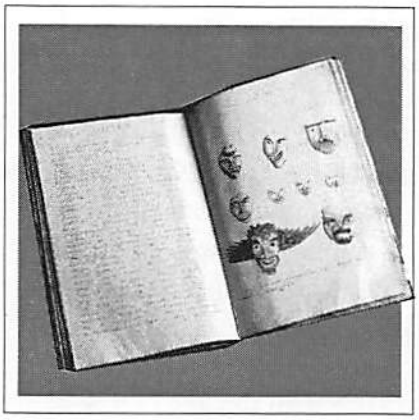
In 1732 Russia sent another voyage to try to find America. The fate of this journey and its sailors is a tragic trick of history. Once more the sturdy *St. Gabriel* sailed, commanded by M. S. **Gvozdev** and Ivan **Fedorov.** They traveled close to the westernmost point of mainland North America and their crew went ashore on America's **Little Diomede Island.** They sighted America's mainland at today's **Cape Prince of Wales.** But their travel reports did not reach headquarters until after the Bering voyage of 1741. It is Bering who has been given the credit for Russia's first encounter with America in the Pacific. Captain James **Cook** named the straits for Bering after sailing in the area in 1778.



St. Peter
Model by G. Atavin, St. Petersburg, Russia, 1999

Back in St. Petersburg, Bering persuaded Empress Anna to try another, bigger expedition. This expedition lasted nine years, from 1733 to 1742. It was a huge project, involving more than five hundred men and all the supplies to build several ships. In addition to America, the expedition explored Siberia and the waters around Japan. The first study of the people of eastern Siberia came from this gigantic project. Scientists collected thousands of plants and animals, including species that are now extinct. The mariners made many new maps and charts. And on **Kayak Island**, Bering claimed American land for Russia. But the expedition had a tragic ending.

After all the years of preparation, only a few hours were spent on American land. Bering and half of his crew died of **scurvy,** and his ship, the *St. Peter*, wrecked on Russia's **Bering Island.** Bering's fellow officer, Aleksei **Chirikov**, sailing the second ship, the *St. Paul*, barely made it back to Russia after losing almost one-third of his crew.



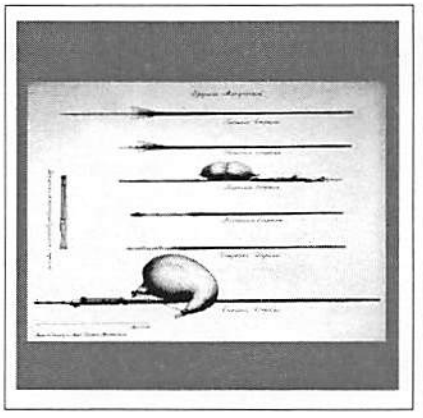
Journal with illustration, "Masks of the Aleuts," 1787-91, G. Sarychev. Detailed journals and log books were kept by all the expeditions.
Russian State Archives of the Navy, St. Petersburg

Hat. Alutiiq. Wood and paint. Collected by. G. Sarychev from Kodiak in the summer of 1790. It is one of the oldest objects from Alaska in a European museum.
Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), St. Petersburg, Russia

For a long time after Bering's voyage, only private fur-hunters explored the route to America. When **Catherine the Great** became Russia's ruler, the government started exploring again. The Billings-Sarychev Expedition of 1785-92 was one of the most ambitious of these official expeditions. Catherine selected Joseph **Billings** to lead the expedition because he had served under the great English captain, James Cook. With Lieutenant Gavriil **Sarychev**, Billings led the successful voyage to describe the northern shores of the Pacific. Empress Catherine the Great gave the orders that guided the scientific explorations of the North Pacific over the next one hundred years. She urged her officers "to bring to perfection the knowledge acquired under her glorious reign."

Arka. Evenk village (Siberia). Drawing by L. Voronin, ca. 1787, in S*ketches and Coastal views...of the Chukchi Sea...*
Russian State Archives of the Navy, St. Petersburg

They were, above all, to describe all the "remarkable places" and "natural curiosities" they encountered and make collections for Russia's museums. The careful journals kept by the captains and naturalists on the two ships show how well they understood the importance of their mission.

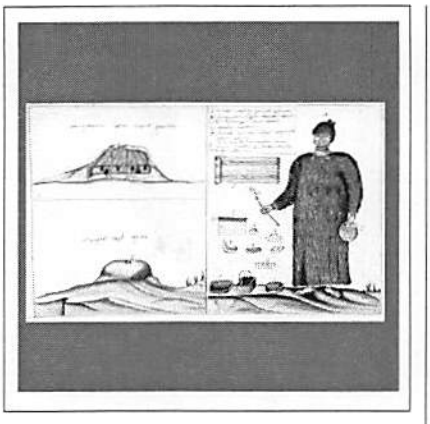


Weapons of the Aleuts. Wclr. P. Mikhailov. Ca 1828.
Estonian State History Museum, Tallinn

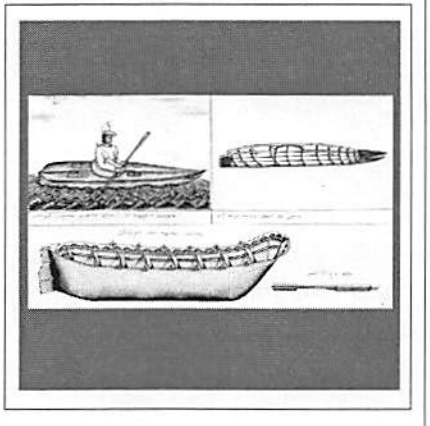
In many situations, words could not describe the people the travelers met. The powerful pictures made by sailing artists tell us about the land and people of the North Pacific.

Aleut/Unangan in a Kayak. Detail from map by Sven Waxell, 1741. First recorded image. Waxell and his 11-year-old son, Laurentz, sailed with Bering in 1741 and survived.
Russian State Archives of the Navy, St. Petersburg

Sometimes even ship's officers made important visual records. Sven **Waxell**, an officer on Bering's ship, drew the first known picture of an **Aleut/Unangan** in a **kayak**.

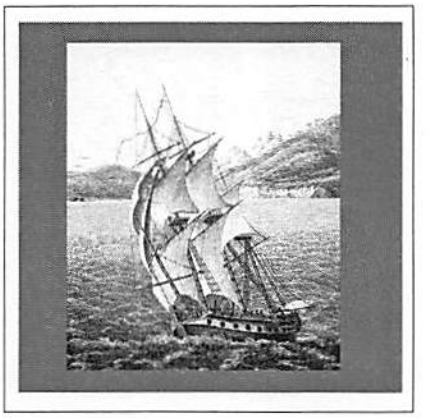


Women's tools and life. By M. Levashov. *Atlas with Views of Kamchatka & Aleutian Islands, ca 1768.*
Russian State Archives of the Navy, St. Petersburg



Aleut/Unangan boats. By M. Levashov. *Atlas with Views of Kamchatka & Aleutian Islands, ca 1768.* Russian State Archives of the Navy, St. Petersburg

Even more detailed views of Aleut/Unangan life were recorded in 1768 by the navigator of the first expedition sent out by Catherine the Great.



The *Hope* [*Nadezhda*], engraving from drawing by W. G. Tilesius von Tilenau. Detail from Atlas of I. A. Krusenstern.
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks

In the 19th century, Russia learned it could sail around the world. That meant it did not have to set out from Siberia to the North Pacific, but could sail from its ports on the **Baltic**. Starting in 1803, Russia sent out forty round-the-world voyages. By this time, Russia had a colonial government in Alaska with its capital at **Sitka** and soon founded **Fort Ross** in California, north of San Francisco. Most of the round-the-world voyages carried supplies, officials, or instructions for the colonists in Alaska and California. The voyages also brought scientists who left a remarkable **legacy**.

Steller's jay mount.
Pratt Museum, Homer, Alaska

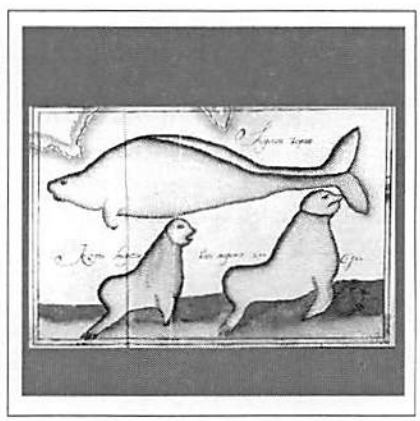
Georg Steller, the naturalist with Bering knew he was in America when he spotted this bird on Kayak Island because he had seen a picture of its relative in a book of paintings about American birds.

Fur Seal Wclr., Anon.,1740s., for publication in Steller, *De bestiis marinis, 1751.*
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks

V. Pape. ca. 1830. Wclr. *Carbo perspicillatus[Spectacled Cormorant].* An extinct species.
St. Petersburg Branch, Archives of the Russian Academy of Sciences

One well-known scientist, Georg **Steller**, sailed with Bering in 1741 to America. He only had ten hours to spend on Kayak Island, collecting and recording all that he saw in that "remarkable place."

During the voyage and later on Bering Island, he identified the **Steller's jay**, the **northern fur seal**, and the **Steller's sea lion**. His most important work, however, was in describing the **spectacled cormorant** and the **sea cow.**



Detail from S. Waxell map, 1741. Sea cow (upper), fur seal (l.) and sea lion (r.). The sea cow is extinct; the Steller's sea lion is on the endangered list.
Russian State Archives of the Navy, St. Petersburg

These animals were too tasty for their own good. They were hunted to extinction by Russians filling their food lockers as they sailed to hunt sea otters and seals.

Captain *Johann von Krusenstern,* lithograph by V. Krylov, first half 19th century. Commander of Russia's first round-the-world voyage, 1803-06.
Central Naval Museum, St. Petersburg

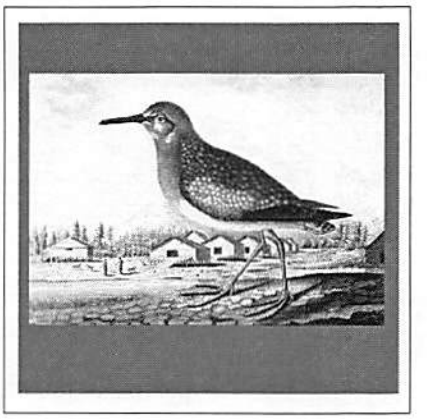
During the nineteenth century, many voyages made rich scientific findings. These expeditions included the first Russian voyage around the globe, from 1803 to 1806. Most of these long voyages had two ships in the expedition—a sailing "buddy" system. The lead ship was commanded by Captain Johann von **Krusenstern**. Yuri **Lisiansky** commanded the second ship.

Captain-Lieutenant Yuri Lisiansky, oil by V. L. Borovikovskii, 1810. Second in command of Russia's first round-the- world voyage, 1803-06.
Central Naval Museum, St. Petersburg

For these first round-the-world voyages, Russia bought two ships in England. The captains supplied the ships with the best British scientific and navigation tools. They took along new scientific instruments such as the thermometer invented by James **Six** to take the ocean's temperature at different depths. From these efforts, scientists learned important facts about earth's magnetism, weather patterns, and the waters of the North Pacific.

Reflecting Circle by Troughton, ca 1800. British Maritime Museum, Greenwich

They used an innovative navigational instrument called the reflecting circle. It increased a navigator's ability to find his position at sea with mirrors that made possible a full 360° reading of the angles among celestial bodies. When used with lunar tables, the circle allowed for a fairly precise calculation of latitude and an approximation of longitude.



Brown Ruff of Sakhalin Island, by W. G. Tilesius von Tilenau, ca 1804. Atlas of I. A. Krusenstern.
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks

One whole volume of Krusenstern's journal of the voyage is filled with scientific reports. Apart from his scientific tasks, Krusenstern charted new areas, especially around northern Japan. The two naturalists on his ship made more than 100 illustrations of Japanese people, plants, and animals.

Bowl in shape of a bird. Wood. Collected by Yuri Lisiansky, Kodiak, 1805. Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), St. Petersburg, Russia

The other ship on the first round-the world voyage traveled to **Kodiak** and Sitka. Its captain, Yuri Lisiansky, made careful charts and detailed studies of the people. His collections in museums in Russia are some of the earliest from Kodiak and Sitka.

Necklace of abalone shell. Collected by Georg von Langsdorff in northern California, 1805.
Staatsliche Museum fur Volkerkunde, Munich, Germany

Georg von **Langsdorff** was a doctor and scientist on this early Russian journey. He made the first collection of objects from northern California as well as notable drawings of the people.

Otto von Kotzebue. Oil by A. A. Tron, 1989. Captain of the *Rurik*, which first explored northwestern Alaska, 1815-18.
Central Naval Museum, St. Petersburg, Russia

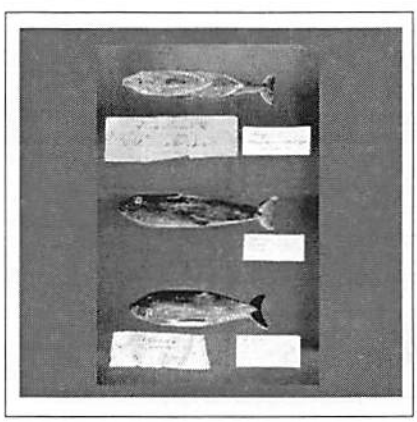
The futile search for what the Russians call the **Northeast Passage** (the route from the Pacific to the Atlantic) inspired many voyages, including Otto von Kotzebue's in the *Rurik*. Kotzebue traveled in 1815 farther north along the coast of America than any Russian sailor before him, but he did not find the fabled Passage.

Men in an Umiak. Field sketch with watercolor. By L. Choris, 1817.
Yale Collection of Western Americana, Beinecke Rare Book and Manuscript Library

Kotzebue met and exchanged greetings with the people he met, including the peoples of St. Lawrence Island. In his journal, he wrote: At a *small distance from the shore, we were met by a* ***baydar****, with ten islanders, who approached us without fear, calling aloud to us, and making the most singular motions, holding fox skins in the air, with which they eagerly beckoned us...How much did I regret not understanding their language, as I should then have been able to relate many interesting things concerning these people.*

Adelbert von Chamisso, engraving by E.T.A Hoffman. The naturalist who traveled with Kotzebue in 1815-18.
Berlin Botanical Museum

Most of Russia's expeditions had an international crew, but none compared to the team sailing with Kotzebue in 1815. The crew came from many countries, and the captain, himself, was from **Estonia.** The naturalist, Adelbert von **Chamisso**, was also a popular poet in Germany.



Cetaceans (whales and dolphins) carved for A. von Chamisso of driftwood by Aleuts/Unangan at Unalaska, 1817.
Museum of Natural History, Berlin, Department of Historical Research

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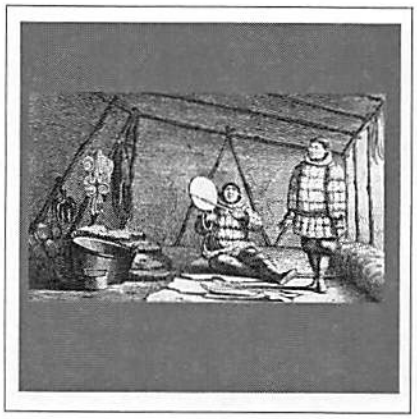
Chamisso added to science knowledge through his studies, collections, and identifications. He published the first study of North Pacific whales, using Aleut/Unangan knowledge in his reports. These whale models were carved for him at **Unalaska**

California Poppy (*Eschscholtzia californica)*, wclr. By A. von Chamisso. First identified in California by Chamisso, 1817.
The LuEsther T. Mertz Library, New York Botanical Garden

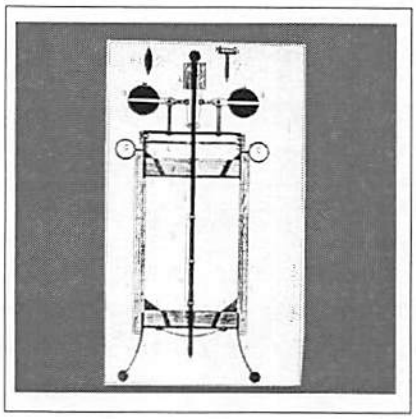
Chamisso and the ship's doctor, Johann **Eschscholtz,** collected many plant and animal species from Alaska and the San Francisco Bay area. In California, Chamisso identified more than 30 new species. He named the California Poppy for his friend, Eschscholtz. Eschscholtz came back to California on a later voyage and identified the California coyote and the giant salamander. In his report of this second voyage, he said that he collected and described more than 2400 animal species in three years in Sitka and California.

Clothing of the Women of the Gulf of Kotzebue. Field sketch with watercolor. By L. Choris, 1817.
Yale Collection of Western Americana, Beinecke Rare Book and Manuscript Library

The Kotzebue voyage of 1815 included the young artist, Louis **Choris.** He helped the scientists by collecting and painting many of their plant and animal specimens. He also made memorable scenes and portraits of the people he saw.

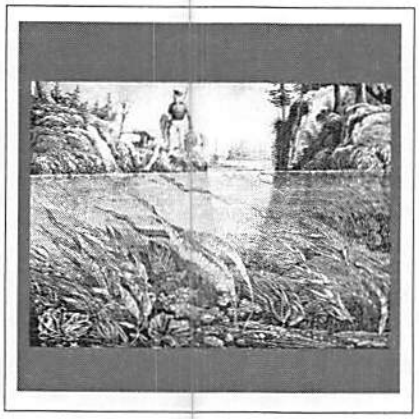


Interior of a Dwelling on St. Lawrence Island. Lithograph by L. Choris. 1817.
Anchorage Museum of History and Art



Lenz-Parrot Insulated Water Bottle ("bathometer"), drawing by Emil Lenz, 1830. Kotzebue voyage, 1823-26.
Museum of the University of Tartu, Estonia

Russian voyages were particularly notable for science experiments. Emil **Lenz**, a young physicist, traveled with Kotzebue in 1823, testing the waters. His new instrument, the "**bathometer**," a kind of insulated water bottle, took the ocean's temperature and measured its saltiness.



Illustrationes algarum, by A. Postels, 1836. This illustration shows fellow naturalist Karl Mertens collecting specimens in a tidal pool.
The LuEsther T. Mertz Library, New York Botanical Garden

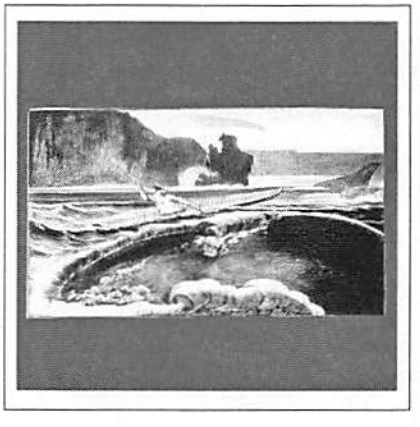
The Russians collected and described every new thing they found. Imagine traveling in the already crowded ship as it filled up with new discoveries! Captain Fedor **Litke** led a voyage that produced 1,200 illustrations, 4,000 specimens, and hundreds of **artifacts**. It was the largest scientific collection up to that date.

Male Figure, wood and hair. Alutiiq. Collected by Joseph Billings, 1790-1791.
Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), St. Petersburg, Russia

Amulet. Aleut. Ivory. Collected 1840s by Voznesensky.
Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), St. Petersburg, Russia

Ten years later, the Russian scientist, Il'ya **Voznesensky**, spent several years in Alaska and California, and sent more than 27 trunks with over 5,000 specimens and artifacts back to Russia.

Aleut in Festive Dress, [Alutiiq] wclr. By Mikhail Tikhanov, 1818.
Scientific Research Museum of the Russian Academy of Arts.



Aleut Hunting the Whale. wclr. By Mikhail Tikhanov, 1818.
Scientific Research Museum of the Russian Academy of Arts.

The naturalists described and collected hundreds of plants and animals unknown in Europe. The artists carefully recorded the people they met. One of these artists, **Mikhail Tikhanov**, painted amazing watercolors of Alaska and California people and places. Sadly, his art career ended with the end of the voyage. He became mentally ill and never painted professionally again.

Over the 142 years, from Peter's order to Vitus Bering to "go north" until Russia sold Alaska in 186, Russia's sailing scientists achieved Catherine's order to "bring to perfection ... knowledge" of the North Pacific. Their science under sail gave us information we still use to understand the land, the waters, the people, the plants and the animals that cover one-quarter of the earth.

Background: The big issues to think about

Why did the Russians explore the Pacific?

- A passage from the Atlantic to the Pacific, through the Arctic Ocean was the goal of all European nations in search of improved routes of trade.
- Russia needed new resources and new markets for the one area in which it excelled in European and Asian trade: animal hides, both fur and leather.
- As Britain and Spain began to show interest in the North, Russia's eastern coast became vulnerable.
- After Russia established a colony in North America, the North Pacific was its highway, connecting Siberia and Sitka with the Kuril Islands.
- The new Academy of Sciences pressed Russia's monarchs to make Russia a center of knowledge and learning.

Activity 1

Read the charge "To All Students Who Embark on These Voyages" This is a parody of Catherine the Great's orders to Captain Joseph Billings in 1785. Most of the language and phrasing is directly from the actual charge, which is printed in full in Martin Sauer's *An Account of a Geographical and Astronomical Expedition....* (see "Resources" in the Appendix.)

Activity 2
Log book

Each Russian ship sailed with record-keepers who wrote and drew the story of the journey. Log books, journals, charts and maps formed the collections of information that guided each expedition. Every expedition added its own records to a growing body of knowledge that was shared among all the voyagers and the scientists at sea and at home. And every shred of information that was published or shared was used by the next voyage to simplify and guide its journey. Or, occasionally, and tragically, if the information was in error, to mislead as well. Your log book is a record of what you learn and experience on your voyage through "Science Under Sail."

Begin each entry with today's date, time, and then describe where you are when writing the entry. Then write about the weather. Is it sunny? Raining? Snowing? Always include a description of the wind—speed and direction—an especially significant ingredient when you are under sail. Record your first log book entry. "On this date, this is what I know about Russian exploration in Alaska and the Pacific from 1728-1867, and these questions are what I want to know."

Activity 3
Exhibition overview

Following your reading of the exhibition overview, add a sentence or brief description in your log book about the people and places to whom you were introduced today.

Activity 4

Begin a timeline of Russian and related world events from 1700-2000.

Science Under Sail: Russia's Great Voyages to America, 1728-1867

"Noble Emulation of Such Great Men"

Voyagers and Their Stories

Admiral F. P. Litke, lithograph, 1850s. Central Naval Museum, St. Petersburg

Captain Johann von Krusenstern, lithograph by V. Krylov, first half 19th century. Central Naval Museum, St. Petersburg.

Captain Otto von Kotzebue. Oil by A. A. Tron, 1989. Central Naval Museum, St. Petersburg, Russia

Captain Vasily M. Golovnin. Central Naval Museum, St. Petersburg

Article II

You are to examine the record of Her Majesty's expeditions of discovery in the great voyages to America from 1728-1867, understanding all accounts of the time and circumstance of said voyages and of such great men as have gone before you in these endeavors.

SUMMARY

In this lesson, students become acquainted with some of the key leaders of Russia's great voyages to America. Brave or foolish? Bold or cautious? With energy and deep commitment to the lonely task of command, these seven champions of Russia's explorations to America led the way to grand discoveries in science and seamanship. Our leaders are the Russian Empress, Catherine the Great, and the voyagers:

- Vitus Bering,
- Gavriil Sarychev,
- Yuri Lisiansky,
- Vasily Golovnin,
- Otto von Kotzebue, and
- Fedor Litke.

MATERIALS

- "Voyagers and Their Stories" narrative*
- maps of voyager routes and place names*
- log-books, pencils or pens

* *included with the Instructional Guide*

ACTIVITIES

1. Students read biographies of Catherine the Great and the voyagers. (estimated duration: 20-30 minutes)

2. Students portray the six voyagers and Catherine in a panel while their classmates try to guess their identities in "Who Am I? The Game Show." (estimated duration: 20-30 minutes)

3. Students write imagined accounts in their log books of being shipwrecked with one of the voyagers or Catherine. (estimated duration: 20-30 minutes)

4. In Addition: Students write a travel guide newspaper article based on one of the voyager's journeys. (estimated duration: 20-30 minutes)

A VOYAGER TO ADD TO THE STORY:

Thought to be 11 years-old when he sailed with Vitus Bering, Laurentz Waxell was the son of Bering's first officer, Sven. Almost nothing is known of Laurentz's experiences on that deadly 1741 voyage of the *St. Peter*. Laurentz and his father were among the few who made it back to Kamchatka, and Laurentz's father attributed their survival to the skill and knowledge of Georg Steller whose ability to identify health-giving plants revived many who had fallen ill to scurvy on the voyage.

After 1741, Laurentz continued his naval career, distinguishing himself and rising to the rank of fleet captain. In 1778, Catherine the Great made him and his two brothers noblemen. Baron Laurentz Waxell was about the same age as George Washington, who in 1778 was in the thick of the Revolutionary War as commander of the American forces.

"Noble Emulation of Such Great Men"

Voyagers and Their Stories

Imagine traveling by land one-quarter of the way around the earth in order to build a ship to sail to you know not where. Or picture yourself setting out to make the charts for all the places you see because nobody else has been there before you to make them. What would it be like to be the first to describe a place in your log book?

VITUS BERING

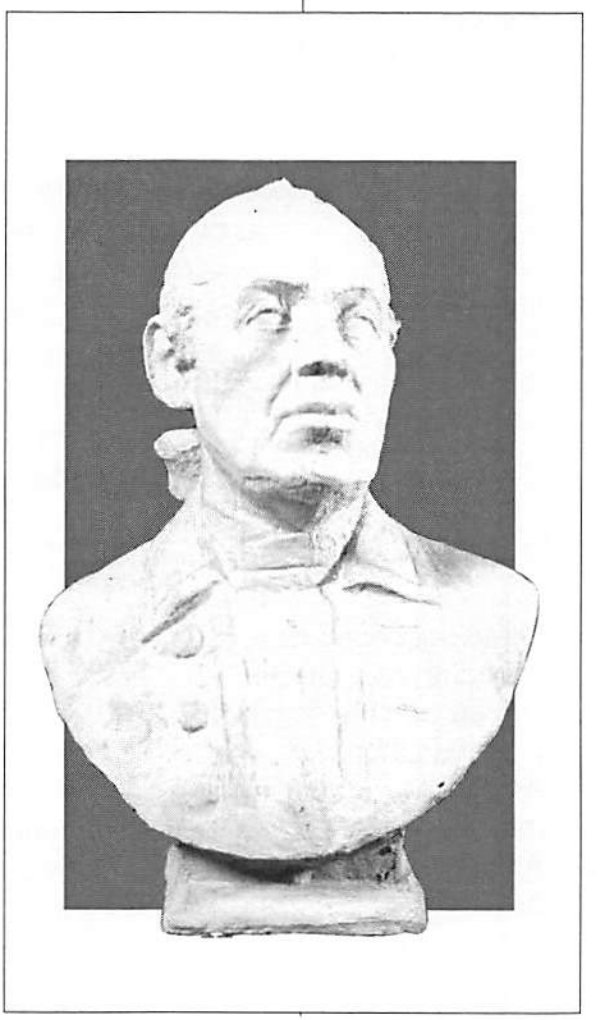
1680-1741

A well-credited explorer

Known primarily for two expeditions, I was not the first European to prove that Asia and America were separated, nor was I the first European to spot the mainland in what is now Alaska. But my expeditions have, nonetheless, become legendary in the story of European explorations. I am sometimes called Russia's Christopher Columbus.

My parents were not wealthy, but my family lived comfortably in our Danish seaport community. My parents named me "Vitus" after an uncle who was a famous poet. Perhaps the family hoped that having my uncle's name would turn me into a writer or that I might become a successful student like my older step-brother who worked for the Court. But I chose to be educated at sea instead of in a school room. At 14, I sailed as a cabin boy.

I mastered navigation, chart-making and geography in my seven years in school at sea. But it wasn't school in the way you think of it. I learned my subjects on the ship through practical experience. And I learned my subjects well enough to be invited to join the Russian Navy.



Bust of Vitus Bering, a reconstruction from his skeletal remains, 1992 by Dr. Viktor Zviagin, Moscow. Photograph courtesy Wieland Hintzsche

Then in 1724, the Emperor, Peter the Great, directed me to sail "along the land which goes to the north and ... appears to be part of America." After sighting **St. Lawrence Island,** my ship, the *St. Gabriel,* sailed through the stormy seas of the **Strait** that now bears my name. I went as far north as it seemed safe to go and turned around at 67° 18'N.

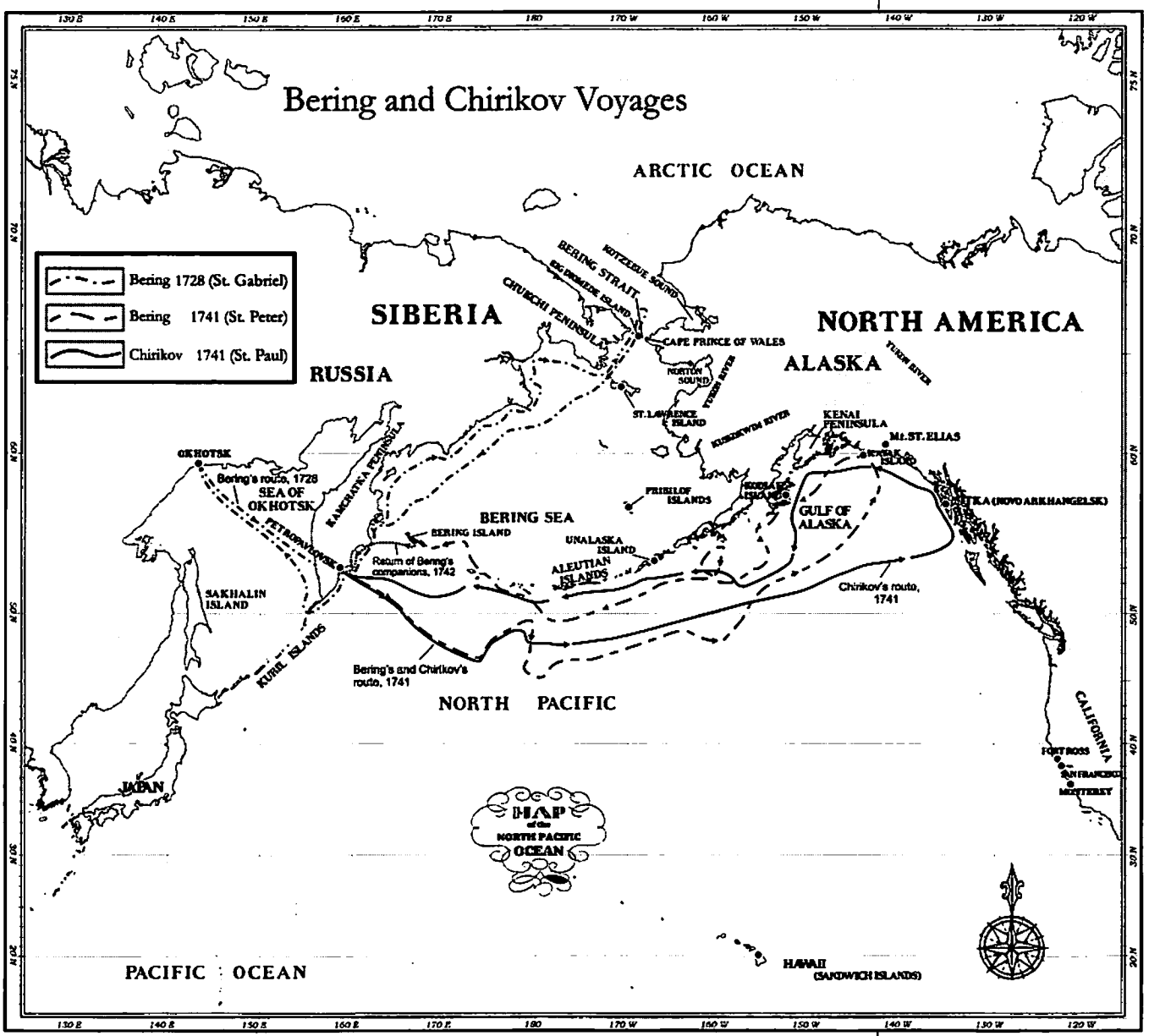
My second expedition started from **St. Petersburg** in 1733. More than 1000 men and 400 horses worked for four years to move all the gear and equipment across **Siberia.** Except for the wood, everything had to be carried to the **Sea of Okhotsk**—a journey of more than 7,000 miles, more than one-quarter of the way around the earth. Then the carpenters needed another three years to build the *St. Peter* and the *St. Paul* and two small boats for each ship. Finally in June, 1741, I sailed east on the *St. Peter*, with my second-in-command Aleksei **Chirikov** on the *St. Paul.* Soon after beginning the voyage, our ships lost sight of one another. I sailed on, sighting Mt. **St. Elias**, and stopping for a few hours at **Kayak Island** before turning my ship back to Russia.

Bering, himself, did not write long letters or the detailed journals of some of our other mariners. Or if he did write them, we do not know about them. Perhaps there are missing Bering journals somewhere in an attic or old bookstore, just waiting for you to discover them.

After all the years of preparation, the voyage lasted a few months—from June to November, 1741. The *St. Peter* shipwrecked on a Russian island, only a few sailing-days from our home port in Siberia. Half of my crew did not live to return to **Kamchatka.** A victim of **scurvy**, I, too, died during the winter. The island is now called **Bering Island.**

You know a little about my personality from the writings of those who sailed with me. Georg **Steller**, the physician and naturalist, shared my cabin during that last voyage. After years of preparation, I was not going to let the naturalist go ashore in America. When I finally gave in and permitted him to walk on America, I ordered the ship's trumpets blown, teasing the naturalist by pretending he was being honored by the music. At the end of ten hours, when Steller begged for more time on land, I ordered his immediate return. But I gave him a chocolate treat when he returned to the ship!

Often described as a cautious mariner, Bering stayed with his ship every time it anchored in America's waters. His crew made three landings on American soil; but Bering never set foot on shore!



Map designed by Mark Matson. Anchorge, Alaska. 2000

CATHERINE THE GREAT

1729-1796

Leadership for Russia's expeditions

Surprisingly, there are no geographic place names in Alaska for Catherine, although some geographers suggested re-naming the Aleutian Islands for her.

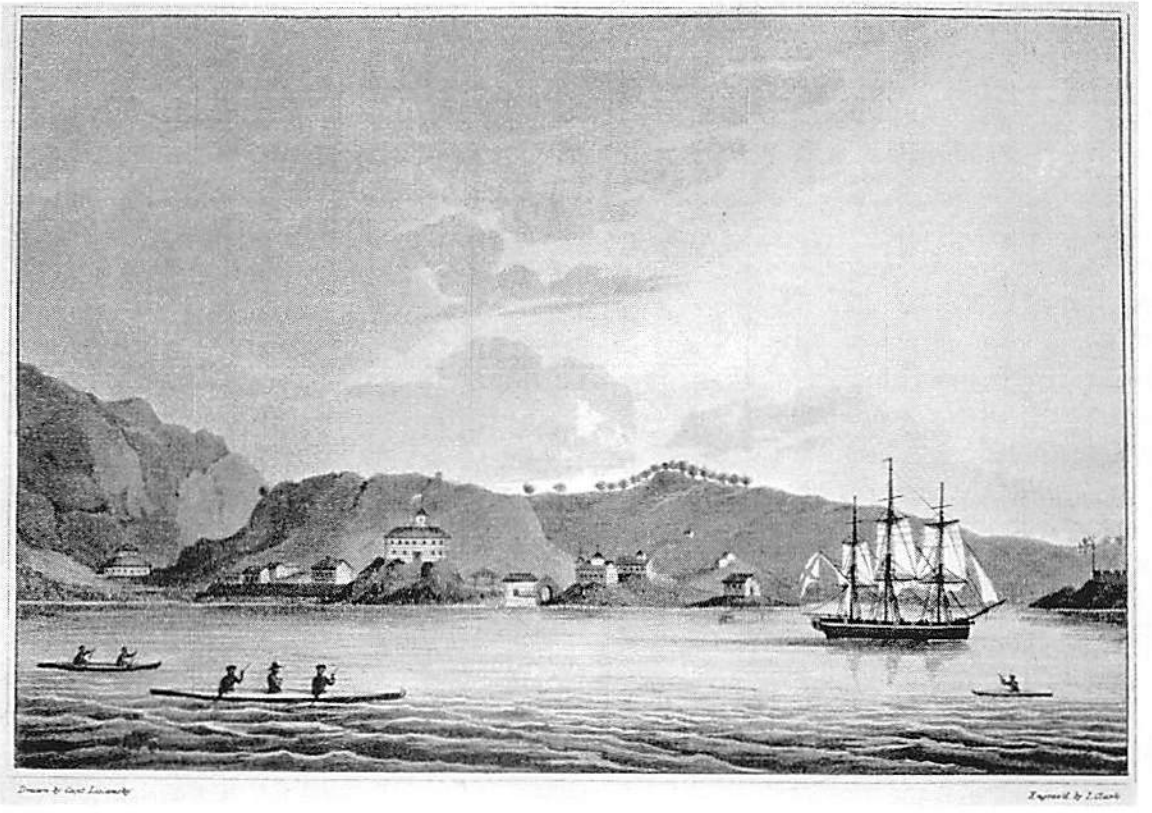
I was 33 years old, when I became the ruler of Russia. When my husband, Peter III (the third) died, I was his successor, even though I was born in Germany.

I always loved art, literature, science, and politics. As Russia's ruler, I extended the education system, opening the first school for girls. Through my encouragement, the first magazines were published in Russia, and the first private bookstores opened. As an example to my subjects, my son, Paul, and I received the first Russian vaccinations against **smallpox**.

I was known as Catherine the Great and Catherine II (the second). I ruled Russia for 34 years, from 1762 to 1796. I was famous for my energy, ambition, and intelligence. I was very interested in the discoveries being made in the **Eastern Ocean** (the Pacific Ocean) by the fur companies, but I was disturbed by the unruly fur hunters. I saw the opportunity for science discoveries, and for the promise of new lands which Russia would rule. I also wanted new subjects for the Russian crown. I ordered my navy to organize "secret" expeditions to explore the **Aleutian Islands** and the coast of the Alaska mainland. In 1776, when your country was fighting for independence from Britain, I was concerned about the British officer Captain **Cook** and his voyages in the North Pacific. Therefore, I commanded every expedition to leave markers with the words "Russian Territory" everywhere they sailed along the American coast.

Catherine the Great.
Alaska State Library/Alexander F. Dolgopolov Collection/Neg. 01-3871

Nine years later in the year 1785, I ordered a major expedition to explore eastern Siberia and northwestern North America. Besides important scientific aims, the "Northeastern Secret Geographical and Astronomical Expedition" also had the political goal of strengthening Russian claims to lands on both sides of the North Pacific. As expedition commander, I appointed one of Captain Cook's mariners, Joseph **Billings**



Harbor of St. Paul in the Island of Cadiack, lithograph by Yuri Lisiansky, *A Voyage Around the World in the years 1803, 4, 5, and 6.* England, 1814

What's in a name?

How does a place get its name? Many mountains, islands and waters in Alaska are named for the Russian explorers. Some were named by later explorers honoring those who traveled before them. For example, the English Captain James Cook named the Bering Straits in honor of Vitus Bering. Captain Golovnin named the Bering Sea to honor his predecessor. Captain Vancouver named Chirikov Island in honor of Aleksei Chirikov who sailed with Bering. Litke named Cape Sarychev, and Kotzebue named Sarychev Island for Gavriil Sarychev.

Other places were named by the explorers themselves. Bering named the town where he and Chirikov set sail for their two ships; Petropavlovsk is *St. Peter* and *St. Paul* combined. Kotzebue's journal records locations he named for members of his crew: Chamisso Island, Eschscholtz Bay. He named Kotzebue Sound for himself: "In compliance with the general wish of my companions, I called this newly discovered sound by my name." (Kotzebue, 1821)

Some names came from explorers who wrote what they heard the Alaska Natives say. Kodiak is the modern spelling for what was known as Kadyak or Kikhtak or Kikhtowik or Kadiak. Modern-day Sitka may come from a Tlingit name said to mean "by the sea."

The most complete history of Alaska place names is the *Dictionary of Alaska Place Names* by Donald J. Orth. Names of places in the United States become official when they are recognized by the US Board on Geographic Names.

GAVRIIL SARYCHEV

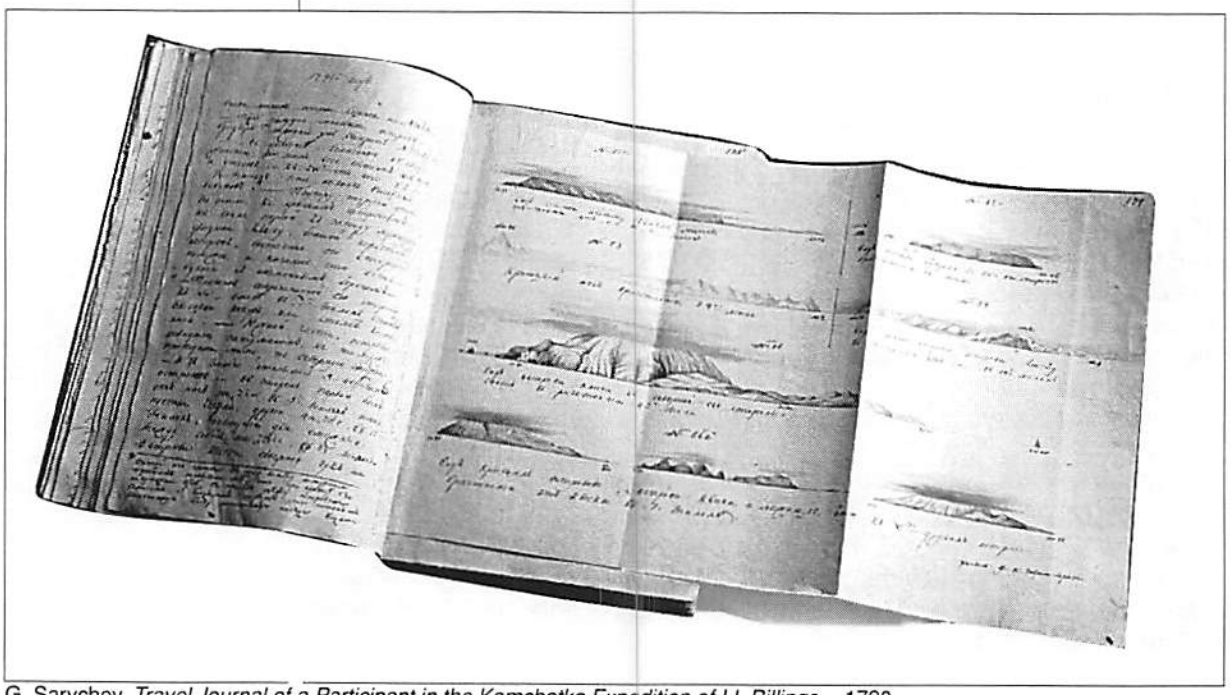
1763-1831
A sailor's sailor

A graduate of one of the first classes of the new Naval Cadet Corps, Gavriil Sarychev was only 22 when he was assigned to the "Northeastern Secret Geographical and Astronomical Expedition." Talented in astronomy and **hydrology**, he joined other illustrious expedition members: Christian Bering, a grandson of the noted Vitus Bering; Captain Joseph Billings, who had sailed with the famous Englishman, Captain Cook; and Dr. Carl Heinrich Merck whose family founded a medicine company that still does business around the world.

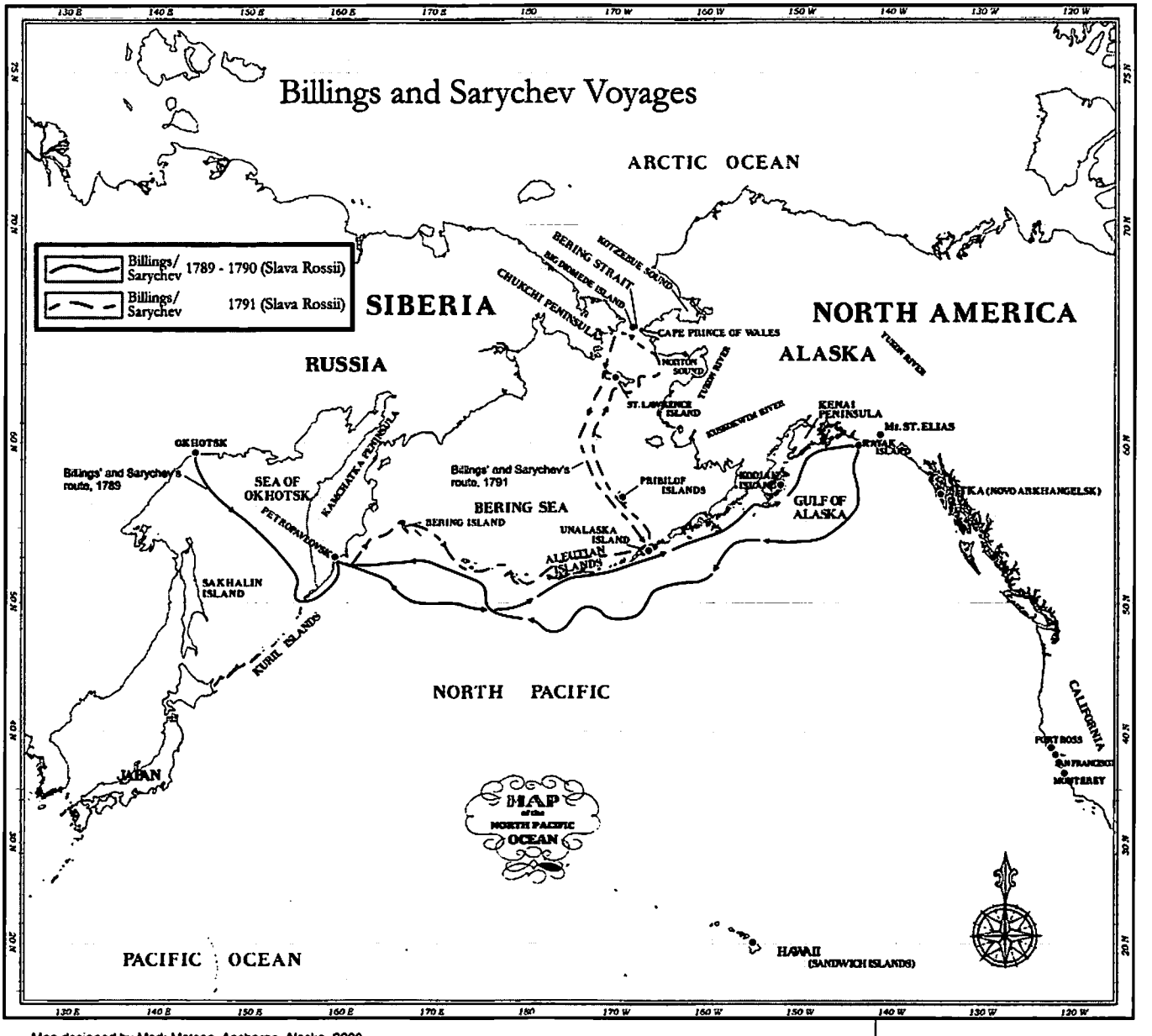
In mid-September of 1789, two ships sailed from **Okhotsk** to carry out Catherine the Great's orders. One ship ran **aground** and was destroyed. Captain Joseph Billings and I were the captains. We had already worked for years to build our two vessels. Time and money now made it necessary to sail into the Eastern Ocean on only one ship.

In the mild summer weather of 1790, Billings and I and all our crew dashed eastward out of **Petropavlovsk** in the *Glory of Russia (Slava Rossii)*. The expedition recorded its studies, according to Catherine's orders, as it traveled to **Unalaska**, **Kodiak**, and Kayak Island. Returning at summer's end to Petropavlovsk, the ship had few supplies, little water, and many crew ill with scurvy. I wrote in my journal that the fresh water was "the sweetest beverage we had ever enjoyed in our lives."

After a winter in Petropavlovsk, the refreshed crew and the restocked ship returned to Unalaska in 1791. Then the expedition turned west and north to explore lands around Bering



G. Sarychev. *Travel Journal of a Participant in the Kamchatka Expedition of I.I. Billings...* 1790.
Russian State Archives of the Navy, St. Petersburg



Map designed by Mark Matson, Anchorge, Alaska. 2000

Strait. On the Siberian side of the Strait, Billings and several crew left the ship to continue the overland studies of Siberia while I took command of the *Glory of Russia* and sailed back to Unalaska where my crew and I spent a harsh winter in Unalaska. By winter's end in 1792, many had died from scurvy.

When I began my voyages along the Aleutian Islands, few of the land forms were charted. By the time my voyages concluded, my detailed charts of the coasts and drawings of the land forms replaced the vague shapes of earlier maps. Publication of my journals brought me fame, and my atlas is still useful. The Navy promoted me to full admiral, and gave me the honored position of hydrographer-general. I lived to be 67 years-old and died in the great cholera epidemic of 1831.

YURI FEDOROVICH LISIANSKY

1773-1837

A fast sailor

My father was a priest in the Russian Orthodox Church. I signed up for the Russian Naval Cadet Corps—the official navy school—at the age of 10. Two years later, I was in the thick of a war with Sweden. At 20, I was a full lieutenant, sent by Catherine the Great to England to serve in the British fleet and learn how they did things. During those years I sailed in several campaigns to North America where I became ill with yellow fever. As I recovered from the disease, I visited the United States, and met America's first president, George Washington.

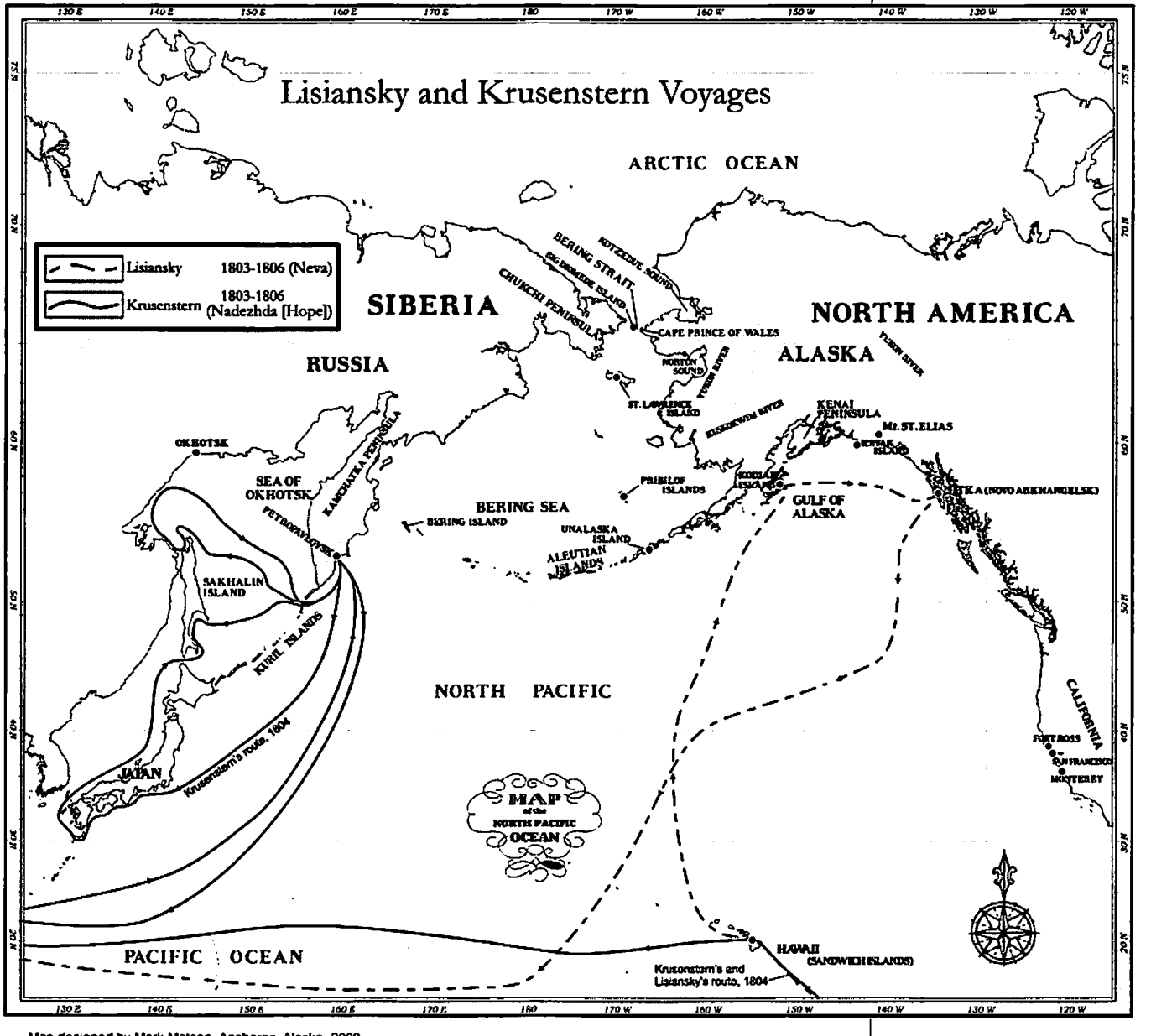
Captain Yuri Lisiansky, oil by V. L. Borovikovskii, 1810. Central Naval Museum, St. Petersburg

Johann von **Krusenstern** was planning the first Russian round-the-world voyage and remembered my reputation as an excellent sailor. He picked me to be the second-in-command for the voyage. I had learned English so well that I was sent to Britain to buy the two ships for the expedition. Krusenstern commanded the *Hope* and I commanded the *Neva*. We began our trip in 1803 from **Kronstadt**, Russia. Eight months later, we arrived in Hawaii, where we learned that the **Tlingit** had destroyed the new Russian settlement in Sitka, two years previously. I sailed to Kodiak and then to Sitka where I fought alongside **Alexander Baranov**, the **Russian-American Company** manager, to re-establish the Russian fort.

I spent the next year in Kodiak and Sitka observing the people, the land and the weather. In 1805, I loaded the *Neva* with furs from the Russian-American Company and prepared for the voyage home. My ship arrived in Russia several days before the ship of my commander, Krusenstern. He was irritated that I had reached home before him, but I was quite proud of the fact that I could sail so fast.

Our voyage showed that the round-the-world route was possible and that expeditions no longer had to use costly land transportation across Siberia. My charts were, for a long time, the best available for much of the North Pacific. My collection of **artifacts** from the places I explored is one of the largest donations to Russia's museums.

In 1809, I retired to write my voyage account for the Admiralty. But the Admiralty rejected the document each time I submitted it "because of my errors in the Russian language." I knew the languages of my education—English and French—better than the language of my country—Russian. Discouraged by the official reaction, I finally published my amazing story at my own expense. Naturally, I made my own English translation; it was published just two years later and was a great success.



Map designed by Mark Matson. Anchorge, Alaska. 2000

VASILY MIKHAILOVICH GOLOVNIN

1776-1831

A Prisoner escapes

"V. M. Golovnin was of medium height, his eyes reflected intelligence and kindness; when he spoke of human stupidity, weaknesses and faults there was a mocking smile on his lips, but the usual expression of his face was grave and severe."

I was an orphan with no place to go during holidays, so I worked much harder than other students at the Naval Cadet Corps. At 14, I earned the rank usually given to graduates. Before I was 17, I had fought in a war and been decorated for bravery.

By 1807, I was commander of the ship, *Diana* on a voyage from Kronstadt to Kamchatka. While rounding Africa's **Cape of Good Hope**, I learned that Russia was at war with England! My ship was detained in **Capetown** until a dark night thirteen months later, when I slipped the *Diana* past the English guards and headed for open water. With a good sea and favorable winds, I escaped and sailed on to Kamchatka.

Explorations to Sitka and Japan followed. While surveying the **Kuril Islands**, I landed with members of my crew to get fresh water, and was taken prisoner by the Japanese. My men and I were prisoners for more than two years. Finally released in 1813, I sailed back to Petropavlovsk and then traveled overland across Siberia to St. Petersburg. My journal of the imprisonment was translated into several languages and became a best seller. I became famous in Russia and many other countries.

Captain Vasily M. Golovnin.
Central Naval Museum, St. Petersburg

As a commander, I was strict but fair, and had a reputation as one of the best officers in the Imperial Navy. When I was appointed to head a new round-the-world expedition in 1817, many of the crew from the *Diana* signed up to sail with me again. Ambitious, young officers such as Fedor **Litke** and Ferdinand **Wrangell** competed for the honor of sailing with me on the *Kamchatka*.

