ALASKA Tidelines

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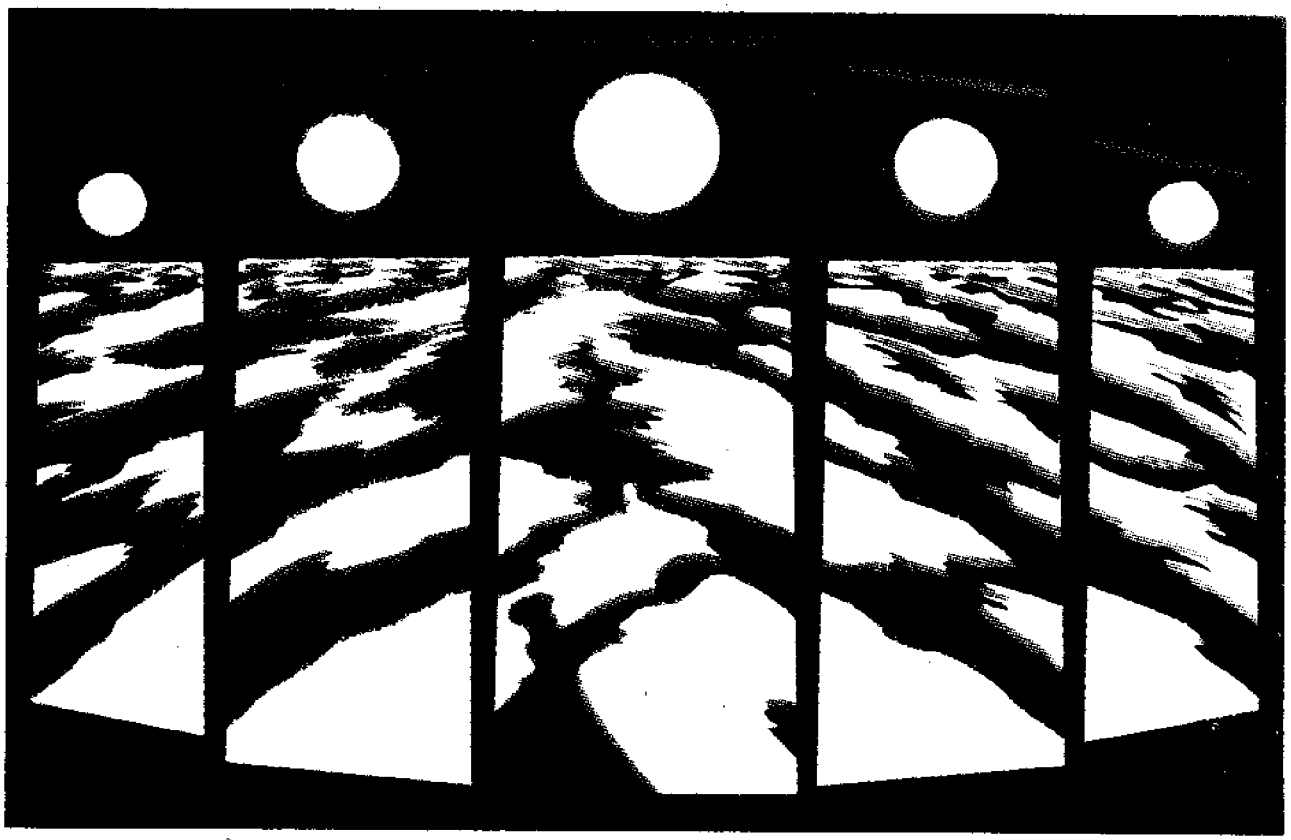
The Great Arctic Ice Machine



"Prudhoe Profile," by Keith Appel, well-known Anchorage artist, associate professor and chairman of the Art Department, University of Alaska, Anchorage.

Wheels within wheels, like most machines, around and around it goes. Even at the Pole the ice is never still. Driven by winds and currents, it cracks and splits to bare the food-rich waters beneath. It is home for the seals, the walrus, the polar bears—a summer hiding place for the bowhead whales.

In September the polar ice pack has pulled back as far as it will go—just over the horizon from northern Alaska, sometimes still within sight. Then temperatures drop as the days grow shorter. The wind swings around out of the north northeast. And the Great Arctic Ice Machine cranks up.

New ice forms along the shore and within the pack. The ice mass grows and begins to spread south—sometimes slowly, sometimes very swiftly, depending upon the weather. It closes in over the Beaufort Sea, then the Chukchi Sea, then down it goes through the funnel of the Bering Strait to fan out in a great arc over the Bering Sea. There it will stay until April when the prevailing winds shift and the ice begins to melt. Then the whole system turns around to move the ice back north again.

Back and forth, season after season. Nothing can stop the Great Arctic Ice Machine. But can we handle it or harness it? What effect will it have on the development of Alaska's rich offshore oil deposits and other resources? How does it work? What does it do? These are some of the questions *Alaska Tidelines* asked Dr. Lewis H. Shapiro, sea ice specialist with the University of Alaska's Geophysical Institute.

HOW DOES IT WORK?

