VOLUME 8 NUMBER 3 JULY 1978

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National Oceanic and Atmospheric Administration

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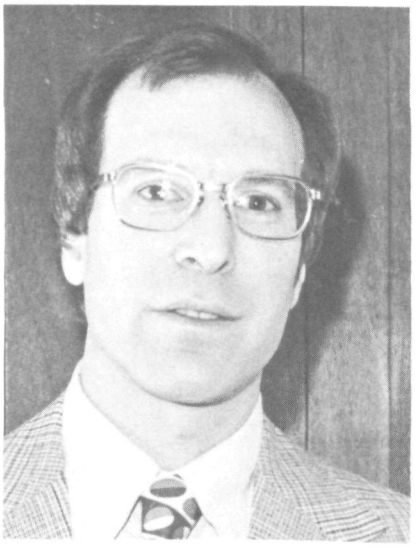
Dealing With Oil Pollution



As NOAA turns its attention to questions of management and conservation of ocean and coastal resources, we become increasingly involved in every aspect of oil pollution problems. We are improving our understanding of oilspills and their effects, applying our regulatory and funding programs to mitigate the problems, and working with other agencies in spill prevention and control.

NOAA's Environmental Research Laboratories and fisheries centers carry out research on the effects of oil pollution on the marine ecosystem. The Marine Ecosystems Analysis and Outer Continental Shelf Environmental Assessment Programs both address the scientific aspects of oil pollution. NOAA's Spilled Oil Research Teams play a vital role in providing prompt scientific support to clean-up operations, as well as in providing initial damage assessments of major oil spills such as the Argo Merchant and Amoco Cadiz disasters. The Office of Ocean Management has recently initiated studies on the economic impact of oil pollution on fisheries, recreation, and other ocean uses.

NOAA's leading role in ocean pollution is recognized in the new National Ocean Pollution Research, Development, and Monitoring Planning Act of 1978, which makes NOAA the lead agency for coordinating and establishing priorities for ocean pollution research in the federal government. The five-year plan required by the Act will guide the federal government's research in this field.

NOAA's involvement extends beyond research, however. The marine sanctuary legislation, the Endangered Species Act, and the Coastal Zone Management Act give NOAA responsibilities to identify critical areas and regulate activities where special protection against oil pollution is needed. The Coastal Energy Impact Program provides funding to states to ameliorate both direct and indirect environmental damage caused by past offshore oil development. The Deepwater Ports Act requires NOAA to evaluate the environmental risk of proposals for such ports.

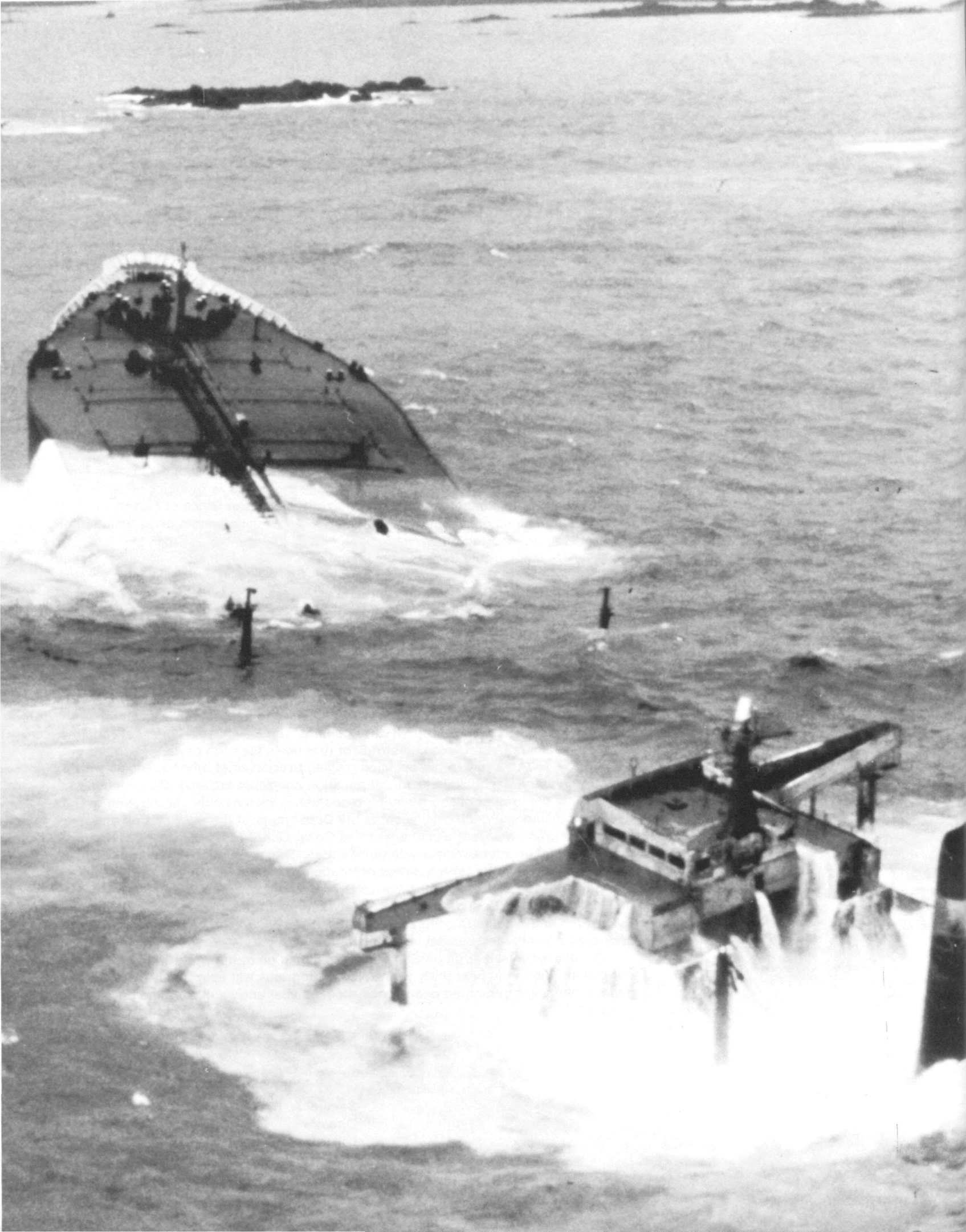
Finally, NOAA's role in the decision-making processes of other agencies with direct regulatory responsibilities for oil pollution control is growing. Our scientific expertise in the area of offshore marine resources is increasingly contributing to important ocean use decisions, such as the Department of the Interior's oil and gas leasing program. NOAA is working with the Coast Guard to develop regulations governing tanker safety and pollution prevention. This year for the first time, NOAA was represented on the United States delegation to the Conference of the Intergovernmental Maritime Consultative Organization, which produced an international agreement to upgrade tanker safety and pollution prevention regulations.

The Fish and Wildlife Coordination Act also gives NOAA the opportunity to help assure wise ocean and coastal use decisions.

By all accounts, a large portion of the remaining oil of the world will move across our oceans within the next thirty years. NOAA programs will help to assure that this generation leaves behind an ocean ecosystem as vital and healthy as the one we received.

Samuel A. Bleicher

Samuel A. Bleicher
Director
Office of Ocean Management



The SOR team worked with French scientists at

The World's Worst Oil Spill

By ROLAND PAINE

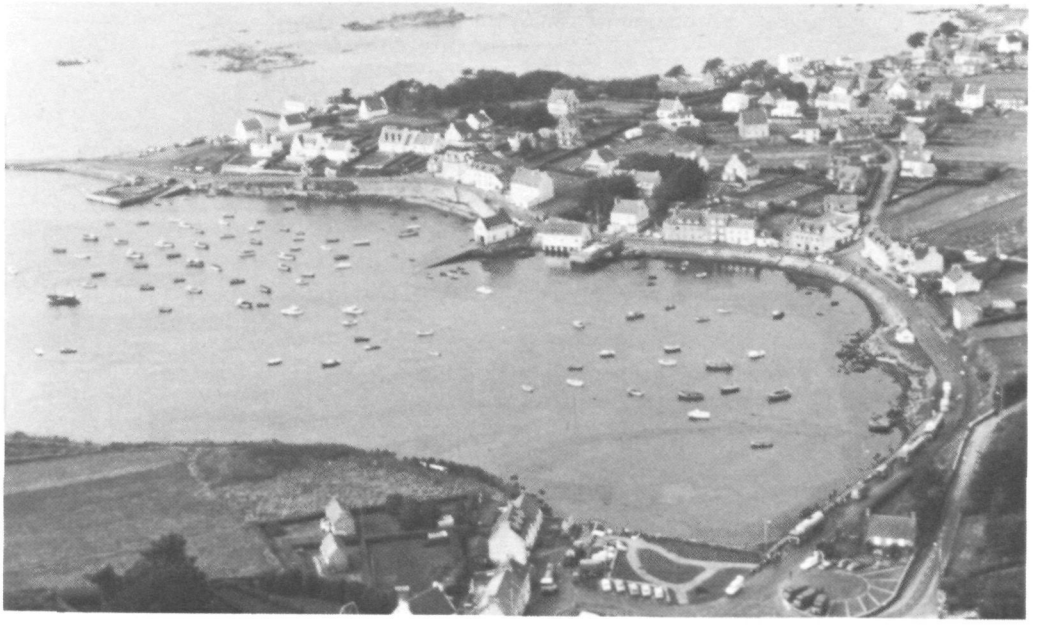
THE AMOCO CADIZ WAS BIG. At 1,067 feet, she was only 25 feet shorter than the U.S. Navy's Nimitz-class nuclear-powered aircraft carriers, and her displacement—223,000 tons—was much more than twice the full load displacement of the nuclear carriers. She was four years old, a supertanker with modern navigation and control gear. She was owned by an American oil firm, flew the Liberian flag, and had an Italian master. She was on charter to a Dutch oil firm, and carried a full load of light crude from Iran and Saudi Arabia.

She went aground off France on March 16, and she caused the world's worst oil spill.

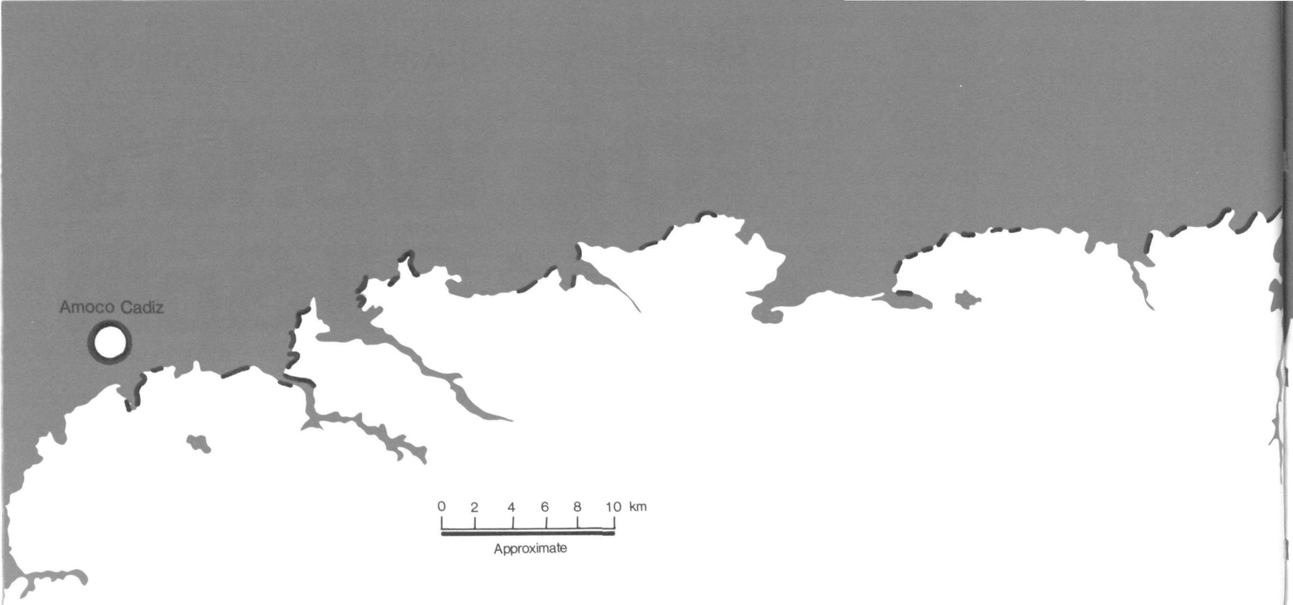
Exactly what happened is still not clear. However, her steering mechanism failed in heavy seas as she was en route to England, where her cargo was to be put on lighters for transshipment to Rotterdam. Attempts to take her in tow were unsuccessful because of the heavy seas, and about midnight she drifted onto rocks about two miles off the small Breton fishing and resort town of Portsall, where she began to break up and leak oil. Westerlies pushed the strong-smelling crude toward shore. Hastily erected barriers were of no avail in the stormy conditions, and soon the oil was fouling the beaches, cliffs, rocks, and estuaries for miles along the north shore of Brittany.

Upon learning of the March 16 grounding and breakup of the ship, Dr. Wilmot Hess—Director of NOAA's Environmental Research Laboratories—telephoned Dr. Lucien Laubier, Director of Frances's COB (Centre Océanologique de Bretagne, or Breton Oceanological Center) to offer assistance. Dr. Hess and Dr. Laubier are well acquainted from joint work on the U.S.-French Cooperation in Oceanography, and Dr. Laubier's laboratory is located in Brest, the largest city near the area of the spill. Dr. Hess briefed Dr. Laubier on the capabilities of NOAA's Spilled Oil Research (SOR) teams and their experience in quick-response short-term scientific work on previous spills.

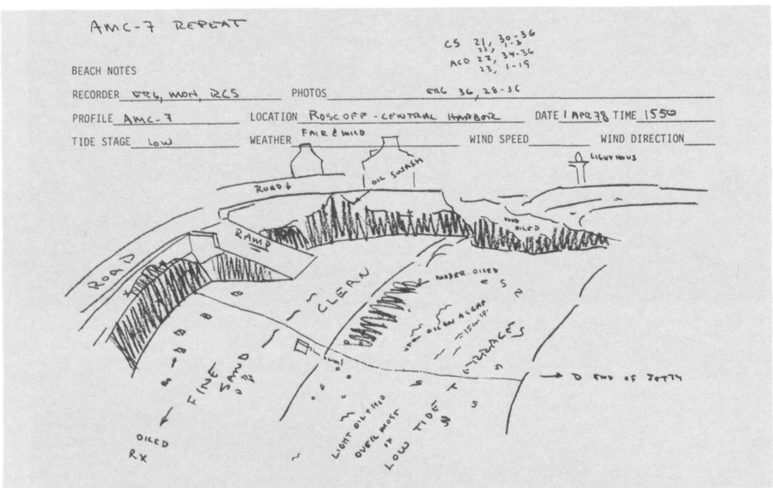
The overall objectives of the SOR teams are to assist the On-Scene Coordinator (in the U.S.) in carrying out the duties outlined in the National Contingency Plan,



The fishing and resort village of Portsall in Brittany, with part of the fishing and pleasure boat fleets at anchor (above). About a mile and a half off Portsall Rocks the bow of the Amoco Cadiz (below) protrudes from the sea, where the supertanker went aground and broke up.



Map of north coast of Brittany showing areas of oil accumulation from Mar. 22-29, adapted from beach survey map made by the geology team. Map does not show extent of oil accumulation in estuaries; increased vulnerability of west-facing beaches because of prevailing winds and currents is clearly shown.



Field sketch of oiled beach, done by the beach processes group from the University of South Carolina, who examined the many and varying effects that the oil had on the differing landforms of the Brittany coast.

to study and assess environmental damage resulting from a spill, and to carry out physical, chemical, and oceanographic studies of the behavior, movement, and dispersion of the oil at sea and in the surf zone. Dr. Laubier expressed great interest in the concept and the offer, and said he would call back. In the meantime, SOR team members were alerted and asked to prepare research programs that might best suit the situation.

The following day Dr. Laubier called Dr. Hess to accept the offer, requesting assistance particularly in the area of physical oceanography and beach processes. The French were well established in biological studies and long-term physical measurements.

On the late afternoon of March 18—48 hours after the grounding—five members of the team were on their way to France. With them, they took a full field kit, previously assembled on the basis of their experience with earlier spills such as the Argo Merchant wreck off Massachusetts. The kit includes a complete field chemistry laboratory for field extractions, sterile bag samplers, drift cards, exposure suits, radio equipment, and necessary glassware. In addition, it includes data bank cameras—which show on each frame of exposed film the exact time of exposure, and other information as noted by the photographer—and photo processing equipment. The kit consists of 24 pieces of luggage, taken by hand by the team members.

The original NOAA team bound for France consisted of three SOR team scientists—Dr. Peter Grose of the Environmental Data Service, from Washington, D.C.; team leader David Kennedy of the Environmental Research Laboratories, from Boulder; and Dr. Jerry Galt of the Pacific Marine Environmental Laboratory, Seattle, Washington. With them as part of the team were two University of South Carolina scientists, Eric Gundlach and Craig Shipp, who are experts in beach processes—the interactions of oil and water on the sand. They were joined later by Dr. Miles Hayes, Director of the university's Coastal Research Division.

Another oil spill expert and NOAA consultant, Dr. Roy Hann of Texas A & M University, was enroute to the spill and joined the SOR team in Paris. Dr. Hann possesses unique capabilities as an engineer coupled with scientific cleanup experience in spills dating back to the Metula incident off Chile in 1974.

The team members were met at the airport at Brest by Dr. Laubier, warmly welcomed, and briefed on the latest situation and on the French scientific effort. They were also given official letters that they could show to the local populace, identifying them as American members of the French team. In company with Dr. Laubier and his chief, Yves La Prairie—director of CNEXO (Centre National pour l'Exploitation des Oceans) in Paris—they immediately visited the area near the Portsall Rocks where the ship was aground, saw the ship and oil beginning to foul the beaches, and took their first oil sample.

The land that the SOR team saw is an ancient province of France, part of a great peninsula that stretches far to the west of most of the nation. It lies south of the English channel, below Cornwall and Devonshire in England. It is a gently rolling land, once heavily forested, with a varied rocky coastline that reminded team members of the coast of Maine or of parts of the northwest. Rocky headlands and bluffs alternate with sandy beaches, which are important resort and recreational resources. Numerous small estuaries provide outlets for streams and rivers, and nurseries for fish and shellfish.

The hardy Bretons have been fishermen and farmers for generations, and many of the older people still speak the Breton language, a Celtic tongue related to Cornish and Welsh rather than to French. Place names give evidence of this distinct culture and language, and the SOR team members found themselves working in or passing through towns with names like Ploudalmezeau, Trolouc'h, Kerverven, and Plouescat. Neat white houses, customarily with a chimney at each end and always with a steeply pitched black slate roof instead of the red or blue tile common to many other parts of France, made up the towns and villages.

Brittany is also a land replete with megalithic monuments, and the American scientists occasionally saw menhirs—huge rocks that had been stood on end by some ancient people, the relics of a long-lost culture—as they passed on their way to beach and shore.

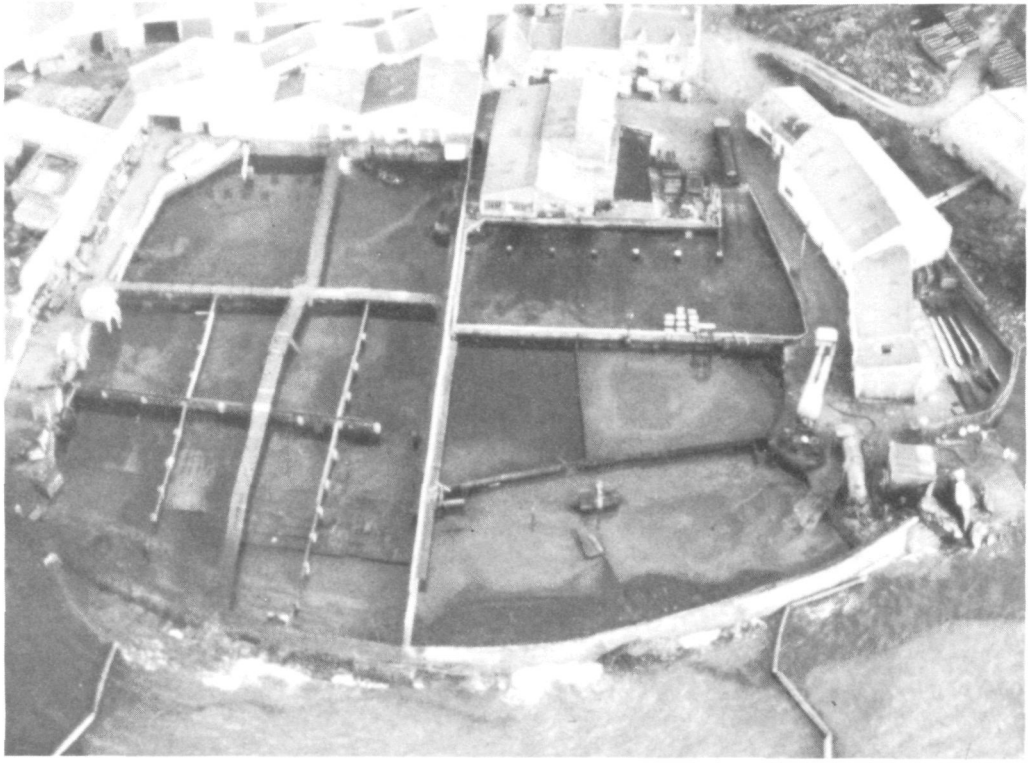
One of the great contributions of Brittany to the cuisine of France is seafood—lobster, clams, mussels, crab, cockles, shrimp, oysters, salmon, and trout. Both commercial fishing and mariculture operations support this extensive industry. Another commercially important resource of the sea is kelp, and near the town of Portsall, small piles of flat stones are laid out in long neat rows, and the kelp placed on them to dry after it has been harvested. Nearby, SOR team members also were able to see brightly painted fishing boats, pulled high up on the bluff to escape the oil and there to wait, unused, until the effects of what the French called "la marée noire"—the black sea—have disappeared.

Jerry Galt (left) of PMEL and Craig Shipp of the University of South Carolina make geology transect along heavily oiled beach.

By Sunday evening, March 19, the Amoco Cadiz had spilled an estimated 22 million gallons, approximately one-third of its cargo, into the cold waters off the Breton coastline. This was about as much as had been spilled by the Torrey Canyon in 1967. During the weekend the winds continued from the west and northwest, and the oil continued to be driven onto the shores of Brittany.

It was already apparent that this was becoming the world's worst oil spill. With worsening weather, attempts made by the owners and contractors to pump the remaining oil out of the ship had to be abandoned. Ultimately the entire 220 thousand tons of oil—216 thousand tons of crude as cargo, and four thousand tons of engine oil—went into the sea.

Two hundred and twenty thousand tons of oil is 63 million gallons. By contrast, the Torrey Canyon, wrecked in 1967 off Land's End, England—only about 100 miles north-northwest of Portsall Rocks—spilled 29.4



Top photos show two clean-up methods attempted. Left, an "oil mop" is dragged mechanically through marsh covered with oil, then wrung out in tank truck (not shown); right, French army trucks pressed into service to carry away heavily oiled sand. At bottom, lobster and shellfish holding tanks at Roscoff were overrun with oil.

million gallons, and the Argo Merchant wreck off Nantucket Island in 1976 dumped less than eight million gallons into the sea.

Using the facilities of the guest house at the COB as its headquarters, the SOR team arranged for necessary logistics support, including a helicopter and fixed-wing aircraft, and put the scientific plan into operation.

The overall SOR team objectives for this event were three, and each encompassed within it several tasks and the means for achieving the desired results.

The first objective was to conduct studies of the movement, distribution, and behavior of the oil. This was accomplished primarily by establishing a grid system for the aircraft flights, with the planes following precisely defined paths while vertical photographic records were made of oil and ocean at regular intervals. As planned, non-oiled areas as well as oiled were photographed. With the photographs, the missing areas between frames could be estimated and statistical mapping of the oil distribution obtained. It was probably the first time that this technique has been used in a systematic manner in an oil spill.

One feature stood out right away. The oil slick was generally confined to within three miles of the beach due to the generally onshore winds. This pushing of the oil on shore caused serious biological damage. By contrast, the United States was fortunate to avoid this problem when the Argo Merchant wrecked off the coast of Massachusetts because the winds in that case were generally offshore.

The photography was supplemented by visual observations and attempts to measure relative water-oil velocities by means of dye markers. The latter technique, successful on other spills, had to be abandoned because the oil sheen was so heavy that it masked the dye color, and because the dye "pills", or sources of the dye, were swallowed up by advancing fingers of the thick "mousse." Mousse is the term adopted by the SOR team to denote a water-in-oil emulsion having the consistency of a chocolate mousse dessert.

The second objective was to study effects of the beaching of oil—beach processes. This was undertaken by the South Carolina group, which has had extensive oil spill research experience, also dating back to the 1974 Metula spill off Chile. Using a series

More clean-up methods. At left, buckets of oil wrung from mops and squeegees sit in front of plastic bags full of oiled sand, seaweed, and gravel. At right, tank trucks pump oil from separation pits dug in back of high tide line.

of factors including wind and wave characteristics, beach activity and grain size, oil characteristics, and initial biological effects, the group has devised a classification of coastal environments in terms of potential oil spill damage—a vulnerability index. In order of increasing vulnerability, these environments range from exposed, steeply dipping rocky shores through exposed tidal flats to sand and gravel beaches and ultimately, the most vulnerable of all, salt marshes and mangroves. The group observed more than 100 areas of affected beach and shore in the light of this index.

To carry out their work, they employed standard geological techniques, going from beach to beach to make transects, visual observations, and sketches, and sometimes to dig trenches so that they could look at oil-sand stratification. Indeed, they saw more of the details of the oil's effects on beaches than did any of the other team members. They were also able to observe and make some judgments about varying types of beach cleanup methods used.

The third objective was to study the chemical fate of the oil, and concentrations of oil in the water column. The team collected samples for chemical analysis, working closely with the French. Some samples were analyzed to give the total oil content, using ultraviolet fluorescence.

Two other objectives were to observe and assess cleanup techniques, the province of Dr. Hann, and to survey the biological consequences of the spill, a task began about two weeks after the spill by Dr. Bud Cross and continued by Dr. Don Hoss, both of the National Marine Fisheries Service laboratory at Beaufort, N.C.

Field work began in concentrated fashion on Monday and Tuesday, the 20th and 21st. The beach processes group, strengthened with the addition of Laurent d'Ozouville of the Centre Océanologique de Bretagne, began at Portsall, the area closest to the tanker, and worked eastward, following the general trend of the oil. The physical oceanographic team, working closely with Dr. Alain Cavanie, head of COB's physical oceanography department, made their first aircraft flight—a two-hour reconnaissance of the beaches—on Tuesday. These flights continued regularly thereafter whenever the weather permitted. Indeed, despite the continuing bad weather, the team missed flying only one of 12 days. On several days, the winds were up to 40 knots, with rain and low ceilings.

On Thursday, March 22, the SOR team was expanded with the arrival of Dr. John Calder and Lt. John Kineman, NOAA Corps—chemists from OCSEAP (Outer Continental Shelf Environmental Assessment Program) in Boulder. They took over responsibility for conducting the chemical oceanographic work, and began collecting water samples on Thursday, March 24. The laboratory fluorometer analysis showed surprisingly high amounts of oil in the water—amounts up to several parts per million. This, they noted, was much higher than had been found in the Argo Merchant spill, and implied very bad news for the living resources in the Breton coastal area.

The chemical team also used a towed fluorometer from a ship to acquire both vertical profiles and transverse sections of oil in the water column. Among the most important areas where this work was carried on was one of the chief oyster and mussel culture estuaries, called—in the old Breton tongue—Aber Wrac'h.

In this manner the SOR team scientists—working during the day as subteams, and coming together in the evening—pursued their research. The physical oceanographers took to their aircraft, photographing and noting what they saw, and visiting the coast line for ground samples. The chemical group took its samples and, with the help of facilities made available by COB, made preliminary analyses. The South Carolina group, dubbed the "Beach Boys" by coworkers, worked steadily eastward from Portsall, examining beaches, laying out transects, coring, sketching, and determining the amount of damage to each kind of terrain. It also revisited areas to note the changes that occurred in time.

For example, on March 25 and 26, the "flood tide," the great spring tide that was the highest of the year, came in, adding to the difficulty of those fighting the effects of the spill. It washed the oil higher up on beaches and onto roadways and in towns, and when it receded its high mark was an oily band that stretched intermittently for miles along the coast.

In the evening the various groups returned to COB, processed film, performed laboratory work, and met to compare observations, exchange ideas, and plan the following day's activities. Continual contact was maintained with the responsible French scientific authorities so that everyone could be fully informed of all programs, activities, and findings of all the groups. In addition, they usually carried out

their field work together with their French counterparts.

During its stay in Brittany, the SOR team was joined by Dr. John Laseter of the University of New Orleans, a specialist in hydrocarbon chemistry who is helping do chemical analysis on the many samples collected.

On Tuesday, March 28, the overflight group noted that, with strong winds from a different direction, masses of oil had started to move toward the south coast of England. NOAA notified the U.S. Embassy in London of this situation, but by the following afternoon the winds had died down and the oil once more came under primary influence of currents and tides, which continued to push it eastward along the coast of Brittany. By the end of the second week the operation had largely wound down, although Calder and Kineman accompanied a French group on the research vessel Le Suroit for a five-day cruise to survey the waters offshore of the impacted coastal areas and take samples for chemical analysis.

Many interesting and useful lessons have already been learned from this work. The shoreline of Brittany that was affected by this disastrous spill is geologically similar to that of northern Maine and Nova Scotia, and parts of southeastern Alaska, in the sense that it is a shoreline of bedrock control with large tides and often heavy, high waves. There are interspersed sandy beaches, gravel beaches, and marshes. Members of the SOR team observed in one place, for example, that the waves were pounding on rocks which in turn were beating the oil to a froth. The reflected waves off the rocks tend to push the oil away from the beach, helping to keep it clean. In this area, and others like it, there should be little long-term effect.

In a small bay with a western exposure near the town of Lannion, however, they observed a marsh where the oil was simply collecting, compacting, settling—in some cases up to 20 centimers in thickness. This area has the top vulnerability index, of 10. Biological effects on the marsh were studied by Dr. Cross and others to see how the marine biota handled the very heavy oiling, and they plan to conduct resurveys from time to time. Such marshes are likely to suffer ecological damage for many years to come. Similar marshes near the Metula spill in 1974 are still seriously impacted.

Beaches that have an easterly exposure generally were not heavily oiled because the westerly winds tended to push the oil past them.

The team also found beaches layered horizontally with oil, sometimes with sand on top making it appear that the beach was not oiled. Successive tides and surfs, sometimes bringing in oil, sometimes bringing in sand, caused this. It indicated that beach cleanup plans should include digging down below the surface to see if there is concealed oil.

On the day that the wind turned offshore, the team noted not only that the oil in the ocean began moving in the new direction, but that the beaches acted as a source of oil. The oil bled off the rocks back into the sea, and a natural cleansing process took place along the shoreline. This was, of course, cleansing in only one sense, because the oil that was cleaned by the wind from the beach was again polluting the water.

Above, tank trucks pumping oily water directly from harbor; at left, heavy oil slick on water (foreground) damps incoming waves. Facing page, fishermen at Portsall wait by their boats, pulled high up on a cliff to avoid the spill.

NOAA scientists were to see some beaches—particularly a small headland in the Bay of Lannion—where thousands upon thousands of shellfish and other sea creatures, such as sea urchins, had washed up on the shore after the oil had spread to their breeding areas. At Roscoff a major lobster cooperative, where lobsters and crabs imported from all over the world are held for sale, was critically affected. Its holding pens were heavily oiled, and staff of the organization expect them to be unusable for perhaps a year. Tanks are now being used to hold a limited number of the animals, with unpolluted salt water brought in by tank truck from the neighborhood of Brest. Oyster culturists along the shore were also hard hit, and the animals being grown on suspended racks or in beds were essentially wiped out in the area of the spill.

Effects on the kelp near Portsall and on the coastal fishery are not yet known, but are expected to be severe. Kelp that SOR team members saw washed up on shore was often heavily oiled. Fishermen in the area at one point turned their fishing permits back in to the government, and no commercial fishing is planned for this season. Some experimental fishing has been conducted, and reportedly the fish caught had an undesirable oily taste.

Dr. Hann of Texas A & M has contributed highly useful observations on the scope of the cleanup problems. This spill constituted a disaster of major proportions, and technology used to fight such a large spill has to be vastly different from that used to combat the 12-18,000 small oil spills that the U.S. experiences each year.

The strategy for spills of this kind, he noted, is first to eliminate discharging the oil to the environment. In the case of the Amoco Cadiz, the stormy weather and rapid deterioration of the ship made this impossible. The French decided, after about 90 percent of the cargo had been lost, to bomb the ship so that the remaining oil

would be spilled and not serve as a continuing pollution source after major cleanup operations were under way.

The second step was to provide protection to the areas that are environmentally most sensitive. The mariculture facilities and exposed estuaries thus received priority for protection, and large numbers of booms were deployed in the early days of the spill. The high stresses of the storm, and later the spring tides, eventually rendered all these attempts ineffective.

On the Lannion Peninsula, where there were several days' lead time before the oil reached the area, some resort communities bulldozed the top layers of sand from the beaches and stored it in high piles above the high tide line. Once the oil is cleaned from the beach-face, the plan is to cover the area again with the clean sand.

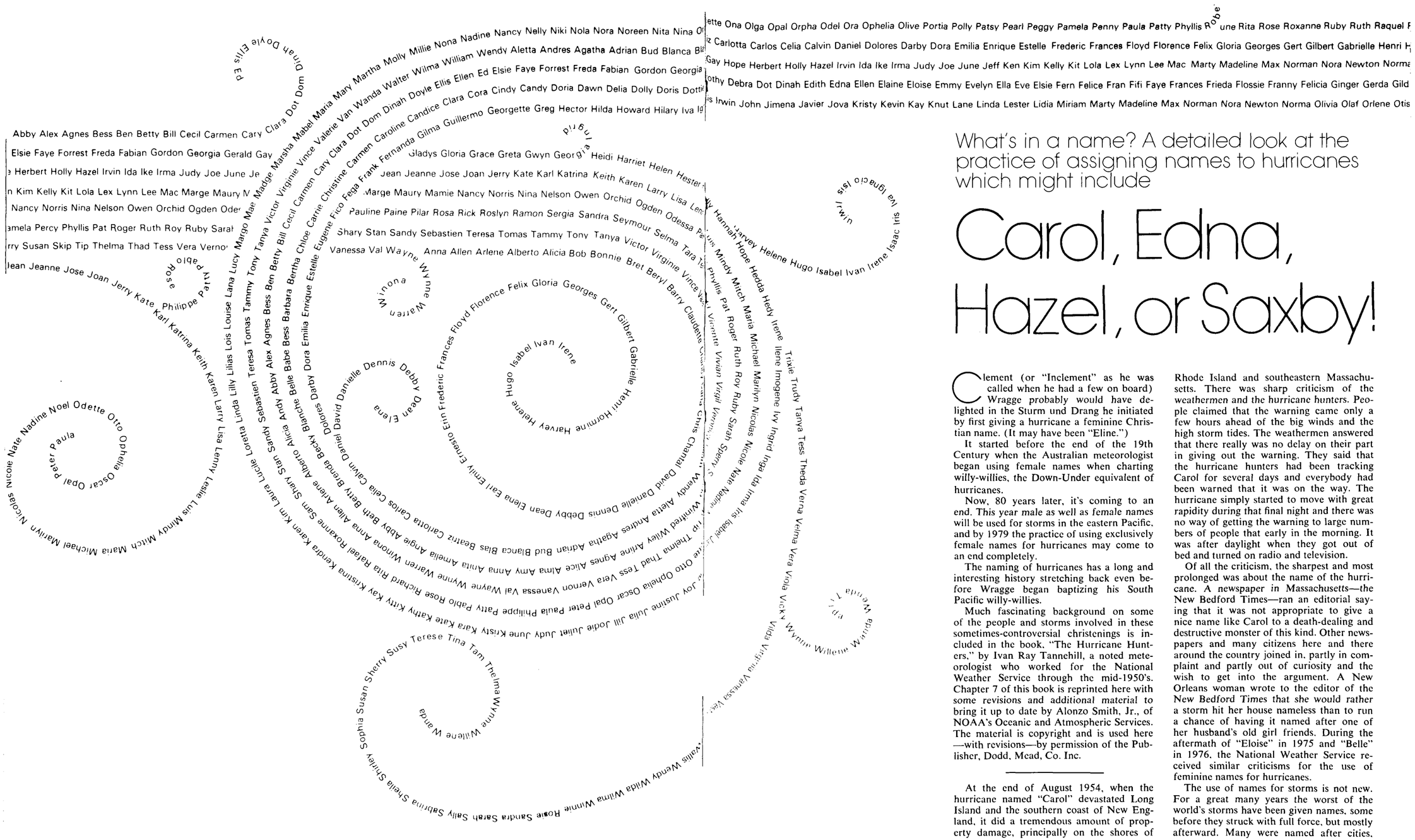
The third phase of the operation, Dr. Hann found, was to collect the floating oil from the surface of the water, where it was thick enough for pumping and for vacuum equipment to be used.