On my maps and charts from the *Kamchatka* voyage, I named places as the Natives called them. In my journal, rather than call Natives and Indians dull-minded, as explorers had before me,

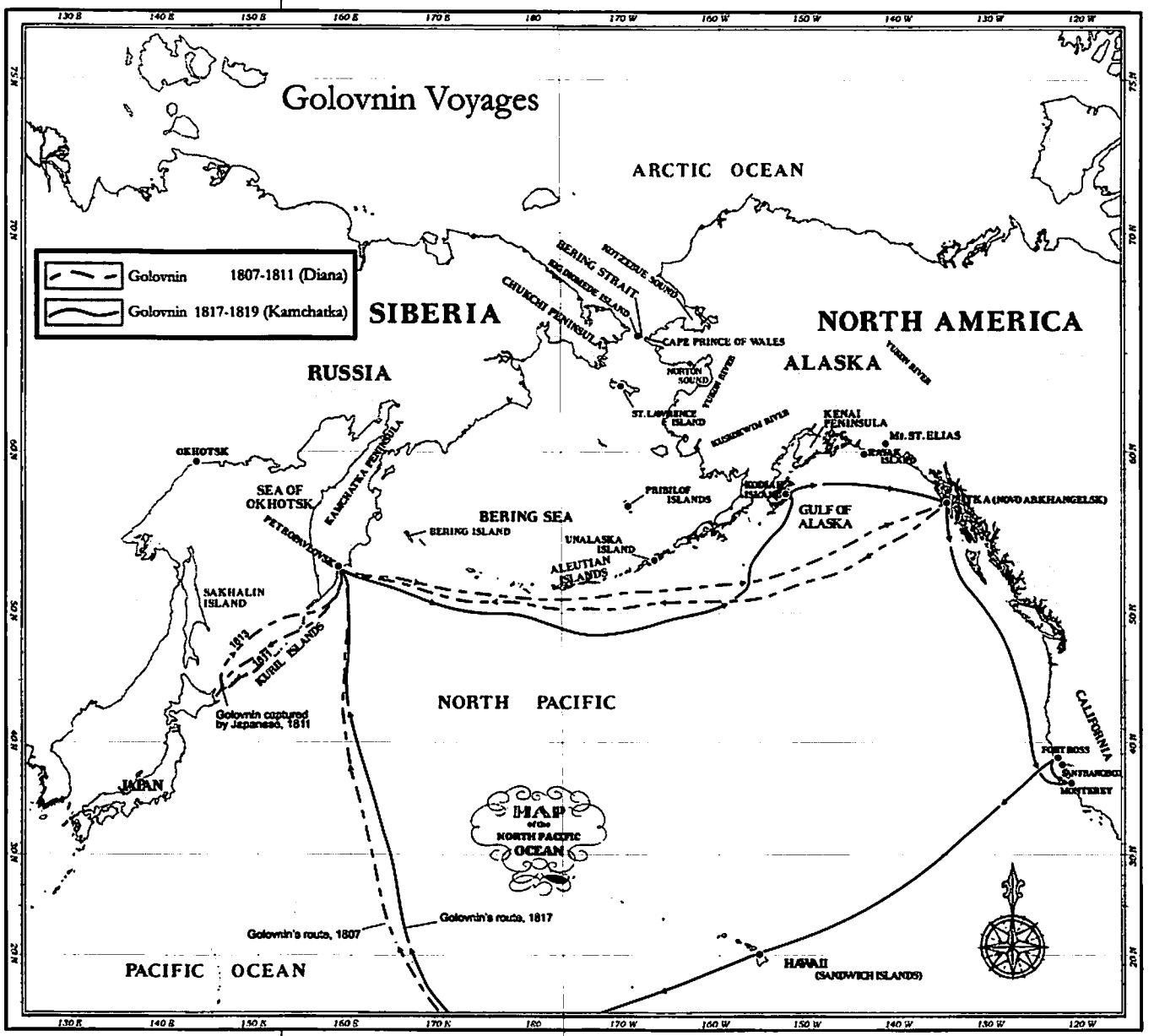
I found them intelligent and tried to understand their way of life. I appreciated the agricultural promise of California, describing it as "one of those blessed regions of the globe."

I returned to Kronstadt after the two-year voyage. It was so successful that we "had lost not a rope, anchor, stream anchor, mast, or top-mast, nor torn one major sail." Litke reported that the crew "returned home healthier than when they started out." (Pierce) Although my official journal of the expedition was published, my personal manuscript, "Recollections of My Voyages" was lost.

The mariners on Russia's great voyages to America came from many countries besides Russia. Denmark, Estonia, England, Poland, and Germany are a few examples. This international community sometimes changed its membership depending on who was at war with whom. If a captain from England signed on for a three-year, round-the-world voyage on a Russian ship, he might find by the end of his voyage, that he was the leader of an enemy vessel. Limited communications meant that years could pass before events at home were known to those aboard ship.

In 1821, I became assistant director of the school from which I had graduated, the Naval Cadet Corps. To help train the students, I translated an English history of shipwrecks and added a volume on Russian shipwrecks. My superiors were upset with me for the addition, because it showed mistakes that had been made in the Russian Navy. I continued to have important positions in the navy after that publication, but I never went to sea again. In 1831 I died of cholera in the great epidemic that also killed Gavriil Sarychev.

*Journal of a Voyage Around the World on the Sloop of War "Kamchatka" 1817-1819...*by V. M. Golovnin. St. Petersburg, 1822.
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks



Map designed by Mark Matson.
Anchorge, Alaska. 2000

OTTO von KOTZEBUE

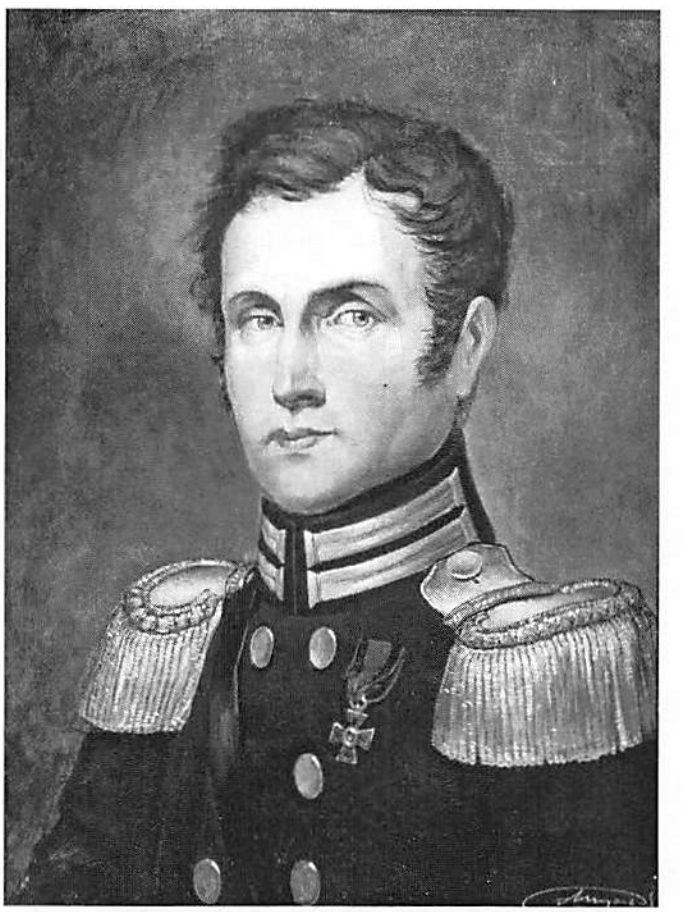
1788-1846

An early start

In 1815, I left Russia on the *Rurik* and sailed west on an eventful voyage where flying fish landed on the ship's deck and swarms of insects blown from Africa turned the sea red. In a storm off South America's **Cape Horn**, a wave washed me overboard. Ropes swept by the waves caught me as if in a safety net, and I was able to fling myself back on deck.

Born in **Estonia**, I grew up in a well-to-do noble German family. I began my sea education young! At the age of 7, I entered the Naval Cadet Corps. At 15, I was invited by Krusenstern to join the first Russian round-the-world expedition. On this voyage I became an expert at mapping and making astronomical observations.

My mentor, Krusenstern then recommended me to be the captain of the *Rurik*, a ship built by a Russian noble who was deeply interested in science. The **patron** wanted a round-the-world expedition to find the **Northeast Passage** from the Pacific to the Atlantic. My ship was loaded with the latest instruments and charts from England and the first food in tin cans. My crew included artists and scientists such as Adelbert von **Chamisso**, Louis **Choris,** and Johann **Eschscholtz.**



Captain Otto von Kotzebue.
Oil by A. A. Tron, 1989.
Central Naval Museum, St. Petersburg, Russia

Arriving on the Siberian Coast in June of 1816 after my eventful voyage from Russia, I soon set sail for the Bering Strait. Sailing further north than any European before me, I met the Americans of

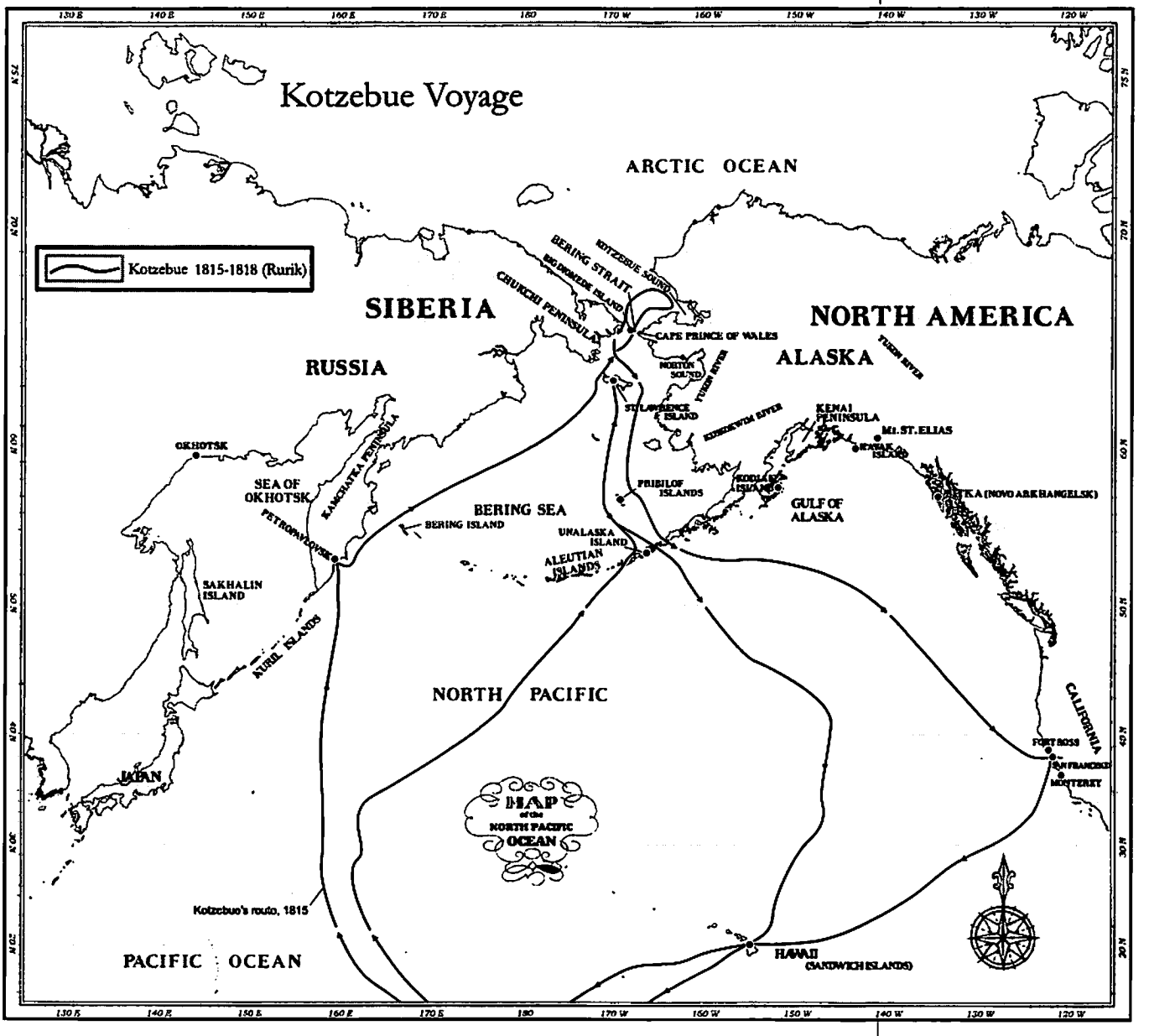
the area—the **Inupiat**—and rubbed noses with some of them in greeting.

But winter's storms were blowing in, so I sailed south to San Francisco and **Fort Ross**, and then to islands of the South Pacific. In the spring of 1817 I turned north again, landing in **Unalaska**, where I picked up supplies to help my travel in the unknown waters above Bering Strait. But ice and a back injury stopped me from clear sailing, and I abandoned the quest for the Northeast Passage. I returned to Russia three years after I had left.

This decision to turn back and my personality (some called me "prickly") led to criticism from my staff and managers of Russian settlements in locations such as Fort Ross. As commander, however, I succeeded in bringing my crew home in good health. I had no battles with the many Native groups I met. And I set a record for northern sailing while measuring tides, temperatures, magnetic influences, and the transparency of the water. I discovered and named many islands and accurately identified their geographical coordinates. My scientists made important discoveries including a mammoth tusk found in Kotzebue Sound, and identified hundreds of plants and animals, such as the California grizzly bear and the California poppy.

From 1823-1826, I set out on the *Enterprise* for my third round-the-world voyage. Dr. Eschscholtz, who had sailed earlier on the *Rurik* and the physicist, Emil **Lenz** were among the scientists on board. Lenz added to the knowledge of the oceans using the water sampling and temperature-reading instrument known as the **bathometer**.

After thirty-four years of service in the Russian fleet, I retired. I was 42 years old. My name is now recorded in Alaska's geography at the city of Kotzebue and Kotzebue Sound.



Map designed by Mark Matson. Anchorge, Alaska. 2000

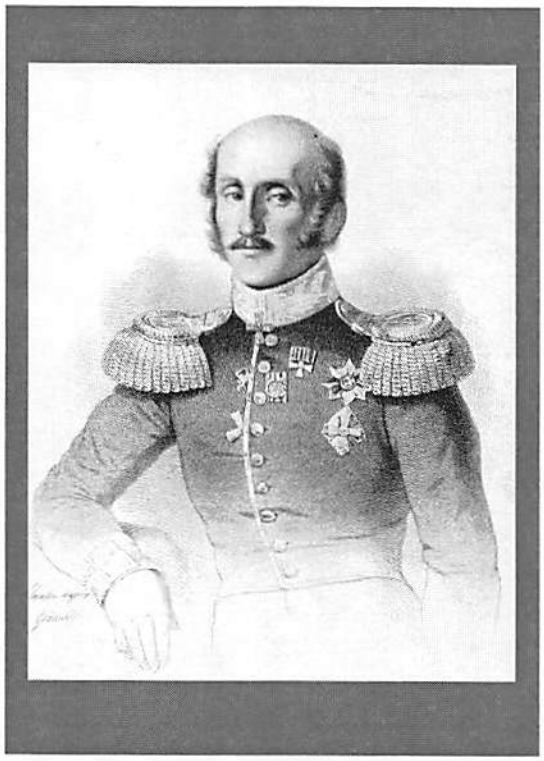
FEDOR PETROVICH LITKE

1797-1882

The serious scientist

I had useful talents, as did Russia's other great explorers. Golovnin excelled in foreign languages. Lisiansky painted remarkable pictures. Kotzebue wrote lively accounts of his voyages. If there had been a championship award for serious scientist in our group of mariners, I would have won.

The youngest of a large family, I was born in St. Petersburg. My mother died at my birth, and my father's second wife sent me away at the age of 7. Raised by various relatives after my father's death, I followed my brother-in-law's example by volunteering for the Navy. My war record and my brother-in-law's acquaintance with Golovnin gained me an appointment on the *Kamchatka* for the round-the-world voyage of 1817-1819. Then because of Golovnin's recommendation, I was appointed to lead an expedition to survey Russia's Arctic in 1821.

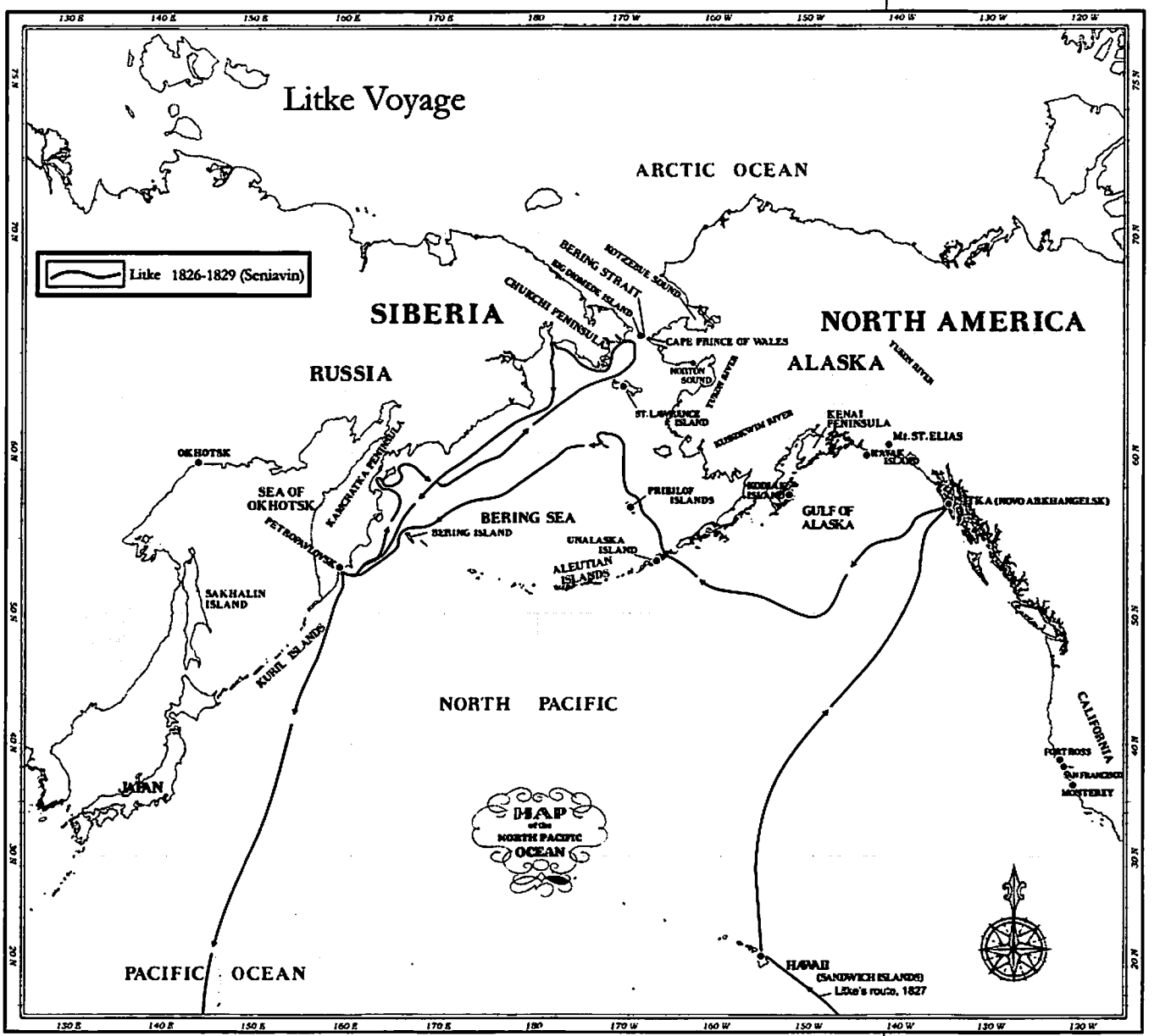


Admiral F. P. Litke, lithograph, 1850s. Central Naval Museum, St. Petersburg

My next major assignment was command of a round-the-world voyage. As captain of the *Seniavin* from 1826-1829, I prepared charts of more than 1000 miles of the coasts of America and Asia. My charts of the Aleutians were the most complete made to that date. I took measurements hourly on my barometer that proved that air pressure increased from the equator to the poles. I measured gravity at various places using the **invariable pendulum**. My hydrology studies discovered an equatorial counter-current in the western part of the Pacific Ocean. I personally wrote up the data collected on the voyage, and following its publication, became famous as the outstanding geographer and hydrographer of my time. More than a thousand drawings by my naturalist supported my reports of the voyage.

In 1845 I founded the Russian Geographic Society, and I later became President of the Academy of Sciences.

What propelled these explorers to take on journeys of unknown length and distance? Why did they subject themselves to hardship and danger? Why do astronauts today hurtle into space?



Map designed by Mark Matson. Anchorge, Alaska. 2000

Activity 1
Biographies of Catherine the Great and the Voyagers.

Read the biographies of Catherine the Great and the voyagers, recording unfamiliar words in your log book. Organize into individual, small group or partners for the reading.

For discussion: Note pronunciations of the names (see Glossary) and alternate spellings. The spellings in this Instructional Guide are the anglicized versions of these names. Other sources you look at may have alternate spellings. Discuss the variety that can appear when names are translated from one language to another.

Are these biographies primary or secondary sources of historical record? Why? Are the included pictures primary or secondary sources? Why?

Activity 2
Who Am I? The Game Show.

Seven students portray the named voyagers and Catherine. Each student becomes familiar with his/her person and then submits to the quizzing of the remainder of the class.

(Alternate: Class divides into seven small groups. Each group studies one character, practicing becoming that person. Then new groups are formed with each group composed of one representative for each of the seven characters.)

Answers to classmates are limited to "yes" or "no" and no answer may be given to questions about specific dates.

Questions should be generated by fellow classmates by reading the biographies and noting one or two questions about each named person. These are some examples:

Did you write and publish your journal?
Did you serve in the British navy?
Did you die during your famous voyage?
Did you sail around the world?
Did you try to find the Northeast Passage?
Did you become a naval cadet at the age of 7? at the age of 10?
Were you born in Denmark?
Were you a prisoner of the Japanese?
Did you meet President Washington?

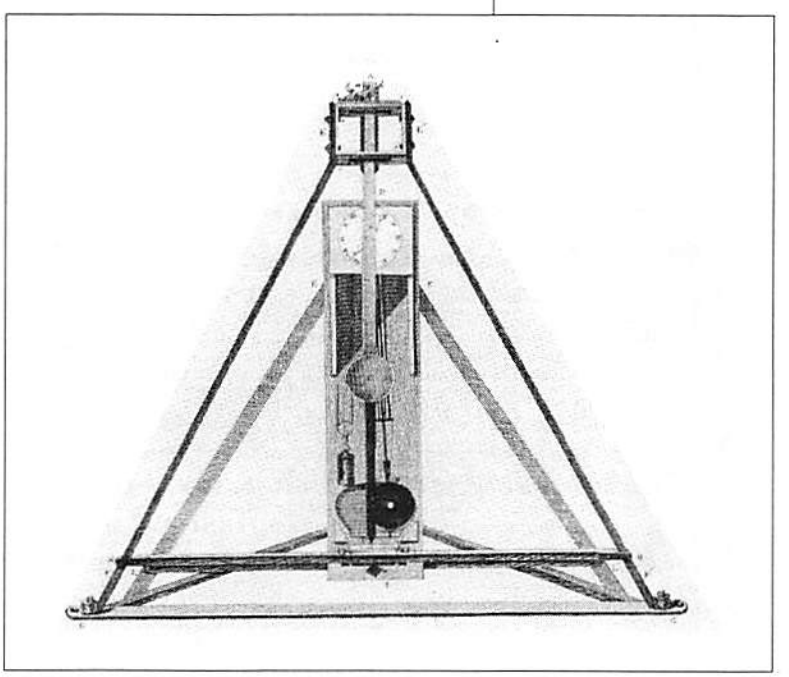
After all participating class members have had an opportunity to ask voyagers and Catherine a question, students can begin to guess identities.

In Addition: Activity 3
Log Book: Shipwrecked.

Write an entry in your log book about the following topic: Imagine that you have been shipwrecked with one of these people. Who would you prefer to be with? Why do you choose that person? How would that person behave in your disaster? In what ways would that person be helpful? What would that person do to help you survive? Do you have any useful gear that survived the wreck with you? What? How do you plan to use it? How do you keep warm? Are there animals in this place? What must you do to survive? How will you do this? What things will you use? What will you eat? Is there water? How do you keep it fresh? Store it? How does your partner in this shipwreck help you solve these problems? Make a sketch of your shipwreck location.

In Addition: Activity 4
The Explorer's Travelogue.

You can write a newspaper article travel guide based on one of the explorer's journeys. The final lesson in the Instructional Guide engages the whole class in creating a newspaper about the Russian explorations. This optional activity can contribute to that activity.



Invariable pendulum from A. I. Alekseev, *Fedor Petrovich Litke.* Ed. by Katherine L. Arndt, trans. by Serge LeComte.
The Rasmuson Library Historical Translation Series, Vol. X. Fairbanks, University of Alaska Press, 1996, original pub. in Russian in 1970

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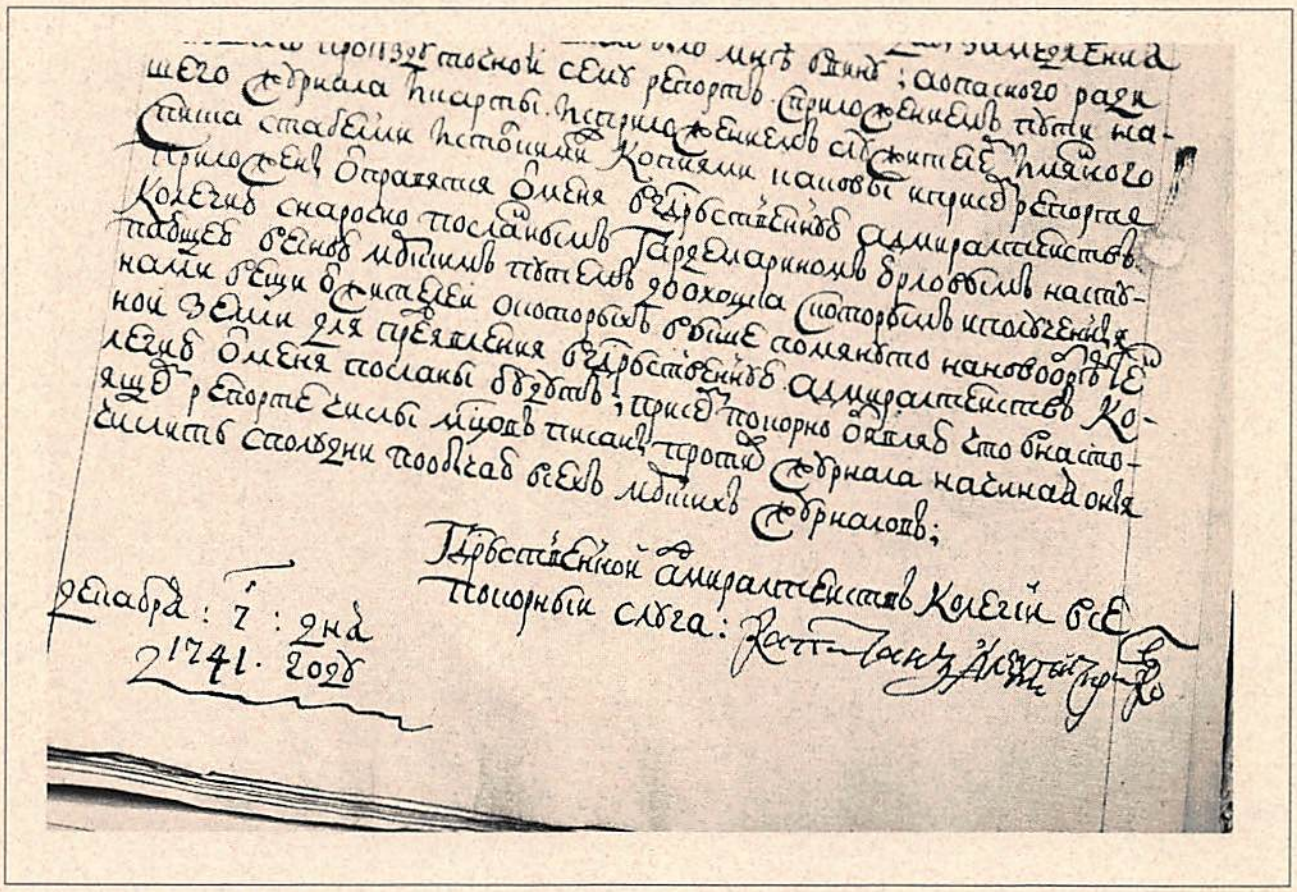
Sauer, Martin. *An Account of a Geographical and Astronomical Expedition to the Northern Parts of Russia, for Ascertaining the Degrees of Latitude and Longitude of the Mouth of the River Kovima; of the Whole Coast of the Tshutski, to East Cape; and of the Islands in the Eastern Ocean Stretching to the American Coast.* London. 1802.

NEWS FLASH: December 1999. After eighty-one days, Tori Murden completed her row across the Atlantic alone. At 36, she was the first American and the first woman to complete this 3,000 mile journey. Not daunted by the winds of hurricane Lenny, Murden rowed through the 20-foot waves, sometimes losing ten miles in a day. Completing her voyage in the French Caribbean island of Fort-Du-Bas, Guadeloupe, the Kentucky lawyer admitted to wobbly legs when she first stood on land.

"Journals Relative to Your Expedition"

Record-Keeping



Page from the *Report of A. I. Chirikov to the Admiralty College about the Voyage to America, December 1741.* Russian State Archives of the Navy

Article III

To prevent misunderstanding of our Imperial intentions, you are to examine the journals relative to your expedition.

SUMMARY

This lesson describes record-keeping during the Russian voyages to America and contains a sample from the journal of Aleksei Chirikov, Captain of the *St Paul* during the voyage of 1741.

MATERIALS

- "Journals Relative to Your Expedition" narrative*
- Log books, pens, pencils

* *included with the Instructional Guide*

ACTIVITIES

1. A "Warm-up." Students witness an event and describe it in their log books. (estimated duration 10-20 minutes)

How do you focus students on the need to hone observation skills? How do you remind them that history begins with present-day events that are subject to interpretation?

Try this warm-up activity to direct their attention. The activity uses a staged event—a "live drama" such as that suggested below—or one that you select from a video clip. If you choose a video, use a current event or a segment from an action-oriented video, and be sure you know its maturity rating. The "event" should be brief and students should not know beforehand that they are to record the action.

Event suggestion: An unidentified person enters the classroom and loudly asks the teacher for an object which the teacher gives the person. The action can be embellished through language, reentry by the person claiming the object is wrong, increasing the number of "actors," and so on. The students, as witnesses to the "historical event," describe the event in their log books.

2. Students read a journal sample, discuss it and complete 10 written focus questions. (estimated duration 20-30 minutes)

Older students may wish to read the narrative to themselves or with a partner. Younger students may wish to read it aloud in small groups, with a partner, or with the teacher as reader. Point out the unusual language and vocabulary. Ask students to look at the "To think about/talk about" topics before reading. You may also prefer to assign the focus questions before the reading. Locate the expeditions on the time-line begun in Lesson One. Using the map of voyage tracks, locate the route of the *St Paul*.

3. Students choose from three suggested topics and write in their log books. (estimated duration 10-20 minutes)

4. In Addition: Students read a fictional journal of Laurentz Waxell, the 11-year-old who sailed with Bering on the voyage of 1741. See chapter five, *Alaska: Indians, Eskimos, Russians, and the Rest* by Cora Cheney. New York: Dodd, Mead & Co. 1980.

"Journals Relative to Your Expedition"

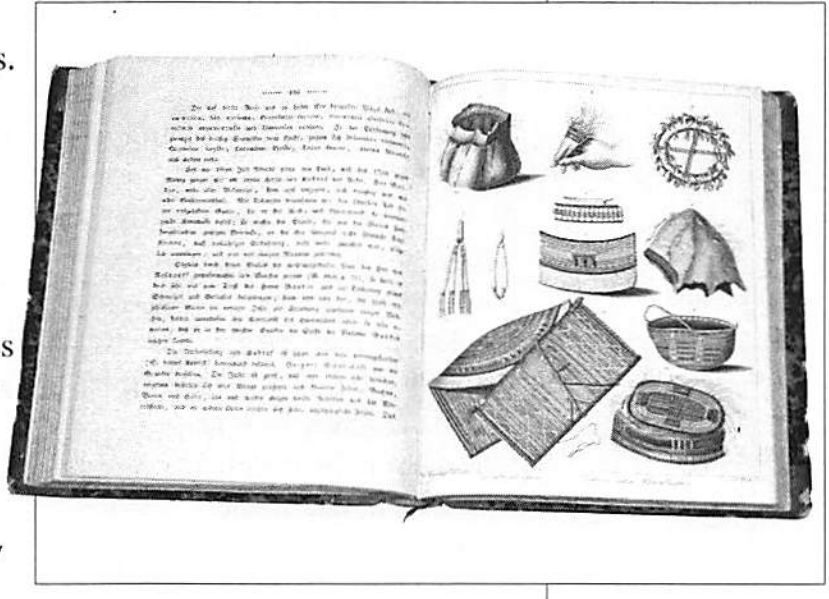
Record-Keeping

When you are sailing in a place no one has been before, how do you know where you are? What to expect? What you will see? How do you know what is important to describe on an expedition? What happens to your writing when the voyage ends?

Every ship Russia sent to America carried record-keepers who documented and illustrated the story of the journey. Officers and scientists entered notes in the ship's log book, and scribbled and sketched in the official journals. Artists drew and painted what they saw. Navigators made charts and maps of the journey's route. Crew members kept personal diaries.

Each kind of record served a particular purpose. The ship's log book was the nautical story of the voyage. It listed the ship's speed and position, and described the weather, sail changes and repairs to the ship. In the nineteenth century, the terms log book and journal meant the same thing, but historians now often distinguish between them. The journals were usually kept by the officers and scientists on board, and provided descriptions of observations and events guided by the expedition's orders. Many of the log books and journals were later published in elegant volumes with detailed maps and illustrations. Some of the records, alas, were never published or were somehow lost on the way to publication. Diaries were the more private writing by individuals and were seldom meant for publication.

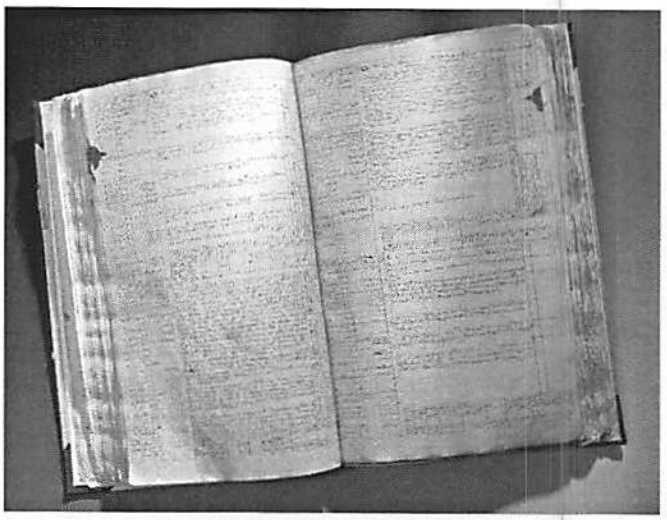
Each expedition added its own records to the growing body of knowledge that cumulatively expanded the horizons of knowledge about the great North Pacific and lands bordering it.



Georg von Langsdorff, frontspiece in Georg von Langsdorff, *Journal of a Voyage Around the World from 1803 to 1807*, London, 1813-1814.
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks

MYSTERIES

Many of the journals and log books from Russia's great voyages to America disappeared and later reappeared. Vitus **Bering's** log book of the *St. Gabriel* was long thought to be lost, but in 1973 it was uncovered in the Soviet Naval Archives.



Chaplin's log of the St Gabriel. *Journal of a Sojourn on the Kamchatka Expedition by Midshipman Peter Chaplin and A. I. Chirikov,* 1725-1731. Russian State Archives of the Navy, St. Petersburg

Dr. Carl Heinrich **Merck**'s journals from the **Billings-Sarychev expedition** vanished for many years. Almost 145 years after the expedition, a book-buyer who was poking around in a bundle of antique papers in a German second-hand bookstore recognized the remarkable pile of papers in his hand. He knew he had discovered the excellent records that Merck had made.

Another intriguing tale of missing and tardy journals comes from the first Russians to see the North American mainland—M. S. **Gvozdev** and Ivan **Fedorov**. In 1732 they sailed north in the *St. Gabriel*, Bering's sturdy little ship from the voyage of 1728. They spotted the westernmost tip of the American mainland, **Cape Prince of Wales**, and used sign language to communicate with the local men who paddled out to the ship. But the record of their achievement was not acknowledged in their lifetimes, and until recently most historians assumed that Bering was the first European explorer to see America.

After Gvozdev and Fedorov returned to **Kamchatka**, they sent incomplete maps and log books to the government offices. Somehow these unfinished documents were lost. It was only later, when Gvozdev asked for a promotion and had to re-create the full record, that the complete story was officially received. By then Bering had the reputation as the first European to see America, and all Gvozdev had was his promotion. (Perhaps it shows what can happen if you don't turn your journal in on time.)

POWERFUL STORIES

In addition to the scientific reports and geographic records, early journals and log books told powerful stories of danger, death and rescue.

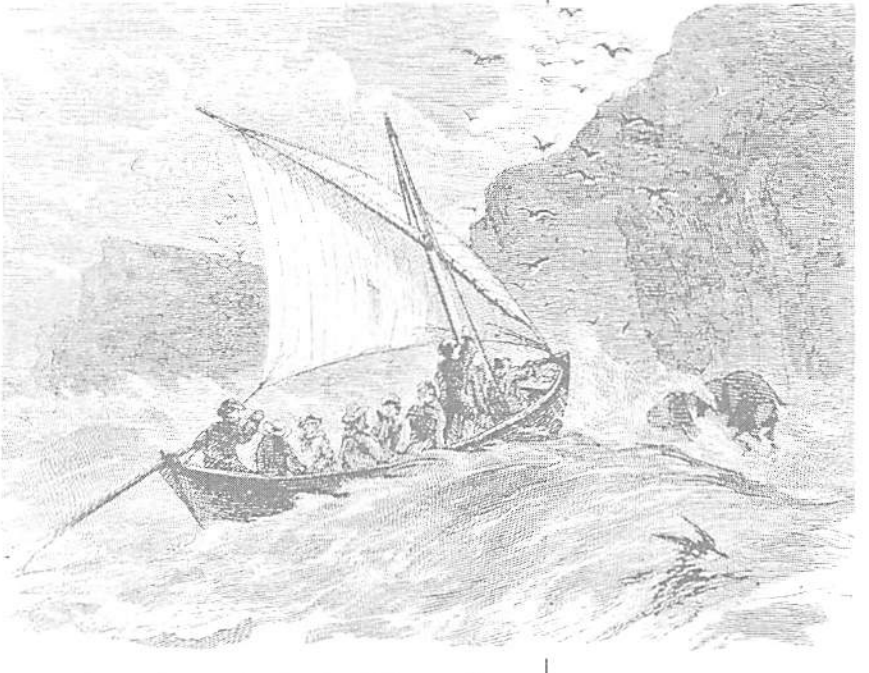
Vitus Bering and Aleksei **Chirikov** set out in 1741 from Kamchatka in their two ships,

the *St. Peter* and the *St. Paul*. Empress Anna ordered the two captains to find America and to locate "appropriate sites for harbors and places where one could take refuge during storms or ice at sea. Also look for forested areas which would have lumber suitable for shipbuilding." She commanded the captains to keep their ships together. "If one is shipwrecked, the other could provide assistance and information." However, just two weeks after starting the voyage, fog and wind and dark stormy seas drove the ships apart. Chirikov and Bering never saw one another again.

Chirikov sailed on for several more weeks, curious about the new lands he saw. Built to sail in deep water, the *St. Paul* could not navigate in the shallow waters near land. Chirikov launched his two small boats to explore close to the shore, and to find water and food to re-supply the ship. He sent one of the two boats to investigate a bay near present-day Hoonah, Alaska. His journal reports what happened:

CHIRIKOV'S JOURNAL

"On July 18 we were in 58° northern **latitude**, and on shore saw much more snow on the mountains. Fearing that we would be unable to make an appropriate survey of the land, and being unable to reach a warm climate, in which it is better to make a survey than in a cold climate, that same day at 4:00 in the afternoon I sent Fleet Master Dementev and ten armed [crew] ashore in the **yawl** to examine the bay ....



The coast was very rugged everywhere, with high mountains coming right down to the shore. The water is usually very deep in such places. We took **soundings** in a number of sites, as is apparent in the journals of all the officers .... The bottom was gravel everywhere, and we also found that in many places huge rocks protruded above the water. For that reason I did not anchor the **packet boat** there, but anchored off the bay, took note of the place, took our **bearings** and then **tacked** into the wind and drifted.

Journal, continued on page 54

When I sent Dementev ashore, I reminded him of the instructions we had been given, which he had already read several times. [The instructions included orders to signal the waiting ship.] .... However there were no signals from him. We saw him approach the shore, but then we saw nothing after he landed. We waited five days for him to return to us, **holding under sail** as close as possible to the bay into which he had gone. In the beginning the weather was such that the **longboat** could easily have come out to us. But then came heavy rains with clouds and strong winds, which carried us away from the bay ....

"Explorers eagerly awaited the published accounts of their colleague's voyages and members of the various Academies of Science corresponded with one another to discuss the new discoveries these voyages brought back. Before new expeditions set forth, the latest publications, journals, and atlases were collected for the new voyage, and several copies put on board for reference. These publications revealed the strong international cooperation which contributed to the success of each subsequent expedition." (Middleton)

On July 23 we again approached the bay the longboat had entered and we saw a fire on shore, which we supposed had been built by the [crew] we had sent there. We had not seen any other fires for the entire distance we had sailed along the coast, nor had we seen any structures or boats or other signs of life. For that reason we did not think there were any persons living there. Believing the fire was a signal to our ship, since it was stirred up several times, we fired a cannon shot, but they did not come out to us. The time for leaving was just right and we sailed in close to shore. When we fired the cannon, the fire was built up on shore.

On July 24 we decided that the boat had been damaged and for that reason could not come out to us, although the weather was favorable. Therefore all the senior and junior officers agreed, and signed a statement, that the small boat should take a carpenter, a **caulker** and all necessary equipment and go in to repair the longboat. The **boatswain** and one other volunteered to take these men in ....

I gave orders to the boatswain, a copy of which is **appended** to this report. I emphasized that he should look for the boat when he reached shore; that he should immediately pick up the navigator Dementev and three or four [crew] and return to us. The weather was very calm at that time, so we sent him ashore. We followed and approached very close and observed that the boatswain went onto shore with the small boat at 6:00 PM. However he did not make the signals I had instructed him to make, nor did he return to us at the time expected although the weather remained very calm.

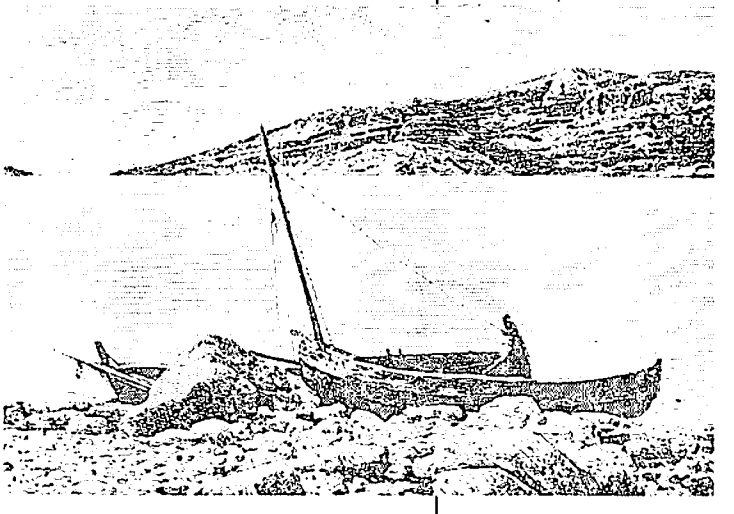
Journal, continued on page 55

On July 25 at 1:00 PM we saw two rowboats coming out from the bay where our boats had been sent. One was small and the other somewhat larger. We hoped that these were our boat and longboat returning. We went to meet them, but realized that the boat was not ours because its bow was very pointed and the oars were not the same. The men rowed with the oars close to the sides, and the boats did not come close enough to our packet boat for us to make out the faces of the men. We did see that there were four men seated in the boat. One was at the rudder and the others were rowing. One man, dressed in red, stood up when they were still some distance away and shouted twice, 'Ahai! Ahai!'

They waved their hands and then immediately turned and rowed back to shore. I ordered that white flags be waved and that our men bow, so the others would come up to our ship. Many of our [crew] did this, in spite of the fact that the boats were being rowed quickly to shore. We could not pursue them because the wind was calm and their boat was very swift. The other large rowboat, farther from our ship, returned, and then both of them went back into the same bay from which they had come.

We then realized that the [crew] we had sent were very likely in trouble since the navigator Dementev had already been gone eight days, and had had plenty of time to return. When we sent the boatswain, we did not leave our position. The weather remained calm, and if they had not encountered some misfortune they would already have returned to us.

We supposed that because the American natives did not dare come up to our packet boat, they had been hostile toward the men we had sent to their shore, and that they had either killed them or taken them captive. We continued sailing in the vicinity until evening, however, waiting for our boats. It was not until night that we moved offshore because of the danger. All during the night we kept the light burning on the stern of the ship in hope that when they saw it they might come out to us at night.



... Early on July 27 we took counsel as to whether we could go on, because we no longer had a small boat on our ship either to send ashore on **reconnaissance** or to take fresh water for our own use.

Journal, continued on page 56

The explorer's journals often showed the changes in the lands and people they encountered. Vasily **Golovnin** wrote about the dramatic death rate of the Native population around the Spanish missions in California. Otto von **Kotzebue's** journals described the sadness in the **Aleut/Unangan** communities where the fur-trappers kept hostages to force hunting.

On the basis of subsequent calculations we were then about 2,000 minutes [**nautical miles**] from this harbor of [**Petropavlovsk**] and had only 45 barrels of water left, which was scarcely enough for such a long voyage. We did not know what winds we might encounter, nor did we know whether the barrels were still full of water or whether some had seeped out.

Consequently, [we] agreed that on that very day we should turn back toward Petropavlovsk. I am appending an exact copy of our decision. We realized that it was still early for us to turn back, and had it not been for the obvious misfortune we could have continued our voyage for some time. However during our return voyage there were almost constant **headwinds** in one quarter of the compass between northwest and southwest, and we could not know whether some unexpected disaster might befall our ship ....

On August 21, realizing that headwinds had been blowing for a long time, with the consent of the officers I ordered that the crew cook **kasha** only once a day for two days and twice on the third day, for there was a shortage of water. Each man was to receive the smallest possible amount of drinking water. I also ordered that kasha be cooked for the officers only once a day. Whenever it rained the crew collected rainwater from the sails, using pails and other containers. It was bitter and tasted of tar, but the crew willingly drank it because they had tried drinking rainwater previously and said it was healthy, that the bitter tar would cure **scurvy**.

To prevent the men from becoming weak on the reduced rations, I ordered that on the days when of necessity they had only one serving of kasha (except for senior and junior officers and their servants), they were to be given a cup of straight **spirits** in addition to their regular rations. Because the headwinds continued, we had no hope of obtaining more water and we were still far distant from this present harbor. I therefore gave the order that the men were to be given kasha only every other day in order to conserve water. The men themselves were in favor of this and lived on **sea biscuits** with butter. On certain days when extra rations were dispensed they had **salted meat** which they cooked in sea water. From September 14 on, I had to order that kasha be cooked and given to the men only once a week. The other six days they had to eat almost everything cold. However, any of the crew who wished, could use their drinking water ration to cook the sea biscuits, but this would then be the only hot food they would receive ....

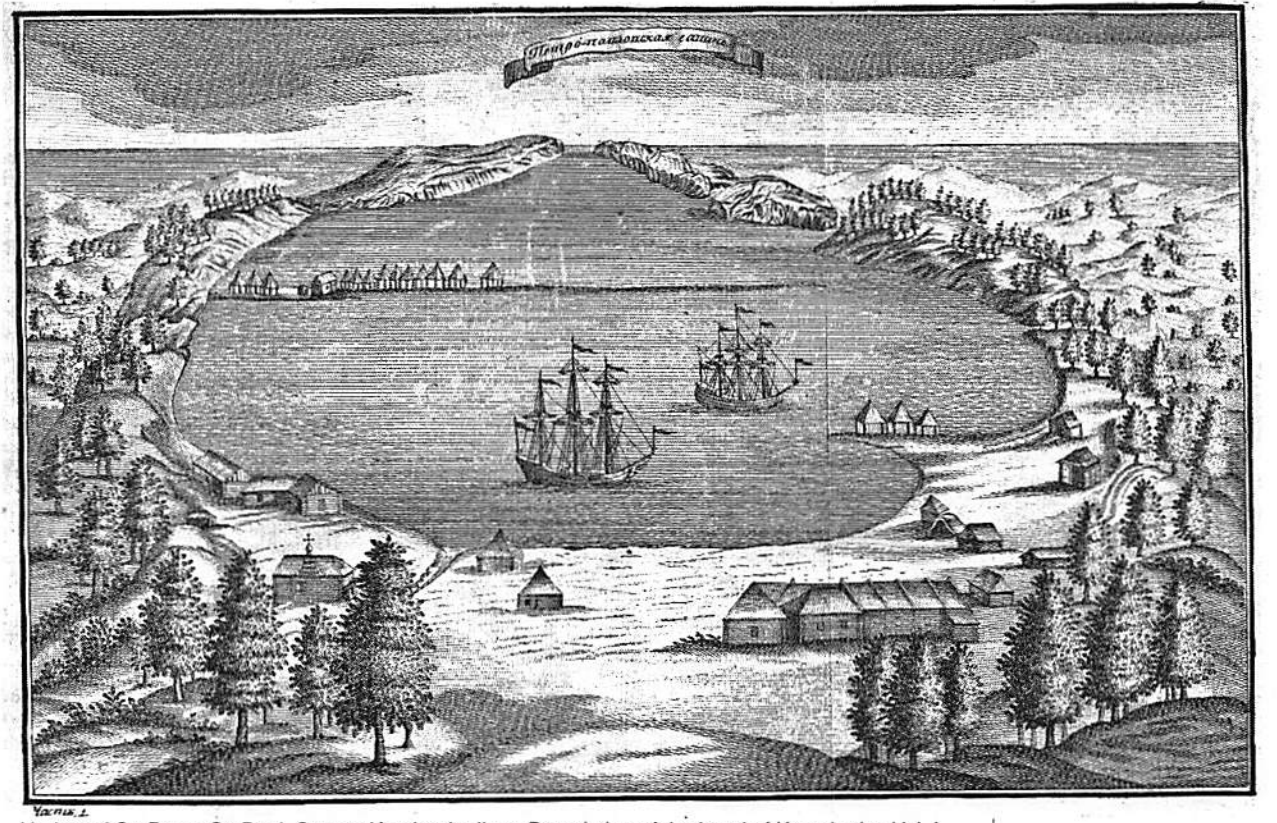
By the end of September all the members of the crew were seriously ill with scurvy. Many were bedridden and could not stand

Journal, continued on page 57

watch, and those who did manage to stand their watches did so only by exerting the last of their strength. From September 16 until we came into harbor six men died. The names of those who died and were left in America and the dates are recorded in the official register .... At that time I was also very ill with scurvy and was so weak I did not expect to live. According to custom I was prepared for death. I could not go up on deck from September 21 until our return to harbor. The navigator was in command of the ship. Although he himself was very ill he would not give in, and by exerting himself to the utmost he remained almost constantly on deck in command. I gave him as much assistance as I could and by studying the calculations of our voyage from the journal, I advised him what course to follow. But when the calculations we had kept on the outward voyage indicated we should have sighted Kamchatka but the land failed to appear, I ordered him to steer west close to the parallel of this harbor ....

On October 8 at 7 AM we sighted the land of Kamchatka, and on the 19th at 9 PM we entered the bay and lay at anchor. By then we had consumed all the fresh water we had except for two barrels which we had distilled from sea water by boiling it in kettles .... The Captain Commander [Bering] had still not returned by that date, and it is not known where [he is] ...." THE END

The mystery of Chirikov's missing men was never solved. Bering and half of his crew perished on Bering Island. The survivors returned to their home port the following year.



Harbor of St. Peter, St. Paul. Stepan Krasheninnikov, *Description of the Land of Kamchatka*, Vol. I. St. Petersburg, 1755

Activity 1
How well do you observe events?

You have just witnessed an "historical event" Describe the event in your log book. What happened? What did you see? What did you hear? When you read your record out loud, does it agree with the record others in your class wrote? How do the records differ? If an "official" report of the action were written, how would it differ from the informal record?

Activity 2
Record-Keeping on Russia's Great Voyages to America.

When you read the journal from Chirikov's voyage on the *St. Paul*, answer these questions:

1. What are the dates of Chirikov's journal entries?

_____

2. What did Chirikov do when he saw a fire on shore?

_____

3. How many days did Chirikov wait before sending in the second boat?

_____

4. What did Chirikov order his crew to do when he saw the "American natives"?

_____

5. How many members of the crew disappeared in the small boats?

_____

6. What food did the crew eat?

_____

7. How did the crew collect more water to drink without boats to go ashore?

_____

_____

8. What disease made the crew sick? _____

9. Who was in command of the *St. Paul* when it arrived in Kamchatka?

_____

10. How much water was left when the *St. Paul* returned to Kamchatka?

_____

Activity 3

Log books: Select one of these topics to write about in your log book, using the first person voice.

1. There are no written records of the observations of "American natives" when Chirikov's ship arrived. What do you suppose the record would be if their observations had been written? Write this imaginary entry in your log book.

2. Alaska Natives tell of a Russian sailing vessel that sent a small boat and men to shore to fill their water barrels. The Russian crew took the opportunity to leave the ship forever, to **desert**. Imagine you are a member of Chirikov's crew who survived after going ashore. Why don't you return to the ship? How do you live? What do you do with your boat and other supplies? How do you communicate with the people you may meet? Write about your experiences in your log book.

3. Laurentz Waxell was 11 years-old when he sailed on Bering's ship, the *St. Peter*. What do you suppose he thought when the *St. Peter* and the *St. Paul* were separated? What do you imagine he thought of his commander Vitus Bering? Write a log book entry as though Laurentz were the author.

TO THINK ABOUT
TO TALK ABOUT

Is Chirikov's journal a primary or secondary source?

What difficulties does the historian face when trying to use documents like these?

Can you create a "map" from Chirikov's description?

How well did Chirikov follow Empress Anna's directions?

Why did Chirikov "append" the decision to sail back to Kamchatka?

In Addition: Activity 4
Laurentz Waxell—the Boy Who Sailed with Bering.

Chapter 5 of *Alaska: Indians, Eskimos, Russians, and the Rest.* by Cora Cheney includes a lively, illustrated fictional journal of Laurentz Waxell, the 11-year-old who sailed with Bering on the voyage of 1741. If you can locate this book, read this chapter. While based on facts of the voyage, author Cheney tells you at the very beginning that this is a "could-be journal." Note that there are a few errors in the chapter, including the spelling of Steller's name and the caption saying that Steller drew the illustration of the sea cow and the sea lions. (Actually it was Laurentz's father, Sven Waxell who made the drawing.) When you read a story like this, how important is it to know that it is fiction and not fact? When you write your "could-be journal" entry in Activity 3, how will you let another reader know that it is imaginary and not fact?

How important are written records in modern-day travel? What kind of record does a cruise line captain or an airline pilot have to keep? Do astronauts write journals, and log books? How many kinds of written records does your teacher keep in her/his work? Do you have journals or records written by your ancestors or other family members?

Answers to Activity 2, "Record-Keeping on Russia's Great Voyages to America":

1. What are the dates of Chirikov's journal entries? July 18 - October 19.

2. What did Chirikov do when he saw a fire on shore? Fired a cannon shot.

3. How many days did Chirikov wait before sending in the second boat? Seven days.

4. What did Chirikov order his crew to do when he saw the "American natives"? Wave white flags and bow.

5. How many members of the crew disappeared in the small boats? 15. 11 in the first boat; 4 in the second.

6. What food did the crew eat? Kasha, sea biscuits with butter, salted meat.

7. How did the crew collect more water to drink without boats to go ashore? They collected rainwater from the sails using pails and other containers.

