VOLUME 6 NUMBER 3 JULY 1976

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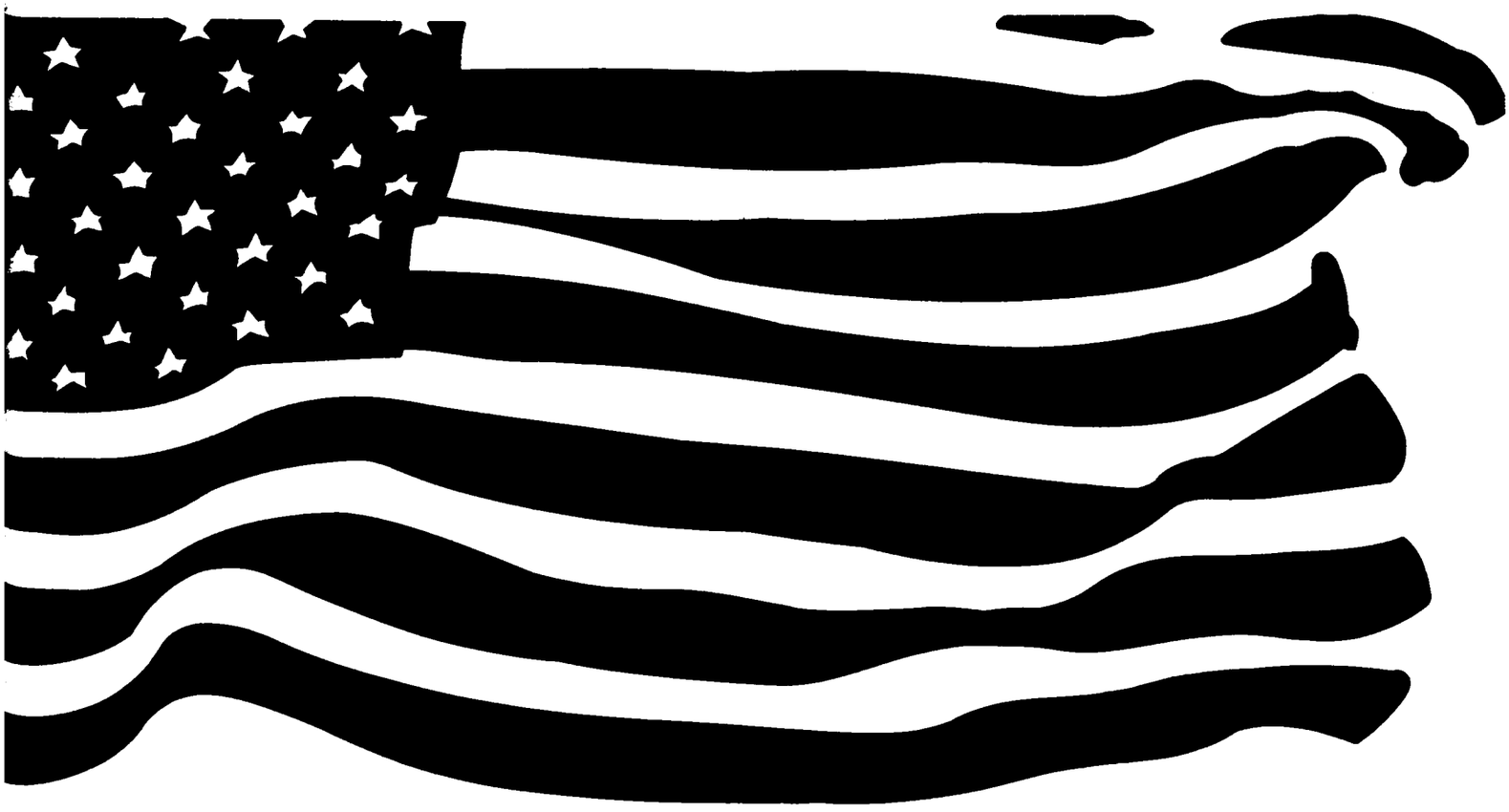

Beautiful!

National Oceanic and Atmospheric Administration

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Beautiful!

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A Message From the Administrator

This issue features a special section outlining some of the cooperative efforts of NOAA and the United States Coast Guard. Our focus on our work with the Coast Guard is symbolic of our wide interactions with other agencies of the Federal Government. We could, for example, have featured our cooperative efforts with many other agencies, such as the Federal Aviation Administration, the National Aeronautics and Space Administration, the U.S. Geological Survey, the Bureau of Land Management, the Environmental Protection Agency, the Energy Research and Development Administration, various arms of the Department of Defense, to name a few.

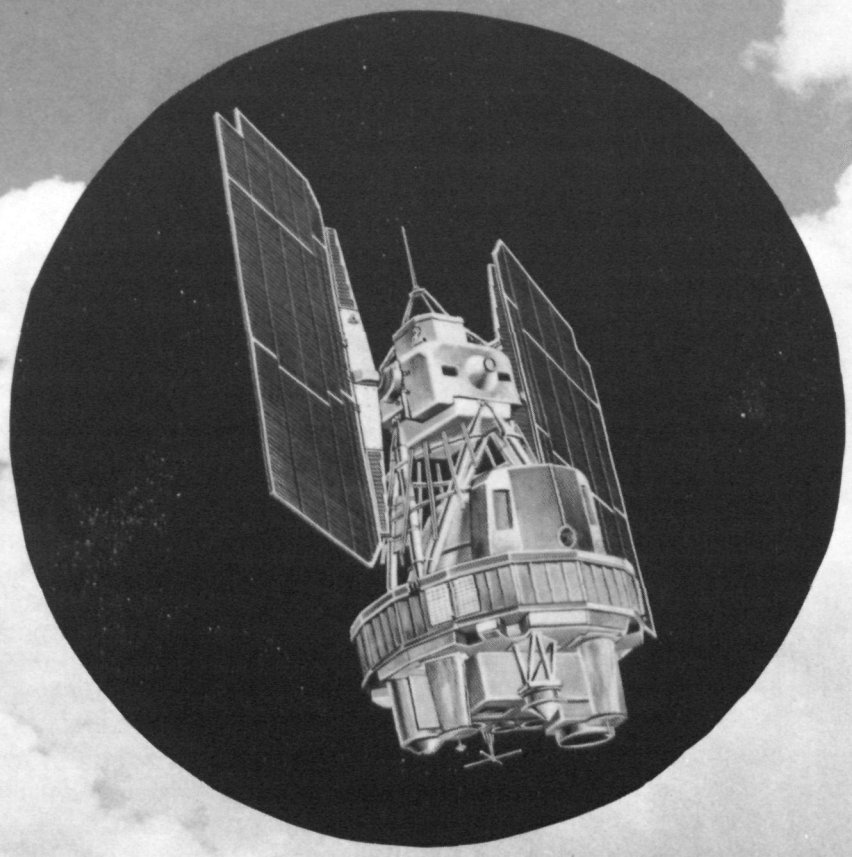
Many of NOAA's missions could not be effectively carried out without the close support and participation of the Coast Guard. Now with the Fisheries Conservation and Management Act of 1976 a matter of law, the relationship between our two organizations will be even closer and more vital. Extended fisheries jurisdiction will tremendously enlarge and complicate responsibilities of both organizations. The Nation is fortunate to have the Coast Guard acting as the principal enforcement and surveillance force in the months and years to come as NOAA takes on the broad fisheries management responsibilities.

Whether it be the broadcast and observation of weather conditions along our coasts and at sea, participation in our marine science efforts, the enforcement and surveillance of the fisheries regulations and international agreements, or close participation with us in some of our ocean engineering efforts, we have always received cooperative and generous support from the Coast Guard. For this we are deeply appreciative.

Today the accomplishment of almost all of our national goals requires the close and harmonious working relationship with many different Federal agencies. Our work with the Coast Guard explains why NOAA works hard to initiate and nurture these kinds of relationships. Our citizens rightfully expect that jurisdictional impulses will not get in the way of the provision of the kind of services which they deserve. The statutory charters of Federal agencies today are so extensive as to be almost forbidding on the one hand while fiscal constraints, on the other, suggest that one effective way to get our job done is to try to enlist the talents, expertise, facilities and interest of other agencies in a cooperative mode.

Such efforts are not always easy to bring about. There are indeed institutional rivalries and jealousies that must be overcome. There are concerns about "turf". Some of these differences of view among agencies stem from similar statutory requirements placed upon agencies by the Congress. In these cases, however, rivalries are petty and these need to be excised to the extent that it is humanly possible. The fact that we can achieve widespread cooperative efforts among agencies is proof that it can be done and is proof that the results clearly exceed the sum of its parts.

Robert M White



LACIE: FORECASTS FOR A HUNGRY WORLD

BY CHARLES G. THOMAS

Our space, agriculture, and weather agencies will test advanced satellite techniques for surveying and forecasting important food crops . . . This is a promising and potentially vital contribution to rational planning of global production.

Dr. Henry F. Kissinger
U.S. Secretary of State
Rome, Italy, November 4, 1974

To the uninitiated it seems incredible.

For us, a crop forecast was always Walter Brennan or some other crusty actor crumbling a clod of dirt in his hand as he squinted out over his parched land. The forecast was always for a poor crop.

Needless to say, that's not (and probably never was) the way it's done. Out in Texas, the National Weather Service measures the ground water available to crops with a neutron counter. In Alabama they've developed a computer model for certain crops which describes (in mathematical terms) how a plant grows and can compress a whole season into a few minutes. The Environmental Data Service models large-scale climatic fluctuations and assesses the effect they will have on grain yields in major crop regions of the world.