Finally, there came the removal of the stranded oil. It was collected by trenching or digging pits, and gradual removal to larger pits and eventually to pump trucks that could take it away. Returning to the scene six weeks later, Dr. Hann noted that the work had become much more difficult, as the oil had soaked into sand, seaweed, and gravel, and each load that was hauled away contained a lesser percentage of oil and greater percentage of other material than had been true shortly after the spill. The necessity for prompt removal became very apparent as a result of these observations.

The French mounted a massive cleanup effort, involving their civil defense, military, fire departments, public works departments, and multitudes of volunteers, and with vast quantities of such simple but vitally necessary tools as shovels, squeegees, and trash cans. Legions of pump trucks from community sanitary services were pressed into service to pump oil out of pits where it was deposited by beach cleanup crews. For U.S. planning purposes, their experience should be taken into account.

During their two-week period of concentrated effort, the SOR team put one or more field parties on the beach each day, made 13 aircraft flights—eight helicopter, five fixed-wing—and mounted three short cruises on a small local fishing vessel. They obtained more than 900 slides, most of which were immediately processed. A motion picture consisting of 12 rolls of film was made on March 28, covering 115 km of shoreline. They worked closely with their French colleagues throughout the period, benefitting greatly from their help, advice, and support. All this was undertaken on the worst oilspill the world has known, posing problems that are not localized to the French coast.

Conversations have subsequently been carried on by Dr. Hess and others concerning continuation of joint research efforts on the effects of this spill, and SOR team members and other scientists have made follow-up visits to examine longer-term effects. The lessons that are being learned from these efforts will be useful to all environmental scientists and planners. □



What's in a name? A detailed look at the practice of assigning names to hurricanes which might include

Carol, Edna, Hazel, or Saxby!

Clement (or "Inclement" as he was called when he had a few on board) Wragge probably would have delighted in the Sturm und Drang he initiated by first giving a hurricane a feminine Christian name. (It may have been "Eline.")

It started before the end of the 19th Century when the Australian meteorologist began using female names when charting willy-willies, the Down-Under equivalent of hurricanes.

Now, 80 years later, it's coming to an end. This year male as well as female names will be used for storms in the eastern Pacific, and by 1979 the practice of using exclusively female names for hurricanes may come to an end completely.

The naming of hurricanes has a long and interesting history stretching back even before Wragge began baptizing his South Pacific willy-willies.

Much fascinating background on some of the people and storms involved in these sometimes-controversial christenings is included in the book, "The Hurricane Hunters," by Ivan Ray Tannehill, a noted meteorologist who worked for the National Weather Service through the mid-1950's. Chapter 7 of this book is reprinted here with some revisions and additional material to bring it up to date by Alonzo Smith, Jr., of NOAA's Oceanic and Atmospheric Services. The material is copyright and is used here —with revisions—by permission of the Publisher, Dodd, Mead, Co. Inc.

At the end of August 1954, when the hurricane named "Carol" devastated Long Island and the southern coast of New England, it did a tremendous amount of property damage, principally on the shores of Rhode Island and southeastern Massachusetts. There was sharp criticism of the weathermen and the hurricane hunters. People claimed that the warning came only a few hours ahead of the big winds and the high storm tides. The weathermen answered that there really was no delay on their part in giving out the warning. They said that the hurricane hunters had been tracking Carol for several days and everybody had been warned that it was on the way. The hurricane simply started to move with great rapidity during that final night and there was no way of getting the warning to large numbers of people that early in the morning. It was after daylight when they got out of bed and turned on radio and television.

Of all the criticism, the sharpest and most prolonged was about the name of the hurricane. A newspaper in Massachusetts—the New Bedford Times—ran an editorial saying that it was not appropriate to give a nice name like Carol to a death-dealing and destructive monster of this kind. Other newspapers and many citizens here and there around the country joined in, partly in complaint and partly out of curiosity and the wish to get into the argument. A New Orleans woman wrote to the editor of the New Bedford Times that she would rather a storm hit her house nameless than to run a chance of having it named after one of her husband's old girl friends. During the aftermath of "Eloise" in 1975 and "Belle" in 1976, the National Weather Service received similar criticisms for the use of feminine names for hurricanes.

The use of names for storms is not new. For a great many years the worst of the world's storms have been given names, some before they struck with full force, but mostly afterward. Many were named after cities,

towns or islands that were devastated. Others had gotten their names from some unusual weather that came with them or from ships that were sunk or damaged. One of them was named "Kappler's Hurricane" after a weather officer named Kappler who discovered it.

During the latter part of the nineteenth century, a New Englander, Sidney Perley, collected all the available records of storms and other disasters, together with strange phenomena in New England, starting with a big hurricane in 1635, when there were only a few settlers, and continuing down to 1890. His book, *Historic Storms of New England,* was published in Salem, in 1891. He listed floods, earthquakes, dark and yellow days, big meteors, eclipses, avalanches, droughts, great gales, tornadoes, hurricanes, and storms of hail and heavy snow. Prominent among them were the "Long Storm" of 1798, the "September Gale" of 1815, and the "Lighthouse Storm" of 1851.

The "Long Storm" as the name suggests, was of long duration. It began on the seventeenth of November and continued with terrific gales and heavy snow until late on the twenty-first. This violent weather was unprecedented so early in the winter. From Perley's account it seems that the center of the storm crossed Cape Cod. A great many vessels were lost and there was much suffering among the people.

The "September Gale" of 1815 became famous because of a poem written in later years by Oliver Wendell Holmes, who was six years old at the time of the big gale. Holmes remembered and lamented the loss of his favorite pair of breeches, in part as follows:

"It chanced to be our washing day,
And all our things were drying;
The storm came roaring through the lines,
And set them all a flying;
I saw the sheets and petticoats
Go riding off like witches;
I lost, ah' bitterly I wept,—
I lost my Sunday breeches."

Holmes entitled the poem *The September Gale* and so this became the name of the storm. Actually, it was a hurricane quite like those that struck New England in 1938, 1944 and 1954. Years afterward, a New Haven man named Noyes Darling became interested in the storm of 1815 and traced its course by a collection of newspaper accounts from many places and by the logs of ships which had been in the western Atlantic when the hurricane passed. In 1842, he plotted all this information on a map and was able to figure its course. This was rather remarkable, for a study since that time shows that the tracks of hurricanes which do great damage in New England must adhere closely to one path—far enough eastward to clear the land areas as they go northward and far enough westward so that they do not go out into the ocean before they reach the latitude of Nantucket. Those which strike shore to the southward may reach New England but passage over land causes them to lose much of their fury on the way. Darling's plotted path was correct according to experiences since that time.

The "Lighthouse Storm" of 1851 commenced in the District of Columbia on Sunday, April 13, reached New York on Monday morning, and during the day struck New England. It came at the time of the full moon and so the storm-driven waters joined with the high tides, and the sea, rising over the wharves at Dorchester, Massachusetts, came into the streets to a greater height than had ever been known before. All around the coasts of Masachusetts and New Hampshire there was much property damage. The event which gave the storm its name was the destruction of the lighthouse on Minot's ledge, at Cohasset, Massachusetts. It was wrecked and swept away. At four o'clock the morning after the storm some of the wreckage was found strewn along the beach. Two young men, assistant light keepers, were killed. Since this was a very dangerous rock and many vessels had been lost there, a new lighthouse was erected at the same point soon afterward.

One of the most noted storms of the nineteenth century was "Saxby's Gale," which caused a great amount of destruction in New Brunswick on October 4, 1869. The amazing fact was that this storm was predicted nearly a year before by a Lieutenant Saxby of the British Navy. In November 1868, he wrote to the newspapers in London, predicting that the earth would be visited by a storm of unusual violence attended by an extraordinary rise of tide at seven o'clock on the morning of October 5, 1869.

Saxby wrote the following explanation of his forecast to the newspaper:

"I now beg to state with regard to 1869 at 7 A.M. October 5th, the Moon will be at the part of her orbit which is nearest the Earth. Her attraction will be therefore at its maximum force. At noon of the same day the Moon will be on the Earth's equator, a circumstance which never occurs without marked atmospheric disturbance, and at 2 P.M. of the same day lines drawn from the Earth's centre would cut the Sun and Moon in the same arc of right ascension (the Moon's attraction and the Sun's attraction will therefore be acting in the same direction); in other words, the new moon will be on the Earth's equator when in perigree, and nothing more threatening can, I say, occur without miracle. The earth it is true will not be in perihelion by some sixteen or seventeen seconds of semidiameter.

"With your permission I will during September next (1869) for the safety of mariners briefly remind your readers of this warning. In the meantime there will be time for the repair of unsafe sea walls and for the circulation of this notice throughout the world."

It seems that Saxby had made other similar forecasts. Commenting on one of his predictions, a London newspaper, the Standard, said:

"Saxby claims to have been successful in some of his predictions, and he may prove either lucky or clever on the present occasion. As the astronomical effect will operate over the entire globe, it is exceedingly likely there will be a gale of wind and flood somewhere."

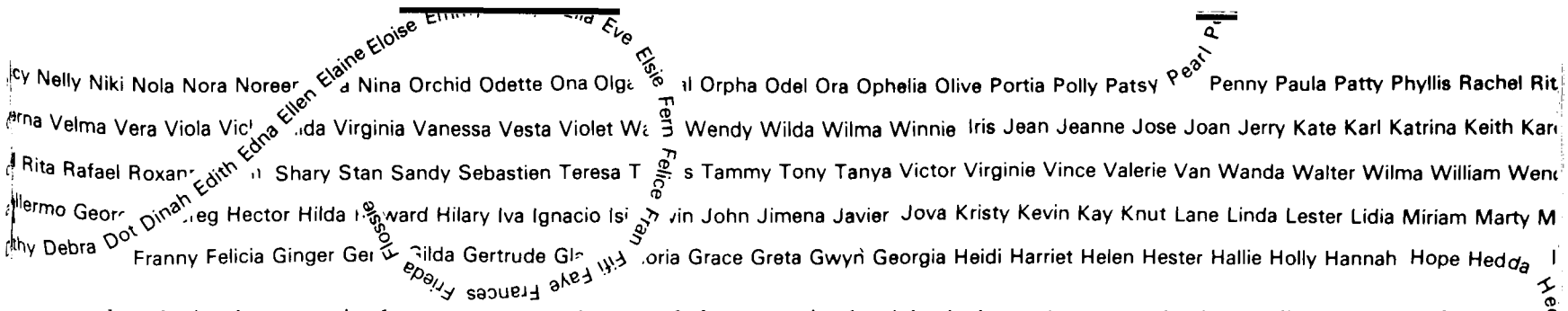
The extraordinary fact is that a citizen of Halifax, Nova Scotia, disturbed by Saxby's prediction for October 5, 1869, wrote to the local newspaper the week before:

"I believe that a heavy gale will be encountered here on Tuesday next 5th October beginning perhaps on Monday night or possibly deferred as late as Tuesday night, but between these two periods it seems inevitable. At its greatest force the direction of the wind should be southwest, having commenced at or near south.

"Should Monday the 4th be a warm day for the season an additional guarantee of the coming storm will be given. Roughly speaking the warmer it may be on the 4th, the more violent will be the succeeding storm. Apart from the theory of the Moon's attraction, as applied to Meteorology—which is disbelieved by many, the experience of any careful observer teaches him to look for a storm at next new moon, and the state of the atmosphere, and consequent weather lately appears to be leading directly not only to this blow next week, but to a succession of gales during next month."

Actually the fourth began as a warm day in New Brunswick and later in the day the storm became violent, as predicted by the Halifax citizen, named Frederick Allison.

There were high tide and heavy rain at Halifax but the weather in general was a disappointment, for the citizens, after seeing the warning in the newspaper, had made many preparations about the wharves, moving goods to higher floors in warehouses,



and anchoring boats out in the stream or securing them with lines in all directions.

Near by in New Brunswick, however, the storm on October 4 was severe. The gale rose to hurricane strength between 8:00 and 9:00 P.M. The tide at St. John was above any preceding mark. Vessels broke away from their moorings and some were badly damaged. Buildings were flooded and in St. John and other cities and towns in the area, buildings were demolished or unroofed, tracts of forest trees were uprooted, and cattle were drowned in great numbers.

All of this was rather remarkable as the storm reached its height at about 9:00 P.M. on October 4th, which was actually after midnight by London time and therefore on October 5th. Regardless of these circumstances, this is an instance of a storm that had a name—"Saxby's Gale"—long before it occurred and for years afterward. Some weathermen thought that it was of tropical origin and had been a hurricane in lower latitudes, but if so, it came overland in its final days, for it was felt at Washington, Baltimore, Philadelphia, and in parts of New England on the third and early on the fourth, with heavy rains and gales in many localities.

A few hurricanes have been named for the peculiar paths they followed. One that was very unusual was the "Loop Hurricane" of October 1910. It was an intense storm that passed over western Cuba, after which its center described a small loop over the waters between Cuba and Southern Florida. When it finally crossed the coast of western Florida, it caused tides so high that many people had to climb trees to keep from drowning. The "Yankee Hurricane" was so named by the Mayor of Miami. It was first observed to the east of Bermuda in late October 1935, moving westward. On approaching the coast of the Carolinas, it took an extraordinary course, almost opposite to the normal track at that season, and went southwestward to southern Florida, with its calm center over Miami on the fourth of November. In the same year, another unusual storm known as the "Hairpin Hurricane" started in the western Caribbean, moved northeastward to Cuba, and then turned sharply southwestward to Honduras, describing a track shaped like a hairpin. It cause one of the worst disasters of that region. Loss of life exceeded two thousand.

Examples of storms named after ships are "Racer's Storm" in 1837, named after a British sloop of war which was caught in its hurricane winds in the Yucatan Channel. Another one of great violence was called "Antje's Hurricane," because it dismasted a schooner of that name in the Atlantic in 1842.

In Puerto Rico, a hurricane may be given the name of the saint whose feast is celebrated on the day on which it strikes the island. The most famous are: Santa Ana, July 26, 1825; Los Angeles, August 2, 1837; Santa Elena, August 18, 1851; San Narcisco, October 29, 1867; San Felipe, September 13, 1876; San Ciriaco, August 8, 1899; and the second San Felipe, September 13, 1928.

One of the worst hurricanes during the twentieth century was the one in 1928, "San Felipe." It caused damage estimated at fifty million dollars in Puerto Rico, and later struck Florida, causing losses estimated at twenty-five million dollars. Puerto Rico lost three hundred lives, Florida nearly two thousand. Other noteworthy hurricanes during this century include:

Hurricanes	Deaths	Damage
1938	600	$350M
1944	46	100M
1954—Carol	60	460M
—Edna	21	40M
—Hazel	95	500M
1955—Connie	25	>50M
—Diane	184	>500M
—Ione	7	>50M
1958—Helene	0	>5M
1960—Donna	50	>50M
1972—Agnes	122	2,000M
1974—Carmine	1	>50M
1975—Eloise	4	>50M
1976—Belle	5	>50M

One of the well-known storms of the West Indies was the "Padre Ruiz Hurricane," which was named after a priest whose funeral services were being held in the church at Santa Barbara, Santo Domingo, on September 23, 1837, when the hurricane struck the island, causing an appalling loss of life and property destruction.

Before the end of the nineteenth century, a weatherman in Australia named Clement Wragge had begun giving girls' names to tropical storms. Down in that part of the Southern Hemisphere, hurricanes are called willy-willies. They come from the tropics on a southwest course and turn to the south and southeast on approaching or passing Australia. Their winds spiral inward around the center in a clockwise direction—the opposite of the turning motion of our hurricanes.

Wragge was the government meteorologist in Queensland, and later ran a weather bureau of his own in Brisbane. A tall, thin, bewhiskered man who stammered, he was known all over Australia as a lecturer on weather and similar subjects. Australians of that time said that, as likely as not, when due to talk about big winds, he would arrive at the lecture hall with "too many sheets out" and fail to keep on his feet during the lecture. Though his name was Clement, he was better known in Australia as "Inclement."

Storms which did not come from the tropics were called by men's names. Generally, Wragge called them after politicians who had earned his disfavor, but for some reason he used girls' names for the willy-willies. As an illustration for his weather journal called "WRAGGE," he had a weather map for February 2, 1898, with a willy-willy named "Eline." He predicted nasty weather from a disturbance named "Hackenbush."

E. B. Buxton, a meteorologist for Pan American Airways, went to the South Pacific in the late thirties and, after hearing about Wragge and his names for willy-willies, adopted the idea for his charts. He recalled particularly using the name "Chloe" for hurricanes.

With few exceptions, the hurricanes of the twentieth century went unnamed in the United States until 1951, although some were referred to in terms of place and date; for instance, the "New England Hurricane of 1938." Unofficially, a few had names of people. In 1949, while President Truman was in Miami addressing the Veterans of Foreign Wars, the first hurricane of the season was called "Harry," and a little later a bigger one which the newsmen said had greater authority struck southern Florida and it was called "Hurricane Bess."

In sending out advices and warnings of West Indian storms, it was not considered necessary to have names, as it was seldom that more than one was in existence at the same time. In 1944, when aircraft reconnaissance began, it became customary to get reports by radio-telephone and voice was used increasingly in other ways by the hurricane hunters. But this gave no particular trouble until September 1950, when there were three hurricanes in progress at the same time.

Two were in the Atlantic, one north of Bermuda and the other north of Puerto Rico. The third appeared in the eastern Gulf of Mexico. When aircraft were dispatched into these storms and began reporting, there was increasing confusion. Other communications and public advices became mixed and there was much uncertainty as to which storm was meant. Use of letters of the alphabet to identify them was no help, for letters B, C, D, E, and G sound much alike by radio-telephone; also A, J, and H. Numbers were no better because weather reports

1971 Ten Year List

1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Arline	Agnes	Alice	Alma	Amy	Anna	Anita	Amelia	Angie	Abby
Beth	Betty	Brenda	Becky	Blanche	Belle	Babe	Bess	Barbara	Bertha
Chloe	Carrie	Christine	Carmen	Caroline	Candice	Clara	Cora	Cindy	Candy
Doria	Dawn	Delia	Dolly	Doris	Dottie	Dorothy	Debra	Dot	Dinah
Edith	Edna	Ellen	Elaine	Eloise	Emmy	Evelyn	Ella	Eve	Elsie
Fern	Felice	Fran	Fifi	Faye	Frances	Frieda	Flossie	Franny	Felicia
Ginger	Gerda	Gilda	Gertrude	Gladys	Gloria	Grace	Greta	Gwyn	Georgia
Heidi	Harriet	Helen	Hester	Hallie	Holly	Hannah	Hope	Hedda	Hedy
Irene	Ilene	Imogene	Ivy	Ingrid	Inga	Ida	Irma	Iris	Isabel
Janice	Jane	Joy	Justine	Julia	Jill	Jodie	Juliet	Judy	June
Kristy	Kara	Kate	Kathy	Kitty	Kay	Kristina	Kendra	Karen	Kim
Laura	Lucile	Loretta	Linda	Lilly	Lilias	Lois	Louise	Lana	Lucy
Margo	Mae	Madge	Marsha	Mabel	Maria	Mary	Martha	Molly	Millie
Nona	Nadine	Nancy	Nelly	Niki	Nola	Nora	Noreen	Nita	Nina
Orchid	Odette	Ona	Olga	Opal	Orpha	Odel	Ora	Ophelia	Olive
Portia	Polly	Patsy	Pearl	Peggy	Pamela	Penny	Paula	Patty	Phyllis
Rachel	Rita	Rose	Roxanne	Ruby	Ruth	Raquel	Rosalie	Roberta	Rosie
Sandra	Sarah	Sally	Sabrina	Sheila	Shirley	Sophia	Susan	Sherry	Suzy
Terese	Tina	Tam	Thelma	Tilda	Trixie	Trudy	Tanya	Tess	Theda
Verna	Velma	Vera	Viola	Vicky	Vilda	Virginia	Vanessa	Vesta	Violet
Wallis	Wendy	Wilda	Wilma	Winnie	Wynne	Willene	Wanda	Wenda	Willette

are sent by number and the advisories issued on each storm are numbered, so that the number 3 could be the number of the storm, the number of the advice, and element of the weather, the hour, etc.

The agencies involved in weather and communications in connection with hurricanes met early in 1951 and decided to identify storms by the phonetic alphabet, which gave Able for A, Baker for B, Charlie for C, etc. (Able, Baker, Charlie, Dog, Easy, Fox, George, How, Item, Jig, King, Love, Mike, Nan, Oboe, Peter, Queen, Roger, Sugar, Tare, Uncle, Victor, William, Xray, Yoke, Zebra)

In the 1951 season, this worked very well in the communications and the public began to speak of hurricanes by these names. At the start of the 1952 season, the agencies began to use the same list of names, starting with Able for the first storm, but soon ran into difficulty. A new international alphabet had been introduced as follows: Alpha, Bravo, Coca, Delta, Echo, Foxtrot, Golf, Hotel, India, Juliet, Kilo, Lima, Metro, Nectar, Oscar, Papa, Quebec, Romeo, Sierra, Tango, Union, Victor, Whiskey, Extra, Yankee, Zulu.

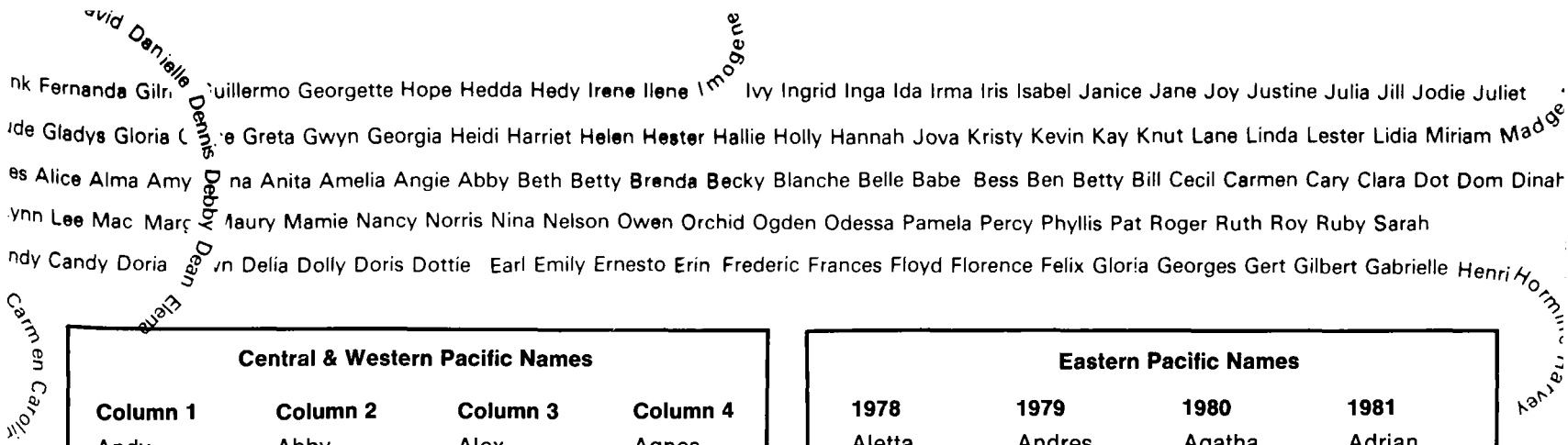
Some of the agencies had begun using the new alphabet in their communications, while others stuck to the old one. So the third storm of the season was "Charlie" part of the time and the rest of the time some wanted to call it "Coca." At the end of the season there was no agreement as to which phonetic alphabet should be used and there was criticism for having continued an alphabet which was obsolete internationally.

After a long discussion, military members of the conference suggested adoption of female names, which had been used successfully for typhoons in the Pacific for several years. Just how this practice originated is not known, but it was thought by some persons to have come from the book *Storm*, by George R. Stewart, which was published in 1941. In this book a fictitious Pacific storm is traced to the United States and its effects on the people are narrated in the style of a novel. A young weatherman at San Francisco, according to the story, called the storm Maria. Also there was Wragge's use of female names for willy-willies in Australia and Pan American Airway's practice in connection wtih hurricanes as early as 1938. At any rate, with these Pacific precedents, the weathermen and hurricane hunters adopted the following list for 1953 for hurricanes in the Atlantic, Caribbean and Gulf of Mexico: Alice, Barbara, Carol, Dolly, Edna, Florence, Gilda, Hazel, Irene, Jill, Katherine, Lucy, Mabel, Norma, Orpha, Patsy, Queen, Rachel, Susie, Tina, Una, Vicky, Wallis.

This list worked perfectly in 1953; the public was pleased; the communicators were happy about it; the newspapers thought it was colorful; and use of the same names began to spread in Canada and some of the countries to the southward. The same list was adopted with enthusiasm for the 1954 season.

In 1954, Alice and Barbara were minor hurricanes in the Gulf of Mexico, although Alice broke up in tremendous rains in the upper watershed of the Rio Grande, after moving inland over Mexico. There were floods which broke records for all time as the water moved down the river. The third storm, Carol, started a controversy in the press and many letters were written to the editors and to the Weather Bureau, some favoring the scheme or trying to get a little fun out of it, but most of them finding objections of one kind or another. It was almost impossible to change in the middle of the season, even if the hurricane hunters had wanted to, so it was continued during 1954 and each new hurricane aroused further comment. Later Hazel came along about the middle of October, a very severe hurricane from the Caribbean Sea. It turned northward between Cuba and Haiti and caused terrible damage and much loss of life. Later it struck the coast of the Carolinas and crossed the eastern states northward to New York. Loss of life in the eastern states was variously estimated from fifty to eighty, and the damage to property, especially from falling trees, was enormous. There was another flood of complaints, this time about the name Hazel.

Before the argument was ended it threatened to be almost as stormy as some of the smaller hurricanes so named. Early in 1955 the Weather Bureau had a meeting with the Air Force, Navy and others interested in deciding the question. By that time the



Central & Western Pacific Names

Column 1	Column 2	Column 3	Column 4
Andy	Abby	Alex	Agnes
Bess	Ben	Betty	Bill
Cecil	Carmen	Cary	Clara
Dot	Dom	Dinah	Doyle
Ellis	Ellen	Ed	Elsie
Faye	Forrest	Freda	Fabian
Gordon	Georgia	Gerald	Gay
Hope	Herbert	Holly	Hazen
Irvin	Ida	Ike	Irma
Judy	Joe	June	Jeff
Ken	Kim	Kelly	Kit
Lola	Lex	Lynn	Lee
Mac	Marge	Maury	Mamie
Nancy	Norris	Nina	Nelson
Owen	Orchid	Ogden	Odessa
Pamela	Percy	Phyllis	Pat
Roger	Ruth	Roy	Ruby
Sarah	Sperry	Susan	Skip
Tip	Thelma	Thad	Tess
Vera	Vernon	Vanessa	Val
Wayne	Wynne	Warren	Winona

Eastern Pacific Names

1978	1979	1980	1981
Aletta	Andres	Agatha	Adrian
Bud	Blanca	Blas	Beatriz
Carlotta	Carlos	Celia	Calvin
Daniel	Dolores	Darby	Dora
Emilia	Enrique	Estelle	Eugene
Fico	Fefa	Frank	Fernanda
Gilma	Guillermo	Georgette	Greg
Hector	Hilda	Howard	Hilary
Iva	Ignacio	Isis	Irwin
John	Jimena	Javier	Jova
Kristy	Kevin	Kay	Knut
Lane	Linda	Lester	Lidia
Miriam	Marty	Madeline	Max
Norman	Nora	Newton	Norma
Olivia	Olaf	Orlene	Otis
Paul	Pauline	Paine	Pilar
Rosa	Rick	Roslyn	Ramon
Sergio	Sandra	Seymour	Selma
Tara	Terry	Tina	Todd
Vicente	Vivian	Virgil	Veronica
Willa	Waldo	Winifred	Wiley

Atlantic Names

1979	1980	1981	1982	1983
Ana	Allen	Arlene	Alberto	Alicia
Bob	Bonnie	Bret	Beryl	Barry
Claudette	Charley	Carla	Chris	Chantal
David	Danielle	Dennis	Debby	Dean
Elena	Earl	Emily	Ernesto	Erin
Frederic	Frances	Floyd	Florence	Felix
Gloria	Georges	Gert	Gilbert	Gabrielle
Henri	Hermine	Harvey	Helene	Hugo
Isabel	Ivan	Irene	Isaac	Iris
Juan	Jeanne	Jose	Joan	Jerry
Kate	Karl	Katrina	Keith	Karen
Larry	Lisa	Lenny	Leslie	Luis
Mindy	Mitch	Maria	Michael	Marilyn
Nicolas	Nicole	Nate	Nadine	Noel
Odette	Otto	Ophelia	Oscar	Opal
Peter	Paula	Philippe	Patty	Pablo
Rose	Richard	Rita	Rafael	Roxanne
Sam	Shary	Stan	Sandy	Sebastien
Teresa	Tomas	Tammy	Tony	Tanya
Victor	Virginie	Vince	Valerie	Van
Wanda	Walter	Wilma	William	Wendy

opinions received by mail were overwhelmingly in favor of continuing female names. In the meantime, there had been a surprise. A storm having some of the characteristics of a hurricane was sighted in the Caribbean Sea in January and, in the absence of a decision on names to be used in 1955, it was called Alice from the 1954 list. Later, the names for others in 1955 were decided as follows: Brenda, Connie, Diane, Edith, Flora, Gladys, Hilda, Ione, Janet, Katie, Linda, Martha, Nellie, Orva, Peggy, Quenna, Rosa, Stella, Trudy, Ursa, Verna, Wilma, Xenia, Yvonne, Zelda.

In 1971 the National Weather Service prepared a semi-permanent list of ten sets of tropical storm names in alphabetical order. Names beginning with Q, U, X, Y, and Z were not included because of their scarcity.

A separate set of names is used each year, beginning with the first name in each set.

Things remained stable for a number of years, but change was in the wind. At the World Meteorological Organization Region IV Meeting in April 1977, a Hurricane Committee was established to develop a new list of names to be used in the Atlantic beginning in 1979. Region IV recommended that the revised list contain not only male and female names, but also take into account the languages (Spanish, French and English) indigenous to the Atlantic/Caribbean region. At the 32nd Interdepartmental Hurricane Conference (IHC) the members proposed such a list for the Atlantic.

In the interest of maintaining consistency, the 32nd IHC adopted a revised list of names for the Eastern Pacific, which was implemented this year. In addition, the IHC suggested a similar list of names for typhoons in the Central Western Pacific. This list is being coordinated with the WMO Region V.

Thus, for the first time a system now exists to revise names for tropical storms throughout the major portions of the Northern Hemisphere. In the future, instead of "Carol, Edna, Hazel or Saxby" we could have "Carlos, Emilia, Henri or Sandra"! □

Tax Time In Yup'ik

By VIRGINIA SIMS *

Photography by Craig Wiese and Virginia Sims

"AWFULLY WHITE, isn't it?"

It is. Also flat, and frozen, and empty, and seemingly endless. From the window of the small plane, flying over the vast delta region of Western Alaska that lies between the Kuskokwim River and the Yukon, the horizon seems to vanish in a merging of snow and white sky.

In the summertime, the area would be a shimmering maze of waterways, marsh, and tundra—one of the greatest nurseries in the world for ducks and geese. But now it is locked tightly under a sheath of ice and snow. All that can be seen are twisting, scroll-like traces of nameless streams and sloughs. The only sign of life is the occasional flat track of a snowmachine—as much of a surprise here as a bicycle track across the Sahara.

But for Alexie Pavilla, sitting in the rear of the plane, there is much to observe, consider, remember. As a Yup' ik Eskimo, this is his country. As an Alaska Sea Grant Marine Advisory Agent, this is his territory.

Pavilla is flying today because this trip from his home at Atmautluak to Mountain Village is a little over the 100-mile limit he has set for himself for traveling by snowmachine. (Personally, he would much prefer to be down there on the snowmachine.) And there is another reason: with the April 15 deadline for filing income tax returns fast approaching, he is very busy.

In this area where fishing is about the only industry, much of Pavilla's time is taken up with such concerns as workshops on gear construction and repair, quality control, and basic business management. But from January through April, the big rush comes in helping his Yup'ik-speaking people cope with the intricacies of the Internal Revenue Service forms that can send English-speaking executives running for their attorneys.

Of course, these people are not executives. They are commercial fishermen, living in one of the most economically depressed areas in North America. And Pavilla is no attorney. In fact, his formal education ended with the eighth grade. But under the tax laws, any fisherman who owns and operates one of the long flat river skiffs—kicked along by a five-year-old outboard, with a pile of gear in the bottom—qualifies as a small businessman. And Pavilla, bolstered by a keen intelligence, tireless dedication, and a wide knowledge of the tax laws as they apply to his people, is there to see that they get all the breaks they have coming.

Alexie Pavilla, Alaska Sea Grant Marine Advisory Agent, (left) helps fellow Yup'ik with Income Tax forms; on facing page, he begins another trip to a small village.

"Before, the people used to just send their fish tickets (records of sale to the fish buyers) to the IRS and pay their income taxes on their gross earnings," Pavilla explained. "They didn't take any deductions for expenses, or cost of equipment, or depreciation, or anything. They were paying far too much in taxes.

"So I try to tell them to keep receipts, or some kind of records—to just write down how much something costs and the date. This seems a little bit hard for some of the people around here. But they are learning."

So Pavilla crisscrosses his territory—which is larger than the state of Maine—trying to spread the word, lend a hand, and add a few more villages to his already impossible beat.

To many visitors, it is a surprise to find that this remote section of Southwest Alaska not only is Eskimo country, but is almost like a Yup'ik Eskimo nation. Its people have clung to their old culture, probably more closely than have any of Alaska's other native groups. Although many are bilingual to some extent, more than 90 percent still speak their traditional Yup'ik.

The Yup'ik area runs roughly from Bristol Bay in the south to Unalakleet on Norton Sound, which is generally regarded as

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* *Virginia Sims is with the Alaska Sea Grant Program in Fairbanks.*

the dividing line between the Yup'ik Eskimos and their arctic cousins, the Inupiaq Eskimos to the north. Except for Bethel, the region's one city of any size, the 16,000 Yup'ik people live in small villages sprinkled among the myriad waterways and along the low-lying Bering Sea coast.

Here, the Eskimo is at home and the *kass'aq* (pronounced "gussuk") is the stranger. (Kass'aq, the Yup'ik word for white person, is believed to come from the Russian word *Cossack,* harking back to Alaska's old days under the czars and the Eskimo's first encounter with the white man.)

Alexie Pavilla was born and raised in the old-style sod house of the Alaska Eskimo. His village, which was about 60 miles northwest of Bethel, has now vanished like many of the fragile settlements of the delta region. In 1948, when he was 12 years old, the family moved to the nearby village of Kasigluk, and he started to school for the first time. He was also introduced to the English language.