8. What disease made the crew sick? Scurvy.

9. Who was in command of the *St. Paul* when it arrived in Kamchatka? The navigator.

10. How much water was left when the *St. Paul* returned to Kamchatka? Two barrels.

Sources cited:

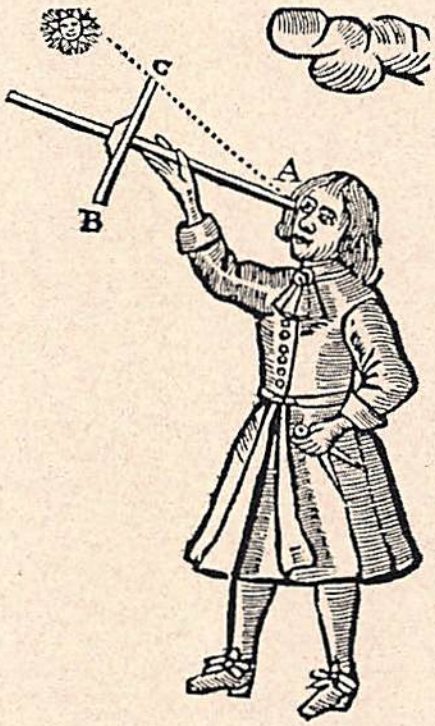
Chirikov's journal is quoted in translation courtesy of the Oregon Historical Society. Basil Dmytryshyn: editor and translator. *Russian Penetration of the North Pacific Ocean: Three Centuries of Russian Eastward Expansion, 1700-1797*. Volume 2. Oregon Historical Society Press. 1988.

Middleton, John. "The Community of the Ship: Life Aboard Russian Ships in the 18th and 19th Centuries." Draft Manuscript.

Science Under Sail: Russia's Great Voyages to America, 1728-1867

"Forming an Exact Chart"

Way-Finding and Map-Making



The Deſcription of the Croſs-Staff.

This Inſtrument is of ſome antiquity in Navigation, and is commonly uſed at Sea, to take the Altitude of the Sun or Stars, which it performs with ſufficient exactneſs, eſpecially if it be leſs then 60 degrees, but if it exceed 60, it is not ſo certain, by reaſon of the length of the Croſs, and the ſmallneſs of the graduations on the Staff.

Article IV

Whether you shall travel by sea or land, you are to have made instruments for navigation and to form exact charts of these almost unknown parts of the territories and to use them in the successful completion of your journey.

SUMMARY

The technology of navigation and the sophistication of the charts and maps went hand-in-hand in the era of Russia's great voyages to America, 1728-1867. Successful voyages depended on the navigator/captain's intuition and ability to sail by dead-reckoning until the instruments of navigation improved the odds in the late 1700's. As the voyages to America followed, one after another, the blank areas on the map of the North Pacific filled with details. Islands formed coastlines. The Alaska mainland took shape. Charts showed the hidden sea floor. Mountains grew topographic detail.

MATERIALS

Materials are listed in each activity in this chapter and repeated in a complete list at the end of this chapter.

ACTIVITIES

Activities: Alert: Some of these activities require cooperation from the weather—a clear day or a clear night.

1. Students make a simple compass to find magnetic north. (estimated duration 20-25 minutes)
2. Students find the North Star (Polaris) on a star chart. (estimated duration 5-10 minutes)
3. Students see the lines of latitude on the earth and the lines of longitude on the earth. (estimated duration 15-20 minutes)
4. Students follow an explorer's track (route) on a map using latitude and longitude coordinates. (estimated duration 10-20 minutes)
5. Students draw on a sphere (orange or grapefruit), and then lay its peel out to examine the change to a flat "map." (estimated duration 10-20 minutes)
6. Students compare Russian maps with contemporary maps. (estimated duration 15-20 minutes)

Additional Activities

There are several additional activities related to way-finding and map-making. Directions and materials for these activities are in the Appendix. They may be combined with this lesson or with the lesson: "Vessels of Sufficient Strength & Convenience" Life on a Russian Ship.

A. Students make a simple angle-of-elevation measuring tool to find latitude. (estimated duration 15-20 minutes) P. 166

B. Students find their latitude using the angle-of-elevation tool and the North Star. (estimated duration 15-20 minutes) P. 168

C. Students locate places on a map using latitude and longitude coordinates. (estimated duration 15-20 minutes) P. 170

D. Students draw a mountain profile while in motion. (estimated duration 15-20 minutes) P. 172

E. Students take a sounding to determine depth to the "sea" floor. (estimated duration 25-30 minutes) P. 173

F. Students use a knot line to measure speed. (estimated duration 20-25 minutes) P. 175

G. Students look at and interpret their local maps. (estimated duration 15-20 minutes) P. 177

H. Students look at tide tables to see variations in tides and the variety of information available in the tables. (estimated duration 15-20 minutes) P. 178

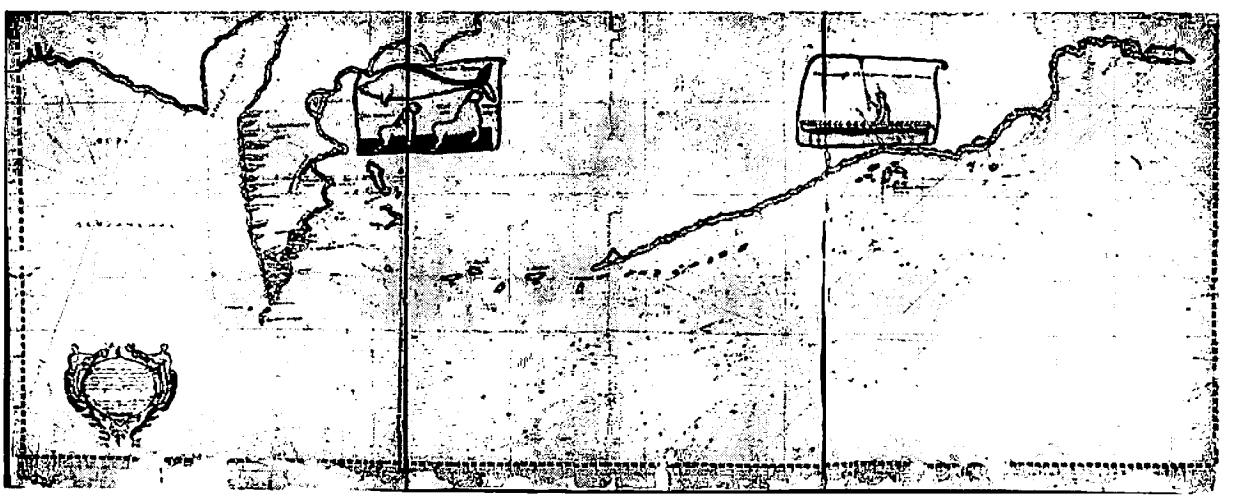
"Forming an Exact Chart"

Way-Finding and Map-Making

Have you ever journeyed not knowing where you were going, or when you might arrive? Imagine the apprehension and expectation of such a trip. Perhaps the travelers to the moon felt that way in our century, although the astronauts knew what they would find (the moon), and they were —except for brief hours— never out of touch with their homes (NASA on earth). Our travelers of these 140 years did not know what they would see or find on their journeys and they were out of touch with their homes for years.

Sailing "at the whim of wind and waves," Vitus **Bering** set out in 1741 on a second search for America. He had three navigation instruments to guide him: the compass, **quadrant**, and **telescope.** His lieutenant, Sven **Waxell,** voiced his worry:

> "I do not know where there is anything more dreary or unpleasant in the world than thus having to navigate in an unknown sea. I speak from experience and can truthfully say that I did not get many hours' peaceful sleep during the five months I was away on the voyage, and never seeing known



The Bering Expedition: *Map of Visible Land—America and Islands Recently Discovered under the Command of Captain Commander Vitus Bering...*1744. From the journal of Lieutenant Waxell. Russian State Archives of the Navy, St. Petersburg

land. I was in a continual state of uneasiness, always in danger and uncertainty. ... for two or three weeks we never had sight of the sun, and at nights were unable to see the stars. This precluded any possibility of observing the **latitude** on which we were and of correcting our **dead reckoning**. We had to sail along without knowing what was what and that in an unknown and undescribed ocean, like blind people who do not know whether they are going too quickly or too slowly." (Waxell)

Early **mariners** depended on luck, clues from the winds and tides, waves, memory and some elementary **charts** to find their way across the oceans of the world. Bering's three navigation instruments, the compass, the quadrant and the telescope gave him limited information about his location, which he calculated by a method called "dead reckoning."

Reflecting Circle, by Edward Troughton, ca. 1800.
National Maritime Museum, Greenwich, London

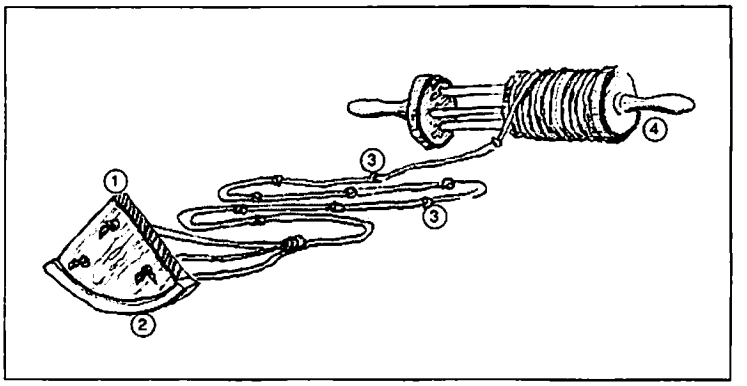
Intuition and experience counted for a lot in sailing by dead-reckoning. The term came from the phrase "deduced reckoning" which meant that the mariner located his ship by using the record of the ship's continuously changing speed and course. In order to calculate the course of the ship, the mariner must know from his log book how much distance he had made in an hour's time. Guessing by the eye is not easy on a featureless ocean landscape. How do you know your speed and distance? By the **log** with its attached line of knots, flung overboard once each hour to trail behind the ship. The mariner fed the line out for a certain period of time—measured by the half-minute sand-glass or by rhythmic counting. Then he could calculate the speed of the vessel in terms of the **nautical mile**. For example, Bering's ship the *St. Peter* had a top speed of five **knots**. As the half-minute hour-glass ran out of sand, five knots would have run over the edge of the boat into the sea which earlier measurements had shown to be equal to five nautical miles an hour (or 6,080.2 feet X 5.)

By contrast with Bering's limited tools, Johann von **Krusenstern** and Yuri **Lisiansky**, in the first Russian round-the-world voyages, carried many more improved instruments, including a **chronometer**, **reflecting circle**, **sextant**, **theodolite**, and **artificial horizon**.

Finding latitude: the compass and angles of elevation

To find your position traveling in a north-south direction, you needed to know your latitude. In

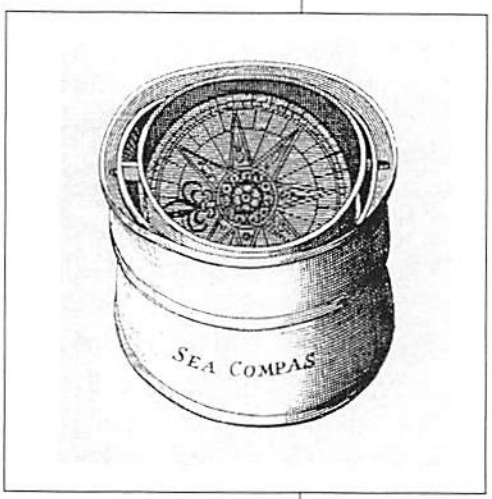
continued on page 64



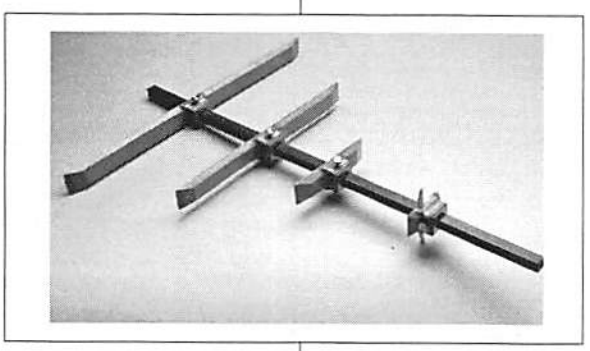
log n. [ME. *logge*, probably of Scandinavian origin; cf. Nor. laag, from the root of ON. *liggja* to lie.
1. [Originally an ordinary piece of wood] An apparatus for measuring the rate of a ship's motion through the water. The common log, or chip, consists of the *log chip* —often exclusively called the *log*, (1 in the illustration)—, and the log line, the former being commonly a thin wooden quadrant of five or six inches' radius, loaded with lead on the arc to make it float point up (2). It is attached to the log line by cords from each corner. This line, from a point about 15 fathoms from the log chip, is divided into equal spaces, called *knots* (3), each bearing the same proportion to a mile that the time during which the runout of the line is measured bears to an hour. This period, generally measured by the *log glass*, is 28 seconds in American and British naval practice, elsewhere usually 30 seconds, these time intervals corresponding to knots of 47 feet, 3 inches and 50 feet, 8 inches respectively. The line runs freely from the *log reel* (4), so that when the log is thrown the water holds it from being drawn forward and the speed of the vessel is shown by the number of knots run out. Where the water is shallow, and tidal currents strong, the log chip is often replaced by a lead, or sinker, the apparatus then being known as a *ground log*.
2. Hence: a. The record of the rate of a ship's speed or of her daily progress;1 also the full nautical record of a ship's cruise or voyage; a log slate; a log book. b. The full record of a flight by an aircraft.
3. Hence, any record of performance; specifically a. The record of an engine, boiler, or other test, in which a series of observations have been taken. b. The record of the progress in drilling a well, containing notes on formations, casing used, etc.

What a coincidence of language! The log is flung overboard and its record put in the log book. The knots are counted to record the nautical mile. (Say "knot" and "nautical" out loud to yourself.) Even today, sailors report their speed in "knots," a hold-over from that old knotted line and its log.

the North Pacific Ocean, the sun and **North Star** (the "Pole" star) are the oldest guides for dead reckoning. The angle of the North Star above the horizon at any place (with minor adjustments) equals the latitude of that place.



The **compass** is the most common of navigation's tools. Still in use, the compass is based on a magnetized needle that points toward north. The early compass was a piece of magnetized iron floating in water; in later versions it was a magnetized wire hung above a **compass rose** and then suspended in a stand so as to remain level in spite of the ship's movement. In early times the compass would often fail, the needle needing "refreshing" over long distances by being stroked with the **lodestone**, a piece of soft iron capable of creating a magnetic field around another piece of iron. Sometimes the compass would fail because the mariner kept its container in the neighborhood of other chunks of iron.



Cross staff.
Central Naval Museum, St. Petersburg

Other navigation instruments used over the centuries measured the angle of elevation of a celestial body (the sun, the stars, the moon) in relation to the horizon or to other celestial bodies. In approximate historical order, they included the **cross staff**, the **backstaff**, the **quadrant**, the **octant**, reflecting circle, and then the sextant. Mariners still navigate with the sextant today. All these devices needed to be used with mathematical tables. Using these tables took several hours in 1800, but only a few minutes in modern times. With today's Global Positioning Systems (GPS), that few minutes is reduced to a few seconds.

To use the **backstaff**, the observer stands with his/her back to the sun and manipulates the staff (or quadrant) so that the sun's light, concentrated by a pinhole into a bright spot) comes into alignment with the horizon when viewed through a slit. Bering used a device similar to this one.

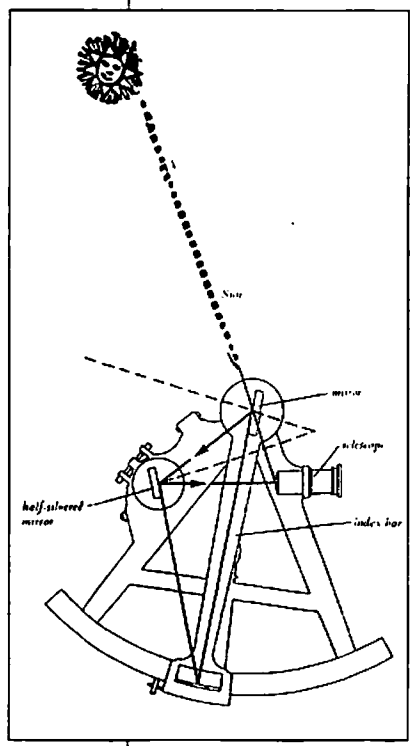
The early cross staff and backstaff led to the **sextant**. It worked with the sun reflected through two mirrors. The mariner lined up the horizon with the sun. Instead of using a graduated staff to mark off the angle of the sun, inventors came up with the idea of using parts of a circle. Thus, instruments were called quadrants when they were

shaped like a quarter of a circle, and sextants when they were a sixth part of a circle, or octants when they were an eighth part of a circle. The sextant was used by Krusenstern and Lisiansky.

The mariner needed to measure speed which he could estimate with the log line and he needed to know his latitude position which he could do with the compass and instruments like the sextant. He also needed to measure time accurately. Over the centuries he told time by rhythmic counting, then by the sand-glass, and in the late 1700's, by the chronometer. The chronometer was one of the most important inventions in navigation, for it made it possible to tell time in spite of the motion of the ship and the effect of salt on metals. Once the mariner could tell time accurately, he could find his longitude.

Finding Longitude

Finding your longitude means knowing where you are when you travel east-west. The ways of finding latitude came centuries before the ways of finding longitude. Longitude was known to be an important idea long before anyone figured how to measure it accurately. Countries like England offered huge rewards for the first person to figure it out. Longitude—east-west direction— is measured by time, with one minute of time traveled by the earth's rotation equal to fifteen minutes of longitude. But to tell time accurately, the sailor needed a reliable watch. That watch is the chronometer, invented in the mid 1700's. Bering had no chronometer and no accurate way to tell time when he was when traveling east-west. By contrast, Krusenstern and Lisiansky had the advantage of the chronometer and could calculate longitude more accurately than Bering did.



Sextant with reflecting mirrors and angle to sun. (See also illustration in Chapter 5, "Life on a Russian Ship" showing sextant in use.)

Charts, Maps and "Road Signs"

Knowing how to get to where you want to go means first knowing where you are. Sounds easy in this day, when you are sitting in a room in a place with lots of identifying signals—place signs, room numbers, street names, directional arrows. In this modern age there are even instruments in cars that speak to you and tell you by signals from GPS that you are "forty-two minutes from your destination and have traveled twenty-three miles." But if you are upon the featureless North Pacific Ocean in 1741 and have nothing at all to give you a location signal, how do you know where you are?

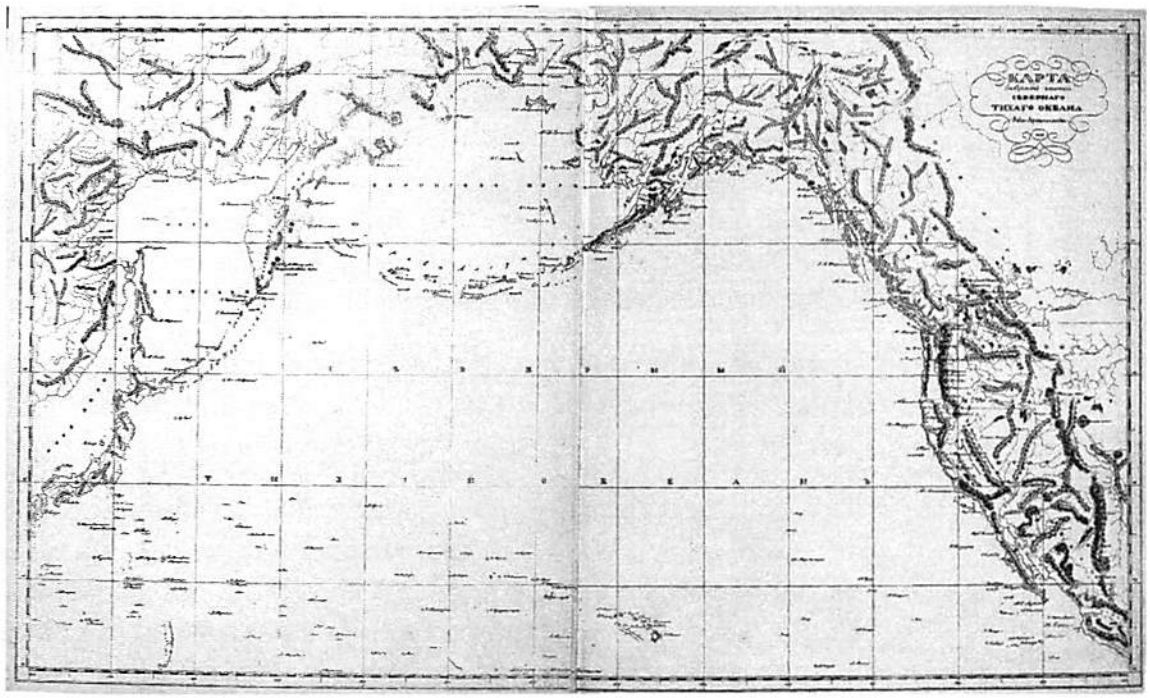
How important is accurate time-telling for navigation today? Space travel was not possible until a new kind of clock was invented that told time by the atom. The atomic clock is so accurate that it gains or loses no more than a second in 200,000 years. Mechanical clocks like the chronometer—although a big improvement over earlier time-telling instruments—are disturbed by changes in temperature, air pressure, and the eventual fatigue of their moving parts

While it was generally accepted that the earth was not flat, the charts and maps that guided our mariners were (flat, that is). The problem of how to represent the **spherical** earth on a flat surface became a mathematical solution devised by a person named **Mercator**. But his solution meant that the only part of the globe where distances were accurate was at the **equator**. Mariners in the far north, our mariners, were stuck with the greatest distortions of all in distance and thus the greatest opportunity for error in navigation. To really use Mercator's maps, the mariner needed to do complex calculations in **trigonometry**. Later navigator's books included page after page of mathematical tables to adjust for the distortions.

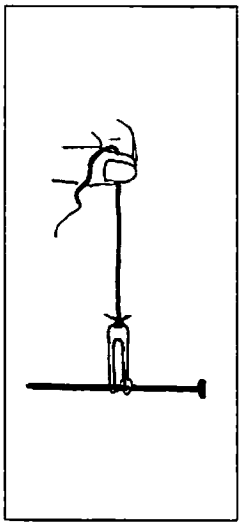
The challenge of accurate maps was multiplied by the absence of accurate charts. The charts were the keys to the contact with land —AND to avoiding contact with land. Early charts showed limited information about the coastline (where water and the land met above the surface of the ocean) and the sea floor (where water and land met land below the surface of the ocean). Calculated by "**sounding**" to the sea floor when in sight of land, charts gave crucial measurements that could keep a ship from going "**aground**." There were no charts for the islands Bering saw. He had to measure every depth to assure himself that he was not in danger of smashing on a rock or sailing onto a shallow sand bar.

But all that changed as the Russian voyages to America continued. During the one hundred years from Bering's first expedition in 1728, Russia organized eleven voyages that gradually filled in the map of the North Pacific in such detail and with such accuracy that these early Russian charts were used even during World War II. Each successive voyage contributed more and more information so that by the time of the **Tebenkov Atlas** of 1852, the Russian maps were among the most detailed pictures of the North Pacific in the world.

Do you know where you are? In addition to traveling about 1000 miles an hour while standing still on a swiftly rotating globe, I am at 61° 14′ N; 149° 53′ W. Where are you? Does accurate navigation and measurement still make a difference with all the modern devices we have?



Atlas of the Northwestern Coast of America...compiled by Mikhail Tebenkov. St. Petersburg, 1852. Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks



Activity 1
You Can Make A Simple Compass.

You will need:

- an iron nail
- bar magnet (NOT a horseshoe magnet)
- paper clip
- piece of string or strong thread about 3 feet (.9 m)long
- a permanent marking pen

Directions:

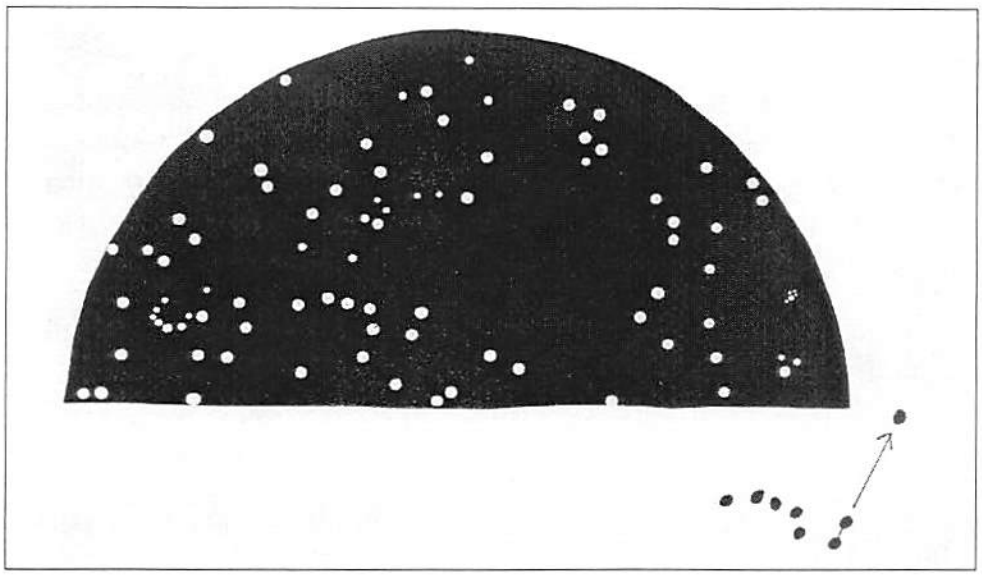
1. Magnetize the nail by snapping its head against one end of the magnet. Pull the nail away along the magnet.
2. Try to pick up the paper clip with the nail. If it will not pick up the paper clip, repeat step 1 again.
3. Make a nail holder by bending the paper clip around the nail.
4. Tie the string to the paper clip. Slide the paper clip until the nail balances parallel to the floor when you hold the string.

Take the nail to a place where you can tie its string — a tree branch, a chair back. Don't tie it next to something made of iron or steel.

When the nail stops spinning, one end will be pointing north and one south. Which is which? Your shadow will point north (outside in the sun) if you are in the contiguous United States, Canada and Alaska. Look at your shadow and mark the north end of your nail with the marker pen.

Activity 2
You Can Find the North Star.

On a clear starry night, there is one sure way to find north. It works anywhere in the northern hemisphere. Look for the Big Dipper. One of the most familiar star groups in the northern sky, the Big Dipper never sets and is high enough in the sky to be seen easily.



Find the Big Dipper in this star chart. A line drawn through the two stars at the end of the Big Dipper points to Polaris, the North Star. Draw a line from the end of the Dipper to the next star. That is the North Star.

The North Star lies over the North Pole and does not change position. When you face it, you are facing north. The position of the North Star can also show you how far north you are. If it is directly over your head, you will be at the North Pole. If it is quite low on the horizon, you are a long way from the Pole.

Activity 3
What Are the Lines of Latitude and Longitude on Earth?

You will need:

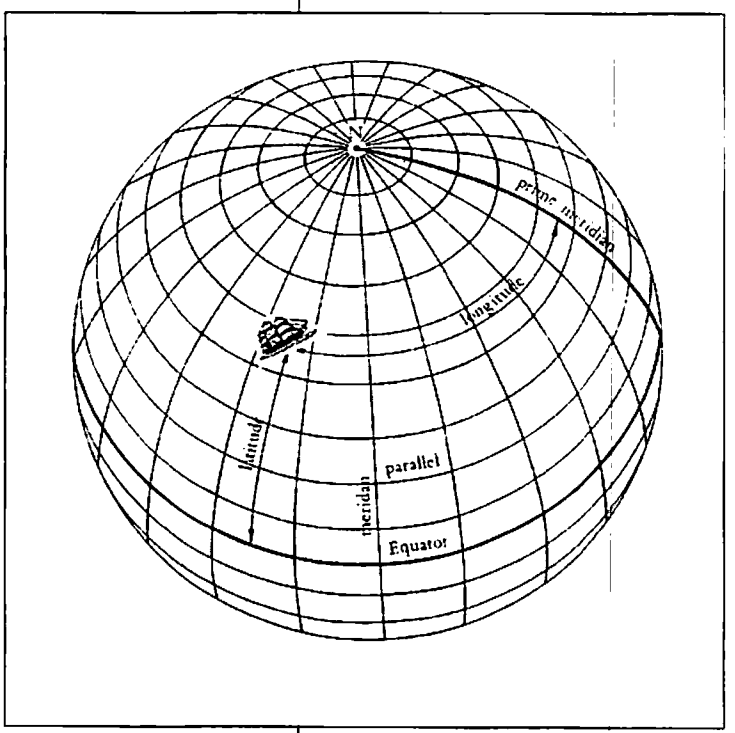
- a large orange or a grapefruit
- a permanent marking pen
- a globe (optional)

Directions

Latitude:

Using a grapefruit or an orange, draw the lines that represent latitude on the earth. Begin by drawing a line around the midpoint. That is the equator at 0° of latitude. The north and south pole are at 90°. Draw lines parallel to the equator to show each 10° change in latitude.

There are 90° of latitude north of the equator and 90° of latitude south of the equator. Each parallel line marks 10°.



Longitude

Using a grapefruit or an orange, draw the lines that represent longitude on the earth. The first line will be your prime meridian. Including the prime meridian, there are twenty-four lines around the sphere that meet at the north and south poles. Each line represents an hour's time change. At the equator, each meridian represents a little more than one thousand miles. That means that at the equator, a person standing still travels more than one thousand miles an hour as the earth rotates on its axis. It also means that the closer you are to the North Pole (our mariners join that group), the less you travel as the earth rotates on its axis. Northerners get fewer "frequent-earth-flier" miles than the people at the equator.

Activity 4
You can follow an explorer's route (track) using latitude and longitude.

You will need:

- map of earth showing longitude and latitude but no place names*

* *included with the Instructional Guide*

Directions:

Eleven-year-old Laurentz Waxell sailed with Bering in 1741. You can show the route he took. Locate the following latitude and longitude coordinates on your map. Then connect the dots:

(1) Begin here: **58° 57′ N, 30° 20′ E**

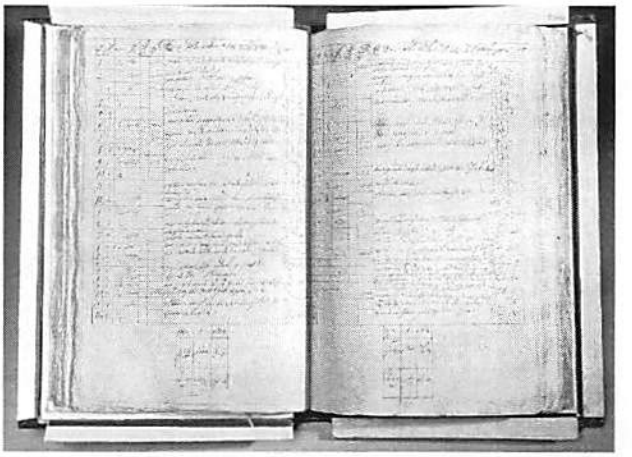
(2) You will need to jump over the edge of the map when you get to the edge and then hop back on at the left side to get here. You can roll your map into a tube to see where to connect again)
53° 13′ N, 158° 56′ E

(3) Be sure you stay south of this location or you will run aground.
53° 30′ N, 166° 20′ W

(4) This is where you can turn around and try to get home in time to avoid winter's storms. Your friend Steller went on the land here.
59° 55′ N, 144° 25′ W

(5) This is where you will be all winter when the *St. Peter* runs aground.
55° 40′ N, 167° 13′ E

(6) Finally, back to your home port
53° 13′ N, 158° 56′ E



Log-book of the *St. Peter* open to sighting of America. *Watch Journal from the Packet Boat, St. Peter. 1741-1742.*.
Russian State Archives of the Navy, St. Petersburg

Answers to Activity 4

(1) Begin here: 58° 57′ N, 30° 20′ E
St. Petersburg, Russia
Former capital of Russia, founded by Peter the Great. This was your home.

(2) You will need to jump over the edge of the map when you get to the edge and then hop back on at the left side to get here. You can roll your map into a tube to see where to connect again)
53° 13′ N, 158° 56′ E
Petropavlovsk, Russia
Named for Bering and Chirikov's ships, the *St. Peter* and the *St. Paul*. The departure location on Kamchatka for your voyage in 1741.

(3) Be sure you stay south of this location or you will run aground.
53° 30′ N, 166° 20′ W
Unalaska, Alaska

(4) This is where you can turn around and try to get home in time to avoid winter's storms. Your friend Steller went on the land here.
59° 55′ N, 144° 25′ W
Kayak Island, Alaska
The location in America where some of Bering's crew first stepped on land.

(5) This is where you will be all winter when the *St. Peter* runs aground.
55° 40′ N, 167° 13′ E
Bering Island, Russia
This is the island where Bering's ship the *St. Peter* ran aground and where Bering died. It is located in the Komandorskiye Ostrova Islands (Commander Islands).

(6) Finally, back to your home port
53° 13′ N, 158° 56′ E
Petropavlovsk, Russia

Activity 5
How Does the Flat-Earth Map Compare to the Real, Curved Earth?

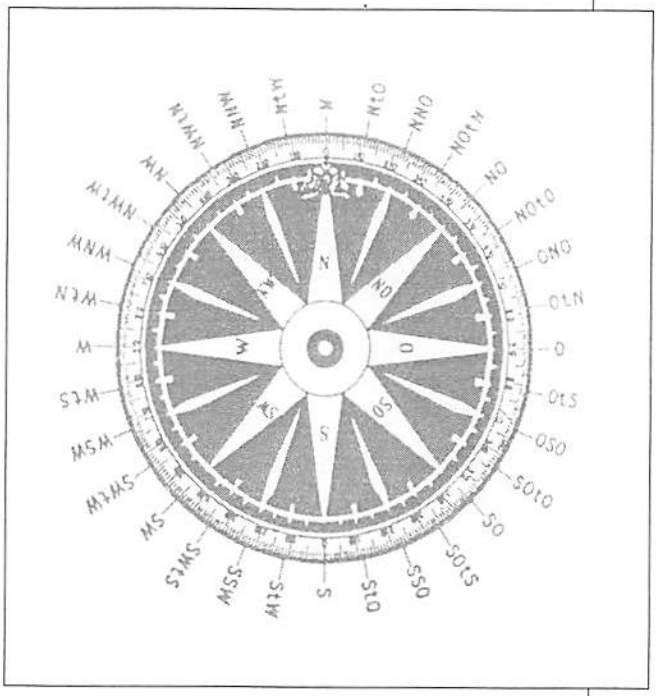
You will need:

- large oranges or grapefruit
- permanent marking pens

Directions:

With a marking pen, sketch a picture on a large orange or grapefruit. You can sketch a friend's head or a picture of the earth's lands as they appear on a globe. Then carefully take off the peel and try to lay it flat. Look at the change in appearance. What does your sketch look like when you flatten it?

The problem of using a flat map to show the earth's sphere is the problem you have when you try to make a flat picture with your orange peel!



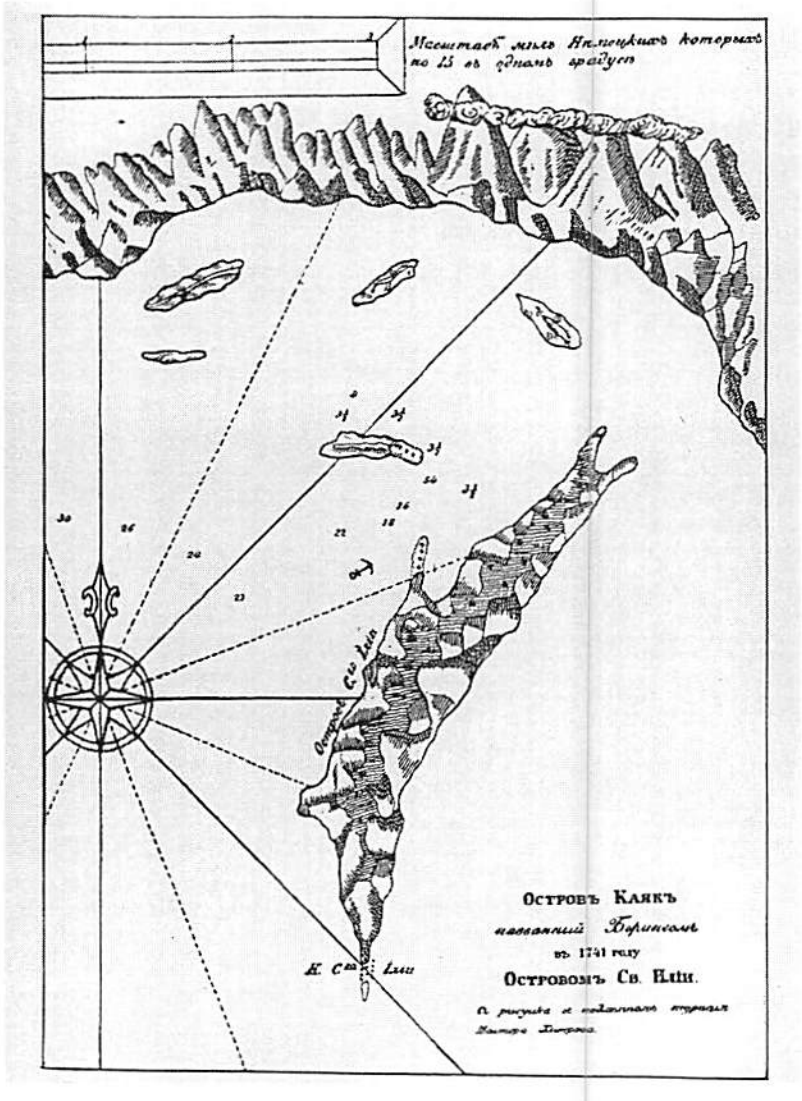
Activity 6
Looking at Russian Maps and Charts

You will need:

- Bering's map of Kayak Island*
- contemporary map of Kayak Island*
- Lisiansky's map of Kodiak Island*
- contemporary map of Kodiak that includes latitude and longitude.

The US Geological Survey (USGS) has the most comprehensive maps. Goode's Atlases also show and list latitude and longitude.

* *included with the Instructional Guide*

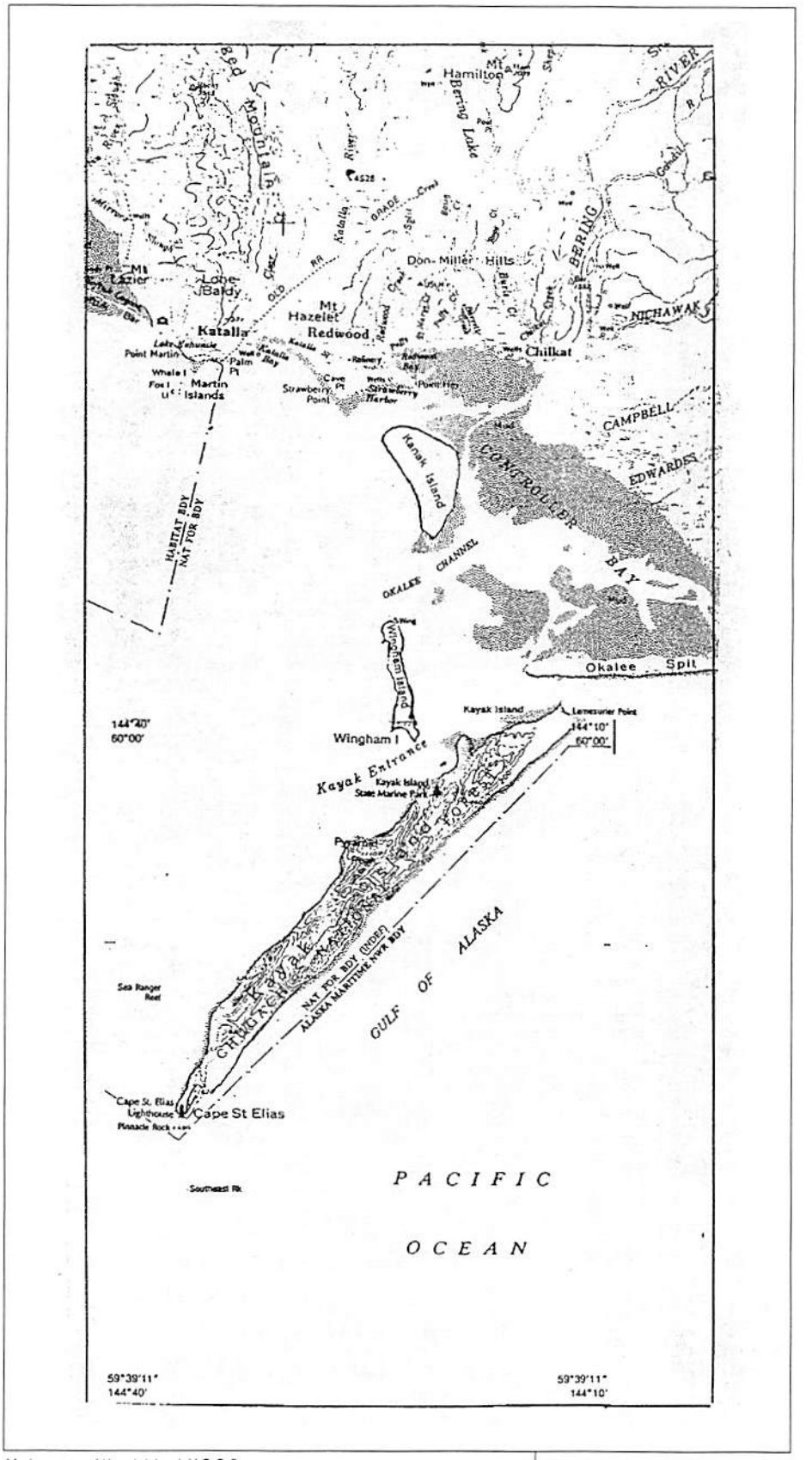


Khitrov's sketch map of Cape St. Elias (Kayak Island) 1741.
Frank A Golder, *Bering's Voyages...*, New York, 1925.
Used with permission of the American Geographical Society

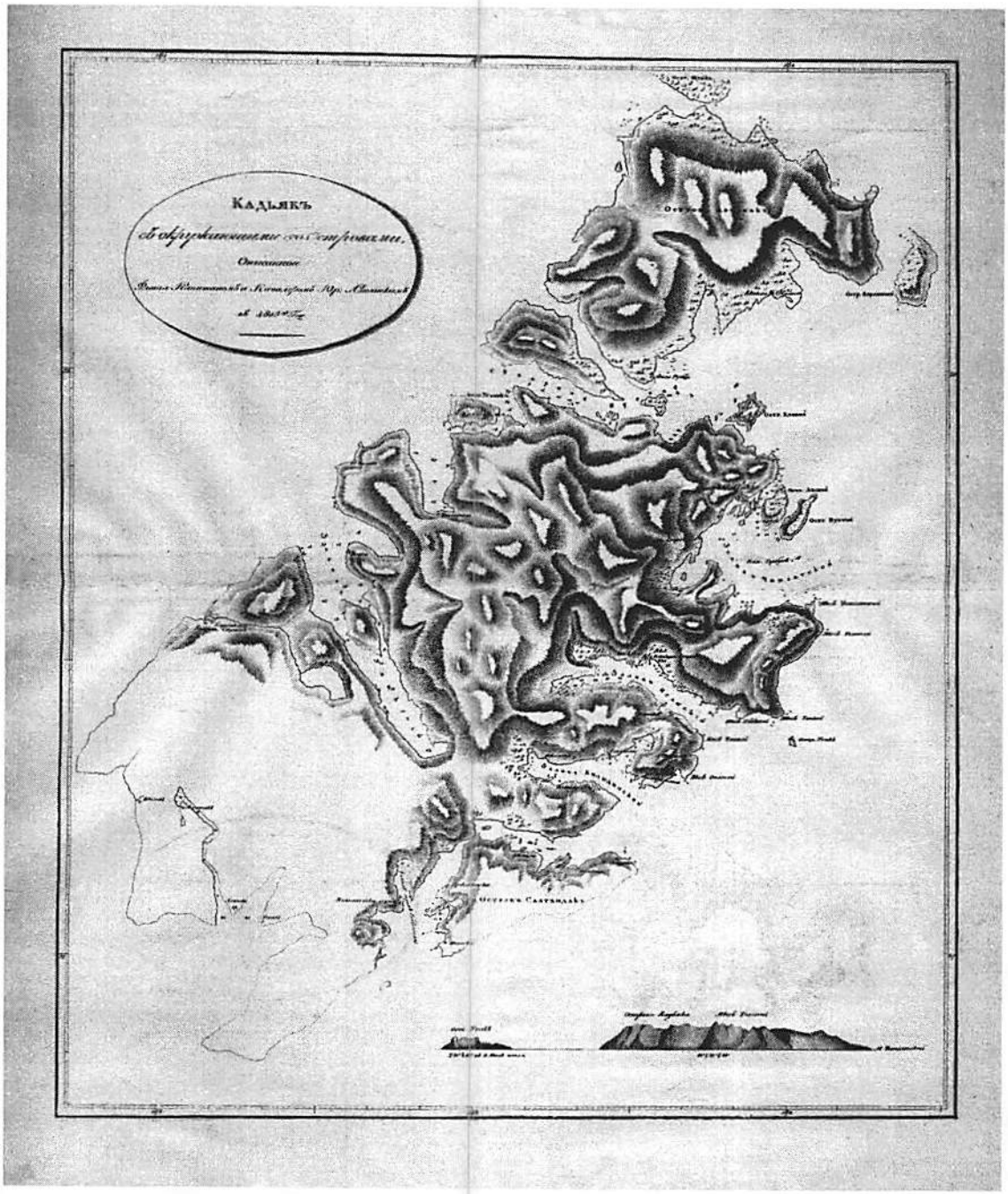
Directions:

Russian charts and maps of **Kayak Island** and **Kodiak Island** show remarkable detail. This Kayak Island map was produced during Bering's voyage in 1741. Which way is north on the map? What do the numerals mean? How does it show mountains? What areas are named? How do they compare with the modern names? Can you find the scale on the map? What are the distances? How do they compare with the marked distances today?

How does this modern map of Kayak Island compare with the map made in 1741?



Modern map of Kayak Island. U.S.G.S.



Kodiak Island in the Gulf of Alaska, (Map) Yuri Lisiansky, *A Voyage Around the World in the years 1803, 4, 5, and 6.* England, 1814

This Kodiak Island map is from Yuri Lisiansky's atlas, drawn during the winter of 1804. How does its detail compare with a modern map? Are there any variations? What are they? Do you see where Lisiansky's map shows the **topography** of the mountains he saw? How does that way of showing topography differ from the modern way? Look at the mountain profiles at the bottom of the map. Why do you suppose Lisiansky put them on his map? How would another person use them?

Sources Cited:

Waxell, Sven. *The American Expedition.* Translated by M. A Michael. London: William Hodge. 1952.

News flash: October 1999.

A $125 million spacecraft was destroyed on its way to Mars. The spacecraft flew too close to Mars and broke apart or burned up in the Mars atmosphere because of a navigation error. NASA reports that the problem happened because the numbers used to guide the navigation of the spacecraft were in English measurement instead of metric measurement. NASA had previously used metric measurement in its other Mars missions.

The inaccurate numbers had been used since the launch last December but were not noticed at first. The difference in the two ways of measuring added up over the months as the spacecraft journeyed to Mars.

Materials list for activities, Science Under Sail, Chapter 4

1. You can make a simple compass.

- an iron nail
- bar magnet (NOT a horseshoe magnet)
- paper clip
- piece of string or strong thread, about 3 feet (.9 m) long
- permanent marking pen

2. You can find the North Star.

- star chart*

3. What are the lines of latitude and longitude on the earth?

- oranges or grapefruit, the larger the better. Use their innards later to ward off scurvy in the lesson "Life on a Russian Ship." (Several of these activities call for oranges or grapefruit. Students working in teams can share these citrus spheres, so that one citrus is used by a group of 4-5 students for the latitude/longitude activities, and the other citrus are used for the curved earth to flat-map project.)
- permanent marking pens
- a globe (optional)

4. You can follow an explorer's route (track) using latitude and longitude.

- map of the earth with longitude and latitude, but without place names*

5. How does the flat map compare to the curved earth?

- large oranges or grapefruit
- permanent marking pens

6. Looking at Russian maps and charts.

- Bering's map of Kayak Island*
- contemporary map of Kayak Island*
- Lisiansky's map of Kodiak Island*
- contemporary map of Kodiak that includes latitude and longitude. The US Geological Survey (USGS) has the most comprehensive maps.

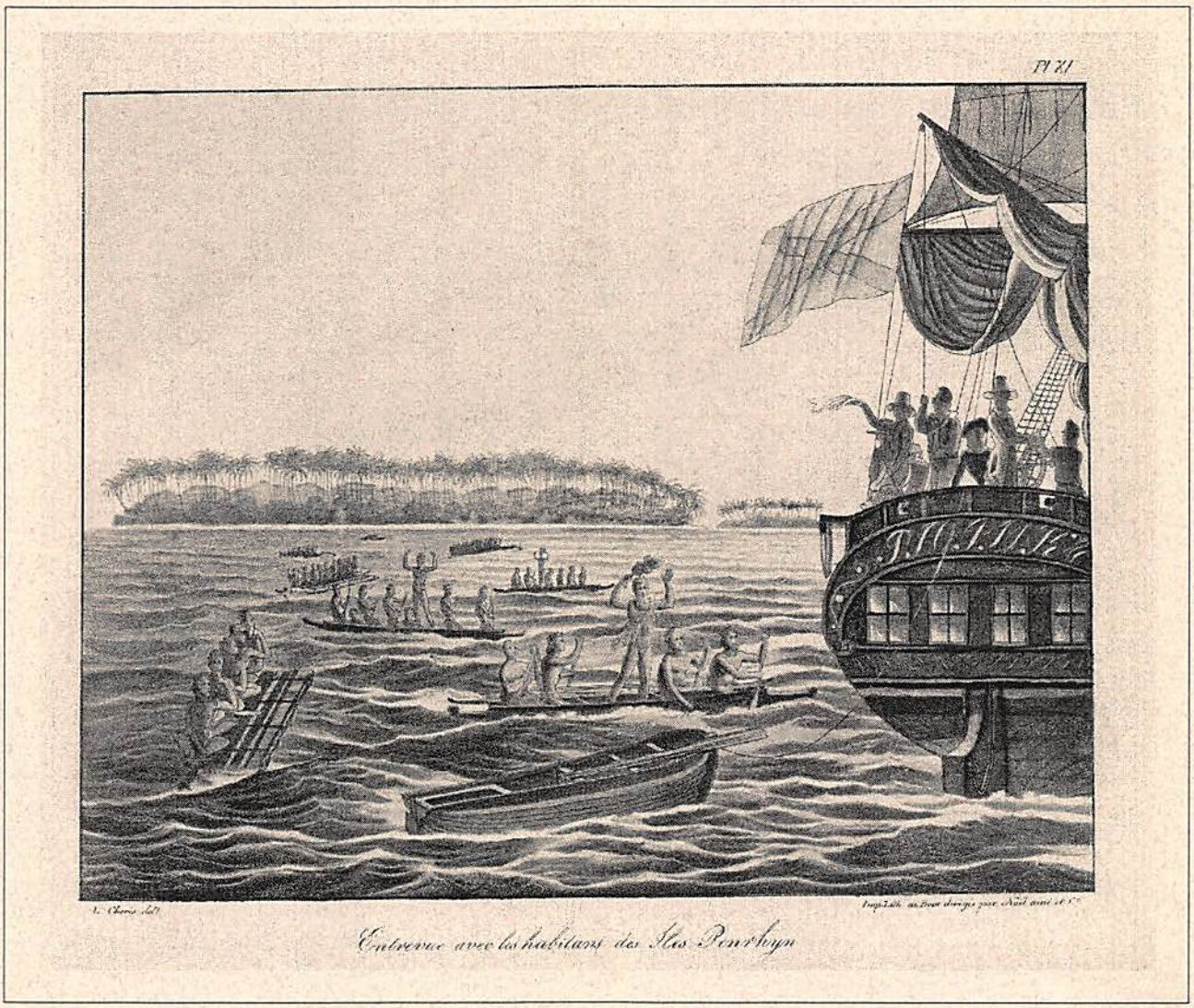
* *included with the Instructional Guide*

Please see, also, related activities A-H, pages 166-178

Science Under Sail: Russia's Great Voyages to America, 1728-1867

"Vessels of Sufficient Strength & Convenience"

Life on a Russian Ship



Sailors on the *Rurik* , Louis Choris, lithograph, *Vues et paysages des regions equinoxiales...*, pl. 11. Paris, 1826

Article V

You are to occupy a vessel of sufficient strength and convenience for you and your crew-mates and you are to observe in all matters the instructions of your officers. You will take all necessary steps to ward off scurvy.

SUMMARY

Students read about a "day" on a Russian ship in the North Pacific, and do activities related to navigation and living on a ship.

MATERIALS

- CREW CARDS—one set to cut apart and distribute (see pages 155-162)*
- crew signs—one set to cut apart and distribute (see pages 163-165)*
- string so that crew signs can be worn around the neck
- hole punch
- duty roster* (Make an extra copy of the back sides of the 4 pages of the crew cards for the ship's Master)
- masking tape
- log-books, pens, pencils

* *included with the Instructional Guide*

Optional Materials:

- food such as kasha; sauerkraut; cranberry juice; crackers such as "Pilot Bread"; or others suggested in the narrative
- hammock
- boxes labeled wheel, water barrel, cannon, boat, sails, ballast
- books and pictures of life at sea in this era, especially the Dorling Kindersley book, *Cross-Sections: Man-of-War* by Stephen Biesty and Richard Platt. This visual guide to life on a British ship of the same time period is highly recommended for use with this activity. See Resources for other suggestions.

ACTIVITIES

1. What Was the Day Like on Board a Russian Ship? (estimated duration for reading and preparation 40-80 minutes; estimated duration for life-on-ship experience 40-120 minutes)

Students use crew cards to get assignments for a "day" on a Russian ship. After reading a narrative description of a typical day, they complete a specific task described on the card and present their results at the end of the day's "inspection." A "meal" follows.

Because the tasks listed on the cards vary in difficulty, you may prefer to assign the cards. There are 36 crew cards. The crew cards are prioritized to allow you to reduce the number according to your class size. Some crew cards have a compass symbol ✵ on the front which means that additional student research is needed. Depending on your school and community resources, you may wish to give out crew cards the day before so that there is time for research outside the class room. For some assignments, you will want to distribute activities A-J, pages 166-180, included in the Appendix.

After the inspection, serve a "meal " with miniature portions of food. The students may be relieved to know that the selections will help ward off scurvy. As an alternative, the cook and his/her crew draw the food.

Delineate the outer perimeter of the Russian ship on the floor in masking tape. Lay out the main deck as described by Middleton (see Appendix). Mark on the floor the location of the galley stove, the hatch to the lower deck. The illustration of the model of the St. Peter may give you more clues.

The activity may appear chaotic at times. You will wish to pause the crew at that point and ask what arrangements need to be made to work in tight quarters. What discipline is needed on a ship for everyone to do his/her job well? How would the Russian mariner behave? What would happen if the Russian mariner did not follow orders?

2. Students write about their work on a Russian ship in their log books. (estimated duration 15-20 minutes)

In addition:

3. Students discover and explain examples of the language of the sea. (estimated duration 20-30 minutes)

4. Students draw a Russian ship. (estimated duration 20-30 minutes)

Activities A - J and the Steller Crossword Puzzle (pages 166-182) provide directions for some of the tasks on the crew cards and offer additional experiences for the active mariner.