These are examples of space-age applications of meteorology to agriculture. And here, "space-age" is a particularly apt term as the U.S. has literally gone into space to demonstrate the practical benefits of remote sensing to worldwide agricultural interests. Relying heavily on satellite data, NOAA, NASA, and the Department of Agriculture are jointly involved in LACIE (for Large Area Crop Inventory Experiment). The experiment is designed to see if data on areal coverage, gathered by NASA's LANDSAT earth resources satellites, and the crop yield meteorological models, developed and operated by NOAA's Environmental Data Service, can improve the speed and accuracy of crop production estimates in foreign areas. The basic LACIE equation then is: Area (LANDSAT) $\times$ Yields per unit area (NOAA models) = Total Crop Production.

The importance of programs such as LACIE can hardly be overstated.

It's a hungry world. Each week, the num-

ber of additional people to be fed grows at the rate of over 1.4 million, or 75 million a year. And we are all, to a certain extent, at the mercy of a fluctuating atmospheric environment. For 40 years the U.S. and Canada enjoyed an ever-increasing, bounteous series of harvests. With our vast reserves we could act as a cushion against world food shortages. There was always food available to be purchased by or given away to countries in need.

Harsh winters, droughts, and typhoons cut output in the Soviet Union, Argentina, Australia, the Philippines, and India in 1972. A change in ocean currents and overfishing off the coast of Peru decimated the anchovy catch, a major source of protein for animal feed. This important food output dropped 33 million tons from the previous year's 1,200 million. To meet the added demand of increased population and higher living standards, it should have increased by at least six million tons. And it's not always the other fellow's problem. According to one prominent world food expert, "In 1970 not one in 100 economists anticipated that by 1974 the U.S. would plant all its farmland and having done so, we would still be hanging on by our fingernails." The nation's winter wheat crop was damaged by drought, wind, and erosion this spring and in some areas of the Great Plains was beyond salvage in spite of moisture gains in late April and May. In the U.S.S.R. the 1976 winter wheat crop suffered a severe loss due to a fall drought and winter kill.

Programs such as LACIE, of course, cannot prevent drought and winter kill or affect crop yields directly, but they can benefit both producers and consumers by helping reduce the uncertainties which affect the management and marketing of major crops. Faster, earlier, and more accurate production estimates would assist in rational planning for the most effective use of limited stockpiles for emergency food distribution.

So, in 1974, the LACIE program got underway. It is being conducted in three phases—extending over three global winter and spring wheat crop seasons. The first phase began in November 1974 and concentrated on the most important wheat growing region of the United States—the hard red wheat region of the Great Plains. The early work was devoted to an evaluation of the ability to locate, identify, and estimate the area in wheat in the Plains, and also to test when yield models developed by NOAA scientists.

In the second phase of LACIE—now being conducted—the major area of coverage remains the Great Plains; however, others are being analyzed. Phase II began in October 1975, extends through April 1977 and involves an integrated test of the crop identification and area estimation capability along with use of yield estimates from CCEA models to predict wheat production in the regions being studied.

In Phase III, the LACIE capability should be able to support the estimation of wheat area, yield, and production in several countries.

To understand LACIE, one must know a little about LANDSAT and what it can tell its earthbound controllers.

LANDSAT, a 891-kilogram (nearly a ton), butterfly shaped observatory flying in a 920-kilometer (570-mile) circular, near polar orbit, views each area of the earth at least once every 18 days. One of the electronic sensors on board the satellite measures reflected energy. Just as the eye *sees* reflected sunlight in visible wavelengths (such as blue, green, and red) the satellite's sensor *measures* the reflection. The electronic sensor, however, is sensitive to more than the visible wavelength. It also can "see" the ultraviolet and infrared wavelengths, as well.

Light energy from the sun arriving at the earth is absorbed by plants for growth or is reflected from the plants and its wavelength altered depending on the composition of the vegetation. As different plans reflect energy different ways, it is possible to classify plants by their reflective pattern, or "spectral signature."

Assisted by computers, scientists can recognize the characteristics of a plant viewed by the sensor aboard the satellite. LANDSAT, then is capable of making a large area crop inventory—and the initials L.A.C.I.E. begin to make sense.

Because of its importance to the U.S. economy and the accessibility of a large crop against which to check their data, LACIE's managers chose wheat as the test crop for the demonstration.

The satellite's capability to assist scientists in the identification and measurement of wheat areas, however, provides only one component for the estimation of wheat production. For Department of Agriculture crop-reporting purposes, production (area in wheat multiplied by yield for that area) is the quantity of primary importance. An approach to yield estimates—using meteorological data from ground stations and satellites—was already being developed at NOAA and was considered the most promising for support of initial LACIE large-scale demonstrations.

This was the job assigned to NOAA's Environmental Data Service and its Center for Climatic and Environmental Assessment (CCEA).

Wavelength measurements of the wheat crops under study are received from LANDSAT and processed into computer-compatible tapes. At NASA's Johnson Space Center in Houston, Texas, the data are analyzed to identify wheat crops and the sample areas are integrated into an overall acreage estimate.

The sample areas are also combined with historical patterns for a large (county-size) area to obtain the total area currently planted with the crop. Historical patterns of crop location, cropping practices, and planting trends are generally well established for agricultural regions.

Crop yields is directly associated with weather, soils, agricultural technology, diseases, and insects. The main weather factors are rainfall both before and during the growing season, and temperature.

Part of NOAA's role in LACIE is to provide accurate data on precipitation types, accumulative precipitation amounts, surface temperatures, and such phenomena as the occurrence of droughts, floods, and freezes—essentially over the entire globe. This in-

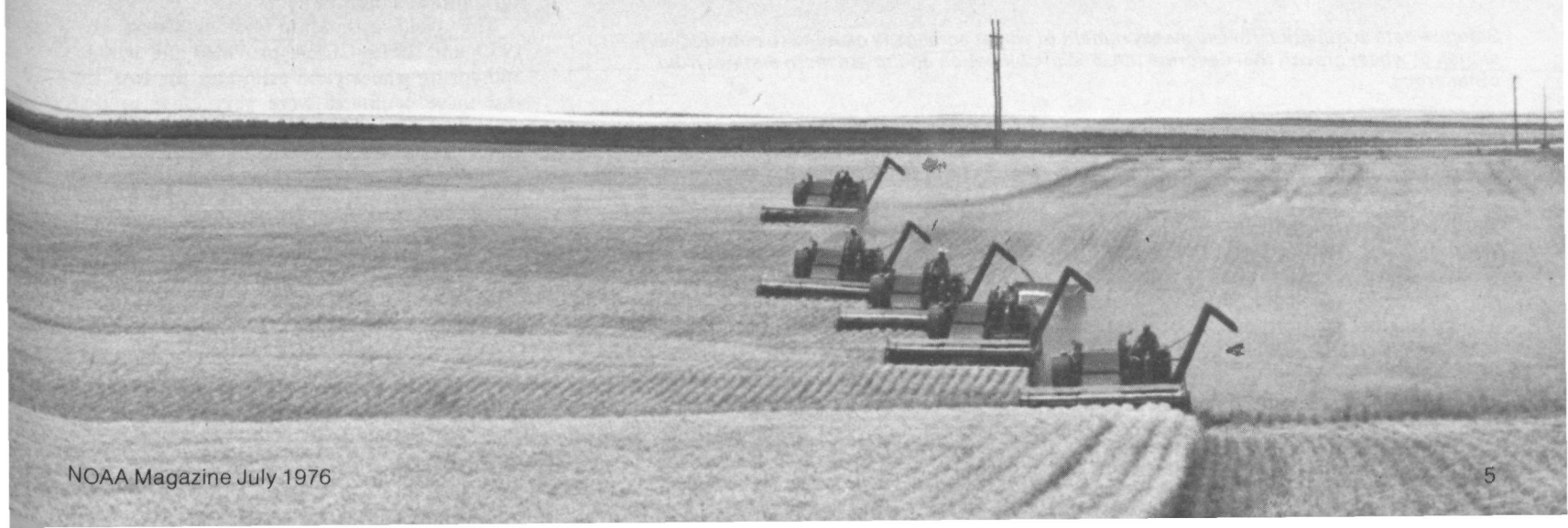
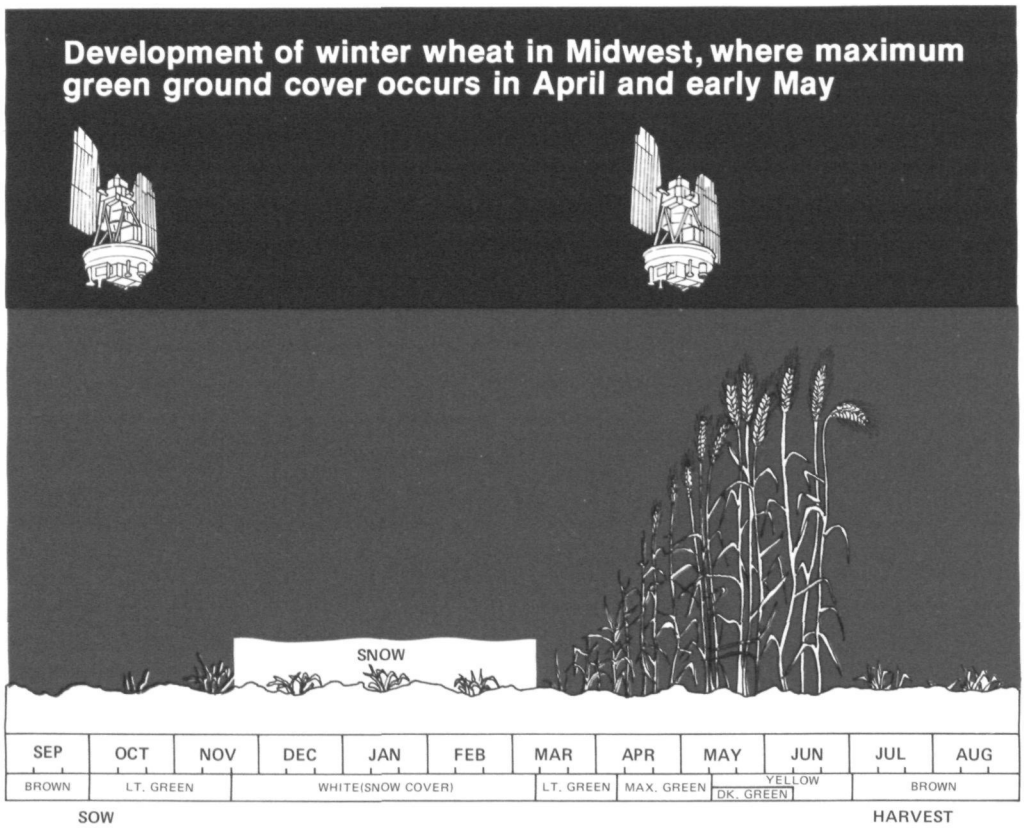


Photo: Leon LaPorte, NOAA

Discussing LACIE computer operations are Dr. James D. McQuigg (right), Director of the Center for Climatic and Environmental Assessment, and Malcolm Reid, head of CCEA's Climatic Assessment Division.