"I spent a year in the first grade, and then for some reason I was jumped to the fifth grade," he recalled. "But at that time I didn't care much for education. When I finished the eighth grade I quit. I didn't go to high school."

Except for a month at a bookkeeping and business school in Canada and ten months at a welding school in California, both sponsored by the Bureau of Indian Affairs, that was the extent of his formal education. He supported his wife, Lena, and his growing family of six children in the traditional way by fishing, hunting, and trapping.

All that changed in 1970, when Pavilla answered an ad in Bethel's weekly newspaper *Tundra Drums,* calling for a bilingual Yup'ik-speaking person with a background in fishing, gill net repair, and outboard motor repair. "I had some background in all of that," he chuckles. "I'd been doing that since I was a little boy." He was called to Fairbanks for an interview, and hired on the spot by John P. Doyle, head of the Marine Advisory Program of the University of Alaska Sea Grant.

That first year, Pavilla held workshops on gear repair, net mending, and fish handling in villages all the way from the lower Kuskokwim River to the mouth of the Yukon. The hours were long, the distances great, and the welcome—in this area where anyone with a link to the State or Federal government is viewed with suspicion—wasn't always certain.

"At first, some people thought I might be a state fish and game guy or something," he explained. And while time has taken care of much of this misunderstanding, it can still be a nagging problem, especially in a new village where somebody thinks Alexie is from the IRS and that somebody finds out that he owes money in taxes. But that doesn't happen very often.

So, in early March—income tax time—Alexie Pavilla sets out to help his far-

flung people, joined by another Marine Advisory Agent, Craig Wiese of Cordova, and this writer, a member of the Sea Grant staff in Fairbanks. Wiese is along to help out on what has become an overpowering income tax load, and also to conduct some workshops on small business loans. His article "Commercial Fishing Loans: Where to . . . How to. . . ." which appeared in a fall issue of *Alaska Seas and Coasts,* a Sea Grant newsletter for the commercial fishing industry, drew wide attention and Wiese is now in demand as a speaker.

Normally, the trip from Bethel to nearby villages would be made via Pavilla's snowmachine, with a sled towed along behind to accommodate passengers, backpacks, and sleeping bags. But this time it is made, unbelievably, in a new little Opel which Pavilla's son Mike purchased with profits from a successful $15,000 fishing season.

Driving down the frozen freeway of the broad Kuskokwim in a sportscar is an experience one doesn't forget: Oscarville, with a huge American flag flying, whistling by to starboard; Napaskiak, with the tiny onion-shaped dome of its Russian Orthodox church, looming to port, and the island where Pavilla sets up his summer fish camp coming up hard ahead.

The first destination is the village of Napakiak (not to be confused with Napaskiak), 10 miles down river from Bethel. Here we are greeted by yapping sled dogs, flapping laundry (it is the first sunny day in weeks), and friendly nods for Pavilla. Permission is granted by the head of the Village Council to set up shop in the "City Hall," a fairly new prefabricated structure with two small offices and a meeting room.

While tables are cleared and chairs unfolded, the announcement goes out on the village radio-telephone in a torrent of Yup'ik—with the words "income tax" coming through loud and clear. IRS forms are spread out, coffee is made, and soon the room is crowded with people with problems. Pavilla and Wiese set to work.

It is really more of an income tax service than an income tax workshop. Each case is individual, of course. And there is the added burden of translating "business expenses" to "new gaff hook," as well as English to Yup'ik and back again.

Except for an improvised supper of bread and cheese and canned fruit purchased at the village store, work continues without a break until 8 p.m. Then the scene shifts to the dimly lit, split-log village meeting house where Wiese will conduct the loan workshop, with Pavilla translating.

Establishing credit of any kind is hard in this land of no VISA cards, few charge accounts, and little collateral, but Wiese carefully traces the various routes and sources available. Among them is the BIA small business loan program which applies only to businesses that are at least 51 percent native-owned and operated. Wiese emphasizes the "operated."

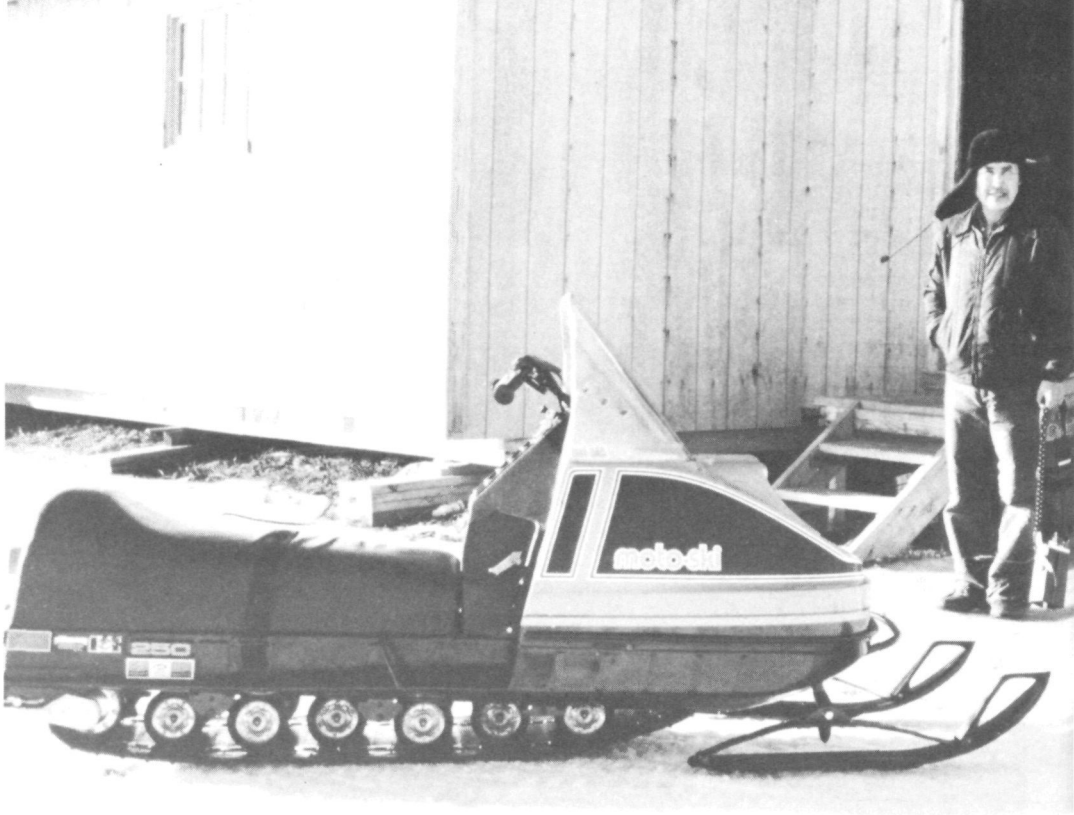
"That means if a native woman marries a gussak, she must still be in charge of the operation to qualify under this loan program," he explains. Although "women's lib" has a long way to go in this culture, the all-male Eskimo audience nods its approval.

There are questions and lengthy answers from Pavilla in Yup'ik. ("That person thought you were the official who could make the loans," he tells Wiese, who laughs and shakes his head.) But finally, late in the evening, the session is over. Somebody rounds up the key to the clinic, which doubles as the village hostelry, sleeping bags are rolled out, and a long day ends.

The tax sessions continue through the next morning and into the afternoon until Pavilla calls a break for a little ice fishing. The northern pike are running; it is a glorious day; and people are bent over holes all over the river. At one point, a snowmachine pulls up with a sledful of kids and mothers in tow. The kids race off with their fishing gear and the mothers uncork a thermos of coffee. We all catch fish, then reluctantly head back for more taxes.

The following day is taken up with a full round of business in Bethel. Pavilla and Wiese make a spot apperance on local TV and arrange for a half-hour airing of the loan workshop in English and Yup'ik at a later date. As the sun sets, we finally take off for Pavilla's home in Atmautluak—a 45-minute ride on the snowmachine, but two hours in the Opel, which must follow the river ice down the Kuskokwim, up the Johnson, and then the Pitmigtalik. It is dark long before we arrive, but Pavilla knows every twist and turn.

What must travel be like here in the fierce midwinter blizzards?



Pavilla's transportation from village to village varies from snowmachine to aircraft.

Scenes of activities carried on by inhabitants of small fishing villages who depend upon Alexie Pavilla for assistance in coping with the requirements posed by faraway people and organizations.

"I don't trust airplanes when the weather is bad," Pavilla admitted. "I would much rather travel by snowmachine."

"Do you take survival gear along in case you get stuck?"

"I usually take a little bit of dried fish."

"And emergency shelter?"

"I take a tarp."

"Have you ever been stuck?"

"Not yet," he laughs.

Pavilla's home is snug and warm when we arrive. Everybody is starving, and Lena sets to work at once on white fish soup "Eskimo style." It has barely begun to simmer before Pavilla's cousin, who is head of the village council, comes in to say that the men are gathered at the school waiting to hear about the loan programs. There is no help for it. Back to work.

It is after midnight when we return. Lena and the three girls are on the sofa watching TV, leaning sleepily against each other, domino-fashion. It is hard to tell which is Lena. The soup is still hot—and delicious.

Before the charter plane comes the next morning for the flight to Mountain Village, Pavilla explains his working set-up. His "office" is a walled-off partition in the corner of the village snowmachine sales and service shop at the edge of town where he keeps his sole piece of personal office equipment, a two-drawer filing cabinet. But there is no electricity in the building, which means that during the short winter daylight hours he must do most of his work on the kitchen table at home. And this, in a family with six youngsters and in a house where the main room is the kitchen and living room combined, can be less than efficient—especially in a job which involves detailed work with lots of forms.

"Sometimes the kids pick up my papers or my mail, and things get lost," he explained. "There was one form I was supposed to sign and return before a certain date—and it was five months late. And if Lena wants to clean the house, I have to stop or she has to wait."

Number one on his list of priorities is another filing cabinet — or two filing cabinets if they're small. "I really need this," he insisted. The second item on the list is a part-time secretary from the village, who could keep track of his mail while he's on the road and maybe even make a dent in some of the paperwork.

"Alexie is about the only 'official' the people around here really trust," says Bill Miller, the white superintendent of the Napakiak village schools and longtime resident of the area, "because they know he is here to help them."

But Pavilla feels that he can use a little help with the helping. "Like having Craig come down here to explain about the boat loans and to help with the income taxes," he said.

"Also this spring we are planning to have another Marine Advisory Agent conduct a workshop on boating safety. Last summer, six people were lost in this area. That's too many.

"We also need somebody to talk about aquaculture and fish hatcheries so that we can build up our more valuable salmon runs. My people don't know anything about salmon hatcheries.

"I will translate—and maybe we could put these workshops on TV or videotape so that we can play them again."

Alexie Pavilla is the only person in Alaska doing this kind of work. Does he think it should be expanded to other areas? "Perhaps to the north—up around Kotzebue. But in most other places people speak more English than they do here. Here, it is all Yup'ik."

With time, of course, this will change. But meanwhile, the need is unique. □

Advice to mobile home owners

BEWARE THE WIND!

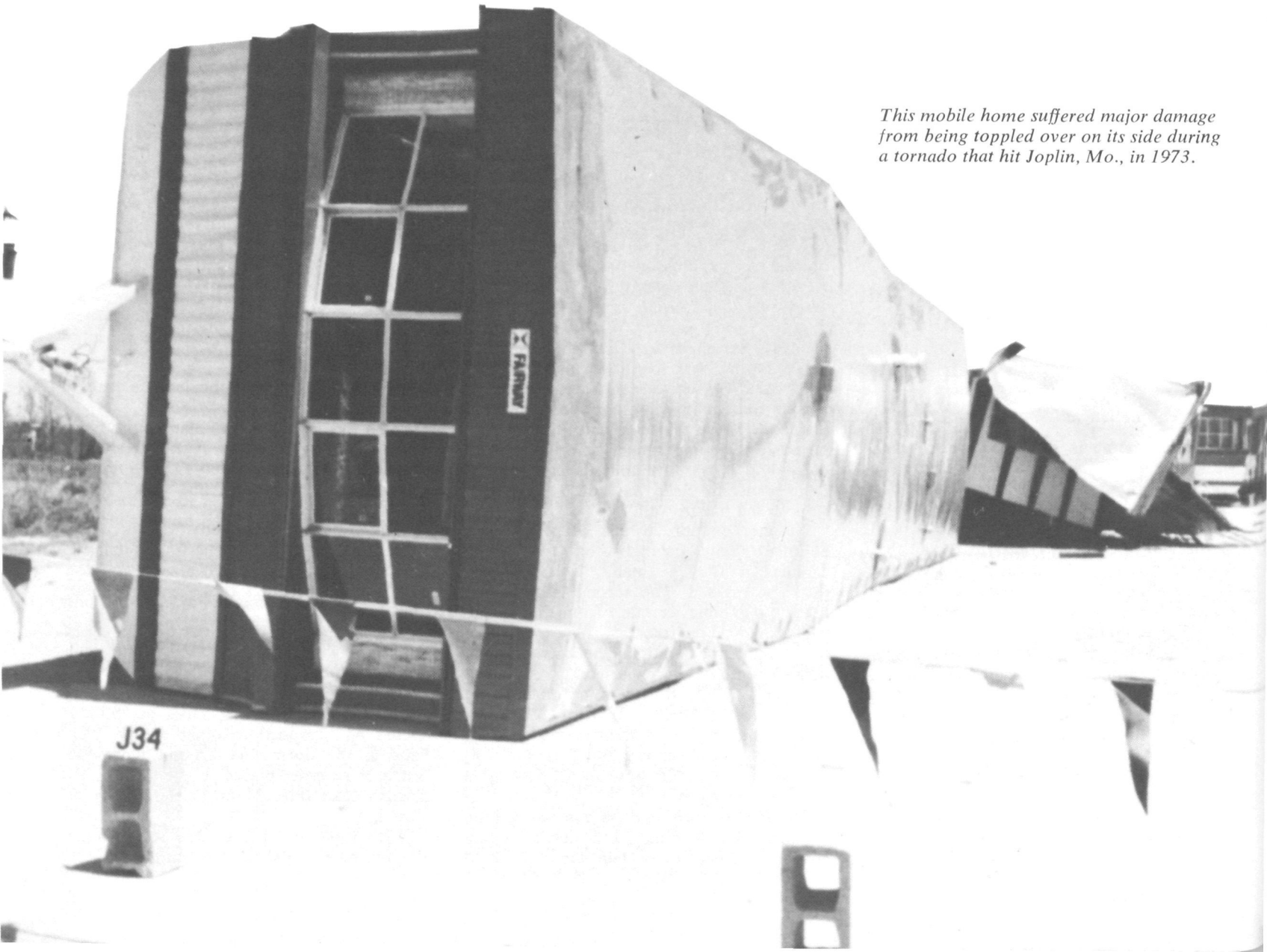
By EDWIN P. WEIGEL

Mobile homes have become a way of life for many Americans. Today about 8½ million of us live in these lightweight, inexpensive dwellings.

They are the only type of modern housing available for personal ownership that can be bought for less than $15,000, and they provide the only opportunity for many families to realize the traditional goal of owning a home of their own.

But they pose a problem in that they are vulnerable to windstorms, much more so than most dwellings. National Weather Service officials, well aware of the important and useful niche that mobile homes occupy in the housing market, have long been concerned about this vulnerability and have sought ways to tell mobile-home dwellers how to cope with it.

To document the conviction that mobile-home dwellers need a special kind of vigilance against strong winds, the Disaster Preparedness unit of the National Weather Service asked for a special engineering study on the problem by the Institute for Research at Texas Tech University, under the direction of Dr. Joseph E. Minor. Dr. Minor's prinicipal investigators were Dr. W. Pennington Vann and Dr. James R. McDonald, of the Institute staff. That report, prepared under a grant from NOAA, is now available.



This mobile home suffered major damage from being toppled over on its side during a tornado that hit Joplin, Mo., in 1973.

A key finding is that not only are mobile homes extremely vulnerable to tornadoes and hurricanes, but also to lesser winds that may have little or no effect on other residential structures. Mobile homes can be rolled over or collapsed by winds of severe thunderstorms, especially if the homes are not anchored to the ground with tie-downs. It is not uncommon for thunderstorm winds to exceed 70 miles per hour, and such winds "may be expected at almost any location in the U.S. once every few years," the report says.

Conclusion: No matter where a mobile home is located, it ought to be securely anchored to the ground with tie-downs. Says the report: "Tie-downs should be made mandatory for all mobile homes in the United States." Many states have passed such legislation, and the Texas Tech investigators believe all should—soon.

But that's not all. Although tie-downs definitely help, the report says, they are still not enough to insure safety. Consequently: "All occupants of mobile homes, with or without tie-downs, should be prepared to evacuate their homes in favor of a more substantial structure or shelter any time a severe thunderstorm, hurricane, or tornado warning is issued for their immediate vicinity. These storms are all capable of producing windspeeds than can cause major and severe injury or death."

Lastly: "Each mobile-home park should be required to have a windstorm-warning signal and a shelter or other structure usable as a shelter within easy reach (2-3 blocks) of every mobile home. These shelters can normally be designed as functional spaces, such as recreation or laundry rooms."

Why the insistence on evacuation to storm shelters even when mobile homes are tied down?

The authors say opinions among experts vary on how much wind a well-anchored mobile home can resist. "One expert believes that 80 mile-per-hour winds will destroy a mobile home even with tie-downs, while another with equally broad experience believes that a properly anchored home will withstand winds of at least 120 miles per hour."

The authors conclude that this difference of opinion, combined with known variabilities in the strength of mobile homes, in tie-down products, in ground characteristics, and in siting, makes it advisable for mobile-home occupants to seek sturdier shelter when winds of 70 miles per hour or greater are forecast.

What if there is no shelter? In this situation, say the authors, "Staying in the mobile home is probably preferable to being unprotected outdoors if the home is tied down."

Notice the word "probably." The uncertainty here involves variables such as the type of storm, the relative sureness that a mobile home will feel its full fury, and the amount of time available.

The authors do not address the question of what action to take if a mobile home is in the path of a tornado, but Weather Service officials have long advised people not to stay in a mobile home in this situation, whether it is tied down or not. Their safety rules advise seeking refuge in a "ditch, culvert or ravine" if sturdier shelter is not available. These would provide some degree of protection.

Dr. McDonald, when asked about this seemingly difference of opinion, said, "If I had enough time to get to a ditch or a culvert, I probably would try for it, rather than risk being caught in a mobile home when a tornado hits. But if I had doubts, I probably would stay in the mobile home. I've seen what happens to people when they are caught in the open amidst flying debris. So it's a matter of timing."

Just what is the relative risk of wind damage to mobile homes as compared with conventional homes?

The authors approach this question in two ways. One is by statistics on mobile-home damage and injuries; the other is by post-storm studies of specific incidents.

Damage statistics, they point out, are sketchy, since "there is no single source of completely reliable data of this type." Neither Red Cross nor insurance company figures tell the whole story. Red Cross statistics cover only relatively large calamities where their services are called for by others. This by no means covers all incidents, especially smaller events involving a few people each, of which there are many. Red Cross statistics for the six-year period 1969 to 1975 show involvement in events where an average of 2,135 mobile homes were damaged or destroyed per year, compared with 30,698 other dwellings so affected. This works out to 6½ percent mobile homes, 93½ percent other dwellings. The nationwide ratio of mobile homes to conventional homes, according to 1975 Census figures, is 5 percent and 95 percent. So even Red Cross statistics, incomplete as they are, show a higher risk in mobile homes.

Insurance company claims suggest a far greater risk. Claims submitted to one firm alone, Foremost Insurance Company, averaged almost 21,000 per year during the early 1970's.

Probably the best clue to relative risk of deaths, injuries, and property damage in mobile homes comes from a study made by Professor Grant Darkow of the University of Missouri, using the NOAA National Climatic Center's monthly publication, "Storm Data," supplemented by newspaper clippings of strong-wind incidents. By this means, he found that 602 mobile homes were damaged or destroyed in Missouri during the six-year period 1970 to 1975, involving 13 deaths and 178 injuries, compared with 859 other dwellings damaged or destroyed in that same period, with eight deaths and 154 injuries. When you consider that mobile homes were only 3 percent of all dwelling units in Missouri at that time, this suggests a risk of windstorm death or injury in a mobile home 35 to 40 times as great as in other dwellings.

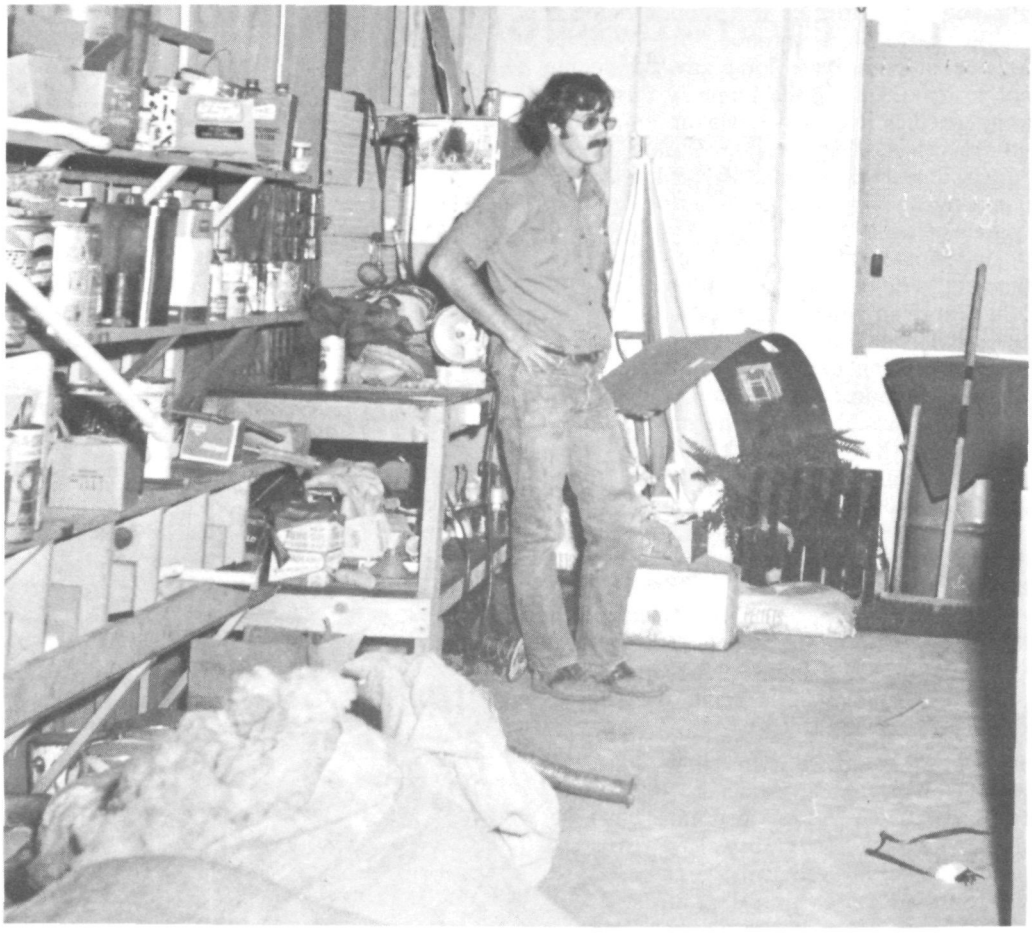
Hurricane Celia demolished this mobile home community in Corpus Christi, Texas, in August 1970. Peak winds were measured at 161 mph; residents (who had evacuated) would not have been safe even had the homes had tie-downs.

Such risk estimates, of course, do not take into account what would have happened if all the mobile homes involved had been properly tied down—for a very simple reason: insufficient data.

In the second approach to relative risk in mobile homes—engineering analyses of wind damage in specific incidents—the authors found, as mentioned earlier, "a special susceptibility of mobile homes to moderate winds not associated with tornadoes and hurricanes." Frequently, the damaged homes had not been tied down, or were inadequately secured. They also found "that lightweight homes without tie-downs can slide off their piers or be overturned at windspeeds as low as 50 miles per hour.

This is why they recommend tie-downs be mandatory.

They also looked into the effects of nearby terrain, shielding, mobile-home construc-



About 80 people escaped injury in this underground shelter when a huge tornado demolished a 44-unit mobile home court in Salina, Kansas, September 25, 1973. Shelter was especially built of reinforced concrete to withstand tornadoes; clubhouse above was swept away.

tion, the direction of orientation, skirting, and anchoring systems, all of which have some effect on risk. Among findings:

- Windspeeds will be reduced about 30 percent by hilly or suburban terrain compared to what those winds would be in flat, open terrain.
- Shielding by nearby buildings, rows or clumps of trees, solid fences, or embankments can be very important in reducing wind effects. Such shielding is known to have saved many mobile homes from destruction.
- The main structural problem with mobile homes has been that roofs and roof connections were not strong enough. Next in importance: weak walls and wall connections.
- If a mobile home can be so oriented that its long narrow shape points into the wind, this can have a marked effect on resistance. If broadside, it is much more easily overturned. But guessing which direction most strong winds will come from is highly uncertain, at best, and a wind approaching from a corner can be as damaging as when approaching broadside.
- Skirts covering the open area between the floor of a mobile home and the ground have often been mentioned as having a strong effect on resistance to wind. The authors say this idea has yet to be verified. Skirts often fail in strong winds. In fact, wind tunnel tests indicate skirting may either increase or decrease the overturning tendency of the home, depending on the height of the floor above the ground, and other details.
- The most crucial cause of serious wind damage is lack of adequate support on the ground and anchoring into the ground. Proper anchoring and support can help prevent most of the severe types of damage, with the exception of windborne missiles and loss of a portion of the roof. Both over-the-top ties and frame ties should be used, to provide vertical and horizontal resistance to wind forces. Many systems of anchoring omit one of these types. Other common deficiencies are too few ties, poor connections, and insufficient anchoring strength. Many errors were found in setting up and supporting mobile homes, including poor soil conditions at the site, weak piers on which the mobile home rests, lack of footing or caps on piers, improper installation of anchors into the ground, and improper tensioning of over-the-top ties.

In their studies of mobile-home damage, the authors found several hazards which are especially pertinent to lightweight dwellings. These included:

- Damage from gusts imbedded in straight-line winds. These were sometimes incorrectly attributed to small tornadoes.
- Damage from missiles, including other mobile homes. Because of their relatively fragile construction, mobile homes are especially susceptible to this type of damage. A major problem is the tendency of a mobile home to slide or overturn if it is not anchored well, and crash into other mobile homes, sometimes rolling or tumbling before doing so. Occasionally, mobile homes have flown through the air several hundred feet when lifted by tornadoes, injuring or killing occupants of both the airborne homes and the homes struck.

In their conclusion, the authors see "a great need for comprehensive, in-depth engineering field studies of the damage suffered by mobile homes in windstorm incidents, so that a greater understanding of the influence of various factors may be obtained.

"Many times such a study is not carried out . . . following a major disaster because the mobile-home damage is considered less significant than the damage to conventional residences. . . . Damage to isolated mobile homes by less severe windstorms is often overlooked also because the total amount of damage does not seem to justify a trip by a competent inspector. In both cases, however, the necessary time, money and effort should be expended so that the true resistance of mobile homes to strong winds can be ascertained. This need is especially true for mobile homes with tie-downs, and, because of the many variables affecting tie-down systems, a large number of post-storm investigations will likely be needed before reliable conclusions can be reached."

They also see a need for properly designed wind-loading tests of full-scale mobile homes that are tied down in several different ways.

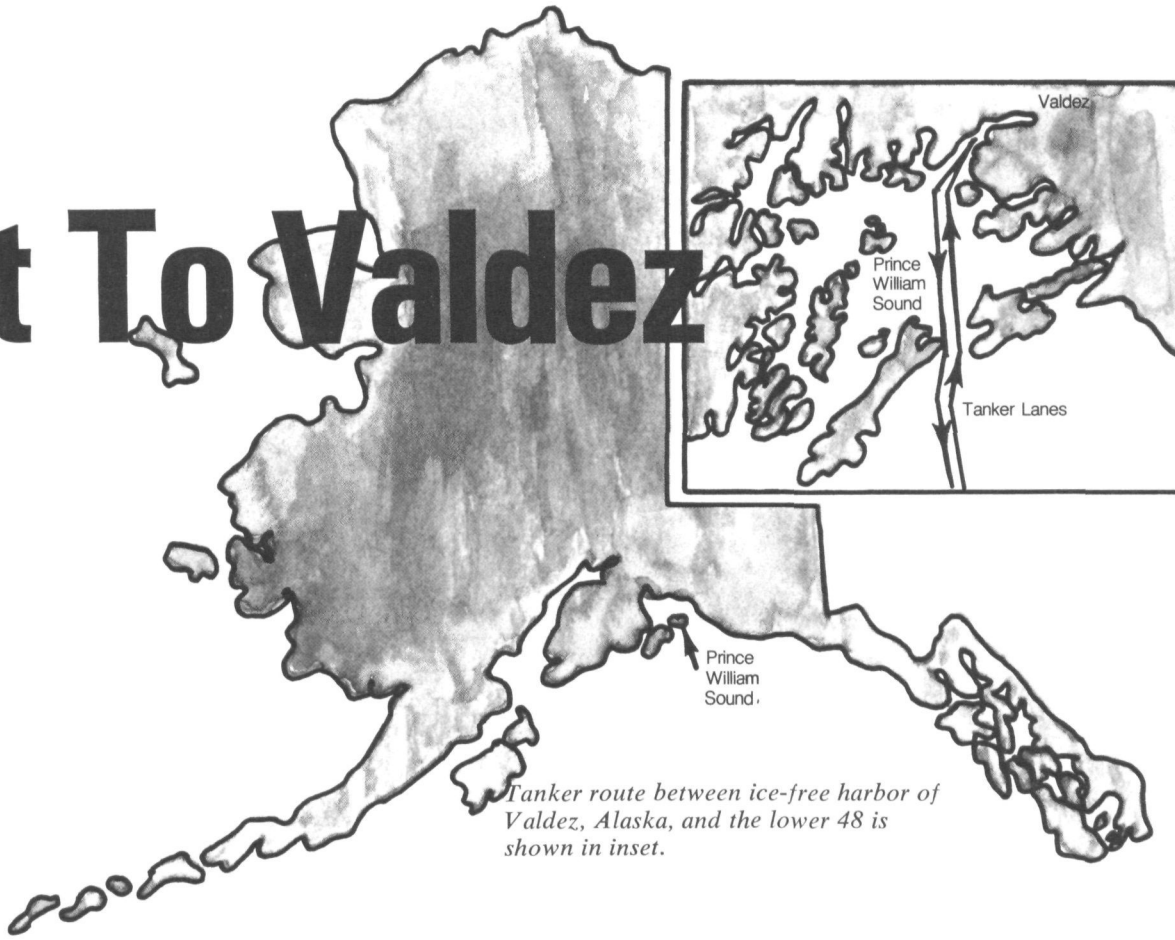
By this and other means, they believe we may be able to help minimize the deaths and injuries in mobile homes that now occur all too frequently. □

How To Get Copies Of Texas Tech Report

Copies of the 145-page report on which this article is based are available for $5 from the Institute for Disaster Research, Texas Tech University, Box 4089, Lubbock, Texas 79409. Ask for "An Engineering Analysis: Mobile Homes in Windstorms." Make checks payable to Texas Tech University.

Transit To Valdez

By CDR. RICHARD E. NEWELL



Tanker route between ice-free harbor of Valdez, Alaska, and the lower 48 is shown in inset.

The supertanker Arco Juneau eased into the northbound sea lane, on course for Hinchinbrook Entrance, the gateway to scenic Prince William Sound. Beyond the barrier islands lay 3,000 miles of predominantly primitive, wooded coastline. Great fiordal arms of water branch off in all directions from the Sound's central basin. The most imposing of them bears due north of the Entrance, and in its farthest reaches, rimmed by the high, rugged Chugach Mountains of Alaska's south coast, lies Port Valdez—home of the region's largest community and end of the pipeline for North Slope oil.

To the Arco Juneau's skipper, Capt. Emory McGowan, the transit to Valdez ("Valdeez") on a foggy July morning in 1977 would be less a matter of scenic enjoyment than of navigational safety—all the more so because of the special nature of his mission: to oversee the first commercial shipment of North Slope oil back home to the "Lower 48."

This southward flow of crude oil from the wells at Prudhoe Bay is a two-sided effort. The push to bolster dwindling domestic energy supplies is being moderated by the insistence that the natural environment should not be despoiled. One of the many groups working to achieve this balance is NOAA's Marine Ecosystems Analysis (MESA) Program, managed by the Environmental Research Laboratories.

MESA's goal is to understand and predict the effects of natural processes and human activities on marine biological communities and their habitats.

The program serves as a focus for cooperative efforts among government agencies, environmental organizations, universities, and industry to investigate ecosystem problems beyond the research capability of any single agency.

MESA's latest coastal research target is Prince William Sound, where expanding oil development has stimulated other commercial activities and their accompanying environmental stresses. As with its nearly completed New York Bight Project and newly initiated Puget Sound Project, the intention is to give managers the environmental information they must have in order to deal wisely with marine issues.

Christine Carty, NOAA Corps Lieutenant and Acting Manager of MESA's Prince William Sound Project, explains, "our interest in the Sound began in 1972 when MESA was formed, but due to the extensive pollution problem in the New York Bight, a decision was made to focus the initial MESA efforts there." She adds that, for most MESA studies, it takes about five years to define the components of the ecosystem, pinpoint those that are most sensitive, and conduct the studies needed to show how these areas would be affected by actual or potential pollutants.

One major product of MESA's Prince William Sound work will be an integrated source book that environmental managers can consult. This document will include a synthesis of marine resource information, descriptive and predictive models, and strategies for assessing the effects of commercial development on the Sound's ecosystem. Special care will be taken to present these facts and tools in a brief, lucid form, for they must become the primary ingredients of a manager's personal "data base" for making socially responsible decisions.

The urgent need for MESA's involvement here in Prince William Sound is underscored by the picture of environmental degradation presented by the New York coastal area. MESA will apply some of the lessons learned there to Prince William Sound, to help insure that what happened in the New York Bight is not repeated here on Alaska's south coast.

The possibility of oil pollution is the heart of the problem. The danger can be greatly reduced by technological safeguards and attention to detail, but there are natural factors that make the job harder. One lay just ahead of the Arco Juneau, at Hinchinbrook Entrance.

This passage between Hinchinbrook and Montague Islands is one of the most dangerous parts of the tanker route. Although it's over 7 miles wide, the middle one-third of the passage is occupied by Seal Rocks, a 2½-mile reef topped by two bare rocks 30 and 37 feet high. The area around the Entrance is subject to extreme storms, poor visibility, erratic winds, and strong tidal currents. Tremendous seas, steep and breaking, sometimes occur here. Combine these conditions with tanker traffic, and you have a potential oil spill site.

Other potential spill sites lie to the east,

along the Alaskan continental shelf, where the search for new sources of oil has been underway since late 1976. Huge semi-submersible drilling rigs are held directly over their undersea wells by anchors connected to computer-controlled tension winches. Wind, waves, and currents aren't likely to push the rigs off station, but oil may somehow escape into those waters. If it did, it would stand a fair chance of drifting into Prince William Sound. That possibility was raised by a NOAA mathematical model of the offshore water circulation, and it was verified by releasing drift cards and satellite-tracked buoys in various offshore areas. As a result of this research, some of the Federal oil lease tracts in the northern Gulf of Alaska have been taken off the market.

So far, the offshore wells have turned up dry. If, and when, that oil is found, there is still a chance that the Sound will have to deal with an additional, watered-down version of the same threat posed by local tanker traffic.

The Arco Juneau, with Seal Rocks astern, slipped safely through the Entrance, just as her sister ship, Arco Fairbanks, had done many times before her. The Fairbanks spent 45 days that spring plying the Sound to familiarize the harbor pilots and ships' masters with these waters and their hazards, as part of a special Coast Guard program. The pilots each took written tests and made 14 round trips between Cape Hinchinbrook and Valdez. Part of each sea captain's examination was to reproduce from memory the entire nautical chart of the Valdez transit area.