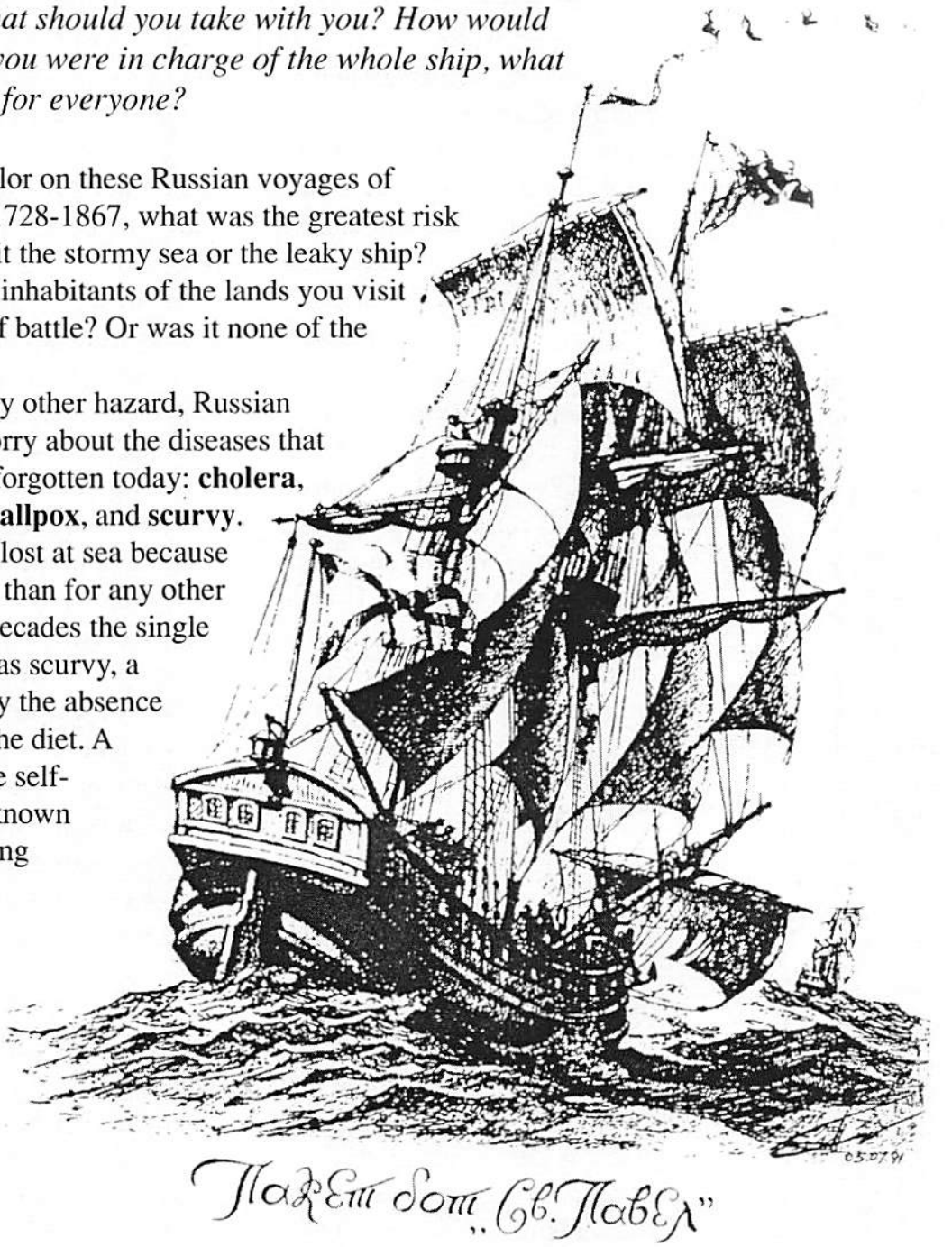
"Vessels of Sufficient Strength & Convenience"

Life on a Russian Ship

You are about to sail away on a small ship for one or two or three years. What should you take with you? How would you decide? If you were in charge of the whole ship, what would you take for everyone?

If you were a sailor on these Russian voyages of discovery from 1728-1867, what was the greatest risk you faced? Was it the stormy sea or the leaky ship? Was it the angry inhabitants of the lands you visit and the danger of battle? Or was it none of the above?

More than any other hazard, Russian sailors had to worry about the diseases that we have almost forgotten today: **cholera**, **yellow fever, smallpox**, and **scurvy**. More lives were lost at sea because of poor nutrition than for any other reason, and for decades the single greatest threat was scurvy, a disease caused by the absence of vitamin C in the diet. A ship needed to be self-sustaining in unknown waters, but holding food for long voyages was a challenge. During the early voyages of Russian exploration,



St. Peter and the *St. Paul.* Engraving by I. Pshenichnyi, 1980's.
Central Naval Museum

there was no refrigeration, or tin cans, or food-storage methods that we know today. Even a voyage of three or four months in the early 1700's meant running out of fresh food and having to rely on barrels of flour that may have dampened in the sea air, or boxes of crackers that may have turned soggy and moldy. Many ships carried live animals to provide food for the crew, but then they had to bring food and water for the animals and fit them into already small spaces.

Later Russian round-the-world voyages carried sauerkraut, **bouillon**, herbal teas and cranberry juice among the food stores to ward off scurvy. All hands returned alive and well. By the time of Otto von **Kotzebue's** voyage in 1815, the tinned can had appeared and its successful use on Kotzebue's ship contributed to no lives being lost from the dreaded disease.

The great voyages of discovery, "especially those of the 18th century proved to be sea-going laboratories where experiments in nutrition, medicine, **hygiene** and **sanitation** were conducted while advances in naval architecture, navigation, **hydrography** took place as the ship explored uncharted seas .... A sailor in **Bering's** time would be lucky to return alive and could expect the majority of his comrades to not share in that luck." (Middleton) One hundred years later, a sailor could start the voyage alive, healthy, and with the reasonable expectation that the ship would return.

Naval service, although risky and dangerous, was, for many, a way to assure an improved future and fortune. As in other countries, service in the military meant a chance for advancement that other parts of society could not provide. "A person born into the **serf** class in Russia could conceivably find himself an admiral at the end of a distinguished (albeit unique) career. Service on board a ship embarking upon a voyage of exploration was almost a certain path for advancement." (Middleton) However, from 1705 until 1793, service was for life. **Recruits** who left their villages were mourned as though dead, for few returned. During **Catherine the Great's** reign, the nobles were released from obligatory service and the term of service for the lower classes was reduced from life to twenty-five years.

• Choose a CREW CARD and then read the following, noting where you fit in as a crew member. If your crew card has this compass symbol ⚙ you may need to do additional research in order to carry out your task on the ship.

What Was the Day Like on Board a Russian Ship?

(adapted from Middleton)

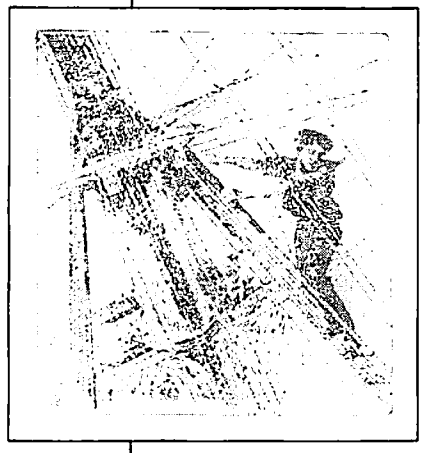
At 3:30 AM in the warm darkness below the main deck, the sailor's canvas **hammocks** slung from the beams swing to the roll of the ship. Mess tables have been pulled up for the night and sea chests slid to the sides. On the deck above, you hear muffled footsteps and the occasional voice of the **boatswain's** mate of the watch. The ship's bell rings seven times. The steps become more hurried, and from above through the hatch, the shrill whistle blown by the boatswain's mate and the deep voice commands "pervaya, na vakhtu" *call the first watch.*

The day begins.

In other parts of the ship, the **quartermaster** wakes the mates and the lieutenant of the **watch.** The mates sleep **mid-ship**. The lieutenant shares a cabin with the **ensign**, and the secretary, artist and naturalist all share another cabin in the stern. The **warrant officers** sleep in private cabins, with their rooms clustered around the galley.

The quartermaster at the wheel and the sailors at lookout are relieved. The navigator's mate makes the first entries in the log with ship's speed, course, and other information the officer of the watch thinks important. The cook lights the galley fires, and next to the galley, the boatswain and carpenter emerge from their cabins to go on deck to make the day's first inspection of the ship. The cook begins breakfast: one of several types of **kasha** (porridge) served with butter and molasses, tea, and fruit preserves.

The off-duty watch crawls back into their hammocks feeling damp and ready for four more hours of sleep. They swing gently in their hammocks as the galley stove warms the lower deck and the smells of breakfast lull them to sleep.



Above their heads, the first watch begins to scrub down the decks and polish the brass fittings, eager for the call to breakfast.

Four hours later, the boatswain's pipe shrilly calls again, all hands to "up hammocks" and come on deck. The hammocks are rolled with their sheets, pillows and blankets inside, lashed at intervals, carried on deck and placed in netting above the upper deck. The rolled hammocks serve as protection against attack by spears or small arms fire. Linen sailcloth covers them from the spray and rain. When hammocks are stowed and the decks cleaned and aired by all the sailors, the captain comes up on deck. Eight bells signal the end of the morning watch and the

beginning of the **forenoon** watch.

The bells tell time by ringing each half hour. Eight bells was 12:00. One bell was 12:30; two bells 1:00, three bells 1:30 and so on until eight bells ring again at 4:00 signaling a new watch. Then at 4:30, one bell rings, starting the four-hour cycle again.

When the captain comes on deck at 8:00 AM, the boatswain makes his report and asks permission to **pipe** all hands to breakfast. The watch that is going on duty is served first.

Chests and sea-bags are brought up so that the lower deck can be cleaned. The cabin boy tidies the captain's cabin. The carpenter and boatswain set their crews to work repairing the **rigging**, **tarring** lines, making new mats, and painting the boats. The off-duty watch mend their clothes, relax or practice the crafts sailors are famed for, such as decorative rope work and carving. During the forenoon watch, the members of the **mess** on meal detail assist the cook in the galley. The surgeon checks his medical supplies and the ensign looks over the signal flags to assure they are all in order.

One day each week in the forenoon watch, the crew wash their clothes and hang them to dry. The sailmaker and his apprentice mend sails. The gunner and gunner's mate count and clean the weapons and inspect the ammunition. The carpenter and cooper's mate examine the water barrels, taking apart any that are empty. The master and his mate inspect the holds, and when they find a leak, they call in the **caulker**. Noticing that provisions have shifted, they ask the **purser** to see that supplies are re-stowed in the **hold** to help **trim** the ship.

At sea, the day officially begins at noon. The mates and their instructors, the master and navigator, take the **noon sight** to determine the position of the ship. All calculations are entered into the ship's log and the distance traveled from the previous noon sight is recorded. Eight bells strike the end of the forenoon watch and the crew is sent to dinner, the mid-day meal. But prior to dinner being served, the cook comes up on deck with a bowl or plate of food and salutes the captain. While the cook stands at salute, the captain samples the meal and gives permission to serve it to the crew. Everyone hopes the meal will include meat, but the salt on the six-month-old mutton had to be cleaned off and the mess crew forgot to soak it overnight.

Dinner will be stew with whatever vegetables are available, served over kasha or rice or pasta.

Then the sailors gather in the mess, sit down at tables lowered from the ceilings and wait to be served by one of the mess-mates. A "mess" has several meanings. It is the place on the berth deck where the mariners eat and sleep, and it is a group of mariners who share a table. One of the mess gathers and cleans the dishes and utensils, helps the cook with meal preparation and serves the meal. This job rotates through the mess.

Supper is served between 4 PM and 8 PM and is similar to, but lighter than the mid-day dinner. During this meal the sailors might have a dessert made of wheat porridge with a cranberry syrup or jelly.

Just before sunset, the crews are **called to quarters** to practice battle stations. There they are inspected by the officers and after being relieved, collect their hammocks from the netting on the upper deck, and go below to sling them on the lower deck. The ship's secretary makes sure all the ship's log books and journals are properly **stowed**.

At eight o'clock (eight bells) the evening watch begins and the relieved watch can sleep for four hours before the middle watch (12 midnight). The purser collects the candles from everyone but the officers. The artist and the naturalist plead to keep theirs for a while longer. They have specimens to describe. The master-at-arms begins his rounds through the ship, checking on the water level in the **bilge**, and looking at the stores. He looks with especially keen eyes for any un-extinguished lights that might start a fire. The ship becomes quiet. On deck and in the **foremast**, sailors on lookout stand watch. The quartermaster at the wheel keeps course by the compass lit with an oil lamp. **Sentries** guard the entrance to the officer's decks, the magazine, and the store rooms. At eight bells (4 AM) the day begins again.

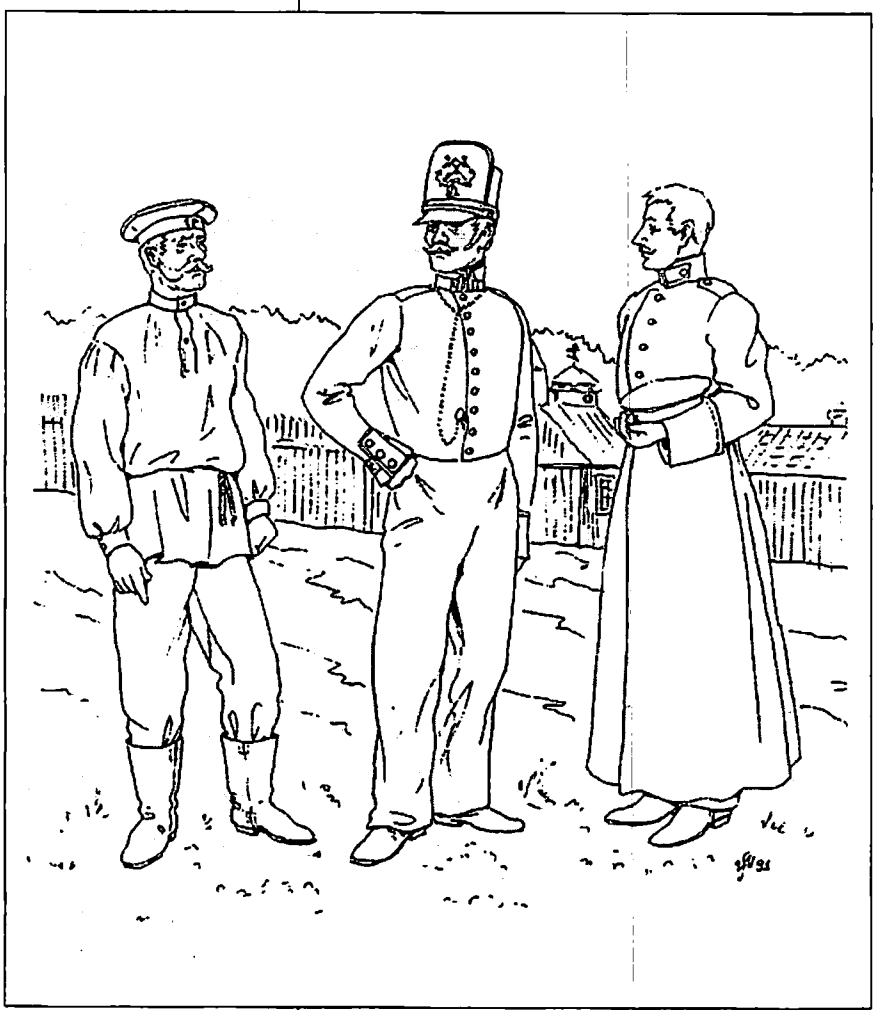
These are the supplies the navy issued you. They are expected to last two years. You have no less than three sets of winter and summer clothes and underwear. The first set should be made of wool. Fur is permitted on the Arctic voyages. Clothing and bedding is aired on deck when the weather permits and is washed as frequently as possible.

Words on the waves:
hammocks
boatswain
quartermaster
watch
mid-ship
ensign
warrant officers
pipe
rigging
tarring
mess
caulker
hold
trim
noon sight
call to quarters
bilge

When is a rope not a rope? When it's on a ship. Then it's a line.

You are personally responsible for:

1 large and one small sailcloth bag
1 sailcloth hammock
8 linen shirts
8 pair wool socks
1 horse-hair mattress
1 pillow
2 linen pillow cases
4 sheets
1 pair shoes
2 pairs socks
2 kerchiefs
1 pair warm boots
1 leather hat with folding ear flaps
1 thick wool blanket
7 flannel shirts
2 wool caps
2 pair wool broadcloth trousers
6 pair summer trousers
2 pullovers in natural linen



Clothing in Colonial Russian America: A New Look by John Middleton.
Limestone Press and University of Alaska Press, Fairbanks, 1996

In 1721 the ingredients for the week's meals consisted of dried bread, beer, salted meat, salted fish, kasha, peas, butter, salt and vinegar. After 1815 naval ships carried canned soups, vegetables, fruit preserves and meats as well as tea and tobacco. By 1819 provisions included granulated sugar, mustard, molasses, and sauerkraut. "...One should have the largest possible quantity of rye bread, properly prepared and preserved, beef broth, cabbage, onions, turnips, carrots, beets, herrings,

horseradish, and a sufficient amount of sauerkraut, contained in oak barrels of the best quality .... The sick should be provided with all types of pharmaceuticals, especially an abundance of those that are considered best for scurvy such as raspberry juice, **tamarind**, good quality wine, and the best wine vinegar. **Tapioca**, arrow root, granulated sugar, and **sassafras** chips may be used instead of tea...." (Middleton)

Bering's boats were known as **packet boats** with "three square sails on each of two masts, three **foresails** on the **bowsprit**, and a **mizzen sail** on the **after mast**." (Middleton) The two ships of Bering's second expedition took three years to build. Two smaller boats for each ship were also constructed, and outfitted with sails, masts and oars. The finished ships were 80 feet long (24.4 m) 22.5 feet wide (6.9 m) and 12 feet deep (3.66 m) in the hold.

By comparison, the *Mayflower* was 104 feet long (31.7 m) and 25 feet wide (7.6 m) with more than one hundred passengers and crew. Kotzebue's ship, the *Rurik*, was also 80 feet long and held only thirty-four men. Adelbert von **Chamisso**, the naturalist on the *Rurik* said: "In the cabin, four men sleep, six men live, and seven men eat .... Between meals, the painter and his drawing board take up two sides of the table, and the third side belongs to the officers .... If anybody wants to write, or in any way make use of the table, he has to wait to take it over for a few fleeting moments that are **parsimoniously** counted and **avariciously** employed; as for me, I cannot work this way."

A crew list (a ship of the type that Bering sailed called for a crew of 60):

Commissioned officers:
- 1 captain (a lieutenant)
- 1 junior lieutenant
- 1 ship's secretary
- 1 ensign

Warrant officers:
- 1 navigator
- 1 master
- 1 gunner
- 1 purser
- 1 boatswain
- 1 priest
- 1 sailmaker

Petty Officers
- 2 quartermasters
- 1 surgeon's apprentice
- 1 master's mate
- 1 navigator's mate
- 1 boatswain's mate
- 1 gunner's mate
- 1 corporal of cannons
- 1 cook
- 1 master-at-arms

Lower ranks
- 1 rigger
- 1 rigger's mate
- 1 scribe
- 8 cannon crew
- 8 sailors
- 5 soldiers
- 2 cabin boys
- 8 sentries
- 2 carpenters
- 1 cooper's mate
- 2 caulkers
- 1 sailmaker's apprentice

60 Total

Actual crew total on the *St. Peter*, 77.

Activity 1
What Was the Day Like on Board a Russian Ship?

After you have your CREW CARD assignment, read "Life on a Russian Ship" noting where your role as a crew member is described. What do you do on the ship? How do you work on the ship? Where do you sleep? Eat? Who do you report to? Who do you take orders from or give orders to?

Each crew card has a task on the back. On the front, the compass symbol ✥ means that some additional research will be needed to complete the task. The resource section lists a few books that will help with the research. For some assignments, there are printed activities in the Appendix. A few of the tasks require you to make notes on the "log slate," your classroom "blackboard." You should prepare your work for presentation at the "inspection" at the end of the day.

You also need a sign with your crew assignment name on it. Consider the sign as a substitute for a naval "uniform." The sign should be worn while on task so that fellow officers and subordinate crew can report to the appropriate person.

You should remember at all times that discipline was important on board a ship. Unruly or disobedient sailors could be flogged and even thrown overboard if they did not follow orders. Besides, there really is not much room on a ship and if someone behaves inappropriately, the entire crew is affected.

Activity 2
Write about Your Work on a Russian Ship in Your Log Book.

Using the crew card, write a description in your log book about your work. What is the name of your crew assignment? What do you do on the ship? Where do you sleep? Where do you eat? Who works with you?

In Addition: Activity 3
Discover the Language of the Sea.

The vocabulary of sailing ships appears unusual to many of us now. In your log book, list the new words you see in this description of a day on a Russian ship. Write the meaning of each word. Then write a prediction: is this a word you will ever use again? Yes? No? Be prepared to support your prediction with a reason.

In Addition: Activity 4
Draw a Russian Ship.

Can you draw a Russian ship? Using the description of the ships in John Middleton's essay in the Appendix, and the illustration of a ship's model on page 88, draw a picture of the vessel.

Sources Cited:

Chamisso, Adelbert von. *Voyage Around the World with the Romanzov Exploring Expedition in the Years 1815-1818 in the Brig* Rurik. Translated and Edited by Henry Kratz. Honolulu, HI: University of Hawaii Press. 1986.

Biesty, Stephen and Richard Platt. *Man-of-War: Cross-Sections.* New York: Dorling Kindersley. 1993. This book is about a British ship much larger than any our explorers used. The Russians admired and bought British ships smaller than the one in the book, but very similar to it. The illustrations and diagrams help us understand life on all sailing ships. (And the book shows you where the "head" is.)

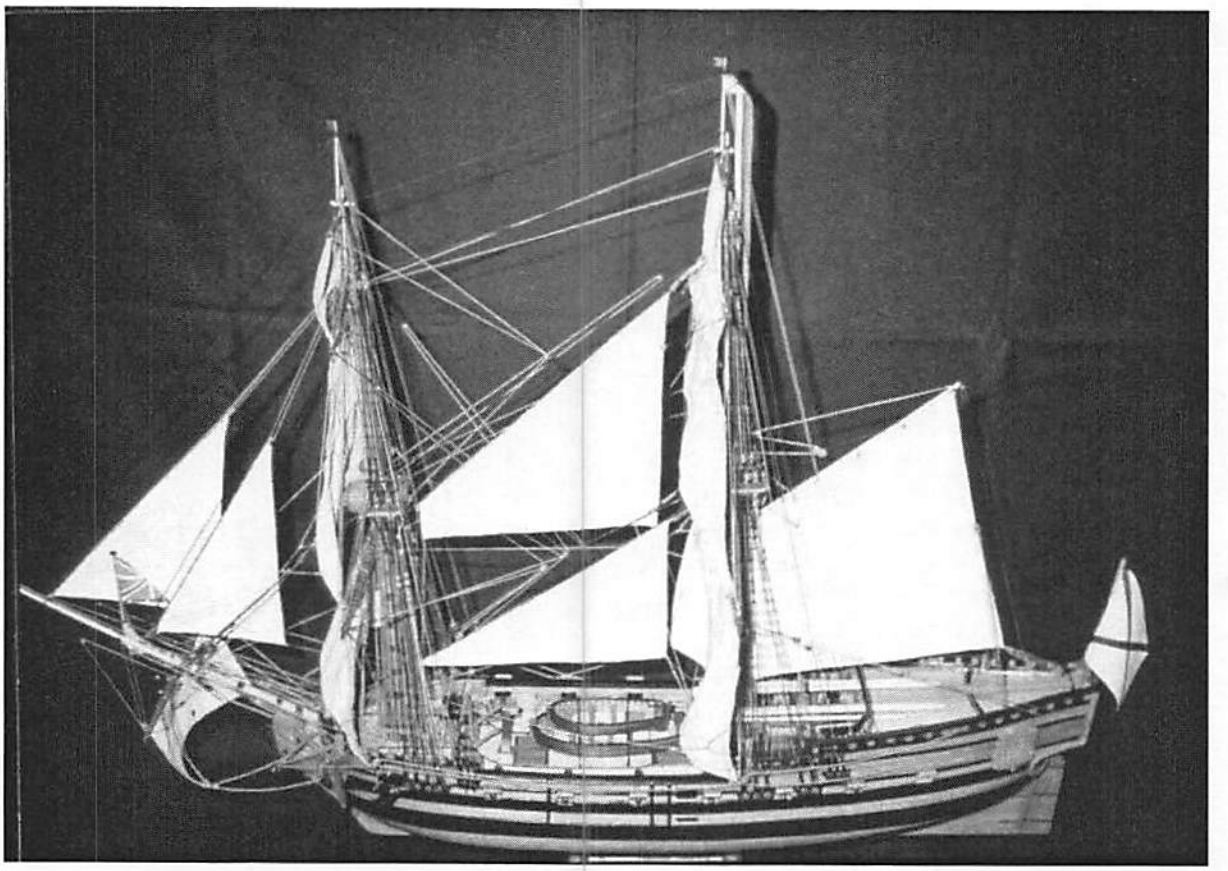
Middleton, John. "The Community of the Ship: Life Aboard Russian Ships in the 18th and 19th Centuries." Draft manuscript.

News Flash: Tall Ships 2000.

Sailing ships like those the Russians sailed to America are known as "tall ships." In the year 2000, 120 of these ships will race during the months of April to December. This will be the largest gathering of tall ships in history. At least half the people on board each ship will be between 15 and 25 years old.

For more information and to track the progress of the race, see "www.tallships2000.com"

How would you behave on a small sailing ship, crowded with your crew mates for months, perhaps years? How do you decide what to take with you on a plane trip? On a camping trip? How do you adjust to a camping trip when it starts to rain? How do you cope if you are on an airplane and there is turbulence?



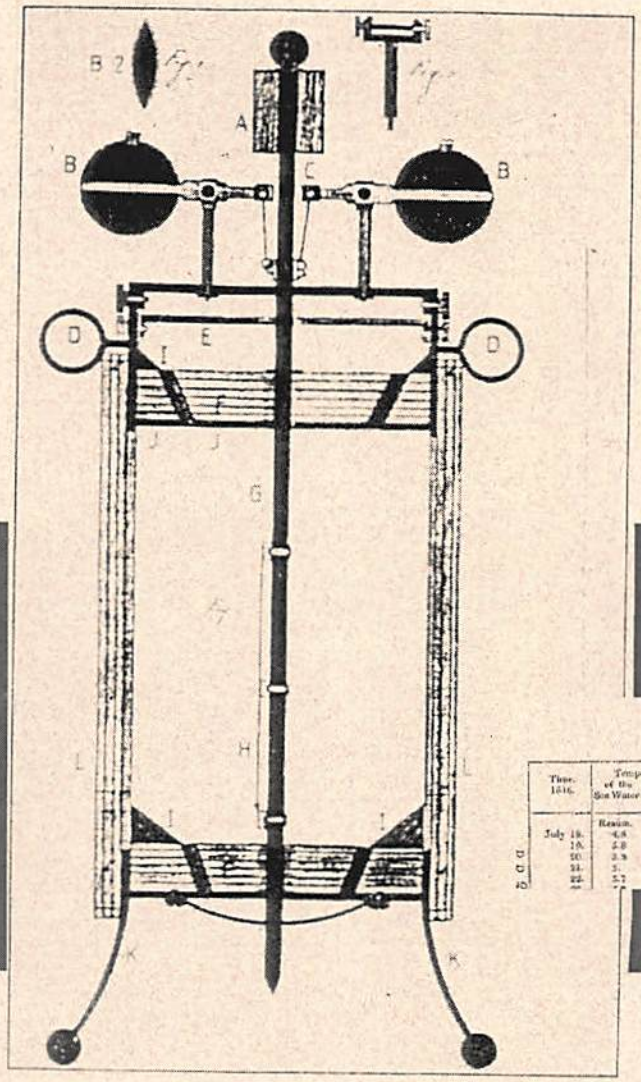
St. Peter, model by G. Atavin, St. Petersburg, 1999

How many masts do you see?
How many boats are on the main deck?
Do you see the flag of St Andrew?

For more description of this ship, see the Appendix, page 184B

"In the Eastern Ocean"

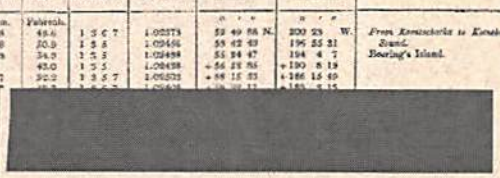
Understanding the Sea



AREOMETRICAL OBSERVATIONS,

FROM THE 18TH OF JULY 1816, TO THE 19TH OF APRIL 1818.

Time. 1816.	Temperature of the Sea Water	Temperature of the Air.	Weight of the Areometer.	Specific Gravity of the Sea Water.	The Ship's Latitude.	The Ship's Longitude.	Observations.
	Reaum.	Fahrenh.			° ′ ″	° ′ ″	
July 18.	4.8	48.6	1 3 6 7	1.02573	52 49 58 N.	200 23 W.	From Kronotzkoi to Kamtschatka Coast.
19.	5.0	50.0	1 3 5	1.02656	55 42 49	196 25 21	
20.	5.8	54.0	1 3 5	1.02656	55 34 47	194 4 7	Bearing's Island.
21.	5.	45.0	1 3 5	1.02656	+56 25 56	+190 8 19	
22.	5.1	50.0	1 3 5 7	1.02656	+56 15 53	+186 15 49	



Lenz-Parrot Insulated Water Bottle ("bathometer"), drawing by Emil Lenz, 1830. Kotzebue voyage, 1823-26.
Museum of the University of Tartu, Estonia

Article VI

When you have assembled your materials, you will collect readings of changes of temperature and content of the waters of the vast area you survey, forming tables of these observations.

SUMMARY

The Russian voyages increased our knowledge of the science of the ocean. One example of this burst of knowledge was in the development of tools and techniques to read the temperature of the ocean's water at depth. In this lesson, students learn the history of Russian ocean science of the period and the basics of thermometers.
This chapter features the sailing scientist Emil Lenz.

This lesson provides several simple experiments that students can do in class or on their own. Select from these activities depending on the skills level of your students. Establishing a work station for each activity permits students to move among the experiments as they complete the work and record results in their log books.

MATERIALS

- narrative with illustrations and experiments, "In the Eastern Ocean"*
- log books with pen, pencils

Materials for each activity are described with the activity, and repeated in a complete list at the end of this chapter.

ACTIVITIES

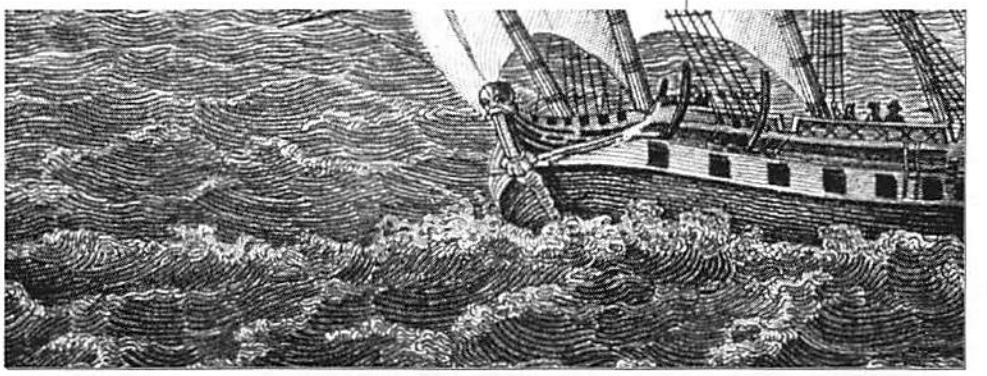
1. Students make a simple thermometer. (estimated duration 10-20 minutes)
2. Students demonstrate the variation in water pressure at depth. (estimated duration 10-20 minutes)
3. Students demonstrate how salt affects the freezing point of sea water. (estimated duration 20-30 minutes)
4. Students demonstrate the affect of temperature on water movement. (estimated duration 10-20 minutes with pause up to 60 minutes for water settling)
5. In Addition. Students explore the World Wide Web and do experiments. (estimated duration 30-40 minutes)
6. In Addition. Students use Kotzebue's chart for advanced explorations and activities. (estimated duration 30-40 minutes) Advanced level.

"In the Eastern Ocean"

Understanding the Sea

What is the significance of ocean temperature? Does it change from location to location on the surface of the water? Does it change at depth? Is the ocean equally salty everywhere? How do the temperature and the salt of the water affect the waves, the tides, the currents of the ocean and thus affect the people who sail the seas? Does ocean temperature change over time?

Through the 1700's, Russia's great voyages to America continued to add information about the coastline of the North Pacific. Mariners and scientists were also concerned about the great highway on which they traveled —the ocean, itself. Knowledge about the character of the water helped guide navigation, giving clues about nearby land and fresh water. The need to know the temperature and **salinity** of the waters led to more accurate instruments. It soon became common practice to take soundings, collect water samples, and measure temperature at each observation.



Detail from The *Hope [Nadezhda]*, engraving from drawing by W. G. Tilesius von Tilenau. Atlas of I. A. Krusenstern.
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks

Until 1803 all Russian government-sponsored voyages in the North Pacific began after arduous journeys thousands of miles overland across Siberia. There had been proposals as early as the 1760s, during Catherine's reign, to try to sail around the world, or through the Arctic, to the Pacific. But the few attempts were blocked by ice or stopped by wars. The idea was revived by Johann von **Krusenstern** who persuaded the Admiralty that Russia should try once again to sail round-the-world to inspect and service the colony in North America. He predicted that the journey would be faster, cheaper, and safer than by

> "Notwithstanding the thousands of ships that have traversed the ocean in all directions, far and near, we still know so little of the numerous interesting phenomena of this immense mass of water, which covers two-thirds of the surface of our globe, that this is precisely a main object of every voyage undertaken for the improvement of science."
> (Horner in Kotzebue, 1821)

following the overland Siberian route. Partnering with another experienced mariner, Yuri **Lisiansky**, Krusenstern supplied his two ships with the newest naval and scientific instruments, including a **thermometer**: "of the kind invented by Six, which shews [sic] the greatest degree of heat or cold, that has taken place during the absence of the observer, as a supplement to an instrument for ascertaining the temperature of the sea under water ...." (Krusenstern)

What Is the Story of Thermometers?

The thermometer used on Krusenstern's round-the-world voyage had the advantage of giving a reading without the observer being present. Like many thermometers, his used the principle that most solids, liquids and gases typically expand when heated and contract when cooled. The thermometer indirectly measures *heat by measuring the expansion and contraction of the material within the thermometer.* By watching how much the material expands as it is heated, we can measure a rise in temperature. By watching how much the material contracts when it is cooled, we can measure a drop in temperature, measured with a thermometer.

Most solids, liquids and gases expand when heated and contract when cooled. The amount by which a substance expands or contracts depends on how much its temperature changes. Temperature is the degree of how hot or cold something is, measured with a thermometer. The thermometer indirectly measures heat by measuring the **expansion** and **contraction** of the material within the thermometer.

The word thermometer comes from combining the words "therm" which = heat and "meter" which = to measure. However, a thermometer does NOT measure heat. It measures the expansion and contraction of the material within the thermometer! For the measurement scale, two standard fixed points are used. Any sort of scale can be used, provided that it is clearly defined so that everyone knows what the numbers mean.

The most common scales we use today to measure temperature are the Celsius and the Fahrenheit scales. Each is named for its inventor. The German physicist, Gabriel Daniel **Fahrenheit** (1686-1736), based his 0° on the coldest temperature he could produce in his laboratory. He called the position on the scale where water froze, 32°, and the position where water boiled, 212°. Anders **Celsius** (1701-1744), a Swedish professor of astronomy whose main interest, actually, was studying the northern lights, invented the Celsius scale. He originally set the boiling point at 0° and the freezing point at 100°. Other scientists later reversed his version to get the modern Celsius scale. Sometimes the degrees on the Celsius scale are

called **Centigrade** (from centi = 100 and grade = step).

- The Celsius scale is based on the division of 100 equal degrees between the boiling point and the freezing point of water. The freezing point of water is 0 degrees C and the boiling point of water is 100 degrees C.
- In the Fahrenheit scale, the freezing point of water is 32 degrees F and the temperature of boiling water is 212 degrees F.

People who observe the weather need a thermometer that records the highest (maximum) and the lowest (minimum) temperature. The person credited with inventing this kind of thermometer in 1780 was James **Six.** Six's thermometer had its first long test on the Russian round-the-world voyage of 1803-1806.

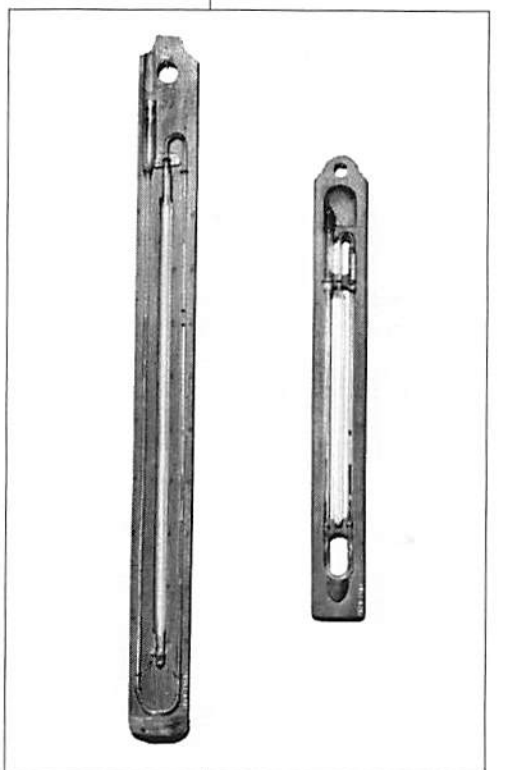
The advantage of Six's thermometer was that it was simple to use and recorded both extremes of temperature in the absence of its observer. An American manufacturer produced them in Philadelphia for customers such as George Washington, a conscientious weather-diary keeper. Washington's Six's thermometer is still on display in Mount Vernon.

How Does Water Pressure Affect Temperature Readings?

Unfortunately, Six's thermometer was not completely accurate at depth, even though he increased the thickness of the glass to compensate for pressure. Another dilemma was the need to collect a water sample at depth without contaminating it with other water as the sample rose to the surface.

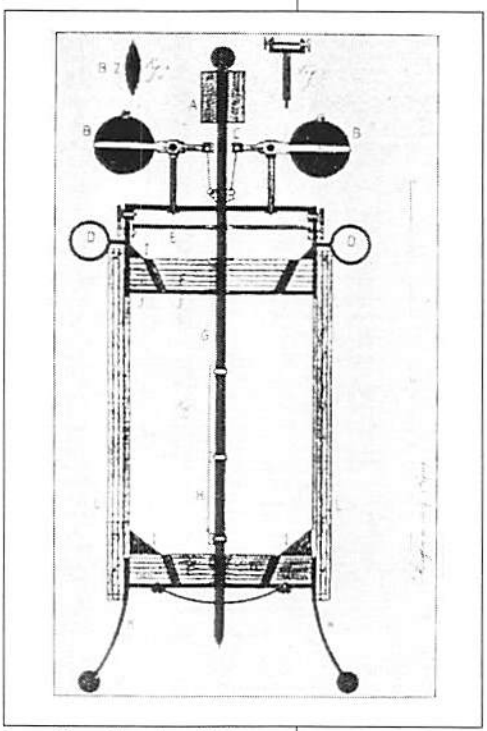
Otto von **Kotzebue**, in his round-the-world voyage aboard the *Rurik* in 1815-18, used Six's thermometer. "I have made the observations myself, with a good Six-thermometer, and can answer for their accuracy. The graduation, both of the thermometer, and of the Six-thermometer, is according to Fahrenheit. As these observations can only be made in a perfect calm, and that in a boat, so that the sea must also be tranquil they are among those which are the most rarely made by navigators."

In most thermometers, the upper point marks the boiling point of water while the lower point stands for the freezing point.



Six's Thermometer.
Photograph courtesy Science and Society Library, SCM/MET/ B610169B

Emil Lenz.
Photograph courtesy Museum of the University of Tartu, Estonia



Lenz-Parrot Insulated Water Bottle (bathometer), drawing by Emil Lenz, 1830. Kotzebue voyage, 1823-26.
Museum of the University of Tartu, Estonia

When Kotzebue returned home from his voyage, he explained the problems he had using Six's thermometer to a young physicist, Emil **Lenz**. Lenz had been recommended as a scientist for the upcoming round-the world voyage scheduled for 1823. At 19, he already showed great promise in physics and geography. Working with Professor G. F. Parrot in Estonia, Lenz created an internal thermometer in an insulated water container that he called a **bathometer**. The Lenz-Parrot insulated water bottle used several innovations that allowed it to collect water samples from depths inaccessible before—1000 to 3000 **fathoms**. The "bottle" part of the bathometer was made of seventeen insulated layers selected from different materials, based on the premise that different materials transfer heat slower than layers of the same material. Valves at the top and bottom stayed open as long as the bottle was descending and closed when it was pulled up. Extra-thick glass for the thermometer reduced the effect of changes in water pressure. Special rigging at the top of the bottle stopped the valves from popping open when the bottle reached the surface. Thus both water sample and at-depth-reading of the temperature would be accurate.

What Is the Temperature of Ocean Water?

The temperature of ocean water varies from place to place and changes with the seasons. Surface temperatures vary at different locations, but at great depths there is little difference in temperature. Because the sun's rays strike the earth most directly at the **equator** and least directly at the poles, warmer water areas occur at low **latitudes** and colder areas at high latitudes.

Ocean water can be hot, more than 500°F (260°C) near vents where water comes through volcanically heated rock. But these places are the exceptions. The ocean in general is cool. Water in the Arctic Ocean can even be 28°F (-2.2°C) and not be ice, even though this temperature

is colder than water's freezing point. How is this possible?

Ocean water contains salt. Salt molecules slow down the water molecule's abilities to bond with each other in the solid form we call ice.

In the early nineteenth century, scientists on the Russian ships wanted to know the character of water in order to understand navigation opportunities. Changes in temperature and **salinity** could mean land was near. For example, by testing the water in various inlets, mariners hoped to distinguish between landlocked bays and passages leading to open ocean. The water in a bay, fed by freshwater rivers or melting ice, would be less salty than the main body of the ocean, whereas water in a clear passage would be of normal salinity and would probably have strong currents running through it.

How Does Temperature Affect Ocean Currents?

Temperature and salinity both affect the **density** of sea water. Density is how closely packed the molecules in a substance are. As ocean water freezes, much of the salt is left out of the ice that forms. The water just below the ice becomes even saltier. This cold, saltier water is dense, so it sinks to the bottom of the ocean. This motion is an important part of the worldwide circulation of deep ocean currents. The water in the deepest parts of the ocean is very cold—just one or two degrees above 32° F (0 ° C).

If you were looking for the effects of pollution in the North Pacific Ocean, would you look at the surface water or deeper? Why?

Records of ocean temperature, salinity, and density continue to be significant for scientists and all those who rely on the oceans. In addition to the thousands of readings done by independent researchers and their movable scientific instruments, the National Oceanic and Atmospheric Administration (NOAA) monitors 189 fixed locations along US coasts, Great Lakes and US territories and possessions. Of primary concern is the actual level of the water with additional data measured every six minutes: wind velocity, barometric pressure, air and water temperature, conductivity and relative humidity. These measurements are transmitted at three-hour intervals via satellite to computers and help us understand many other related conditions in the ocean. For example:

How much salt is in the ocean? Ocean water usually contains about 3.5 percent salt. If you had 100 pounds (45 kilograms) of ocean water, 3.5 pounds (1.6 kilograms) of it would be salt. One estimate states that there are about 5 trillion tons of salt in the world's oceans. Another estimate states that if all the ocean water evaporated and the salt were spread evenly over the whole earth, the pile of salt would be as high as a fifteen-story building, everywhere.

• Different marine species thrive in different water densities. Changes in the chemical composition of water can force species to migrate or perish.

• Marine species are sensitive to the temperature of water. During the **El Niño** which warmed the Pacific, great ocean Sunfish and Barracuda—tropical species—were found in Alaska waters.

• The temperature of water indicates the presence of currents that are important for ship traffic. Both the Gulf Stream in the Atlantic and the **Kurosho Current** in the Pacific (moving north from the sub-tropics) are known by their relatively warm water.

• The oceans are big storehouses of heat, storehouses that are getting hotter according to temperature records. Predictions are that the stored heat of the oceans may be part of a global warming cycle.

How important is it to understand ocean temperature today? What do you know about El Niño and La Niña? How can the records the Russians made affect our understanding of global warming?

News Flash: March, 2000. The temperature of the oceans has increased dramatically over the past forty years according to the National Oceanic and Atmospheric Administration (NOAA). By combining 5.1 million temperature profiles from sources around the world into one data base, NOAA has shown that the ocean's temperature has increased 0.11°F to a depth of two miles. More information is available at the NOAA web site: http://www.noaa.gov/

ALERT: Some of these experiments require preparation the day before—such as freezing ice cubes.

Activity 1
You Can Make a Simple Thermometer.

You will need:

- see-through, clear drinking straw
- ink or colored water
- pay dough or modeling clay
- small bottle or other container to hold the straw upright

Procedure:

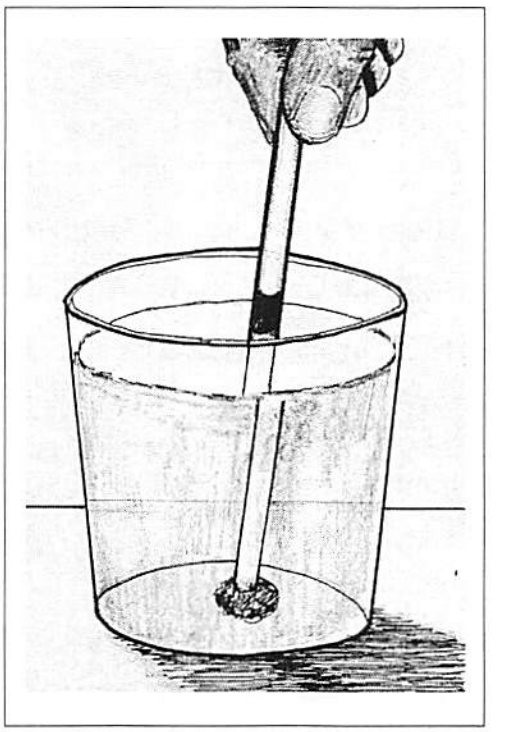
1. Put a drop of ink or colored water inside a clear drinking straw. Tap the straw so that the drop slides half-way.

2. Then block the lower end of the straw with play dough or modeling clay.

3. Stand your thermometer upright in a small bottle.

4. In your log book, predict what will happen when you place your thermometer in a cold place for a short while, and then in a sunny place such as a window sill.

Is your prediction accurate? What happens to the colored drop? Does it move? If it moves after testing it in the two locations, mark a scale in pencil on the side of the straw to record how far it moved in the two locations. In your log book, record your prediction, your result and the meaning of your scale. If you can, explain why the drop moved.



Activity 1:
Results for "You Can Make a Simple Thermometer."

WHY does the drop move?

The air trapped inside the straw will expand when heated and the colored drop will rise in the straw. The air in the straw will contract when cold and the colored drop will lower in the straw.

Like most thermometers, this one uses the principle that solids, liquids and gases typically expand when heated and contract when cooled. The thermometer indirectly measures heat by measuring the expansion and contraction of the material within the thermometer.

Historical Milestones in taking temperatures:

1593. Galileo Galilei designs the first thermometer.

1626. Italian doctor Santorior Santorio is the first to measure human temperature with a thermometer.

1714. German physicist Fahrenheit constructs the first mercury thermometer with an accurate scale.

1742. Swedish astronomer Celsius introduces the centigrade temperature scale.

1780. James Six invents the self-registering maximum/minimum thermometer.

1823. Emil Lenz and G. F. Parrot develop the bathometer.

Activity 2
Water Pressure Experiment.

Why would water pressure be a concern? What is variation in pressure at depth? Try this demonstration.

You will need:

- sharp pencil
- 7 ounce (210 ml.) paper cup
- pitcher of water
- sink or dishpan

Procedure:

1. Use the pencil to punch three holes of similar diameter on a slightly diagonal line at the top, middle, and near the bottom of the cup.

2. Predict what you think will happen when water is in the cup.

3. Hold the cup above a sink or dishpan. Pour the water quickly from the pitcher into the cup, holding your fingers over the two bottom holes. When you move your hand away, what happens?

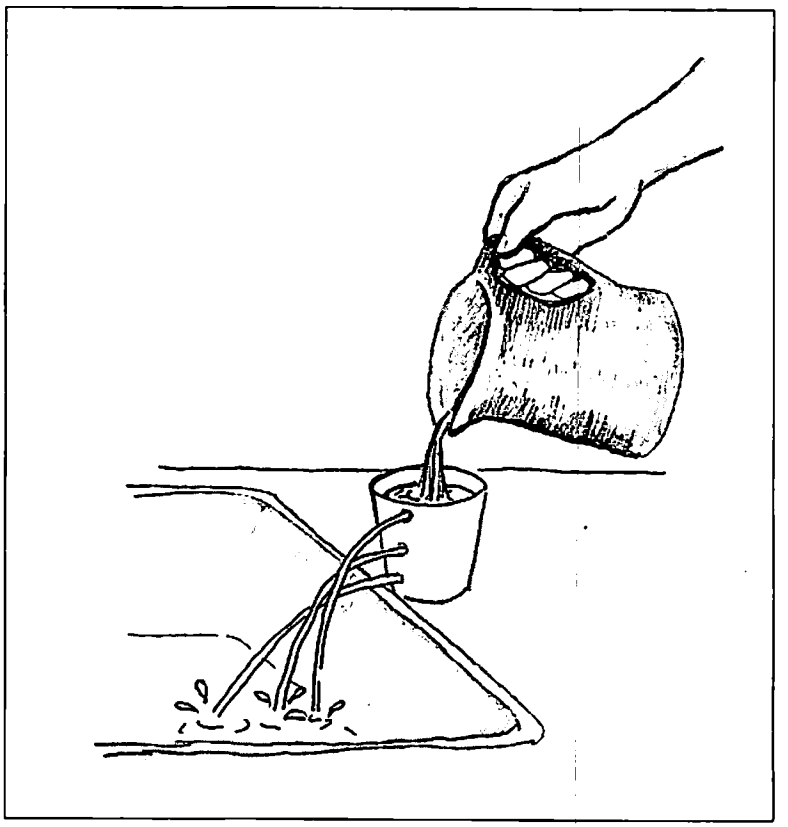
4. Observe the water squirting out of the holes. Notice where the streams of water go. Then draw the container and its water streams in your log book. Which squirts farthest from the can? Which shows the most pressure? Write an explanation for what you see happening.

TO REMEMBER:

- Cold water is denser than warm water.
- Salty water is denser than fresh water.
- BUT frozen water is less dense than unfrozen water.

Activity 2
Results for "Water Pressure Experiment."

WHY do the water streams vary so that the lowest extends furthest? The water near the bottom of the cup has the force of all the water above it pushing it out. The water near the top has very little water—and therefore, little pressure—above it.



The deeper you go in the ocean, the greater the water pressure.

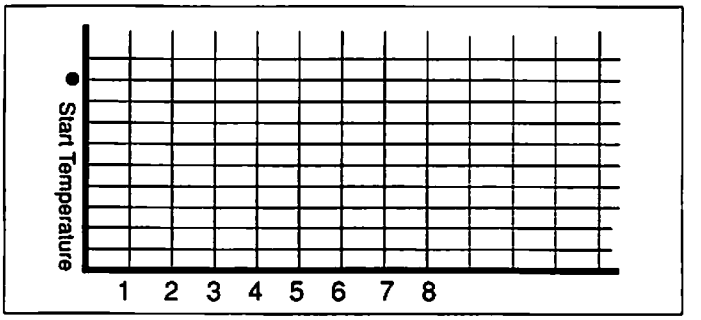
For every 33 feet of water (10 meters) of depth, water pressure increases by about 1 atmosphere. At 10 meters, the pressure is 2 atmospheres (atm); at 20 meters it is 3 atm; at 30 meters it is 4 atm and so on. What is the pressure at the deepest parts of the ocean, 36,000 feet (11,000 meters)?

Pressure makes it difficult to study the deep ocean environments. Only special scientific instruments can withstand such pressures.

Activity 3
Experiment to Show Salt's Effect on the Freezing Point of Sea Water.

You will need:

- water
- 2 glass jars
- salt
- ice cubes
- thermometer
- teaspoon



Procedure:

1. Fill each jar with ice cubes to one inch (2.5 centimeters) from the top. Then add just enough water to cover the cubes. The water level should also be about 1 inch (2.5 centimeters) from the top.

2. Leave each jar standing for 3-5 minutes, then use your thermometer to measure the temperature of the water in each jar. Record your reading and the time in your log book.

3. Add one teaspoon of salt to one of the jars. Stir thoroughly, dissolving the salt. Measure and record the temperature of each jar again. What changes did you note? Repeat the addition of salt to the same jar several times, stirring and then measuring the temperature of both jars. How different is the temperature in each jar? Transfer your records to a chart.

Does the water temperature change after you add the salt? Does it increase or decrease? Why?

Activity 3
Results for "Experiment to Show Salt's Effect on the Freezing Point of Sea Water."

Does the water temperature change when you add the salt? Does it increase or decrease? Why?

Why does the water temperature decrease as you add salt? When you add salt, you lower the freezing/melting point of the water because the salt molecules interfere with the bonding of the water molecules. As you increase the amount of salt, you are increasing the salinity of the water. Almost any dissolved chemical, such as salt, will change the freezing point of water.

Think of the liquid water in your glass jar as a storehouse of heat energy that can be used to melt ice. When you add salt and lower the freezing point, it takes more heat (drawn from the water) to melt the ice. As the melting ice removes that heat, the temperature of the water goes down even more.

Water can absorb and hold lots of heat. Scientists say that water has a high "specific heat capacity" because it takes a lot of heat to increase the temperature of water just a little bit.

The oceans are a big storehouse of the heat on the earth. Scientists are discovering that the ocean's temperature has increased throughout the world's seas to a depth of two miles. Because they have also learned that increases in ocean temperature mean that increases in air temperature are coming, there is even more concern about global warming.

Activity 4
Experiment to Show How Temperature Differences Create Movement (Currents) in the Ocean.

You will need:

- water
- liquid food coloring (red)
- ice cube tray or small plastic container
- clear bottle or jar
- thermometer

Procedure:

1. The day before: Mix a few drops of food coloring into an ounce of water.

2. Freeze this colored water in an ice cube tray or small plastic container.

3. Fill the clear bottle or jar with cool water. Place it where you plan to do the demonstration and let it stand until it reaches room temperature.

4. Measure and record the water's temperature with the thermometer when you put it out. Let the container sit for one more hour after reading its temperature. *Don't move the container. The water must be very still (no turbulence).*

5. Gently set the colored ice in the room-temperature water. What happens to the cold colored water as the ice melts. How would you describe what you see in terms of the ocean?

Why doesn't the ice cube sink?

Activity 4
Results for "Experiment to Show How Temperature Differences Create Movement (Currents) in the Ocean."

What happens to the cold colored water as the ice melts? You should see streamers of dense, cold water sink to the bottom through the warmer water.

How would you describe what you see in terms of the ocean? Similar sinking happens in the ocean when surface waters cool during fall and winter. Cold, salty ocean water sinks to the bottom.

Why doesn't the ice cube itself sink? Water is, indeed, fascinating. When water freezes—unlike other substances— it becomes less dense and therefore floats on the unfrozen water, just as icebergs do. But when water thaws, it behaves like other cold substances and sinks.

Have you ever asked yourself what it really means to say "hot water (and air) rises" and "cold water (and air) sinks"? Think about how cold molecules contract (draw closer together) and hot molecules expand (spread farther apart). Therefore, in any given volume of warm water, there are fewer molecules, less density, making space for the heavier cold water to sink beneath it. The up and down movements due to differences in temperature are called convection currents.

Remember: Cold water is denser than warm water.
Salty water is denser than fresh water.

At this location on the World Wide Web, you can see a beautiful real-time map of the temperatures of the world's oceans: http://www.ssec.wisc.edu/data/index.html

In Addition: Activity 5.
Resources on the Internet.

Two experiments you can do related to actual sea surface temperatures are posted here. These are excellent extensions of the sea surface temperature concepts.
http://podaac.jpl.nasa.gov/kids/ocean.html

Other resources on the internet:

Send your search engine to find "Sea Surface Temperature" and you will find many more web sites. Additional sites are also listed in the Resources section of the Appendix.

In Addition, Activity 6.
Kotzebue's Chart.

Otto von Kotzebue published this chart of the ocean's temperature in various locations and depths in 1821.

Years and Days.	Degree of Heat on the surface of the sea.	Degree of Heat at the bottom of the sea.	Depths in fathoms.	Temperature of the air.	The Ship's Place. Latitude.	The Ship's Place. Longitude.	Transparency of the water.
1815.		The Atlantic Ocean.			North	West	
Oct. 15	+68,5	+55°7	100	+71,1	39s°, 27	12', 57'	10
16	69°1	+55°0	138	72,5	39,4	13°, 8	10
	—	56,0	96	—	—	—	—
1816.		Cape Horn.			South	West	
Jan. 8	54,9	38,8	196	57,6	44', 17	57,31	8
April 7		South Sea.					
Morning.	78,5	68,5	125	79,2	18,17	124,56	13
	—	57,5	175	—	—	—	—
Noon.	79,6	68,0	125	80,0	—	—	—
April 13	80,0	79,0	10	79,8	15°,26'	133,42	13
	—	79,0	20	—	—	—	—
	—	78,8	50	—	—	—	—
	80,0	72,0	100	79,8	15,26	133,42	13
	—	56,0	200	—	—	—	—
		At the Equator.					
May 12	82,5	55,0	300	83,0	0	177,5	14
		North Ocean.			North	South	
June 1	71,0	62,0	100	75,0	29,24	199,26	10
	—	52,5	300	—	—	—	—
6	61,0	59,5	10	68,0	37,3	199,17	2
	—	56,8	25	—	—	—	—
	—	52,7	100	—	—	—	—
	—	43,0	300	—	—	—	—

Temperature graph chart from Otto von Kotzebue, *A Voyage of Discovery into the South Sea and Beering's Straits for the Purpose of Exploring a North-east Passage, undertaken in the years 1815-1818*...London, 1821

His chart offers rich topics for exploration. For example, using the latitude and longitude readings, find some or all of the locations on a map. Compare these temperatures with today's World Wide Web ocean temperature at the same location. Kotzebue refers to the transparency of the water. Research what that means. Is transparency still measured?