Satellite data acquisition for the measurement of wheat acreage is planned to coincide with stages of wheat growth that describe the area of cultivation and/or are more distinct from other crops.

formation, provided by the CCEA's Assessment Division, is derived from an ongoing examination of four basic sources: NOAA's worldwide data base in the World Weather Building near Washington, D.C.; the analyzed surface weather charts prepared by the National Weather Service's National Meteorological Center; the NOAA-4 hemispheric and GOES satellite photos from the National Environmental Satellite Service; and the global climate data provided by the Environmental Data Service's National Climatic Center in Asheville, N.C.

At the CCEA's Model Division at Columbia, Mo., large data sets containing historical yield, weather, and agronomic information were developed for several of the wheat areas under consideration. A substantial part of the work involves assembling detailed yield and weather data covering sufficiently long periods. This is followed by quality control checks and the testing of various statistical regression models to arrive at one that is deemed to perform best. Models were developed which permitted input of daily meteorological data aggregated biweekly or monthly.

These models are simply a set of mathematical equations which are used to estimate wheat yields from meteorological observations. They relate yield to the weather elements which influence the wheat crop throughout its development. The accuracy of these yield models depends upon knowledge of plant response to the many possible combinations of weather stress, application of modern technology, insect and disease outbreaks. Accuracy also depends on the availability of weather observational data. Because rainfall, temperature, and other factors are measured only at certain widely separated points, while crops are continuous over large areas, the weather parameters must be estimated using the materials from synoptic reporting stations. The NOAA environmental satellites are used daily to provide coverage of weather between the sampling points.

An early season estimate is that of potential wheat yield based on the actual weather, up to that point of the growing season. A sudden storm, however, may flatten, flood, or otherwise destroy a crop and prevent harvesting, thus affecting the accuracy of the yield estimates. It has been demonstrated, nevertheless, that weather data averaged over large areas on weekly or monthly time scales can generate useful crop yield estimates.

The yield estimates developed by NOAA are sent to the Johnson Space Center where it is integrated with the acreage information gained by the LANDSAT and a crop production estimate is determined. These estimates can be made a number of times during the growing season with fresh data cranked into the computation making it possible to check the information repeatedly and correct errors.

The periodic estimates from LACIE are provided to the Department of Agriculture. USDA is evaluating the LACIE system results against current operational data in order to determine the cost/benefit ratio of the system. The Agriculture Department is also studying the possible use of the LACIE production estimates in its crop reports, which are made public as a routine service to the domestic and international agricultural community.

The yield estimation system works. In 1975 and 1976 CCEA provided the winter and spring wheat yield estimates for LACIE and these estimates were very close to the official U.S. estimates released by the USDA's Statistical Reporting Service.

The future of LACIE will depend on its cost and the budgetary priorities of the federal agencies involved. To date, however, LACIE has done what it set out to do—it has proven the feasibility of a system in which the use of spacecraft data and flow of weather information for input to computer models can improve the timeliness and accuracy of major crop estimates.

Such technology may be a big step in the right direction for a hungry world.

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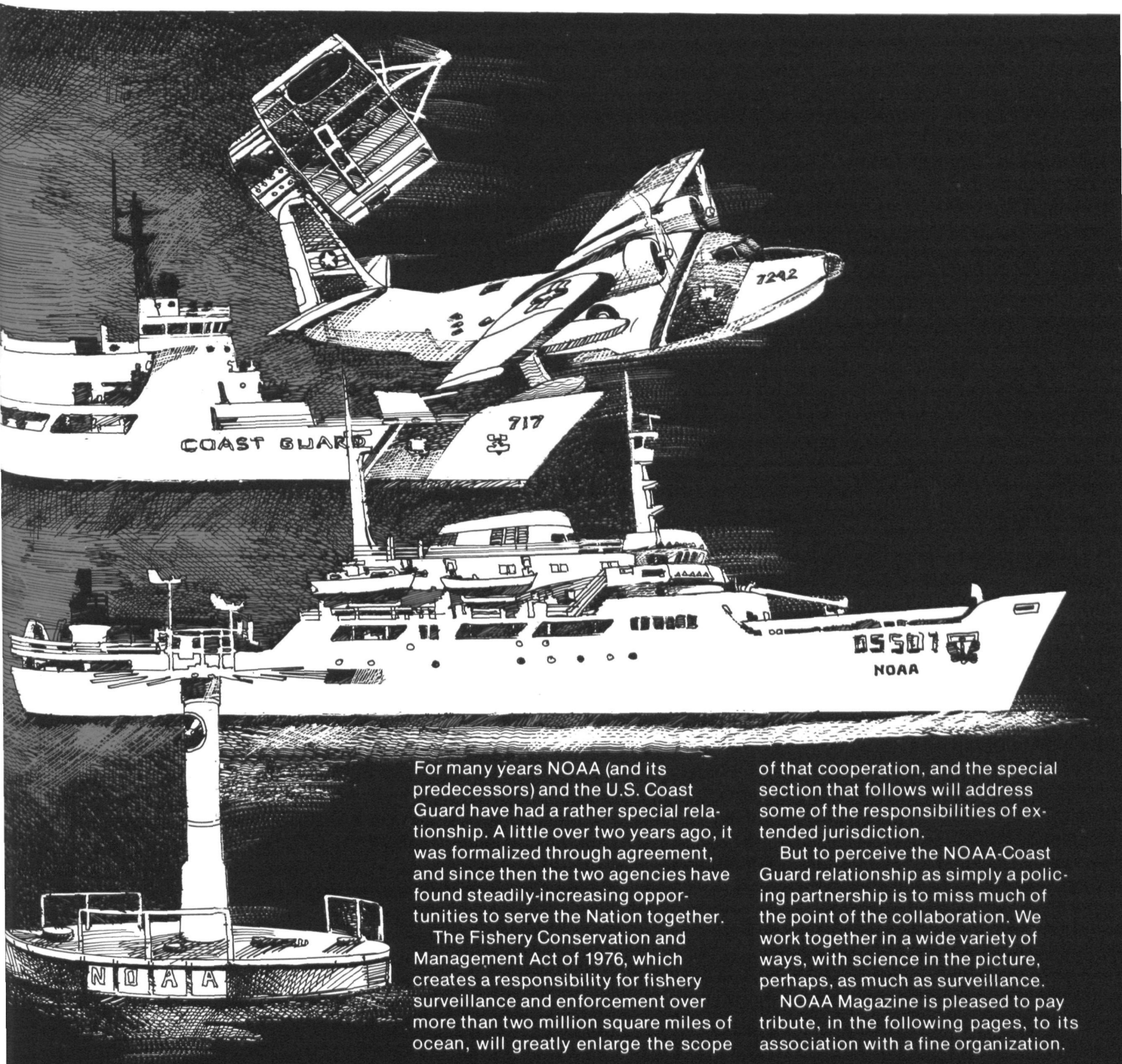
Special Section



For many years NOAA (and its predecessors) and the U.S. Coast Guard have had a rather special relationship. A little over two years ago, it was formalized through agreement, and since then the two agencies have found steadily-increasing opportunities to serve the Nation together.

The Fishery Conservation and Management Act of 1976, which creates a responsibility for fishery surveillance and enforcement over more than two million square miles of ocean, will greatly enlarge the scope of that cooperation, and the special section that follows will address some of the responsibilities of extended jurisdiction.

But to perceive the NOAA-Coast Guard relationship as simply a policing partnership is to miss much of the point of the collaboration. We work together in a wide variety of ways, with science in the picture, perhaps, as much as surveillance.

NOAA Magazine is pleased to pay tribute, in the following pages, to its association with a fine organization.

The fishes of the sea:

The Two-Million Square Mile Challenge

BY GERALD D. HILL

"They said the Soviets were out there fishing with 'ocean liners', and that was the first we knew about it. Those Boston fishermen were amazed—they had never seen any fishing vessels that large."

Charles L. Philbrook, Special Agent in the Gloucester, Massachusetts, regional office of the National Marine Fisheries Service, was reminiscing about the first appearance of foreign fishing vessels off the Atlantic coasts in the summer of 1961.

At first, he said, no one knew if they would be much of a threat to U.S. fishermen, but in 1965 they caught about half of the haddock on Georges Bank. With the lesser amounts taken by the U.S. and Canadian fishermen, as much as 200,000 metric tons total were fished. The fishery was virtually ruined. Today the allowable haddock catch there is only 4,500 metric tons.

The U.S. fisherman's share of the Atlantic catch dwindled from 50 percent in 1964 to 25 percent in 1975.

Early this year, 15 years after the vanguard of the huge foreign fleets appeared, the Fishery Conservation and Management Act of 1976 has become law. With enactment of that law, NMFS and the U.S. Coast Guard have responsibility for enforcing Federal conservation and territorial fishing laws and treaties over a 2.2 million square mile area.