What's the difference between the North Pole and the South Pole? Well, they're poles apart, of course—about 8,000 miles via the TV-type Captain Nemo route straight through the middle of the earth, or some 12,000 miles if you want to go around. And even though both Poles are covered with ice year-round, when it's summer up here, it's winter down there.

But the big difference lies in the physical make-up of these opposite ends of the earth. The Arctic is an ocean almost surrounded by land *(Figure 1)*. The Antarctic is a continent surrounded by ocean *(Figure 2)*. And that has a major effect on the ice produced by these two great polar refrigerators.

The Antarctic ice is free to break off, float away and melt in warmer waters. About 80 percent of its ice pack is lost each year, to be replaced by new ice the following year.

But most of the Arctic ice pack, especially that above Alaska and Canada, has no place to go. Each summer only about 20 inches of ice melts from the top of the pack, to be replaced by ice freezing at the bottom the following winter.

So most of the Arctic pack is made up of ice that is a number of years old. And because it is always on the move, splitting open and slamming back together, this multiyear ice is rough and tumbled and broken.

Don't get the wrong idea from the solid surface of blue in Figure 1 which shows the location of the permanent Arctic ice pack. Check the "Ice Words" list at the bottom of page 3 and draw in some leads, polynyas and floes.

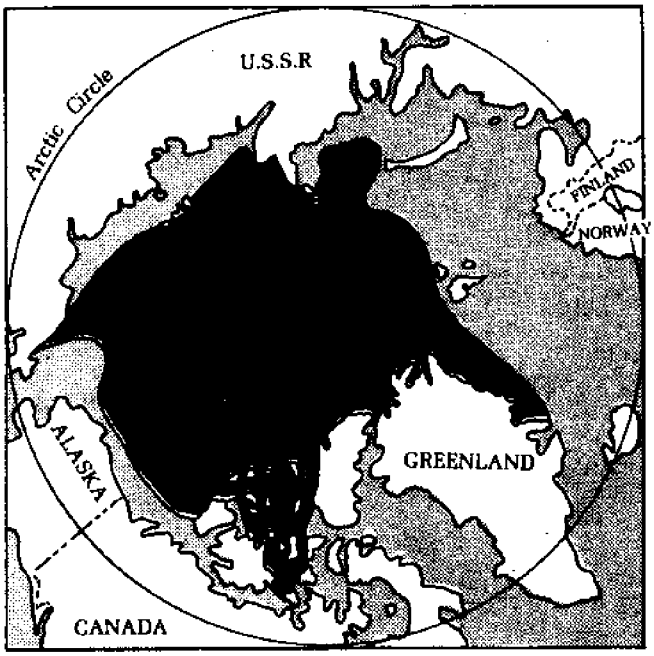


Figure 1. North Pole

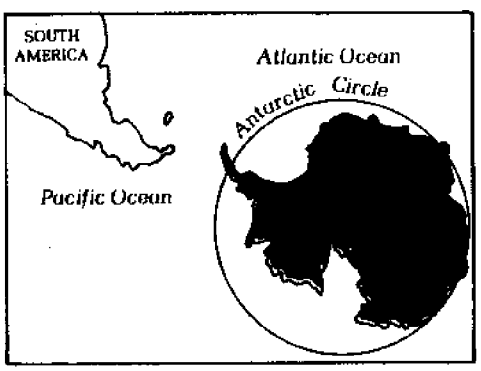
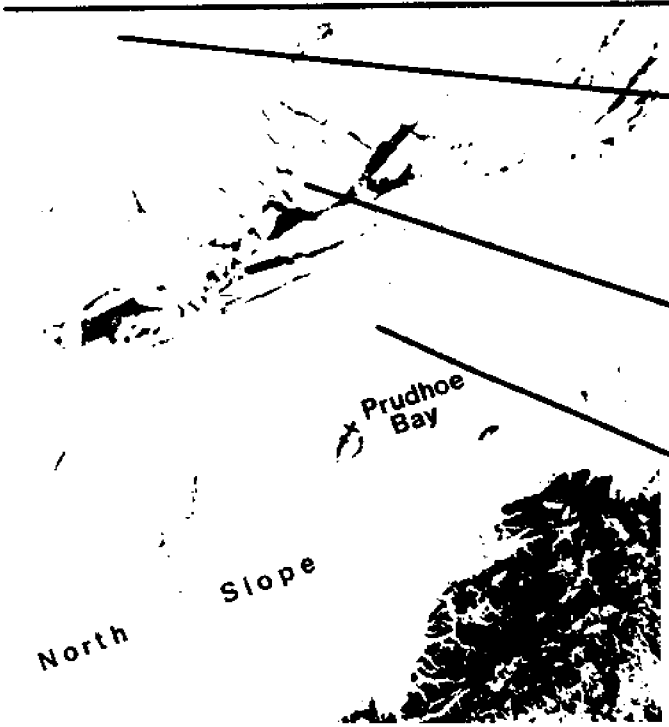


Figure 2. South Pole

(Blue area usually ice-covered year-round.)