Sources Cited:

Kotzebue, Otto von. *A Voyage of Discovery into the South Seas and Bering's Straits, for the Purpose of Exploring A North-East Passage, undertaken in the years 1815-1818.* Volumes I, II, III. London: Longman, Hurst, Rees, Orme and Brown. 1821.

Krusenstern, Johann. Vo*yage Round the World.* 2 volumes. London: 1813

Materials list for activities, Science Under Sail, Chapter 6

1. You Can Make a Simple Thermometer.
- see-through, clear drinking straw
- ink or colored water
- pay dough or modeling clay
- small bottle or other container to hold the straw upright

2. Water Pressure Experiment.
- sharp pencil
- 7 ounce (210 ml.) paper cup
- pitcher of water
- sink or dishpan

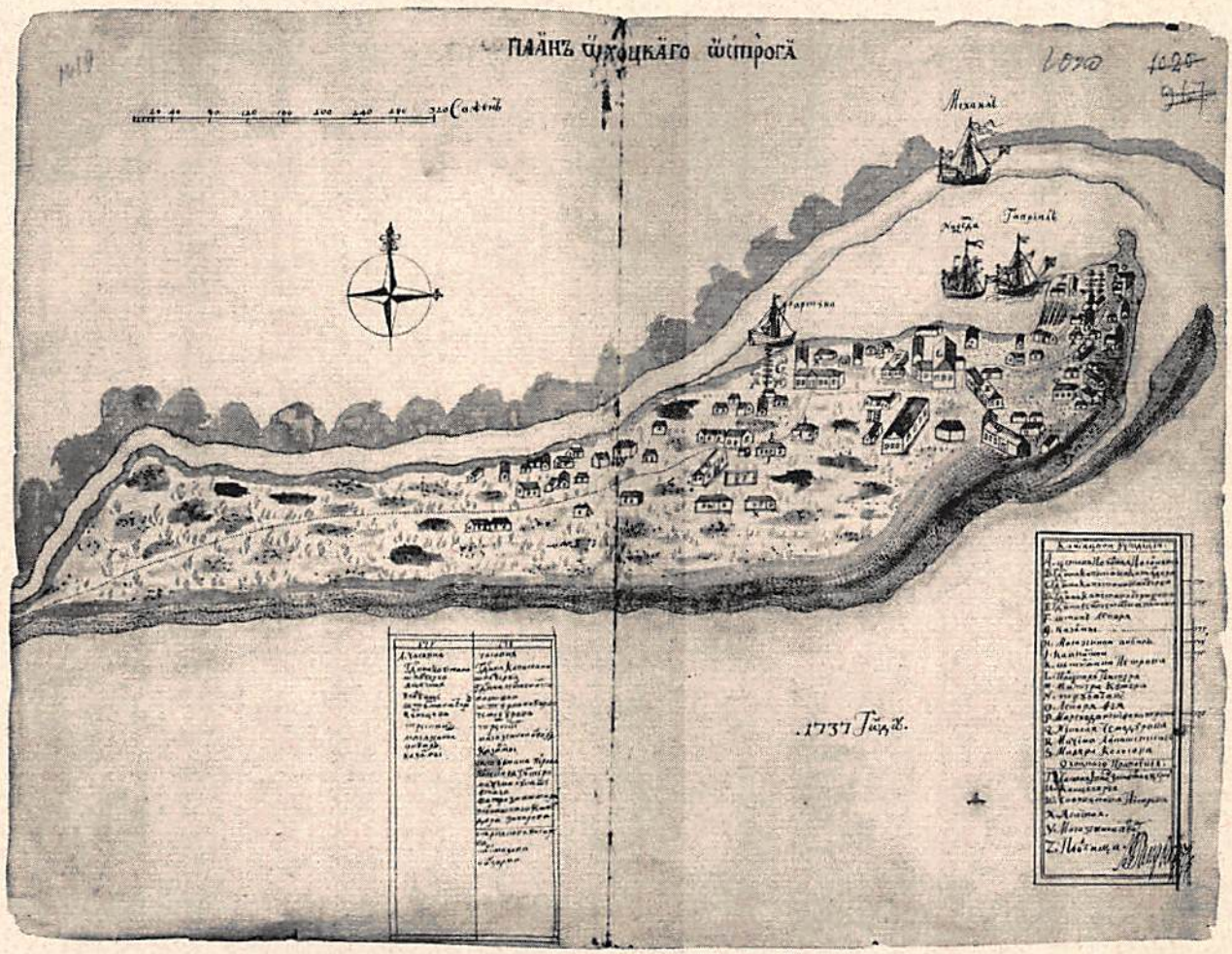
3. Experiment to Show Salt's Effect on the Freezing Point of Sea Water.
- water
- 2 glass jars
- salt
- ice cubes
- thermometer
- teaspoon

4. Experiment to Show How Temperature Differences Create Movement (Currents) in the Ocean.
- water
- liquid food coloring (red)
- ice cube tray or small plastic container
- clear bottle or jar

Science Under Sail: Russia's Great Voyages to America, 1728–1867

"Remarkable Places"

Pictures of the Voyages



Plan of Okhotsk Fort
Martin Spanberg, 1737. *Monumenta Siberiae: Map Series with Explanatory Notes*
Justus Perthes Verlag Gotha GmbH, 1996

Article VII.

You are to make descriptions and even drawings of the most curious productions of nature, and of the remarkable places you see.

SUMMARY

In this lesson students learn a brief history of the visual records of Russia's great voyages to America and practice interpreting what they see in those records. In their log books, they develop observation and pictorial record-keeping skills. Featured artist is Louis Choris.

MATERIALS

- log book, pen, pencils
- paintings in "Pictures of the Voyages" chapter, color pages, and color illustrations on Poster*

Optional Materials:
- colored pencils, colored pens

* *included with the Instructional Guide*

ACTIVITIES

1. Using a directed question guide, students interpret what they see in the visual records of the expeditions. (estimated duration 15-20 minutes) For younger students, first model the interpretation in the class. Students work individually, in pairs, or in small groups to discuss the topics. There are six black and white pictures included in this lesson. Other illustrations throughout the Guide may be included in the activity as well. There are also three color plates associated with this lesson, and a poster which includes one more appropriate image.
- *Ice Cliffs of Kotzebue Sound* by Louis Choris (see color plates)
- *View of the Harbor at Unalaska* by Louis Choris (see color plates)
- *Brown Ruff of Sakhalin Island*, by W. G. Tilesius von Tilenau (see color plates)
- *Fort Ross* by I. G. Voznesensky (see poster)

2. Students observe and sketch in their log books. (estimated duration 20-30 minutes)

3. In Addition: Students refine their drawings and render them in color. (estimated duration 20-30 minutes)

4. In Addition: Students learn specific drawing skills. (estimated duration 10-15 minutes)
If your school or district resource center has an art teacher available, arrange to have different ways to sketch the same object presented in a class session. These are some of the many different ways to draw a visual record:
- blind contours • modified contours • quick sketches • diagrammatic drawing
- finished drawing

5. In Addition: Invite a local artist who draws or paints from nature to come and describe how he/she works. (estimated duration 30-40 minutes)

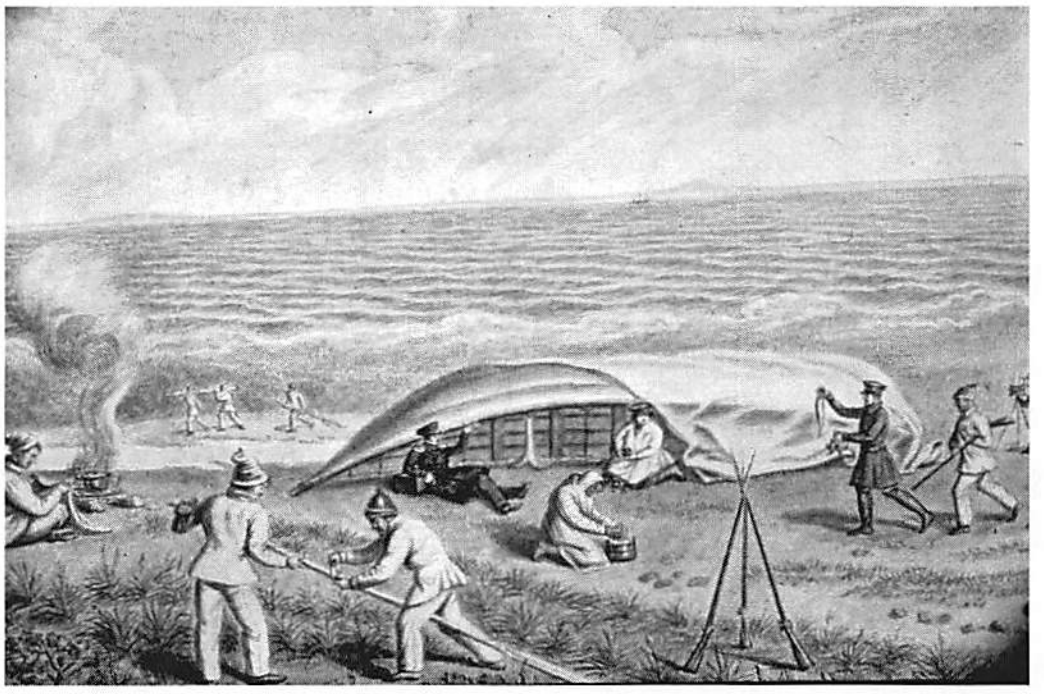
The "Bad Weather" Alternative: Use the windows as your view for the sky drawing. Substitute objects in the classroom. If you have nature specimens in a closet, bring them in as examples to draw, preferably one or more for each student.

"Remarkable Places"

Pictures of the Voyages

How do you make a picture of a place if you don't have a camera? When you return home, how can you describe the sights you saw two years ago at the beginning of your round-the-world voyage?

Before the beginning of photography, drawing and painting were effective ways to document life. When we study these picture records now, we can see details about the past—the people, their homes, clothing, tools and other aspects of cultures—that might be less clear in written reports. In their representation of early cultures, plants, animals and places, these sketches, drawings and paintings also contain information of great interest to today's historians, scientists and anthropologists.



Shore camp on the Bering Sea (artist and date unknown). Possibly the Alexander Kashevarov party of 1838.
Wclr. Anchorage Museum of History and Art

The picture-record keepers of Russia's great voyages were artists or scientists, or sometimes scientists who were also artists.

Interior of a Dwelling on St. Lawrence Island. Lithograph by L. Choris. 1817. Anchorage Museum of History and Art.

Many Naval officers such as Gavriil **Sarychev** and Yuri **Lisiansky** also excelled at picture making. Often it fell to the official naturalist on the voyage to draw or paint the land, plants, animals, people, and objects the expedition encountered.

Louis Choris, Self-portrait. Lithograph, Courtesy Peabody Essex Museum, Salem, MA

Expedition art pictures were later published in finely crafted books and atlases. Some of the pictures were reproduced by print-making techniques that dramatically changed their appearance from the original version. Sometimes the print-maker and publisher even went so far as to add details never recorded by the original artist! Dogs appeared in places where no one had ever seen dogs. Women's clothes were put on men. Native faces became curiously European.

Many of the expedition artists gained fame and recognition. Perhaps the most famous was the young Louis **Choris** who accompanied Otto von **Kotzebue** on the round-the-world voyage of the *Rurik* from 1815-1818. Choris made hundreds of original field sketches of the cliffs, people, and marine animals during the voyages, and must have needed a great deal of cabin space to refine his drawings. Adelbert von **Chamisso**, his cabin-mate, complained about the area Choris needed to work in their cramped ship. But when Choris later published two volumes of his drawings, it was Chamisso who supplied the text. Choris continued his travels following the voyage on the *Rurik*, living for several years in Paris and Mexico. He died in Mexico at the age of 32, the victim of an attack by bandits.

Activity 1
Pictures from the Expeditions.

Select one of the following "Pictures from the Expeditions" (listed on page 108), and write answers to these questions—to the extent possible—in your log book:

1. What is the picture's title?

2. What is the artist's name?

3. Do you know the year the picture was made?

4. What kinds of clues tell you that this is an old picture?

5. How is this picture different from other ones you have seen?

6. What details do you see in this picture?

If you were in this picture:

7. Describe the sounds you would hear.

8. Describe the smells you would smell.

9. Describe the colors you would see.

10. Describe the people you would see. What would they be doing?

11. Describe what you would be wearing.

12. Describe what you would be doing.

To think about:

13. What questions does this picture raise in your mind?

14. Where could you find answers to your questions?

15. How could an historian or a scientist use this picture?

16. Is the picture a primary or a secondary source of information?

Vasily **Golovnin**, commander of the *Kamchatka* wrote that "On all such voyages an artist is essential because there are many things in distant parts of the world which cannot possibly be brought back, and of which even the most detailed description cannot convey a proper understanding. Only a drawing can compensate for these inadequacies."

Pictures from the Expeditions, a List:

A. Krasheninnikov: *The Harbor of Okhotsk*, page 111.

B. Krasheninnikov: *Scenes of Chukotka Village*, page 112.
The first images of Siberia come from drawings made by Stepan Krasheninnikov for his studies during the second Bering expedition. They date from the 1730s and were published in Russia in 1755 and England in 1764.

C. Postels: *Illustrationes algarum* [Illustrations of Algae], page 113.
The Litke voyage of 1826 brought three naturalists to Alaska. One of them, Alexander **Postels**, was also an artist who left vivid records of their research.

D. Voronin: *View of Shelikov's Establishment at Three Saints Bay*, 1790, page 114.
Voronin was the first artist assigned to a Pacific voyage whose work has survived to the present day. Many of his pictures illustrated the Sarychev Atlas of 1802. Voronin's images are among the earliest views of the Russian Settlement on Kodiak Island, dating from 1790.

E. Postels: *Interior of Tlingit Cabin*, page 115.

F. Langsdorff: *Village Scene with Artist*, page 116.
Can you find the artist?

The following pictures are on color pages and on the poster:

G. Choris: *Ice Cliffs of Kotzebue Sound* (see color plates).

H. Choris: *View of the Harbor at Unalaska* (see color plates).

I. Tilenau, *Brown Ruff of Sakhalin Island* (see color plates).

J. Voznesensky, *Fort Ross* (see poster).

Activity 2
Observe and Sketch in Your Log Book.

Many record-keepers find that words are improved by adding sketches and pictures. The sketches may not be intended to be "great" art, but serve as another way to pay attention to a scene or object. By focusing your attention, staying a little longer with your observation, the details of what you see become more clear and vivid. Whether you are skillful at sketching is not important. Looking carefully is what matters.

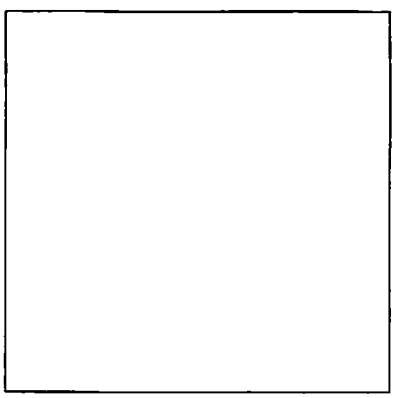
Use your log book and a pencil for these exercises. If possible, go outside to record them.

Sketch the weather:

Begin by sitting for one minute. Do not sketch during that time. Listen and look. Then write down the following information:

The date.
The time.
The temperature.
Your exact location.
What do you hear?
What do you smell?
List ten objects that are closest to you.
Look up at the sky. Are there fast-moving clouds? Long wisps of clouds? Is the sky clear?

Draw a box on your paper that is about two inches square—about this size:



In that box, sketch the cloud patterns or what you see when you look up at the sky. The artists on the Russian voyages detailed clouds in all their landscape pictures. Why were clouds important to them?

Sketch an object:

Now look at the ground or at an object on a table—a leaf, a twig, a tool, a toy, something that interests you. Get close to that one object. Take five minutes to sketch that object as nearly life-size as possible. Then write its description beside it. Guess its size. (You can use your thumb as a comparison: is your object

continued on next page

one thumb long? Two thumbs? More? Less?) The objects that artists sketched during the Russian voyages often showed enough detail to re-create that object in modern times.

Sketch at eye-level:

Stand so that you can move around a little, and sketch what comes into view at eye-level. Hills or mountains or bays or seas. Buildings and their surfaces. People and their objects. Don't get too concerned about making a perfect picture. Label each thing and describe its surroundings. Describe in words all you see at eye-level.

Adapted from *Nature Journaling* by Clare Walker Leslie and Charles E. Roth. Pownal Vermont: Storey Books. 1998.

In Addition: Activity 3

Refine your sketches from Activity 2 and render them in color.

The "Bad Weather" Alternative:

Use the windows as your view for the sky drawing. Substitute objects in the classroom. If you have nature specimens in a closet, bring them in as examples to draw.

What is the role of the artist-observer of nature now that the camera is easily available? What is the relationship of art to science in the present day? For example, how useful are field-guide books of birds or plants with drawings as illustrations compared to field guide books with photographs as illustrations? Compare one of each and think about which you would prefer to use. Do any of your science or history textbooks include paintings of scenes done in the modern age? Why? Why not?

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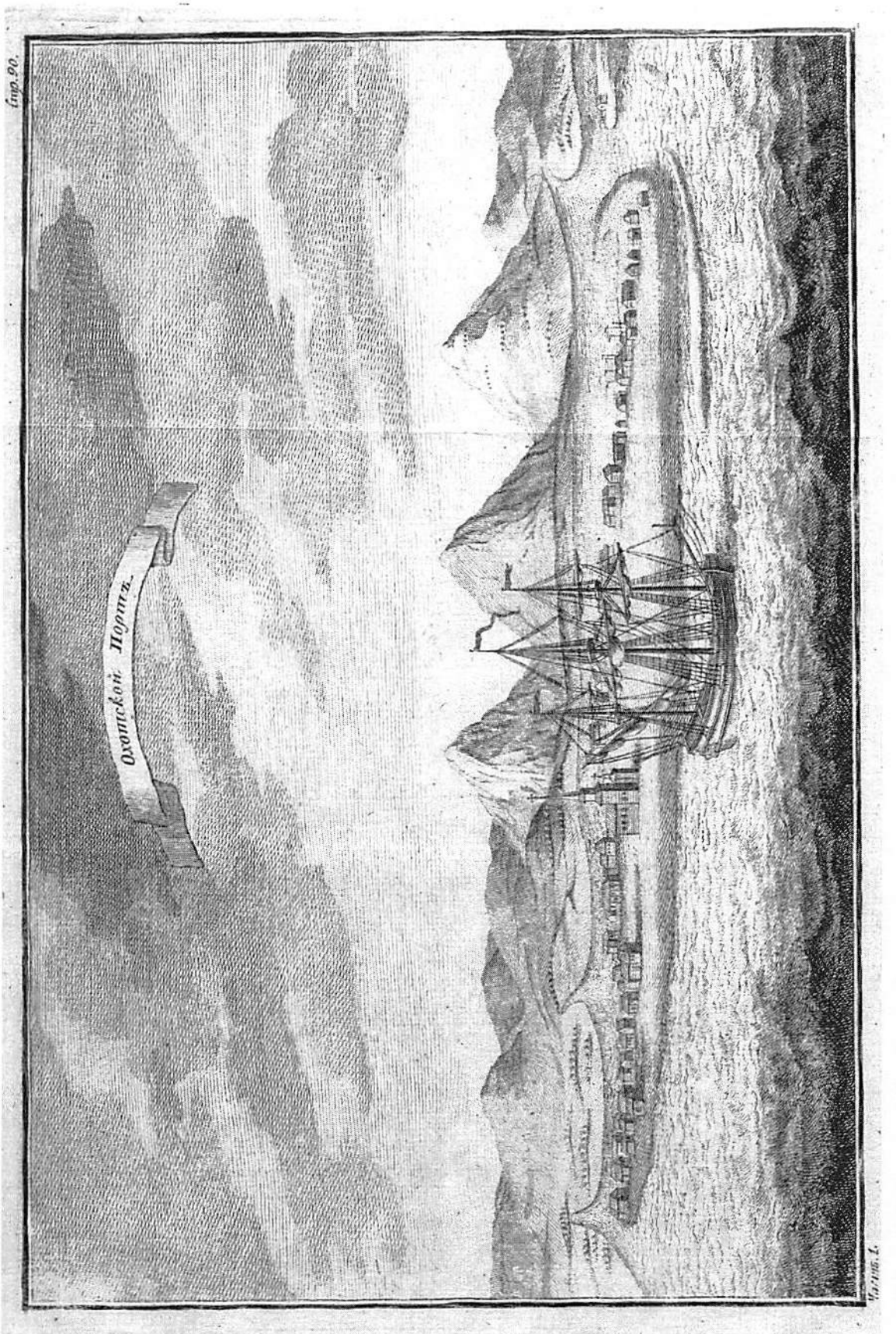
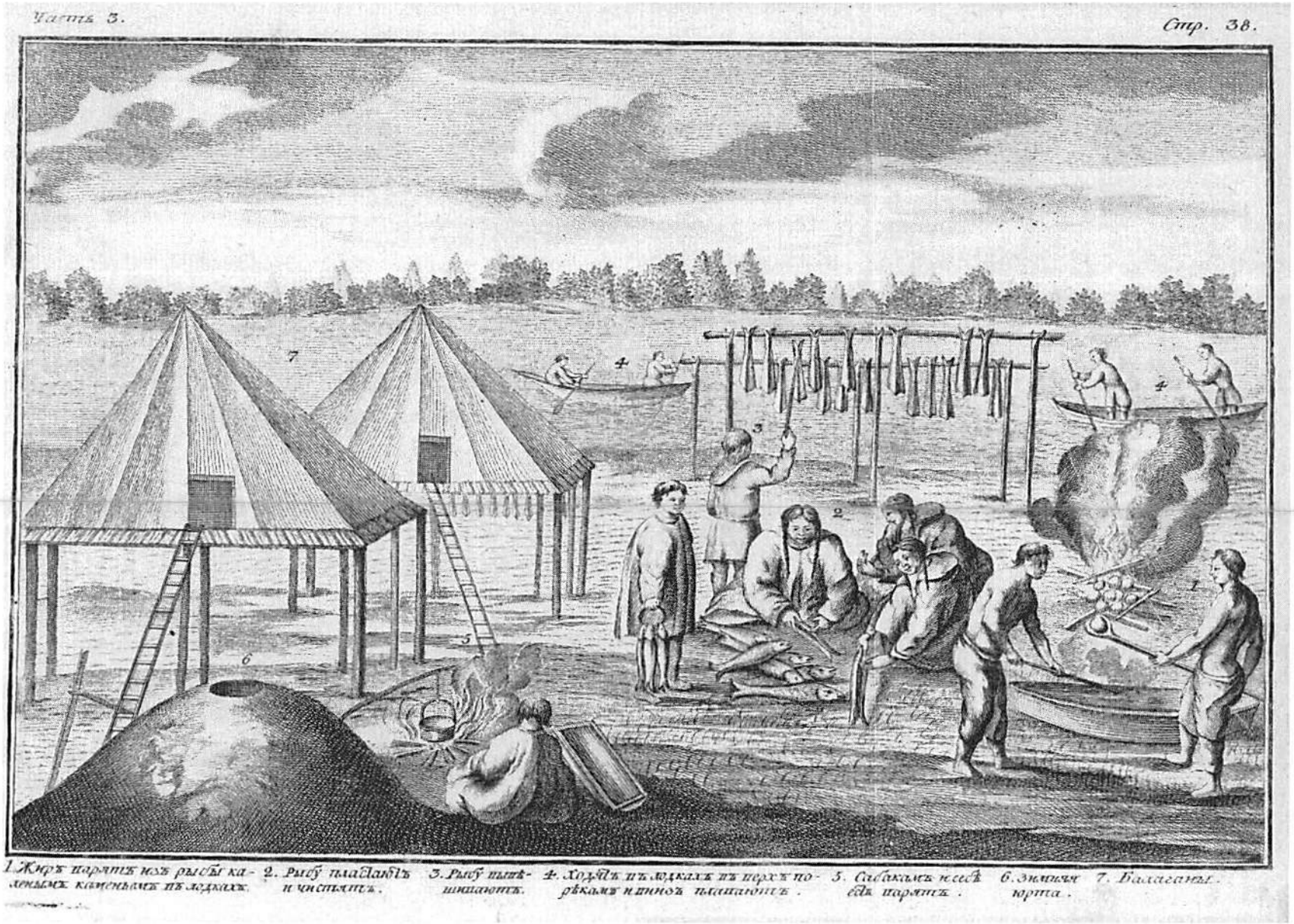
Golovnin, V. M. *Around the World on the Kamchatka, 1817-1819.* Translated, with an introduction and notes by Ella Lury Wiswell. Honolulu HI: Hawaiian Historical Society and the University Press of Hawaii. 1979.

Leslie, Clare Walker and Charles E. Roth. *Nature Journaling*. Pownal VT: Storey Books. 1998.

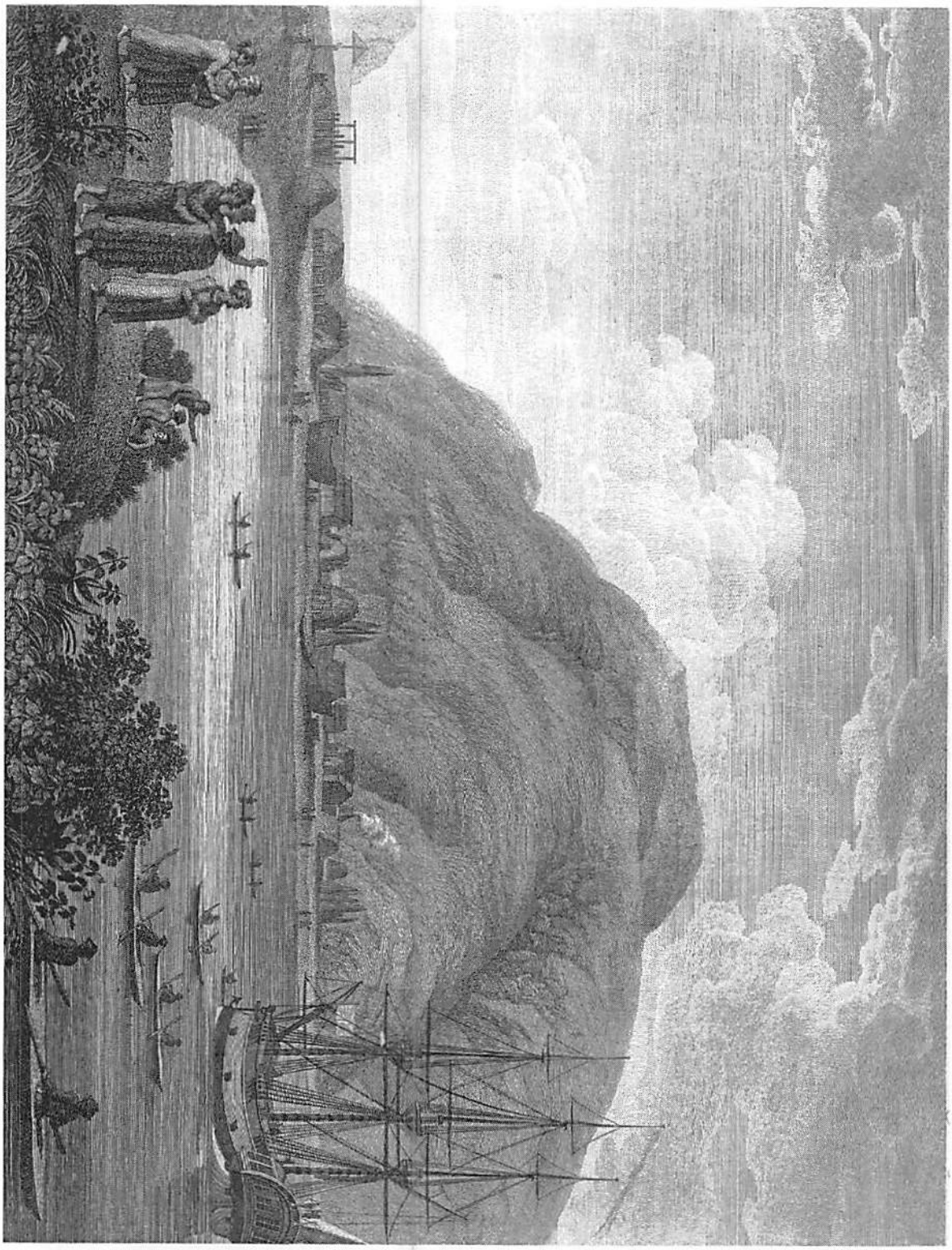


Stepan Krasheninnikov, *Description of the Land of Kamchatka*, Vol. I. St. Petersburg, 1755

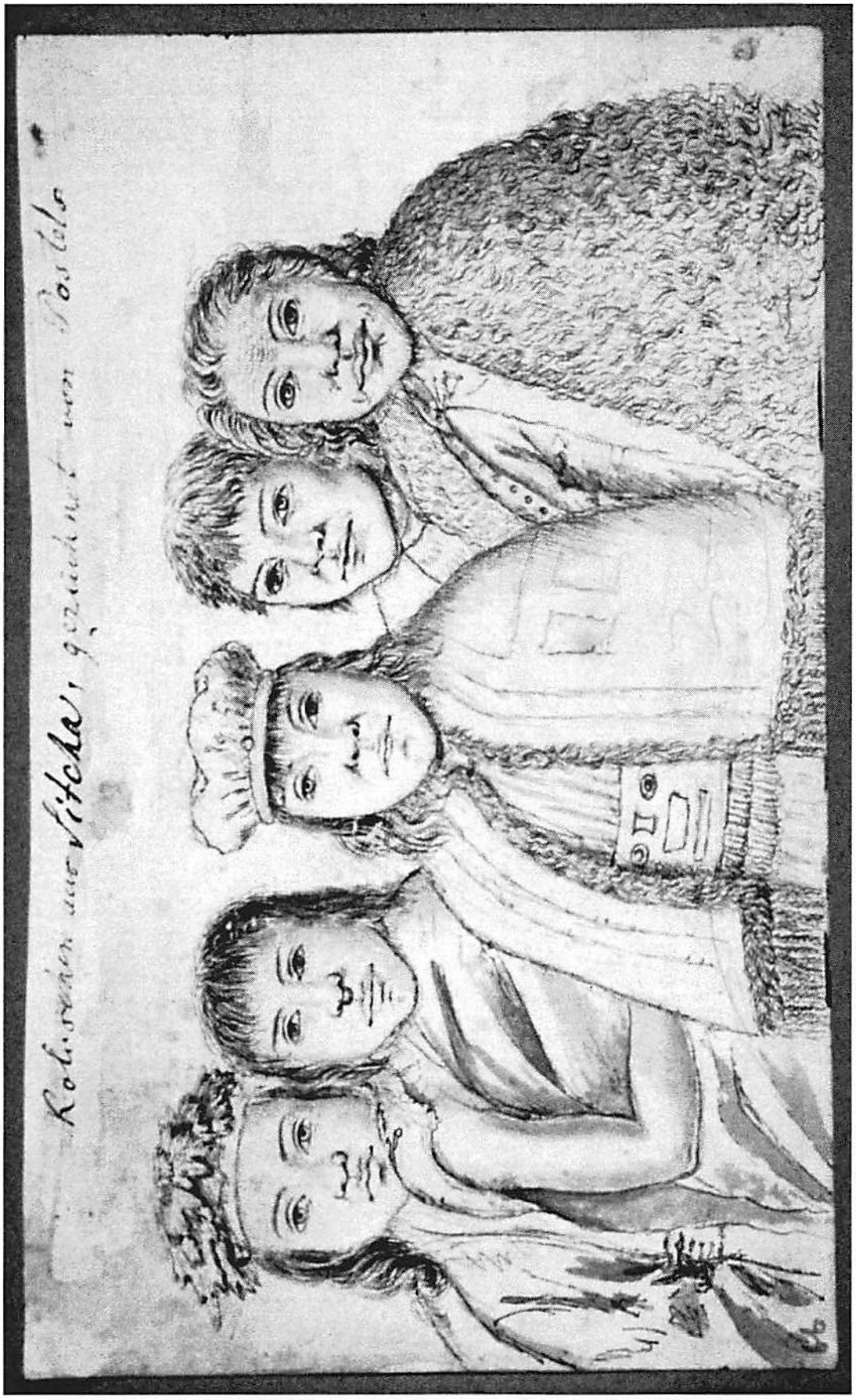


Stepan Krasheninnikov, *Chukotka Village. Description of the Land of Kamchatka*,
Vol. II, St. Petersburg, 1755

Gathering specimens from a tidal pool near Sitka, lithograph by Alexander Postels, in A. Postels and F. Ruprecht, *Illustrations of Algae...*(Latin), St. Petersburg, 1840.
The LuEsther T. Mertz Library, New York Botanical Garden



View of Shelikov's Establishment at Three Saints Bay 1790
Engraving by Luka Voronin, in G. Sarychev, Atlas...St. Petersburg, 1802.
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks



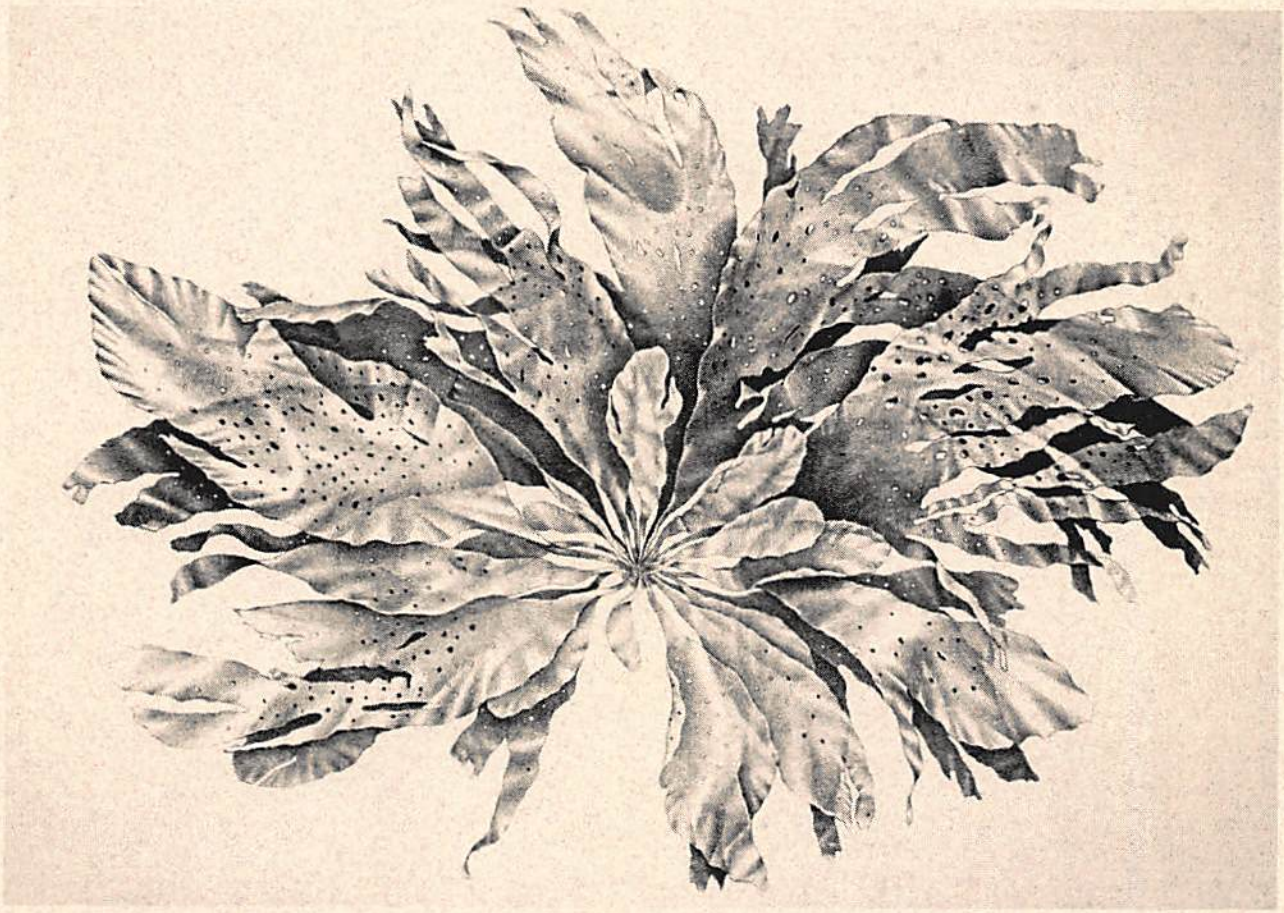
The Kolosh and their Dwelling. Alexander Postels, in F. P. Litke, *Atlas of a Voyage Around the world on the Sloop "Seniavin"*...St. Petersburg. N.d.

Village Scene in Japan, Georg von Langsdorff, *Journal of a Voyage Around the World from 1803 to 1807*, London, 1813-1814.
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks

Science Under Sail: Russia's Great Voyages to America, 1728–1867

"Natural Curiosities"

Plants and Animals



Porphyra pertusa (now *Rhodymenia pertusa*); common name: red eyelet silk. From Postels and Ruprecht, *Illustrationes algarum*, 1840.
The LuEsther T. Mertz Library of the New York Botanical Garden

Article VIII

You will particularly attend to all natural curiosities you observe, employing your leisure time in making complete descriptions of such specimens. You will be careful in preserving the plants and animals that you may collect and catalog.

SUMMARY

A series of remarkable scientists sailed on Russia's great voyages to America. In this lesson students learn about these bold travelers and their contributions to the knowledge of plants and animals in America. This chapter features the sailing scientists:
• Georg Steller • Georg von Langsdorf, • Adelbert von Chamisso • Johann Eschscholtz, and
• Il'ya Voznesensky.

MATERIALS

- narrative for "Natural Curiosities" Plants and Animals *
- log book, pens, pencils
- salmon picture cards*
- reader's theater play: "Science, Samovars, and Sea Cows" *

* *included with the Instructional Guide*

ACTIVITIES

1. Five scientists, a narrator (or narrator chorus) and assorted plants and animals present the readers' theater, "Science, Samovars, and Sea Cows," pages 130-134. (estimated duration for research and rehearsal: 40-60 minutes; presentation 20 minutes or longer depending on number of plant and animal characters) All students participate. Those who are not scientists or a narrator research a plant or animal selected from the list included at the end of the reader's theater. They write a brief description which will be read during the reader's theater presentation and find or draw an illustration of the plant or animal to show the "audience."

2. Students sort and classify salmon pictures based on a taxonomic "process of elimination" chart. (estimated duration 15-20 minutes) Cut apart and distribute the twelve salmon cards so that each student has one or more cards, the directions, and the salmon elimination chart. For younger students, classify the salmon as a group activity. Enlarge the classification guide on a copier so that several students can use it together. For older students: cover the illustrations of the five salmon tails at the bottom before copying the chart for student use.

3. In Addition. Visit a natural history or science museum. (estimated duration 2-4 hours) Study a collection on display. Arrange to interview a curator about the care of the collection. How can specimens be preserved for hundreds of years?

4. In Addition. Begin a collection. (estimated duration 10-20 minutes) Plants and flowers can be quickly "preserved" in a laminator or with transparent contact paper. How is this method different than the one used by our sailing scientists?

5. In Addition. Invite a biologist or geologist into the classroom to talk about collecting, preserving, and organizing collections. (estimated duration 30 minutes)

6. In Addition. There are several web sites that present information about Chamisso. Type his name into the search function of your web browser. (estimated duration 15-20 minutes)

7. In Addition. Read field guide entries. (estimated duration 30-40 minutes) Some guides are recommended in the "Resources" section in the Appendix. How are the guides organized? Do they show the animals or plants in drawings or photographs? Which are easier to use? What are the ways the writers describe the animals or plants? This kind of writing is known as technical writing. How is it different from story writing? Sketch an imaginary plant or animal and then write its description the way the field guide writers do.

"Natural Curiosities"

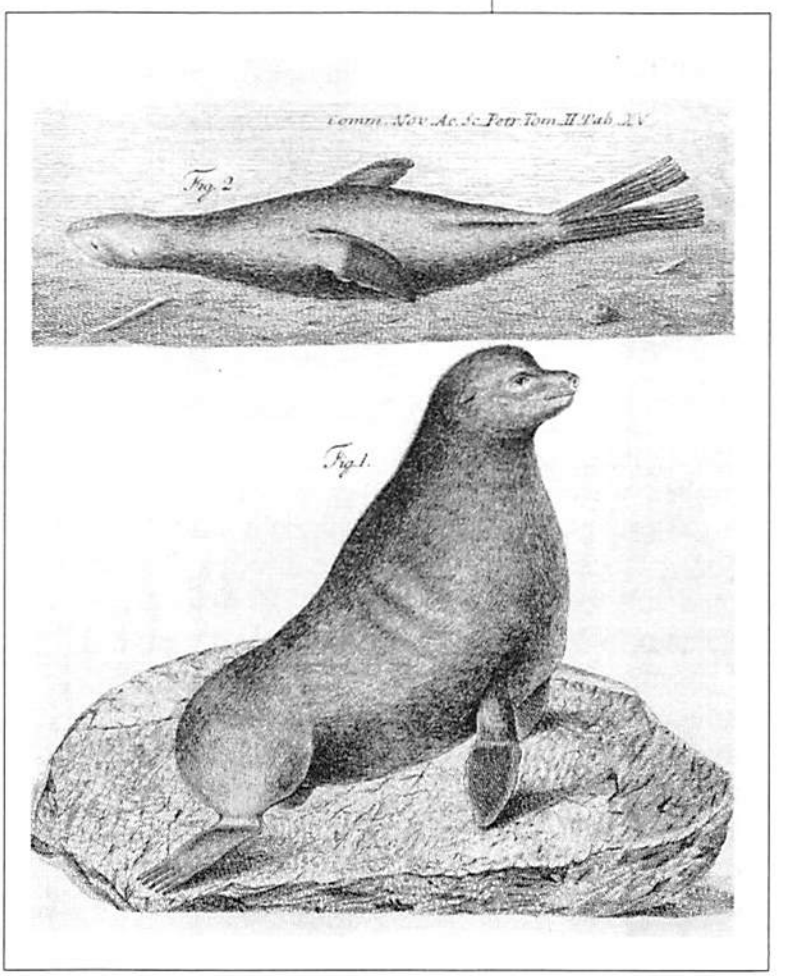
Plants and Animals

How do you decide what to collect to take home? How do you know if you have identified your specimen accurately? How do you save a flower, a seed, a bird specimen to keep it from rotting and falling apart before you get home in two years? When you see a plant or an animal, how do you know if you are seeing the same plant or animal that you saw at home or a different one?

The naturalists and scientists on Russia's great voyages were charged by their leaders with bringing home as many specimens as possible, and the directions for collecting often required bringing home more than one specimen. Few shipping alternatives were available at that time, so that much of what the scientists collected traveled on the long journey with them. Stuffing their cabins and every available space with all kinds of live and dead creatures, these sailing scientists provided the first documentation of the plants and animals of northwestern North America.

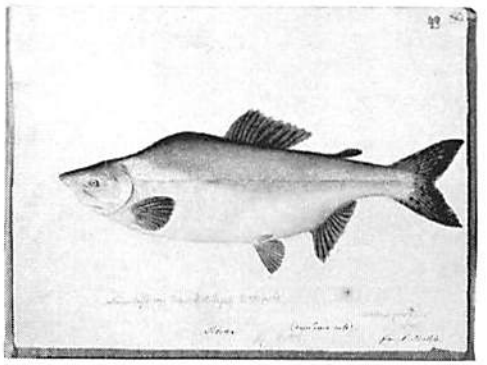
Most of the scientists were from Europe, primarily from Germany and Estonia. The first European scientist, Georg **Steller**, accompanied Vitus **Bering** on the voyage of 1741 to America.

Born and educated in Germany, Steller showed an early genius for natural history as well as a "hot-tempered, overbearing personality." (Pierce) In 1735, at his own request, he was included in the Bering expedition as a botanist to



Anon, Fur Seal, watercolor, for publication in Steller, *De bestiis marinis. 1751.*
St. Petersburg branch, Russian Academy of Sciences Archives

study in Siberia. Working his way across the Siberian countryside and then to Kamchatka, Steller studied the plants and animals in great detail until Bering invited him to continue on the sailing portion of the expedition to America. When the *St. Peter* finally anchored off **Kayak Island**, Bering at first refused Steller the opportunity to go ashore. When Steller finally got permission to go on the land, he moved as fast as possible, noting features of the climate and soil, and collecting unknown plants. He found a deserted Native dwelling and made several notes about the culture of the inhabitants based on the **artifacts** he found. He sent the items back to the ship, begging for more time and was given another few hours. The total time on shore was a mere ten hours.



Alexander Postels: *Salmo tapdisma* (humpy), wclr., ca. 1827.
St. Petersburg Branch, Archives of the Russian Academy of Sciences

The next day, concerned over the changing weather and the changing seasons, Bering ordered the ship to set sail. For the next two months, ship and men were repeatedly hit by storms. Always wet, always cold, the men were hungry and exhausted. The rigging on the ship was rotting and the ship seemed to leak more each day. In relief, the crew put in at what is now **Bering Island**. And then things got really bad.

In yet another storm, the *St. Peter* smashed to pieces. And still the winter storms came, one after the other. The sick men became even more ill: their skin growing pale, their teeth falling out and gums bleeding. Wounds that had healed years before re-opened and bled. Breathing grew difficult. Victims of **scurvy**, Bering and almost half of his crew died. Those who survived included Steller, who used his knowledge to produce a cure for scurvy using local plants and roots. His knowledge and behavior were the main reason why some —including Sven **Waxell** and his 11-year-old son Laurentz— survived that severe winter on the barren island. Steller remained fit and worked on through the eight-month stay,

Apparently Steller was constantly at odds with the ship's officers. He confided his annoyance with all on board to his personal journal. That journal holds one of the few records of the 11-year-old Laurentz Waxell. Steller wrote on November 7 after landing at Bering Island: "When it was evening, I cooked a few ptarmigan as a soup and ate it with Plenisner, young Waxell, and my cossack. During this time, Plenisner made a hut of driftwood and an old sail. Under it we slept overnight with the sick." (Steller)

continuing his scientific research, making discoveries of birds, fish and the remarkable **sea cow**. He also catalogued the physical and topographic features of the island.

By spring the survivors knew they had to reach **Kamchatka**, so they broke up the remains of the *St. Peter* and built a small vessel, sailing it west for the few days' trip to **Siberia**.

Why are so many creatures named for Steller? Was it because he had a big ego and wanted everything named for him? Grumpy he may have been, but in this he was more modest than you might expect. The naming of so many creatures for Steller came from other scientists acknowledging the remarkable breadth of his discoveries and the excellent quality of his work.

These are some of the animals identified by Steller:

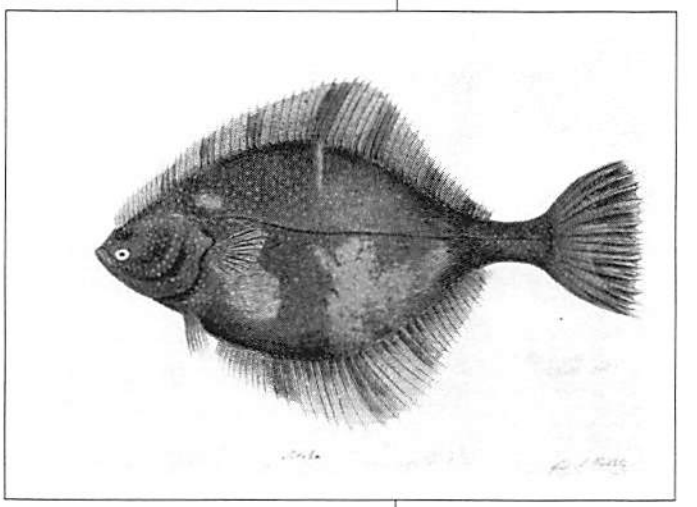
- Clam, *Mya truncata*
- Starry flounder, *Platichthys stellatus*
- Red-throated loon, *Gavia stellata*
- Steller's jay, *Cyanocitta stelleri*
- Steller's eider, *Polysticta stelleri*
- Steller's sea lion, *Eumetopias jubatus*
- Steller's sea eagle, *Haliaeetus pelagicus*
- Sea cow, *Hydrodamalis gigas*
- Spectacled cormorant, *Phalocrocorax perspicillatus*
- Northern fur seal, *Callorhinus ursinus*
- Sea otter, *Enhydra lutris*
- Gumboot chiton, *Cryptochiton stelleri.*

And some of the plants:

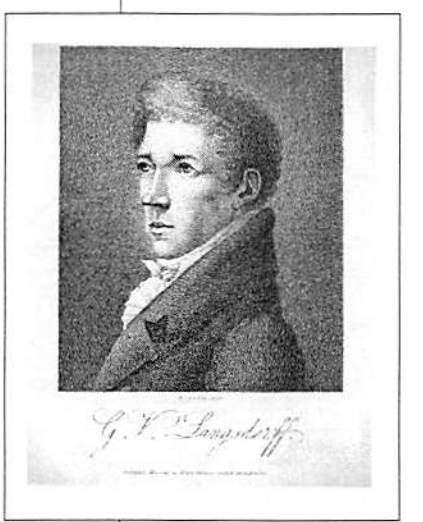
- *Arabis hirsuta stelleri*
- *Artemisia stelleriana*
- *Cassiope stelleriana*
- *Rubus articus stelleri*
- *Smilacina stellata*
- *Stellaria* (genus)
- *Veronica stelleri*

and the sea ape, which no one has seen since.

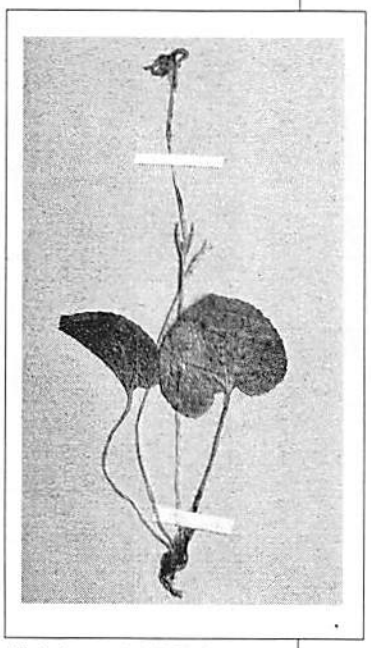
Steller was, however, only the first of a long line of distinguished naturalists whose work elegantly defined America's natural wonders. During the nineteenth century, there were several voyages that had unusually rich scientific aspects, whether recording "remarkable places,"



Alexander Postels , Starry flounder (*Platichtyys stellatus*), first described by Steller in 1743. wclr., ca. 1827.
St. Petersburg Branch, Archives of the Russian Academy of Sciences



Georg von Langsdorff, frontspiece in Georg von Langsdorff, *Journal of a Voyage Around the World from 1803 to 1807*, London, 1813-1814.
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks



Viola langsdorffii Fisch., identified by Georg von Langsdorff in Alaska, 1805. Original specimen.
Herbarium of the V. L. Komarov Botanical Institute, St. Petersburg

Adelbert von Chamisso. Engraving by E.T.A. Hoffman.
Berlin Botanical Museum

"natural curiosities," or the "people they met."

Georg Heinrich von **Langsdorff**, a German, was a trained physician. He heard of the proposed round-the-world expedition of Johann von **Krusenstern** and pleaded to be included. Eager to see America, Langsdorff left Krusenstern's ship after landing in Kamchatka and signed on as personal physician to a director of the **Russian-American Company** so that he could travel to the coastal communities in Alaska and California.

His comments on the hardships of collecting on expedition are revealing: "My research in natural history while in California met with more difficulties ... than are imaginable .... We lived continually on our ship. Loading and unloading was constantly going on. Seal and bird skins I had put on the deck to dry were thrown overboard. One day, when I was on land, the paper I was using for drying plants was carried out of the way, and I was told put by mistake into the lowest hold of the ship .... Live birds I had bought and brought on board were set loose as soon as I turned my back.... Evenings, tired from the hunt, I would bring various ducks and sea birds on board the ship intending to skin them. During the night, someone would petulantly cut off their head. As a result of these incidents and hundreds of similar ones, I was forced to give up any thoughts of doing research and had to acquiesce to Mr. Resanoff's wish that I act as interpreter with the priest in the trade and purchase of grain and other goods we needed." (Langsdorff)

Although most of Russia's expeditions had an international flavor, none was more cosmopolitan than the team assembled for Otto von **Kotzebue's** voyage of 1815.

A popular poet, Adelbert von **Chamisso**, whose family had sought refuge in Germany, was the naturalist; the doctor, Johann **Eschscholtz**, was Estonian. The artist was a German who had been educated in Russia. Kotzebue himself was a German who had settled in Estonia. And all but Chamisso were under 30.

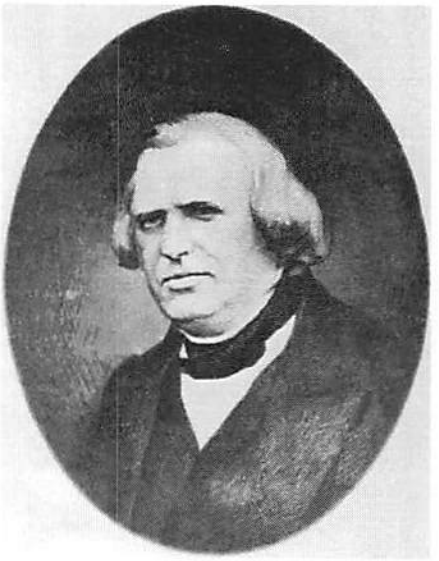
Through his studies, collections, and identifications, Chamisso—a renowned poet—left a more profound mark on science than even Steller. He published the first study of North Pacific whales, using Aleut/Unangan knowledge in his reports. While on Unalaska Island, he conducted the first complete botanical profile in western America. He took samples of every species of plant found there, and published detailed findings. This data reveals how plant culture has changed over time.

Chamisso and the ship's doctor, Johann Eschscholtz, working together, collected an unprecedented number of plant and animal species from Alaska and California. In the San Francisco Bay area, Chamisso identified more than thirty new species, including the California poppy [*Eschscholtzia californica*] and California blackberry [*Rubus ursinus*]. Eschscholtz returned to the same area in 1824 with Kotzebue and produced an outstanding *Zoological Atlas*, which contains his own drawings of some of the more unusual animals he identified—the California coyote and giant salamander, among them. In his report of this second voyage, he notes that he collected or examined and described more than 2400 animal species in the three years of the voyage, many of them at Sitka and in California.

Johann Eschscholtz, frontspiece, *Zoological Atlas*...1829-1833.
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks

As one looks at the work of the mariners and scientists who explored the North Pacific during the Russian era, an impression of remarkable energy emerges. The two Kotzebue voyages as well as the voyage of Fedor **Litke** produced thousands of specimens for the museums in St. Petersburg. Indeed, the Litke voyage of 1826 returned 1200 illustrations, nearly 4000 specimens, and hundreds of artifacts; it was the largest scientific collection made by any European voyage up to that date. Twenty years later, the Russian scientist, Il'ya **Voznesensky**—who spent many years in Alaska and California—sent more than twenty-seven trunks with over 5,000 specimens and artifacts to Russia. The naturalists not only described and collected hundreds of plants and animals unknown in

Europe, they also meticulously recorded details of cultural life very different from anything they had known.



Il'ya G. Voznesensky, ca, 1865. Courtesy Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), St. Petersburg

One of the most purposeful of the naturalists, Il'ya Voznesensky, began working at the Zoological Museum at the age of 11 and worked in one form or another for the institution the rest of his life. When the Academy of Sciences decided that it wanted to build its collections of Siberian and American objects, it hired Voznesensky to go for three years to collect plants and animals. The three years became five and eventually ten. With transportation support from the Russian-American Company, Voznesensky made several trips to California and **Fort Ross,** before it was sold to John Sutter in 1841. He journeyed to many of the **Aleutian Islands**, the **Kenai Peninsula**, **Norton Sound**, Kotzebue Sound, and the **Kuril Islands**. At the conclusion of the ten years, the Academy reported that: "The results of his remarkable expedition, their scientific importance, the value and variety of the collections, exceeded all expectations." (Alekseev) He had described more than four hundred species of plants and animals.