The law gives the United States contol of about 10 percent of the world's fisheries resources, with exclusive fisheries management over all fish within the fisheries conservation zone, except tuna, as well as all anadromous species of the U.S. throughout their range beyond the zone, unless they are within a foreign nation's territorial sea or fishery conservation zone which is recognized by the U.S. Included also is control of all U.S. Continental Shelf fishery resources beyond the fishery conservation zone.

"The 200-mile bill presents a great challenge to all of us," says Morris Pallozzi, Chief of the NMFS Law Enforcement Division. "It gives us the opportunity to protect the stocks and to increase the amount of fish available to our fishermen. Foreign fishing is not closed out, but is limited to those resources available beyond the capability of our own fleets."

During the summer of 1961 the Soviets used about 100 vessels in the northwest Atlantic, with only about 25 to 30 vessels actually on the grounds at any one time.

Photo: U.S. Coast Guard

(Above) LCDR John Potts studies vessel positions on the operations map. (Right top) CG-130 passes over a Soviet stern trawler. (Right) CG cutter Mellon keeps abreast of a Soviet factory ship.

They stayed about five or six months and then left.

"They came back in tremendous numbers in 1962," says Philbrook. "I think they sent practically anything that would float—little trawlers, medium-sized trawlers, stern trawlers, and all kinds of what looked like lend-lease transports.

"We sighted something like 900 to 1,000 vessels that year, but the total catch was only about 200,000 metric tons. This was due primarily to the gill net fishing they were doing. They had so many vessels that Georges Bank was almost covered with gill nets. It was a big mess. Our vessels got tangled up in their nets, and their own vessels also had trouble with the nets. The Soviets realized that this was a poor method and stopped using it. They really began harvesting in 1965 when they caught a huge amount of the haddock stock—80,000 to 100,000 metric tons, including a lot of little fish."

After 1965 other countries came to the Bank to fish. The Poles, East and West Germans, and some Japanese joined the Soviets on the rich fishing grounds. In the 1970's the Bulgarians, Romanians, and Spanish joined in. As the take of fish decreased, the foreign vessels began moving down into the middle Atlantic areas off Long Island and New Jersey, and eventually as far south as the North Carolina coast.

"They found large stocks of herring in the lower middle Atlantic areas and they fished heavily on them," says Philbrook. "It was nothing to fly 25 to 30 miles off Oregon Inet, North Carolina, and find up to 200 ships within a 20-mile area. Every ship was filled to the gunwales with herring. Like other species they became scarce, and now you find fewer ships in the area fishing for herring."

The species caught most recently in great

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numbers by the foreigners is mackerel. During the last three or four years it has been fished very heavily by some of the eastern European countries like Poland, Soviet Union, Bulgaria, and Romania.

"We've learned a great deal about the seasonal patterns of the fleets," Philbrook said. "We know when to expect the fish and when the ships will be after them. Just like the Japanese and the Spanish, they're after squid and can sell all they catch. Sometimes we have as many as 60 Spanish vessels fishing at any one time."

Philbrook says in the early 70's the agents would see about 1,000 individuals in a given year. In more recent years the numbers have dropped to around 800-850.

Prior to the arrival of the foreign fleets in the early 60's, the agents spent their time enforcing the laws governing the mesh size of nets used by domestic fishermen. "It was leisurely work," Philbrook says. "We would engage a Coast Guard cutter on a random basis, go out for four or five days, and board U.S. vessels on the high seas. When the foreign fleets appeared, it was decided that we should be the ones to monitor their activities. We were already using Coast Guard cutters and had some sort of a system established, so we were given this added responsibility."

He mentally compared the past and present. "In those days," he said, "we flew over Georges Bank, not really knowing what to look for, what they looked like, or how to report them. We flew about twice a month. Now the Coast Guard has 19 patrol vessels in the area assigned to patrol work. The patrols are normally two weeks, with a little overrun sometimes to two and a half weeks.

"We try to have an agent on as many of the vessels as we can," he continued. "If we don't have an agent on board, the Coast Guard handles the patrol themselves. In 1975 we were on something like 50 patrols and boarded around 600 vessels on the high seas. In addition to the sea trips, we flew over 180 surveillance flights, totaling more than 900 hours. Our agents traveled more than 125,000 air and over 91,000 sea miles in 1975."

The North Atlantic was not the only area that saw the invasion of the foreign fleets. "The foreign fishery expanded in the Gulf of Alaska in 1963," says James Branson, senior agent in Kodiak. "That was the real year of the explosion. The fleets began to fish along the Aleutians, the Bering Sea, and clear down to Oregon and Washington."

Although the foreign fleets depleted the stocks of fish, there were no laws to prohibit them from fishing along the coasts of the United States and Alaska. In 1964, the Territorial Waters Act was passed, prohibiting foreign fishing within three miles of the coast. In 1966 the Bartlett Act was passed extending these prohibitions to 12 miles and prohibiting foreign fishermen from taking creatures from the Continental Shelf of the United States.

Photo: J.J. Janka

(Top) Soviet factory ship preparing to receive catch from a small catcher boat. (Right) LCDR Potts keeps abreast of the world-wide CG operations.

Photo: U.S. Coast Guard

Both Coast Guard and the Service have the responsibility to enforce these laws and monitor the catches of some species that are regulated under the various treaties and agreements between the United States and other nations.

Perhaps the most well known of our 23 agreements with other nations created the International Commission for the Northwest Atlantic Fisheries (ICNAF). Its purpose is to investigate, protect, and conserve the fishing stocks of the northwest Atlantic Ocean.

By agreement of all members, quotas are placed on certain species found in the area covered. One of the major duties of the agents and the Coast Guard off the New England and mid-Atlantic coast is to inspect all vessels, including American ships, fishing under the ICNAF agreements.

In order to monitor domestic and foreign fisheries, the Coast Guard supplies aerial and vessel support to a small corps of 80 NMFS agents. Daily surveillance is maintained over thousands of square miles, with random trips over sparsely fished areas and more thorough criss-crossing over well-known fishing grounds. Almost all of these patrols carry an agent to furnish fishing ex-

Photo: Gerald P. Hill, Jr., NOAA

(Left) Japanese stern trawler bringing in her net in the Bering Sea. (Right) Soviet stern trawler fishing off the New England coast.

pertise as well as their knowledge of the many agreements.

The Coast Guard has many missions including search and rescue, merchant vessel safety, prevention of marine environment pollution, port safety and security, boating safety, and ice breaking. In recent years it has devoted increasing amounts of effort to fishery patrols. Vessel support to the fisheries teams is provided by 378-foot, high endurance cutters and 210-foot, medium endurance cutters, with flights made in the big four-engine C-130 aircraft, HU-16 amphibians and H-3 and H-52 helicopters. In the twelve month period from July 1974 to June 1975 the Coast Guard flew more than 6,200 hours and accumulated over 2,600 cutter days in fishery patrol activities—a 30 percent increase over the previous year's effort.

With establishment of the 200-mile fisheries zone, says Capt. Paul A. Yost, Jr.—operations officer for the 17th Coast Guard District in Juneau—"we are certainly going to have more action in fishery patrols law enforcement in the Alaskan region—and we would never send one of our ships on a fishery patrol without an agent if we had a choice.

"I can remember when I went out on my first fishery patrol as a skipper on one of our cutters," he continued. "I had spent my life learning how to skipper a ship and I was good at it, but I didn't know anything about fisheries. As I saw the agent come up the gangway, I said to myself, there is the guy who is going to teach me about fisheries and keep me out of trouble."

"Nationwide, our agents flew over 3,400 hours and spent almost 1,700 days at sea in 1975," says Pallozzi. "About half of the flight hours and almost 700 ship days were logged by our agents in Alaska." (Alaska has one-third of the entire U.S. coastline.)

"Our agents will probably tell you they spend 300 days each at sea," says Branson, with a smile. "Actually, most of them average 60 to 80 days at sea, with some going over 90 to 100 days. The patrols normally last 20 to 25 days and when they are not out at sea, they are flying two to three times a week."

This work load is necessary in order to put an agent aboard most ships and planes. The agents provide the Coast Guard with fishing expertise and are often the determining factor in deciding whether to seize a vessel.

With background in the legal implications of treaties, they assess the possibility of carrying through a conviction based on available evidence. Dan Russ, Chief of Law Enforcement for the Northeast Region, says, "We now have no trouble getting the U.S. attorneys to take the seizure cases. One reason is that our agents and the Coast Guard are so thorough in assembling evidence against the violators that they can almost be assured of a conviction if the case has to go to court. Because of such strong and well documented evidence, few countries have asked to go to court—they prefer to settle civil suits out of court to facilitate rapid return of the vessels to the fishing grounds."

The sea patrols are well planned by the Coast Guard and the Service agent who will be on the patrol. Typical was a planning session held in early March in Kodiak when the high endurance cutter Midgett prepared to go on a fishery patrol. Capt. Robert B. Bacon met with his executive officer, his operations officer, and NMFS agent Virgil Crosby to discuss the route, what they would look for, where they believed the foreign fleets would be, and what actions they would take when foreign vessels were sighted. Also attending the session was one of the Coast Guard fishery patrol officers from the air station, who briefed the group on what they had seen the day before.

"These sea patrols are sometimes boring," says Crosby, "but at other times they can be quite exciting. I guess the most danger occurs when we have to board one of the vessels and the seas are rough. We wait until the small Coast Guard boat rides to the top of the wave, and then we reach and grab the Jacob's ladder hanging down the side of the ship. If you grab it too soon, you are likely to be crushed between the two vessels as the small boat rises on the wave."

Many hours on shipboard are spent by the agent giving orientation briefings to members of the crew to assist them in becoming more proficient in species and gear identification and conditions of the agreements monitored. On some patrols agents are called to the bridge many times during the night to identify fishing vessels.