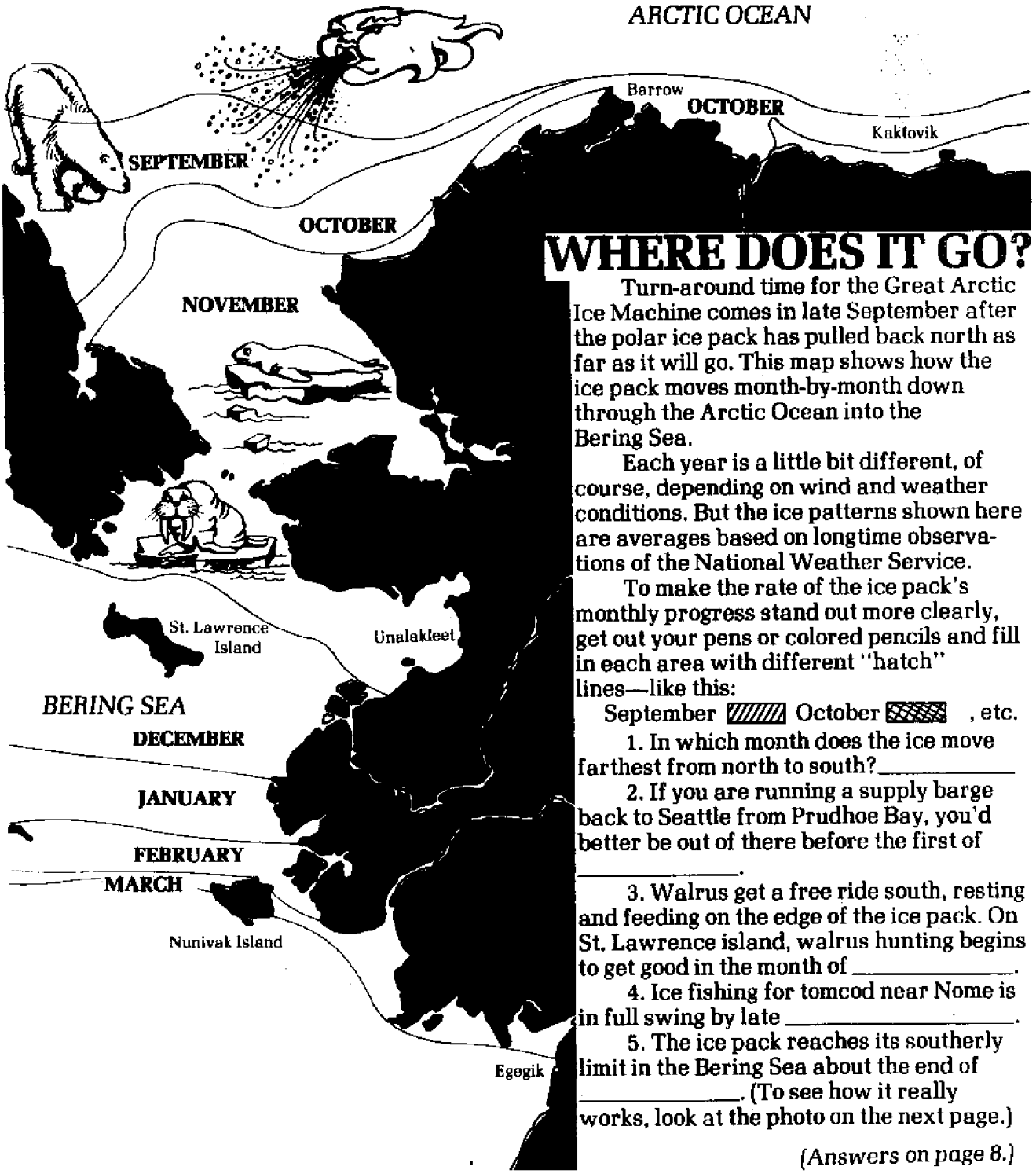


A CLOSER LOOK

PACK ICE: The heavy but broken ice mass that covers the northern Arctic Ocean, or any other drifting ice cover. Multiyear ice freezes to a maximum of 10 feet, but is much thicker where ice ridges form. North of Alaska the pack constantly rotates in a clockwise direction under the influence of a current called the Beaufort gyre (JIGH-er). It moves slowly near the Pole but up to 1-2 miles a day at the outer edge.

SHEAR ZONE: Where the action is, especially in early winter, as moving pack ice grinds against unmoving shorefast ice. Channels open and refreeze. Pushed by winds and moving ice, huge slabs may ride up to form pressure ridges 20-25 feet high, and occasionally up to 80 feet high.

SHOREFAST ICE: Ice attached to the shore, either frozen solid to the bottom in shallow waters or stretching out as floating ice as far as where the waters reach a depth of about 60 feet. Heavy pressure ridging may occur anywhere, but is usually found near the outer edge of the shorefast ice. Tilted slabs or blocks of ice sometimes are jammed against the sea bottom, which tends to keep the inshore ice stable.



WHERE DOES IT GO?

Turn-around time for the Great Arctic Ice Machine comes in late September after the polar ice pack has pulled back north as far as it will go. This map shows how the ice pack moves month-by-month down through the Arctic Ocean into the Bering Sea.

Each year is a little bit different, of course, depending on wind and weather conditions. But the ice patterns shown here are averages based on longtime observations of the National Weather Service.