On that July morning, beyond the swirling fog, the Sound appeared much as it must have to Capt. James Cook, who gave it its name nearly 200 years before—the clear, deep waters; the rocky headlands; the low, tree-covered islands and peninsulas; and to the north, the sheer, glacier-capped mountains etched with perpendicular icy rivulets.

This is the country that Christine Carty is getting to know and love. It's not just the territory, it's the people too. Other projects have shown that the support and input of the local people are needed from the start for a study like MESA's to succeed. So Carty has held town meetings around the Sound, in Valdez, Cordova, and Whittier, to explain MESA's aims and concerns. The response has been positive and helpful. The people support a Federal study of the Prince William Sound marine environment and have some definite ideas about what it should accomplish.

Her next step was a Prince William Sound workshop held in Anchorage, with the broadest possible representation, including private citizens. Carty learned that many development possibilities are being seriously considered. A big push for mining is expected within the next 20 years, especially for gold, copper, holmium, and palladium; the last two are rare minerals now in great demand by industry. The whole Sound will open up to recreation and tourism, with a big upsurge in construction of marinas and tourist facilities. More hatcheries and fish processing plants will be built as the fisheries industry expands. Oil refintries are on the way, to produce fuels for cars, jets, ships, and power plants; and there will be petrochemical plants to make petroleum-based products, such as insecticides.

Although oil is a moving force for development here, Dr. J. Frank Hebard, MESA Director, feels that other environmental threats are equally great. "The present build-up of crude oil shipping merely dramatizes the situation," he says. "Just the influx of people will be a major problem in itself." It's clear that the Sound's abundant resources will be pursued in ways that present a wide variety of serious challenges to resource managers.

Basically, the local population wants the jobs and the business that development will bring, but only if strict environmental safeguards are imposed. Most developers are sensitive to this need.

Lt. Carty explains that part of her job will be "to gather and synthesize the information needed to help developers explore the environmental alternatives; that is, 'If you build your plant or facility this way or that way, these particular environmental effects will follow.'

"We have a great chance to help preserve this beautiful, unspoiled area," she says. "Also, by combining what we learn here with our Puget Sound and New York Bight studies, we'll be able to generalize some of the effects of human activities on any marine ecosystem."

At the moment, Carty is helping to put the finishing touches on a project development plan and shares MESA's hopes for early Congressional approval. This summer she will move from Mesa's Boulder, Colo., headquarters to Anchorage, to establish the Prince William Sound Project Office. There, she can maintain the wide-ranging contacts that the job calls for, but still be just an hour away from the Sound. After she moves, her first job will be to collect existing information on the Sound's ecosystem. In addition to visiting various data centers, she'll talk to naturalists and interview local people who know the environment. Later, in the fall, she'll begin a few research projects, with initial emphasis on oil spill research.

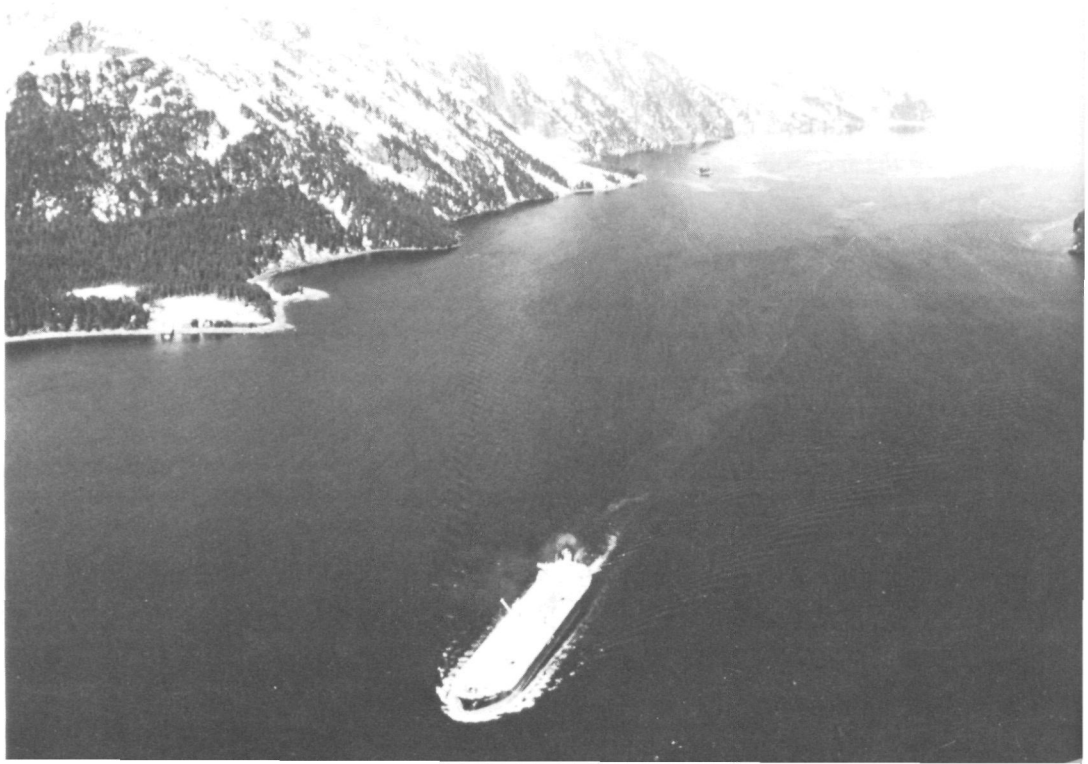
"Alaskans in general have a high regard for Prince William Sound," she says. "Besides making a lot of contacts there and getting lots of free, expert advice, we've received quite a few offers of free or cut-rate help from private citizens. This is what's going to make it all work—the people care."

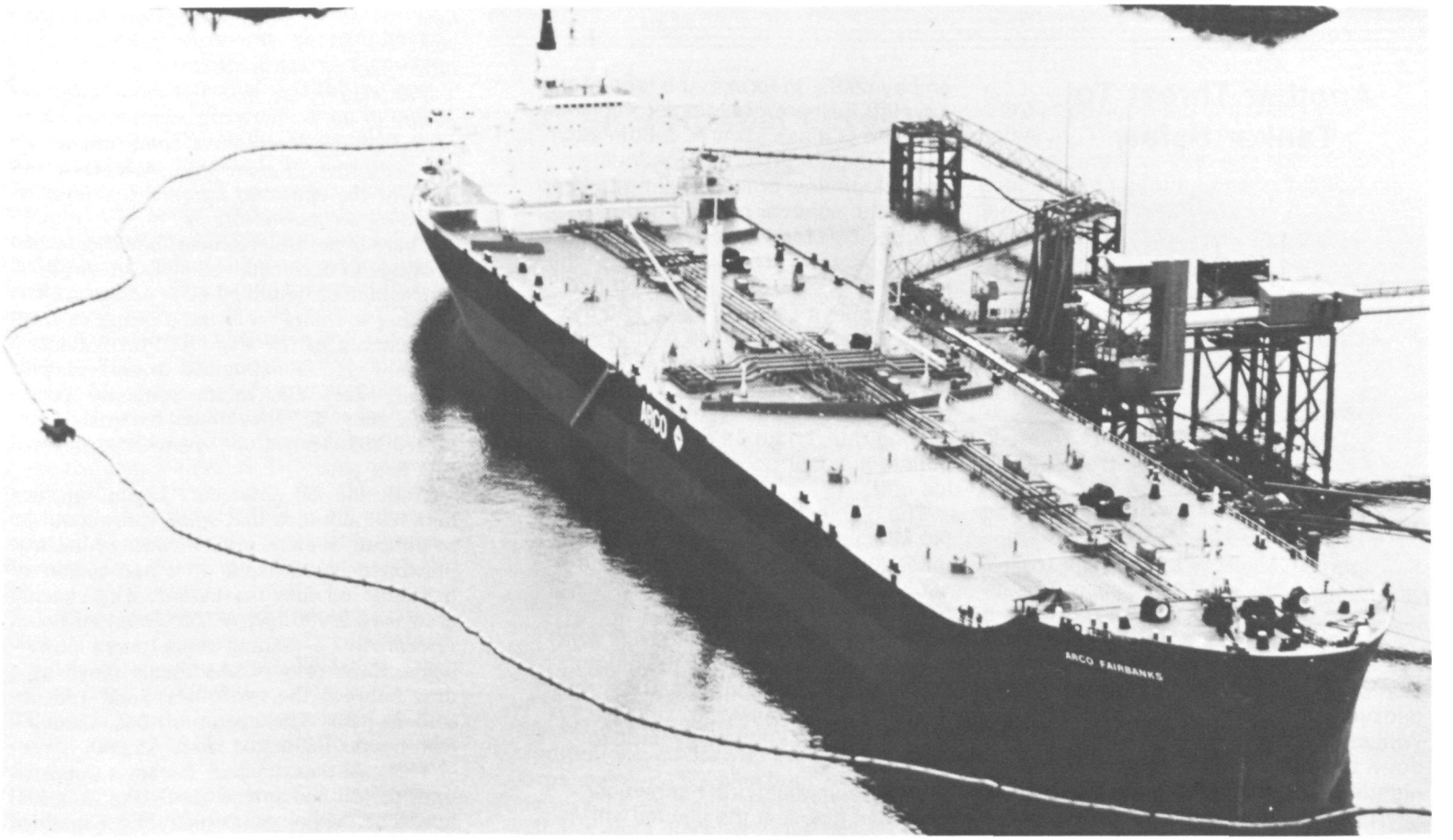
The fact that people care explains why the oil industry has spent millions of dollars on environmental safeguards in Alaska, and why anti-pollution laws are observed so strictly. Everyone realizes that there's a lot at stake besides oil.

A hint of these stakes was at hand as the Arco Juneau continued north toward Bligh Point, at the head of Valdez Arm. Off to the east, a black bear roamed the tidal flats in search of salmon; back on Montague Island, near the edge of the Juneau's spreading wake, a group of sea otters congregated on the gravel beach of a lagoon to swim out, catch, and devour clams, crabs, and octopus. All around the Sound, flying, swimming, and diving waterbirds—kittiwakes, terns, ducks, and cormorants—made up a summer population of five to six hundred thousand.

Unseen is the population that gives life to all the rest. These are the tiny passive floaters and weak swimmers of the tidal zone: the plant and animal plankton that make the quiet coves among the islands and along the shores of the Sound such productive sunken shellfish factories and prolific floating nurseries for fish fry and the larvae of shrimp, crab, and mollusks. This life-giving "soup"

Oil-laden supertanker Arco Fairbanks departs Valdez Narrows on her way south. (Photo: Alyeska Pipeline Service Co.)





Arco Fairbanks, sister ship of Arco Juneau, takes on crude from Trans-Alaskan Pipeline, Port Valdez. Oil boom is deployed to contain any spills. (Photo: Alyeska Pipeline Service Co.)

is the basis for the Sound's vast inventory of renewable resources: the king, Tanner, and dungeness crabs; pink shrimp; razor, butter, and little-neck clams; scallops; and a long list, headed by salmon, of commercially important fish. Near the top of this food web are the birds that come, some from as far away as the tip of South America, to feed and nest. At the very top of the web are the mammals, including the seals, sea lions, sea otter, and whales—even the bear.

The Sound's ecological system is among the most productive in the world, but sometimes a catastrophic event will throw a system out of kilter. The Great Alaska Earthquake of 1964 rocked Prince William Sound with the force of 40 million tons of TNT. The jumbling of some coastal areas played havoc with spawning grounds, nesting sites, and shellfish beds, so that the productivity of pink salmon, ducks, and clams suffered for ten years in some cases.

About ten years is also the estimated recovery time for serious oil spill damage. There is ilttle doubt that a major spill of Prudhoe crude in or near the Sound would be catastrophic to the very abundant life there. The sheltered rocky headlands and the protected tidal flats and salt marshes are especially sensitive to spilled oil and often impossible to clean out without harming the marine life.

Life in the Sound is particularly vulnerable during spring and summer, when feeding and spawning are at their peaks. Spilled oil can smother fish eggs, poison young fish, and disrupt the spawning migrations of mature ones. Sea otters and fur seals are very susceptible too. A coating of oil on their skins causes breathing disorders, elevated heartbeat, sometimes death. Even more vulnerable are the bottom-dwelling creatures—the clams and crabs—that cannot easily get up and move away.

The most obvious victims are the sea birds. They congregate in oil slicks with no inkling of the danger and consume the oil while preening it from their feathers. Those that don't die from oil ingestion may freeze to death in any season or drown, after oil has destroyed their natural insulation and buoyancy. They also may lose their ability to fly and feed, and the eggs of the survivors are apt to develop abnormally.

With 35 miles of Sound behind her, the Arco Juneau paused off Bligh Point to take on the harbor pilot who would guide the 883-foot-long tanker the last 25 miles to Valdez. There was nothing but fog to contend with, and the radar-equipped ship continued on her way. Had the wind kicked up to 40 knots or more here, she would have had to anchor and await clearance from the Coast Guard and oil terminal authorities.

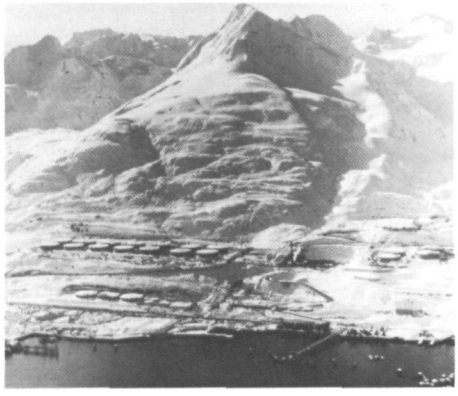
The reason for such caution lay just ahead, at the Narrows. This is the second potential trouble spot along the route—a narrow passage about 1,200 yards wide, with deep water and bold shores. At the far end, about 300 yards off the west bank, sits Middle Rock, a pinnacle marked by a light mounted 30 feet above the water. But even here, where the channel is narrowest, there was plenty of room to spare. The Juneau is 138 feet wide, and tankers will pass through the Narrows just one at a time, under the control of the Coast Guard's $8 million Prince William Sound Vessel Traffic System.

The tugs were standing by to greet her as the Juneau passed Middle Rock and entered the harbor. By 8:45 on that Friday morning, the ship was snugly moored at Berth 5 of the Alyeska Terminal—directly opposite the city of Valdez. The fog gave way to a chill, hazy overcast as preparations began for off-loading ballast.

Discharge of ballast water, taken on to maintain seaworthiness during a tanker's voyage north, is a necessary prelude to loading crude oil. The oily ballast water is off-loaded, treated, and released 1000 feet (303 meters) offshore at a depth of about 200 feet (61 meters). The intention is that the oil should be so diluted that even the tiny plankton would not be threatened.

To assess the impact of ballast-dumping, the Alyeska Pipeline Service Company engaged the University of Alaska to conduct a year-long preliminary study of Port Valdez waters. The 1971-72 study concluded that the planned daily discharge of up to 800,000 barrels of water (one barrel equals 42 gal-

Another Threat To Tanker Safety



Oil terminal at Port Valdez, anchored in bedrock.

Not long after the Arco Juneau's midsummer voyage last year to Prince William Sound, the Coast Guard shut down the shipping lanes there to nighttime tanker traffic for several short periods. The reason: Columbia Glacier, just 9 miles (14 kilometers) west of Valdez Arm, was releasing, or "calving," icebergs into the path of the oil-laden supertankers.

As early as this May, following the winter-spring freeze, icebergs were again floating south from Columbia Bay into the shipping lanes.

The huge 330-foot (100-meter)-high ice cliff at the glacier's offshore terminus is a year-round iceberg machine that works best during summer. Scientists are just beginning to understand why: it may be that the summer icemelt at the glacier's base uncouples it from the bedrock beneath, allowing vigorous calving to occur.

Columbia Glacier's 425-square-mile (1100-square-kilometer) area makes it the largest glacier on the Sound. It's a spectacular 42-mile (67-kilometer)-long river of ice, flowing down from its source high in the snowfields of the Chugach Mountains. It is also the only seafront glacier on the North American continent not to have undergone drastic shrinkage within the past two hundred years; and scientists of the U.S. Geological Survey suspect that it is on the brink of instability. They feel that calving may soon begin to escalate sharply past normal seasonal rates; thousands of icebergs could drop off the face of the ice cliff as early as next summer.

Iceberg discharge has been greater than normal the past three summers, causing unusually large hollows, or embayments, to form in the face of the ice cliff; furthermore, glacier thickness near the cliff has lowered a little each year, indicating that the continuing downslope flow of ice is failing to keep pace with summer melting and calving.

A positive feedback system appears to be operating. The thinning near the ice cliff increases the likelihood that large embayments will form, and the large embayments cause further thinning. Glaciologists take this as a danger signal. Only a very slight change in ice velocity, thickness, or calving rate, could be sufficient to initiate a catastrophic retreat of the ice cliff.

The glacier now extends 25 miles (40 kilometers) into the Sound; it is 4 miles (6 kilometers) wide and up to 4000 feet (1220 meters) thick. When it begins its irreversible retreat, innumerable icebergs will break away, many of them dangerous to shipping. The process may continue at the rate of several miles per year, until the ice cliff erodes all the way back to the shoreline.

USGS scientists don't know just when and how fast the glacier will retreat. Aerial photos show that the embayment filled in normally this past spring, so calving should proceed at the usual rate this summer. Nevertheless, some give the glacier a 50-50 chance to begin shrinking within the next few years, and expect that iceberg calving could increase by up to 50 times the normal rate.

An intensive survey of the glacier is underway to arrive at a scientific estimate of the timing of the retreat and the extent of iceberg discharge. That estimate, made by applying the survey data to numerical models, should be available next spring.

Meanwhile, the Coast Guard is exploring ways to deal with this potential shipping nightmare. Aside from shutting down oil-tanker traffic and the pipeline itself until the iceberg threat passes, alternatives have included towing them away with tugboats or constructing a huge nylon rope barrier to hold them back until they melt.

When Columbia Glacier's proud profile finally begins to recede—when the thunder of its icefalls starts to echo through the Sound on a regular basis—will the mounting iceberg hazard signify another oil spill threat, or a threat to oil shipment itself? Or can the threat somehow be contained? These questions reflect the latest hitch in the challenging campaign to keep the oil moving southward without damaging Alaska's essentially unspoiled environment.

lons or 159 liters), containing less than eight barrels of oil, would probably have little effect on marine life.

Yet many fear that the continuous exposure of the harbor's organisms over a long period of time may have some impact on the ecosystem. Valdez may become a test case for the effects of chronic, low-level oil pollution on marine life.

There is no disagreement, however, when it comes to accidental oil spills of any size. The escape of undiluted oil is unlawful here, whether it comes from the pipeline or from the running of the ship. At Port Valdez, a constant vigil is maintained to prevent spills of any size. Yet, minor spills do occur. When they do, they must be quickly reported and cleaned up—even those as small as a half pint.

Until the oil shipments began, no one here had any idea that small spills could be so difficult to clean up. This fact of life was illustrated by the spill of a half gallon of hydraulic oil into the harbor. The cleanup crew used 2,000 feet (610 meters) of boom (essentially, a floating fence), two powerboats, three rolls of absorbents (used as a drag between the two boats), and 150 absorbent pads. The operation took about 66 man-hours. Estimated cost: $5,000.

This case was unusual; it went unreported until the oil had spread enough to be a real headache. Spills can usually be contained by booms within minutes. Fast action pays off for the spiller, because he is responsible for the cleanup costs. The cleanup job is often contracted out to a local, quick-response cleanup group. If the spiller can't be identified, the group is paid from the multi-million-dollar Coastal Protection Fund, set up by the oil industry.

As of March 3, 1978, 145 billion barrels of oil had been transferred to 235 tankers in Port Valdez, with only 48 spills—15 by tankers and 33 by the terminal. The largest was a 500-gallon spill caused by a small crack in the side of a tanker. Most spills were less than 15 gallons.

In spite of this good record, the local office of the Alaska State Department of Environmental Conservation feels that cleanup skills need improving and that the ability to deal with spills away from the terminal is marginal. If a major oil spill were to occur in Prince William Sound now, it could be disastrous. The nearest major sources of cleanup equipment and expertise, aside from Alyeska'sValdez facility, are at Kodiak and Anchorage. This is too far away for a quick response, especially during heavy weather when likelihood of spills is greatest. Also, the effectiveness of cleanup methods is sharply limited when seas are rough.

This spill-treatment picture makes MESA's proposed ecological research all the more important. Whether oil spills are of the chronic or the catastrophic variety, their environmental impact can be significant. One of Lieutenant Carty's goals will be to predict that impact, given an understanding of the unique marine environment of Prince William Sound.

The need for this type of environmental

prediction escalates not only in proportion to the increased transport of southbound oil, but also in proportion to the economic development of the Sound that this oil business is triggering. When the need for predictions outruns the ability to predict, decision-making is impaired. In this time of strong environmental concern, pollution standards will be set, with or without complete information. If standards are set too low, the environment suffers; if set too high, industry and, ultimately, the consumer's pocketbook suffers. This is why MESA's Prince William Sound research will pay off.

What changes are pipeline oil already bringing to the way of life around the Sound? Besides the boost to jobs and tax revenue produced by the billion-dollar, quake-resistant Valdez oil terminal, an even bigger prospect is in sight for this town. Construction of a $1¼ billion oil refinery, to include environmental safeguards, is being considered. Some feel that this puts Valdez, the "Switzerland of Alaska," at a crossroad. How will increased industrialization affect its growing tourist trade or its future as a fish processing center? Valdezans face some crucial decisions.

Cordova, at the southeast corner of the Sound, just 30 miles from Hinchinbrook Entrance, numbers half the population of Valdez' 5,000. The oil-related concern here centers around its fishing industry. What would be the impact of a major spill on its fisheries? What improvements are being made in oil tanker safety, navigation standards, and oil spill contingency plans? Will offshore wells be drilled nearby? And how can collisions between moored crab pots and passing oil tankers be prevented? (In the event of a collision, the $400 crab pots always come out losers.)

The Arco Juneau sat low in the water—17 feet lower, once her 13 cargo tanks were filled with nearly one million barrels of Prudhoe crude. After three days in port, she was ready to head for sea again. With a long blast of her deep-throated whistle, she cast off from Berth 5 at 4 p.m. on Monday, August 1, meeting a driving rain as she reentered the Narrows en route to the Sound. Within four days, Capt. McGowan had delivered the first shipment of Trans-Alaska Pipeline oil to the Cherry Point refinery in Puget Sound.

Over 200 days and 250 tanker deliveries later, a new breed of ship came to Port Valdez—the Atigun Pass, built specifically for hauling North Slope oil. She's one of a new series of larger tankers being built by many companies to conform with present and anticipated environmental and safety regulations. She carries 1.2 million barrels of oil and has several important pollution-reducing features, plus an abundance of advanced navigation equipment, including a computerized collision avoidance system.

This is the type of tanker that many environmentalists have been waiting for—the kind of ship that may help MESA's ecologists to preserve the beauty and vitality of Prince William Sound, as the oil keeps moving southward. □

MESA's Newest Envoy To Alaska

Science, the sea, Alaska—these have been special to Christine Carty since childhood, and she now has a career that embraces them all.

As Acting Manager of MESA's Prince William Sound Project, Lt. Carty is responsible for setting up a large-scale marine environment research program for a threatened Alaskan wilderness area that must be ranked among the most beautiful and bountiful in the world.

This junior officer recently became MESA's third coastal research manager; the other two are Cdr. Lawrence Swanson for the New York Bight and Dr. Howard Harris for Puget Sound.

How does it feel to have such an important job so early in her NOAA Corps career? "It's amazing," she answers. "Better still, it's working out well. If it were anywhere else but Alaska, I'm not sure that I could handle it all."

She feels she owes a lot to the big-hearted spirit of the Alaskan people. Meeting them, sharing ideas, and making plans, make up a big part of her work. "When I'm up around the Sound," she explains, "I'm really on my own. I have to get to know people in a hurry, and up there it's easy. You can get a lot done by verbal agreements and handshakes. Everyone cooperates."

Unlike bustling Anchorage in nearby Cook Inlet, the communities around the Sound are real frontier towns. "When people spot you for the first time, they'll step up and greet you with a 'Who are you? Haven't seen you around.' They're very friendly."

The source of Lt. Carty's attraction for Alaska goes back to the time when, at the age of ten, she read about that State in a *National Geographic* article. "The harsh environment seemed to force Alaskans to pull together, and I admired that."

Other interests were forming then too. While growing up, she spent summer weekends at the beach in Long Island, where swimming and sailing were favorite pastimes. Her interest in science grew out of her love for the sea. The fact that her father is an engineer probably helped too.

She graduated from Cornell in 1973, specializing in biology, but also getting a broad background in the other sciences. Then, during a visit to the college career center, she spotted an announcement for an upcoming visit by the NOAA Corps recruiter.

"As soon as I saw the 'Oceanic' in NOAA's name, a bell rang. The promise of 'science and service' caught my eye too. Later, during the interview, when I heard that new officers spend their first 18 months at sea, that was all I needed. I was sold." The assurance that she stood a good chance of getting duty in Alaska was just the frosting on the cake, but she never imagined that things would fall into place in the way that they have.

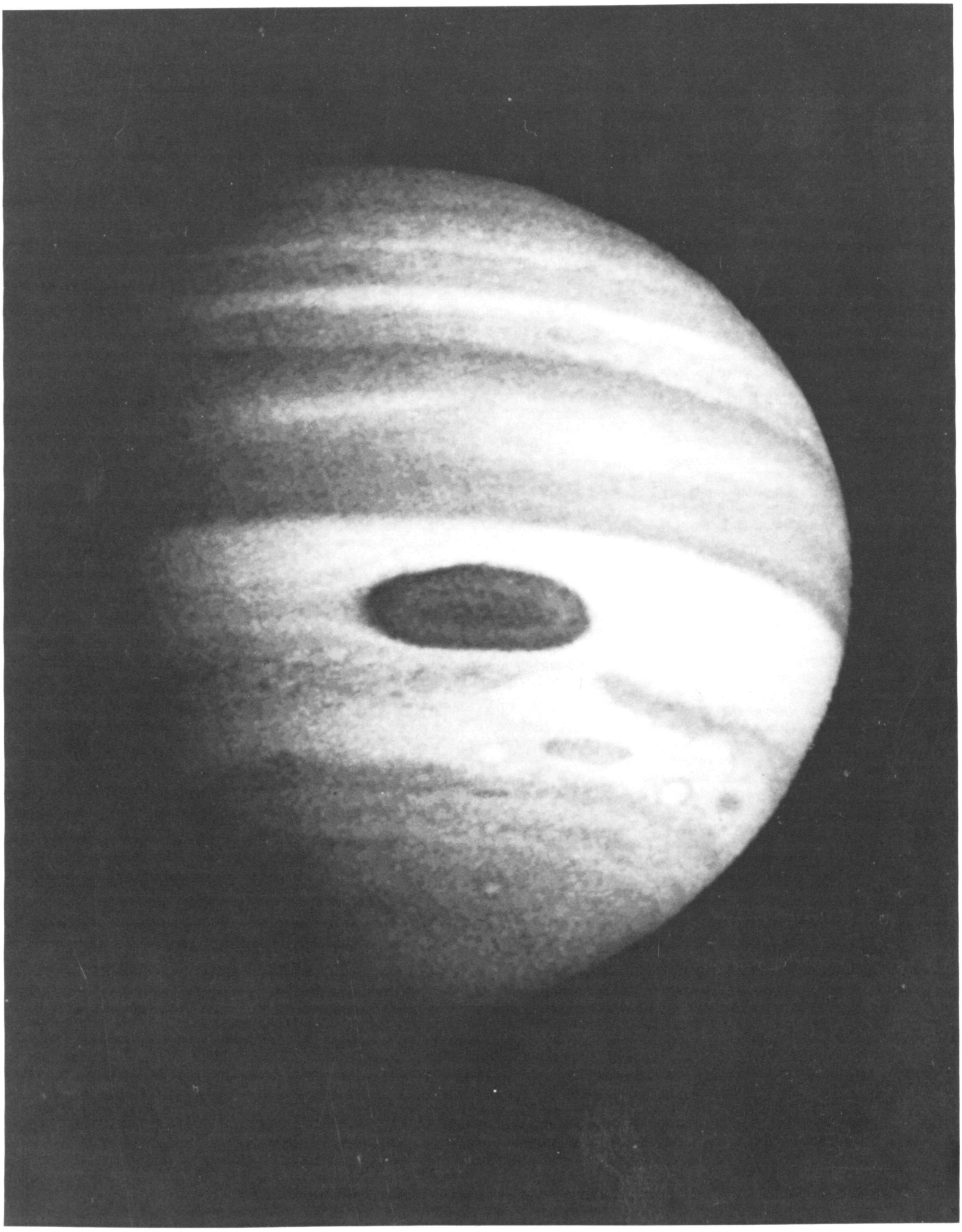
Her first assignment was with the Researcher, based in Miami. During cruises to Dakar, Africa, and around the northwest Atlantic, she served as bridge officer and oceanographic officer. The fact that she and a roommate were the first women to serve aboard that ship meant overcoming a few psychological hurdles, but she comments that "assigning women to sea duty is routine within NOAA."

The Corps next assigned her to Narragansett, R.I., deferring her request for duty in Alaska. As a biologist working in physical oceanography for the Fisheries Service, she felt a bit misplaced; but the time she spent there was, in retrospect, a good learning experience—a real asset to her present work.

She came to Colorado, and MESA, early last year. For the first six months she worked on an assortment of short-term jobs. On the strength of that work, her feeling for Alaska, and the recommendation of MESA's Dr. Lou Butler, who had worked with her for a time aboard the Researcher, she was put in charge of the Prince William Sound Project.

She will be moving to Anchorage soon, where she can be close to her job. There also will be some time to bike and ferry around Alaska's south coast. Her travels around the Sound earlier this year by plane and ferry introduced her to some "unbelievably gorgeous scenery, especially on the trip by float plane from Valdez to Whittier, over glaciers and snow-capped mountain peaks on a brilliant sunny day."

She expects that sea duty will beckon again in the not-too-distant future. When that time comes, her duty request is sure to include a word that's now even more special to her than before: Alaska.



NOAA prepares a historic probe

INSIDE JUPITER

By LOUISE PURRETT-CARROLL

Jupiter, the gigantic body that is something between a planet and a star, coasts through the suburbs of the solar system. Wrapped in its striped coat of gases, more massive than all the others combined, it may hold records from the early days of the universe, and clues to the origin of the solar system, perhaps of life. One of earth's most ambitious—and, to many scientists, most exciting—space missions will try over the next decade to extract some of these clues from the Jovian archive. NOAA scientists are providing one of the key experiments.

A two-part space vehicle will be launched at Jupiter in late 1981 or early 1982. The Jupiter Orbiter-Probe (JOP) will reach its destination nearly three years later. A satellite portion of the vehicle will move into an orbit around Jupiter where it will circle for at least 20 months, transmitting data back home. Meanwhile, the other portion, a probe, will arrow down into the planet's atmosphere.

The mission has been on scientific minds since 1967, when the National Aeronautics and Space Administration's Panel on the Outer Planets recognized it as an essential but not yet feasible step in understanding the solar system. In the meantime, a series of fly-bys were launched to make remote observations of the planet.

The fly-by missions, some of which have yet to reach Jupiter, have had tantalizing results. They provided much new information, but some of it served only to enhance Jupiter's mystery. The missions served another purpose, however; they advanced space technology to a point where the orbiter-probe mission could be done.

By now the importance of the Jupiter probe experiment has become obvious even outside the scientific community, says Dr. Donald J. Williams, Director of NOAA's Space Environment Laboratory. "Through an unusual series of circumstances, the mission came to a vote before Congress. It was approved overwhelmingly—by a two-to-one margin." More than a hundred scientists are participating in the mission, which is being managed by NASA's Jet Propulsion Laboratory.

Jupiter's Great Red Spot stands out sharply in this rectified Pioneer II photo; the spot is a mysterious part of Jupiter's atmosphere, which is believed to be almost all hydrogen and helium, surrounded by an outer layer of solid ammonia.

The mission's specific goals are to determine the chemical composition and physical state of Jupiter's atmosphere and satellites, and to observe the planet's magnetic field and the energetic particles in it.

Williams heads a team of 10 American and German scientists selected from a world-wide competition to design and construct an experiment to study energetic particles in the Jovian magnetosphere.

The Jupiter Orbiter Probe will be the first planetary spacecraft to be carried aboard the Space Shuttle, which passed its initial tests last fall. As the craft nears the end of its three-year voyage, the probe will separate from the main vehicle and angle toward the planet. No one knows how far it will penetrate before it burns or is crushed. Jupiter, as far as scientists know, has no "surface." Instead, the gaseous planet seems to get denser and denser toward its center. On its way to its uncertain end, though, the probe will leave a legacy of the first direct measurements of Jupiter's atmosphere. The probe will carry instruments to measure structure, composition, cloudiness, the energy balance of the atmosphere and to make some observations of the magnetosphere as the probe passes through it on the way to the atmosphere.

The orbiter will circle the planet for at least 20 months, making detailed observations of the magnetosphere and doing remote sensing of the Jovian moons. Its orbit will be adjusted from time to time by gravitational interactions with the Jovian moons.

The scientific importance of the mission, says Williams, cannot be overstated. Jupiter, more than any other planet, holds the key not only to many long-unanswered questions about the birth of the solar system, but is a natural laboratory for studying physical processes thought to be basic throughout the universe. "It's the first time we get to go somewhere else and do a complete test of what we've learned on earth in a vastly different environment." he said.

Previous missions have provided a good deal of information about Jupiter's atmosphere, but, say the JOP mission's planners, the probe's direct measurements are essential because the previous information is all indirect, and "some vital pieces could be grossly wrong."

Jupiter's atmosphere is believed to be composed of elements in approximately the same proportions as exist in the sun, and as existed in the primordial nebula that gave birth to the solar system. This, added to other pieces of evidence, has led some scientists to theorize that Jupiter could be a sun that didn't quite make it. It also means that Jupiter offers a measurable duplicate of unmeasurable quantities. The primordial solar nebula has passed into time, and some of the elements and isotopes in the sun are difficult to measure by remote sensing, or have been depleted by processes occurring since the sun was formed.

Jupiter's atmosphere is nearly all hydrogen and helium, with all other constituants such as ammonia, methane, and water, amounting to less than 0.1 percent. These can still be huge amounts in absolute terms, however. It is believed that the topmost layer of the planet's clouds is solid ammonia, and that there are at least two deeper layers composed of ammonium hydrosulfide and water.

The mission probe is expected to penetrate all three layers to reach the bottom of the water layer. On its way down, it should sense a gradual increase in temperature. Heat flows outward from some source deep within the planet; Jupiter, like a sun, seems to generate heat. The temperature at the base of the water layer is thought to be close to room temperature.

Studying the abudances of elements and isotopes in Jupiter's atmosphere may provide insight into the constraints on conditions and places where these substances are produced and destroyed, and in turn answer questions about the very nature of the universe.

The element deuterium, for example, is believed to have been produced only dur-

ing the "big bang," the mammoth explosion from which our universe is thought to have sprung. Astronomers can use the ratio of deuterium to hydrogen in Jupiter's atmosphere, which theoretically duplicates original conditions, to estimate the mean density of matter in the universe, and to infer whether it is open or closed.