Over 640 air patrols covering more than 500,000 miles were flown by the Alaskan agents in 1975. Most are flown in the Coast Guard's C-130's and sometimes extend from the air station in Kodiak out to the international dateline and back—approximately 2,500 miles. On these flights the agent

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photographs each vessel sighted, notes the nationality, the name and the number, and its activity.

"We do this while flying at about 280 knots 350 feet over the ocean," says Branson. "We normally make one pass and obtain all the information at that time with the help of the pilot and the lookouts on the plane. We have to be accurate and get it in one pass or we wouldn't be able to cover all the area that we have to cover on each one of the patrols." In a year's time the agents in Alaska will make over 6,000 sightings, frequently spotting the same ship several times. Altogether they see about 700 different vessels in a year's time. This compares with approximately 6,700 sightings and 1,200 individual ships seen off the Atlantic coast during the year.

National Marine Fisheries Service agents perform a full range of law enforcement activities, many of which require that they be exposed to personal risk and the danger inherent in the enforcement of criminal laws, frequently in a hostile environment. In 1975 special agents of the southeast region received commendations from the State Department for their outstanding involvement in the pacification of a number of conflicts.

"We had shooting incidents between U.S. and Bahamian lobster vessels," says Charles Fuss, special agent in charge of law enforcement in the southeast region, St. Petersburg, Florida. "It was necessary to send out some of our agents with the Coast Guard patrols on a regular basis up and down the Bahama fishing banks for about three years to settle the problem. They exercised a high level of tact, discretion, and good judgment in their dealings with the people."

Qualifying as a fishery agent takes training and a high degree of skill. Most agents are required to attend the Federal Law Enforcement Training Center in Glynco, Georgia, for eight weeks' training. New agents complete their training by spending much of their first two years accompanying senior colleagues.

The Coast Guard is also stepping up its training for its increased efforts in fishery patrols. In the past it has conducted one week training sessions on the east and west coasts. This year, they are being increased to two weeks. In addition, the various Coast Guard districts conduct three-day training periods on fishery matters. Cdr. T. E. Deming, Chief, Maritime Laws and Treaties Branch of Coast Guard Headquarters says that among the best training they get is that

Photo: Robert K. Brigham, NOAA

(Top) Agent Charles Philbrook on patrol off the New England coast. (Right) Agent Ken Kramer checks the catch of a Japanese trawler.

conducted by the NMFS agents on the ship while out on patrol. Deming feels that the on-the-scene, area-oriented instruction is most important in their training.

The Coast Guard and the Service agents conduct two types of boardings—enforcement and courtesy. Enforcement boarding occurs when authorized by treaty or agreement when there has been an apparent violation of U.S. law, treaty, or convention. The armed Coast Guard personnel and the agent have a right to board the vessel without the captain's permission.

When it appears to the boarding party that a vessel has violated the law, the captain of the Coast Guard cutter is notified by radio. This information is then transmitted by the cutter to the Coast Guard's headquarters operations room in Washington, which is manned around the clock, 365 days a year. Coast Guard operations then notifies the Chief of Enforcement in the Fisheries Service and the State Department that there has been a violation of the law and that they intend to seize the ship. If neither has an objection, the captain of the cutter is notified and he makes the decision on seizing the ship.

More frequent are the courtesy boardings to visit a fleet commander, to visit a vessel of a country that has no agreement with the United States, or visit a ship that is under an agreement but does not require an enforcement boarding under the circumstances. In these cases the Coast Guard and the agents must have the permission of the captain of the vessel to board. Courtesy boardings give both parties the chance to meet and discuss any questions either side may have about the laws, treaties, and agreements. It also gives the agent the opportunity to gain information about the vessel and its intentions, and to establish rapport while in a friendly atmosphere.

"Two years ago it was almost impossible to board a Soviet vessel fishing off the northwest coast," says Wayne Lewis, Chief

of Law Enforcement for the Northwest Region in Seattle, Washington. "Last year things began to change and we were able to board 20 to 25 vessels. We find the face-to-face contact has helped us immensely in finding out what the Soviets are doing. I normally meet with the expedition commander and the fishery technologist and discuss our bilateral agreements in detail with them. We try to iron out any potential problem areas before they develop.

"Two years ago we had a lot of trouble with their ships running through other people's gear," he continued. "Last year we had very few instances of this type and like to feel that our talks with the Soviets had something to do with the reduction of incidents. One of the expedition commanders told me 'If you see a violation, come get me and we will inspect the vessel; they won't hide anything from me.' They are good people to work with."

"We get a great deal of information from courtesy boardings," adds Russ. "Each of our agents who boards a foreign vessel makes a detailed report on the amount of fish, the kind of gear, and so on. These reports are critically important in helping us determine the amount of any particular species that has been taken and the total amount of fish any one country is taking."

Bert Larkins, fishery research biologist at the Service's Northwest Fisheries Center in Seattle, also finds the information gathered by the agents to be very useful in international negotiations. "We use the data gathered by the agents to verify the information given us by foreign countries," Larkin says. "I remember when the representatives of one foreign country denied they were even fishing for a particular species—there was quite a difference between what our surveillance reports said and what they said about what they were catching. We showed them page after page of our reports giving them dates, times, locations, and ship names and numbers that our agents had seen and photographed. Well, with that evidence and our inability to reach agreement on a number of the issues, these negotiations ended. Later on, negotiations were resumed, and they gave us additional statistics that verified what our agents had reported, and agreement was reached," said Larkin. "The country was so impressed with our records and reports they asked to be put on our mailing list so they could have a better idea of what their own ships were doing. I think that says a lot for the validity and the value of the information collected by our agents and the Coast Guard."

Foreign ships are seized when they are caught fishing inside the 12-mile limit or taking creatures of the Continental Shelf. One such seizure occured in January of this year. Ralph Levie, Special Agent in the Gloucester office, was on a two-week patrol on the Coast Guard cutter Chase out of Boston. "We had been boarding vessels on the high seas to assess their catches. Prior to boarding the 260-foot Cuban vessel Golfo de Tonkin, we noticed that the angle of the cables dragging the gear looked as though the vessel was fishing on the bottom or close to it. Because of this we thought the vessel could be taking creatures from the Shelf and would be in violation of the law.

"We boarded the vessel about 10 a.m., and as they hauled in their nets we could see they were using gear designed to fish on or near the bottom. They opened the net and dumped the catch on the deck. We noticed lobsters among the fish. Under the law, fishermen are required to return them to the sea as soon as possible and with as little damage as possible. We watched the lobsters go along a conveyor belt to the processing stations without any attempt to return them to the sea. We had a man stationed in the processing area and he also noted that they were keeping the lobsters.

"We watched the process for about four hours, took pictures of the entire process, and notified the Commander of the Chase of our findings."

After the ship had been detained for about six hours, word came from the skippet of the Chase that it should be seized. "The Coast Guard put on a crew of about 20 men and we rode the ship for two days into Boston," says Philbrook. The ship was fined $40,000 for the violation.

The number of ships seized and the amounts of the fines imposed rose drastically during 1974 and 1975. In 1974, 13 foreign vessels were seized and fined a total of $1.2 million. In 1975 the number rose to 21 with total fines of $3.7 million. As of this writing, the largest fine ever imposed on a vessel was against the Japanese Eikyu Maru #35 for fishing within the contiguous fishing zone off Alaska in November 1975 —$600,000. Another Japanese vessel was fined $580,000 for the same offense in Alaskan waters in March of 1976. Since 1967, more than 80 vessels have been seized and fines of more than $10.7 million have been collected by the United States.

When a vessel is signaled to halt so that it may be boarded, and does not stop but starts to run, "hot pursuit" is begun by the Coast Guard. In order to make a case stick, the Coast Guard must keep the vessel under visual observation from either aircraft or ship during the pursuit. If the observation is being made by an aircraft, it must stay on station until relieved by another aircraft and this continues until a cutter can catch the fleeing ship, make it stop and put a party aboard.

Some seizures have taken up to 20 hours to effect; to end the chase, the assistance of additional vessels is occasionally required. With a number of ships already attempting to outrun Coast Guard captors and sure fines, and the chance of possible increases in would-be escapers, boarding agents will find their ingenuity increasingly tested.

Eugene Fidell, in the Coast Guard periodical, *Proceedings,* tells of a case found in Richard Hill's "Rules of Engagement" in which the British Coast Guard used a psychological approach to outmaneuver an opponent in bringing about a seizure, the like of which has yet to go into U.S. annals:

> "The British, plagued with enforcement problems, developed a special operation in the late 1960's. 'A particular Belgian trawler was known always to be nibbling at the six-mile exclusive limit in the Thames Estuary. One day, after much frustration, a British coastal minesweeper put into execution a carefully laid plan of arrest. It involved several pieces of psychological warfare, a fast approach and a physical interposition by the warship; but the clinching move, at the moment of impact, was the firing of a round of Bofors break-up shot in the direction away from the trawler at the same moment as a well-directed top-size King Edward potato went through his bridge window. This ensured immediate surrender, and the skipper, muttering the Flemish or Walloon for It's a Fair Cop, was fined some princely sum like £ 50 in an English Court.' "

Even though most ships will indicate cooperation, this does not necessarily mean a prompt seizure, as discovered by the fisheries team trying to take the Ryusko Maru #5. After the air patrol spotted the Japanese vessel deploying her nets off Alaska in 1972 and gave a message to stand by for boarding, she complied while the following took place:

The airship circled waiting for a Coast Guard cutter for nearly two hours, until it began to run out of gas. A second plane came as replacement, permitting a return to shore. When the relief plane developed engine problems, the first plane refueled and returned to replace his replacement. Finally, hours later, a cutter arrived and successfully negotiated the seizure which led to a subsequent fine for fishing within the 12-mile limit.