To make the rate of the ice pack's monthly progress stand out more clearly, get out your pens or colored pencils and fill in each area with different "hatch" lines—like this:

September ▨ October ▩ , etc.

1. In which month does the ice move farthest from north to south?_____

2. If you are running a supply barge back to Seattle from Prudhoe Bay, you'd better be out of there before the first of _____.

3. Walrus get a free ride south, resting and feeding on the edge of the ice pack. On St. Lawrence island, walrus hunting begins to get good in the month of _____.

4. Ice fishing for tomcod near Nome is in full swing by late _____.

5. The ice pack reaches its southerly limit in the Bering Sea about the end of _____. (To see how it really works, look at the photo on the next page.)

(Answers on page 8.)

Source: Alaska Regional Profiles: Arctic Region and Northwest Region. AEIDC, University of Alaska.

ICE LINGO

lead (say "leed")—A long narrow stretch of open water through the ice, wide enough for boats to pass through. May open and close very quickly.

polynya (poe-LINN-yuh)—An area of open water surrounded by sea ice. Has a round or irregular shape like a lake, rather than long and narrow like a lead.

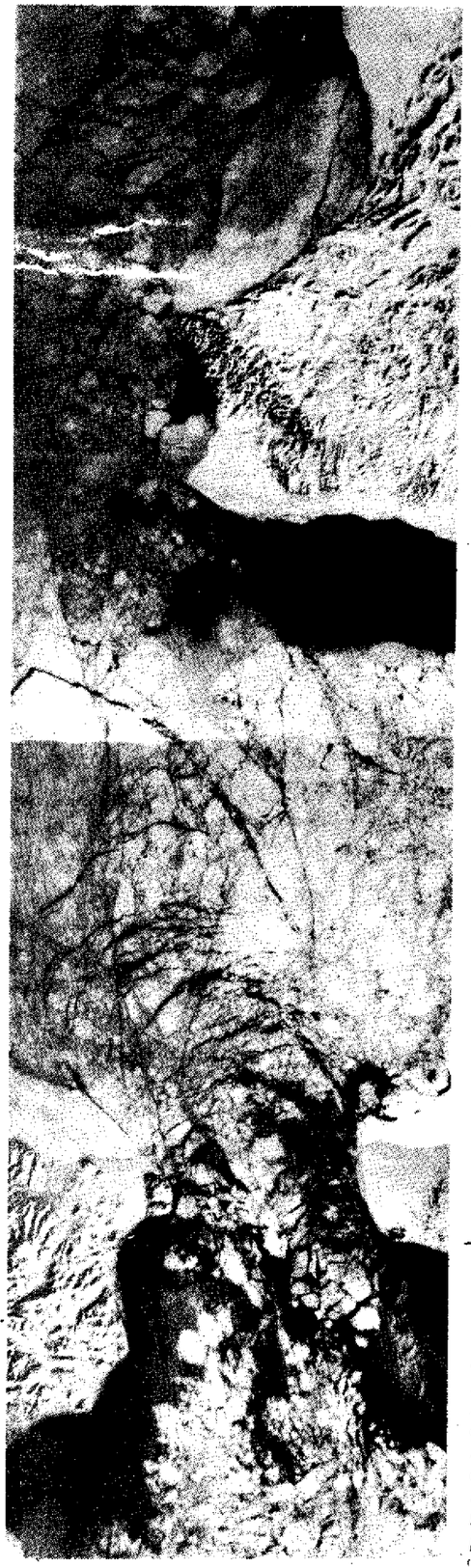
floe (say "flo")—A large chunk of sea ice, usually made up of many smaller pieces frozen together. May measure several miles across.

ice island—A very large flat floe, 90-150 feet thick and up to 300 square miles in size. Ice islands are of frozen freshwater rather than salty brine which makes the sea ice. Most ice islands in the Beaufort Sea have broken off from Canada's glacial Ellesmere Ice Shelf.

pressure ridge—Irregular ridges or mounds of ice, pushed up by the pressure of winds or floes jamming together.

ice override—Large slabs of ice driven by the wind that slide up beaches or up and over small islands.

CAN WE HANDLE IT?



There's a whole lot of interest in the working of the Great Arctic Ice Machine these days. Because for eight to ten months of the year it lies like a restless blanket over offshore areas believed to hold some of the richest untapped oil and gas deposits on the North American continent. And with oil prices soaring and foreign imports dwindling, the push is on to get it out.

But that can be very tricky business. Can we build drilling structures that can stand up to the forces of the ice? Could we ever clean up an oil spill on the ice—or worse, during break-up? Do we have the know-how to risk it?

The state and federal governments think that we do. In December they held an oil lease sale for about a half-million acres of offshore land in the Beaufort Sea *(see map)*, which geologists think might hold 1.25 billion barrels of oil and 3.125 trillion cubic feet of natural gas.

The oil companies think we do, too. They plunked down a little over $1 billion for the right to get at it and, in some cases, they even agreed to share their profits with the State of Alaska when the oil begins to flow later on. It promised to be the biggest payday since the Prudhoe Bay bonanza ten years ago.