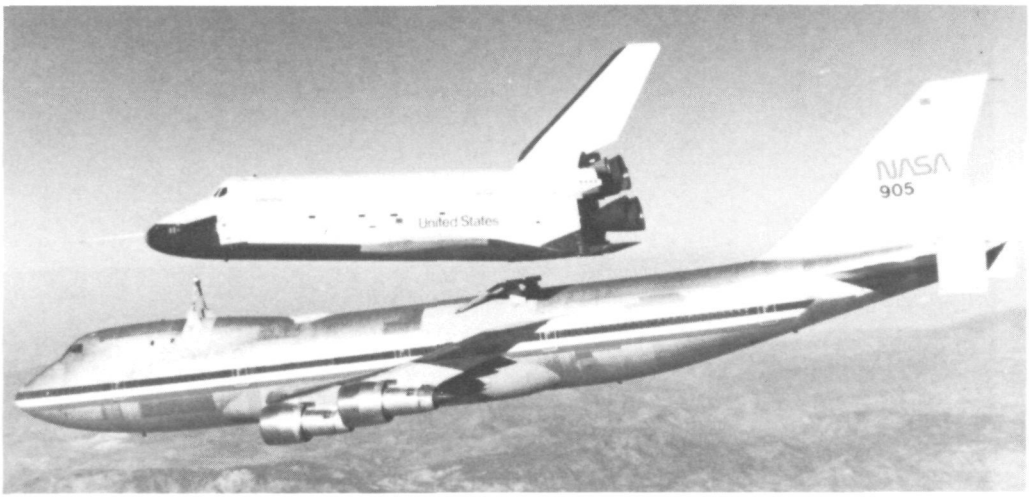
Jupiter may be an archive of gases important not only to the origin of the physical universe but to the beginning of life, as well. Certain biologically important gases, such as HCN and CH_3OH may be present in trace amounts in the Jovian atmosphere. Scientists think that formation of these compounds by sunlight and lightning discharges on earth may have been one of the first steps toward the origin of life on this planet. The probe will carry a lightning detector as well as gas samplers.

The movements of Jupiter's atmosphere are almost as interesting to scientists as its composition, says Williams. The rise, fall, and flow of earth's atmosphere are driven by differential heating by the sun. On Jupiter, there are three driving forces: the sun, the planet's internal heat, and axial rotation. This makes Jupiter's atmosphere a natural laboratory for studying the dynamics of meteorology. Accordingly, one of the things the probe will do is make a vertical wind profile—measurements of wind speeds and directions at different altitudes.

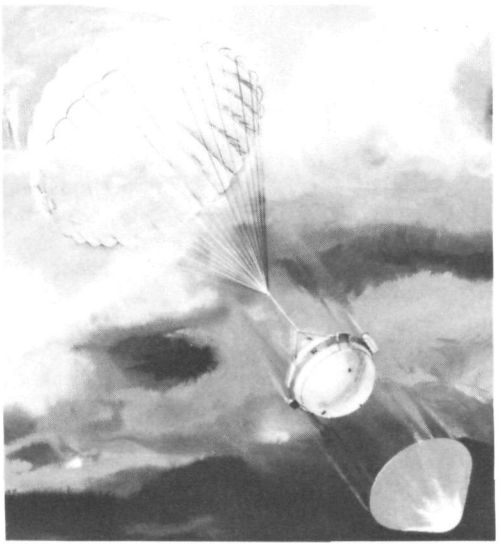
Jupiter itself is the main goal of the expedition, but not the only subject for study. At least 13 moons orbit the giant. Four of them, those seen by Galileo and visible in a small back-yard telescope, are large enough to be considered planets themselves. Ganymede and Callisto are as large as Mercury. These minor planets orbit deep within the magnetosphere of Jupiter, and are subjected to electric and magnetic fields and to charged particle irradiation conditions that no other large body in the known solar system undergoes. They, in turn, could alter the population and distribution of energetic particles in Jupiter's magnetosphere. The satellites vary in brightness, and all show variations in brightness as they rotate, meaning their surfaces must be mottled with areas of different composition.

Jupiter's moons, like Jupiter itself, also stand as records of conditions during the birth of the solar system, and of the processes by which planetary bodies evolve. There, in the same neighborhood of space, are four "planets" that appear to have started from different initial conditions and evolved in different ways. The satellites rotate rapidly, and it is thought that their interiors may still be hot, two conditions that could generate a magnetic field. They could, therefore, offer a real test of theories on how magnetic fields are formed. During its 20-plus months of observation, the orbiter's course will be adjusted to fly close to Ganymede, and to make more distant encounters with Jupiter's other large satellites.

Magnetic fields and magnetospheres are being discovered throughout the universe. Diverse in their properties, they range in size from several thousand kilometers (Mercury) to several million light years (radio galaxy NGC 1265) across.



The Space Shuttle Orbiter Enterprise separates from the 747 carrier aircraft, Oct. 12, 1977; shuttle will have three-year voyage to reach Jupiter.



Red hot nose cone separates from probe portion of Jupiter Orbiter Probe in artist's conception. On opposite page, probe is launched toward Jupiter, to take measurements during 30-minute descent.

Within the solar system, Mercury, Earth, and Jupiter are known to have intrinsic magnetic fields and magnetospheres. The planets' diverse rotation rates, atmospheres, and distances from the sun produce vastly different magnetospheric properties. Saturn is thought to have a magnetosphere that would feel the additional effects of the Saturnian rings. The Earth's moon has no internal magnetic field, and the question has not been settled for Mars and Venus.

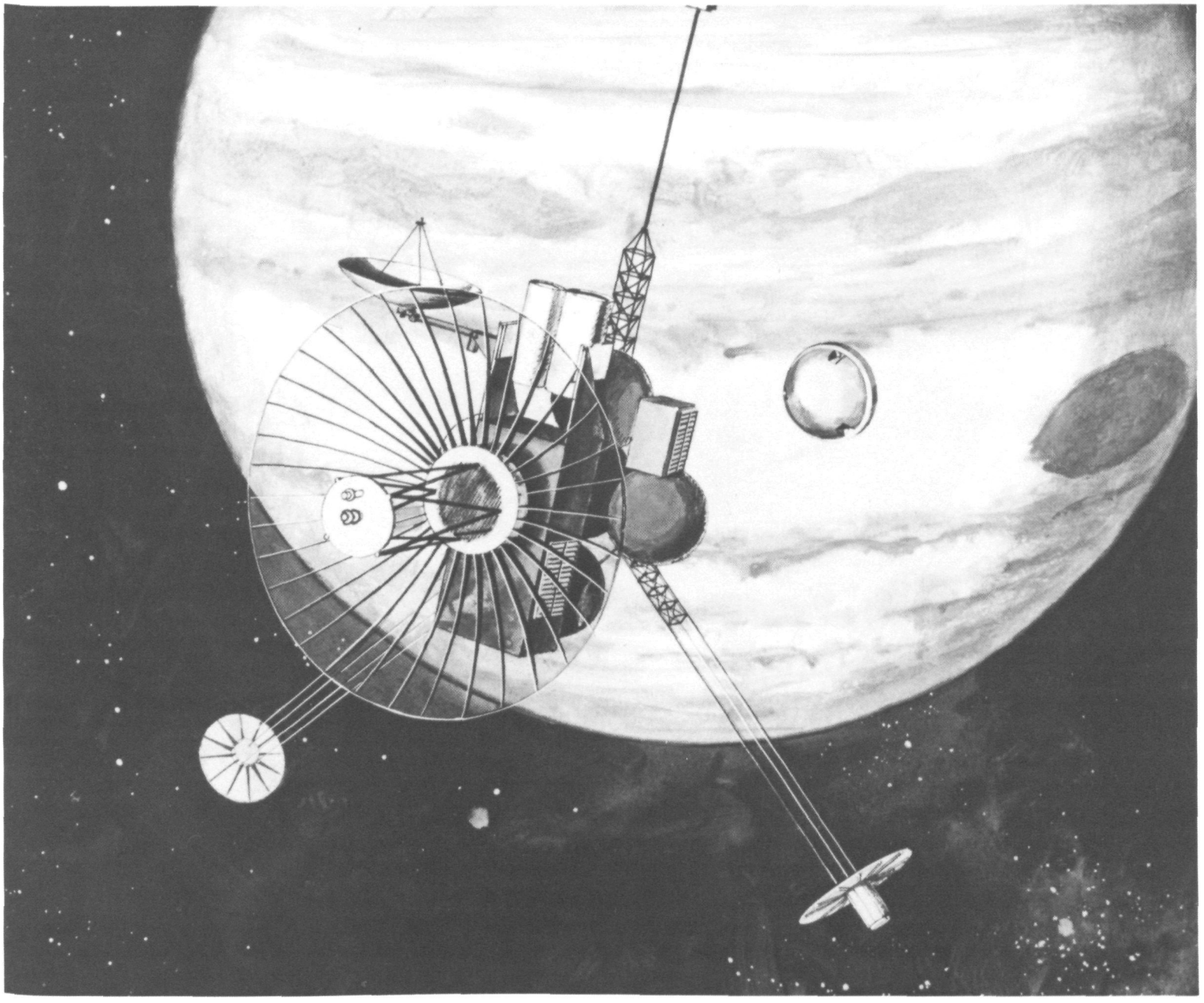
Of these, only Earth's magnetosphere has been thoroughly studied, and Jupiter's is expected to differ from it in important ways. One way is its sheer magnitude: Jupiter's magnetosphere is 100 times greater —a factor of two larger than simple extrapolation from the Earth's magnetosphere would predict. It would exert a more powerful influence over the planet's atmosphere and ionosphere. Interactions with such a powerful magnetosphere could, for example, affect the evolution of the atmosphere. This influence would have been even greater if, as some scientists believe, the solar wind was more intense in the past.

Scientists planning the orbiter-probe mission are especially interested in the energetic particles that make up the fabric of Jupiter's magnetosphere. Recent observations of energetic particles released from Jupiter's magnetosphere into the interplanetary medium revealed a surprising property. The number of particles emitted varies in intensity, and the variations have exactly the same period as Jupiter's rotation: 9.9 hours. Only one thing in the universe emits such periodic radiation says Williams, and that is a pulsar, a celestial source of radio emissions, thought to be a neutron star.

Jupiter orbiter-probe scientists want to find out where the energetic particles in Jupiter's magnetosphere come from and where they go, how energy is transported through the system, and what interactions take place between the magnetosphere, the magnetic field, and the moons.

It is here that the NOAA experiment comes in. The purpose of the experiment, says Williams, is to measure the energy and angular distributions of energetic particles in the Jovian environment. The instrument, which will be on the orbiter, bears the entire burden of energetic particle measurements. Three other instruments on the mission will make observations of different magnetospheric properties.

Responsibilities for the experiment are divided among six institutions: NOAA, Johns Hopkins University's Applied Physics Laboratory, Germany's Max Planck Institute for Aeronomy, Bell Laboratories, and the Universities of Kansas and Alaska. The instrument, explains Williams who is principal investigator for it, "is a large, complicated beast." The entire job, requiring substantial effort from all the cooperating institutions, will be coordinated through NOAA's Space Environment Laboratory:



"We are responsible for the instrument and the experiment."

The instrument, though one of the most complex of its kind ever put together, is descended from instrumentation that has been proven on previous, successful missions, including the Voyager mission and the International Sun-Earth Explorer, says Williams. NOAA's and Applied Physics Laboratory's instruments on both these NASA missions were forerunners of the instruments being built for the Jupiter-Orbiter-Probe. The instrument package will be heavily shielded to protect it from Jupiter's intense radiation belt, with portals to admit the particles that are to be measured.

Composed of two major units, the instrumentation that the NOAA space scientists are overseeing will measure the energies and angular distribution of protons with energies greater than 20,000 electron volts, and electrons with energy greater than 15,000 electron volts. It also will identify the isotopes and elements that are lighter than cobalt.

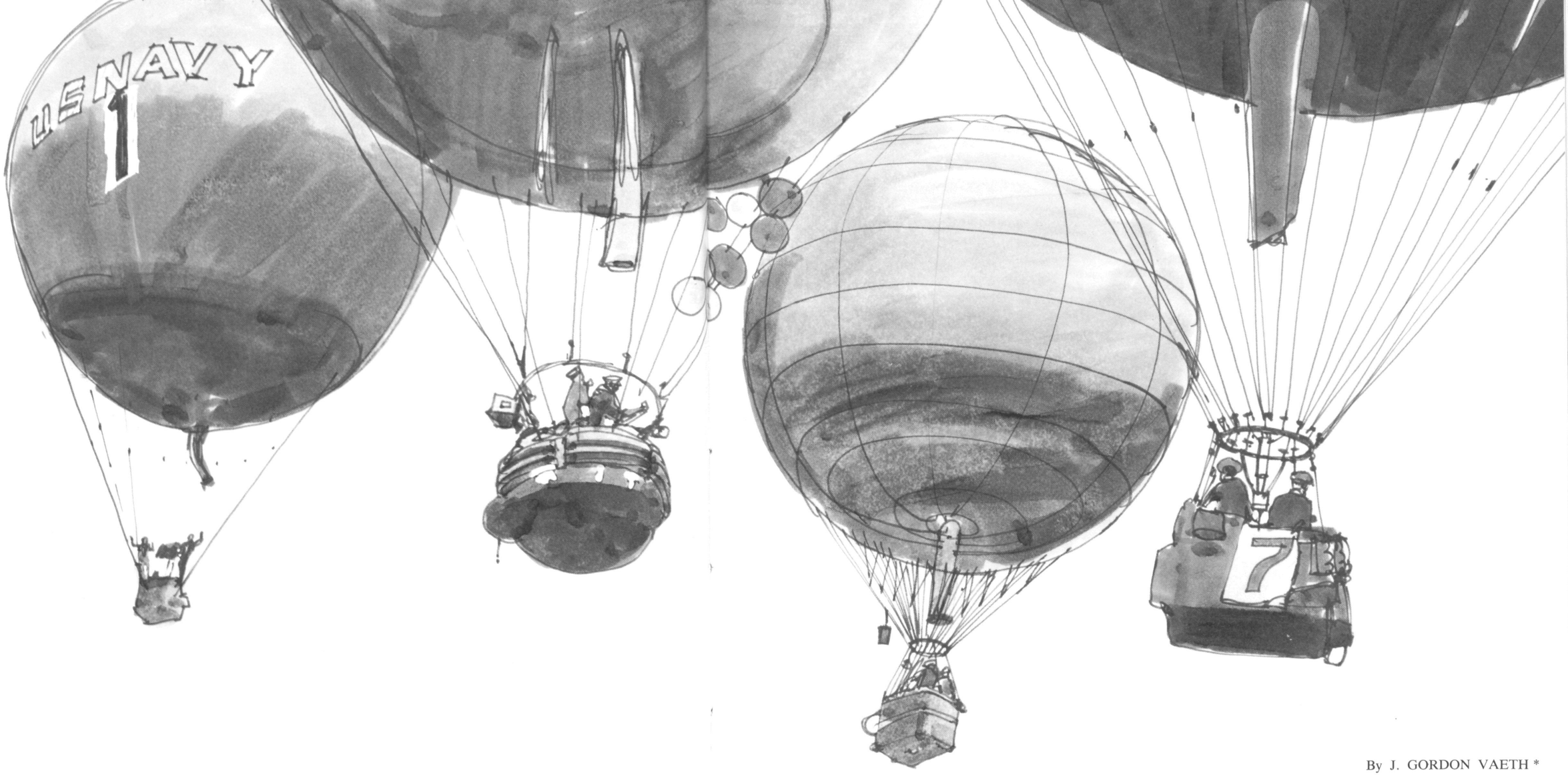
One unit for measuring the energetic particles is a dual purpose instrument, says Williams. One side measures the lower energy particles including electrons. On the opposite side are detectors for higher energy particles. The Jovian magnetosphere is sometimes convulsed by storms, but on a scale much grander than Earth's. The dual instrument, says Williams, "will measure the exceptionally intense radiation which we may find during storm periods in the Jovian magnetosphere."

The second unit has an exceptionally thin particle detector at the portal, and a thicker detector behind it. The instrument follows the tested and true method of identifying elements, says Williams, by measuring the amount of energy a particle loses in traversing the first detector and the amount remaining by the time it reaches a rear detector. "We will also measure the time it takes the particle to go from one detector to the next. This gives isotope and elemental composition."

A unique feature of this instrument, says Williams, is that it will be mounted on a movable platform on the orbiter. The orbiter itself will be spinning as it circles the planet, and the instrument platform will rotate in the other plane. The result will be a three-dimensional picture of particle distribution in the Jupiter magnetosphere. "This is essential to extract the physics of plasma (aggregates of charged particles) around Jupiter," notes Williams.

The entire instrument will weigh 15.2 pounds (6.9 kilograms) and use 5.9 watts (.005 BTU/sec) of power. "It produces 450 bits of data per second which is about what an entire, moderate-sized man-made satellite of five years ago would have done," Williams explains.

Williams' proposed instrument was chosen from among many others by a peer review committee that NASA set up. Over a hundred proposals were submitted, he recalls. It was one indication, he believes, "of the incredible excitment of people involved in the Jupiter mission. It's one of the most exciting things we've ever done." □



Big Bag Classics

When weather determined not only winners but survivors

By J. GORDON VAETH *

The outcome of outdoor sporting events has always been decided to some degree by the weather. No such events, however, have probably ever been influenced by meteorological considerations as much as were the great long-distance balloon races of fifty or so years ago.

In the 1920's and early 30's, balloon racing was a sport eagerly followed by many Americans, much as professional auto racing is followed today. The aeronauts, who manned their wicker baskets and flew their bags of hydrogen to whatever their destinations, were among the best-known personalities of the time.

These men—in those days balloon racing was not a woman's sport—jokingly called themselves "balloonatics." Actually they went aloft and about their business of riding the winds seriously and with professionalism. From their ranks would come a Chief of the U.S. Army Air Corps, Oscar Westover; one of America's great aeronautical engineers, Ralph H. Upson; and a Chief of the U.S. Weather Bureau, Francis W. Reichelderfer.

They and their activities were typical of the "Roaring Twenties." Indeed, a popular song of the day, "Breezing Along with the Breeze." seemed almost to have been written with them in mind. And the success of everything they did, or that they tried to do, invariably depended upon the weather and upon their understanding of it and of how to profit by it. In terms of making practical use of meteorological knowledge, they were tops. They had to be—in order to win and, not infrequently, in order to survive.

Each year, a National Balloon Race was held as an elimination contest to decide who would represent the United States in the next James Gordon Bennett international meet. Bennett, dynamic editor of the *New York Herald,* had sponsored an aeronautical trophy that the Federation Aeronautique Internationale, world certifying body for records set in sports flying, had dedicated to competition between piloted free-flying balloons.

These were not competitions or races decided on the basis of speed. The winning balloon would be that which traveled the farthest Great Circle Distance from starting point to landing place.

The first of the Gordon Bennett races had taken place from Paris in 1906 and had been won by an American, Frank P. Lahm, who brought his balloon United States to earth in Yorkshire, England, having covered 410 miles in 22 hours. Except

* *Mr. Vaeth, who has done some gas ballooning himself, is Director of System Engineering for the National Environmental Satellite Service.*

for 1914-1919, the trophy had been competed for every year since.

The 1923 Bennett meet at Brussels had shown how dangerous this type of sport could be. Three balloons were destroyed and five crewmen, two of them Americans, killed. No one, however, was prepared for the catastrophe that the weather brought the National Race in Pittsburgh in 1928.

Fourteen entries were laid out on Bettis Field as formless piles of rubberized cotton, folded accordion-like atop a protective ground cloth. The hydrogen, 35,000 cubic feet per balloon, was fed into each (fireproof helium was too rare and costly to be used). Filled with this highly efficient, but also highly flammable, lifting gas, the balloons took on their familiar spherical shape. Then, restrained by a net that kept them from shooting skyward they were connected to their baskets. This done, and with crew of pilot and aide aboard, they impatiently tugged to take to the air, looking much like giant mushrooms sitting on the field. Where they would end up, no one could tell. That depended on the winds, on the piloting skill of the participants, and on how far, how long, and in what direction they could navigate and ride the air currents.

Thousands looked on as the racers were released from the upwind end of the field, their order of takeoff decided by lot. Departure was in the late afternoon. About 6 p.m., the last balloon got off. It was Memorial Day, May 30.

The fourteen aerostats—balloons—each about 60 feet tall, lifted off under a low overcast and in warm unstable air. The surface wind was out of the southwest. Pittsburgh lay between two fronts, a warm one to the east and a cold one to the north and west. As the cold front moved in, it was accompanied by severe thunderstorms which seized upon the balloons almost as soon as they were airborne.

Lt. T.G.W. "Tex" Settle, pilot of the Navy entry, was one of those caught and overwhelmed by the atmospheric forces at work. Now a Vice Admiral, Retired, living in Washington, D.C., he vividly remembers watching his altimeter as his balloon was sucked up into the thunderstorm that had suddenly materialized overhead. Pulling on the valve cord, he tried to release enough gas to slow or to stop the out-of-control ascent. As he did, heavy rain poured down and then hail. When at last he leveled off, he was at 8500 feet.

Then came a downdraft and descent, also uncontrolled. Now instead of valving, he ballasted. As fast as he could, he dumped sand. At one time the balloon was dropping so fast that a 30-pound bag of ballast that he threw overboard "fell up" toward the basket. At 1800 feet, he broke through the clouds and succeeded in stopping his fall. Then another updraft caught him and carried him to 9000 feet . . . followed by another downdraft that took him back to 1500. By this time, he had used up his ballast. He had to land, and did so, at Perryopolis, Pa.

Eleven of the 14 balloons were beaten down by the thunderstorms that early evening, all of them within 31 miles from where they had started. Three of the 11 had suffered an even worse fate. The front page of the May 31 *New York Times* told their story: 3 BALLOONS IN RACE HIT BY LIGHTNING; 2 MEN DEAD, 2 HURT.

An Army entry from Langley Field was one of those struck and set afire with Lt. Paul Evert and Lt. U.G. Ent aboard. Evert apparently was killed instantly by the bolt, but Ent stayed with him in the blazing balloon, trying unsuccessfully to revive him. Ent rode the basket to the ground, landed in a river, and escaped with his life.

Walter W. Morton was the other fatality. The bolt that hit the Goodyear V balloon killed him outright and knocked the pilot, Ward T. Van Orman, out cold. The flaming balloon crashed to the ground. When Van Orman came to, he was lying beside the basket, the rain beating in his face. He had suffered a broken ankle.

The City of Cleveland, manned by Carl K. Wollam and J. F. Cooper, was the third entry hit. Cooper was stunned and Wollman, like Ent, stayed to try to bring his companion to. Seeing that he couldn't get Cooper into a chute and over the side, Wollman waited until the last few seconds and then bailed out to lighten the balloon, slow its fall, and lessen its impact. He had waited too long to put on his own chute. So, sticking one arm through the harness, he wrapped it around himself, and, literally clutching onto it for life, dropped from the basket. The chute opened and he landed safely. So did Cooper in the balloon; although severely burned, he survived the experience.

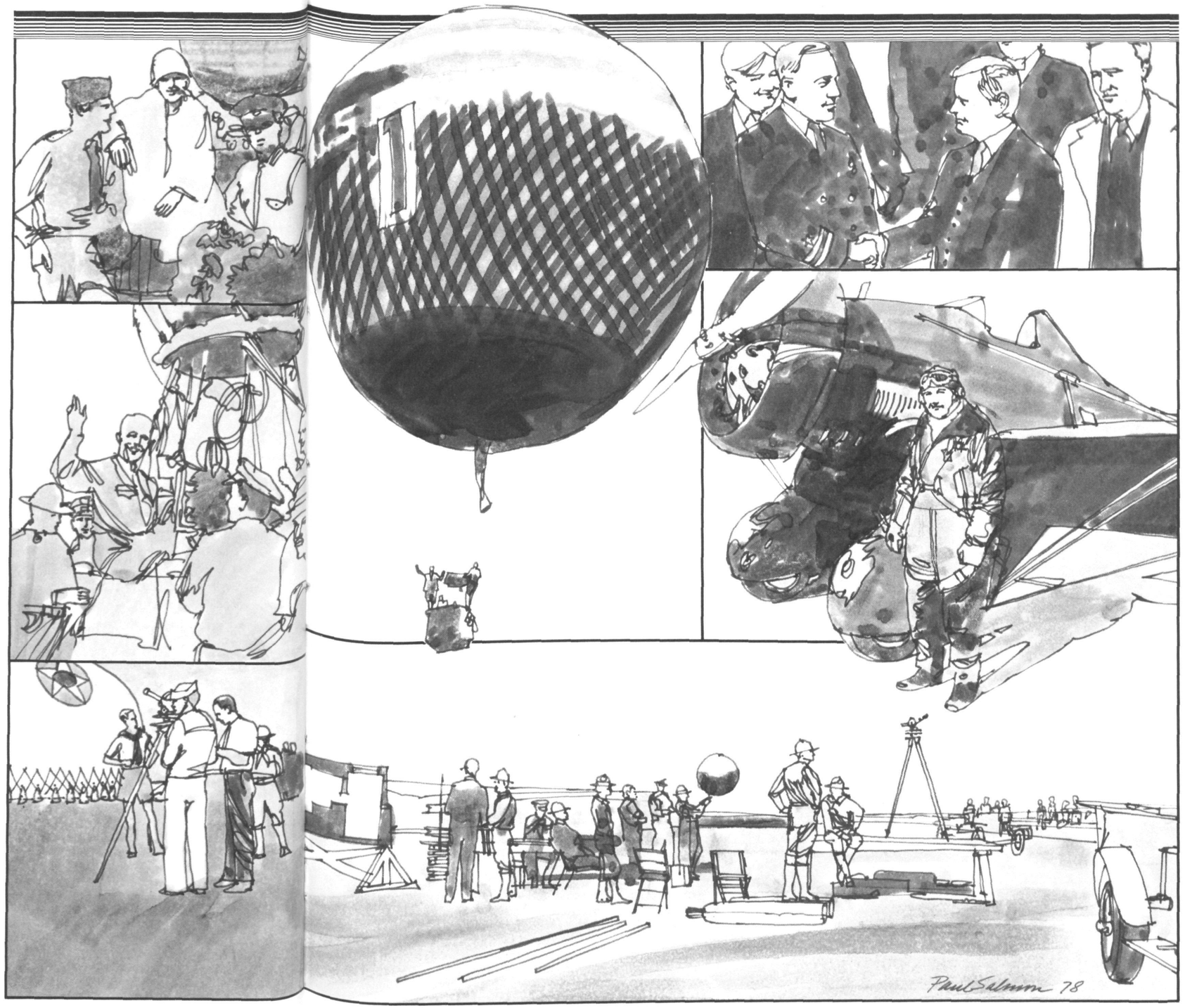
Despite the beating that the elements administered in the 1928 National, three balloons managed to get through the weather to cover reasonable distances. The winner was another Army balloon, crewed by Captain W. E. Kepner and Lt. W. O. Eareckson. They landed near Weems, Va., 261 miles away, after a flight in electrical storms, a snowstorm, and temperatures that froze their drinking water. Enroute they had struck a high-tension wire and later had taken down a telegraph pole and wires.

The tragedy at Pittsburgh shocked the nation. But the balloonists were undaunted.

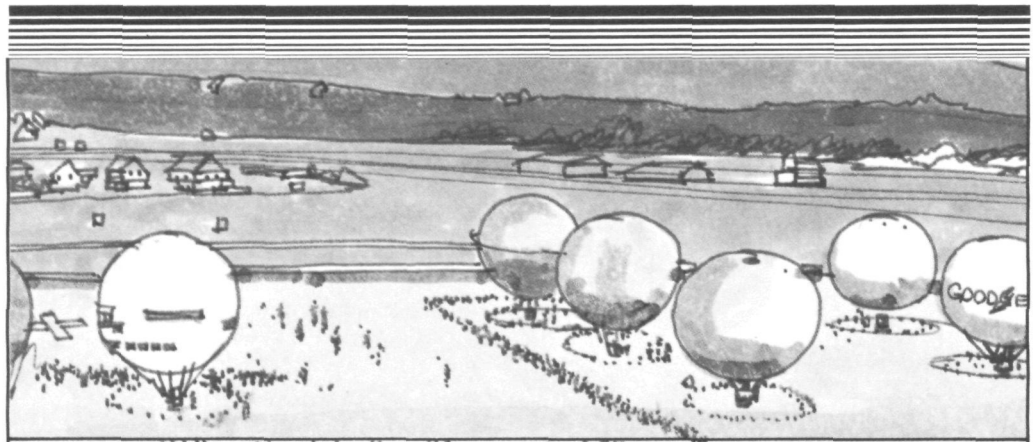
The Gordon Bennett was held right on schedule in Detroit on June 30. Twelve balloons, representing eight nations, competed. The winners, once again, were Kepner and Eareckson with a flight of more than 400 miles.

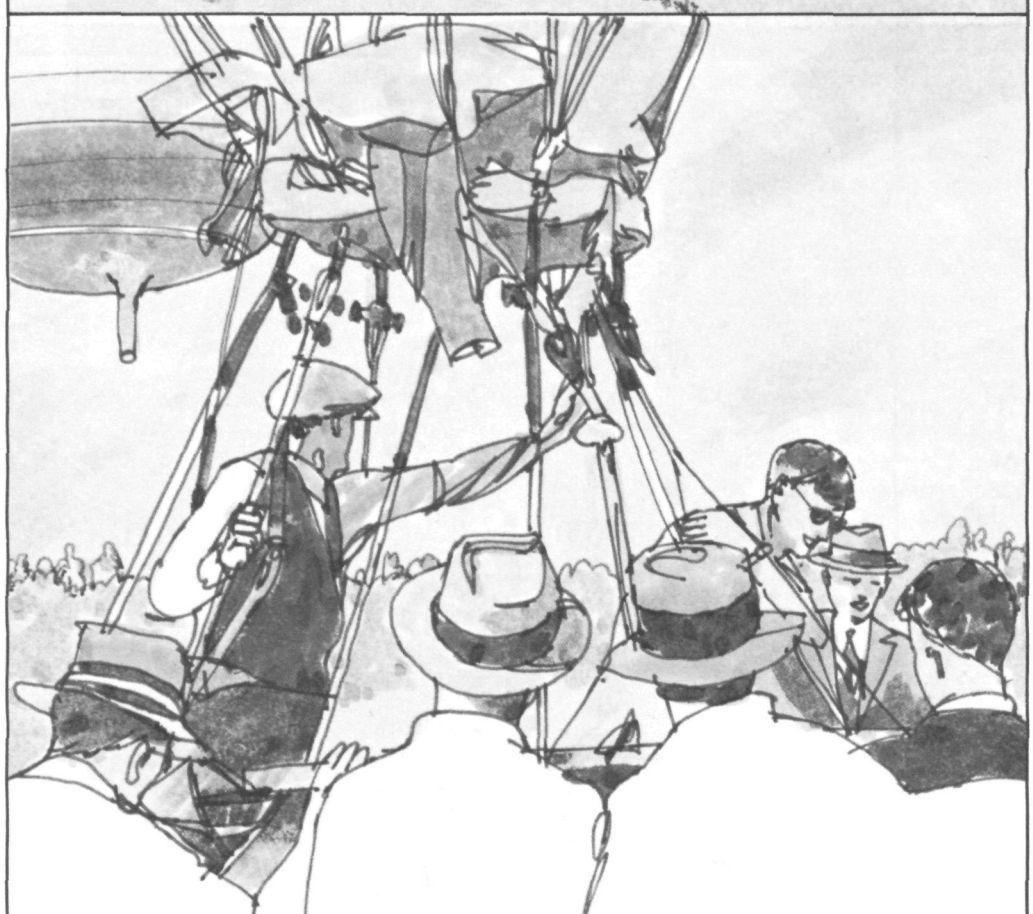
And as preparations went ahead for the 1929 National Race, to be held again at Pittsburgh, much thought was being given by prospective contestants about how to protect themselves against lightning strikes.

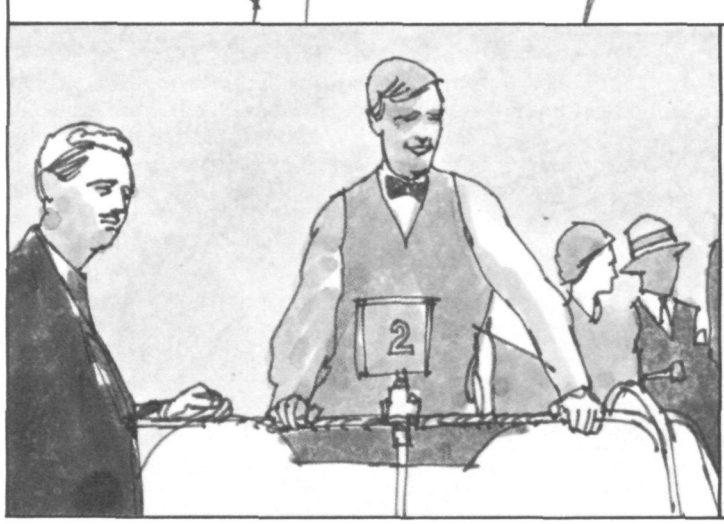
Settle viewed a balloon, especially when wet from rain, as a flying conductor. He proposed keeping that conductor as short as possible in thunderstorms. This meant pulling in the drag rope, radio antenna, and running light, all of which customarily dangled beneath the basket. "If steady valv-



Leaves from a "balloonatics" scrapbook . . . clockwise from top center; ascension of a Navy entry in the National Balloon Race; Acting Mayor McKee of New York welcomes T. G. W. Settle and Ward T. Van Orman on their return from placing first and second in the 1932 Floyd Bennett; leather-suited William E. Kepner; the 1924 National Elimination Balloon Races at Kelly Field, Texas; Francis Reichelderfer (to right of sailor) plying his trade during a pilot balloon sounding; Lt. Cdr. Settle waves from Navy balloon in his last race, 1933; winners of third National Balloon Race, 1927, Lt. W. O. Earickson, sponsor Miss Helen Peck, and pilot Capt. W.E. Kepner.







Balloons being prepared for launch at Gordon Bennett International Balloon Race, Basle, Switzerland, 1932 (top); winner of National Balloon Race in Akron, Ohio, aide W. W. Morton and pilot Ralph T. Van Orman; a later photo of Van Orten (speaking); and the P. W. Critchfield trophy.

ing or pouring of sand is done," he also pointed out, "the vertical stream of gas or sand constitutes added vertical dimension. When valving is essential under thunderstorm conditions, it should be done in short spurts; similarly, ballast should not be dropped as a long stream."

Goodyear's Van Orman, working with a local electrical insulator company, came up with a protective hanging wire device particularly intended to safeguard the crew in the basket.

Twelve entries floated skyward from the University of Pittsburgh Stadium in the 1929 event. For a while, it seemed that meteorological history might repeat itself: there were thick low-hanging clouds and rain. But because no thunderstorms were predicted in the immediate area, officials allowed the race to begin. It was won by Settle, accompanied by aide Ensign Wilfred Bushnell, in a flight that lasted 43 hours and 28 minutes. From Pittsburgh, they had drifted in free flight to a landing on Prince Edward Island in the Gulf of St. Lawrence, a record distance of 952 miles for their size balloon. Van Orman was the runner-up.

Three years later, Settle and Bushnell again proved a winning combination when they took the Gordon Bennett of 1932. Sixteen balloons, 80,000-cubic footers, were filled with coal gas at the Basel gas works in Switzerland and released to the winds. In addition to the United States entries, there were entries from Switzerland, Belgium, Spain, Poland, Germany, France, and Austria. Several were hampered by thunderstorms. But the U.S. Navy's luck held, and the threatening weather was avoided. In a flight uneventful, except for unintentionally frightening cattle, fowl, and occasionally people with their drag roping, Settle kept aloft for 41 hours to reach Daugieliszki, Poland, 960 miles from his starting point. Again Van Orman's balloon placed second.

Van Orman's loss to Settle on these two occasions did little to affect his reputation as "the winningest balloon racer" of the day. He had taken every National Race from 1924 to 1927 and was trying to make it five in a row when defeated by lightning in 1928. He had won the Gordon Bennett in '26 and again in '29 and '30. He would have won it also in '25 had it not been for his unorthodox (to say the least) landing on the deck of a steamship 60 miles at sea off the coast of France.

In 1933, there were distinct signs that the public's interest in balloon racing had crested and begun to fall; this despite the fact that another Gordon Bennett was held that year and a new trophy provided for it by the *Chicago Daily News,* Settle's victory having retired the old one. It was won by two Polish aeronauts who flew 846 miles from Chicago to land in Portneuf County, Quebec. Settle and Van Orman had entered and placed second and third, respectively.