What impact will the new 200-mile fishery zone have on the enforcement activities of the Service and the Coast Guard? NMFS and the Coast Guard have studied various enforcement and surveillance systems to determine the most efficient and least costly means that can be used. Radar and sophisticated navigational equipment are now used for detection, and other sensitive equipment such as satellites and remote sensing devices are being considered. Recruiting additional agents and an expanded training program are being considered.

At the time of this writing, the Coast Guard plans to reactivate four retired Defense Department planes and put its last five spare short-range helicopters into service on cutters equipped with a flight deck, in order to extend patrol detection and surveillance capability. Three Coast Guard cutters will be reactivated, though they are 30 years old and not equipped to handle helicopters; a fourth, an ocean-going buoy tender, will be retired. With the possibility of more foreign national contacts, attention will increasingly focus on the agents and their Coast Guard colleagues. The need for diplomacy, language ability, superior and exact fisheries expertise and thoroughness will continually increase. The Coast Guard and NMFS intend to be ready.

NOAA and the Coast Guard keep

A Watch on the Bering Sea

"I have a contact—straight ahead," barks out the radarman.

"About time," says the pilot. "I was wondering when we would pick up the fleet . . ."

"There she is! A Japanese stern trawler." This from NMFS fisheries agent James Branson.

"Time to drop down to take a closer look," says the pilot, Lt. Cdr. James Wright, as he noses the big jet down to about 350 feet above the choppy sea.

Branson—senior fisheries agent in Kodiak, Alaska—readies his camera as we rapidly close on the vessel at 280 knots. Radar reports another contact, to the right of the ship we're looking at and about four miles away.

"O.K.," Wright says, "we will get this one first and then slip on over and pick up the other one."

As we approach the Japanese ship, we can see that she has her nets over and is trawling through the choppy seas. The pilot alerts the lookouts in the cargo section of the plane.

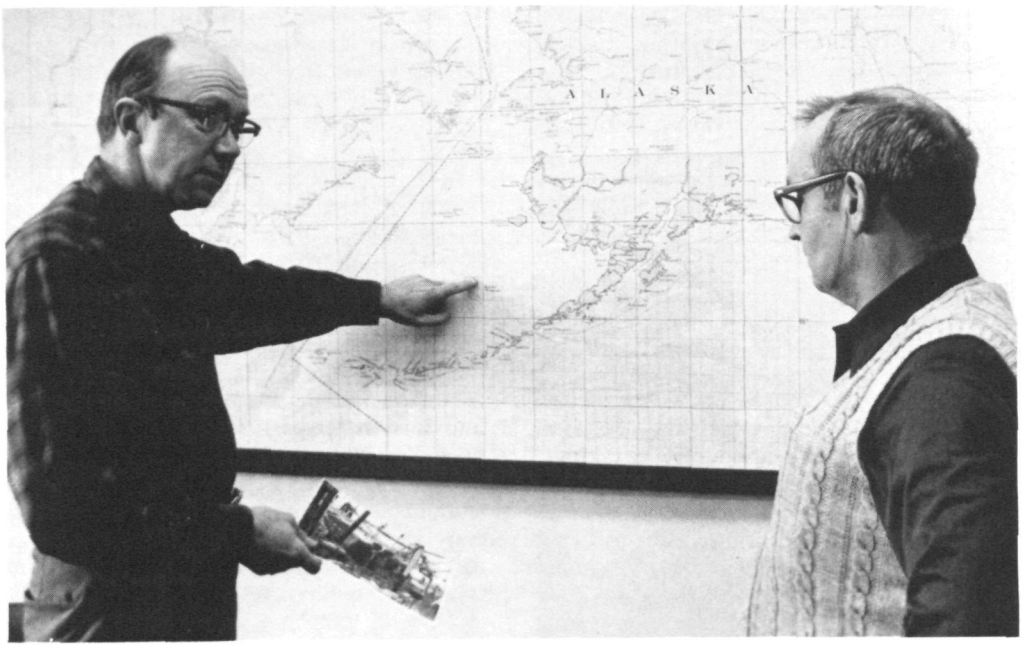
Each ship that is located on the patrols is photographed and the Fishery Service agent records name, number and exact position of the ship as determined by the airplane's navigation equipment.

During the pass on the ship, everyone watches closely to pick up its name and number. Branson shoots the picture with his motor-driven camera and begins his log, which will have more than 40 entries before the flight is over. He also jots down the activity of the ship at that time—fishing.

The process is repeated as we fly over the other ship spotted by the radar. It, too, is a Japanese stern trawler.

We were on one of the many fishery patrols conducted jointly by the National Marine Fisheries Service and the Coast Guard to locate and identify the foreign fishing vessels that come singly or in great fleets to

Ed. note: Gerald Hill, NMFS Public Affairs Officer, researched his article on Coast Guard-NMFS enforcement activities by talking to Coast Guardsmen and fisheries agents at remote airfields, in crowded offices, on a Coast Guard cutter and Coast Guard aircraft—in locations from the ice-choked Bering Sea to Gloucester, Massachusetts. This is his story of one flight with the enforcement agents.



(Top) Senior agent James Branson (left) briefs agent Virgil Crosby on Bering Sea patrol. (Below) Lt. Cdr. James Wright, Morris Pallozzi, Lt. Cdr. Jeff Hamilton and Branson study route on chart. (Right) Soviet liner delivering new crew to trawler.

noaa and the coast guard

fish off the shores of Alaska year round. Also on board today is Morris Pallozzi, Chief of the Law Enforcement Division of the National Marine Fisheries Service.

Our patrol today will take us down the Alaskan peninsula to the southwest as far as Unimak Pass and then to the northwest along the 100 fathom curve which contain some of the richest fishing grounds in the Bering Sea—a nine-hour flight covering more than 2000 miles.

Earlier in the day, in the operations room of the Kodiak Air Station, we joined the two Coast Guard aviators who are flying the mission. Lt. Cdr. Wright and Lt. Cdr. Jeff Hamilton are veterans of many fishery patrols in the Bering Sea and serve as the Coast Guard fisheries patrol officers for the Kodiak area. At the Air Station, Wright briefed us on the weather and then he and Branson poured over the chart as they discussed the route of the patrol.

"Weather is showing a front sitting right in the middle of the route that we were planning on taking," Wright noted. "I think we will go on out and see what the weather is like when we get there—maybe the front will have moved by then or we may be able to go on through it. We'll see what happens after we get in the area."

The crew on the big four-engine C-130 consists of the pilot, co-pilot, flight engineer, navigator (who is also radarman), and the radio operator—all on the flight deck. In addition, there are observers on each side of the plane down in the cargo section. The fishery agent normally sits just behind and a little to the left of the pilot, where he has an unobstructed view of the area.

On our way out to the fishing grounds, Branson describes the fishing vessels used by the Russian fleet. "The Russians use

several types of ships up here. The smallest unit they have is 125 feet long and built without any refrigeration, although some of them have added it. Generally they work with a factory ship. The next size is a medium fishing trawler which has a freezer on board. They run about 178 feet and can work up to 130 days by themselves. They can freeze and box their catch and store it in the hold. They process different species in different ways. Some of them they head and gut; others they freeze in the round. Usually these ships work with a factory ship if there is a large number of fish in the area."

As we move off to the northwest, we pass easily through the weather front as Branson continues his description of the Soviet fishing vessels found in the area.

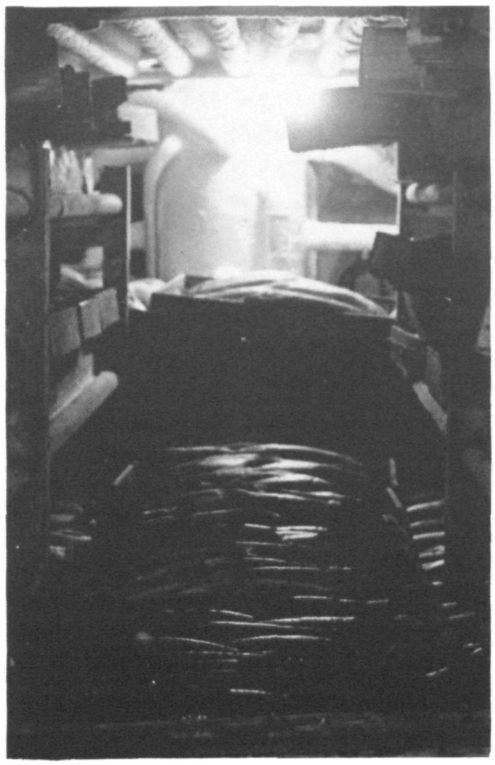
"Then you jump up to the whopping big factory stern trawlers—up to 500 feet. These are fishing and freezer trawlers that can work for 90 days without support. However, they do need to unload their catch because they don't have enough hold space to store their catch. They will fish for a while and then unload onto a refrigerated transport that takes the fish back to the Soviet Far East."

Below us now is a Japanese crab factory ship moving off to the northeast. "That's the Koyo Maru," says Branson. "She is just moving into the area and will start her operations in 40-50 fathoms of water about 250 miles northeast of here. I suspect the Kako Maru is somewhere close by. They were both seen north of Amchitka five days ago."

"Many targets ahead," says radar. We are now above a large concentration of Russian and Japanese boats of all sizes. For the next 45 minutes we make pass after pass over the ships, taking pictures, getting names and numbers, and noting their activity.

"You usually see several types of support vessels with the Russian fleet," continues Branson. "Normally they have a tug and a patrol vessel with any large concentrations of fishing vessels. The patrol vessels are relatively new. We didn't see anything like them for a number of years until we started catching those guys and running them through court.

"After the fines got fairly heavy, every concentration of Soviet ships had a patrol vessel with them to keep them out of trouble. Funny thing though, we have never been able to board one of those patrol ves-



(Top) Pollock and tanner crab on Japanese factory ship. (Above) Frozen salmon in the hold of a Korean vessel. (Right) Branson checks the cargo of a Soviet factory ship.

sels and talk to the people. They are the Russian version of NMFS agents. You'd think they would be as anxious to talk to us as we are to them."