Just to be on the safe side, a number of special limits have been placed on oil activities in the Beaufort, including the following:

•In deeper waters, drilling structures must stay in place for two years before they are used, to be sure they can stand the ice pressures.

•Drilling outside the small barrier islands, where the water is more than 30 feet deep, can only be done from November 1 to March 31. This is to allow time to clean up any possible spills before breakup.

•Drilling in shallower waters also will be limited to the same period, except that the time may be extended to May 15 if ice conditions permit.

Will that take care of it? The Inupiat Eskimo people who live along the Arctic Coast aren't so sure. In a series of suits designed to delay or cancel the sale, they argued that they know far more about the ice than Outsiders do *(see page 6)*.

They warned that surging sea ice could topple drilling rigs like match sticks, and that any kind of oil spill would damage marine life. They also expressed fears that these things, plus more human activity in the area, could harm the already endangered bowhead whale around which their culture is built *(see* Alaska Tidelines, *March, 1979)*.

Some of these suits have yet to be decided in court. So the issue is still in doubt. But whatever happens in the Beaufort will be watched very carefully. The sale is only the first of a number planned over the next five years, which will include seasonally ice-covered areas in the Chukchi Sea, Norton Sound, and the Navarin Basin between St. Lawrence and St. Matthew islands.

With so much at stake on the working of the Great Arctic Ice Machine, *Tidelines* talked to Dr. Lewis H. Shapiro of the University of Alaska, who has done extensive ice research over the past seven years, much of it sponsored by the Alaska Sea Grant Program.

"You really do have to look at ice the way an engineer would," he said, "because ice is an engineering material—just like steel or rock or concrete. And since ice dominates the Arctic, you have to know how to handle it if you want to build safe offshore structures there.

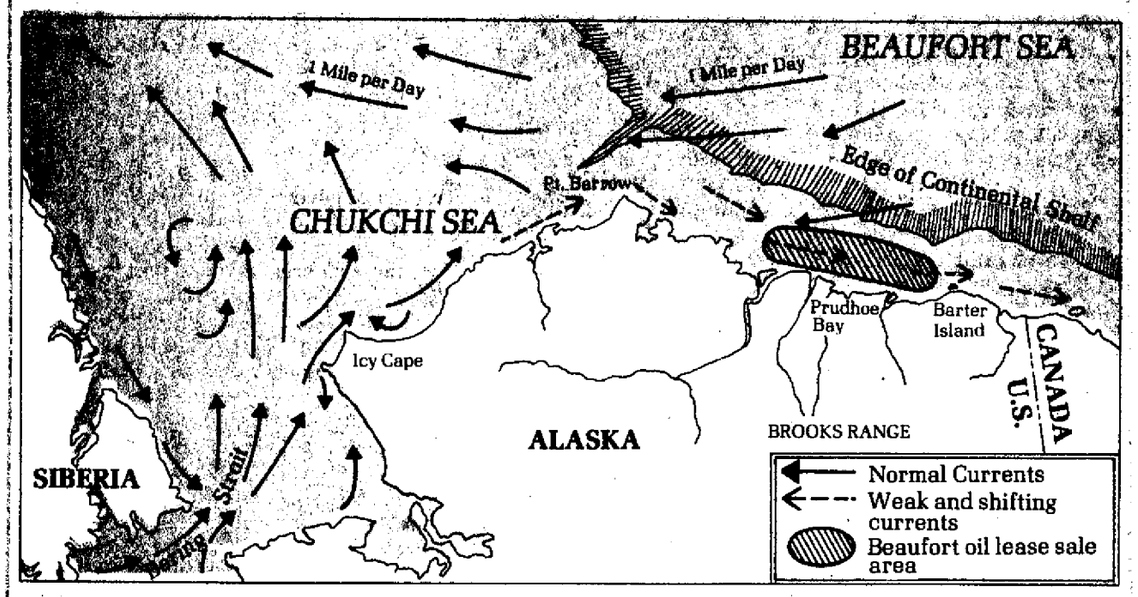
"For example, you should know how fast the ice will be coming at your structure. This is very important because the force of the ice against your structure depends on the speed at which it is moving. If it's coming very fast, it is very strong. You should also know how the ice and your structure will interact when they meet. But the trouble is, these things are difficult to measure and to predict accurately."

Then are we starting too soon? *Tidelines* asked. Could you build a structure out there and have it stand?

"Oh sure you could. No question about it. If you're willing to spend enough money and build a big enough structure, you could put one out there anyplace. But that could be very very expensive.

"What I'd like to see out there is a test structure. One that will give—so that we can measure

(Continued on page 7)



Source: Alaska Regional Profiles, Arctic Region. AEIDC, University of Alaska.

Only an imaginary line running north from Point Barrow separates the Chukchi Sea and the Beaufort Sea. Yet they are very different.

The Chukchi (a Russian word, meaning "keeper of the reindeer") is quite shallow with depths of less than 200 feet. Here the broad flat outer continental shelf stretches hundreds of miles north between Alaska and Siberia and beyond.

Strong currents move up through the Bering Strait, bringing warmer waters of the Bering Sea and the great rivers that feed it. They mix with the colder but weaker Siberian currents and set up a circular flow away from the Alaska mainland. This keeps the winter sea ice moving, so that it doesn't jam tightly against the coast. It provides a good environment for seals and other marine mammals who rest on the ice but feed in the open waters.