It was to be the last such race for either veteran. Settle's naval duties soon would take him to China to command a gunboat on the Yangtze River. And Van Orman decided to retire from further competition.

He continued to be one of Akron, Ohio's most active citizens until his death on March 11, 1978.

With the win by the Poles and the absence of the two great American balloonists from the scene, it was fast downhill for American balloon racing from then on. The yearly "nationals" were soon discontinued. By World War II, the era of the great gas balloon races had ended in the United States.

The racing balloonists of a half-century ago left a legacy of achievement, adventure, and daring. And it is a legacy that those in NOAA now engaged in the practice of meteorology can identify with.

Gas ballooning was more than just flying. The Navy called it a practical exercise in the use of meteorological knowledge and skills.

Those who rode the winds in a gas balloon, particularly one in balance or equilibrium, were for all practical purposes part of the air mass with which they moved. Balloon and balloonist responded intimately to the processes of the atmosphere. The best balloonists were those who most understood and knew how to predict and use those processes. It was one of the secrets of Van Orman's and Settle's success; although in their races against foreign competition, they also were helped by the superiority of American balloon technology. U.S. balloons were famous for their lightness in weight and their gas-tightness.

Racing balloonists carried radio receivers to pick up forecast information. The Navy entries kept watch on Navy Station NAA in Arlington, Va., for the Morse-coded weather data it sent. A radio onboard was useful for another reason: static, its amount, and its increase or decrease in strength, was a valuable indicator of thunderstorm activity when visibility was poor.

In the competitions held here at home, the U.S. Weather Bureau played a major role. Beginning a day or two before the race, and, of course, on the day of the great event itself, the balloonists swamped the local Bureau office in person and by phone requesting the latest weather information and forecasts. And the Weather Bureau members responded in the spirit of the occasion, supplying maps, predictions or advisories, and making upper air soundings.

Today, National Weather Service information is important to another and quite different type of ballooning that uses hot air. But things aren't the same. Perhaps it's because there are so many hot air balloons. Perhaps it's because hot air aerostats don't fly very far (their bottled propane runs out). Or perhaps it's simply that interests change.

Whatever the reason, the public fascination that once fastened upon those who ballooned and raced with hydrogen and coal gas has never been duplicated. And it's probably just as well. Such were their accomplishments that the fame and reputation they acquired should remain uniquely theirs. □

Reichelderfer—Balloonist

All NOAA knows the name Francis W. Reichelderfer, who served as Chief of the U.S. Weather Bureau for 25 years (1938-1963) and was President of the World Meteorological Organization.

Not so well known is that his early career included ballooning and balloon racing.

Recently "Reich," as his fellow balloonists called him, recalled some of his experiences floating, as he put it, like a particle of air with basket, bag, and valve.

He remembers his first race vividly. As one of the only two aerologists on duty in the Navy at the time, he was assigned as aide to fly in one of three Navy balloons that were to compete against three Army balloons at St. Louis in 1919. Came the day of the big race and his balloon was inflated. But it filled up only part way and no more. The rubberized cotton had deteriorated; the envelope simply would not hold gas. So, in his first race, "Reich" never got off the ground. The Army, incidentally, had a balloon that shared exactly the same fate.

Lieutenants F. W. Reichelderfer and J. B. Lawrence teamed up in 1923 as a Navy entry in the National Balloon Race that started out from Indianapolis that year. The "Chief," as former Weather Bureau employees remember him, recalls the trouble they had with the valve. They could not release gas fast enough, not a small problem when a developing thunderstorm carried them to 19,500 feet. The two men took turns hanging onto the valve cord. As they approached their peak altitude, they suddenly heard what sounded like two loud pistol shots—their flotation gear, carried in the event of a water landing, had burst. Finally, they got down safely. Another entry was not so lucky; it went down in the Great Lakes and its crew was lost.

Reichelderfer and Lawrence placed second in that 1923 national competition, thus qualifying themselves for the Gordon Bennett international meet in Brussels that September. Before takeoff, they were presented with a bouquet of flowers. To recieve flowers at the start of a race was considered very bad luck so they unloaded them as quickly and as quietly as possible. As they navigated overnight, they saw they were approaching a line of lights on the ground beyond which it was almost completely dark. Neither of them liked the look of that so they descended. They landed in a field at Putten, Holland. Close by was the southern edge of the Zuider Zee. They had covered too short a distance to win or place in the race. But they had been lucky in one sense. Three other balloons had been struck by lightning and destroyed; five balloonists, including two Americans, had been killed.

Following the 1923 competitions, Reichelderfer continued active in balloon racing but more in the role of providing Navy entries with aerological advice and support than as a rider of the winds himself. During many of these years he was head of the Navy's aerological organization or, later, Aerological Officer at the Naval Air Station at Lakehurst.

It is obvious from the way "Reich" speaks about his ballooning experiences, either in race or other cross-country flights, that he has fond memories of those times. Like his colleague, Tex Settle, he believed then, and now, that free ballooning was a superb way to experience and learn about atmospheric processes. And he recalls the ballooning activities of other Weather Bureau members, such as C. Leroy Meisinger and C. G. Andrus, and also of other Navy aerologists including Howard T. Orville.

"Reich" concluded his reminiscences about his ballooning days with a story about the homing pigeons that balloon and airship crews used to carry for communications in the days before aircraft radio. One of the Navy's "Pigeon Quartermasters" conceived the idea of cross-breeding a pigeon with a sea gull so that the bird could come down on the water to rest if need be. The Commanding Officer, entering fully into the spirit of the suggestion, endorsed it on to higher authority with these words: "Forwarded, recommending approval. If the hybrid is successful, it is suggested that it be in turn crossbred with a parrot, so that the message it is carrying can be delivered in plain language."

And that exemplifies the joie de vivre that was so much a part of ballooning and balloon racing between World Wars I and II.

At the Gordon Bennett International Balloon Race, Brussels, Belgium, 1923, Navy Lt. Francis Reichelderfer (rt.) poses with fellow balloonist.

NGS readjusts the North American datum

AN ENORMOUS TASK FOR COMPUTERS

By GINA BARI KOLATA

IN 1974, the National Geodetic Survey (NGS), which is part of the National Oceanic and Atmospheric Administration (NOAA), embarked on a project of unprecedented magnitude. The project is to readjust the North American Datum—a network of reference points whose longitudes, latitudes, and, in some cases, altitudes must be known to an accuracy of within a few centimeters. Now halfway through their readjustment project, NGS investigators are confident that they can complete the job by 1983, as scheduled. They point out, however, that this project is one of the largest computer tasks ever attempted (about 700 hours of computer time are allotted).

The sheer size of the problem of computing the coordinates of these reference points has forced NGS researchers to deal with problems that arise, as they are fond of putting it, "from pushing the state of the art to its limits." For example, a key step in the problem is to solve about 2.5 million nonlinear equations in 400,000 unknowns. For smaller problems, this task is textbook simple. However, according to Charles Schwarz of NGS, the NGS problem is the largest system of nonlinear equations whose solution has been attempted. The size of this problem forced the investigators to deal with, and protect themselves against, the possibility that the computed solutions would be worthless, or even meaningless.

The North American Datum consists of about 200,000 points described by their longitudes and latitudes and about 500,000 points described by their altitudes. This network is necessary to regional planners, engineers, and surveyors, who need accurate reference points when they make maps and specify property boundary lines, to navigators, and to geophysicists who study the tectonic movements of the earth. Coordinates of these points must be known with great accuracy because detailed maps of regions, such as cities and counties, are made by measuring distances and directions to various sites from the datum points. Any errors in the coordinates of the datum points will lead to even greater errors in the coordinates of the intermediate points whose coordinates are determined from them. In fact, it is a basic principle of engineering that the accuracy of the coordinates of reference points be at least an order of magnitude greater than the accuracy of the coordinates of such intermediate points.

The extensive network constituting the North American Datum has been built up gradually since 1807. New points were continually added and their positions determined in reference to previously existing ones. The datum was last readjusted in 1927, when the coordinates of all points then in the network were calculated with reference to a triangulation station on Meades Ranch in Kansas.

Since 1927, more than 100,000 points have been added to the network, and the network has been extended from the continental United States to include Alaska. The coordinates of these added points were calculated with reference to the 1927 points, which resulted in the propagation of errors in the positions of the 1927 points to errors in the positions of the added points. These errors were, in places, as large as 10 m. Moreover, the surface of the earth itself moved since 1927. In some areas, tectonic movements as large as 5 cm per year have been observed.

It became increasingly obvious that the current datum is no longer adequate for today's uses. In 1971, a National Academy of Sciences committee recommended that the datum be completely readjusted. The new datum will span all of the North American continent. The governments of Canada, Mexico, the republics of Central America, and Denmark (which administers Greenland) have decided to add their own networks to that of the United States and have agreed to support and cooperate with NGS to make the resulting North American Datum consistent.

Since techniques for measuring positions of points relative to each other improved tremendously over the years, NGS investigators believe they will have to do a minimum of remeasuring when they readjust the longitudes and latitudes of the datum points. Instead, they will concentrate on solving simultaneously a set of equations relating the position of every point of the datum to every other point and tying the whole network to a few reference points. They plan to make use of all previous measurements of the positions of the points in the network to get the best fit to the available data. They break their task into two parts. First is a monumental problem in data management and handling; next are the actual computations of the readjustment.

Data management and handling is a problem in part because NGS had not previously computerized its files. Robert Hanson of NGS says this project is, in effect, "dragging NGS into the 20th century." The position of each point in the network was determined several times over the years, but all this data exists on paper and has to be put into a form that can be read by a computer. After 4 years of work, the NGS investigators are only about halfway through entering their data on the computer cards and validating the data. Moreover, this data base must be validated to rule out errors in observations and in data entries into the computer.

To validate the data, NGS researchers are working with small subnetworks of 50 to 200 points and solving for the positions of these points relative to each other. Schwarz reports that, as might be expected, a number of errors were detected. The magnitude of this task is reflected by the enormous number of measurements that must be dealt with. John Bossler, director of the readjustment project, notes that the horizontal control points—200,000 points whose longitudes and latitudes, but not altitudes, are to be determined—are described by some 2 to 3 million observations.

The mathematical portion of the readjustment is, in theory, straightforward. Thus far, NGS investigators are concentrating on the horizontal control points. In order to come up with corrections for the longitudes

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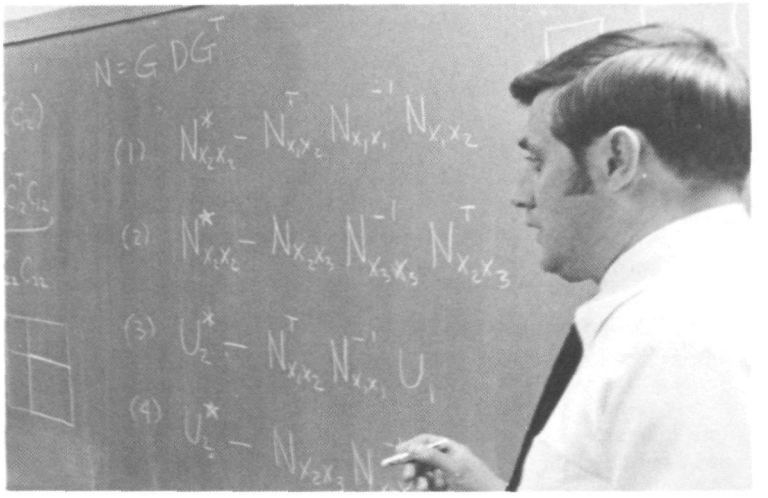
Robert H. Hanson (l) and Dr. Charles R. Schwarz of the National Geodetic Survey examine computer output on project to readjust the North American Datum.



Capt. John D. Bossler, NGS, discusses algorithm for the partitioning of the system of equations.

and latitudes of these points, they must solve simultaneously about 2.5 million nonlinear equations (one for each position measurement of the control points) in 400,000 unknowns (two for each control point—representing corrections for longitude and latitude). These equations are nonlinear because they contain functions, such as sines and cosines, necessary for describing the direction of one point relative to another.

The NGS investigators will first linearize their equations by means of a Taylor series expansion. They plan to solve the linearized equations and to use the solutions to improve their linear approximations to the original equations. Then the whole process of solving the linearized equations will be repeated. According to Schwarz, NGS investigators hope to get away with only one iteration, but if the solutions are not sufficiently accurate, they may have to iterate again.

In order to solve the linearized set of equations, NGS researchers must put these equations into a workable form. Since there are so many more equations than unknowns in the readjustment, the system of equations is said to be overdetermined, meaning that it may have no unique solution. The NGS investigators are using a well-known method, a least squares adjustment, to obtain an answer that gives the best fit to the data. When they apply this method, they obtain a set of 400,000 equations in 400,000 unknowns. These equations should be solvable.

The actual task of solving the 400,000 equations is not so easy. First, there is the problem that the system of equations is too large to fit into the memory of a computer. Second, even if the problem is broken up into more manageable chunks, the answer that comes out of the computer may not be trustworthy. This is because computers can only store numbers of a fixed number of significant digits. Repeated arithmetic operations can cause significant digits to be lost. This loss of digits is especially serious when numbers of disparate sizes are added or subtracted. The NGS problem, as might be expected, requires an enormous number of arithmetic operations. For example, in one step of the problem, the matrix resulting from the least squares adjustment is solved by means of an algorithm known as a Cholesky reduction. This process alone requires about 10^{11} multiplications. Moreover, the numbers in the NGS problem are of disparate sizes.

The NGS researchers plan to break their problem into manageable pieces by a method known as Helmert blocking. This method, which was devised nearly a century ago, provides a way of ordering the points in the North American Datum. Groups of adjacent points are treated as a block. The matrix equation associated with each block is partially solved, and the blocks are mathematically pieced together. Schwarz points out that this process is algebraically equivalent to solving the whole system of equations simultaneously.

The NGS investigators worked with the Helmert blocking scheme so that it takes full advantage of the many zeros that occur in the NGS matrix, thus minimizing the number of necessary computations. The NGS matrix has a large number of zeros that arise because the position of each point of the datum is only measured with respect to a few adjacent points, not with respect to all other points in the network. The zero entries represent all the possible measurements that were not made.

Peter Meissl of the Technical University of Graz, in Austria, recently spent 10 months at NGS analyzing the magnitude of the problem of round-off errors when the readjustment equations are solved by Helmert blocking. He concluded, on the basis of a statistical analysis of the problem, that round-off errors should not cause the computed solution to have fewer significant digits than are thought to be needed. (The NGS investigators want four or five significant digits. Meissl says they are certain to get two to three and are very likely to get four to five.) One reason for Meissl's optimism is that the zeros of the matrix facilitate the computations.

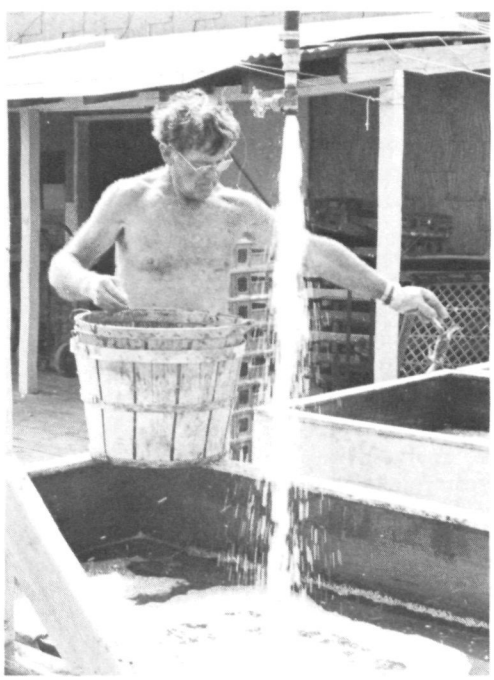
If the solutions to the readjustment equations are incorrect after all, will the NGS investigators recognize it? According to Schwarz, they will. He says they will look at the magnitudes of the position corrections specified by the solutions. If the solutions are correct, the magnitude of the corrections to particular points should be consistent with the magnitudes of corrections for nearby points. The solutions can also be analyzed to determine the estimated errors made in measuring the positions of points. The NGS investigators have some idea of what those errors should be, so they can decide whether the computer solutions make sense. In general, Schwarz says, the corrections should be on the order of 2 to 4 m.

Considering the magnitude of the readjustment project, it might be expected that NGS would be a large and well-funded agency. But NGS has a staff of just 300 people and an annual budget of just $10 million. Moreover, only about one-third of its staff is working on the readjustment of the horizontal control points. (Many of those not working on this readjustment project are surveyors who participate in projects, partially funded by state governments, to determine coordinates of points in between the control points of the datum.) Of the $10 million allocated each year to NGS, about $1 million goes toward paying for computer services. The NGS has no computer of its own but must buy computer time from NOAA.

Despite the small size and limited budget of NGS, its researchers are a proud and confident group who clearly view the task of adjusting the North American Datum as within their means. Hanson notes that the datum will undoubtedly have to be adjusted again, perhaps in 50 to 100 years. But next time, with the knowledge gained from this attempt, the task should be much easier. □

Conserving the Chesapeake's CRABS

Story and Photos By JAMES C. ELLIOTT



Austin Bridges of Bozman, Md., separates his catch at "P. T.'s Crab House"; peelers are placed in tanks for shedding. Below, a basket of the ornery delicacies.

For years, watermen and scientists along the Chesapeake Bay have been concerned over the high mortality rate among soft crabs. According to reports, the mortality rates vary from about 10 percent in some parts of the Bay to more than 80 percent in others. As a result of that concern, Sea Grant researchers at the Virginia Institute of Marine Science at Gloucester Point, Va., and at the University of Maryland are launching investigations into the causes of the mortalities.

The research centers on determining the presence or infestation of bacteria in the shedding blue crabs to see if parasitic organisms are responsible for the high mortalities. The scientists are also investigating handling techniques to determine if they might be a factor.

The importance of the Sea Grant research lies in the hope that it will reduce mortality rates during shedding and, of course, that it will produce higher profits for the sometimes financially beleaguered watermen.

The accompanying photographs illustrate one method of catching crabs. Sea Grant researchers on these projects, however, do not become involved until the crabs reach the dock. At the pier, the watermen—if they haven't done so already — separate the "peelers"—the crabs which are about to shed—from the hardshells, which can be marketed immediately.

The "peelers" are placed in shedding tanks or floats, with the "white peelers," which have a small white spot on their back, separated from the "red peelers," which have a small red spot. The "white peelers" will eat the "red peelers" once they shed. The "reds" also are called ripe peelers meaning that they are ready for shedding and will begin the process in two or three days. The "whites" simply are not that far along, so they are separated from the "reds" until they themselves become "reds" and are put with the other ripe crabs to shed.

The crabs are unique, by the way, in that they "back" out of their shells, leaving so much of their outer structure that it is difficult to distinguish between a live crab and its empty shell.

The actual shedding takes only a couple of hours, and the watermen watch carefully over the crabs to make sure that the now softshelled crabs do not remain in the water so long—usually two to three days—as to become a paper shell,—which is not as desirable as a soft shell.

It is during these periods of the crab's lives that the Sea Grant researchers concentrate.

According to the latest figures, 1,822,000 pounds of peeler crabs are caught a year in Maryland waters of the Bay and approximately 815,000 pounds in Virginia waters. The hard crab catch in Maryland is about 24,660,000 a year, while Virginia watermen bring in approximately 40,850,000 pounds.

Among the various gear used to catch the crabs, at least in Maryland, is the trotline. The trotline is a baited line, sometimes reaching nearly a mile, which has bait spaced from one to five feet apart. At each end of the trotline is weight to anchor the line, and marker buoys that help the crabber locate his line. When the line is put overboard from a medium-sized fishing craft, the entire baited line rests at the bottom of the bay.

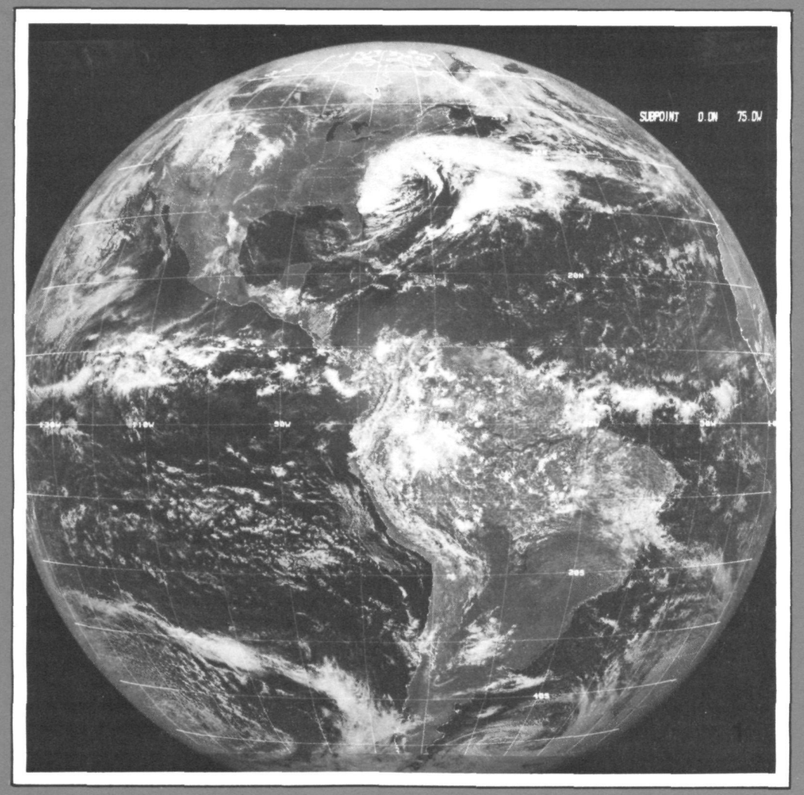
Attached to the side of each boat is a roller mechanism. The roller mechanism permits a procedure that is tantamount to a production line operation in catching the crabs. The waterman starts at one end of his trotline, places the baited line over the roller, and simply moves ahead until he reaches the other end of the line. As the boat moves slowly forward, of course, the baited line is passing over the roller and dipping back into the bay. As it approaches the roller, the crabs are still clutching to the bait, which allows the waterman to net the crab and put it in baskets on the deck of the vessel.

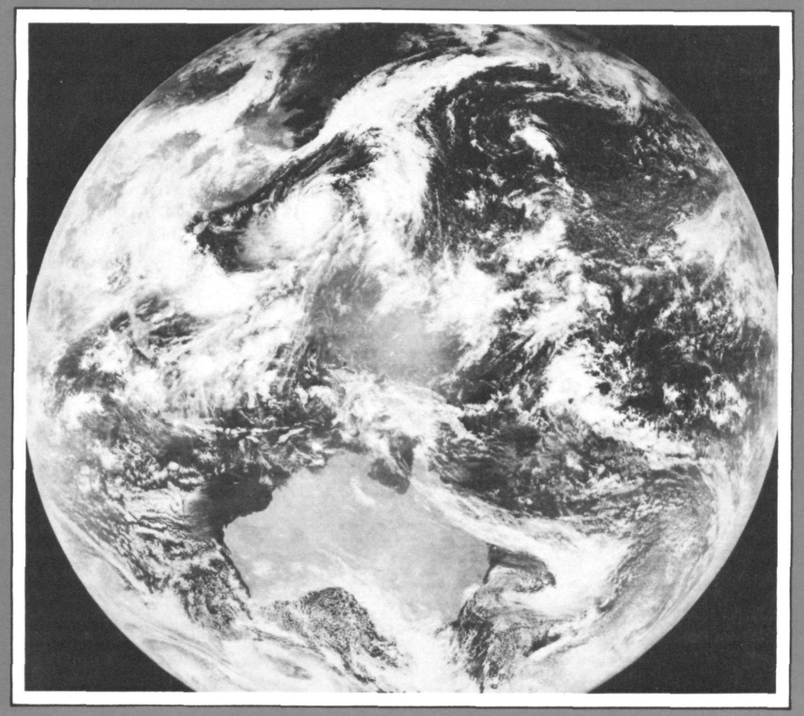
Recently, Austin Bridges of Bozman, Md., demonstrated the trotline operation to representatives of the National Sea Grant Office. This story and these photos are a result of his cooperative effort. □

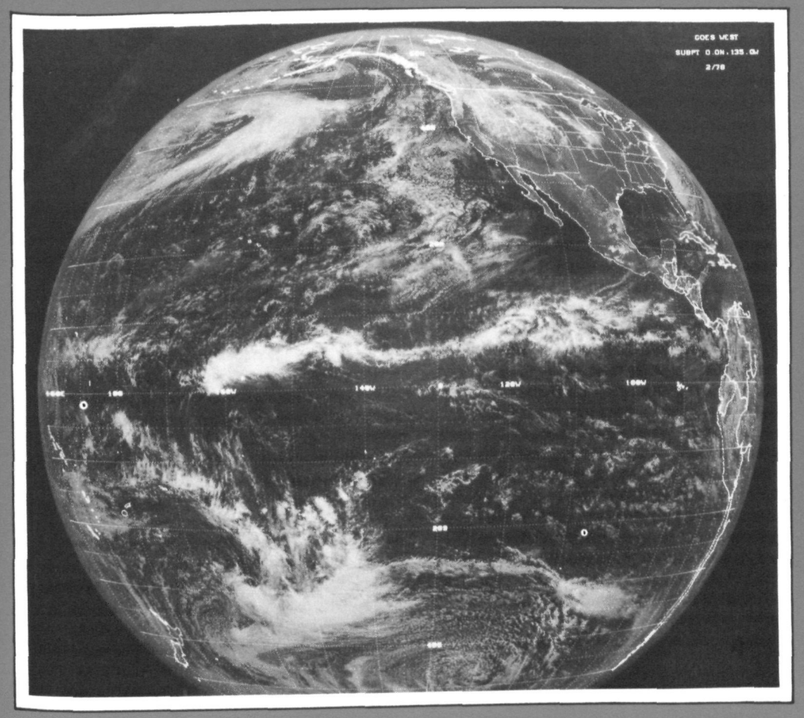
Scenes of a waterman at his trade (clockwise from left); Bridges handles his catch with care; once his course is set, he begins to pay out the line and bait; he stands over a brine barrel to bait another line; and finds time to chat with Ol Cooper, who has been tonging oysters.

International cooperation in space is clearly evident from the environmental monitoring satellite imagery reproduced on these pages. The United States, Japan, and a group of European nations under the bannner of the European Space Agency presently have spacecraft in geostationary orbit all maintaining positions about 22,200 miles (35,700 kilometers) above the equator. In a year or so, the U.S.S.R. will close the gap in this satellite belt around the earth with the launch of its geostationary spacecraft, giving meteorologists their best look ever at weather conditions around the globe.

THE VIEW FROM SPACE







1 NOAA's east coast satellite, GOES-2, is positioned above South America, providing excellent information on that part of the Southern Hemisphere, the Caribbean where many tropical storms affecting the U.S. are born, and the U.S. from the Rocky Mountains east.

2 METEOSAT 1, the first European Space Agency geostationary satellite, overlaps GOES-2's field of vision, especially in the South Atlantic where much of the world's weather develops. The planned U.S.S.R. geostationary satellite will, similarly, overlap METEOSAT 1's coverage area over the Middle East.

3 Japan's HIMAWARI (which translates as "Sunflower") geostationary satellite provides meteorological information above the Far East and Australia, as well as the Western Pacific. To the west, it will overlap the U.S.S.R. spacecraft's coverage, as it already does with GOES-1 to the east.

4 GOES-1 is the U.S. west coast satellite at press time, but plans called for it to be replaced by a new U.S. geostationary satellite—to be known as GOES-3 once in orbit—set for launch in mid June. During the summer and fall, GOES-1 is to be moved to a position over the Indian Ocean under present planning, as a temporary link in the full global coverage desired for next year's Global Weather Experiment.

Project SEA SUB Opens the Door

Visiting King Crab At Home

Story and Photos By WILLIAM HIGH *

THE WILD and isolated land of Southeast Alaska this month is serving as staging area for a series of unique submersible dives in support of marine science studies.

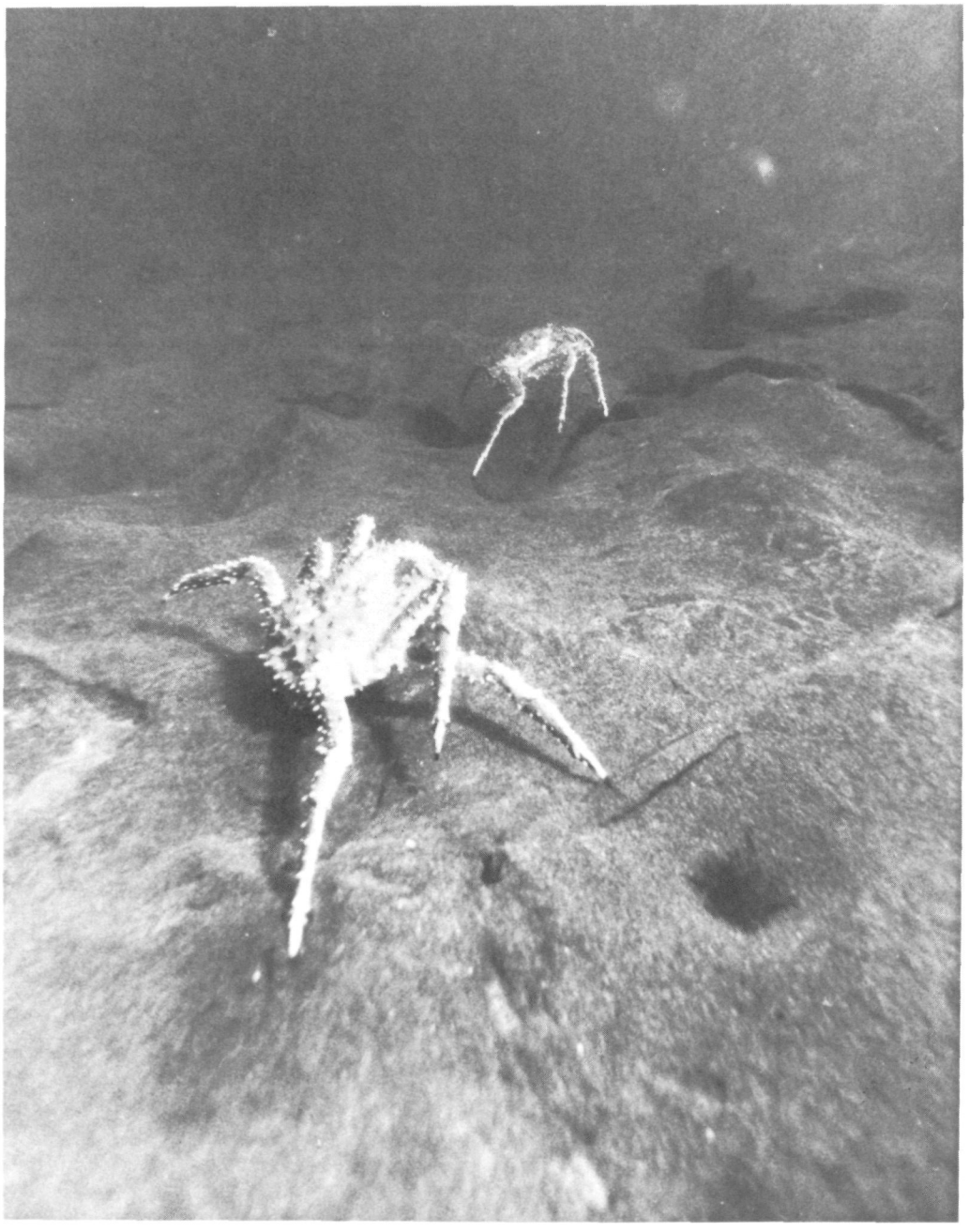
Fishing biologists from the state of Alaska will join NOAA investigators beneath the cold prolific waters to observe and photograph the local inhabitants of the sea floor in this area, previously unexplored by submersible.

The project, named SEA SUB, for Southeast Alaska Submersible Project, will involve dives down to 1,000 feet along the rugged bottom in the search for fish, coral, and king crabs.

The project was initiated when Dr. Murray L. Hayes of NMFS-Seattle appointed an ad hoc planning team chaired by Gary Smith to recommend a scientific program. The team has identified four major science goals for the project. First, we will acquire information about the topography of the sea floor and the distribution of fish over its rugged surface. Second, we will observe the interaction between fish and crabs and various capturing systems such as traps, hook and line or nets. Third, we will locate, identify and collect species of precious coral. Finally, we will record the natural order of marine animals, on or near the bottom, which are unaffected by man's intrusion, and will compare this data with similar areas that have been subjected to extensive logging or to pollutants.

Project SEA SUB investigators believe their direct observations, accurate photographs, and closed-circuit television tapes taken of the marine life in its native environment will provide a greater understanding of animal abundance and its relationship to fishing systems than do present study methods, which are undertaken from the decks of ships hundreds of feet above the creatures.

We are especially excited about this opportunity to see for the first time the Southeast Alaska sea floor and its inhabitants as they naturally occur. Most of us



Five-foot-long king crabs (above) walking along the seafloor are the subject of study by biologists from the State of Alaska and NMFS. At right, fishermen aboard NOAA's R/V John N. Cobb retrieve a sunken gill net, one of the fishing methods to be studied from the submersible.

* *William High is a fishery biologist with the Northwest and Alaska Fisheries Center, Seattle.*

Preparing to lower a fish trap from R/V John N. Cobb, a procedure that will be studied underwater in Project SEA SUB.

associated with Project SEA SUB have spent years aboard research vessels dangling lines, nets, instruments, and cables over the side in an effort to understand the interrelationships between animals and their environment. While we do not suggest that a submersible is the single best method to study the marine environment, we know that the direct observations will add important pieces to the puzzle.

Several NOAA organizations have joined forces to develop a team with broad experience. The Office of Ocean Engineering's Manned Undersea Science and Technology (MUS&T) group, through Dr. William Muellenhoff, arranged for submersible operating funds and served as a liaison between diving scientists and submersible companies, for equipment needs. Dr. Robert Edwards, Director of the National Marine Fisheries Service laboratory at Woods Hole, Mass., has permitted his experienced submersible operations officer, Joseph R. Uzmann, to participate. Louis Barr, from the NMFS Auke Bay, Alaska, laboratory—an experienced aquanaut and science observer aboard other submersible programs—will serve as the deputy project leader. He also will participate in the dives planned to study the possible effects of logging debris on the ocean floor.

The inside waters of Southeast Alaska offer an extraordinary setting for the projected 50 or more dives which will take place over a span of about 20 days. In the course of a year, the waters of Frederick Sound, one of four sites to be visited, may range from mirror calm to a frenzy of wind and waves. In July, however, moderate conditions prevail throughout the fiords and waterways. Occasionally, there are strong tidal currents so special care is required to insure that the submersible can safely maneuver among rock outcrops and canyons.

The expedition will conduct its operations at four locations. Investigations of the deep rocky bottom areas and coastal fiords will take place near Chichagof Island. Our purpose there is to identify the various species and relative abundance of fish and associated species in areas where the bottom is too rough to trawl. The distribution, abundance, and habitat characteristics of the precious coral also will be investigated. Finally, the scientific team will assess the rocky bottom to the extent that such observations may be useful in the design and use of fishing gear. The scientists participating in this particular area will be Dr. Richard R. Straty, Dr. Bruce L. Wing and H. Richard Carlson, all of the NMFS laboratory at Auke Bay, Dr. Richard W.

Grigg of the University of Hawaii, and myself.

These underwater conditions should prove ideal for growth of various cold water coral species. Drs. Grigg and Wing share an interest in the distribution, abundance, and size of potentially valuable corals. Coral samples will be retrieved by observers aboard the sub by maneuvering a simple exterior mechanical arm. Once grasped, samples will be deposited in a collection basket affixed to the sub exterior.

The remote region where dives are scheduled makes it necessary that the sub, its mother ship, and other support vessels carry supplies and equipment for the full 3-week project.