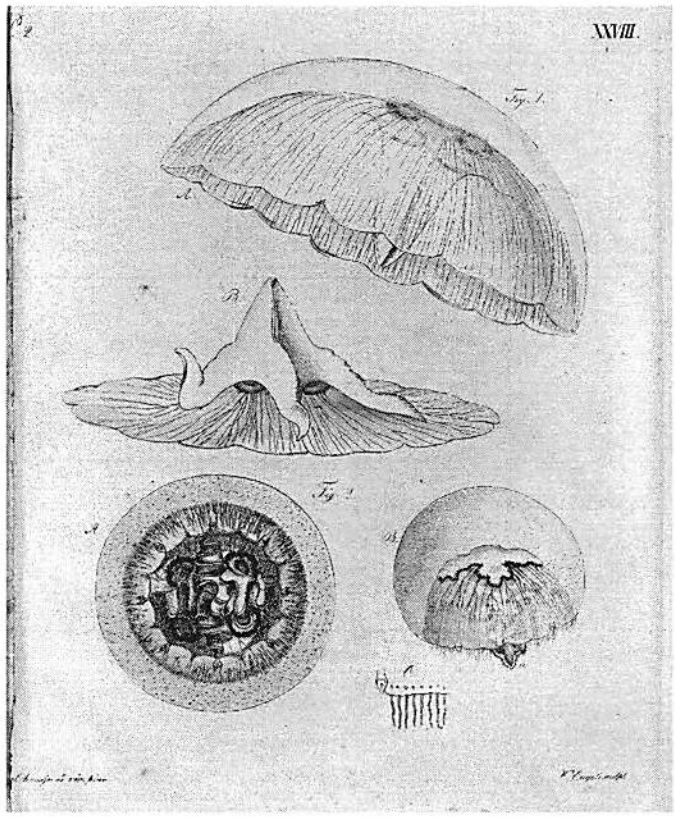
Voznesensky was the premier naturalist-collector in the Russian era. But his daily journal has never been published. Working in the zoological museum and looking after its vast assortments of collections left him little time to complete the full record of his travels or his collections.

Il'ya G. Voznesensky, Marbled murrelet *(Brachyramphus marmoratus)*. Wclr., ca 1840.
St. Petersburg Branch, Russian Academy of Sciences Archives

When you are fishing, how do you know that you have caught the kind of fish that Fish and Game regulations allow you to keep? If you are in Russia, how can you name a fish and have your Russian friends understand which one you mean?

Activity 1
Reader's Theater: "Science, Samovars, and Sea Cows."

Join in a reader's theater production in which five of the foremost sailing scientists meet and compare notes while their plants and animals gather around. Research a plant or animal selected from the list included at the end of the reader's theater (page 134) and write a brief description which will be read during the reader's theater presentation. Find or draw a picture of the plant or animal to show the audience during the reader's theater presentation.



Adelbert von Chamisso, "Salpa," in *De Animalibus quibusdam...*1819.
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks

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News Flash: December, 1999. How many living species are there?

The American Museum of Natural History estimates ten to thirteen million living species. Some groups like mammals are well-studied, but others are little known. Some estimates state that mammals are less than .5% of the total species; insects make up more than 50% of the total species. Another problem is defining a species. Some biologists recognize two hundred kinds of blackberries, others list less than twenty.

Activity2
Sort and Classify.

You have gone fishing and caught some fish. Now you must identify them in order to know which ones you can keep for dinner and which ones you must throw back in the water.

Recognizing a species means that you must know its characteristics. For example, Georg Steller had never been to America before his expedition with Bering, but he knew about the American birds from a book he had studied. When he arrived on Kayak Island and saw a blue jay, unknown in Europe and Russia, he remembered it from that book. He said in his journal: "This bird alone sufficiently convinced me that we were really in America...."

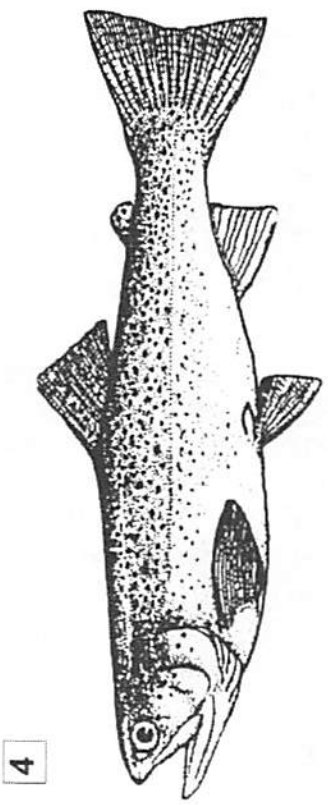
To identify a plant or animal, you follow a trail that can branch many times until it leads to only one choice. Most identification and classification follows a path of paired observations. For example, this salmon identification begins with the observation that salmon have an adipose fin that non-salmon do not have. The adipose fin is a small fatty fin on the back just in front of the tail fin. When two features are listed, both must be present to continue placing the fish in that category.

Many of these fish are actually beautifully colored—not black and white like these pictures. And they are many different sizes. Some of them only live in salt water; some only live in fresh water; and some live in both salt and fresh water. Their names are known world-wide by the Latin scientific name. The common names might be understood here, but completely unknown in another location. Scientific names are especially helpful because they are the code used in all countries, no matter what that country's language is. That means it's possible to know the fish's name whether you are in the United States or Russia or Chile, even though the common name changes in each country. For example, red salmon is *Oncorhynchus nerka* in all those countries, but its common name is red or sockeye in California or Alaska, and "krasno ryba" in Kamchatka.

With your fish cards in hand, sort them by identifying characteristics according to the "Classify the fish" chart, page 128. Your first step is to select all the members of the salmon family and separate them from the non-salmon family. Then follow the arrows to locate each specimen. Fish and Game says you may keep the arctic char, the rainbow trout and the red salmon for your dinner. You may also keep the starry flounder and whitespotted greenling as examples to show everyone which two fish were identified by Steller. But all the rest must be thrown back in the water. Good luck finding your dinner.

Put the number of each fish card in the space by the correct fish name below.

___ Arctic char: *Salvelinus alpinus*
___ Arctic grayling: *Thymallus arcticus*
___ Chum salmon, dog: *Oncorhynchus keta*
___ King salmon, chinook: *Oncorhynchus tshawytscha*
___ Lake trout: *Salvelinus namaycush*
___ Pink salmon, humpback: *Oncorhynchus gorbuscha*
___ Rainbow trout: *Oncorhynchus mykiss*
___ Round whitefish: *Prosopium cylindraceum*
___ Silver salmon, coho: *Oncorhynchus kisutch*
___ Sockeye salmon, red, blueback: *Oncorhynchus nerka*
___ Starry flounder identified by Georg Steller: *Platichthys stellatus*
___ Whitespotted greenling identified by Georg Steller: *Hexagrammos stelleri*



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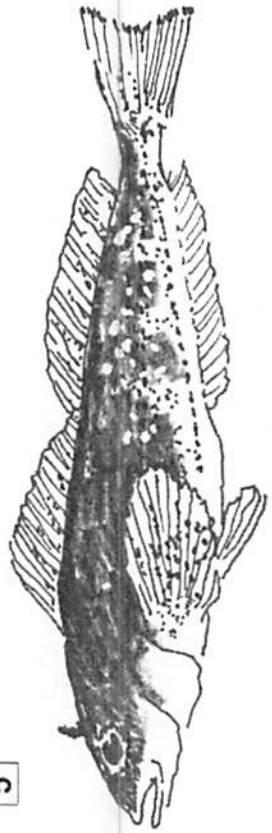

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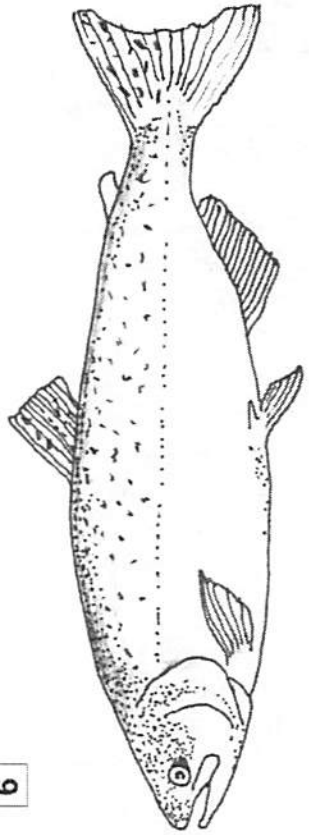

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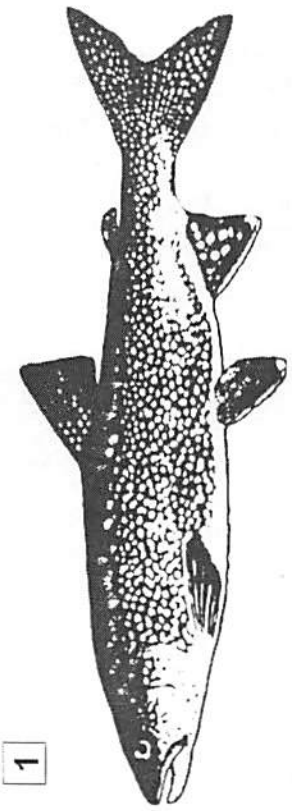

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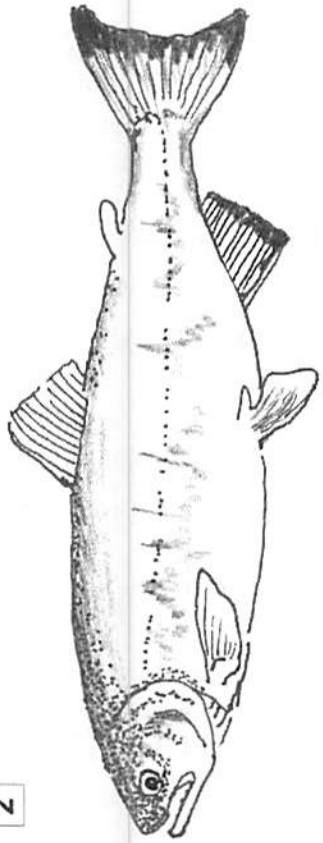

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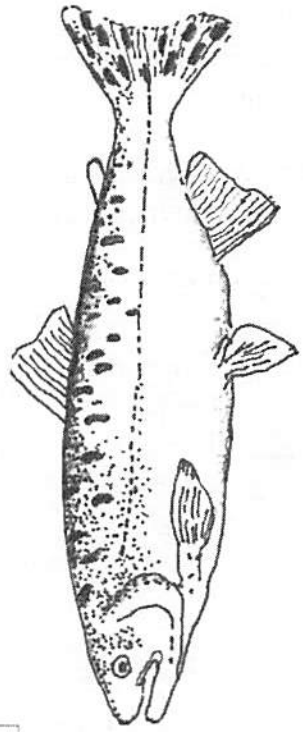

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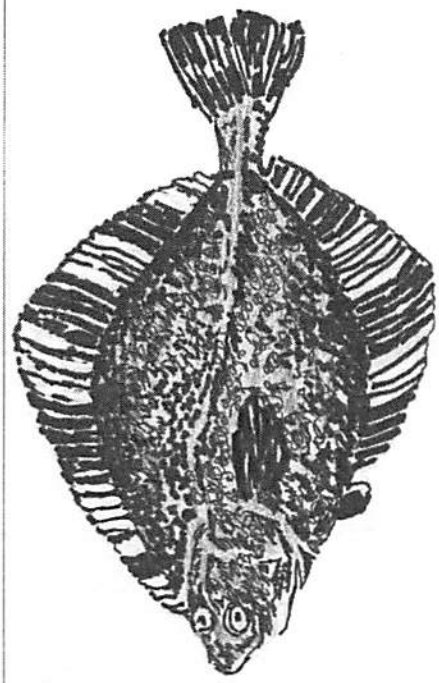

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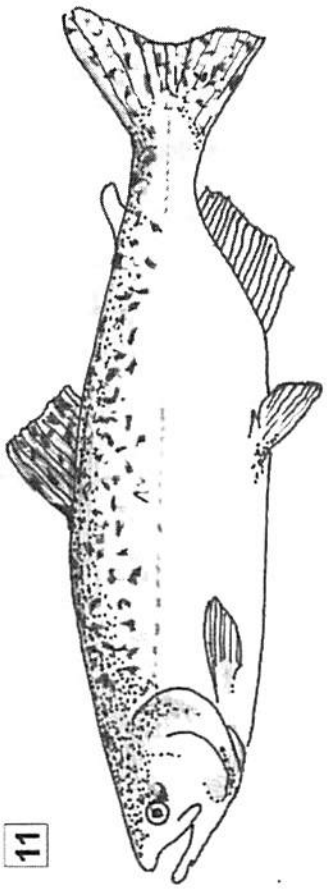

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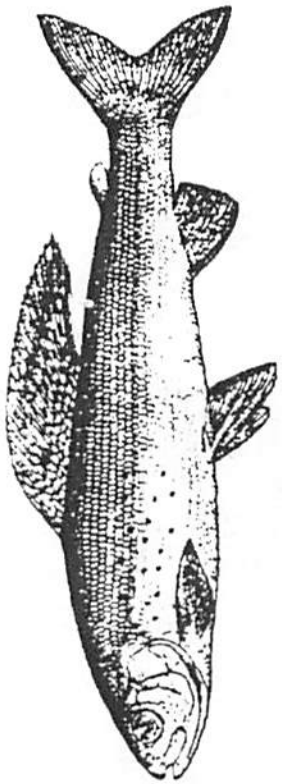

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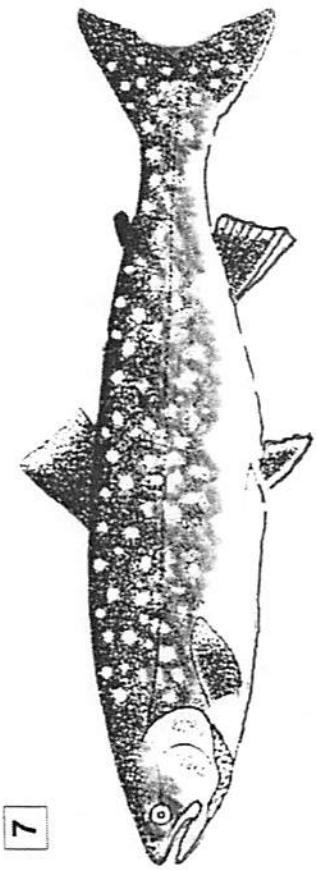

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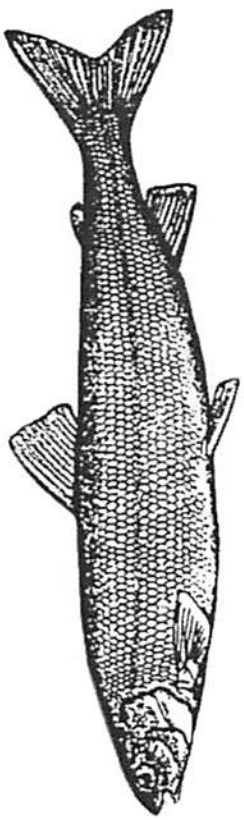

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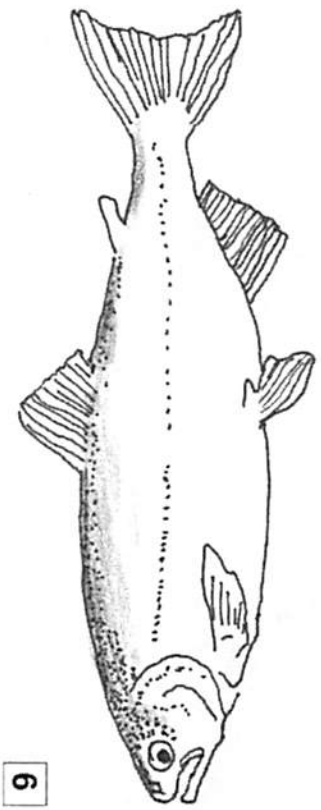

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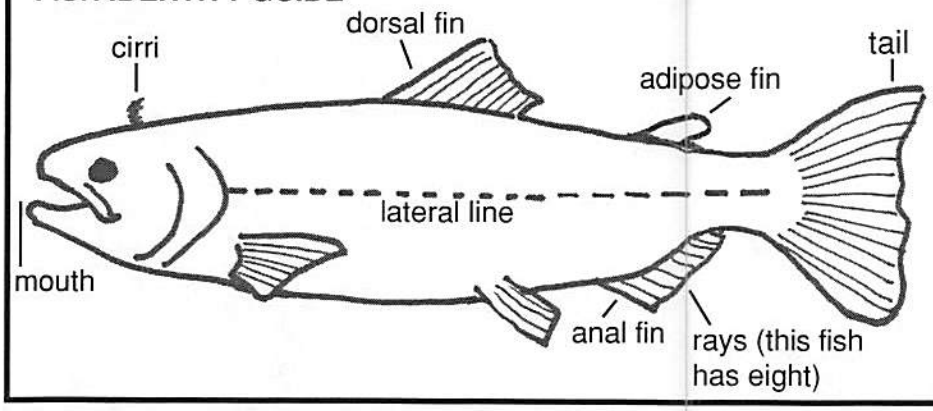
FISH IDENTITY GUIDE



Classify the Fish Chart

Begin Here

Salmon family : All with adipose fin

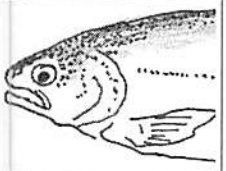
OR

Not salmon: no adipose fin

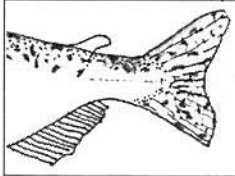
- Long dorsal fin; no cirri: STARRY
- Long dorsal fin with notch; cirri: WHITE-SPOTTED

Dorsal fin huge: ARCTIC GRAYLING

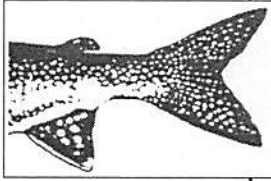
Mouth large; scales small



Mouth small; scales large: ROUND WHITEFISH



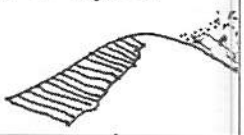
Black spots on light back-ground or NO spots; tail not forked



Light spots on dark background; tail forked

Fewer than 12 rays on anal fin: RAINBOW TROUT

More than 12 rays on anal fin



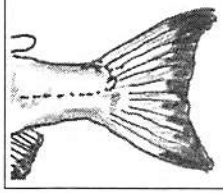
A few large, scattered spots; tail slightly forked: ARCTIC CHAR.

Many small oval spots; tail deeply forked:LAKE TROUT

No spots on tail

Spots on tail

Black on tip of tail: CHUM SALMON



No black on tip of tail: RED SALMON

Large oval spots on tail and back: PINK SALMON

Irregular spots on back and tail: KING SALMON

Irregular spots on back and upper half of tail only: SILVER SALMON

ANSWERS to Activity 2
Sort and Classify.

7 Arctic char: *Salvelinus alpinus*
12 Arctic grayling: *Thymallus arcticus*
2 Chum salmon, dog: *Oncorhynchus keta*
11 King salmon, chinook: *Oncorhynchus tshawytscha*
1 Lake trout: *Salvelinus namaycush*
3 Pink salmon, humpback: *Oncorhynchus gorbuscha*
4 Rainbow trout: *Salmo gairdneri*
8 Round whitefish: *Coregonus quadrilateralis*
6 Silver salmon, coho: *Oncorhynchus kisutch*
9 Sockeye salmon, red, blueback: *Oncorhynchus nerka*
10 Starry flounder identified by Georg Steller: *Platichthys stellatus*
5 Whitespotted greenling identified by Georg Steller: *Hexagrammos stelleri*

SCIENCE, SAMOVARS, AND SEA COWS: READER'S THEATER

TIME: The present

PLACE: The Samovar Tea and Coffee House in St. Petersburg, Russia

CHARACTERS:

CHAMISSO: Adelbert von Chamisso (naturalist/poet on the Kotzebue round-the-world voyage of 1815-1818).

ESCHSCHOLTZ: Johann Eschscholtz (doctor/naturalist on two Kotzebue round-the-world voyages 1815-1818 and 1823-1826).

LANGSDORFF: Georg von Langsdorff (naturalist/doctor on Krusenstern/Lisiansky round-the-world expedition 1803-1806).

STELLER: Georg Steller (naturalist/botanist on Bering's 1741 voyage).

VOZNESENSKY: Il'ya Voznesensky (naturalist on several voyages to the California coast and Alaska 1839-1849).

NARRATOR

And **PLANTS** and **ANIMALS** our scientists identified.
(see list, page 134)

STAGE DIRECTIONS:

Each reader wears a sign with the plant, animal or character name.

Science, Samovars, and Sea Cows: Reader's Theater

NARRATOR: Here at the Samovar Tea and Coffee House in St. Petersburg, we have just come upon some of our most noted scientists: [pointing to the characters] I see Adelbert von Chamisso, Johann Eschscholtz, Georg von Langsdorff, Georg Steller, and Il'ya Voznesensky. They appear to be comparing notes about experiences during their great voyages to America. Let's listen.

STELLER: [In a grumpy voice] I have never been so angry as the day when Captain Bering said I could not go ashore. The reason I joined this voyage was for the chance to explore new lands. New plants. New animals. New birds. I dreamed about it for weeks .

NARRATOR: Steller is hot-tempered and sensitive to anything people say around him. He was only able to confide his annoyance to his journal.

STELLER: I wanted to stay longer on Kayak Island. Anything longer than ten hours would have pleased me. But when I sent word back to the ship, the Captain replied that I should get back pronto. I thought the Captain was angry with me, but when I made it back to the ship, he treated me to a cup of hot chocolate.

CHAMISSO: Captain Kotzebue was always irritated with me. I asked him right at the beginning what I should be doing on board the ship and he said that the "first thing I must learn is that the chief task I had to do was to make myself as inconspicuous as possible, to take up as little space and to be around as little as possible." I was having my own problems with seasickness, and I gave my offering to the sea early on in the voyage. I was always seasick when there was rough water.

STELLER: I was fortunate. I was never seasick, but there were those around me who were very sick. I was the captain's physician, but could not save his life. The captain and half the crew died. Scurvy was what killed them. On my ship we didn't lose people to drowning or disaster, but to ill health.

ALL [nodding in agreement]: Yes! Scurvy was a huge problem!

ESCHSCHOLTZ: I was the ship's physician also. We learned that eating sauerkraut and meat helped prevent scurvy. We celebrated crossing the equator with a party and a play and the first canned meat ever eaten by sailors. The meat was so well preserved that we could eat it even a year after we left home.

STELLER: Oh, I envy you, Eschscholtz. I never crossed the equator. With our maps and navigation instruments we could never have made it. In fact, we had to trudge across most of Siberia by dog sled in order to even start our sailing.

VOZNESENSKY: Yes, Steller. Your voyage was short, just one summer in 1741. Exactly ninety-nine years after you, I was in Alaska. What changes. You would have been amazed. But I had to sail around the world to get to Alaska, and it took me a year and a half to get there.

STELLER: It took my Captain Bering more than seven years to travel 7000 miles across Siberia and then build the ships we sailed on.

LANGSDORFF: [excited voice] I was on the first Russian trip around the world in 1803. What an honor to be included! I begged Captain Krusenstern to take me along as the ship's physician and naturalist. Speaking of coincidences, do you know that I was sailing along the Pacific Coast from Sitka to California the same year America's Lewis and Clark were camped on the mouth of the Columbia River. We planned to make a little boat trip up the Columbia, but the weather was too rough. If we had been successful, we might have met them. I have always liked traveling.

CHAMISSO: I liked to travel, also. But life on the ships was always crowded and sometimes tempers were short. Eschscholtz and I liked to relieve the tension sometimes with a little fun.

ESCHSCHOLTZ: You call it fun, Chamisso, but I wonder what the sailors called it. Do you remember the time we hid that sailor's mattress in plain sight?

CHAMISSO: [laughs] I sure do. When we were sailing in the tropics, it was so hot that a lot of us slept outside on the decks. This poor sailor moved his mattress on deck, and Eschscholtz and I put it right back on his bunk.

ESCHSCHOLTZ: He looked everywhere but in his own bed for it.

CHAMISSO: [with amazement] And on one of those hot nights there were flying fish landing on Captain Kotzebue's bed on deck. He woke up, surprised to catch a fish in his sleep!

NARRATOR: That would have been a creative way to gather specimens. All of you were responsible for collecting plants and animals and getting the specimens back safely to Russia. Wasn't that a hard job?

ALL [loudly]: Yes!

VOZNESENSKY: I tried to catch a small animal on the coast of Brazil. I ran after it, slipped and fell from the rock cliff into the ocean. I did not know how to swim, and there was no one around to help me. [frightened voice] I was alone. Luckily the waves swooped toward the shore and threw me back at the rock. I grabbed the cliff, but I couldn't climb out because there was no place for my feet. I hung there like the sea snails all around me. I thought I was done for, right there. Then the next waves heaved me up. I grabbed another higher rock that stuck out from the cliff and scrambled to shore.

LANGSDORFF: My research in California met with more difficulties than are imaginable. We lived continually on our ship. Loading and unloading was constantly going on. Seal and bird skins I had put on the deck to dry were thrown overboard.

ESCHSCHOLTZ: I hated the crowding on the ship. There were always conflicts about drying specimens. I made a complete collection of corals in the South Pacific. I brought them aboard ship and stacked them carefully in the chicken coops for bleaching and drying. [speak while holding nose shut] Now it is true that coral bodies in this condition do not make a very pleasant odor. The next morning they had all been thrown overboard. [use regular voice here]I did keep at it and made the most detailed collection and record ever of those corals, but it was always a challenge to get the specimens safely home.

VOZNESENSKY: [sad voice] My fish specimens didn't always survive the trip back to Saint Petersburg. Even though I was the acknowledged expert at preserving specimens and taught people from Kenai to Sitka to California how to do it, my fish did not get home looking too good. In fact, the only time my employers really criticized me was for the quality of my fish.

NARRATOR: What about the plants? I understand that the exhibit at the Museum has plant specimens that some of you collected more than 150 years ago. How did you get the plants home safely? They seem so fragile.

LANGSDORFF: Paper is the key to preserving plant specimens. You need to dry them in paper. One day, when I was on land, the paper I was using for drying plants was carried away. I was told it was put by mistake into the lowest hold of the ship. It got soaking wet down there in the damp hold.

CHAMISSO: I know just what you are describing, Langsdorff. All my specimen drying papers were full of plants. Then one night when we had gone ashore, the seamen used the plant-filled paper packets to pad their beds, make them more comfortable, I guess. On a rainy night no one thought to rescue the papers. They became soaked, the specimens were ruined, and I had to scrounge for paper for the rest of the trip to dry my botanical samples.

VOZNESENSKY: [bragging voice] I sent home 2,000 specimens of dried plants. Apparently in my ten years of collecting in America, I gathered and mounted more specimens than anyone. 3,687 mammals, birds, and fish. And I sent to Russia bird eggs, nests, and over 10,000 insects.

ESCHSCHOLTZ: I remember Chamisso in the Sandwich Islands—I think you call them Hawaii now—collecting plants. He saw a beautiful grass that he did not remember seeing before and pulled out a few samples. Then this Hawaiian ran up and yelled at him. Apparently the grass was rice, and they had tried for many years to get it to grow. This was the first successful crop, and Chamisso, our botanist, had pulled it out.

CHAMISSO: Scientists can make mistakes. We all do it.

ALL: Yes, we do.

NARRATOR: Science is a risk-taking process. What about the big specimens or the live ones? How did you bring them home?

LANGSDORFF: Most of the time we had to make drawings and illustrations. I became skillful at drawing my collections.

STELLER: Yes, Langsdorff, you made some of the best drawings of any of us. My few sketches were very rough by comparison. None of them survived, apparently.

ESCHSCHOLTZ: My Atlas from the second voyage with Kotzebue contains my drawings. You can see them in the Atlas at the *Science Under Sail* exhibit. In my report of the three years of this second voyage, I described more than 2,400 animal species, many of them at Sitka and in California. On the first voyage with Kotzebue, however, I relied a lot on the artist, Choris, for the pictures.

CHAMISSO: So did I. Eschscholtz is right. Choris was a fine artist. To get examples of the whales I identified, I asked the Aleut/Unangan to carve wooden models. I did a few of my own drawings and watercolors, too. But I also like the watercolors that Voznesensky did of his fish.

VOZNESENSKY: After I was told that my fish were not coming home in good condition, I did more watercolors of them. *Science Under Sail* showed these watercolors to the public for the first time ever!

NARRATOR: I bet some of you wish you had that great invention, the camera, on hand to make pictures.

STELLER: How I wish I had one when I saw the sea ape. No other scientist has ever seen it. I'd really like this group to have a look at it. Being shipwrecked destroyed most of my collections. I did come back with more than 300 sea otter skins that inadvertently helped trigger the rush of Russian fur hunters to the Aleutian Islands.

LANGSDORFF: I was able to show later that the Russian fur hunters had hunted the sea otter almost to extinction.

VOZNESENSKY: And I collected bones and the skull of the Steller's sea cow from Bering Island, just one hundred years after Bering died there. That's an animal that became extinct all too fast.

STELLER: During the awful winter of 1741-42 that I spent on Bering Island after we were shipwrecked, the Steller's sea cow helped save our lives. It provided us with healthy food that also helped cure the scurvy for the half of the crew that survived.

NARRATOR: [sad voice]The sea cow is gone now. Extinct. Russian fur traders quickly learned about this delicacy, and within thirty years, the species vanished. Along with the spectacled cormorant Steller identified. As extinct as the dinosaur.

CHAMISSO: I identified the California grizzly bear and by the twentieth century, it, too, was extinct.

ALL [sadly]: They never learn.

ESCHSCHOLTZ: Let us remember some of the other creatures we identified. The ones that do exist in the twentieth century.

STELLER: Creatures of the sea:
Steller's sea lion, *Eumetopias jubatus*
Sea otter, *Enhydra lutris*
Gumboot chiton, *Cryptochiton stelleri*
Clam, *Mya truncata*

CHAMISSO: And the plants:
California poppy, *Eschscholtzia californica*
California blackberry, *Rubus ursinus*
Hairy rockcress, *Arabis hirsuta stelleri*
Kotzebue grass of parnassus, *Parnassia kotzebuei*
Unalaska Indian paintbrush, *Castellija unalaschensis*
Mountain harebell, *Campanula lasiocarpa*
Yerba buena, *Satureja chamissonis*
Chamisso willow, *Salix chamissonis*
California rose, *Rosa californica*
Arctic lousewort, *Pedicularis langsdorffii Fisch*
Northern primrose, *Primula borealis*

ESCHSCHOLTZ: Don't leave out the animals:
California valley coyote, *Canis latrans*
Hoary marmot, *Marmota caligata*
California (Pacific) giant salamander, *Dicamptodon ensatus*
California slender salamander, *Batrachoseps attenuatus*

LANGSDORFF: And the birds:
Red-throated loon, *Gavia stellata*
Steller's jay, *Cyanocitta stelleri*
Steller's sea eagle, *Haliaeetus pelagicus*
Marbled murrelet, *Brachyrampus marmoratus*

VOZNESENSKY: And the fish
Starry flounder, *Platichthys stellatus*
Whitespotted greenling, *Hexagrammos stelleri*

NARRATOR: These are only a few of the thousands and thousands of marine life, plants, animals, birds, and fish that you identified on your great voyages to America. We owe you all a hearty round of applause for your contributions to our scientific knowledge. Cheers!

THE END

"All the People You May Meet"

Cultural Comunities

Aleut in a Kayak. Detail on Sven Waxell's map, 1741. First recorded image.
Russian State Archives of the Navy, St. Petersburg

Article IX

With regard to the All the People You may Meet, you will inform yourself of their customs and culture, particularly the manner of their vessels for transport on the seas.

SUMMARY

Russia's great voyages to America led to picture and object collections from more than a dozen cultural communities. Artists captured images that words alone could not describe. Boats of all types and sizes were included among the many objects that fascinated the scientists and mariners. Featured people in this lesson:

- Mikhail Tikhanov, artist
- Gavriil Sarychev, a mariner on the Billings/Sarychev Expedition
- Carl Merck, naturalist on the Billings/Sarychev Expedition
- V. M. Golovnin, captain
- Il'ya Voznesensky, naturalist and collector
- Sven Waxell, lieutenant from the Bering voyage of 1741

MATERIALS

- ruler, meter stick
- diagram: "Proportioning the Kayak to the Hunter"*
- log book, pen, pencil
- pictures of people the Russian mariners saw on their expeditions*

* *included with the Instructional Guide*

ACTIVITIES

1. Students describe "first contact" from the point of view of the "people they met." The book, *Encounter,* by Jane Yolen, provides an example you may wish to consult and read to your class. (estimated duration 10-20 minutes)

2. Students design a kayak using traditional measuring systems. (estimated duration 20-30 minutes)

3. In Addition. Students look at their own collections and consider questions that serious collectors would ask themselves. (estimated duration 15-20 minutes)

4. In Addition. Students examine Tikhanov's paintings in this lesson— and any other illustrations you wish to add from the *Instructional Guide*. They consider questions 6 though 15 from Lesson 7, "Remarkable Places," page 107, to direct their observations about the paintings. (estimated duration 15-20 minutes)

Editor's note: When we say Aleut/Unangan in these lessons, we are recognizing the Unangan wish to be called by their traditional name, and simultaneously acknowledging the transitional connections some of us still make to older terminology imposed upon them by the Russians. For a description of the changing names of some groups of Native Alaskans, see "Indigenous Identity on Kodiak Island," by Gordon L. Pullar, *Native Cultures in Alaska*, Alaska Geographic Society, Vol. 23, Number 2, 1996; and "There is No Such Thing as an Aleut" by Barbara Švarný Carlson, "Alaska Native Writers, Storytellers, and Orators, the Expanded Edition," *Alaska Quarterly Review*,Vol.17, Numbers 3 & 4, 1999.

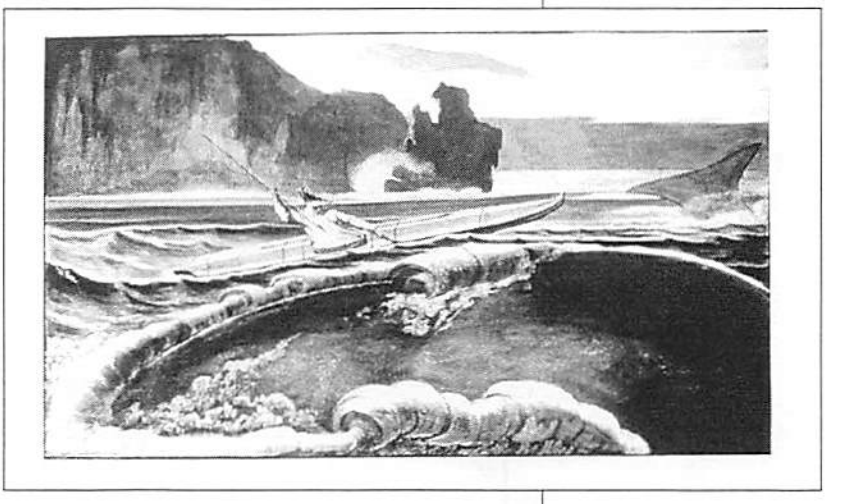
"All the People You May Meet"

Cultural Communities

What was it like to see people you have never heard of before? To look at their clothes? To view their tools, their implements, their boats? To hear a language that you could not understand, and to know that you had no way to make sense out of it. If you were the first Aleut/Unangan to see Bering's crew on the St. Peter, what did you think?

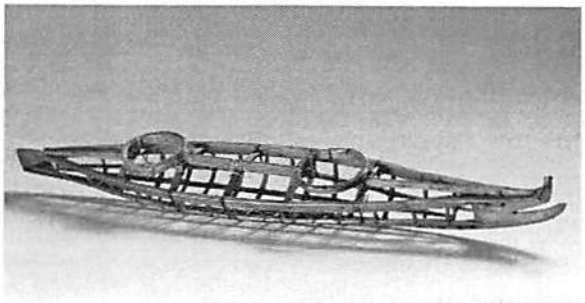
"As for what the residents thought of the inquisitive visitors, only indirection can guide us for there are no surviving records. Most of the oral history concerns the cultural upheaval and loss of life resulting from the fur trade. Many of the naval officers in this story, however, were also inspectors, whose job was to report on abuses of the fur harvesters and the Russian-American Company. Their journals contain interviews with individuals about conditions in Russian America; this might suggest that the officers presented a sympathetic and encouraging audience to Native informants. We also know that the **indigenous** people of **Siberia** and Alaska provided the travelers with much useful information about their way of life, herbal remedies, and natural phenomena." (Smith)

Cumulative accounts of observations show in pictures and journals what the early Russian expeditions saw on their journeys. Many cultural communities were itemized and recorded as the Russian explorers, their scientists and artists traveled thousands of miles. In Siberia, they described and catalogued the Chukchi, Itelmen, Evenk and Yakut. Expeditions to Japan wrote and pictured the Ainu. Voyages along the California Coast produced records of the Northern Valley Yokuts, Costanoan, Patwin, Miwok, and Pomo. In Northern Alaska, voyagers met and described the Inupiat and Siberian Yupik; in Southern Alaska, the Tlingit and

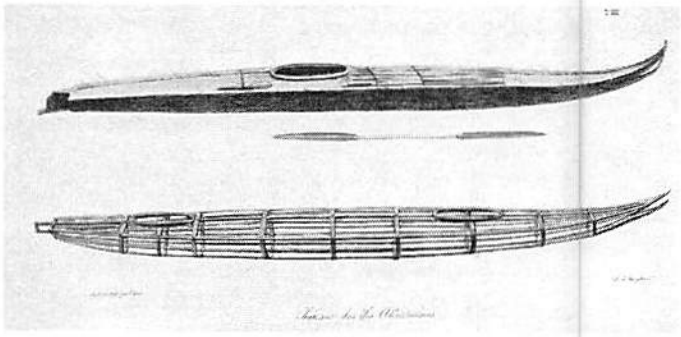


Aleut Hunting the Whale. wclr. By Mikhail Tikhanov, 1818.
Scientific Research Museum of the Russian Academy of Arts.

Vitus **Bering's** crew first met "Americans" near or on Bird Island—an **Aleutian island** in the Shumagin group. Over a three-day period, Sven **Waxell** and several of Bering's crew saw **Aleut/Unangan** in **kayaks** on the sea and on shore. They attempted to communicate with each other through sign language, an exchange of gifts, and the translations of a Siberian Native. A drawing of that early contact has come down to modern times on a 1741 map by Waxell.



Skin boat collected by Yuri Lisiansky 1804-05. Shell, wood, sinew.
Central Naval Museum, St. Petersburg



Boats of the Aleuts by Louis Choris, 1816, with Von Kotzebue Expedition; lithograph 1822.
Anchorage Museum of History and Art

Haida. Forays near the Alaska Peninsula brought records of the **Alutiiq**, Kenaitze, Tanaina and **Eyak**. "Upon its 'rediscovery' by Russia in the middle 1700's, Alaska was peopled by perhaps 75,000 Native inhabitants living in some nineteen major linguistic and cultural groups." (Veltre) Perhaps the most described and the most affected of all "the people they met" were the Natives the Russians called the "**Aleuts**." These residents of the 1300 mile-long island chain that ranges from **Kamchatka** to the Alaska Peninsula are today known to be several Alaskan people, including the **Unangan** of the eastern islands; and the Alutiiq of **Kodiak** Island, Prince William Sound and the Alaska Peninsula.

Living in a maritime world, the Aleut/Unangan and Alutiiq depended on the sea, developing a rich cultural life based on the ocean's resources and limitations. Every able-bodied adult man had his own skin boat for hunting and transportation. Often the strength of the village was measured by the number of boats available. These boats, called kayaks in our contemporary language, were the true forerunners of the modern kayak. Constructed with a framework covered with sea mammal skins, the boats were as long as 35-42 feet for many paddlers, or sized down to fit a solitary individual. The ocean environment often

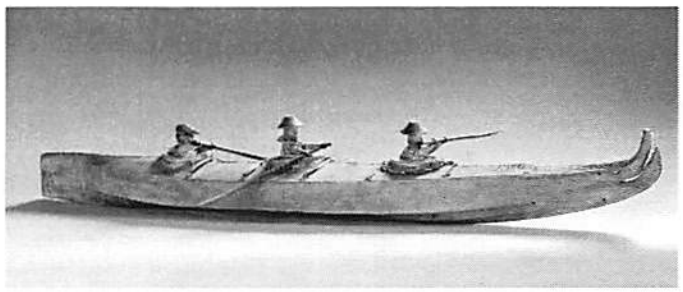
forced the Aleut/Unangan or Alutiiq paddlers to stay at sea for days in rough and stormy seas, but the ingenious drip skirt that fit over the hatch made the kayak watertight. Modern kayaks use this same design.

It was often the man in a kayak that the Russians first spotted on their voyages. The pictorial record and the journals depict the boats they saw and labeled kayak, baidara, baidar, angiak, khayak, khayakhpak, or canoes. Descriptions of these boats at Kodiak in 1790 come to us from Carl **Merck,** naturalist on the **Billings/Sarychev Expedition**:

> "Until recently they still had large boats that seated 20 men (Angiak). Now they have only one-seaters (khayak) and two-seaters (khayakhpak). The three-seater boats are used only by the **promyshlenniki** because of their greater comfort. Their leather boats are somewhat wider and shorter than those of the Aleuts. They are not as fast either. Their oars are shorter, with one paddle and with a short handle crossways on top. They kneel in those boats."

Gavriil **Sarychev**, a captain on the Billings/Sarychev Expedition, spent the winter of 1790-1791 in Unalaska. There he personally experienced the exceptional seamanship of the Aleut/Unangan and their boats while surveying and charting the coast line. In stormy weather he would put on the Native "upper garment of fish **entrails**, put a wooden hat on my head, and take the oar in my hand." He described his companions, the Aleut/Unangan, rowing "with the most perfect tranquillity and unconcern, while I was in no small trepidation, fancying that every billow which approached me would inevitably swallow me ...." (Sarychev) But Sarychev continued to explore in the little boats, using their navigability to get close to land and record fine details about the meeting of the sea and the shore.

The Aleut/Unangan called their boats by the Unangam Tunuu words: iqyax̂ for "kayak" or "bidarka"; uluxtax̂ for the two-to-three-hatch skin boat; and nix̂alax̂ for bidar.

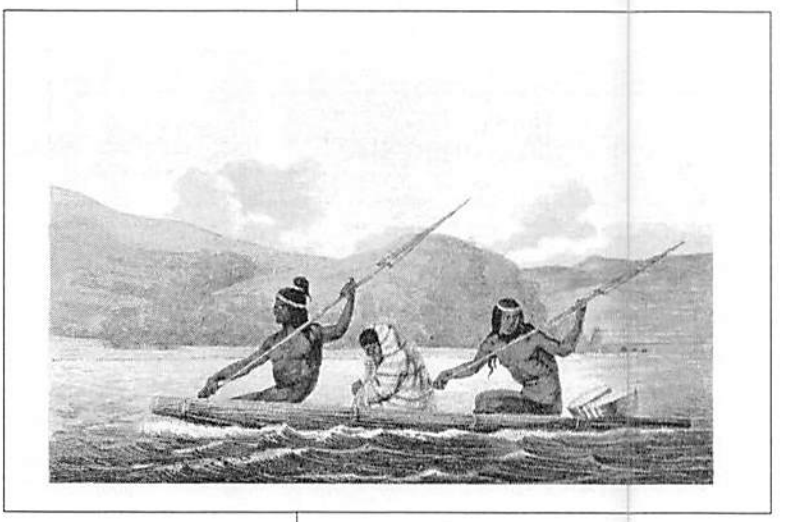


Three-hatch kayak model collected by Lisiansky, Kodiak, 1804-1805.
Central Naval Museum, St. Petersburg

Explorers sailing to California noted details about the boats in that region as well.

V. M. **Golovnin** visited the area around Fort Ross in 1818. He had read about reed rafts in the journals of earlier explorers who said that the boats showed the "unusual stupidity of the local Indians." By contrast, Golovnin wrote:

> "On first observing the natives and their boats, one would assume, of course, that these people are extremely stupid or lazy; however, one should consider that these people spend their lives constantly roaming from place to place, that they seldom travel by water, that they do not use anything from the sea in their diet other than shell food picked up on the beaches at low tide, and that moving from place to place on land, through forests and over mountains, they would not carry along wooden boats that they would be obliged to discard after spending so much time and labor on them. Hence, the invention of grass rafts that are used only occasionally, can be made up in a few hours, and can be left behind at no cost, should not be regarded disdainfully...."



Boats of the Port of San Francisco, by Louis Choris, 1816; lithogaph, *Voyage pittoresque autour du monde...* Paris, 1822.
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks

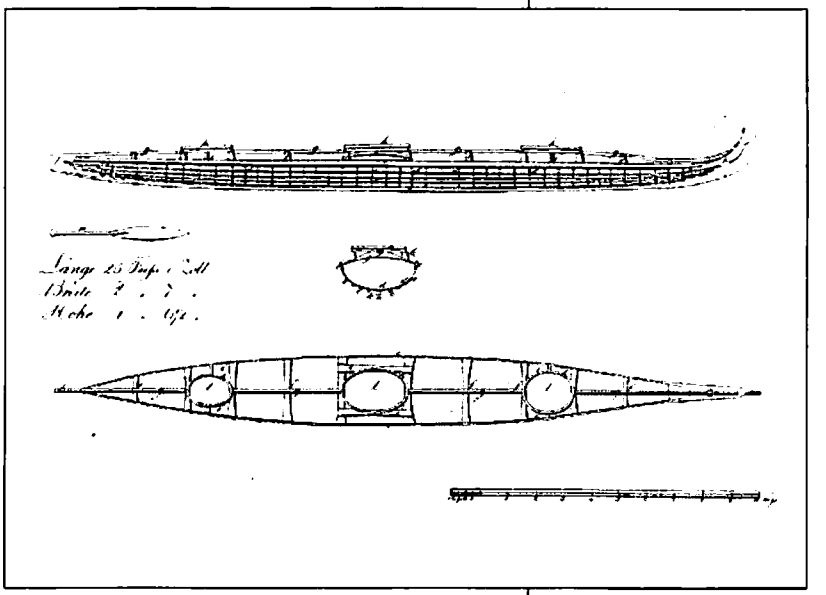
As sea-going mariners, the men and crews of the Russian ships were fascinated by the variety, quality and craftsmanship of the boats in all the cultures of the North Pacific. But Catherine the Great ordered her expeditions to bring back records about much more than boats. She commanded them to detail observations about the peoples'

- "dispositions and different corporeal qualifications;
- governments, manners, industry, ceremonies, and superstitions religious or profane;
- traditions, education, and manner of treating their women;
- useful plants, medicines, and dyes;
- food and manner of preparing it;
- habitations, utensils, carriages, and vessels;
- manner of life and economy;

- modes of hunting, fishing, making war, and treatment of domestic animals;
- likewise languages of which you will collect vocabularies, according to the plan sent with the Expedition, marking the pronunciation according to the Latin orthography;
- dress, ornaments, instruments, and arms of these people;
- tombs and other monuments of antiquity."

Her eagerness to have objects and records from the many cultural communities led to exceptional journals and artifacts in Russia's collections. Among the great collectors, the most prominent was Il'ya **Voznesensky**. Famed as a naturalist, Voznesensky also brought back to Russia more than 1,000 cultural artifacts. His collection holds objects that are valuable because he documented everything—noting the name of the object, the way it was used, the materials of which it was made and where it came into his hands. He also collected systematically, acquiring large assortments of clothing, masks and hats.

Many of the great commanders were noted collectors. Yuri Lisiansky was as well known for his ethnographic studies as for his maritime work. His atlas contains drawings of many of the objects which he gathered and took back to Russia for the Academy of Sciences, and his collections are among the earliest from Kodiak and Sitka. V. M Golovnin's voyage around the world on the *Kamchatka* carried a generous supply of objects from North America to the Russian Academy of Sciences. And it was on Golovnin's ship that one of the most skilled of the Russian artists painted stunning portraits of the "people they met."



Luka Voronin, *Aleuts and Their Kayaks* in G. Sarychev, *Atlas., St. Petersburg, 1802.*
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks

In 1806, a Russian prince asked the Academy of Arts in St. Petersburg to take his serf, Mikhail **Tikhanov**, for training. Born in 1789 (est.), Tikhanov showed great talent in art at an early age and was given a scholarship to the Academy of Art for professional training. One of his paintings was awarded a gold medal, but it was not actually given to him because his status as a serf meant that he was not eligible to win the prize. In 1815,

when he completed his academic study of art, he was freed.

In 1817, he was recommended as the artist for Golovnin's round-the-world voyage on the *Kamchatka*. Following instructions, Tikhanov painted all his subjects in full face and in profile, which appears at first glance like two individuals. His careful depiction of clothing, **regalia**, ornamentation and weapons makes these pictures an important resource for researchers. As Pierce notes: "Tikhanov was one of the few artists who painted Alaskan women ... He usually indicated the names and places of origin of his subjects, and sometimes the names." Although we do not know for sure, the records of others on the journey state that Tikhanov made preliminary rough drafts while on land and then reworked and painted the completed watercolors while he was sailing.

Tikhanov: *Pannoiak, Woman of Kodiak,* Wclr.
Scientific Research Museum of the Russian Academy of Arts, St. Petersburg

Tikhanov: *Aleut Hunter (Alutiiq)* Wclr.
Scientific Research Museum of the Russian Academy of Arts, St. Petersburg

Near the end of the voyage, Tikhanov became seriously ill. By the time the *Kamchatka* returned to Russia in 1819, Tikhanov's mental illness was acute and he was never able to work again at the same level of creativity, although he lived forty more years.

It is not known for certain how many paintings he produced; only about forty-five are identified today. An entire series that was to illustrate Golovnin's record of the journey was never published. The numerous sketches that Tikhanov mentioned in a letter to the Director of the Academy of Arts have never been found.

To think about:
How do the pictures of the people the mariners met compare with written descriptions? Are written descriptions more complete or more limited in their ability to tell us the whole story?

How do you feel when you go to a strange place and meet new people? Have you ever been somewhere that you did not understand the language? What were you thinking when you tried to figure out what others were saying? How do you read the visual clues that tell you what those other people think is appropriate behavior? How do you know if you are following all the unwritten rules?

Activity 1
Describe "first contact" from the point of view of the "people they met."

Experiences of first contact between Europeans and indigenous groups are voluminously recorded by Europeans, but lacking in record from the groups met. To off-set these scarce records, we invite you to imagine what those early contacts may have been like from the Native perspective. The book, *Encounter*, by Jane Yolen, provides an example that you may wish to consult and read.

Imagine that you are the Aleut/Unangan who first saw the Russian ship, the *St. Peter* and its captain, Vitus Bering in 1741. Perhaps you observed an 11 year-old boy waving to you from the deck. You did not know that his name was Laurentz Waxell. Did you guess what he was saying to you? Were you worried? Curious? Tell us more about yourself as you describe this experience in your log book.

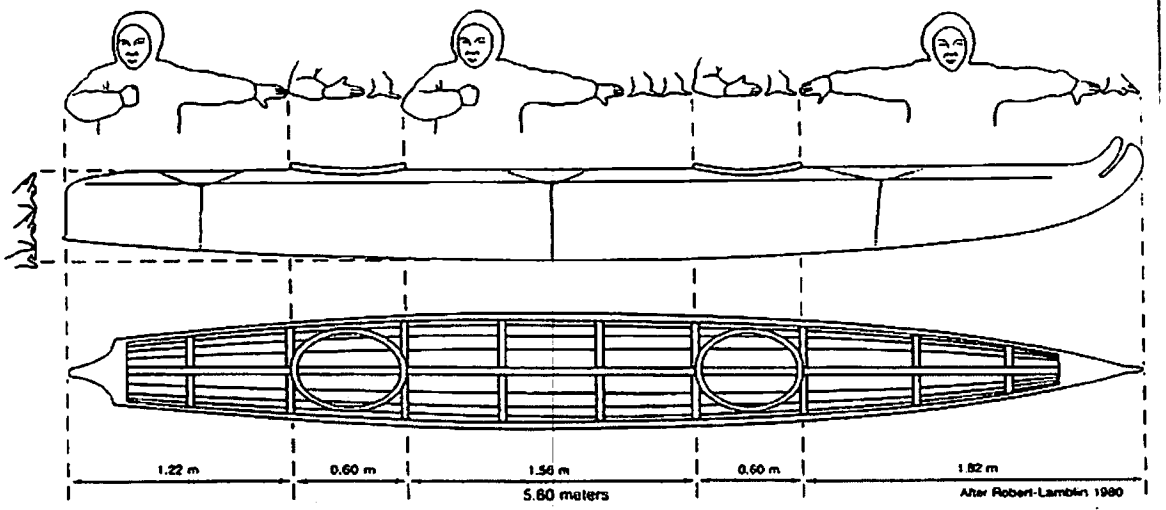
We do not know what Laurentz Waxell thought of this first contact, either. His father is credited with making the first European picture of an Aleut/Unangan. What do you suppose Laurentz thought of that same experience? Would he have had different impressions of the event than the Aleut/Unangan in his father's (Sven's) picture?

Activity 2
Design a Kayak.

You will need:

- ruler, meter stick
- diagram: "Proportioning the Kayak to the Hunter"
- log book, pen, pencil

192a Proportioning the Kayak to the Hunter



"Proportioning the Kayak to the Hunter" from *Crossroads of Continents: Cultures of Siberia and Alaska.* William W. Fitzhugh and Aron Crowell. Smithsonian Institution. 1988.

Directions:

Working with a partner or partners, use the illustration, "Proportioning the Kayak to the Hunter" as a guide to calculate the size of a kayak you will build for yourself. Sketch your kayak in your log book and record its dimensions. Record how many hand and arm lengths you need. Also record the dimensions in feet/inches and centimeters/meters. Using parts of your body to measure is a traditional way to calculate sizes and distances.

We assume that ways of measuring must always have been one way. But measurements in traditional European cultures have changed over time, and many of the ways of measuring were just like those used by Alaska's Natives. What is the "foot"? It's a

measure that we inherited from the length of an English king's foot. The division of the foot into twelve equal parts came from the thumb measured from the end to the first joint. Why a "foot" is still called a "foot" and an "inch" is not called a "thumb" is another story. Today, the foot, inch, yard are called the "English" system of measurement.

The USA is one of the very few countries to still use this system. Most of the world uses the metric system. The metric system comes from a way of calculating figured out in France. French scientists divided the distance from the North Pole to the equator into ten million parts. One part was made the unit of length and was called a meter.

One of the most important guides in measuring is to standardize the system you use to avoid confusion. Look at the "News Flash" onpage 77 for an example of the problem that measurement system variations can cause.

In Addition: Activity 3

Are you a collector? What do you collect? How do you store or display your collection? What do you know about the objects in your collection? Do you keep detailed records for each object? Do you know when you got the object? Where you got the object? Has the object been in your family for a long time? Who first collected it or made it?

In Addition: Activity 4

When you look at the pictures the artists made of the people they met, what do you see? Using questions 6 though 15 from Lesson 7, "Remarkable Places" as a guide, describe the pictures in detail in your log book.