On the other hand, the Beaufort Sea (named for Sir Francis Beaufort, a scientifically inclined British naval officer) has a narrow continental shelf. The waters are shallow behind a long line of small barrier islands that stretch all the way to Mackenzie Bay in Canada. But the ocean floor drops off sharply 30-60 miles from the Alaska coast.

Even during the summer months the polar ice pack is seldom more than 30-40 miles away. And the Beaufort waters run with the cold strong westerly winds and currents of the Arctic Ocean. These tend to force the ice against the coast. Fewer marine mammals find this to their liking, except for denning mother polar bears **(see** *Tidelines,* **Dec. '78-Jan. '79).**

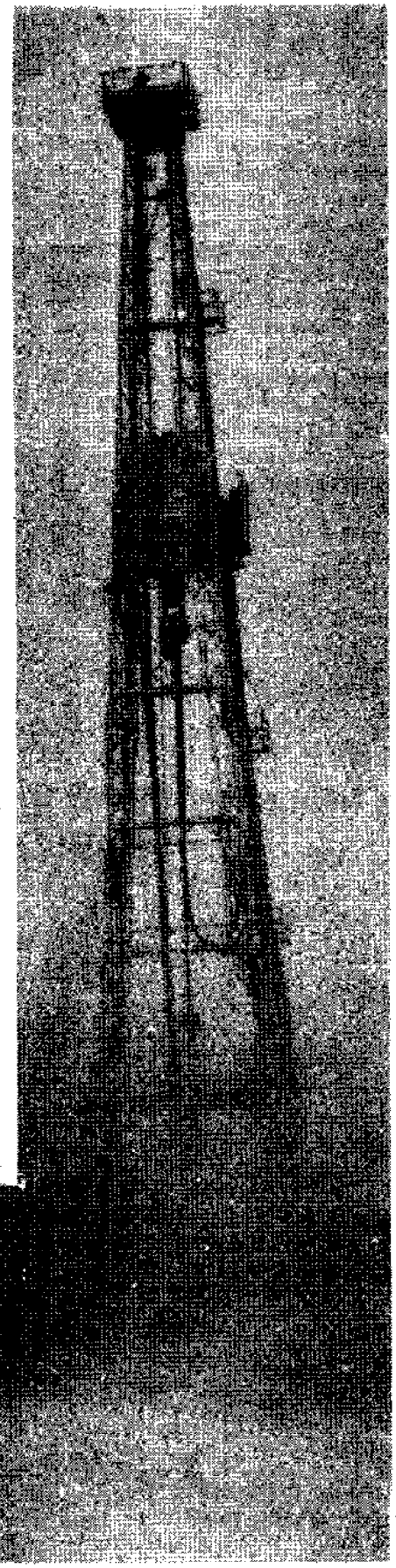
Look at a large map of Alaska. How many villages are there along the Chukchi seacoast? Along the Beaufort seacoast? What effect have ice conditions had on the settlements of people who subsist on marine mammals?

WHOOSH!

Can the ice pack really squeeze through the narrow Bering Strait? This satellite photo shows that it can—and it does. Pushed by a strong northerly wind, some of these floes moved south almost 30 miles in one day. The dark areas are open water or new ice. The white is old ice or snow-covered land. Compare this photo with the map on page 4. Then see if you can locate Wales and Point Hope on the photo.

Courtesy of Geophysical Institute, UA.

WHAT THE ELDERS SAY



To the Eskimo people of the Arctic coast, the ice is as much a part of their lives as the land itself. Their ancestors have hunted and fished those frozen waters for thousands of years. And timewise, to them, the past ten years of scientific ice observations are as slight as a small snowball lying on the vast shelf of shorefast Arctic ice.

Scientists are aware of this. And to tap this knowledge, they have been interviewing Eskimo elders who have lived along the Beaufort Sea. Here are some exerpts from those interviews:*

"I am 73 years old. I was 15 years old when we first moved to the coast. We began in Canada and traveled towards Barrow, building a house and spending several years at each place we stopped...

"There was a time in November, 1932, when five people went out ice hunting seals from Cross Island...The wind started to blow very hard from the west. The ice broke up behind them and they drifted away.

"They were out for about five days. They knew they were way out in the ocean because even though they were on a big high ice chunk, the moon would disappear below the horizon when they were in the trough of big waves. When they would wake up there would be water all around, and each nightfall they would look for high ice chunks to sleep on. The waves would break on the ice, but when the temperatures went down it would freeze up so they could travel towards the shoreline.

"They made it to Flaxman Island on the new formed ice. The ice was so thin they couldn't walk on it without breaking through. Yet these men drove over it with their dog team. It was a miracle that they survived."

—Henry Nashanknik, Barrow

"The ice in front of the Colville (River) piles up and forms pressure ridges when it freezes in the fall...The ice never sits still... (it) is always moving. In the wintertime the ice goes out when the wind is from the west on the ocean side of the barrier islands...No matter how thick the ice is, even in the dead of winter, it would break up and there would appear big bodies of open water...