"I think we should take a look at the ice cap," Wright says as he banks the plane off to the northeast. As we near the ice cap, we notice the water beginning to calm as the ice begins to appear, first in long streaks, then in clumps, and finally as we near the cap, in large sheets. The edge of the ice cap is like a shoreline, very distinct and clear cut.

With the ice comes a hazard that is well known and respected by all who fly in the north—"white-out." A white-out is an atmospheric-optical phenomenon of the polar regions where neither shadow nor horizon nor clouds can be seen. As we fly over the cap, everything turns white, our sense of depth is lost, and it is very difficult to determine where ground stops and sky begins.

"You watch the instruments and I'll watch the ground," Wright tells his co-pilot.

Although we are only 400 feet or so off the ice cap, it's hard to see the ground as we fly through the white haze. We do spot two ships, side-by-side about 1,000 meters from the edge of the ice cap.

"These ships come up into the ice to transfer their cargos," says Branson, "because the seas are calm in here and it is easier to make the transfer.

"I think we had better get out of this area," Wright says. "I don't see anything else up here and I don't like to be in this white-out condition for any length of time."

Flying southwest towards St. George Island in the Pribilof Islands, we ask Branson about the number of ships that are seen in the area now as compared to earlier years.

"The number of ships has decreased but the efficiency of those that are here has increased. The Soviets have gone from a lot of small units to some that are only a little larger but much more efficient. The Japanese have done the same thing.

"The main species taken by the foreign fleet up here is pollock and I estimate the fleet takes a little over four billion pounds each year. Then they take almost another billion pounds of other species. Pacific perch was a real big fishery up until 1965 when they literally destroyed the resource both in the Gulf of Alaska and the Bering Sea. They are still taking on the order of 120,000 tons incidentally to fishing for other species. Black cod and turbot are other target species. The Russians started fishing for Atka mackerel about three years ago. We hadn't realized there were that many of them around until they started a fishery for them. They aren't a particularly good fish but it apparently is a resource of some size."

As we cruise along at 1,000 feet several miles off St. George Island, we see the barren, snow-covered, wind-swept island that is famous for its seal population. No seals today, however, because they don't appear on the rookeries until spring. We do see the tiny village of snow-covered houses without any sign of life.

The weather becomes worse as we move westward from St. George. Winds have picked up to 50 knots and the seas are running close to 20 feet. Even in the high seas and strong winds, we find another group of Japanese and Soviet vessels fishing. We see one Japanese stern trawler dragging downwind with water slopping clear up on the main deck to the wheelhouse.

"I'm surprised to see the Russians still fishing in this kind of weather," says Branson. "They don't normally fish when it gets this rough. The Japanese are different—there's just no quit to those people. They bring their big fleets out here where there is one factory ship and perhaps 25 trawlers. They catch and process up to 1,200 tons of fish a day. They have two 11-hour shifts with the fishing boats working from dawn to dusk and beyond, seven days a week, regardless of the sea state." He paused, and reflected on some of the events of that wild and wintry part of the world. "The Japanese are really fishermen and sailors," he continued. "A few years back, the Japanese lost five of their catcher boats. They were fishing in such heavy seas with waves so high that the ships would go to the top of a wave and straight down, either by the bow or the stern. The next year some of their trawlers picked up some of the bodies in the same area—they had hardly moved at all."

The airplane is buffeted as we bank and turn to get the pictures of the group of ships. Wright and Hamilton make it look easy, but we recognize the high degree of skill required to maneuver the big airplane among the ships in such high winds at an altitude of 400 feet.

"Time to start home," says Wright as he gets a status report on the fuel supply from the flight engineer. Although the patrol was scheduled to go almost to the international dateline, we won't make it today because the weather is getting worse and we have used much of our fuel making passes over the many ships that we have seen during the day.

We climb to about 20,000 feet and start the long trip back to Kodiak. As we drone towards home, we go back with Branson and Pallozzi into the cargo area. Branson begins filling out the reports required after every patrol.

Nine hours and over 2,000 miles later, we touch down at Kodiak, ending another of the hundreds of joint National Marine Fisheries Service/Coast Guard fishery patrols.

Chartmaking-- A Two-Way Street

Mariners of every description, from the humblest weekend sailors to skippers of giant oil tankers, benefit in many ways from the traditional close cooperation of the U.S. Coast Guard and the National Ocean Survey. Every knowledgeable boater carries his nautical chart with him on his craft, and much of the information on these charts is provided by the U.S. Coast Guard Auxiliary and the U.S. Power Squadrons. Under a 1962 agreement, the members of these organizations maintain a close surveillance of charted waters, for changes that might have occurred since the chart surveys were made or the charts printed. Their comments and suggestions are forwarded to the Survey for use in updating later editions of the charts.

In return for this invaluable assistance, NOS provides copies of the latest editions of the charts, related publications, reporting forms, and instructions. For their helpful cooperation, NOS also annually presents awards to individuals, flotillas, and district leaders.

Supplementing the nautical charts with much more detailed information are the NOS Coast Pilots, which also reflect a great deal of information provided by the Coast Guard and its auxiliary. For big-ship captains, the Coast Guard prints Notices to Mariners, which use information obtained from NOS on hazards to navigation including overhead cables and bridges, wrecks, obstructions, depths, and controlling depths in channels.

Hydrographic and topographic survey units of the National Ocean Survey furnish the Coast Guard the positions of fixed aids to navigation, during survey operations, and also notify the Coast Guard of defects they may detect in the floating aids to navigation maintained by the Coast Guard.

Close coordination is maintained by the two organizations in the automated plotting of LORAN A and C lines of position on nautical charts, as well as in the display of other electronic aids to navigation. The Survey also provides the positions of landmarks and reference stations for use by USCG buoy tenders, which service and position the floating markers. For Coast Guard use in pre-determining angles for marker positioning, NOS furnishes charted positions of aids to navigation by digital plotter.

And for the fishermen, NOS provides chart overlays showing "fish havens" in relation to published Coast Guard Fish Haven buoys.

Teamwork by Coast Guard and NWS helps

Bring the Ships Home Safely

BY NANCY PRIDGEON

On any day of the year, at any time of the year, several thousand ships are at sea in the oceans of the world. Every one of them needs good, up-to-date weather forecasts to assure a safe voyage home. With the increased accuracy of weather instruments—the coming of age of weather science—and more rapid communications, they are getting weather forecasts more quickly and reliably than ever before.

The National Weather Service and the United States Coast Guard have joined hands to make this possible. The two services share a common goal—the protection of life and, where possible, property.

To achieve this goal, Weather Service constantly monitors the weather, issues forecasts and emergency warnings, and untiringly seeks ways to improve its services. The Coast Guard patrols the navigable waters of the nation—its ocean shores, its bays and inlets, its Great Lakes and inland waterways.

With ships and planes, the Coast Guard patrols far more than the Atlantic coastline it was originally directed to protect when Congress mandated it in 1790. Today's Coast Guard has responsibility for the offshore areas of the Atlantic coast, the Gulf of Mexico, the Pacific, Alaska and Hawaii. Coast Guard cutters ply the Great Lakes and patrol America's mighty rivers. While they are doing this, Coast Guard personnel perform an astonishing variety of related duties.

On the high seas, Coast Guard observers send back weather summaries, check ocean-positioned data buoys, and collect oceanographic information for scientists and researchers. From shore stations, they broadcast the National Weather Service marine forecasts, display daytime or night (light) warning signals for recreational boatmen, fishermen, and ships, and take weather observations to relay to the Weather Service's National Meteorological Center. In dire emergencies, the Coast Guard itself may issue emergency warnings, in accordance with its Weather Service agreement.

Dramatic rescues in pounding seas, lonely lighthouse vigils, and solitary foot patrols along deserted beaches are the stuff of the Coast Guard's well-deserved hero image. The other side of the coin is the quiet service it performs with weather instruments.

For more than a decade, the Coast Guard has operated the highly successful Automated Merchant Vessel Report (AMVER) system. AMVER is a computer-operated program for mutual assistance at sea. All vessels of all nationalities are encouraged to participate. By filing an AMVER message with the Coast Guard, the oceanbound ship records its time of departure, sailing route and method (rhumb line or great circle), speed destination and estimated time of arrival. It also gives other useful information, such as whether it is carrying radio telephones or facsimile, search radar or other SAR (search and rescue) capabilities, and whether there is a doctor on board.

(Above) Ocean Station HOTEL must maintain position no matter how the sea rages. (Right) Offshore Coast Guard towers collect weather and oceanographic information as they also serve as navigational warning stations.

The AMVER computer, located at the Coast Guard Station, Governor's Island, N.Y., can pinpoint the location of each ship at any time. The AMVER system makes almost every ship afloat a potential rescue ship.

In late 1975, an explosion and fire rocked the South Korean fishing vessel Kwang Myung as it sailed about 300 miles off the Oregon coast. Within two hours, Coast Guard C-130 long-range aircraft from San Francisco had located the burning ship. Two of the 36 crew members had been killed in the blast and two more were seriously injured. The crew was huddled at the forward end of the ship away from the fire.

There were heavy seas and strong winds, and the aircraft could offer little assistance. A storm was brewing—the weather would worsen as the day progressed. Because of the storm and the disturbance of the disabled ship from land, Air Force in-flight refuelable helicopters could not be used.

noaa and the coast guard

Photo: U.S. Coast Guard

noaa and the coast guard

The nearest Coast Guard cutter was at least 30 hours away.

A query to AMVER revealed four ships close enough to reach the burning ship before it sank. Nearest was the 556-foot British tanker, Anco Templer, on course from the United States to Japan. She was notified and immediately turned to the rescue. Five hours after the original distress call from the Kwang Myung, the Anco Templer had the stricken vessel in sight.