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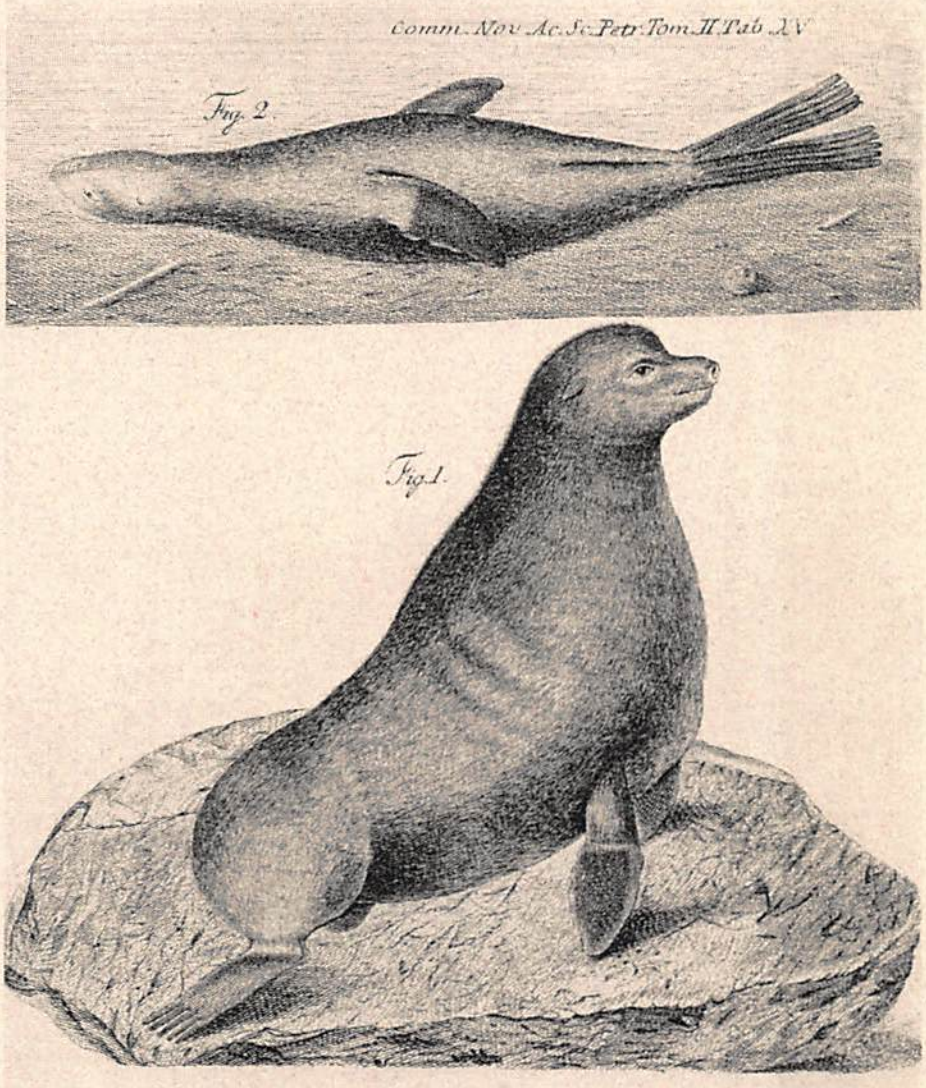
Science Under Sail: Russia's Great Voyages to America, 1728-1867

"Such Perfect Knowledge"

The Legacy



Anon, Fur Seal, watercolor, for publication in Steller, *De bestiis marinis. 1751.*
St. Petersburg branch, Russian Academy of Sciences Archives

Article X

You are authorized to make conclusions and observations of such perfect knowledge as has been produced in these voyages and remark on their clear and present import for all who will follow you.

SUMMARY

The legacy of Russia's great voyages to America resounds with powerful contributions in mapping, natural history and ethnographic material.

MATERIALS

- large format paper, 11 X 17 for newspaper reproduction
- log books and pens, pencils
- computers with internet access

ACTIVITIES

1. Students write, illustrate and publish a hypothetical newspaper dated October 1867, following the ratification of the treaty turning Alaska over to the United States. (estimated duration 20-30 minutes for student group planning; 40-90 minutes for production)

The newspaper describes Russia's great voyages to America, 1728-1867. This is a whole class activity. For inspiration about newspaper recreations from the past, look at:

Fleischman, Paul. Dateline: Troy. Cambridge, MA: Candlewick Press. 1996.

Johnstone, Michael. *The History News: Explorers*. Cambridge, MA: Candlewick Press. 1997.

2. Students use internet access and the World Wide Web to connect with contemporary centers of Native culture, and with students and scientists in Russia and the USA. (estimated duration 20-30 minutes) In addition to the web sites listed in the student lesson pages, there are resources through the internet to contact students in Russian schools. What do they know about Russia's great voyages to America? As in any communication via the internet, teachers should monitor the students. These are sites recommended by local teachers and should be reputable, but teachers should stay alert as they are used. See the ëKeypals Web sites in the Resources section of the Appendix.

Your class may find it interesting to know that sixth grade students in Seward, Alaska, articulated the skeleton of a Steller's sea lion that is exhibited in the "Legacy" section of the Science Under Sail *exhibition.*

"Such Perfect Knowledge"

The Legacy

To what extent did the voyages achieve Peter the Great's dream of creating an "empire of knowledge" and Catherine's desire to perfect the knowledge of her empire beyond the Pacific?

With extensive collections, detailed written journals and atlases, and spectacular drawings and paintings, the Russian legacy continues to affect us. The record is especially powerful when we look at the contributions of Russia's great voyages to our knowledge of:

- Charts and maps,
- Natural history, and
- Ethnographic material.

Hat. Alutiiq. Wood and paint. Collected in 1790 at Kodiak by. G. Sarychev.

Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), St. Petersburg, Russia

Charts and records of the oceans:

Russian records give a broad picture of the evolving conditions of the planet.

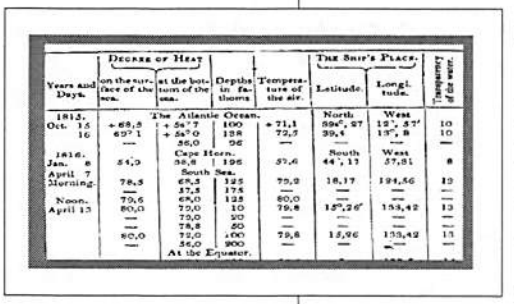
- Data from Otto von **Kotzebue's** voyage of 1823 moves the earliest date for information about the ocean waters back fifty years. Russian charts allow scientists to study the changing ocean floor and coast.

- Detailed tables from the hydrologic studies of the voyages provide a much earlier baseline for sea temperature, salinity, and chemical-content than had been known before, giving us valuable information today as scientists and policy makers consider courses of action for protecting the ocean environment.

- Information about land-based climate and weather has a longer record than often considered because Russians established the first weather station in western North America in **Sitka**.

- Early Russian records of volcanic activity show a long history of volatility.

- Maps and atlases such as the **Tebenkov Atlas** of 1852 are still used for research on Native Alaska place names and locations.

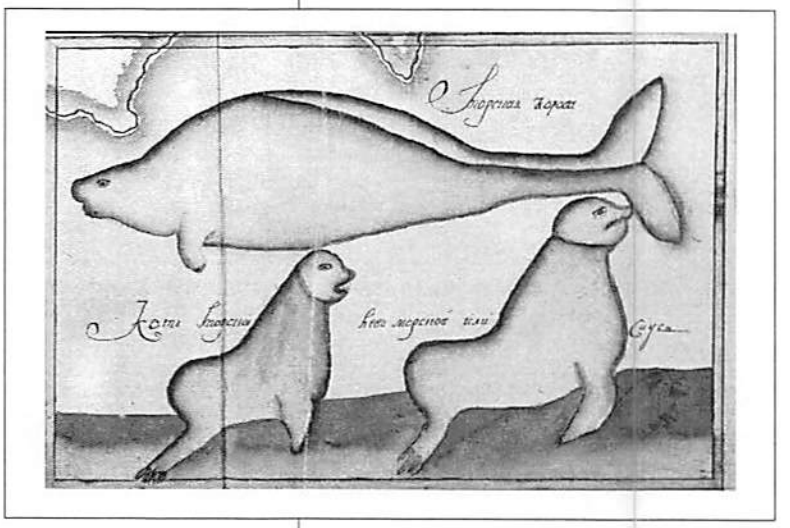


Years and Days.	Decrease of Heat: on the surface of the sea.	Decrease of Heat: at the bottom of the sea.	Depths in fathoms	Temperature of the air.	The Ship's Place: Latitude.	The Ship's Place: Longitude.	Transparency of the water.
		The Atlantic Ocean.			North	West	
1815. Oct. 15	+ 68,5	+ 54°,7	100	+ 71,1	89°, 27	13°, 57'	10
16	67°,1	+ 54°,0	138	72,5	39,4	13°, 8	10
	—	56,0	96	—	—	—	—
		Cape Horn.			South	West	
1816. Jan. 8	54,9	58,8	196	57,6	44°, 17	57,51	8
		South Sea.					
April 7 Morning.	78,5	68,3	125	75,2	18,17	194,56	12
	—	67,5	175	—	—	—	—
Noon.	79,6	68,0	125	80,0	—	—	—
April 13	80,0	72,0	10	79,8	15°,26'	153,42	12
	—	72,0	30	—	—	—	—
	—	78,8	50	—	—	—	—
	80,0	72,0	100	79,8	15,26	153,42	13
	—	56,0	900	—	—	—	—
		At the Equator.					

Temperature graph chart from Otto von Kotzebue, *A Voyage of Discovery into the South Sea and Beering's Straits for the Purpose of Exploring a North-east Passage, undertaken in the years 1815-1818*...London, 1821

Habitat migration of species: What plants and animals are indigenous to a region? From the early records of naturalists and Russian scientists, it is possible to compare the geographic distribution of a species in the nineteenth century with its range today. Understanding the habitat migration of species gives further clues to the decline or growth of a species.

Data on extinction: The spectacled cormorant is now seen only in pictures. Engravings



Steller's sea cow, only drawing from life. Detail on map by Sven Waxell, 1741. Russian State Archives of the Navy.

of fish and plants in **Siberia**, now extinct, but etched into copper plates 270 years ago, help us visualize the natural world of the past.

Scientists use the data collected many years ago by naturalists and others to understand the facts and causes of species extinction. The habits of the twenty-seven foot-long sea cow are known only through the records of Georg **Steller**, the only scientist to describe the animal before it became extinct 250 years ago. His visual observations and records detail the animal's sounds, feeding, behavior, and color and condition of the flesh. The rib bone of the sea cow, found on the island where Steller spent the winter of 1741, tells scientists the diet and age of the giant animal. Bones found long after the extinction give us clues with sophisticated DNA readings, but they do not tell us behavior, sounds or the "look" of the creature. For example, we all speculate on the color of the dinosaurs—were they pink or green or beige or polka-dotted? There is no record to help us with that information.

Larger than the largest male walrus, a Steller's sea cow measured as much as twenty-seven feet long (8.2 meters) and twenty-two feet around (6.71 meters). (How big was the Steller's sea cow? Measure it out in your classroom or school hall.) Each animal probably weighed up to eight thousand pounds (10 metric tons). Steller saw them in herds along the shore of **Bering Island**. "These animals," he wrote, "are busy with nothing but their food. The back and belly are constantly

seen outside the water, and they munch along just like land animals with slow, steady movement forward." This is detail that we cannot find in the creature's bones.

Scientists think the entire sea cow population totaled less than two thousand when Steller first described it. Its habitat was limited to a small area of the ocean where the temperature of the water was *just right and appropriate food was available.* Slow-moving and easily-hunted, the sea cow proved an easy source of food for Russians exploring the Alaska coast. The crew on Steller's ship were the first Russians to hunt and eat the sea cow. A mere twenty-seven years later, the entire population had been killed for food and skin to make boats. This amazing animal now exists only as a few skeletons in museums.

The Steller's sea cow is extinct. The Steller's sea lion is now on the endangered list. History is instructive, for while the Russians are responsible for the demise of the sea cow and decimation of the sea otter population, they also introduced the first marine mammal conservation program in the North Pacific, as early as 1803.

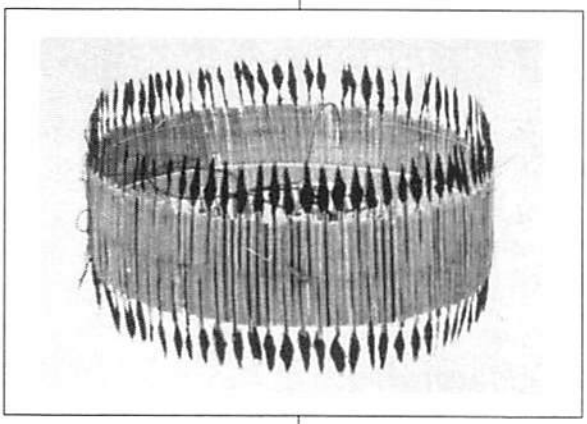
The natural history record is full of "firsts" from these expeditions:

- First description of the sea lion, sea eagle, sea cow and spectacled cormorant, Steller, 1741.
- First descriptions, drawings of Pacific cetaceans by Adelbert von **Chamisso**, 1816.
- First descriptions and collections of Alaska flora and fauna, Steller, 1741; Chamisso and Johann **Eschscholtz**, 1815-1818.
- First descriptions and collections of California plants, Steller, Chamisso and Eschscholtz, 1815-1818.
- First descriptions of the California animals such as the bear, coyote, salamander, Chamisso 1815-1818; and Eschscholtz, 1815-1818 and 1823-1826.
- First drawings of southeast Alaska species of plants and animals, Alexander **Postels**, Kittlitz, Mertens, 1826-1829.
- First drawings of Alaska and California animal species, Il'ya **Voznesensky**, 1838-1848.

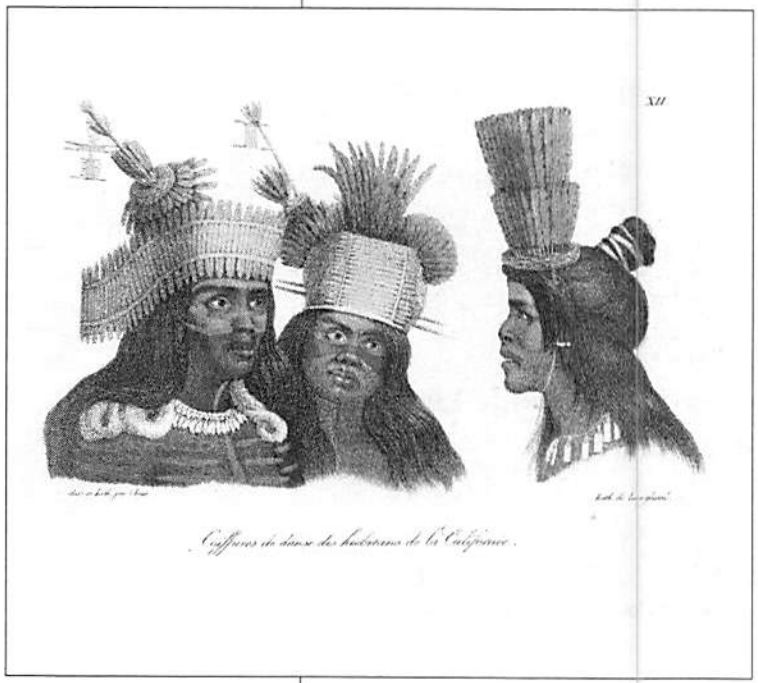
Records from past explorations provide keys to Native heritage

The long and tragic record of exploitation and disease that affected the cultures, especially the **Aleut/Unangan** cannot be minimized. Ironically, though, it was these same early contacts that may now provide some of the keys to reclaiming heritage thought lost. Reclaiming the past gives meaning to the present.

Knowledge about the cultures of Native peoples in Siberia, Alaska and California at very early contact with western culture provides some of the keys to past traditions. Added to the knowledge of Elders and the oral history of the cultural community, the records and collections of significant ethnographic materials develop contemporary focus on today's rich and stimulating living cultures.



Feather headband collected by G. Langsdorff in California.
Staatliches Museum für Völkerkunde, Munich



Painting of men wearing feathered headbands, Louis Choris lithograph, *Voyage Pittoresque autour du monde*...Paris, 1822.
Archives, Alaska and Polar Regions Department, Rasmuson Library, University of Alaska Fairbanks

Significant ethnographic material landmarks include:

- First studies of **Kamchatka** by Krasheninnikov and Steller, 1730's.
- First encounter with the Aleut/Unangan as recorded by Sven **Waxell** and Steller, 1741.
- First images of Aleut/ Unangan dress, implements, dwellings, by Levashov, 1760's.
- First views and descriptions of **Kodiak** life and people by **Billings-Sarychev Expedition**, 1790-1791.
- First census of the **Aleutian Island**s by Yuri **Lisiansky,** 1805.
- First European glossary of Alaska Native languages by Davydov, 1805.
- Earliest drawings of clothing, implements and arms of California's northern peoples. Georg von **Langsdorff,** 1805; Louis **Choris**, 1816.
- First depiction of **Inupiat** of Kotzebue Sound and Siberian Yupik of St. Lawrence Island by Choris, 1815-1818.
- First portraits of Copper River people by Mikhail **Tikhanov**,1818.

- First paintings of men and weapons of the Alaska Peninsula, P. Mikhailov, 1826-1829.
- Earliest collected objects from northern California in European museums, Langsdorff, 1805-1806.

You are already building your legacy. Is it about extinction or discovery? Collecting or identifying? Are you mapping new territory or helping others find theirs? Are you writing it? Painting it? Drawing It? How will others know how amazing you are?

Activity 1
Discovering the Written Record.

This is a cooperative activity for the entire class. What is the legacy of Russia's great voyages to America? Imagine that you are opening a time capsule that contains a newspaper from Russia in 1867. The newspaper is a compilation of the Russian voyages of exploration from 1728-1867. The descriptions and articles are for the American readers who are interested because Russia has just sold Alaska to the Untied States.

All the class participates on the staff of the newspaper. Begin with a staff meeting. Discuss the articles to include in the paper. You may find it helpful to look at a local newspaper to create the list of possible articles. Name the paper. Date the paper. Consider illustrations.

One person, the editor, assigns articles to each reporter with deadlines. Publish the paper.

The Legacy: Unangam Aleut Dance Group

I feel great pride when I see the Atka dance group perform traditional dances not seen for almost two hundred years. This revival of traditional dance was made possible by those who documented the information in writing, painting and the collection of dance **regalia**.

My mother was born on Atka in 1929. She left the island during the WWII evacuation, attended boarding schools and eventually married my father, a sergeant in the Army. We moved every two years until my father retired from the service. My junior year of high school, we moved to Anchorage. When we arrived, I was very happy to find other people who knew the word 'Aleut,' but I still had a lot of other questions about the Aleut culture. Some of these questions were answered when I saw the Atka dance group perform.

The Atka dance group provides valuable information about traditional culture. The dance regalia shows the clothing worn before contact with the Russians. The dancers use the Aleut language in singing their songs, and they explain the context of dance and rituals during their performances.

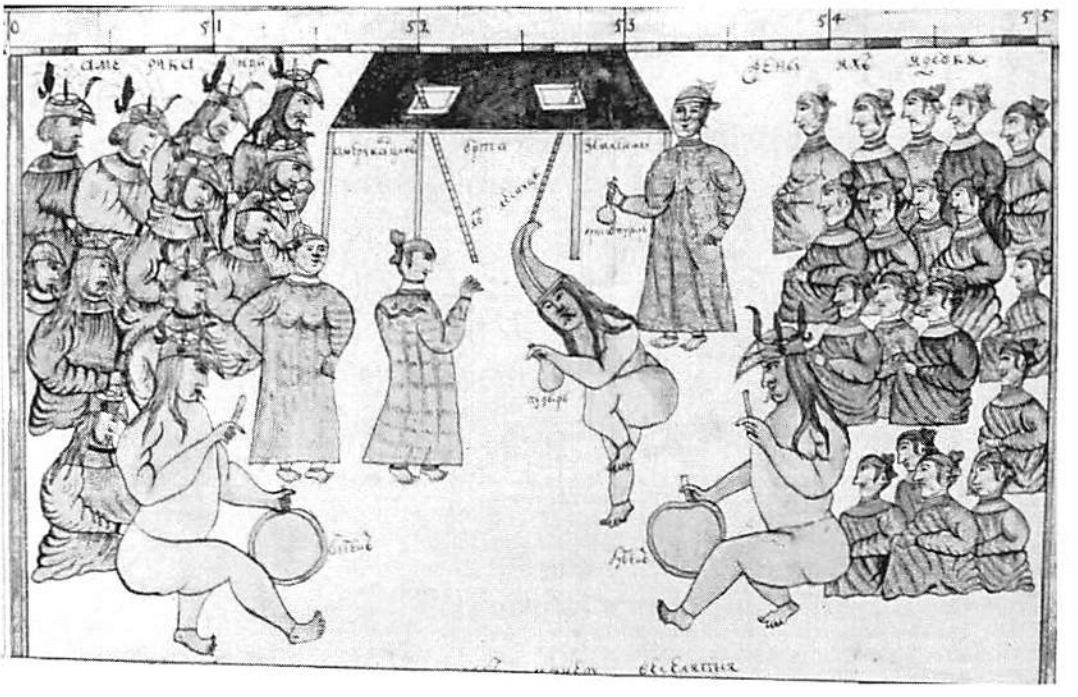
The group began in the 1994-1995 school year. A Native woman from Russia spent a year in Atka working with the students and their parents, making the regalia and developing the songs and dance routines. The school made a commitment to the group. The dance activities took the place of physical education classes. The dance group used written accounts from the Russian-American period and objects in the museums to reconstruct the traditional dress. Paintings like this one made by the Russians showed pictures of the dance. Portions of songs and dances were remembered by the Elders. These accounts were pieced together with audio and video recordings made in the early 1900's to create the dance routines.

The Atka school has twenty students; all are members of the dance group. Since 1994, a total of 25 have participated in the group. Three of the graduates perform with the group when they have the chance.

continued on page 151

The dance revival was possible because of the information collected about it in early years. Of course, the revival would not have been necessary without the disruption of Aleut culture in the first place by the Russian occupation. Before the arrival of the Russians, the estimated population of Unangam Aleuts ranged from twelve to fifteen thousand; now there are approximately three thousand living in the region. Where there were villages on every island throughout the region, now there are only eleven villages. The Russian occupation of the Unangam Aleut region caused a great upheaval of the social, cultural and economic practices of the traditional life.

Patricia Petrivelli,
Aleut Anthropologist



Dance, wclr. Detail from a map by T. Shmalev, 1774.
Russian Archives of Foreign Policy.

Activity 2
Making Contact.

The Alutiiq Museum & Archaeological Repository, Museum of the Aleutians, and Alaska Native Heritage Center all maintain web sites and have email addresses. The Alaska Native Knowledge Network includes connections with education resources throughout Alaska. Contact one of them to learn about contemporary Native Alaskan culture. Fort Ross, California also has an active site on the World Wide Web.

Alaska Native Heritage Center
http://www.alaskanative.net

Alutiiq Museum & Archaeological Repository
www.Alutiiqmuseum.com

Museum of the Aleutians
http://www.aleutians.org

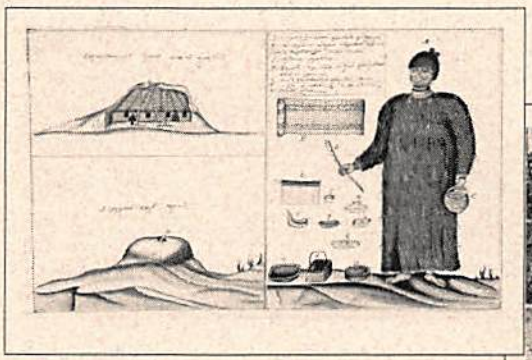
Alaska Native Knowledge Network
www.ankn.uaf.edu

Several Fort Ross California sites offer information and links. They include:
http://parks.sonoma.net/rosshist.html

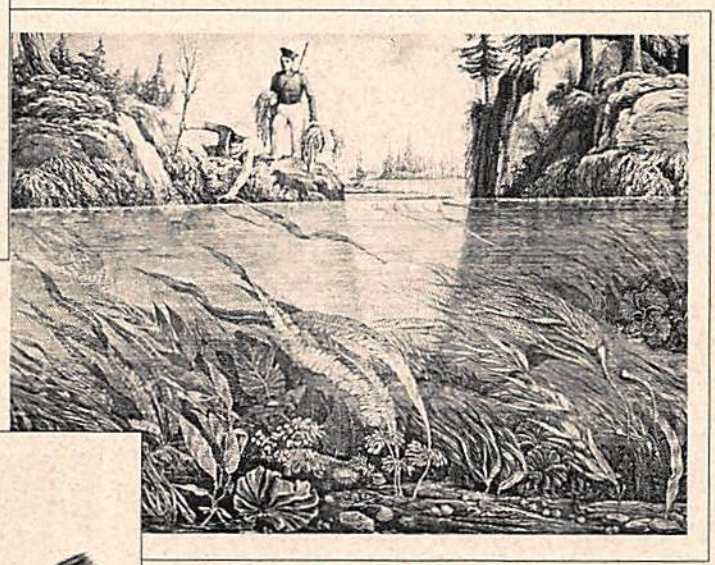
and the Fort Ross ~ Global Village project which brings children from Russia, Alaska, and California together on the Internet to study archaeology and history at Fort Ross
http://www.nobackroads.com/mendo/ftross.html

News Flash: November 11, 1999
The US Fish and Wildlife Service has announced critical habitat zones for the endangered Steller's eider. Listed as threatened in 1997, the Steller's eider nests along the Arctic Ocean and winters on the Alaska Peninsula and the Aleutian Islands.

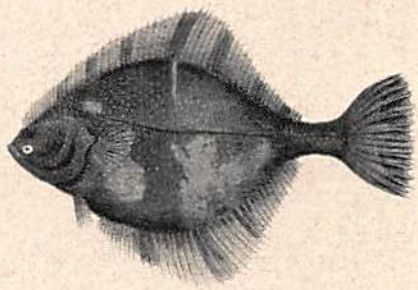
Science Under Sail: Russia's Great Voyages to America, 1728–1867



Women's tools and life. By M. Levashov. *Atlas with Views of Kamchatka & Aleutian Islands,* ca 1768.
Russian State Archives of the Navy, St. Petersburg.



"Gathering Specimens near Sitka," from *Illustrationes algarum,* by A. Postels, 1836.
The LuEsther T. Mertz Library, New York Botanical Garden.



Alexander Postels, Starry flounder (*Platichtyys stellatus)* first described by Steller in 1743. wclr., ca. 1827.
St. Petersburg Branch, Archives of the Russian Academy of Sciences

Activity Pages

CONTENTS

"People and Places" name cards for chapter one, "Expeditions of Discovery," Overview. Pages 153-154.

"Crew Cards" for chapter five, "Vessels of Sufficient Strength and Convenience," Life on a Russian Ship. Pages 155-162.

"Crew Signs" for chapter five, "Vessels of Sufficient Strength and Convenience," Life on a Russian Ship. Pages 163-165.

Additional activities to use at any time, especially with chapter four, "Forming an Exact Chart," Way-Finding and Map-Making, and chapter five "Vessels of Sufficient Strength and Convenience," Life on a Russian Ship:

A. Students make a simple angle of elevation measuring tool to find latitude. (estimated duration 15-20 minutes) Pages 166-167.

B. Students find their latitude using the angle of elevation tool and the North Star. (estimated duration 15-20 minutes) Pages 168-169.

C. Students locate places on a map using latitude and longitude coordinates. (estimated duration 15-20 minutes) Pages 170-171.

D. Students draw a mountain profile while in motion. (estimated duration 15-20 minutes) Page 172.

E. Students take a sounding to determine depth to the "sea" floor. (estimated duration 20-30 minutes) Pages 173-174.

F. Students use a knot line to measure speed. (estimated duration 20-30 minutes) Pages 175-176.

G. Activity 10. Students look at and interpret their local maps. (estimated duration 10-20 minutes) Page 177.

H. Activity 11. Students look at tide tables to see variations in tides and the variety of information available in the tables. (estimated duration 15-20 minutes) Page 178.

I. Knot tying (estimated duration 20-30 minutes) Pages 179-180.

Crossword puzzle based on Steller's experiences (use at any time) Pages 181-182.

Map of the world-blank, Page 183

People and Places name cards for Overview Chapter

Aleksei Chirikov (a-lek-SAY CHEER-a-kov)	**Kayak Island**
Aleutian Islands	**James Six**
Baltic	**Johann von Krusenstern** (yo-HAN fon kru-ZEN-stern)
Bering Island	**Louis Choris** (LU-ee KOR-ees)
Catherine the Great	**M. S. Gvozdev** (guh-VOZ-djev)
Fedor Litke (FEY-dor LIT-kee)	**Mikhail Tikhanov** (mik-HI-el tih-CON-of)
Gavriil Sarychev (gav-REEL sar-ee-CHEV)	**Otto von Kotzebue** (AH-toe fon KAWT-zuh-boo)
Georg von Langsdorff (gey-ORG fon LANGS-dorff)	**Vitus Bering** (VEE-tus BARE-eeng)
Georg Steller (gey-ORG STELL-er)	**Peter the Great**

People and Places name cards for Overview Chapter One

Vasily Golovnin (VA-sil-lee GUL-of-neen)	**Northeast Passage**
Joseph Billings	**Fort Ross**
James Cook	**Il'ya Voznesensky** (ill-E-ya voz-ne-SEN-skii)
Sven Waxell (sven VAX-ell)	**Adelbert von Chamisso** (AH-del-ber fon cha-MIS-so)
Cape Prince of Wales	**Ivan Fedorov** (ee-VON FE-dor-of)
Kodiak (KOH-dee-ak)	**Yuri Lisiansky** (YUR-ee lis-YAN-ski)
Emil Lenz (EH-meel LENS)	**Johann Eschscholtz** (yo-han esh-HOLZ)
Estonia (es-TONE-ee-ah)	**Unalaska** (Un-a-las-ka)
St. Petersburg	**Siberia**

CREW CARD 1 **Captain**  Commissioned Officer *Private Mess*	CREW CARD 2 **Lieutenant** Commissioned Officer Duty-watch Officer's Wardroom	CREW CARD 3 **Ship's Secretary** Commissioned Officer *Officer's Wardroom*
CREW CARD 4  **Ensign** Commissioned Officer Off-Duty Watch *Officer's Wardroom*	CREW CARD 5  **Surgeon** Warrant Officer *Officer's Wardroom*	CREW CARD 6 **Navigator** Warrant Officer *Officer's Wardroom*
CREW CARD 7  **Master** Warrant Officer *Officer's Wardroom*	CREW CARD 8 **Purser** Warrant Officer *Officer's Wardroom*	CREW CARD 9 **Gunner** Warrant Officer *Warrant Officer's Mess*

Crew Cards for Ship Life Chapter 5

CREW CARD

Ship's Secretary

This is a busy crew. You need to record all their activities and reports.

CREW CARD

Lieutenant

How far have you traveled since the last watch? Take a reading on the log-line and record it on the log-slate.

Take a sounding to be sure you are not getting into shallow water.

You are in command of the Gunner for this duty.

CREW CARD

Captain

You have the only private cabin on the ship. Of course, the whole crew is curious about what's in there. Please describe it. (You might need to use a lot of imagination to do this, but remember that your crew respects and admires you and does not wish to be embarrassed by what you tell them.)

CREW CARD

Navigator

Take a compass reading.

Read your latitude by the North Star.

Read your longitude and latitude on a modern map.

Log all readings on the log slate.

You command the Navigator's Mate and a Sailor.

CREW CARD

Surgeon

Three sick sailors have reported to you. Perhaps they have scurvy What is scurvy? What will you use to treat it? Will they recover?

CREW CARD

Ensign

Your Russian flag is called the "flag of Saint Andrew." What does it look like? Make a "flag" for your ship.

You are in charge of all signal flags. Research their meaning and prepare a signal.

You command the Sentry.

CREW CARD

Gunner

There are no hostilities, so weapons are not needed at this time.

Report to the Lieutenant.

How far have you traveled since the last watch? Take a reading on the log-line.

Take a sounding to be sure you are not getting into shallow water.

CREW CARD

Purser

You need to make a shopping list for the next stop in a port. What are all the supplies you should have on this ship? (You might need to make a few guesses for this one). You are in command of the purser's mate.

CREW CARD

Master (*You might be the busiest person here. The Captain knows that you are really in charge of the day-to-day running of the ship.*) You are responsible for the schedule and all duty assignments. With the duty roster in hand, make sure all crew are on task. But the ship is listing a little. It's time to do a ballast report. Your ship carries 90 puds (3,240 pounds) of ballast. What is the purpose of ballast? Are there modern equivalents?
You command the Master's Mate

Crew Cards for Ship Life Chapter 5

CREW CARD 10  **Boatswain** Warrant Officer *Warrant Officer's Mess*	CREW CARD 11  **Carpenter** Warrant Officer *Warrant Officer's Mess*	CREW CARD 12  **Sailmaker** Warrant Officer *Warrant Officer's Mess*
CREW CARD 13  **Quartermaster** Petty Officer Duty Watch *Petty Officer's Mess*	CREW CARD 14 **Boatswain's Mate** Petty Officer Duty Watch *Petty Officer's Mess*	CREW CARD 15 **Cook** Petty Officer *Petty Officer's Mess*
CREW CARD 16 **Gunner's Mate** Petty Officer Duty Watch *Petty Officer's Mess*	CREW CARD 17 **Master-at-Arms** Petty Officer Duty Watch *Petty Officer's Mess*	CREW CARD 18  **Master's Mate** Petty Officer Duty Watch *Petty Officer's Mess*

Crew Cards for Ship Life Chapter 5

CREW CARD

Sailmaker

The Captain has asked for a report.

What are sails made of? How and why do sails work? What are some sail names?

You command the Sailmaker's Apprentice.

CREW CARD

Carpenter

The Captain has asked for a report. What do the Caulker and the Cooper do on the ship? What tools do they use? What are these parts of the ship?
Mast. Bow. Stern. Keel. Yard.

You command the Caulker and the Cooper's Mate.

CREW CARD

Boatswain

How do you pronounce the name of your job? Find and draw a picture of the boatswain's whistle to show the crew.

Ordinarily you would command the Boatswain's Mate, but that person had petty officer mess duty today.

CREW CARD

Cook

You are in charge of preparing the meal of crackers, kasha, sauerkraut and cranberry juice.

You command the cabin boy, Boatswain's Mate, and sailors of the mess.

CREW CARD

Boatswain's Mate

Report to the Cook. You are in charge of cooking and serving in the warrant officer's mess.

CREW CARD

Quartermaster

You are the ship's keeper of time. How do you do it? what are your tools? How do you let the crew know what time it is?

New crew members want to know. What is it like to sleep in a hammock? How do you get in? How do you get out?

CREW CARD

Master's Mate

Report to the Master and assist in all scheduling and duty assignments.

The ship is listing a little. It's time to do a ballast report. Your ship carries 90 puds (3,240 pounds) of ballast. What is the purpose of ballast? Are there modern equivalents?

CREW CARD

Master-at-Arms

Every ship had a "police officer," and you are it.

You are in charge of keeping all supplies neat and collecting them at the end of the day. Return them to the Purser.

CREW CARD

Gunner's Mate

There are no hostilities, so weapons are not needed at this time.

Report to the Cook. You are in charge of cooking and serving in the petty officer's mess.

Crew Cards for Ship Life Chapter 5

CREW CARD 19 **Navigator's Mate** Petty Officer Duty Watch *Petty Officer's Mess*	CREW CARD 20 **Purser's Mate** Petty Officer Duty Watch *Petty Officer's Mess*	CREW CARD 21 **Rigger** Duty Watch *Sailor's Mess 1*
CREW CARD 22 **Sailmaker's Apprentice** Off-Duty Watch *Sailor's Mess 2*	CREW CARD 23 **Cabin Boy** Duty Watch *Sailor's Mess 1*	CREW CARD 24 **Caulker** Off-Duty Watch *Sailor's Mess 2*
CREW CARD 25 **Cooper's Mate** Duty Watch *Sailor's Mess 1*	CREW CARD 26 **Sentry** Off-Duty Watch *Sailor's Mess 2*	CREW CARD 27 **Sailor** Duty Watch *Sailor's Mess 1*

Crew Cards for Ship Life Chapter 5

CREW CARD

Rigger

(What does a Rigger do on the ship?)

Practice and demonstrate two knots.

You command Sailor(s).

CREW CARD

Purser's Mate

Report to the Purser.

You need to make a shopping list for the next stop in a port. What are all the supplies you should have on this ship? (You might need to make a few guesses for this one).

CREW CARD

Navigator's Mate

Report to the Navigator.

Take a compass reading

Read your latitude by the North Star.

Read your longitude and latitude on a modern map.

Log all readings on the log slate.

CREW CARD

Caulker

Report to the Carpenter.

The Captain has asked for a report. What do you and the Cooper do on the ship? What tools do you use? What are these parts of the ship? Mast. Bow. Stern. Keel. Yard.

CREW CARD

Cabin Boy

Report to the Cook.

You are responsible for meal preparation and serving the meal for the Captain and the Officers in the wardroom.

CREW CARD

Sailmaker's Apprentice

Report to the Sailmaker.

The Captain has asked for a report.

How and why do sails work? What are some sail names? What are sails made of?

CREW CARD

Sailor

You are cook for sailor's mess 1.

Report to the Cook.

CREW CARD

Sentry

Report to the Ensign.

Your Russian flag is called the "flag of Saint Andrew." What does it look like? Make a "flag" for your ship.

Research signal flags and their meaning and prepare a signal.

CREW CARD

Cooper's Mate

Report to the Carpenter.

The Captain has asked for a report. What do you and the Caulker do on the ship? What tools do you use? What are these parts of the ship? Mast. Bow. Stern. Keel. Yard.

Crew Cards for Ship Life Chapter 5

CREW CARD 28 **Sailor** Off-Duty Watch *Sailor's Mess 2*	CREW CARD 29 **Artist** *Officer's Wardroom*	CREW CARD 30 **Naturalist** *Officer's Wardroom*
CREW CARD 31 **Sailor** Duty Watch *Sailor's Mess 1*	CREW CARD 32 **Sailor** Off- Duty Watch *Sailor's Mess 2*	CREW CARD 33 **Sailor** Duty Watch *Sailor's Mess 1*
CREW CARD 34 **Sailor** Duty Watch *Sailor's Mess 2*	CREW CARD 35 **Sailor** Duty Watch *Sailor's Mess 1*	CREW CARD 36 **Sailor** Off- Duty Watch *Sailor's Mess 2*

Crew Cards for Ship Life Chapter 5

CREW CARD

Naturalist

Describe a specimen

CREW CARD

Artist

Draw a specimen

CREW CARD

Sailor

You are cook for sailor's mess 2.

Report to the Cook.

CREW CARD

Sailor

Report to the Rigger for knot-tying.

CREW CARD

Sailor
Report to the Navigator.

Take a compass reading.

Read your latitude by the North Star.

Read your longitude and latitude on a modern map.

Log all readings on the log slate.

CREW CARD

Sailor

Report to the Rigger for knot-tying.

CREW CARD

Sailor

Report to the Rigger for knot-tying.

CREW CARD

Sailor

Report to the Rigger for knot-tying.

CREW CARD

Sailor

Report to the Rigger for knot-tying.

Gunner's Mate

Master-at-Arms

Master's Mate

Navigator's Mate

Sailmaker's Apprentice

Purser's Mate

Cooper's Mate

Captain	Boatswain
Lieutenant	Carpenter
Ensign	Sailmaker
Surgeon	Cook
Navigator	Rigger
Master	Cabin Boy
Purser	Caulker
Gunner	Sentry

Artist	Sailor
Naturalist	Sailor
Sailor	Sailor
Sailor	Sailor
Sailor	Sailor
Quartermaster	
Boatswain's Mate	
Ship's Secretary	

Activity A
You Can Make a Simple Measuring Tool to Find Your Latitude.

You will need:

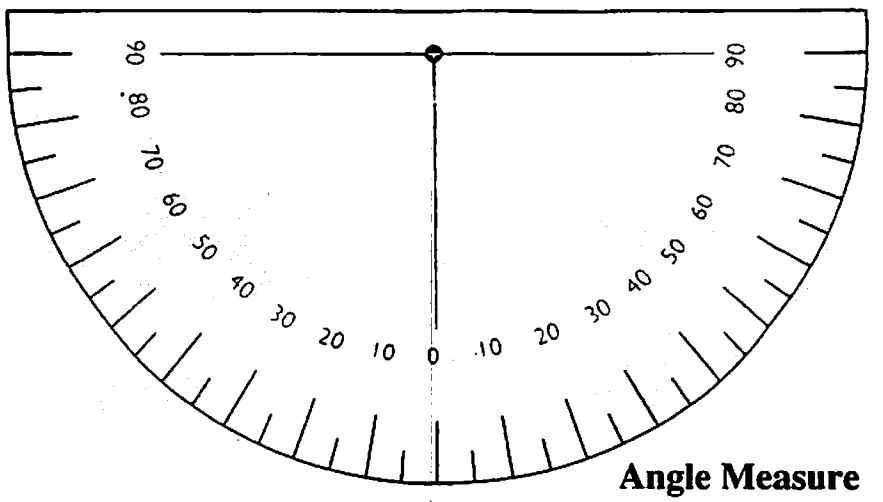
- the angle measure in this lesson*
- cardboard for backing the angle measure
- glue
- drinking straw
- tape
- scissors
- string (12-18 inches long)
- a weight such as a metal washer or a key

** included with the Instructional Guide*

Directions:

1. Glue the angle measure to a piece of cardboard.

2. Trim the cardboard to match the outlined shape of the angle measure.



Angle Measure

Activity A (continued)

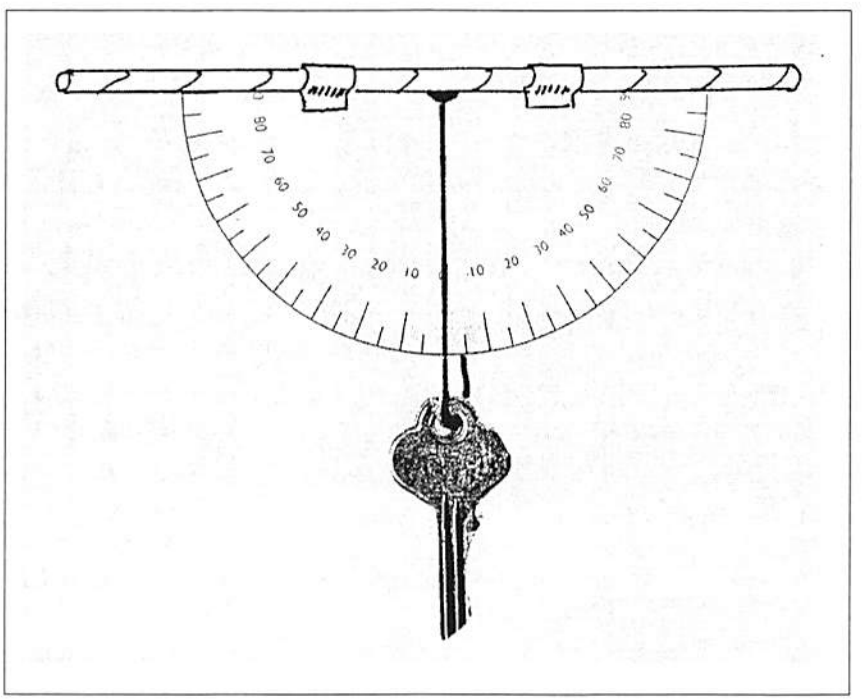
3. Tape a straw to the straight edge of the angle measure.

4. With scissors, punch out a hole at the dot on the angle measure.

5. Loop the string through the key or washer, and put one end through the punched hole on the angle measure. Tie the ends of the string together, leaving enough so the string can hang free. Be sure the string crosses the 0° mark when the straw is horizontal.

Now you are ready to find your latitude in Activity B.

This measuring tool uses some of the same basic concepts as the Russian mariner's cross staff, backstaff, quadrant, octant and sextant.



Activity B

You can find your latitude and measure how far you are from the North Pole!

You will need:
• angle measuring tool (from activity A)

Directions:

Look for the North Star—Polaris— on a clear night. The two stars that form part of the Big Dipper's bowl are the pointers. Once you have found Polaris, look at it through the straw with the curved side of your angle measure hanging down. After the weight stops swinging, pinch the string against the edge of the angle measure. Read the degree number.

If the number of degrees is 45, your latitude is 45 degrees north or 45°N. You would be 3,114 miles from the equator. How far would you be from the North Pole? Every 15° measures another 1,038 miles.

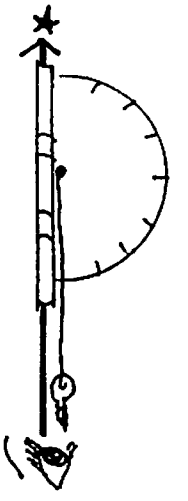
To the teacher: if it is too cloudy for North Star observations outside, you can set up a simulated North Star locator.

1. Find your location's latitude. US Geological Survey maps are a good source. DeLorme Map books are in print for each state and show latitude.

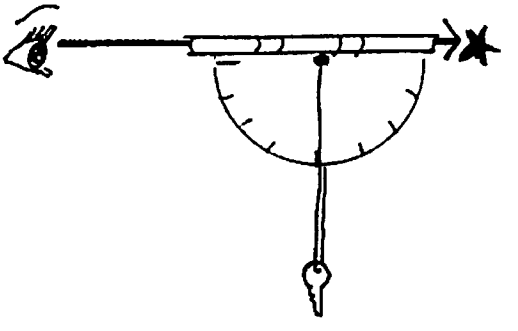
2. Pin a group of stars on a north wall in the pattern of the Big Dipper and the North Star. Holding your angle measuring tool, look at the North Star and step away until your angle measures the same as your location's latitude. Mark that spot on the floor with a masking tape X. Set up a series of steps (books, ladder) so that each student can measure from that X with the same eye level height as the original marker. Students can work in pairs to help each other take readings.

Activity B

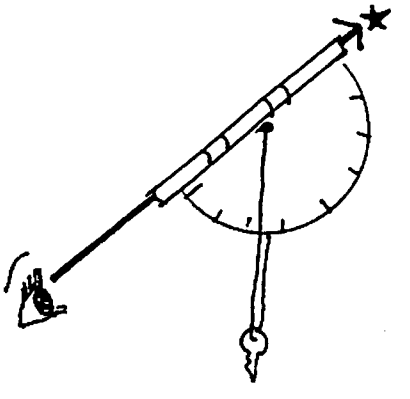
If you are looking at the North Star at this angle, you are at the North Pole



If you are looking at the North Star at this angle, you are at the Equator.



If you are looking at the North Star at this angle, you are midway beween the North Pole and the Equator.



Activity C

You can locate places on a map using latitude and longitude coordinates.

You will need:

• map of earth (see page 183) with longitude and latitude but without place names*

Directions:

Using the following degrees of latitude and longitude, locate these places on the map.

(1) 55° 40′ N, 167° 13′ E

(2) 38° 37′ N, 123° 30′ W

(3) 22° 00′ N, 158° 00′ W

(4) 59° 55′ N, 144° 25′ W

(5) 57° 24′ N, 153° 32′ W

(6) 53° 13′ N, 158° 56′ E

(7) 50° 25′ N, 4° 14′ W

(8) 27° 30′ S, 48° 30′ W

(9) 57° 8′ N, 135° 18′ W

(10) 58° 57′ N, 30° 20′ E

(11) 53° 30′ N, 166° 20′ W

12) 33° 2′ S, 71° 32′ W

(13) 67° 18′ N, 169° 50′ W

Answers to latitude and longitude locations:

(1) 55° 40′ N, 167° 13′ E
Bering Island, Russia:
This is the island where Bering's ship the *St. Peter* ran aground and where Bering died. It is located in the Komandorskiye Ostrova Islands (Commander Islands).

(2) 38° 37′ N, 123° 30′ W
Fort Ross, California:
The California outpost for Russian sea otter hunting and supplies for the Russian-American Company in Sitka.

(3) 22° 00′ N, 158° 00′ W
Hawaii (the Sandwich Islands):
The Russian round-the-world voyages often stopped in the Sandwich Islands for provisions and research.

(4) 59° 55′ N, 144° 25′ W
Kayak Island, Alaska:
The location in America where some of Bering's crew first stepped on land.

(5) 57° 24′ N, 153° 32′ W
Kodiak Island, Alaska:
This was an important location for the Russian-American Company, and an important stopover for many mariners.

(6) 53° 13′ N, 158° 56′ E
Petropavlovsk, Russia:
Named for Bering and Chirikov's ships, the *St. Peter* and the *St. Paul*, the departure location on Kamchatka for some Russian voyages to the North Pacific.

(7) 50° 25′ N, 4° 14′ W
Plymouth, England:
The British port where many Russian voyages got supplies.

(8) 27° 30′ S, 48° 30′ W
Sta. Caterina Island, Brazil:
Port where voyages often stopped before beginning the difficult trip around the tip of South America.

(9) 57° 8′ N, 135° 18′ W
Sitka, Alaska:
Former capital of Russian America.

(10) 58° 57′ N, 30° 20′ E
St. Petersburg, Russia:
Former capital of Russia, founded by Peter the Great.

(11) 53° 30′ N, 166° 20′ W
Unalaska, Alaska:
Location of many stops by Russian voyages.

(12) 33° 2′ S, 71° 32′ W
Valparaiso, Chile:
Port visited by Kotzebue and others for supplies after completing the trip around the tip of South America.

(13) 67° 18′ N, 169° 50′ W
Farthest north Bering sailed in 1728:
Bering's ship, the *St. Gabriel*, sailed past Big Diomede Island into the Strait that now bears his name.

Activity D

You Can Sketch a Mountain Profile While in Motion.

You will need:

- large picture, poster, or a slide of a mountain profile (or a real mountain vista, if available)
- (optional) rocking chair
- pencils, pens
- log book, paper

Directions:

Mountains seen by Russian mariners were drawn to help others recognize locations. Maps like Yuri Lisiansky's map of Kodiak Island, page 76, show this kind of "profile" drawing. Sketch a mountain profile in your log book while in motion.

While you are standing up, move from one foot to other while sketching the mountain. Sitting in the moving rocking chair also replicates the sailor's experience of working on a rolling ship at sea. How does the motion affect your sketch?

Activity E

You Can Take a Sounding to Find Depth to the Sea "Floor."

If you do this activity with a partner, one can "sound" and one can record the data.

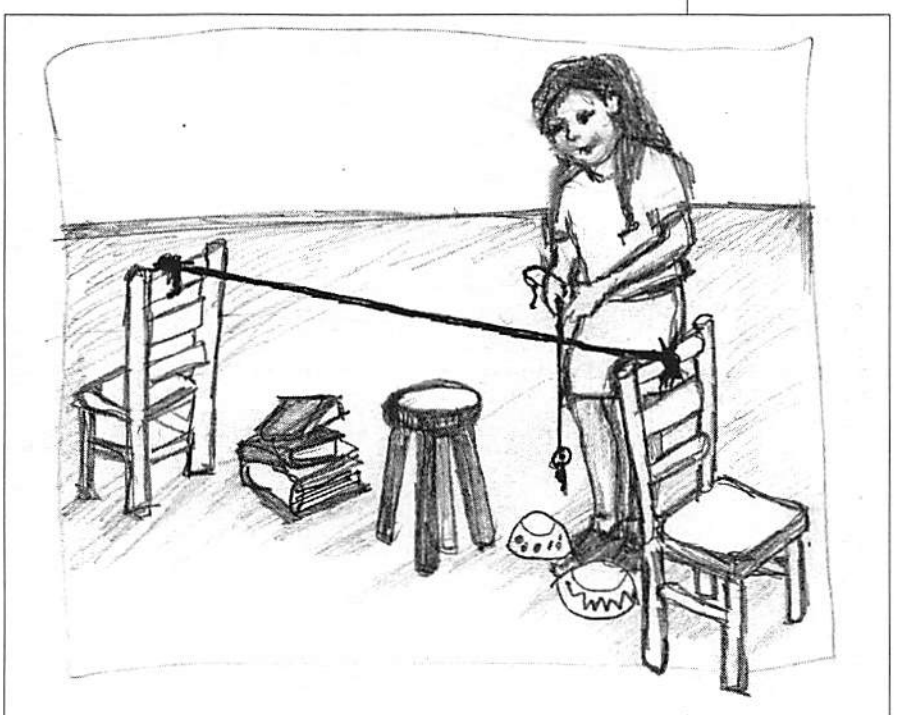
You will need:

- 2 identical chairs with backs at least 30 inches (75 cm tall)
- scissors
- ruler
- string or cord
- permanent blue or black pen
- objects to pile on the floor such as books, stool, pots, large bowls
- washer, key or other weight.

Directions:

1. Place the chairs 3 feet (.9 m.) apart with backs toward each other. Think of the top of each chair back as your "coastline."

2. Cut a length of string or cord 4 feet long (1.2 m). Tie one end to the back of each chair. When you are finished tying, the string should be tight and level and 3 feet (.9 m) long. Think of the string as the surface of the ocean.



continued next page

Activity E, continued

3. Put a mark every 4 inches (10.2 cm) along the string with your pen.

4. Place the books, pots and other objects under the string. Think of these objects as the ocean floor.

5. Measure the distance from the floor to the string. Then cut another piece of string 12 inches (30 cm) longer than that dimension.

6. Tie one end of the second string to a washer or key.

7. Put a mark every 2 inches (5 cm) along this second string with your pen. Think of this string as the "sounder."

8. Hold the "sounder" beside the surface string, next to the back of the first chair. This is the zero mark. Slowly lower the sounder until the weight touches an object or the floor. Use the marks on the sounder to determine the depth of the ocean. Round off the measurement to the nearest pen mark and record it in your log book.

9. Continue measuring the depth of the ocean every 4 inches (10.2 cm) across the length of the surface string and record each measurement in your log book.

Extension: Use your log book record to make a graph of your measurements.

Adapted from *Oceans for Every Kid: Easy Activities that Make Learning Science Fun* by Janice Van Cleve. New York: John Wiley & Sons, Inc. 1996.

Activity F

You can show how mariners used a knotted line (the log line) to measure speed of travel.

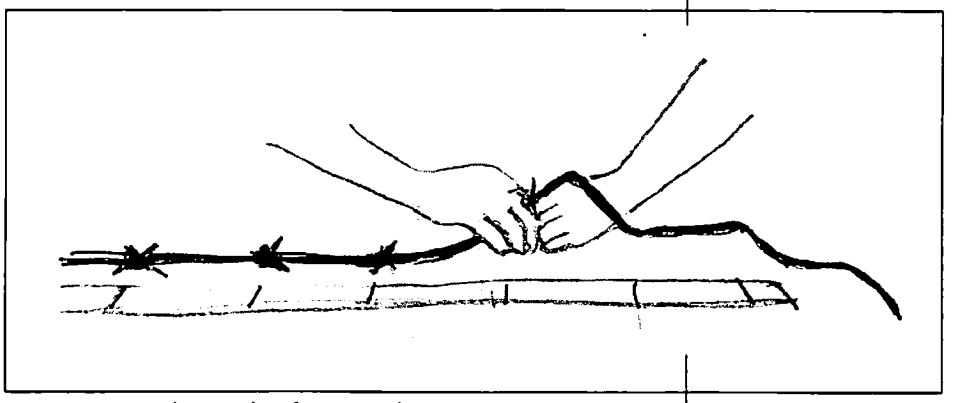
Partners are needed for this activity.

You will need:

- yardstick (meter stick)
- 11 foot (3.3 m) string
- long pencil or a 12 inch (30 cm) piece of dowel
- scissors
- (optional) stopwatch
- log book
- pen or another pencil

Directions:

1. Cut a length of string 9 feet long (2.7 m). Tie a knot in each end.
2. Cut eight pieces of string 3 inches (7.5 cm) long.
3. Tie a piece of the short string every 12 inches (30 cm) along the 9 foot (2.7 m) string. Tie the short pieces tight so that they do not move along the long string.

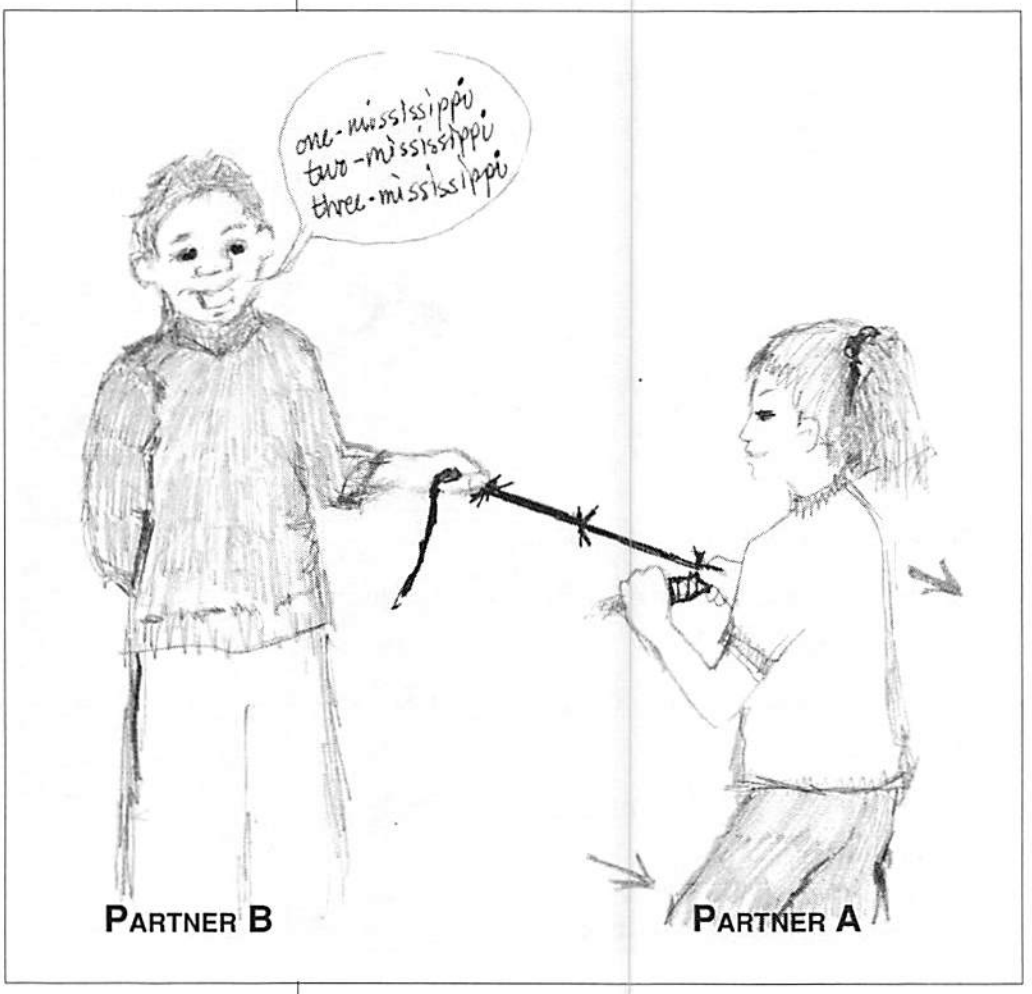


4. Wind the long piece of string up around the center of the pencil or dowel.
5. Partner A holds the ends of the pencil in both hands. Partner B holds the end of the string.
6. Partner B should count by seconds while partner A walks slowly backward, letting the cord unwind and counting the knots as they pass over the pencil. One way to count seconds is to say out loud: one Mississippi; two Mississippi; three Mississippi for each second.
7. Stop unwinding when Partner B says 3 seconds have passed. How many knots unwound? Record the number of seconds and the number of knots in your log book.