"There are different kinds of fish out there, salmon, white fish, flounders; different kinds of birds; seals, polar bears, and bearded seals. That is why we oppose the oil drillings around here. This spring the elders talked about how they wouldn't like to see oil rigs in the ocean. Unless that oil rig is put in safe with strong supports, the moving ice would think nothing of it."

—Samuel Kunaknana, Nuiqsit

AEIDC

*"Historical References to Ice Conditions Along the Beaufort Sea Coast of Alaska," by Lewis H. Shapiro and Ronald C. Metzner, assisted by Kenneth Tuovak, Geophysical Institute, University of Alaska, 1979.

...HANDLE IT?

(Continued from page 5)

the various forces and movements of the ice in order to learn exactly what the ice can do. That would cost a lot too, probably tens of millions of dollars. But we're going to need it sooner or later when we drill offshore in other areas. It isn't enough to simply put up a rigid structure and watch it for two years to see if it stands. If it doesn't, you haven't learned very much.

"It's not such a difficult problem in nearshore waters. There you can build a gravel island, large enough to provide a good working surface and high enough to be clear of heavy storm surges. Then you put a heavy sandbag berm or wall around it so that if the ice overrides it will run up the wall, break and pile up on the other side. The ice doesn't come at you like a galloping horse, you know. You can keep it cleared away with heavy equipment. It's a problem that can be handled."

What about oil spills?

"That is a problem. That's the biggest unknown.

"If you're on a gravel island or stable shorefast ice, you would hope it comes up the drill hole onto the surface where you can clean it up. If it spills under the shorefast floating ice, it becomes a touchy matter. You might break holes in the surface and pump it out or skim it off. You would lose some, but you could get most of it.

"But an offshore spill with a strong wind driving the ice—you wouldn't have a chance of getting it. Not a chance. That's one very good reason for limiting drilling to the winter months.

"Right now nobody is thinking about going out into waters more than 60 feet deep. But some day they're going to do it. And there will be subsea pipelines, and shipping terminals, and all sorts of other facilities.

"So there's going to be a real need for scientists and engineers trained to work on all Arctic-related problems—and on ice problems in particular. There's a real need for them right now. And I think that would be a great field for young Alaskans to think about."

COLD WATER MAY SAVE YOUR LIFE

Jackson, Michigan—A car driven by 18-year-old Brian Cunningham skidded off the road and plunged into an ice-covered pond. As the young man struggled to free himself, the car rolled over, filling with water, and sank to the bottom.

It was 38 minutes before rescuers could bring him to the surface. His body showed no signs of life and he was declared dead at the scene.

But as it was being loaded into the ambulance to be taken to the morgue, the "lifeless" body gave a loud gasp. Startled rescuers began artificial respiration at once while the ambulance raced for the hospital.

After 15 hours of revival effort and breathing support, Brian woke up and recognized his mother at his bedside. Two weeks later he was back in college where he continued to pull "A" grades.

That story is true. And although it happened in Michigan, it is very important to Alaskans. Because if that water hadn't been very cold—like all Alaskan water— Brian probably wouldn't have survived. And if by some miracle he *had* survived, he certainly would have suffered brain damage, which usually occurs if the brain has no oxygen for more than four minutes.

What kept him alive? Medical researchers believe that if your face is suddenly plunged into very cold water, your body may respond with a life-saving reaction. They call it the "mammalian diving reflex." And they say it is similar to the system that allows whales, porpoises and seals to spend long periods of time under water.

This shock of cold water slows down blood circulation to all parts of the body except the heart, lungs and brain. In this way the oxygen supply in the blood goes to the organs that need it most. And when the brain is cold, it requires less oxygen than usual.

Unfortunately, it doesn't work for everybody. Research directed by Dr. Martin S. Nemiroff of the University of Michigan shows that the younger the person, the better are his or her chances for survival. The majority of those saved were under four years old.

Survival seems to depend on:

- How long the person is under water.
- The age of the person.
- Whether the water is 70° or colder. (All of Alaska's lake, river and coastal waters are well below 70°.)
- How well the rescuers do their jobs.

REMEMBER: The victims look dead. Their skin is blue and cold to the touch. There is no sign of breathing or heart beat. The eyes are staring and the pupils are enlarged.

WHAT TO DO:

1. Clear the air passages and begin mouth-to-mouth rescue breathing at once. Do not worry about getting water out of the victim's lungs—the body will absorb that quickly.
2. Check for heart beat. (Sometimes rescue breathing will start the heart beating again.) If there is no heart beat, begin external heart massage immediately.
3. Keep the victim from losing more body heat, but don't try to rewarm him or her. Rewarming may harm the victim.
4. Get the victim to a hospital or clinic as quickly as possible. Keep up the rescue breathing and heart massage until medical help is available.
5. Don't give up—especially if the victim is a child.

(A booklet on cold water drowning, with basic instructions for mouth-to-mouth rescue breathing and external heart massage, has been published cooperatively by the Michigan Sea Grant Program and the U.S. Coast Guard. For a free copy, write the Alaska Sea Grant Program, University of Alaska, Fairbanks, AK 99701, or call: 479-7086.)