The second area to be covered is in the vicinity of Steamer Bay and Rodman Bay. In Steamer Bay, the group will observe the distribution, abundance and other characteristics of the fish, crab, and shrimp populations in an undisturbed, rocky estuary. These findings will be compared to the conditions found in Rodman Bay, an area which has been extensively logged. The investigators during this phase will be Louis Barr, NMFS-Auke Bay; Dr. Howard M. Feder, University of Alaska, Fairbanks; and Duane Petersen, NMFS-Juneau.

Scientist-observers will join the operation for several days at a time when dives are made in support of their special research projects. Bush pilots flying small float planes will transport participants and necessary supplies to and from the various dive areas and the small Alaska fishing towns, such as Petersburg or Sitka, which are serviced by scheduled airlines.

The wild, isolated nature of Southeast Alaska will present the surface support team many opportunities to view the creatures of this wild frontier land. During previous research cruises to the area, scientists have encountered bear and deer along the beaches, and have seen up to 17 bald eagles in view at one time, soaring or diving for silvery salmon en route to the stream of their birth. Whales and porpoises commonly beach and blow or roll while feeding along tide rips.

The behavior and efficiency of sedentary fish gear, such as traps, pots, and longlines will be investigated at the third location, in Frederick Sound. The data and observations collected during this effort will be used in the future to improve the design of various types of fishing gear. In addition, observations will be made to determine the distribution and abundance of precious coral in the area.

The NOAA research vessel John N. Cobb, under the command of Capt. Peter Larsen, will set and retrieve fish traps, sunken gill nets, and crab pots for study through the viewing ports of the submersible. The research team will then make on-the-spot observations as those species that live near the bottom come near the fishing gear. We hope to learn how frequently fish and crabs enter or escape the gear, as well as how many animals are present in relation to the numbers captured.

The fourth part of the project involves investigations of the Alaskan king crab population, also in Frederick Sound. However, for this phase the diving location will move to Pybus and Gambier Bays. The Frederick Sound area of Southeast Alaska has historically produced approximately 200,000 lbs. of king crab per year, and Pybus and Gambier Bays have been important fishing areas. During the past two years, however, king crab landings in these areas have averaged only 40,000 lbs., and the cause of decline is poorly understood.

The scientific team will examine the crab populations of these two high yield bays, relate the behavior of king crab to fishing gear design, and assess the effects of derelict crab pots as potentially significant causes of population mortality. Participants will be Timothy Koeneman and Guy Powell of the Alaska Department of Fish and Game, and Robert Loghry and myself from NMFS-Seattle.

While submerged, the submersible will tow a small brightly colored float at the surface. The location and direction of travel of the submersible will thus be tracked by the surface support team, which will divert nearby fishing vessels or other marine traffic away from the submersible's path.

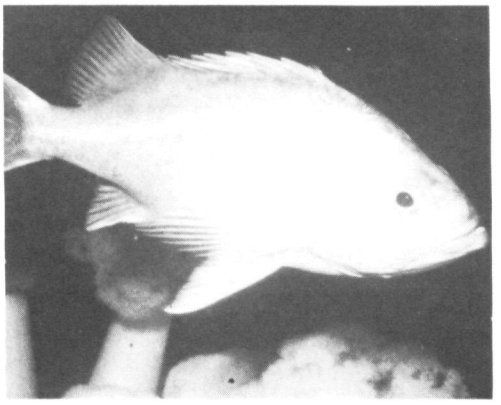
Direct radio voice communication between the submersible pilot and mother ship personnel is a major safety feature. Also, frequent radio reports from the scientist-observer will permit surface support team members to follow the progress of the dive and share important observations.

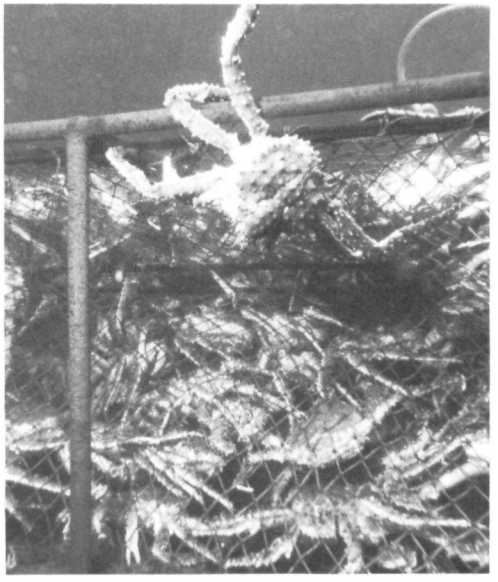
Some dives will take place on commercial fishing grounds where nets or lines may have been lost. Observers aboard the submersible will be alert to avoid possible entanglements while pursuing their studies.

Science team leader Dr. Richard Straty will observe how rockfish and other species are distributed over rough sea floor areas. At present, it is not possible to estimate adequately the quantity to fish in rough bottom areas, because sampling nets become fouled among rocks or on steep cliffs. After viewing the typography from a submersible, a better understanding of how to design gear to sample fish residing there will be obtained. Also, photographs will be made from which it should be possible to count the numbers of fish and shellfish per unit area. From these estimates, fishery scientists will be able to make more accurate determinations of the quantity of fish that can be harvested without damaging the overall population.

Estimates of the efficiency of sampling systems such as traps, pots, and gill nets will result from underwater observations and television recordings. It will then be possible to redesign the sampling gear to insure that it more accurately reflects the population surveyed.

One or two diving scientists will join the submersible pilot for undersea cruises lasting up to four hours or more. In these cases, air supplies will permit extended stays, despite the limited interior space.





Canary rockfish (above) will be studied by underwater scientists, as will "pots" such as this one, which contains nearly 100 king crabs.

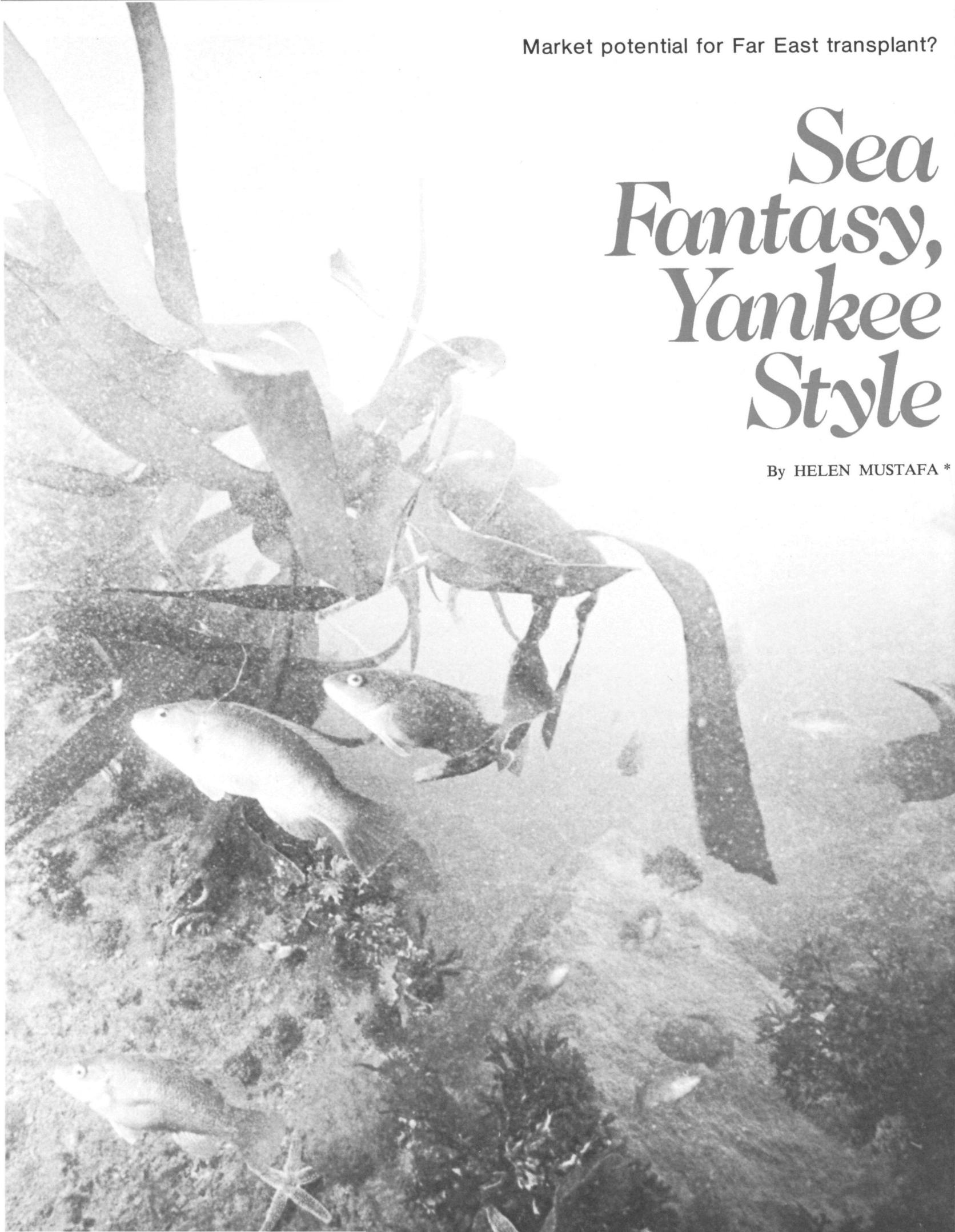
Permanent records of the animals encountered, their distribution, and behavior will be made on both film and video tapes. A pressure-proof camera and electronic flash, mounted outside the sub, will be activated by the scientists observing worthy subjects through the small viewing ports. Four hundred pictures can be taken during each dive, thereby allowing the scientists to later study animal activity in the increased comfort of the laboratory. In addition, a small hand-held television camera and tape recorder can be directed through the scientists' viewing port to obtain extensive motion records of the various fish and different types of sea floor encountered. Such permanent records will greatly increase the value of each dive since several investigations will be able to share the films and tapes.

Project SEA SUB, one of a continuing series of submersible dives sponsored by NOAA to unlock the deep ocean secrets along our Continental Shelf, promises to be exciting and to have a great potential for man's benefit. □

Market potential for Far East transplant?

Sea Fantasy, Yankee Style

By HELEN MUSTAFA *



During a January trip to the Far East of the Soviet Union as interpreter for the National Marine Fisheries Service, I dined on an exotic salad called "sea fantasy." When I asked my dinner partner, Dr. Isabella Gusarova, an algologist for the Soviet Union's Far East Marine Biological Institute, about the salad's ingredients, she emphasized a local seaweed called "sea cabbage." Although the purpose of the trip was to discuss fisheries research at six locations in the Soviet Union and Japan, I made sure to scout out the necessary information to concoct a Yankee counterpart of the salad upon my return.

Soviet sea cabbage (*Laminaria japonica*) grows off the southwestern shore of Sakhalin Island and the southern shore of the Kuril Islands in the Northwest Pacific. The largest specimens, stretching to 50 feet in length and looking like ruffled kite tails, prefer the rocky, current-swept waters of the Kuril Islands. Because of the jagged bottom upon which *L. japonica* grows, it only can be harvested by hand or with a four-pronged hook. The Soviets harvest enough of this sea cabbage, though, to satisfy their own tastes and to export some to the Japanese.

Some of the crop is dried, but most of it is used fresh. This fondness for fresh sea cabbage may be the reason that I did not come across sea cabbage dishes in any restaurants in Moscow. My Soviet acquaintances assured me, however, that canned sea cabbage is readily available there.

Normally, the Soviets marinate the fresh fronds of the sea cabbage before blending them into the sea fantasy salad—a mixture of seaweed, squid, onion, and spices. Far Easterners customarily serve the salad as an appetizer along with smoked fish, pickled fish, and caviar, or as a "zakuska" (snack) with cocktails. The Soviets seem to have an unwritten rule that one cannot drink without also indulging in some sort of zakuska! There are also sea cabbage recipes for soups, stuffings, and vegetable side dishes. *Rybnoe Hozaistvo,* a monthly journal of the Soviet Ministry of Fisheries, has even published some recipes for canning the seaweed.

Japan is the major league as far as seaweed eaters are concerned. Japan is the only country in the world to make full use of its seaweed resources. Traveling by train on Honchu Island from Niigata to Tokyo to Shimizuo, I found seaweeds comprising a part of many meals and snacks and carrying such labels as "nori," "wakame," "kombu," "hijiki," and others. These tongue-tantalizing products with the tongue-tangling names are used in salads, soups, vegetable dishes, sandwiches, or rice crackers, are candied and even used to hold and wrap rice.

Japan's favorite seaweed product is nori, made of *Porphyra.* The average Japanese consumes more than 70 sheets of nori per year! (A sheet is about eight inches on a side.) Kombu, another favorite, is simply dried *Laminaria,* some of which is *L. japonica,* the Soviet sea cabbage which the Japanese import or are allowed to harvest off the shores of the Sakhalin and Kuril Islands.

One-third of all seaweed produced in Japan comes from cultivation. Nori cultivation, where the seaweed is grown on heavy netting stretched between rows of bamboo poles, is typical of Japan's aquaculture of seaweed. Many land farmers engage in the sea farming of nori because it is harvested in the early spring, an off-season for land farmers. After this red seaweed has been harvested, it is finely chopped and spread on small bamboo mats to dry. Dry nori as well as other dried seaweeds come attractively packaged and sell well in Japanese supermarkets.

The taste of those delicious dishes I sampled in the Soviet Union and Japan lingered after my return to my home in Woods Hole, Mass. I searched the shelves of my local grocery store for seaweeds from New England's shores. However, the

The author in her kitchen, cooking up a batch of "Yankee sea fantasy" from New England kelp.

** Ms. Mustafa is Special Assistant to the Director, Northeast Fisheries Center, National Marine Fisheries Service.*

only domestic seaweed I found for sale was fresh "dulse" (*Rhodymenia palmata*). Usually eaten raw, dulse is a good laxative, but has a strong marine flavor which, I am sure, one has to become accustomed to. (I did find several species of dry Japanese seaweed on sale, which had been packaged and distributed by an American company.)

So, if I were to create a truly American version of sea fantasy or some other exotic seaweed concoction, it was going to require a little field scavenging. Although *Laminaria japonica* does not grow off New England's shores, I discovered from books on aquatic vegetation at the National Marine Fisheries Service Laboratory in Woods Hole, that many other species of *Laminaria* (commonly called kelp) are abundant off the coast of New England. A little beachcombing turned up *L. agardhii, L. digitata,* and *L. longicuris* along the sandy beaches of Cape Cod and *L. digitata* and *L. saccharina* along the rocky shores of Cape Ann.

I "lucked out" on gathering fresh supplies of these seaweeds when two of the National Marine Fisheries Service's divers, Dick Cooper and Cliff Newell, returned from a conditioning scuba dive along a Cape Cod Bay jetty with seabags full of the seaweeds. Newell felt that anyone could collect the 10- to 15-foot-deep growing plants simply by using a snorkel, even though some of the seaweeds had to be torn from the rocks or taken with their holdfasts still around seashells.

That evening I sorted, cleaned, and washed the diver-collected seaweed, then placed it into boiling water for 15 minutes. Following the basic Far East formula, I whipped up a fantastic sea fantasy salad *a la* boiled *L. digitata*. The boiled *L. agardhii, longicuris,* and *saccharina* ended up in a stew, a vegetable side dish, and a lasagna, respectively.

To prepare the stew, I sauteed thinly sliced onions in vegetable oil, added ground beef to the onions, browned the combination, added seaweed (cut into approximately one-inch squares), tossed in some seasoning, added a taste of tomato sauce, and simmered the stew for 10 minutes. To prepare the vegetable side dish, I sauteed thinly sliced onions and finely grated carrots in a little vegetable oil until the carrots were soft, added cut seaweed and a little soy sauce, and simmered the dish for 10 minutes. The seaweed lasagna is a basic lasagna recipe except for the seaweed pasta. This latter innovation is a boon to those of us who are trying to cut down on carbohydrates. Seaweed carbohydrates are not sweet and do not significantly increase the body's blood sugar content.

All told, the four dishes made from our own seaweeds equaled or excelled their Far East counterparts. For taste, versatility, and nutritional value, I found the seaweeds from New England's shores hard to top for delicious and quick meals. If properly marketed, perhaps as a frozen food, Yankee seaweed might become as "Northeast" as succotash. □

Tasty seaweed salad (above) prepared by Russian chef gave idea to Ms Mustafa, shown (right) holding some domestic "salad greens"; below, NMFS diver harvests some seaweed for dinner.

Recreational fishermen from all coasts gathered recently at a Virginia symposium in a spirit of new hope—for the first time, the recreational and commercial fishermen are as one in the eyes of the law.

Richard A. Frank, NOAA Administrator, told a luncheon audience that equality for recreational fishermen "is no longer an issue legally arguable.

"The Fishery Conservation and Management Act explicitly indicates that both recreational and domestic commercial fishing are to be promoted, and equal consideration must be given recreational needs and domestic commercial fishery needs. The requirement for fair and impartial consideration for all groups, as well as for ecological needs, is now the law," said Frank.

The group, more than 150 strong, attacked a wide variety of problems in the two-day Marine Recreational Fishing Symposium held in Norfolk, Virginia. The Symposium is an annual event sponsored by the International Game Fish Association, National Coalition for Marine Conservation, National Marine Fisheries Service, the National Oceanic and Atmospheric Administration, and the Sport Fish Institute.

William Gordon, National Marine Fisheries Service Director in the Northeast Region, stressed the necessity for cooperation between commercial and recreational fishermen and said the idea that they are working against each other should be discarded.

"Since the resources we are dealing with are public property, every attempt must be made to ensure rational use," said Gordon. "The fishery agencies at all levels of government have the greatest responsibilities to achieve this end. Now that we are in the midst of a major change in ocean fishery resource management, the Regional Fishery Management Councils now must share responsibility. Even this level of inquiry and action may not settle many of the issues adequately unless full support and understanding from the public is gained.

"Another important issue must be faced and resolved,"he said. "There must be a willingness on the part of all concerned to face the issues and scientific facts, and a sincere desire to compromise in the public interest. Too often this has not been the case and scientific evidence and other facts are pushed aside. As a result, the Councils must be prepared with facts—scientific, economic, and social—so that expedient political actions do not lead to more bitterness and animosity. From my standpoint, the real problem is to resolve sport/commercial conflicts as expeditiously and equitably as possible so that fishermen can close ranks to confront issues that threaten the resources for all."

In a conference marked by a wide variety of approaches to the problems and opportunities of recreational fishing, the need for more research, and more useable data, was stressed by speaker after speaker.

That recreational fishing is no minor avocation became apparent immediately: Bruce Freeman, an NMFS marine biologist from Gloucester, Mass., said it is the most popular outdoor sport in the Nation, and possibly in the world. It also produces $30 million a year in economic gain.

Today, he said, nearly half of the U.S. population lives within 50 miles of the coast; if present trends continue, more than 80 percent may live within the area by the year 2000. As this occurs, additional destruction

Richard A. Frank, NOAA Administrator, is interviewed by Norfolk television at the Marine Recreational Fishing Symposium.

Recreational Fishing Comes of Age

By GERALD D. HILL, JR.

of the environment is bound to happen unless definite efforts are taken to prevent it.

"It is an indisputable fact that the most complete and thorough method of eliminating a species of fish is to destroy its environment," said Freeman. "There is conclusive evidence that considerable amounts of our estuarine and shoreline environments have been destroyed by our thoughtlessness, especially during the past 25 years."

Seasonal changes in the aquatic environment, patterns of ocean currents, and availability of a large food supply combine to foster a wide array of fish species—some 400 in all—within the Middle Atlantic Bight, according to Freeman.

"It behooves us to concentrate our efforts in learning as much as possible about the lives of the handful of very important species," he said. "But we must not lose sight of the fact that all the fishes as well as the other organisms living in the sea are interrelated in some way. We must also learn that we cannot treat recreational fishing intelligently without considering all of the biological, sociological, and economic demands placed on it by the various groups that use the marine environment. Only when this is done can we ever have wise management of our fishery resources."

Dr. James Timmerman, Executive Director, South Carolina Wildlife and Marine Resources, reinforced Freeman's statement. Timmerman said, "A considerable amount of information is available relative to those species entering the shore-based recreational fisheries; however, the amount of statistical, economic, and social data available on these fisheries is quite limited, especially in the case of the latter two data types."

He said that continued funding and effort in terms of life history and population dynamics research on recreational species is required because of the importance of these types of information in the management process.

"The establishment of a comprehensive and responsive marine recreational fisheries statistics program is of paramount importance," he told the group. "In the areas of economic and social data required for the management of marine recreational fisheries, a tremendous amount of research is needed. Information on the economic impacts generated by these shore-based fisheries should be undertaken. Research in the area of social sciences is required, specifically in terms of defining the characteristics of and variations between different types of marine anglers.

"The establishment of a marine recreational fisheries license would assist considerably in alleviating this funding inadequacy," Timmerman said.

"Such a license would serve to document participation in the fisheries and provide a sampling base which could be used to obtain statistically valid biological and economic information needed for management purposes. Both of these types of information would benefit the marine angler, because without such information it is almost impossible to adequately represent him—or her—in any kind of management decisions."

According to Timmerman, management of marine recreational fisheries should occur throughout the geographic range of the species entering these fisheries. "The States, acting individually, have often taken a parochial approach to fisheries management," he said. "The State-Federal Fisheries Management Program has enabled the States and the Federal Government to act in concert in establishing regional management plans, in setting regional research priorities, and for funding needed research. Working through the Atlantic States Marine Fisheries

Commission, it is possible to implement management decisions, arrived at through the State-Federal Fisheries Management Program, on a regional basis.

"Only by working on a cooperative basis to identify and define marine recreational fisheries research needs, and then providing adequate funding to meet these research needs, can real progress be made in effectively managing our marine recreational fisheries," he concluded.

John Mehos is a commercial fisherman who also serves as Chairman of the Gulf of Mexico Fishery Management Council. Mehos made a strong plea for better statistics and research on recreational catches that are essential to Management Councils when they prepare plans for the species found within their jurisdiction.

"In Texas, commercial shrimp landings in 1976 had a dockside value of $120 million. There are about 4,500 commercial boats in the area with another 8,000 recreational shrimp boats," Mehos said.

One of the requirements under the Fishery Conservation and Management Act of 1976 is to prepare management plans using the best scientific data that are availble.

Mehos said that most of the Council members want better data and want to fill some data gaps before they believe they can achieve effective planning. "One of the primary data gaps on recreational fishing, which is acknowledged among fishery managers, is the general lack of statistical information on the size of the recreational fish catch," said Mehos. "The need for these data becomes increasingly acute as we approach (and exceed) maximum sustainable yield in our fisheries. The fishery management councils must act on best available data which in most instances are inadequate."

"The National Marine Fisheries Service, which inherited the additional responsibility for marine recreational fishing with no budgetary increase, is embarking on a continuing survey of recreational fishermen and their catch. Cost for the first year is estimated to be $1.25 million," said Mehos. "The Gulf Council endorses this survey and strongly urges full funding of the proposal even if it meant redirection of 'Extended Jurisdiction' funds from lower priority projects."

Other speakers profiled the ways of fish—and those who catch them—along the Atlantic coast. Harry Speir, a Maryland Fisheries Administration biologist, reporting on a Chesapeake Bay area survey made by the State, found that the business of pleasure fishing was booming. By virtue of its size and location, the Chesapeake shares many of the fish species from more northern or southern waters and is probably the center of distribution of the striped bass and blue crab. The survey covered 582 square miles of the upper Chesapeake Bay. Information on fishermen effort, harvest, success, concerns, and economics was derived from 11,000 private boat fishermen interviews and catch logs from 2900 charterboat fishermen trips. The charterboat business is

Terry L. Leitzell, NOAA Assistant Administrator for Fisheries (top) and Robert J. Ayres, Director of the Office of Marine Recreational Fishing, NMFS, address the symposium.

active on the Chesapeake Bay and there are an estimated 350 full or part-time Maryland operators. About 15 percent of the 411,000 fishing trips on the survey portion of the Bay were made by charterboat fishermen, and they caught about 14 percent of the total 3.3 million fish landed during the survey.

"Trailered boats constitute 50 percent of the 130,000 boats registered in Maryland, and 90 percent of these trailered boats are used in tidewater. The percentage of trailered boats has been rising steadily while the percentage of water-stored craft has been dropping," Speir said.

"This Chesapeake Bay study concludes that trailer boats dominate the estuarine sport fishery and will form the bulk of sport fishing pressure increases," he said.

"One of the attractions of saltwater fishing is the variety of species available or potentially available. Regardless of the variety available, fishermen usually tend to concentrate effort on one or two species. This preference varies with region and may be related to either abundance or trophy value of the species. An interview question in the Chesapeake Bay survey asked for what species anglers were fishing. Of those who had a preference (80 percent of the sample), 34 percent sought bluefish, 27 percent sought striped bass, 26 percent were crabbing, 10 percent were fishing for white perch, and 1.4 percent were fishing for spot. However, crabs made up the largest single species catch by number overall, and white perch constituted the largest single species catch of finfish," said Speir.

Gene Huntsman, an NMFS biologist from Beaufort, N.C., dealt with the platforms from which fish are caught—charterboats, headboats, private boats, fishing piers, and surf.

Forty-one headboats, 260 charterboats, and literally thousands of private vessels are active between Cape Hatteras, N.C., and Cape Canaveral, Fla.," said Huntsman. "There are 56 fishing piers in this South Atlantic Bight area."

Reef fishes are vulnerable only to fishermen aboard boats; and of the types listed, headboats probably produce the greatest catch. In 1976, the Bight headboat catch of reef fishes was 2,500,000 pounds taken with 150,047 angler days. Charterboats provide important cacthes of reef fishes off North Carolina, but apparently not elsewhere in the Bight. A preliminary estimate of the 1977 North Carolina charterboat catch of reef fishes is 200,000 pounds.

"Private recreational vessels are important in taking reef fishes off northeast Florida only, but their involvement there is significant," said Huntsman. "At this time, however, we can estimate neither fishing activity nor catches associated with private vessels."

Coastal pelagic fishes are vulnerable to anglers on vessels, piers, and the beach. Headboats are unimportant to the catch of coastal pelagics, while private vessels are extremely important throughout the Bight. In some areas, piers provide substantial catches of coastal pelagic fishes, mainly bluefish and Spanish mackerel. Bluefish are landed by surf fishermen, particularly off North Carolina's Outer Banks.

Information on the magnitude of recreational catches of coastal pelagics is scarce. The best information available is from North Carolina where, in 1977, 1,200,000 pounds were taken by charter boats and 130,000 pounds were taken from piers.

Commercial fisheries for both reef fishes and coastal pelagic fishes occur in the Bight. Reef fishes are taken by handline, trap, and trawl and coastal pelagics primarily by trolling and by gill nets. Because bluefish commonly occur in close proximity to land and enter estuaries, they are captured by a wider variety of commercial fishing gear.

"Despite differences in potential fishery production of reef fishes and coastal pelagic fishes, they both have value to recreational fishermen. In contrast to big game fishing, fishing for reef and coastal pelagic species allows a high quality ocean fishing experience at costs acceptable to the average fisherman," Huntsman concluded.

Dr. Frank Carlton of the National Coalition for Marine Conservation was the moderator. □

Sea Fare

OCEANS WEEK SPECIALTIES

On April 15, NOAA Administrator Richard A. Frank held a reception abroad the Researcher in honor of Oceans Week '78. National Marine Fisheries Service seafood consumer specialists from Alaska to the Gulf of Mexico came to Washington to prepare favorite regional dishes. Sea Fare this month presents varied and delicious recipes for Oceans Week—or any week.

Boiled Shrimp with Cocktail Sauce

1½ pounds raw, peeled, deveined shrimp, fresh or frozen
1 quart water and 2 tablespoons salt
Cocktail Sauce or Remoulade Sauce

Thaw shrimp if frozen. Combine water and salt; bring to a boil. Place shrimp in boiling water and simmer for approximately 5 minutes. Drain. Rinse with cold water. Remove any remaining particles of sand vein. Serve with Cocktail Sauce or Remoulade Sauce.

Cocktail Sauce

1 cup chili sauce
½ cup catsup
1 tablespoon horseradish
¼ teaspoon salt
1 teaspoon Worcestershire sauce
2 tablespoons lemon juice
½ teaspoon liquid hot pepper sauce
¼ cup finely chopped celery
2 tablespoons finely chopped green onions and tops
1 tablespoon finely chopped sweet pickle relish

Combine all ingredients; chill. Makes approximately 2 cups sauce.

Remoulade Sauce

1 cup mayonnaise or salad dressing
2 tablespoons water
2 tablespoons Creole mustard
1 tablespoon chopped sour pickles
1 tablespoon chopped capers
1 tablespoon chopped parsley
½ teaspoon chervil
½ teaspoon tarragon leaves
1 teaspoon anchovy paste
2 small finely minced garlic cloves
⅛ teaspoon salt
¼ teaspoon paprika
¼ teaspoon liquid hot pepper sauce
¼ teaspoon white pepper
2 tablespoons chopped green onions and tops

Combine all ingredients. Serve as sauce for boiled shrimp. Makes 1½ cups sauce.

Calico Scallop Broil

1 pound calico scallops, fresh or frozen
⅓ cup melted margarine or butter
2 tablespoons lemon juice
1 clove garlic, minced
1 teaspoon salt
¼ teaspoon white pepper
⅛ teaspoon cayenne pepper
¼ cup chopped parsley
Paprika

Thaw scallops if frozen. Remove any remaining pieces of shell particles and wash. Place scallops in a single layer in a well-greased dish, approximately 12 x 8 x 1 inches. Combine margarine, lemon juice, salt, pepper, and cayenne. Pour over scallops. Broil approximately 4 inches from source of heat for 4 to 6 minutes or until the scallops are done. Garnish with parsley and paprika. Makes approximately 100 hors d'oeuvres.

Calico Scallop Kabobs with Sweet Sour Sauce

1 pound calico scallops, fresh or frozen
1 can (1 pound 4 ounces) pineapple chunks
2 green peppers, cut into 1-inch cubes
¼ cup melted margarine

Thaw scallops if frozen. Remove any remaining shell particles and wash. Drain. Alternate scallops, pineapple chunks, and green pepper cubes on small skewers or toothpicks. Place skewers on a well-greased broiler pan. Brush with margarine. Broil about 4 inches from source of heat for 5 to 7 minutes, or until scallops are done. Pour Sweet 'N Sour Sauce over kabobs. Serve hot. Makes approximately 15 to 20 hors d'oeuvres.

Sweet 'N Sour Sauce

1 cup apple juice
¼ cup vinegar
3 tablespoons sugar
2 tablespoons catsup
1 tablespoon grated onion
1 tablespoon melted fat
2 teaspoons soy sauce
⅛ teaspoon salt
2 tablespoons cornstarch

Combine ¾ cup apple juice, vinegar, sugar, catsup, onion, fat, soy sauce, and salt in a saucepan and bring to a boiling point. Dissolve cornstarch in remaining ¼ cup apple juice. Add gradually to hot sauce and cook until thickened, stirring constantly. Makes approximately 1½ cups sauce.

Chili Spanish Mackerel Bites

1 pound skinless Spanish mackerel fillets, fresh or frozen
1 cup dry bread crumbs
1 teaspoon salt
1 teaspoon chili powder
2 tablespoons melted margarine or cooking oil
Chili Sour Cream Sauce

Thaw fish if frozen. Cut fillets into 1-inch cubes. Combine bread crumbs, salt, and chili powder. Coat each fish bite with crumb mixture. Place fish bites in a single layer in a well-greased baking pan, approximately 15 x 10 x 1 inches. Pour margarine over fish. Bake in a very hot oven, 450° F., for 15 to 20 minutes, or until fish is done and flakes easily when tested with a fork. Makes approximately 30 fish bites.

Chili Sour Cream Sauce

1 cup dairy sour cream
4 teaspoons minced green chilies
2 teaspoons pickle relish
⅛ teaspoon salt

Combine all ingredients in small bowl: chill. Serve as dip for Hot Chili Spanish Mackerel Bites. Makes approximately 1 cup sauce.

Creamy Croaker Dip

¾ pound cooked, flaked croaker
½ pint (1 cup) small curd cottage cheese
½ pint (1 cup) dairy sour cream**
½ cup shredded raw carrot
¼ cup well-drained chopped sweet pickle
2 tablespoons chopped pimiento
1 teaspoon cream style prepared horseradish
½ teaspoon Worcestershire sauce
¼ teaspoon liquid hot pepper sauce
Chopped parsley
Assorted crisp vegetables or favorite crackers or chips

Combine cottage cheese, sour cream, carrot, pickle, pimiento, horseradish, Worcestershire, liquid hot pepper sauce, and salt; mix well. Stir in flaked fish. Chill several hours before serving. Sprinkle with parsley. Serve with assorted crisp raw vegetables (carrot, cauliflower, or cucumber slices, celery chunks, cherry tomato halves, etc.) or crackers or chips as desired. Makes about 3 cups dip.

** *Note: Yogurt may be substituted for sour cream, if desired.*

Croaker Salad In Puff Shells

1 pound cooked, flaked croaker
1 cup finely chopped celery
½ cup mayonnaise or salad dressing
2 tablespoons chopped onion
2 tablespoons chopped sweet pickle
¼ teaspoon salt
⅛ teaspoon white pepper
Puff shells

Combine all ingredients except puff shells. Mix thoroughly. Cut tops from puff shells. Fill each puff shell with approximately 2 teaspoonfuls of salad. Makes approximately 55 hors d'oeuvres.

Puff Shells

½ cup boiling water
¼ cup margarine or butter
⅛ teaspoon salt
½ cup flour
2 eggs

Combine water, butter, and salt in a saucepan and bring to a boil. Add flour all at once and stir vigorously until mixture forms a ball and leaves the side of the pan. Remove from heat. Add eggs, one at a time, beating thoroughly after each addition. Continue beating until a stiff dough is formed. Drop by level teaspoonfuls on a well-greased cookie sheet, 15 x 12 inches. Bake in a very hot oven, 450° F., for 10 minutes. Reduce heat to 350° F., and continue baking about 10 minutes longer. Makes approximately 55 puff shells.

Herring Pinwheel Canapes

2 pounds herring fillets, fresh or frozen
6 ounces boiled ham, sliced thin
1 can (2 ounces) anchovy fillets
½ cup grated Parmesan cheese
¼ cup butter or margarine, melted
Assorted party breads or Melba toast

Thaw frozen fillets. Cut fillets in half and remove backbone and dorsal fin. Place fillets skin side down on a work surface. Place a piece of ham and anchovy fillet on one half of each fillet. Sprinkle with cheese. Fold over remaining half of fillets. Place stuffed fillet on a well-greased baking pan, 15 by 10 by 1 inches; pour butter over fillets. Bake in a moderate oven, 350° F., for 15 to 20 minutes, or until fillets flake easily when tested with a fork. Cool at room temperature and chill thoroughly in the refrigerator. Cut fillets into small pieces and place on bread or toast. Serve as an appetizer or a canape.

New Bedford Walnut Fried Whiting

2 pounds whiting fillets or other fish fillets, fresh or frozen
1 teaspoon salt
¼ teaspoon pepper
1½ cups fresh bread crumbs
1½ cups ground walnuts
1½ teaspoons crushed rosemary
1 teaspoon marjoram leaves
½ teaspoon leaf thyme
1 cup all-purpose flour
2 eggs, beaten
⅓ cup margarine or butter
⅓ cup cooking oil
Lemon wedges

Thaw fish if frozen. Sprinkle with salt and pepper. Combine bread crumbs, walnuts, rosemary, marjoram, and thyme. Roll fillets in flour, dip in egg, and roll in crumb mixture. Heat margarine and oil in a fry pan until hot, but not smoking. Place fish in pan and fry at a moderate heat for 4 to 5 minutes or until browned. Turn carefully and fry 4 to 5 minutes longer or until fish is browned and flakes easily when tested with a fork. Drain on absorbent paper. Serve with lemon wedges. Makes 6 servings.