8. Rewind the string and repeat steps 5-7, but this time Partner A walks as fast as possible. How many knots unwound? Record the number of seconds and the number of knots in your log book.

More knots unwind when you walk fast than when you walk slow. Counting the knots when you move at different speeds is like the knot counting mariners did when they figured the speed of their ship. Partner A is like the log at the end of the knotted line, thrown overboard as a weight to let the line feed out. The word knot is still used as the measurement word for a ship's speed. See page 63 for more information.

Adapted from *Oceans for Every Kid: Easy Activities that Make Learning Science Fun by* Janice Van Cleve. New York: John Wiley & Sons, Inc. 1996.



Activity G

You Can Understand Your Local Maps

You will need:

- contemporary map of your location that includes latitude and longitude. The US Geological Survey (USGS) has the most comprehensive maps. DeLorme Map books are in print for each state and show latitude and longitude. Goode's Atlases also show and list latitude and longitude.
- log book
- pencil or pen

Directions:

Look at your local map and record the following in your log book:

What are some of the symbols on your local map?

What is your location in latitude and longitude?

What is the scale of your local map?

Are there particular topographic features shown on your local map such as mountains or streams? How are they shown?

Does your community's museum or historical society have earlier maps of your area? How are they different fromthe modern ones ?

Activity H

You Can "Read" Your Local Tide Table.

You will need:

- tide-table book, often available free from local banks or sports stores
- log book
- pencil or pen

Directions:

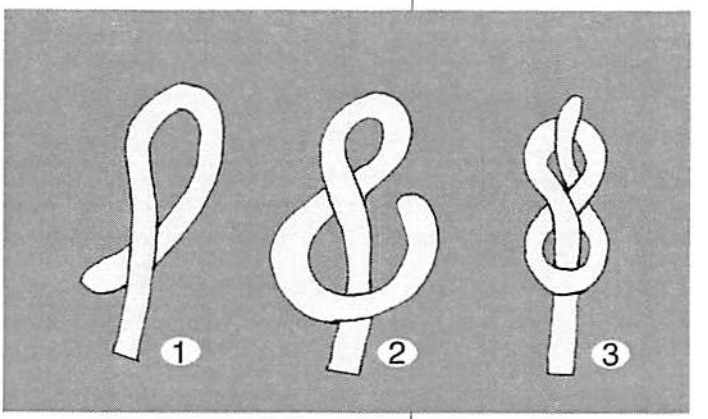
Tide tables are an example of the information available to simplify the sailor's work. In some places in Alaska, the tides change as much as 35 feet in 6 hours. How would such an extreme tide affect a ship and its crew?

In your log book, record some of the kinds of information available in the tide table. For example, what does your tide table tell you about the moon? What does your tide table tell you about success in fishing? Does your tide table have any measurement guides in it besides tide readings? Does it tell you about safety tips? Does it have any maps in it? Does your tide table explain what the tides are and what causes them?

Find your birthday in the tide table; list your birthday's tides in your log book.

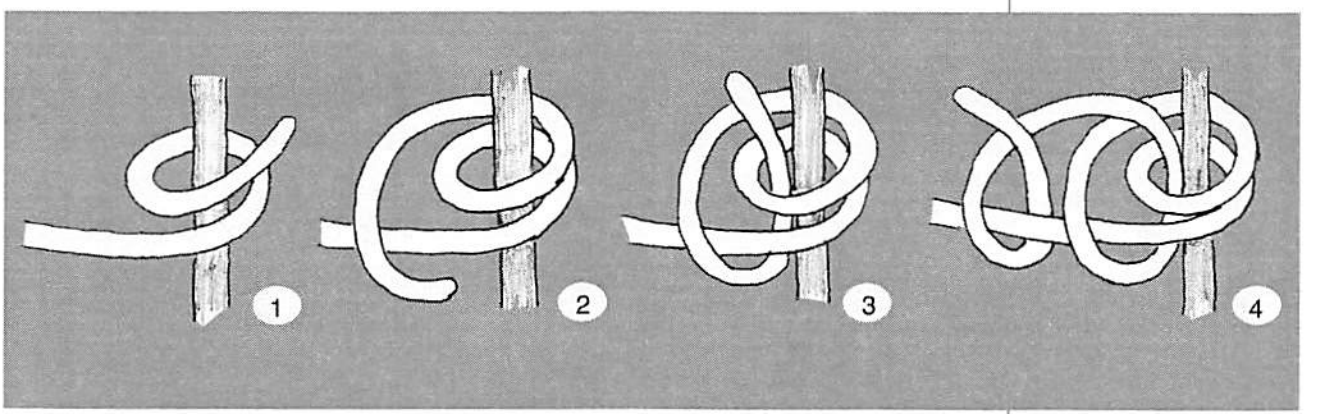
Activity "I"
You Can Tie Knots the Way Sailors Do.

You will need:
• a length of line 18 - 20 inches (45.7 - 50.8 cm) long or a long shoelace.



The Figure 8 Stopper knot:

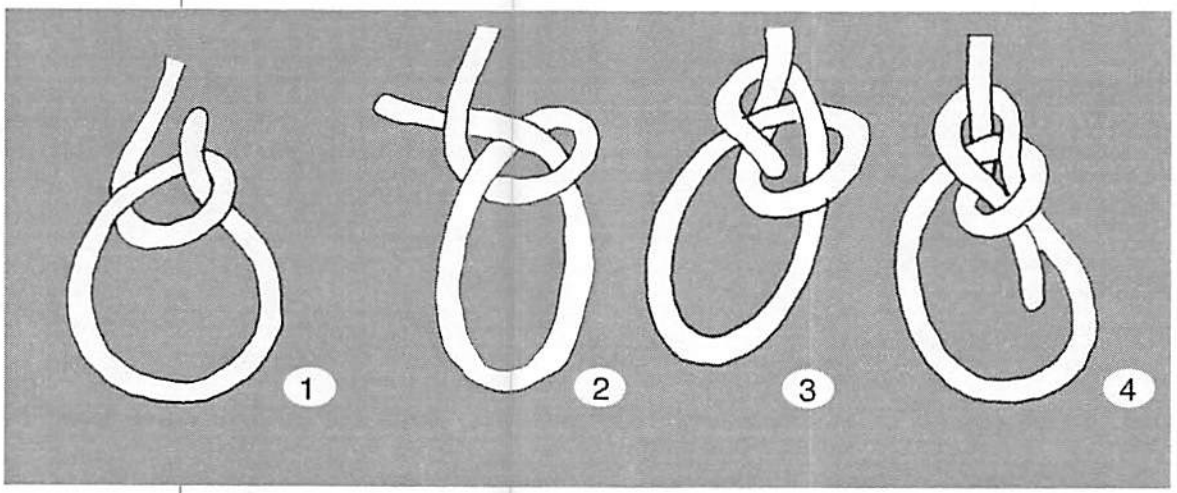
This is a good knot to tie along the length of a "knot "line if you want to check on your ship's speed. This knot will not come undone until you want it to, and then it unties easily.



The Fisherman's Bend:

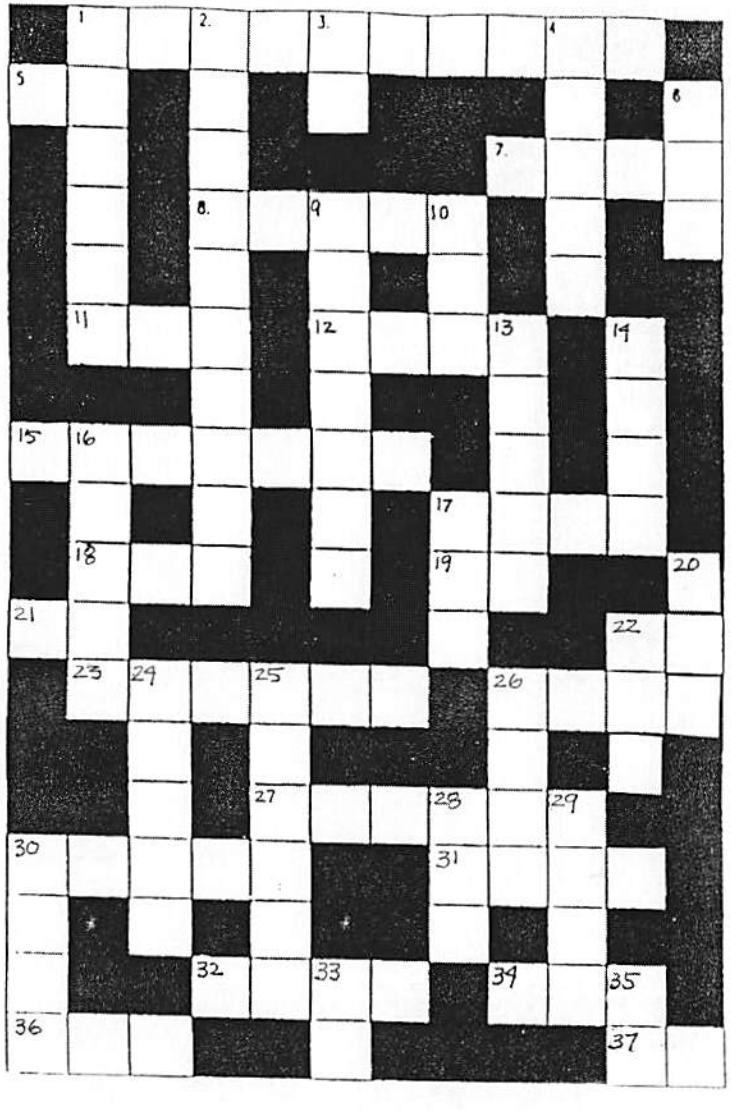
This knot is useful to tie a line to an object. Be sure you keep the loop wide open until you are ready to complete the knot in steps 3 and 4. Be sure to pull the knot tight after step 4.

Activity "I"
You Can Tie Knots the Way Sailors Do.



The Bowline:
This is the knot mariners use the most! It is considered by some to be the most useful knot you could ever learn.

Steller Crossword Puzzle



ACROSS

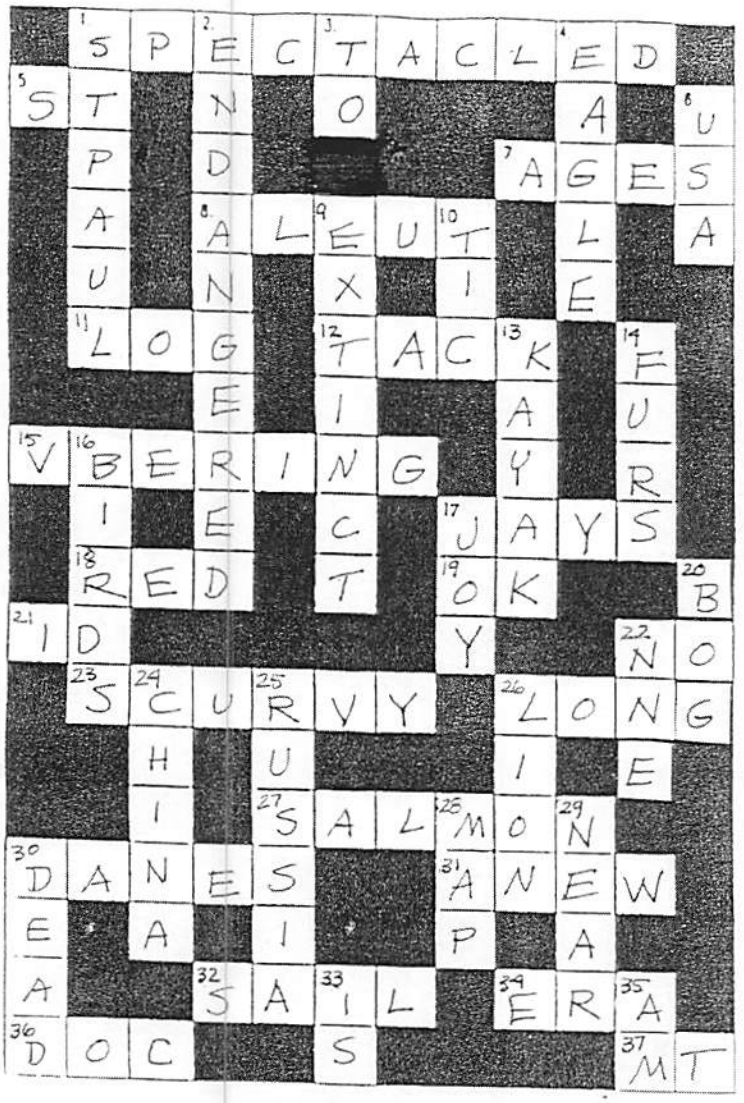
1. A large, flightless, extinct bird: the _____ cormorant.
5. Many ships were named in honor of a saint. Abbreviation for "saint."
7. The _____ of the voyagers were young, except for Vitus Bering.
8. Russian name for a culture that inhabits the Aleutian Islands.
11. A ship's journal is called a _____ book.
12. Sail in a zig-zag to catch the wind.
15. Captain of the *St. Peter*, first initial and last name.
17. The bird that convinced Steller that he was on American land (plural).
18. A species of fox and a color of many foxes.
19. A slang word meaning "all right."
21. Steller's job was to identify and describe wildlife. Abbreviation for "identify."
22. When Steller asked to go on land for the first time, Captain Bering told him _____.
23. An illness resulting from the lack of vitamin C in the diet.
26. A kind of boat carried on the Russian ships to go from the ship to the land, a _____ boat.
27. A type of berry and a type of fish described by Steller.
30. Captain Bering and other people from Denmark.
31. The *St. Peter* was built _____ to bring the survivors back to Kamchatka.
32. The *St. Peter* and the *St. Paul* got their power from the wind in the _____ (singular)
34. A word meaning a very long period of time.
36. Steller and many of the sailing scientists were also healers. (slang abbreviation).
37. The Aleutian Islands are the tops of volcanic mountains. Abbreviation for "mountain."

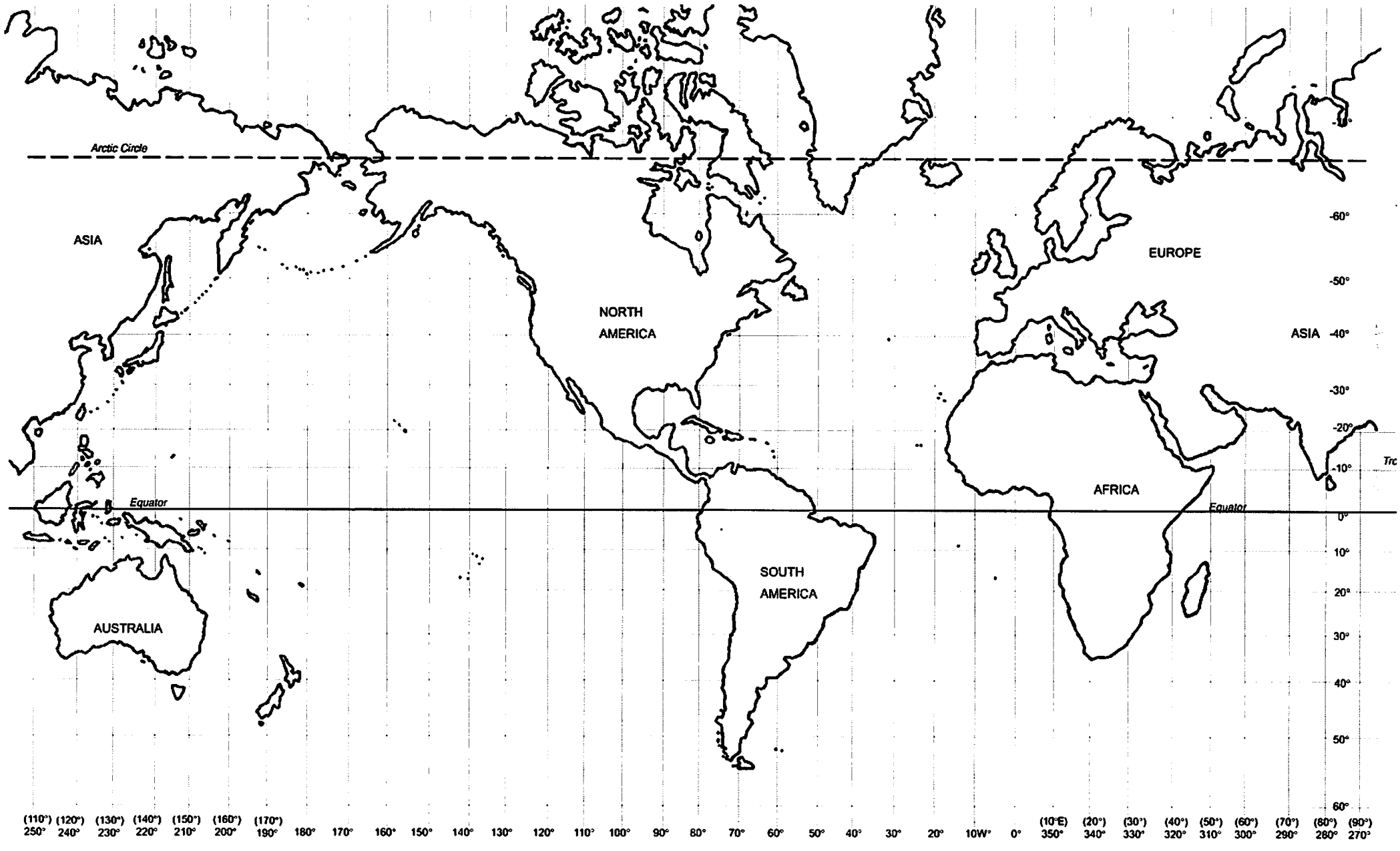
DOWN

1. The name of the ship captained by Aleksei Chirikov.
2. Almost extinct.
3. Laurentz Waxell also went _____ sea on the St. Peter.
4. A large, fish-eating bird of prey described by Steller, the Steller's sea _____.
6. A country in which many North Americans live, abbreviation.
9 The Steller's sea cow became _____ about 30 years after Steller described it.
10. Sound a clock like a chronometer might make; _____ toc.
13. This island is where Steller first stepped on American land, _____ Island.
14. Russian hunters came to the Aleutians to get these to sell.
16. The spectacled cormorant and the Steller's sea eagle are _____ that Steller described.
17. A feeling the marooned sailors from the St. Peter felt when they returned home in 1742.
20. Wet, marshy area.
22. A north and east direction, abbreviation.
24. Country in Asia where furs from Alaska were sold.
25. Captains Bering, Kotzebue, and Krusenstern all worked for this country.
26. An aggressive marine mammal described by Steller, Steller's sea _____ .
28. A device used to find one's way. At sea it's called a chart; on land it's called a _____ .
29. When shipwrecked on Bering Island, crew members of the *St. Peter* were actually quite _____ Kamchatka.
30. Early Russian mariners sailed by _____ reckoning.
33. A piece of land surrounded by water, abbreviation.
35. The time before noon, abbreviation.

adapted from "Steller Crossword Puzzle" Pratt Museum, Homer Alaska.

Answers, Steller's Crossword Puzzle




Arctic Circle
ASIA
NORTH AMERICA
EUROPE
ASIA
AFRICA
Equator
Equator
SOUTH AMERICA
AUSTRALIA
Trc
-60°
-50°
-40°
-30°
-20°
-10°
0°
10°
20°
30°
40°
50°
60°
(110°) 250°
(120°) 240°
(130°) 230°
(140°) 220°
(150°) 210°
(160°) 200°
(170°) 190°
180°
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90°
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70°
60°
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(10°E) 350°
(20°) 340°
(30°) 330°
(40°) 320°
(50°) 310°
(60°) 300°
(70°) 290°
(80°) 280°
(90°) 270°

Meeting the Standards

The Science Under Sail Instructional Guide is a multi-disciplinary series of lessons incorporating science, social studies, language arts, and art. It provides student learning experiences appropriate for the following State of Alaska Standards.

English/Language Arts:
A. A student should be able to speak and write well for a variety of purposes and audiences. 1. 2. 3. 4. 5. 6.
B. A student should be a competent and thoughtful reader, listener, and viewer of literature, technical materials and a variety of other information. 1. 2. 3.
C. A student should be able to identify and select from multiple strategies in order to complete projects independently and cooperatively. 1. 2. 5.
D. A student should be able to think logically and reflectively in order to present and explain positions based on relevant and reliable information. 1. 2.
E. A student should understand and respect the perspectives of others in order to communicate effectively. 1. 2. 3. 4.

Science:
A. A student should understand scientific facts, concepts, principles, and theories. 1. 2. 4.
B. A student should possess and understand the skills of scientific inquiry. 1. 2. 3.
C. A student should understand the nature and history and science. 3. 4. 5. 7. 8.
D. A student should be able to apply scientific knowledge and skills to make reasoned decisions about the use of science and scientific innovations. 1.

Geography:
A. A student should be able to make and use maps, globes, and graphs to gather, analyze, and report spatial (geographic) information. 1. 2. 3.
B. A student should be able to utilize, analyze, and explain information about the human and physical features of places and regions. 1. 2. 3. 4.
D. A student should understand and be able to interpret spatial (geographic) characteristics of human systems, including migration, movement, interactions of cultures, economic activities, settlement patterns and political units in the state, nation, and world. 1. 4. 5.
F. A student should be able to use geography to understand the world by interpreting the past, knowing the present, and preparing for the future. 1. 3.

History:
A. A student should understand that history is a record of human experiences that links the past to the present and the future. 1. 2. 4. 5. 6. 7.
B. A student should understand historical themes through factual knowledge of time, place, ideas, institutions, cultures, people, and events. 1 a. 1 b. 4.
C. A student should develop the skills and processes of historical inquiry. 2. 3. 4.
D. A student should be able to integrate historical knowledge with historical skill to effectively participate as a citizen and as a lifelong learner. 6.

Arts:
A. A student should be able to create and perform in the arts. 4.
B. A student should be able to understand the historical and contemporary role of the arts in Alaska, the nation, and the world. A 1. A 4.
C. A student should be able to critique the student's art and the art of others. 2.

Cultural Standards:
D. Culturally-knowledgeable students are able to engage effectively in learning activities that are based on traditional ways of knowing and learning. 5.
E. Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and process of interaction of all elements in the world around them. 5. 6. 7.

Appendix

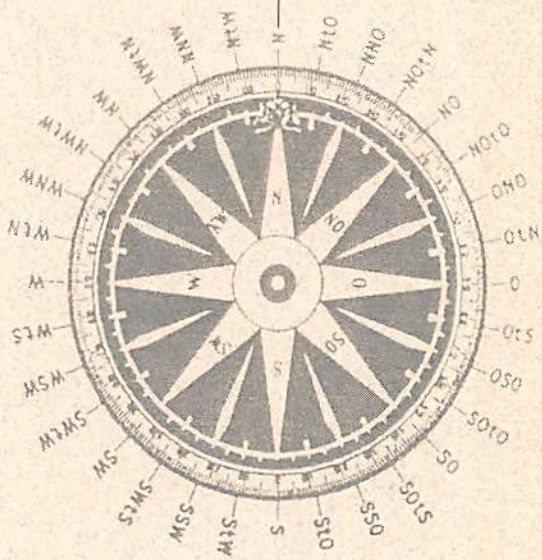
Contents

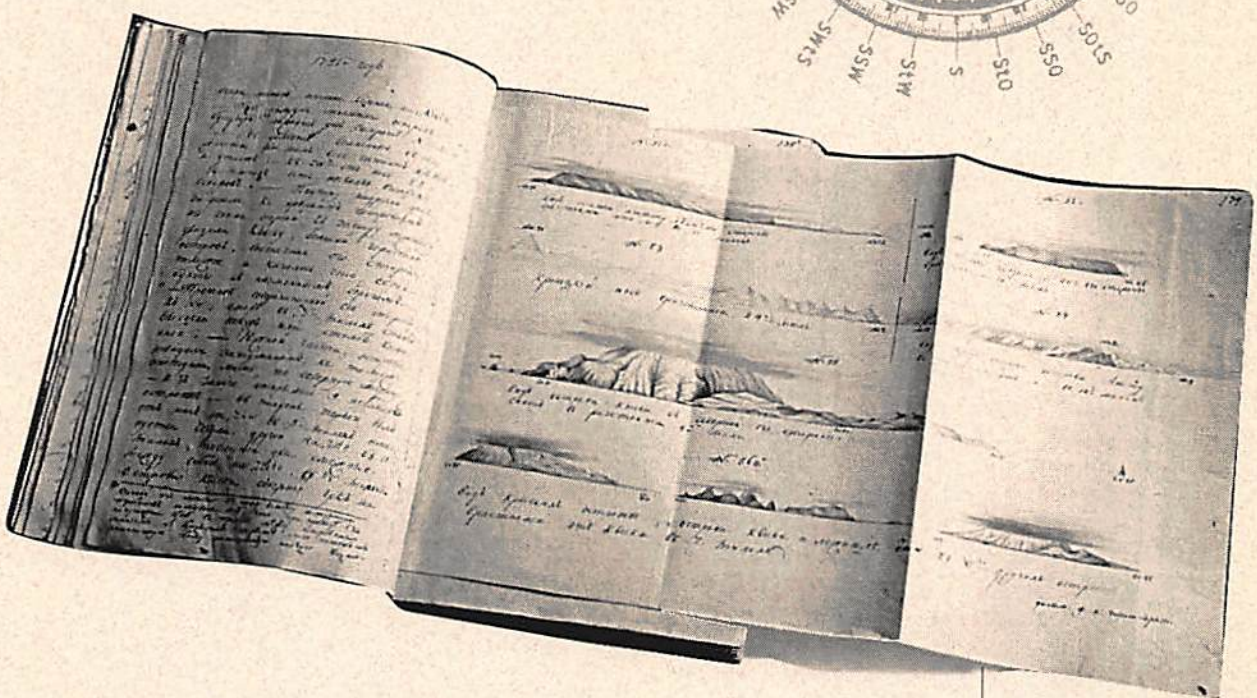
A Russian Ship, by John Middleton

Timeline

Glossary and Pronunciation

Resources





The *St. Peter* and *St. Paul*

from "The Community of the Ship or Life Aboard Russian Ships in the Eighteenth and Nineteenth Centuries," by John Middleton. Unpublished essay.

The finished ships were 80 feet long (24.4 m) 22.5 feet wide (6.9 m) and 12 feet deep (3.66 m) in the hold. The layout of the ship was typical for the eighteenth century. The main, or weather deck, was the working area for the crew. The area before the foremast was used for handling the anchors and cables, and the lines or "sheets" for the foresails on the bowsprit. Here were also found the ship's heads (toilets) for the crew. Immediately after the foremast was the chimney from the galley stove, located on the lower deck. Behind this was the ship's bell, used to mark the time in half-hour increments. The companionway hatch, the main access to the lower deck, was located between the bell and the ship's launch, or longboat, which sat between the two masts. On either side of the deck were located the main part of the ship's armament, 9 three pounder and 5 two pounder cannons. Three falconets, smaller swivel guns, were also mounted on the afterdeck or carried in the longboat. The capstan, a large winch used in moving heavy yards, boats, and the ship itself in an anchorage, sat on the port side next to the mainmast. Behind the mainmast was the afterdeck, where the tiller used in steering the ship, was connected to the rudder post.

Below the afterdeck were the cabins of the captain, officers and scientists. As space was at a minimum, the scientists on the *St. Peter* and *St. Paul* shared the captain's cabins. On the lower deck the crews ate and slept. Hammocks were rigged in the evenings and taken up in the mornings so that the lower deck could be used during the day for the different watches at meals or at work. To the right and left of the galley were the cabins of the warrant and petty officers. Here also were the storerooms for the boatswain, sailmaker, and carpenter. In the stern section of the lower deck, beneath the officer's cabins, was the powder magazine.

The ship's hold, below the lower deck, was the main store room for the ship. Here were kept all the provisions, dry and wet stores, trade goods, spare parts, and part of the ship's ballast, 90 puds (3,240 pounds) of cast iron, which was stowed aft beneath the captain's cabin.

Science Under Sail: Russia's Great Voyages to America, 1728-1867
TIMELINE

1725 Peter the Great dies.

1725 Bering expedition begins in St. Petersburg.

1728 Vitus Bering's voyage through the Straits that now bear his name (*St. Gabriel*).
Chaplin's map of Siberia.

1732 M. S. Gvozdev and Ivan Fedorov - first sighting of North America (*St. Gabriel*).

1741 Bering-Chirikov voyage to Alaska (*St. Peter and St. Paul*).
Georg Steller science contributions.
Sven Waxell map of the voyage with first image of Aleut/Unangan.
Aleksei Chirikov map - first map of northern North America.
Gerhard Muller map (pub. 1754-58) of Bering voyages.

1755 Stepan Krasheninnikov description of Kamchatka - first ethnographic study.

1745-63 Various *promyshlenniki* make discoveries of islands.

1762 Catherine the Great becomes Empress.

1764-68 P. Krenitsyn and M. Levashov map of Aleutian islands (*St. Paul, St. Catherine*).
Atlas with first detailed charts and vivid drawings of Aleut/Unangan.
Findings published by Wm. Coxe in 1780 in English - widespread distribution.

1778 Captain Cook in the North Pacific, encounters Russian settlement at Unalaska.

1785-92 Billings-Sarychev expedition (*Slava Rossii, Chernyi Orel*).
Luka Voronin - artist.
Carl Merck - naturalist.

1803-06 Johann von Krusenstern and Yuri Lisiansky (*Nadezhda* [*Hope*] and *Neva*).
First Russian circumnavigation of globe.
First use of chronometer (in Britain not in official use until 1826).
Tilesius von Tilenau - naturalist - information about Japan.
Georg von Langsdorff - naturalist (drawings and artifacts).
J. C. Horner - astronomer.
Accomplishments: information about waters and currents of Pacific; improvements in charting and astronomical determinations; correction of earlier textual information about Pacific; weather information; Lisiansky: ethnographic information and charts of Sitka and Kodiak.
Visit to Japan produced new information and many illustrations.

1807-13 V. M. Golovnin (*Diana*).
Described and mapped the Kuril Islands.
Captured by Japanese; Japanese-Russian grammar; observations on Japanese life and customs.

1812 Founding of Fort Ross in California: Settled by Russians, Aleut/Unangan, and Alutiiq to expand the sea otter hunting range.

1815-18 Otto von Kotzebue (*Rurik*).
Organized by Count N. P. Rumiantsev for scientific purposes.
Johann von Eschscholtz, doctor and naturalist.
Adelbert von Chamisso -naturalist.
Louis Choris - artist.
Discoveries regarding characteristics of the Pacific waters; charting of northern coast of Alaska; ethnographic data about peoples of northern Alaska; classification of many plants and animals in Alaska and California; new data about the South Seas and Hawaii.

1817-19 V. M. Golovnin (*Kamchatka*).
Mikhail Tikhanov - artist (vivid watercolors of Alaska and California Natives).
Charting.
Detailed notes on conditions of the Russian American Company and the Aleut/Unangan.

1823-26 Otto von Kotzebue (*Predpriiatie* [*Enterprise*]).
Johann Eschscholtz - doctor and naturalist.
Emil Lenz - physicist.
Ernest Hoffman - naturalist.
Virgil Price - astronomer.
Discoveries by Lenz regarding nature of Pacific currents; water temperatures at different depths; development of an accurate bathometer (insulated water bottle); measurement of salinity.

1826-29 Fedor P. Litke (*Seniavin*).
Karl Mertens - naturalist.
Alexander Postels - naturalist.
Baron Friedrich von Kittlitz - ornithologist.
Summary of all findings on east and west shores of Bering Sea; detailed atlas; discovered western part of equatorial counter current; studied fluctuations in barometric pressure at different latitudes.
Measurement of gravity with the invariable pendulum.

1826-29 Mikhail Staniukovich. Sailed in company with Litke (*Moller*).
Pavel Mikhailov, artist: detailed drawings of Native peoples.
Mapping of Alaska Peninsula.

1838 Alexander Kashevarov exploration of Arctic coast of Alaska using Inupiat boats and guides.
Detailed charts of both sides of Bering Sea.

1839-49 Il'ya Voznesensky collecting and exploring in Alaska, California and Siberia.

1841 Fort Ross sold to John Sutter.

1852 Teben'kov's Atlas, the compilation of Russia's cartographic accomplishments during the previous century.

1867 Treaty transferring Alaska to United States of America.

PARALLEL TIMELINE (selected dates)

1752 Benjamin Franklin flies homemade kite during a storm, proving that lightening is a form of electricity.

1769 John Watts invents the steam engine.

1776 Declaration of Independence of the United States.

1792 George Vancouver explores the Northwest Coast.

1806 Lewis and Clark reach the Pacific where they camp for the winter as Russian ship with Langsdorff on board sails past.

1812 Napoleon invades Russia.
USA declares war on Great Britain.

1814 Francis Scott Key writes the star Spangled Banner.

1850 California, first territory on the Pacific to become a state.

1859 World's first oil well drilled in Pennsylvania.

1861-1865 North and South fight Civil War.

NOTE: for a comprehensive related timeline, please see *Russian America Timeline, 1648-1990* by Barbara Sweetland Smith, Redmond J. Barnett, and Ayse Gilbert. Anchorage, AK: Anchorage Museum Shop. 1990.

after mast: mast to the rear (stern) of the ship.

aground: stuck on land that is beneath water.

Aleut (AL-ee-oot): Natives of the Aleutian Islands as named by the Russians. See also Unangan.

Aleutian Islands (ah-LOO-shen) *(See maps).*

Alutiiq (ah-LOO-tick): Native Alaskans living on Kodiak Island, Prince William Sound, and the southern Alaska Peninsula.

amber: fossilized tree sap, usually yellowish brown.

amulet: a charm worn to ward off evil or to bring good fortune.

appended: added on.

artificial horizon: instrument to imitate the horizon, even when the real one is not visible.

artifact: object made by a human, especially objects gathered for collections.

avariciously: greedily.

backstaff: navigation instrument to read the angle above the horizon of the sun or stars in order to determine latitude.

baidar (by-DAR): a name the Russians gave to a skin boat of the Aleut/Unangan and Alutiiq. Also spelled baydar.

Baltic: *(See maps).*

Baranov, Alexander (1746-1819): leader of the Russian-American Company in Alaska from 1791-1818.

bathometer: an instrument to measure temperature and provide water samples at great depth; also called an insulated water bottle.

baydar: see baidar.

bearings: directions or relative positions.

Bering Island *(See maps).*

Bering Strait *(See maps).*

Bering, Vitus (BARE-eeng, VEE-tus) (1680-1741): Captain who commanded an early Russian voyage landing in America.

Big Diomede Island (DIE-o-meed) *(See maps).*

bilge: lowest area inside a ship.

Billings, Joseph (1761-1806): commander of the expedition of 1785-1792 that was ordered by Catherine the Great to sail into the Eastern Ocean (Pacific).

Billings-Sarychev Expedition: expedition of Billings and Gavriil Sarychev to carry out Catherine the Great's orders.

boatswain: officer on the ship in charge of riggings.

bouillon: meat juice.

bowsprit: a spar or mast sticking out from the bow of a ship.

Cape Horn: Southernmost point of South America.

Cape of Good Hope: Southernmost point of Africa.

Cape Prince of Wales *(See maps).*

Capetown *(See maps).*

cartilage: firm, connecting tissue.

Catherine the Great (1729-1796): Catherine II, Russian ruler from 1762-1796, who ordered major expeditions to explore the North Pacific.

caulker: a person who makes a ship water-tight.

Celsius: temperature scale with 0° the freezing point of water and 100° the boiling point of water. Also the name of Anders Celsius (1701-1744) who invented the Celsius scale.

centigrade: degrees on the Celsius temperature scale.

Chamisso, Adelbert von (cha-MIS-so, AH-del-ber fon) (1781-1838): poet and botanist on the Kotzebue round-the-world voyage of 1815-1818.

chart: a map, especially a marine map, showing coastlines and sometimes depth to ocean floor.

Chirikov, Aleksei (CHEER-a-kov, a-lek-SAY) (1703-1748): captain of the *St. Paul*, companion vessel on the expedition led by Vitus Bering in 1741.

cholera: a contagious, often deadly, disease spread through contaminated drinking water.

Choris, Louis (KOR-ees, LU-ee) (1795-1828): artist on the Kotzebue round-the-world voyage of 1815-1818.

chronometer: timepiece that makes it possible to calculate longitude.

compass rose: a picture showing directions on a map; usually a design like a flower with 32 points.

compass: an instrument for determining direction, usually with a magnetized pointer.

contraction: decreasing in size or volume.

Cook, James (1728-1779): British captain famous for discoveries in the North Pacific, 1776-1779.

cooper: a barrel maker.

cross staff: navigation instrument to read angle of sun or stars above the horizon in order to determine latitude.

dead reckoning: deduced reckoning of a ship's position based on distance logged and course steered.

degree: in determining latitude and longitude, there are 90 degrees north and south of the equator. Also written with the symbol ° as in the location of Anchorage, Alaska at 61° N, longitude 149° W; or San Francisco, California at latitude 37° N, longitude 122° W.

density: in physics, a measure of mass in a given volume.

dentalium: a tooth-like shell.

Eastern Ocean: the Pacific Ocean, as the Russians sometimes called it.

El Niño: an unusually warm current in the Pacific Ocean.

ensign: a ship's officer of the lowest rank.

entrails: inner organs of an animal.

equator: circle around the earth that is equidistant from the North and the South Poles; the zero degree (0°) line for determining latitude.

Eschscholtz, Johann (esh-HOLZ, yo-han) (1793-1831): physician and naturalist on two Kotzebue voyages: 1815-1818 and 1823-1826. His first name is also spelled Ivan or Ioann.

Estonia (es-TONE-ee-ah) *(See maps).*

expansion: increasing in size or volume.

Eyak: peoples of Prince William Sound in the Copper River area.

Fahrenheit: temperature scale with 32° the freezing point of water and 212° the boiling point of water. Also the name of Gabriel Daniel Fahrenheit (1686-1736) who invented the Fahrenheit scale.

fathom: nautical length equal to six feet (1.8 m.).

Fedorov, Ivan (FE-dor-of, ee-VON) (? - 1733): assistant navigator on the first Russian voyage to see the Alaska mainland, 1732.

festoons: strings or chains of hanging decorations.

foresail: sail on the mast nearest the front (bow) of the ship.

foremast: mast nearest the front (bow) of the ship.

forenoon watch: duty time for sailors in the four hours before noon.

Fort Ross (California. see maps).

galley: a ship's kitchen.

garnets: glass trade beads.

Golovnin, Vasily Mikhailovich (GUL-of-neen, VA-sil-lee) (1776-1831): Russian captain of the round-the-world voyage of 1817-1819.

Gulf Stream: an ocean current always present in the Gulf of Mexico.

Gvozdev, M. S. (guh-VOZ-djev) (1702 - after 1759): surveyor on the first Russian voyage to see the Alaska mainland, 1732.

hammocks: hanging canvas beds for sailors.

headwinds: winds blowing toward you.

Hieromonk Gideon (c.1770-1843): priest who was a passenger on Russia's first round-the-world voyage; lived in Kodiak from 1804-1806.

hold: cargo space in a ship.

holding under sail: keeping sails up.

hydrographic; **hydrography**: the science of measuring and charting waters of the earth, especially for navigation.

hydrology: study of the characteristics and distribution of the waters of the earth.

hygiene: cleanliness.

Ice Curtain: a barrier to communication caused by differences between the former Soviet Union (Russia) and the West (Europe and the United States), especially affecting studies of the North.

indigenous: native to a region; first to live in a region.

Inupiat: a northern peoples formerly written about as Eskimos.

invariable pendulum: instrument used by Captain Fedor Litke to measure gravity variation on his round-the world voyage, 1826-1829.

Irkutsk (ear-KOOTZ) *(See maps).*

Kalusch: a Russian name for the Tlingit people, also spelled Kolosh.

Kamchatka (cam-CHAT-ka) *(See maps).*

kasha: a porridge or cereal made from buckwheat.

Kayak Island (KEYE-yak) *(See maps).*

kayak (KEYE-yak): a small skin boat (*See baydar*).

Kenai Peninsula (KEY-nigh) *(See maps).*

knots: the ties in a measuring line to tell the speed a ship is traveling; a measure of speed at sea or in the air equal to one nautical mile (1.15 land miles).

Kodiak; Kodiak Island (KOH-dee-ak) *(See maps).*

Kotzebue, Otto von (KAWT-zuh-boo, AH-toe fon) (1788-1846): captain of two major Russian round-the world voyages, 1815-1818 and 1823-1826.

Kronstadt (KRON-stat) *(See maps).*

Krusenstern, Johann von (kru-ZEN-stern, yo-HAN fon) (1770-1846): captain of the first Russian round-the-world voyage, 1803-1806. His first name is also spelled Ivan or Ioann.

Kuril Islands (cur-REEL) *(See maps).* Also spelled Kurile.

Kurosho Current: a current in the Pacific Ocean off the coast of Japan.

Langsdorff, Georg von (LANGS-dorff, gey-ORG fon) (1774-1852): naturalist/doctor on Russia's first round-the-world voyage 1803-1806.

latitude: distance on the earth north or south of the equator, shown as parallel lines and measured in degrees and minutes. Anchorage, Alaska is at latitude 61° 12' N. San Francisco, California is at latitude 37° 45' N.

legacy: something handed down from the past.

Lenz, Emil (LENS, EH-meel) (1804-1865): scientist on the Kotzebue voyage of 1823-1826; co-inventor of the bathometer (also called an insulated water bottle).

Lisiansky, Yuri (lis-YAN-ski, YUR-ee) (1773-1837): captain of one of the ships on Russia's first round-the-world voyage of 1803-1806.

Litke, Fedor (LIT-kee, FEY-dor) (1797-1882): captain of Russian round-the-world voyage, 1826-1829; founder of the Russian Geographic Society and President of Russia's Academy of Sciences. His name is sometimes written Lütke; Fedor is sometimes written Frederic.

lodestone: a piece of naturally-occurring magnetized rock.

log: the record of a ship's nautical journey; also the wood that ends the knot line and helps tell a ship's speed.

longboat: small ship's boat.

longitude: distance on the earth east or west of a line known as the Prime Meridian, and measured in degrees and/or minutes. Anchorage, Alaska is longitude 149 ° 52' W. San Francisco, California is at longitude 122 ° 25' W.

map: a drawing of a part of the surface of the earth or of the sky.

mariner: a sailor.

Mercator, Gerhard (1512-1594): geographer who showed a way to draw the spherical earth on a flat map.

Merck, Carl Heinrich (1761-1799): physician and naturalist on the Billings-Sarychev expedition, 1785-1792.

mess: the place on a deck where sailors eat; also the group of mariners who share a meal.

mid-ship: middle of the ship.

minute: In determining latitude and longitude, a sixtieth of a degree. Also written with the symbol' as in the location of Anchorage, Alaska at latitude 61 degrees 12' N, longitude 149 degrees 52' W. San Francisco, California is at latitude 37 degrees 45' N, longitude 122 degrees 25' W.

mizzen sail: sail on the third mast from the front (bow) of a ship.

Mt. St. Elias *(See maps).*

mutton: meat from sheep.

nautical mile: distance at sea or in the air equal to 6,076 feet (1.852 kilometers).

noon sight: measure of the angle of the sun in relation to the horizon at noon to help with navigation.

North Star: the Pole star used for guiding navigation north of the equator.

Northeast Passage: the Russian term for the water route from the Pacific to the Atlantic across the top of North America.

Norton Sound *(See maps).*

Okhotsk (ah-HOTE-sk) *(See maps).*

packet boat: broad, heavy, two-masted ship 60-80 feet long; originally designed to carry mail, cargo and passengers on a fixed route.

parsimoniously: in a stingy way.

patron: a person who supports with money or gifts the work of others.

perforation: hole.

Peter the Great (1672-1725): Peter I, Russian ruler from 1694-1725.

Petropavlovsk (pet-ro-PAV-lov-sk) *(See maps).*

physiognomy: the face.

pipe: make the sounds calling sailors to duty; the instrument used to call sailors to duty.

Polaris: the North Star.

Postels, Alexander (PAW-stuls) (1801-1871) scientist and artist who sailed round-the world with Fedor Litke in 1826 on the *Seniavin.*

Pribilof Islands (PRIB-uh-lof) *(See maps).*

Prime Meridian: the line now running through Greenwich England that is used as the beginning line (0° line) for calculating longitude.

promyshlenniki: Russian fur hunters and traders.

purser: officer in charge of the accounts and supplies (stores) of a ship.

quadrant: instrument divided into a quarter of a circle that is used to measure the altitude of sun or stars above the horizon.

quartermaster: officer in charge of the ship's wheel and navigation devices.

quarters; called to quarters: duty station in battle; reporting to duty station.

reconnaissance: general survey of a region.

recruit: someone newly signed on for duty on a ship.

regalia: clothing and ornament worn for ceremonial purposes.

rigging: ropes, lines, and devices used to control the sails of a ship.

Russian America: Russian colonies in America.

Russian-American Company: company that ruled Russian America from 1799-1867.

salinity: saltiness; the amount of salt dissolved in the ocean.

salted meat: meat cured in salt and water (brine) to slow its spoiling.

Sandwich Islands: now called Hawaiian Islands (*See maps*).

sanitation: using cleanliness to protect health.

Sarychev, Gavriil (sar-ee-CHEV, gav-REEL) (1763-1831): a captain on the Billings-Sarychev expedition (1785-1792) ordered by Catherine the Great to explore the Eastern Ocean (Pacific).

sassafras: a flavorful root.

sauerkraut: salted and fermented cabbage.

scurvy (SCUR-vee): disease caused by the lack of vitamin C in the diet.

sea biscuits: crackers that do not spoil quickly and are used for meals on ships.

Sea of Okhotsk (ah-HOTE-sk) *(See maps)*.

sentries: guards.

serf: person in Russia who was owned by the state or a land owner.

sextant: navigation instrument to read angle of sun or stars above the horizon in order to determine latitude or longitude.

Siberia *(See maps)*.

Sitka *(See maps)*.

Six, James (1731-1793): scientist who invented a thermometer used to read maximum and minimum temperature.

smallpox: contagious disease with fever and sores; historically a deadly disease having killed millions, but now almost never experienced.

sounding; soundings: water depth measurements.

spherical: three-dimensional, rounded.

spirits: alcoholic liquor.

St. Lawrence Island *(See maps)*.

St. Petersburg *(See maps)*.

Steller, Georg (STELL-er, gey-ORG) (1709-1746): naturalist/doctor on Bering's 1741 voyage; first European scientist in Western North America.

stores: supplies on a ship.

stowed: put away on a ship.

strait: narrow passage of water connecting two larger bodies of water.

tack: sail in a zigzag pattern to catch the wind.

tamarind: pods of a tropical tree.

tapioca: a root starch.

tarring: coating on lines and sail cloths to preserve them.

Tebenkov Atlas (tuh-BENK-ov): set of maps and charts published in 1852 that brought together all the charts of the great Russian voyages.

telescope: an instrument for making distant objects appear nearer and larger.

theodolite: elevation-measuring instrument used to survey on land and at sea when the horizon was not visible.

thermometer: an instrument to measure expansion and contraction, and thus heat.

Tikhanov, Mikhail (tih-CON-of, mik-HI-el) (1789-1852): artist on Golovnin's round-the-world voyage, 1817-1819.

Tlingit: Peoples of the northwest coast of North America.

topography: surface features of an area.

trigonometry: a branch of mathematics that deals with angles and sides of triangles.

trim: to balance a ship by rearranging its cargo.

tundra: the treeless plains of the Arctic and far north.

Unalaska *(See maps)*.

Unangan (oo-NUNG-an): the word used by the people of the Aleutian Islands to name themselves.

Voronin, Luka (Vore-O-nin, Lew-ka) (1765-after 1790): artist with the Billings/Sarychev expedition of 1785-1792.

Voznesensky, Il'ya (voz-ne-SEN-skii, il-E-ya) (1816-1871): scientific explorer in America and Siberia from 1839 to 1849.

warrant officers: officers in the Russian Navy such as the purser or boatswain. These officers rank below the commissioned officers—for example, the captain and ensign—and above the petty officers—mates, for example.

watch: period of time when a crew is on duty, usually four hours; also the group of a ship's crew that is on duty.

Waxell, Sven (VAX-ell, sven) (1701-1762): lieutenant on Bering's voyage to America.

Waxell, Laurentz (1730-?): son of Sven, Laurentz sailed on Bering's voyage of 1741 at the age of 11.

Wrangell, Ferdinand von (VRAN-gel) (1796-1870): Russian captain who sailed with Golovnin and later was governor of Russian America (1830-1835).

yawl: a ship's small boat.

yellow fever: acute disease of warm climates carried by mosquitoes.

Yupik, Siberian: northern peoples of St. Lawrence Island, formerly written about as Eskimos.

Yup'ik: northern peoples of the Bering Sea, and lower Yukon and Kuskokwim regions, formerly written about as Eskimos..

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Videos:

A PBS production of *Longitude* by Dava Sobol is available on videocassette.

Russian America: The Forgotten Frontier, video of the 1990 exhibition is available from the Anchorage Museum of History and Art Shop.

Naa Kahidi theater. *Keet Shagoon: The Origin of the Killer Whale.* (videocassette). Juneau, AK: Sealaska Heritage Foundation. 1988. Southeast Alaska folktale depicted in live performance with full Tlingit regalia and English narration.

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The cable channel, Arts and Entertainment, series on *Captain Horatio Hornblower*, sets the mood of the time and shows lively scenes on board ships contemporary with our Russian expeditions.

Steller Sea Lion in Jeopardy. Alaska Department of Fish and Game. Juneau, AK

Resources on the World Wide Web:

http://dcz.gso.uri.edu/amy/avhrr.html

http://topex-www.jpl.nasa.gov/discover/ocean_planet.html
This site summarizes the TOPEX/Poseidon satellite mapping of the ocean's surface and has good information on temperature effects.

http://www.ssec.wisc.edu/data/index.html
At this location, you can find an excellent real-time map of the ocean's temperatures.

http://www.pmel.noaa.gov/bering/gasst.html
Here you will see sea surface temperature for the Gulf of Alaska.

http://podaac.jpl.nasa.gov/kids/ocean.html
Two actual experiments in sea surface temperature are posted here

Ask An Expert
http://www.askanexpert.com/
Ask scientists and other experts questions about many topics.

The Alutiiq Museum & Archaeological Repository, Museum of the Aleutians, and Alaska Native Heritage Center and the Alaska Native Knowledge Network all maintain web sites with their email addresses.

Alaska Native Heritage Center: http://www.alaskanative.net

Alutiiq Museum & Archaeological Repository: www.Alutiiqmuseum.com

Museum of the Aleutians: http://www.aleutians.org

Alaska Native Knowledge Network: www.ankn.uaf.edu

Several Fort Ross California sites offer information and links. They include:
http://parks.sonoma.net/rosshist.html

and the Fort Ross ~ Global Village project which brings children from Russia, Alaska, and California together on the Internet to study archaeology and history at Fort Ross:
http://www.nobackroads.com/mendo/ftross.html

ëKeypals Web sites

Russian Keypals: http://web66.coled.umn.edu/schools/RU/Russia.html
Links to Russian schools at a variety of levels. The school names are listed; you click on the one you want.

Intercultural E-Mail Classroom Connections: http://www.iecc.org
IECC (Intercultural E-Mail Classroom Connections) is a free service to help teachers link with partners in other countries and cultures for e-mail classroom pen-pal and project exchanges. At last count, more than 7650 teachers in 82 countries were participating.

Rigby Heinemann Keypal Lists: http://www.hi.com.au/
Get in contact with teachers and classes from around the world, or individual students in the following age groupings: students from age 5 - 10 years; students from age 11 - 13 years; or students from age 14 - 20 years.

Mighty Media Keypals Club www.mightymedia.com/keypals/
Over 25,000 registered users from 76 countries. The KeyPals Club is a place for young people, teachers and students to locate and correspond with other youth and students around the world.

Resources for the Student:

Books that may help readers in grades 4-8 make connections with the adventures, the topics or the era.

Biesty, Stephen and Richard Platt. *Man-of-War: Cross-Sections*. New York: Dorling Kindersley. 1993.

Blumberg, Rhoda. *The Remarkable Voyages of Captain Cook*. Riverside, NJ: Macmillan. 1991.

Bouchard, David. *The Journal of Etienne Mercier - Queen Charlotte Islands 1853*. Custer, WA: Orca Book Publishers. 1998.

Cassidy, John. *Earthsearch: A Kid's Geography Museum in a Book*. Palo Alto, CA: Klutz Press. 1994.

Cheney, Cora. *Alaska: Indians, Eskimos, Russians, and the Rest*. New York: Dodd, Mead & Co. 1980. Well-illustrated account of selected episodes in Alaska history; includes chapter of a fictional journal of Läurentz Waxel [Waxell], a boy who sailed with Bering on the voyage of 1741.

Cheney, Theodore: *Living in Polar Regions: a Cultural Geography*. New York: Franklin Watts, Inc. 1987. Comparison of modern life in Barrow, Alaska; Chersky, Siberia; and Great Whale River, Canada.

Ford, Corey. *Where the Sea Breaks Its Back*. Bothell, WA: Alaska Northwest. 1992. Steller's journal told as fiction.

Granberg, W. J. *Voyage Into Darkness*. New York: E. P. Dutton & Co., Inc. 1960. Completely fictional account of Bering's second expedition told through the point of view of the boy, Laurentz Waxel [Waxell].

Green, Paul. *I Am Eskimo, Aknik Is My Name*. Bothell WA: Alaska Northwest. 1992. Alaska Native life in the Kotzebue area in the early part of the 20th Century.

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Hoyt-Goldsmith, Diane. *Arctic Hunter*. New York: Holiday House. 1992.
First person narrative of a modern Inupiat boy's life in Kotzebue.

Hurd, Edith Thacher. *Song of the Sea Otter*. San Francisco, CA: Sierra Club. 1983.

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Krupp, Robin Rector. *Let's Go Traveling*. New York: Morrow Junior Books. 1992.

Magocsi, Paul R. *The Russian Americans*. New York: Chelsea House. 1987.

Matthews, Rupert. *Explorer*. New York: Alfred A. Knopf, Inc. 1991.

Murphy, Claire Rudolf. *Friendship Across Arctic Waters: Alaskan Cub Scouts Visit Their Soviet Neighbors*. Lodestar. 1991. Cub scouts from Nome travel by plane across the Bering Strait to visit the scout troop in Provideniya, Russia.

Murphy, Robert. *The Haunted Journey*. New York: Farrar Straus & Giroux. 1969. Bering's expeditions described in a lively and embellished story.

Ragan, John David. *The Explorers of Alaska*. New York: Chelsea House. 1992.

Reed, Don C. *Wild Lion of the Sea: The Steller Sea Lion That Refused to Be Tamed*. San Francisco, CA: Sierra Club. 1992.

Ross, Stewart. *Fact or Fiction: Conquerors & Explorers*. Brookfield, CT: Copper Beech Books. 1996.

Sutton, Ann. *Steller of the North*. Chicago: Rand McNally. 1961.

Tolhurst, Marilyn. *The Explorer's Handbook*. New York. Dutton Children's Books. 1998.

Wortman, Elm. *Four Against the Wilderness*. Edna Bay, AK: Top Notch. 1992. (Also published as *Almost Too Late*. New York: Random House. 1982). A contemporary family survives a shipwreck in Southeast Alaska.

Yolen, Jane. *Encounter*. Orlando, FL: Harcourt Brace Jovanovich. 1992. A Taino Indian boy on the island of San Salvador recounts the landing of Columbus and his men in 1492.