Dear Spout,

I understand that the Institute of Marine Science at the University of Alaska keeps marine specimens that have been collected for five years. What happens to them after that? Would it be possible for my high school biology class to get some of the specimens that aren't needed any longer?

Charlotte Titus
North Pole Jr/Sr. High School

Dear Charlotte,

That's an interesting idea!

The specimens you're talking about have been gathered by scientists doing research work under the Outer Continental Shelf Environmental Assessment Program. Species include crab, shrimp, worms and small fishes.

Many of these specimens must be kept, of course, as part of the research collection. But at the end of the project there should be plenty left over.

Getting them out to biology classes that would like to use them will take some doing, however. Among other things, they would have to be identified and sorted into useful packages. (Right now they're pretty well jumbled up).

But if enough schools or biology classes are interested, we'll certainly give it a try. So let us know. (And if it does work out, Charlotte, your class will be on top of the list.)

SPOUT

February issue:
Alaska's Scariest Fishery

Answers to map questions: 1-November. 2-October. 3-December. 4-November. 5-March.

FREEZE & THAW

Starred (*) words are based on information in this issue.

ACROSS

* 1. The Great Arctic Ice Machine is never still. It is always on the _____.

* 5. Ice that freezes out from the coast is called shore _____ ice.

* 9. While Arctic ice is usually rough and uneven, Antarctic ice is usually smooth and _____.

10. Preposition meaning to move up on.

11. Left End, as in football (abbr.).

12. Daughters of the American Revolution (init.).

14. Lower right (abbr.).

15. "If at first you don't succeed, _____, _____ again."

*17. The Antarctic is a continent surrounded by water. The Arctic is an _____ almost surrounded by land.

19. Off base (abbr.).

21. Eastern Time(abbr.).

*22. Oil companies paid hundreds of millions of dollars last December for the right to drill off _____ in the Beaufort Sea.

25. In math, the opposite of "subtract" is _____.

*28. The polar ice pack moves back and forth, _____ and fro.

29. A noun or verb ending, as in end_____.

31. Equal Opportunity (init.).

*32. A "lead" in the ice is an _____ stretch of water.

34. The end of a hymn or a prayer.

36. Peter's friends call him _____.

*37. The polar ice pack is usually smallest in the month of _____ (abbr.).

DOWN

* 1. Break-up comes after the ice begins to _____.

* 2. Slabs of ice that slide up onto the beach or small islands are called "_____ rides."

3. The day World War II ended in Europe is called _____ (init.) Day.

4. Finish.

* 5. To build safe structures in Arctic waters, engineers must consider the _____ of the ice.

6. An indefinite article, such as "a."

* 7. The first four letters of an island in the Bering Sea where there are many walrus.

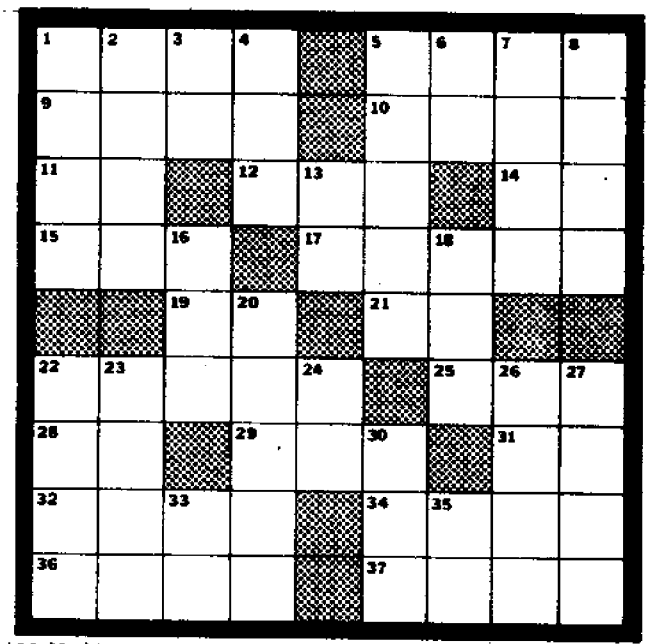
8. When something is ripped, it is _____.

*13. The North Pole lies near the center of the _____ (init.).

16. "_____-Hoo!"

18. Estimated Time of Arrival (abbr.).

*20. Salty water, like sea water, is called _____.



*22. Nothing can _____ the Great Arctic Ice Machine.

*23. Point _____ is a village on the shores of the Chukchi Sea.

24. Northeast (init.) backwards.

*26. Floating shorefast ice seldom stretches over water more than 60 _____ deep.

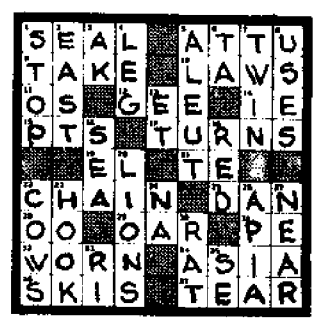
27. Short for "do not."

*30. Rich oil and _____ deposits are believed to lie in Alaska's outer Continental Shelf.

33. The Latin and French word for "and."

35. You and _____.

(Answers in February issue.)



Answers to November X-Word

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