Marinated Squid

2 pounds cleaned squid, fresh or frozen
1½ quarts boiling water
2 tablespoons salt
1 cup white vinegar
¼ cup water
¼ cup olive oil
4 cloves garlic, finely minced
1 tablespoon oregano
½ teaspoon salt
¼ teaspoon black pepper

Thaw frozen squid. Wash the mantle (body) thoroughly, inside and out. Cut squid into ½-inch pieces. Place squid in boiling salted water. Cover and return to the boiling point. Simmer for 10 to 15 minutes or until squid is tender. Drain and rinse thoroughly in cold water. Drain.

Combine vinegar, water, oil, garlic and seasonings. Add squid. Place in a sealed container and marinate in the refrigerator. Serve with toothpicks.

noaa/update

No Ill-Effects Seen

On-site DOMES Data Released

Industry's first efforts to harvest manganese nodules from the Pacific Ocean floor thus far have had no serious impact on the ecosystem, preliminary analyses by NOAA observers show.

NOAA oceanographers report that they found little persistent effect from mining operations conducted over the past two months by the Ocean Management, Inc., vessel SEDCO 445. (See story in NOAA News, May 5, 1978.) They emphasize, however, that there could be chronic long-term, low-level effects which have not yet been identified or studied.

Scientists with NOAA's Deep Ocean Mining Environmental Study (DOMES) monitored the Sedco 445's mining activities from the agency's research ship Oceanographer, in an area some 865 nautical miles (1,600 kilometers) southeast of Hawaii, in water about 15,000 feet (5,000 meters) deep.

The monitoring included samples and measurements taken along the sea floor—from which the mining collector lifts manganese nodules along with some sediments and small bottom-dwellers in vacuum cleaner fashion—and around the plume of sediments discharged by the mining ship at the surface, as well as in the water columns between the sea floor and the surface.

Comparisons were made between light and nutrient levels, and other factors in the discharge plumes and corresponding measurements of the undisturbed ecosystem outside the plume.

The effect of the mining ship's collector on the sea floor was also observed with deep-sea cameras, and box cores were taken of the disturbed sediments to determine changes in the kind of life forms found there.

Preliminary analysis of benthic (sea-floor) plume data, the scientists report, indicates that this plume did not propagate far upward into the water column, tending to rise no more than a few tens of meters above the bottom. However, the plume may increase in thickness with time and distance from the collector.

They found no evidence of significant lateral spreading in the benthic plume, although there were tentative indications that the plume moved horizontally, carried on slowly moving, deep-water currents. Considerable current-meter data remains to be analyzed, however, before firm conclusions can be drawn regarding the movement of the benthic plume.

The NOAA investigators found evidence of a rather rapid resettling of disturbed material near the mining collector. This "repiling" of the disturbed material near its point of origin suggested that the benthic plume did not migrate over a broad area.

Surface plume data suggests that much of the particulate sediments discharged by the mining vessel at the surface settled out of the surface plume, and returned to the sea floor. Dissolved constituents in the surface plume could be detected for periods of a few hours; but neither particles nor chemical differences could be detected in plume water more than about 24 hours old. This may mean, the NOAA scientists report, that surface plume effects are transient, with no detectable difference between plume water and undisturbed water a day or two after mining.

One of the crucial questions that still must be answered, the Commerce Department researchers note, is whether discharged material accumulates at the pycnocline, a marked change in water density at about 180 feet (60 meters), which separates the well-mixed surface waters from the denser waters of the deeper sea.

Another vital question is how this remote but important corner of the global ecosystem will be affected by not one, but fleets, of mining ships. Preliminary answers to this may come from further analysis of data obtained during this year's DOMES voyages.

1000 Attend March CZM Symposium

Coastal Zone '78, a national symposium on the technical, environmental, and socio-economic aspects of coastal zone planning and management, was held in San Francisco, Calif., March 14-16.

NOAA's Office of Coastal Zone Management, with the American Society of Civil Engineers, and The Conservation Foundation, sponsored the event which drew more than 1,000 participants. More than 200 papers were presented covering topics such as "Planning and Management Considerations," "Environmental Considerations," and "Engineering and Other Technical Considerations."

Major speakers at the conference were Secretary of Commerce, Juanita M. Kreps; Chairman of the Council on Environmental Quality, Charles Warren; Congressman John Breaux of Louisiana; and Major General C. I. McGinnis of the Army Corps of Engineers.

Coastal Zone '78 according to its sponsors, was created to bring together planners, engineers, environmentalists, government administrators, and interested individuals in hope of stimulating productive discussion and interaction on leading coastal zone management issues. The symposium provided a forum for discussion of coastal zone management, beneficial use, protection and development leading to a better understanding of the interrelationships between the environmental, socio-economic, engineering, and regulatory decisions involved.

Others cooperating in sponsoring the Coastal Zone '78 symposium included NOAA's National Ocean Survey, the Army Corps of Engineers, the Fish and Wildlife Service, the Bureau of Land Management, the Geological Survey, the Environmental Protection Agency, the Department of Housing and Urban Development, the Federal Insurance Administration, the Marine Technology Society, the American Shore and Beach Preservation Association, the Urban Land Institute, and the Coastal Society.

New Members Named To Sea Grant Panel

Seven new members have been named to the National Sea Grant Review Panel.

Five replace members of the 15-person panel whose terms have expired, while the other two succeed members who have resigned.

Appointed to three-year terms are Paul D. Triem, Vice President and General Manager, Umpqua Division, Bohemia Inc., Eugene, Ore.; Dr. Lloyd N. Ferguson, Professor of Organic Chemistry, California State University, Los Angeles; Dr. Arturo Morales-Carrion, Executive Director, Puerto Rican Foundation for the Humanities, San Juan; Mrs. Mary Lou Munts, State Representative, 76th Assembly District, Wisconsin; and Walter V. Yonker, Laboratory Director, National Food Processors Association, Seattle, Wash.

The other new members are Dr. Roy A. Young, Chancellor of the University of Nebraska in Lincoln, Nebr.; and Dr. Charles L. Drake, Chairman of the Department of Earth Sciences, Dartmouth College, Hanover, N.H.

Dr. Young will fill a two-year term vacated by former U.S. representative Charles A. Mosher, who resigned to accept a position as Executive Director for the House Committee on Science and Technology. Dr. Drake replaces Dr. George S. Benton, formerly Vice President of the Homewood Divisions of Johns Hopkins University, who has been named Associate Administrator of NOAA. Dr. Drake will serve a one-year term.

Members whose terms have expired include Dr. Sanford S. Atwood, President, Emory University, Atlanta, Ga.; Dr. Werner A. Baum, Chancellor, University of Wisconsin, Milwaukee; Phillip Eisenberg, Chairman of the Executive Committee, Hydronautics, Inc., Washington, D.C.; Harold E. Lokken, Manager, Fishing Vessel Owners Association, Inc.. Seattle, Wash.; and Harvey Weil, Senior Partner, Kleberg, Mobley, Lockett & Weil, Corpus Christi, Tex.

The panel serves in an advisory capacity, assisting the management of the Sea Grant program in the development of policies and programs in providing matching-fund grants to colleges and universities for research, education, and advisory services related to marine resource utilization.

AMS Urges Concerted Effort on Flash Floods

Trailer in which three died in a November 1977 flash flood in western North Carolina. The AMS believes tragedies such as this might be prevented. Photo: Malcolm Gamble, Asheville Citizen Times

The Nation's leading weather scientists have urged a concerted effort by Federal, State, and local officials to deal with flash floods, the country's number one stormy-weather killer.

Dr. George P. Cressman, Director of NWS, described the concern of the American Meteorological Society over the Nation's flash flood problem at an AMS conference in Los Angeles. He outlined a nine-point program designed to reduce the death toll and property damage from flash floods, which kill nearly 200 persons a year and cause a billion dollars in damage.

Cressman is also President of the American Meteorological Society. This professional organization has a membership of 9,000 meteorologists and others involved in atmospheric, hydrologic, and ocean sciences.

Along with efforts to improve forecasts and warnings of sudden, destructive floods, Cressman said steps must be taken to increase regulation of areas subject to flash-flooding, certify and monitor the safety of dams, and improve information on frequency of maximum precipitation and associated runoff for design and planning. He also called for strengthened ties between meteorologists, hydrologists, engineers, social scientists, and action agencies in communities.

Cressman urged action to improve the ability to monitor and detect flash-flood conditions, to increase the capability to forecast the location and magnitude of rainfall, and to improve the capability to forecast small-scale phenomena such as thunderstorms. Other important steps included improving public awareness and developing community warning programs.

"The death toll and property damage from flash floods can be significantly reduced if positive action is taken, and the AMS urges the Nation to act now," Cressman said, quoting a statement of concern endorsed by the AMS.

"AMS members recommend that the Federal Government provide leadership and resources needed to reduce the tragic losses from the Nation's number one natural disaster—the flash flood."

Researchers Join Forces In Hawaii

Tsunami research at the University of Hawaii has combined with the Environmental Research Laboratories of NOAA to form the Joint Institute for Marine and Atmospheric Research (JIMAR).

The new institute is expected to increase the effectiveness of oceanic, atmospheric, and geophysical research being conducted by NOAA and several departments at the University.

Scientists working on problems of mutual interest may meet at the institute and it will also be a center to train scientists in disciplines involved in the oceanographic, atmospheric, and geophysical sciences.

Dr. Charles Helsley, director of the Hawaii Institute of Geophysics (HIG) at the University, has been named interim director of JIMAR.

According to Helsley, the institute will maintain a strong emphasis on long period waves and tsunamis, but in the future it will implement more programs to broaden the scope of marine and atmospheric research.

NOAA is providing approximately $150,000 to JIMAR and will assign three of its personnel to the institute.

There is also a fellowship program with enough funds to host three visiting scientists from other institutions in the U.S. or other nations.

Dr. John Apel, director of NOAA's Pacific Marine Environmental Laboratory (PMEL), Dr. D. James Baker, Jr. of PMEL in Seattle, Dr. Harold Loomis, and Dr. Lester Spielvogel of PMEL's Joint Tsunami Research Effort in Honolulu were named senior fellows of the new institute. Also named as senior fellows representing the University are Dr. Charles Helsley, Dr. William Adams, Dr. Robert Harvey, and Dr. Martin Vitousek of the Hawaii Institute of Geophysics.

Ozone Thinning Held Dangerous To Zooplankton

Some shrimp near Seattle are getting sunburns, as part of a study to determine the effects that thinning of the atmospheric ozone layer might have on terrestrial and aquatic life.

"Scientists as well as the public are increasingly concerned that pollutants in the upper atmosphere may deteriorate the protective ozone layer and therefore allow dangerous ultraviolet radiation to reach the earth's surface," Dr. David Damkaer of NOAA's Environmental Research Laboratories said. "But there is very little information on the effects of ultraviolet radiation on living creatures, particularly its effects on marine life."

With funds from the Environmental Protection Agency, Damkaer is studying the effects of varying levels of ultraviolet radiation on zooplankton—tiny drifting animals—that live in the upper layers of the sea. So far, the scientist and his colleagues at the Pacific Marine Environmental Laboratory have found that ultraviolet radiation can have dramatic, even lethal, effects.

Although it has not yet been possible to determine exact subsurface ultraviolet light levels, Damkaer speculates that shrimp larvae may already be living near their tolerance limit for ultraviolet, and that a slight increase could be damaging.

Weather Radio Network Passes 200, Goal Is 340

The NOAA Weather Radio network has now passed the 200 mark. The 200th station to come on the air was WXK-84 at Memphis, Tenn., on May 2. Three days later, on May 5, WXK-47 at Bristol, Tenn., became the 201st.

The pace of installations of NOAA Weather Radio transmitters has accelerated greatly in the past two years. The ultimate goal of 340 stations serving 90 percent of the U.S. population by 1979 should be met easily, according to Earl Estelle, National Weather Service program leader.

So popular has this system of continuous tape-recorded weather broadcast become that the National Weather Service now has cooperative agreements with about 35 states and Puerto Rico to hasten completion of the system.

Each of the very high frequency FM radio stations serves a population within a radius of about 40 miles from its transmitter with the latest storm bulletins and weather observations and forecasts — 24 hours a day, seven days a week.

The system has a feature which allows listeners to be alerted automatically, if they choose. NOAA Weather Radio receivers costing as little as $35 can be bought which will either sound a siren or come up to audible volume from a silent state when a forecaster presses a button in his office, indicating a storm bulletin is forthcoming.

Eskimo Take Limited

Two Whale Species Increasing

Good news for two depleted species of whales has been announced by Administrator Richard A. Frank.

The Pacific gray whale, once severely depleted because of commercial hunting in the last century, is now approaching its mid-1800's level of approximately 15,000 animals.

And the most complete bowhead whale research program ever undertaken has indicated that more animals than expected — 2264 — passed Point Barrow between April 15 and May 30, with others expected during June.

Frank, who is also U.S. Commissioner to the International Whaling Commission, said the Alaskan spring bowhead whale hunt ended with Eskimo whalers, operating for the first time under IWC regulations, landing 10 bowheads and striking but losing another five. The quotas, established by the IWC and adopted by the United States, permitted the Eskimos to land 12 bowheads and strike 18, whichever occurred first. The two whales remaining in the 1978 quota will be taken in the September—October hunt.

Pointing out that last year the Eskimos landed 29 bowheads and struck but lost another 82, Frank expressed his satisfaction with the outcome of the bowhead hunt, and his admiration for the manner in which Eskimo whalers and Alaskan officials conducted it. The spring season brought an unprecedented effort to hunt with new efficiency and to eliminate as far as possible wasteful wounding of the great animals, he said.

Praising Eskimo whalers for their performance during the spring hunt, Frank said: "The Eskimos entered the season with strong reservations, and with a concern for their traditions and food needs, but they accepted the necessity for quotas, compiled with the quotas, and essentially regulated themselves."

He praised the Alaska Eskimo Whaling Commission, the Alaskan Department of Fish and Game, and the National Marine Fisheries Service for highly effective teamwork.

The gray whale, Frank said, "represents a triumph of conservation. It vividly demonstrates that humankind can indeed protect endangered species."

Ruthlessly exploited for more than a century, the gray whale has been on the IWC's protected list since 1946.

Alaskan Eskimos were limited in their hunt for the bowhead whale. The quota is either 12 landed or 18 struck.

Frank cited a study conducted by Drs. Allen A. Wolman and Dale W. Rise of NMFS that showed a 1978 count indicating a total population of about 11,000, plus or minus 2000 animals, as the whales passed southward off Monterey, California. In November and December 1977, other researchers counted gray whales leaving the Bering Sea at Unimak Pass, Alaska, and estimated a population of 15,120. NOAA officials, taking into account a variety of factors, estimate the probable population at between 11,000 and 15,000.

Inquiry Held

Scuba Accident Kills Diver

Douglas Fewer, an oiler and diver on the NOAA Ship George B. Kelez, died March 29 during a research dive in the New York Bight off Long Island.

Fewer and another diver, Richard Rutkowski of the Atlantic Oceanographic and Meteorological Laboratories in Miami, were collecting water samples on the ocean floor at a depth of about 47 feet when the accident took place. According to Rutkowski, Fewer suddenly disappeared while the two men were working. He was found unconscious on the surface.

Fewer was picked up by a Coast Guard cutter in the area, transferred to an Air Force helicopter, and flown to Groton, Conn., for treatment in a hyperbaric chamber, but was pronounced dead on arrival there.

NOAA has appointed a fact-finding committee to investigate the accident, the first fatality involving a NOAA diver in the Administration's history. The investigating committee includes Lt. Cdr. Abram Y. Bryson, Jr., and Cdr. John T. Atwell of the Atlantic Marine Center, and Dr. Morgan Wells of NOAA's Manned Undersea Science and Technology Office.

Fewer had been with NOAA since 1974 and was a certified diver.

Rules Published On Reinbursment

NOAA has published final rules for reimbursing members of the public for the costs of participating in NOAA administrative proceedings.

"The regulations recognize that public participation is an essential element of a sound, balanced decision-making process," Richard A. Frank, Administrator of NOAA, said. "To assure public participation, it often may be necessary to provide some measure of compensation for attorneys' fees, expert witness fees, and other costs incurred by members of the public who otherwise would find it financially impossible to participate. The new regulations allow us to foster public participation in this fashion."

Early Hints Preceded '75 Island Quake

A major earthquake which struck Hawaii in 1975 was preceded by several months' warning from nature, Arch C. Johnston of the NOAA-University of Colorado Cooperative Institute for Research in Environmental Sciences (CIRES) in Boulder, Colo., has reported.

Johnston found that vibrations from other earthquakes far distant from Hawaii slowed down as they passed through the area where the major Hawaiian quake later occurred.

The pressure waves from an earthquake travel through the earth at a rate that varies with the properties of the crust and mantle, according to Johnston. Seismological stations in Hawaii —part of a volcano observatory network run by the U.S. Geological Survey — routinely monitor the rumblings of the islands' volcanoes, and pick up more distant disturbances, including seismic waves from the active Fiji and Tonga island chains, some 3,000 miles (4,800 kilometers) away. In comparing the waves' arrival times at three stations in the observatory network, Johnston found that, beginning about three and a half years before the Kalapana earthquake, a given signal from one of the Fiji quakes took about a fifth of a second longer to reach the station nearest the Kalapana epicenter than had previous signals. The travel time returned to normal a few months before the quake occurred.

The other stations showed no such change, and did not change relative to each other. This means, Johnston said, that the slowing down of seismic signals was caused by some change in the immediate vicinity of the station; a more widespread or distant cause would have registered on instruments at the other stations as well.

A number of scientists at CIRES and elsewhere are studying such earthquake precursors, in hopes they may someday lead to accurate predictions of quakes.

Fisheries Researchers To Get New Vessel

A new ship, a 120-foot multiple purpose fisheries research vessel designed to accommodate 17 crew and scientists, will be added to NOAA's fleet, according to a National Ocean Survey request for proposal for construction.

The ship will be a modified stock design combination crabber/trawler with a single controllable pitch propeller, Kort nozzle and bow thruster which will serve a twofold purpose by gaining more efficient propeller control and the desired bollard pull needed for fisheries research.

The main propulsion system is to be sized for 1250 shp. Two 200 KW generators for ships service will be provided.

As required by the Fisheries Management and Conservation Act of 1976 (Extended Jurisdiction—200-mile limit), the ship will provide stock assessments as a basis for fishery management actions by using conventional types of commercial gear including bottom trawls, midwater trawls, bottom and surface longlines, gill nets, and pot fishing. It will have two research laboratories capable of CTD and biological data collection and will be fitted with an 8′ x 20′ scientific van.

According to R.Adm. Allen L. Powell, Director of NOAA's National Ocean Survey, the ship has been envisioned as taking advantage of existing stock fishing vessels now being designed and constructed on both coasts as well as the Gulf. Adm. Powell first used the stock hull concept when he played a key role in the construction of the NOAA Survey vessel Ferrel in 1968.

CEDDA Publishes Third In Series On Brine Disposal

The Marine Assessment Division of EDS' Center for Experiment Design and Data Analysis has completed the third in a series of reports on environmental analysis of brine disposal areas for creation of a National strategic petroleum reserve. The report entitled, "Analysis of Brine Disposal in the Gulf of Mexico, 3. Capline Sector," was prepared for the Federal Energy Administration (FEA) under an interagency agreement between FEA and NOAA.

Previously published reports are for Bryan Mound (near Freeport, Tex.) and, West Hackberry, La. These reports also considered the environmental consequences of brine disposal in the Gulf of Mexico.

The third report includes sections on the brine dispersal model of the Massachusetts Institute of Technology (MIT) and sections on ecological factors prepared by Texas A&M University.

NOAA, University Agree To Share Port Aransas Lab

NOAA and the University of Texas have reached a cooperative agreement to share the National Marine Fisheries Service's laboratory at Port Aransas, Tex.

NOAA has been working actively to find a suitable use for the facility since it became necessary to suspend temporarily the Federal programs at the laboratory.

The University will operate the facility as part of its Port Aransas Marine Laboratory, University of Texas Marine Science Institute, and will build a major program for mariculture research and teaching there.

The University also will provide space and facilities to the Texas Parks and Wildlife Department.

As part of the mariculture program, the University will make free space available to other institutions, agencies and schools for research and development projects which are compatible with that program.

The University will operate and maintain the three-building, 22,-250 square foot facility, at no cost to the government for three years, with an option for a two-year extension. One Federal employee will remain at the laboratory, and the few remaining Federal workers will be assigned to other National Marine Fisheries programs on the Gulf Coast when the University occupies it.

A typical Federal Aviation Administration Air Route Traffic Control Center. The Weather Service now provides a meteorologist to assist FAA operations.

NWS Provides New Service For FAA Control Centers

A program in which 13 of the nation's Air Route Traffic Control Centers, operated by the Federal Aviation Administration, are getting the services of National Weather Service meteorologists was inaugurated this spring.

In accordance with an agreement signed this year between FAA and NWS, three Weather Service meteorologists are now assigned to each of 13 FAA Centers. The program will be expanded later to include all 20 Centers.

The NWS meteorologists are monitoring weather conditions important to aviation within each Center's control area and keeping flight controllers continuously advised of weather changes, particularly those that may pose a hazard to aviation or impede air-traffic flow. The same weather information is being sent to FAA control towers and Flight Service Stations with Enroute Flight Advisory Service.

The NWS meteorologists also are disseminating weather reports received from pilots, providing detailed weather briefings and forecasts for Center personnel, and conducting weather training for air-traffic specialists.

FAA is furnishing all the supplies and communications equipment needed by the meteorologists to carry out their tasks. This includes satellite photo recorders, facsimile equipment for receiving NWS radar images, and a link with the Weather Service's National Facsimile Circuit.

The enroute Centers now receiving the new services are: Atlanta, Houston, Chicago, Indianapolis, Cleveland, Washington, Boston, Fort Worth, Jacksonville, Memphis, Miami, New York, and Kansas City.

Fossils Reveal Climate Records 2500 Years Old

Natural records trapped in fossilized pollen are revealing the first detailed picture of changing climatic conditions in the northeastern United States over the past 2,500 years.

Studying fossil pollen contained in lake sediments, a NOAA scientist has determined that recent decades are the warmest in the upper Midwest since 1200 A.D. But, according to Dr. J. Christopher Bernabo, National Research Council resident research associate with NOAA's Environmental Data Service, long term trends in the same area show annual rain and snowfall since 600 BC has increased 50 percent with some overall cooling.

Bernabo says his initial research in Michigan shows that the past 30 years in this region have been warmer than any similar period since about 775 years ago, when it was roughly as warm but drier than today.

Further study indicates a cold "Little Ice Age" period occurred from approximately 1450 to 1850, with temperatures about 2 degrees F. cooler than the current 30-year mean.

Ocean Resource

Data Buoy Aids Studies

A 100-ton NOAA Data Buoy, named OTEC-2, began collecting data in the Gulf of Mexico, beginning in March, to provide important information on the mechanics of extracting energy from the sea. The collection system is a project of the NOAA Data Buoy Office, part of the NOAA Office of Ocean Engineering. NDBO, located at Bay St. Louis, Miss., is headed by Dr. Jerry C. McCall.

The 40-foot diameter discus buoy has been equipped to test the effect of seawater on Ocean Thermal Energy Conversion (OTEC) power plants. Such plants, currently in the experimental stage, generate electricity by using the temperature differential between the warm surface layers of the ocean and the colder waters below.

Under an interagency agreement with the Department of Energy, NOAA has moored the huge, unmanned buoy approximately 180 miles west of Tampa, Fla. It will remain on station for three-to six-month periods measuring the effects of biological fouling, corrosion, and scaling on heat transfer surfaces of the heat exchangers to be used in OTEC power plants.

The data collected by OTEC-2, in conjunction with data from similar experiments previously conducted at Hawaii and the Virgin Islands, is expected to provide information vital to the development of large power plants capable of extracting the limitless solar energy stored in the oceans of the world.

Operational OTEC plants in the Gulf of Mexico would provide a substantial additional electrical power source for Gulf Coast states, thus reducing the nation's dependency on oil. Other possible uses of these power plants include the production of metals and chemicals from seawater and air which could then be transported to the continental United States by barge or ship.

NOAA Administrator Richard A. Frank recently presented a NOAA Corps "T" shirt to Secretary of Commerce Juanita M. Kreps. The Secretary good-naturedly agreed to show it off at work one day.

Walsh, Leitzell, Benton Confirmed In Top Posts

James P. Walsh

James P. Walsh, for the past year general counsel of the Senate Committee on Commerce, Science, and Transportation, has been confirmed as Deputy Administrator of NOAA.

NOAA Administrator Richard A. Frank said that Walsh's knowledge and experience in ocean affairs, as well as his understanding of NOAA's atmospheric missions, will be a welcome addition to NOAA's organization.

A native of Coos Bay, Ore., Walsh was director of the Senate's National Ocean Policy Study during 1977 in addition to his Senate committee duties.

From 1972 until last April, the Stanford University graduate served as staff counsel to the Senate Commerce Committee and counsel to the Senate Ocean Policy Study. In those posts he had responsibility for all ocean-related legislative programs, merchant marine, ocean pollution, coastal zone management, and other related subject areas.

Before June 1972, Walsh was Assistant Attorney General for the State of Washington, including service as counsel to the State's Oceanographic Commission.

He is a member of the Law of the Sea Advisory Committee at the State Department, as well as the Washington and District of Columbia Bar Associations and the American Society for International Law.

Terry L. Leitzell

Terry L. Leitzell has been confirmed as Assistant Administrator for Fisheries. He is also Director of the National Marine Fisheries Service.

Since September of 1977, Leitzell has served as special assistant and senior advisor to the NOAA Administrator. Prior to that, as an attorney-adviser in the Department of State, he was the Deputy U.S. Representative to the United Nations Law of the Sea Conference and chief negotiator on the conference committee dealing with marine pollution and marine scientific research. He led delegations to several meetings and conferences on marine environmental protection and law of the sea and served as legal adviser to several delegations to bilateral and multilateral fisheries negotiations. Leitzell was responsible for Executive Branch policy development on law of the sea issues and worked directly with numerous public interest groups on resource and environmental protection policy development.

Leitzell served as consular and commercial officer with the U.S. Foreign Service in Bombay, India, from August 1967 through December 1970.

Dr. George S. Benton

Dr. George S. Benton, former President of the American Meteorological Society and former Vice President of Johns Hopkins University, has been confirmed as Associate Administrator of NOAA.

Administrator Richard A. Frank said Benton, one of the Nation's leading authorities in the atmospheric, oceanic, and hydrologic sciences, will significantly strengthen NOAA's management team. Benton joined the faculty at Johns Hopkins in 1948. He was appointed Professor of Meteorology there in 1957, and Chairman of the Department of Mechanics in 1960.

For three years — from 1966 through 1969—he was Director of the Research Laboratories of the Environmental Science Services Administration, a predecessor agency of NOAA. In 1970 he returned to Johns Hopkins as Chairman of the Department of Earth and Planetary Sciences. He became Dean of the Division of Arts and Sciences in 1971, and Vice President of the Homewood Divisions in 1972.

Univac Computer System To Help Administration

DOC has awarded a $9.1 million, eight-year contract to Univac, Inc., of Minneapolis, Minn., for a new computer system for NOAA.

The new computer, a Univac 1100/42, has more than twice the capacity of NOAA's existing systems which it will replace, an IBM 360/65 and a CDC 6600.

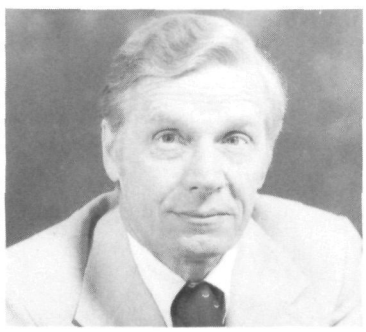
NOAA's computer activities planned for the new system include payroll, personnel, budget, marine and geodetic data systems for NOS, data base support for EDS and the production of economic reports for NMFS.

Delivery of the equipment is expected in September.

NWS Director

Dr. Cressman Heads AMS

Dr. George P. Cressman, Director of the National Weather Service, took office as the new President of the American Meteorological Society (AMS) at Savannah, Ga., on February 1.



Dr. George P. Cressman

The AMS is the leading professional organization for meteorologists in the United States, Since it was founded in 1919. It has become the principal focus for exchange of professional information among U.S. meteorologists. It also serves as a key link with meteorologists of other nations. The AMS publishes six professional journals and conducts from 12 to 20 national and international meetings annually. Dr. Cressman has been a frequent contributor to AMS publications and a leading participant in formulation of the Society's policies.

Club Presents NOAA Man, Wife 1978 Service to Mankind Award

Members of the Sertoma Club of San Diego, an international service organization with more than 33,000 members in the U.S., Mexico and Canada presented their annual Service to Mankind Award jointly to Henry and Elvia Orr of El Cajon, Calif. Orr is a Scientific Illustrator at the NMFS Southwest Fisheries Center in La Jolla, Calif.

The Orrs were honored for their work with severely handicapped people. Elvia puts in many volunteer hours as a sitter for handicapped children and adults. She also teaches English and Spanish reading and writing to elderly and illiterate poor at Edgemoor Geriatric Hospital in San Diego. Henry is actively involved with Recreational Services for the Handicapped and IMPACT (Involvement of Mexican Populace in Active Community Tasks), a non-profit social service agency. He has also frequently volunteered his services as a draftsman for a company producing prosthetic devices for the handicapped.

In 1976, the Orrs took into their home two young Mexicans, Juan Navarro, 27, and Ruben Ochoa, 17. Both young men had tried to cross into the U.S. illegally and, in the process, received serious injuries which will probably prevent either from ever walking again unaided. Elvia taught them reading and language skills while Henry coordinated their job training so that they may be self-supporting on their return to Mexico.

Data Service Prepares Geothermal Energy Maps

Detailed maps of geothermal energy sources in 12 or more Western States are being prepared for the U.S. Department of Energy (DOE) by EDS' National Geophysical and Solar-Terrestrial Data Center (NGSDC). The maps will help demonstrate the importance of heat from the earth's interior in meeting the future energy needs of the United States.

Two maps will be designed for each state to promote the use of geothermal energy as an alternate energy resouce and to identify areas likely to yield such resources. They will also emphasize the occurrence of relatively low temperature resources which can be used in direct, non-electric applications.

One map will be designed to appeal to scientific and exploration personnel while the other will be for use by planners and non-specialists.

The first geothermal maps will be produced for Idaho. These will be printed in late 1978 followed within several months by maps for Arizona. They are scheduled to be completed at a rate of about five states per year.

States participating in this effort include Alaska, Hawaii, Washington, Oregon, California, Idaho, Montana, Nevada, Colorado, Utah, Arizona, and New Mexico. Organizations involved in the production of the maps include the DOE. U.S. Geological Survey, State agencies (in some cases, organizations affiliated with State agencies), the University of Utah Research Institute, the Los Alamos Scientific Laboratories, and other university groups.

NOAA Studies Stability of Ocean's Floor

NOAA scientists are probing the microscopic world of soil particles for clues to instability in continental shelf sediments—instability that can topple an offshore petroleum platform, or wipe away an underwater pipeline.

In these studies, marine geologists from ERL's Atlantic Oceanographic and Meteorological Laboratories in Miami, Fla., are measuring such unconventional quantities as the amount of water between sediment particles, or "pore pressure," and the microstructure, or fabric, of clay sediments.

"These properties determine the ultimate behavior of sediments under the loads imposed by offshore structures and passing storms," said Dr. Richard Bennett, who leads the marine geotechnical program at the Miami facility. "That's why our measurements are attracting the attention of industry, now that so many national energy needs have begun to focus offshore."

Conventional methods of assessing sediment stability, Bennett said, test sample sediments in laboratories ashore. He and his colleagues, however, measure pore pressure in sediments where they lie: in their pressurized, underwater environment.

The next step, according to the NOAA scientist, is to build a much larger self-contained probe for assessing sediment pore pressures at deep-water sites where exploration is pressing seaward.

Part of the work was conducted in the Mississippi Delta area as a cooperative effort between NOAA's Environmental Research Laboratories, the U.S. Geological Survey, Texas A&M University, Louisiana State University, and Sandia Laboratories.

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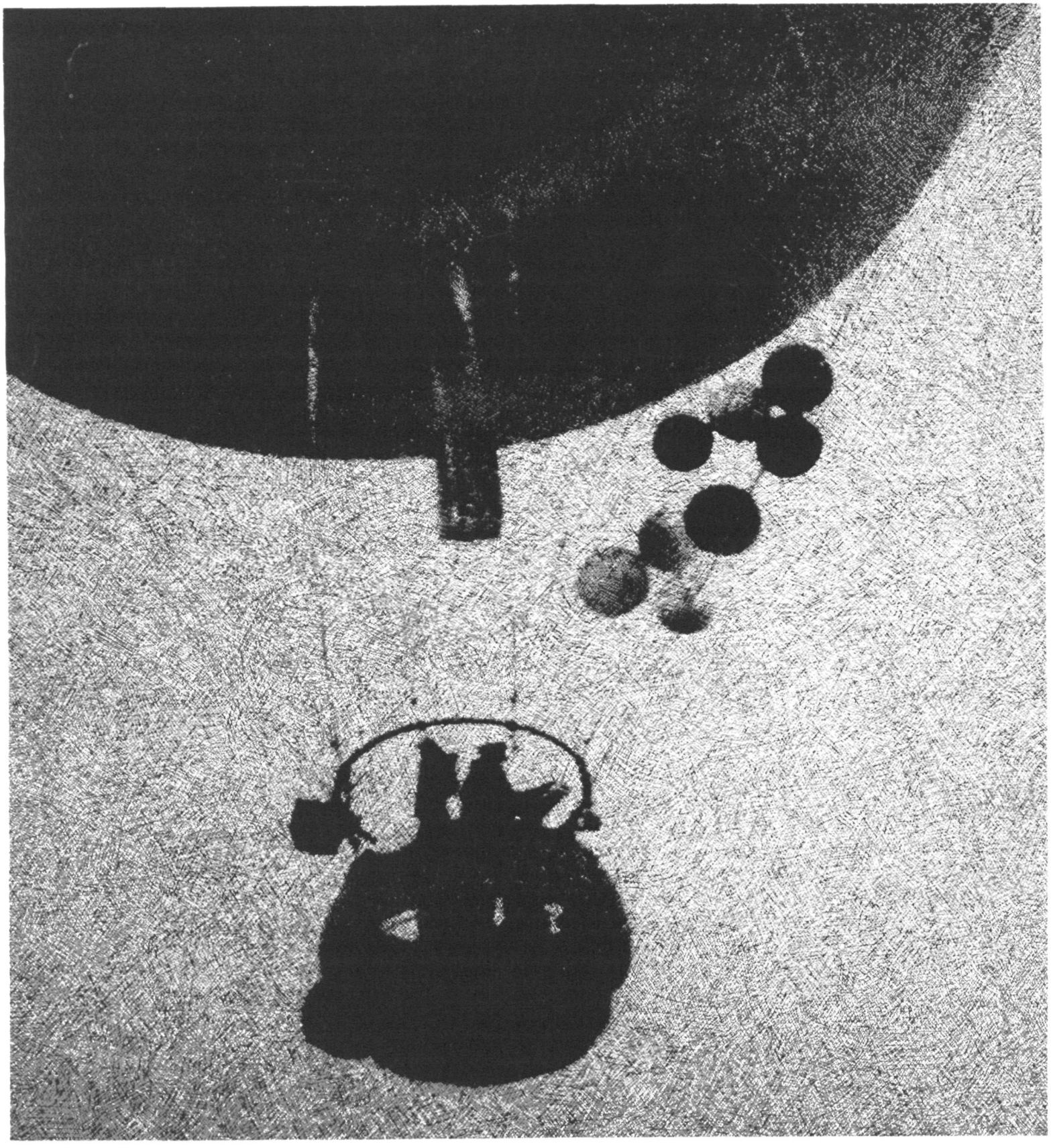

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