Anco Templer was fully loaded with petrochemicals. To approach the burning ship too closely was to risk catching the tanker afire. By now the seas were cresting with waves 15 feet high. The wind had reached 30 knots. The desperate fishermen launched life rafts and the rescue ship fired lines to them. As the Koreans were pulled aboard, the seas were breaking over the Anco Templer's other side. Within 30 minutes, winds had increased to hurricane speed.

"Had we waited, we would not have been able to get them aboard," the Anco Templer's captain said.

The Liverpool Underwriters' Association reports nearly a hundred weather-related casualties at sea each year, due to heavy weather, fog, tropical cyclones (hurricanes, typhoons, and tropical storms), heavy seas and wind. About 40 percent of the total number of ships involved break up or sink.

The Association estimates that 164 of the 886 major weather-related ship casualties from 1964 to 1973 accounted for nearly 2,500 persons missing or dead. Most of the marine accidents were in the Northern Hemisphere or in the Tropics. The most dangerous months were November through April. Two thirds of the casualties occurred near coastlines or harbors, with the other third occurring on the high seas.

In the case of a 557-foot oil-laden tanker, Spartan Lady, snow, sleet, high winds and 20-foot waves hampered rescue efforts when she broke apart about 165 miles southeast of New York.

Coast Guard cutters, C-130 aircraft and amphibious helicopters responded, as did a merchant ship in the vicinity that stood by to help. By the time 28 crew members were plucked from the stern section by helicopter and the remaining eight crewmen hoisted from the bow section, the two sections of the ship were five miles apart. Only one crew member died—of a heart attack. Coast Guard cutters remained in the area for two days to monitor the wreck. After the stern section sank, the bow section was sunk with gunfire.

NOAA Satellites Help Coast Guard Search-and-Rescue

Environmental information, observed from outer space by NOAA satellites, increasingly is becoming a vital tool in search and rescue missions conducted off the nation's shores by the U.S. Coast Guard.

In a number of instances, data provided by the GOES and polar-orbiting satellites have helped the Coast Guard find lost or disabled ships and aircraft quicker and with reduced search costs.

On some occasions, it is believed, the satellite-provided information may have meant the difference between life and death for occupants of the lost craft.

NOAA's involvement in the dramatic business of search and rescue at sea began about a year ago when it became apparent the satellites could provide information previously denied the Coast Guard in such detail; information that gave searchers a more precise idea of where to concentrate their search activities.

Many rescue missions begin when a vessel radios that it is in distress and needs assistance. Usually operations of this sort are relatively cut and dried. The Coast Guard knows where the disabled vessel is and can respond with ships, planes, or helicopters.

But frequently, the first indication a craft is missing comes when the vessel fails to arrive in port when expected. The ship, as far as those on land are concerned, has vanished. Where should search activities be concentrated? Where, in an area perhaps as large as several thousand square miles, might the lost ship be found?

A number of factors need to be considered. What have been the general weather and sea conditions since the vessel's last known position? In what direction and how far may the ship—if disabled—have drifted because of winds and ocean currents? How urgent is the situation? If the craft sank, are sea surface temperatures conducive to survival in the water, and if so, for how long a time?

Satellite imagery is invaluable in helping determine the answers to these questions. Not only can the pictures from space disclose conditions at sea when the lost ship was last heard from, they can update that information every half hour thereafter.

When a vessel or plane is lost at sea, the Coast Guard Rescue Coordination Center charged with conducting search and rescue operations can turn to the field stations of NOAA's National Environmental Satellite Service for assistance; stations in Washington, Miami, San Francisco, Honolulu, and Anchorage.

There, oceanographers and meteorologists, specially trained in satellite imagery interpretation and analysis, pull together past and current information on appropriate ocean and atmosphere phenomena for the general search area. Carefully they evaluate wind velocities and directions, activities of major ocean currents such as the Gulf Stream, low level cloud cover and fog data, sea surface temperatures, and other information.

From analysis of this mass of material, NESS personnel are able to suggest to the Coast Guard where search efforts might be concentrated with the greatest potential for successful completion of the mission.

How many lives have been saved by this added input? No one really knows. But the growing number of Coast Guard requests to NESS for assistance offers strong indication that NOAA's eyes in space are helping save lives at sea.

Photos: U.S. Coast Guard

The CGC Taney (above) warns of winter storms approaching the East Coast from the Atlantic Ocean. (Left) Bow section of the Spartan Lady is five miles from her stern section. (Right) Anxious crew members await helicopter rescue from the stern section of the Spartan Lady.

Since the mariners' most formidable foe is the weather, ships of all nations are encouraged to transmit weather conditions back to shore. Most oceangoing vessels do not carry a weather officer so weather observations are made by the captain and the deck officers at regular time intervals—usually every six hours. Many of these reports are transmitted by the radio officer to the National Meteorological Center.

The Weather Service's National Meteorological Center, at Camp Springs, Md., receives 2,500 synoptic reports daily from ships at sea. Included in shipboard observations are reports from the 53 Coast Guard cutters (high endurance cutters, icebreakers, fishery patrol vessels, reserve training vessels, oceanographic vessels, and some buoy tenders), whose radio operators report weather observations every six hours when underway.

At the National Meteorological Center, these observations are combined with 14,000 daily synoptic reports from land-based stations, 2,500 daily atmospheric soundings from radiosondes, 1,500 daily aircraft observations, 1,200 satellite temperature soundings, 500 radar reports, and 100 satellite photographs. Out of this mass of raw data comes new forecasts, and updates or modifications of forecasts already made. This flood of information into the NMC computers is almost completely automated. Information can be printed out at a rate of thousands of words a minute.

After analysis of the processed data is made by meteorologists and computers, the forecasting begins. NMC issues 72-hour forecasts twice daily, five-day forecasts once daily, and generalized 30-day outlooks twice a month. NOAA's largest computers solve in about an hour the thousands of equations needed to reach a 48-hour forecast for the Northern Hemisphere from the surface to 50,000 feet.

Completed NMC forecasts are speeded to weather service field units by teletypewriter and facsimile for guidance in preparing local forecasts. Local forecasts are teletyped to newspapers, radio, and TV, and in many places also put on the air on NOAA Weather Radio, which broadcasts continuously all day every day.

NOAA Weather Radio broadcasts include marine advisories from its forecast offices along the Atlantic, the Pacific, the Gulf of Mexico, Alaska, Hawaii, and the Great Lakes. Broadcasting continuously 24 hours a day, seven days a week, NOAA Weather Radio transmitters have a range of about 40 miles from each transmitter site.

NOAA and the Coast Guard

Many storms originate or greatly intensify just off the coasts or near land masses, so these broadcasts benefit not only merchant ships and commercial vessels, but ordinary citizens on a holiday—swimmers, weekend fishermen, and casual sailors.

As a supplement to the NOAA Weather Radio, the Coast Guard broadcasts National Weather Service forecasts four times a day, from stations strategically positioned on the nation's coastlines.

For instance, one Coast Guard station, Radio Washington / NMH, transmitting from a location near the nation's capital, reaches marine listeners in and offshore of the New England states, in the West Central and Southwest North Atlantic, and in the Caribbean/Gulf of Mexico offshore waters. It is a two-way radio system; mariners can both receive and send weather information. The broadcasts are also used to alert ships in the AMVER program to the location of a ship in distress.

Some ships are equipped with radio facsimile receivers to receive weather maps transmitted direct from the National Meteorological Center. These are broadcast in the same manner as other shore-to-ship radio transmissions, but in time, the signals will be beamed down from satellites, as is presently the case with many overseas telephone calls.

The Coast Guard presently has 54 broadcasting stations with short-range VHF-FM radio transmitters. Added to the National Weather Service's 60 or so coastally located NOAA Weather Radio transmitters, the stations almost blanket the coastlines. The Coast Guard performs a dual function of receiving synoptic reports and broadcasting the four-times-daily forecasts, while NOAA Weather Radio operates continuously, usually updating tapes every two to three hours.

Other weather infomation broadcasts available to the mariner include storm information for deep water vessels, added to National Bureau of Standards time signals that are broadcast worldwide over their stations WWV (Fort Collins, Colo.) and WWVH (Kauai, Hawaii). WWV covers the weather for the western North Atlantic and eastern Pacific; WWVH covers the North and South Pacific. The broadcasts from each station can be heard through completely in three minutes and alert mariners to storm threats. Regular marine broadcasts must then be tuned in for more details.

Through the efforts of the World Meteorological Organization (WMO), marine weather broadcasts are now available worldwide. Radiotelegraph, radiotelephone, radiofacsimile, radio teletypwriter and voice broadcasts span the world's navigable waters. The goal of the WMO and its member countries is that no ship with proper working equipment need ever be out of touch with land, nor sail blindly into danger.

A major watch-and-warning cooperative venture of the Weather Service and Coast Guard is Ocean Station HOTEL, located 200 miles east of Maryland's Atlantic coast from August to mid-April. Ocean Station HOTEL warns the Atlantic seaboard of the approach of winter storms that might cripple some of the nation's largest cities and industrial areas, were they caught unaware. No matter how foul the weather or how rough the seas, however, Ocean Station HOTEL must stick to its post.

Ocean Station HOTEL is usually the ship and crew of the Coast Guard cutter Taney—one of the Coast Guard's most historic ships. The 327-foot Taney, built in 1936, was at Pearl Harbor, December 7, 1941, and is the only veteran of that battle still in service.

Exceptionally stable ships, the Taney and her sister craft served as convoy escort flag

Photo: U.S. Coast Guard

Data Buoys: Thriving Offspring of The Coast Guard

When NOAA came into being a half dozen years ago, one of the organizations brought into the new agency was the National Data Buoy Center, now the NOAA Data Buoy Office, at the Mississippi Test Facility in St. Louis, Mississippi. The data buoy group came into NOAA from the Coast Guard, and the Coast Guard has continued to maintain especially close ties with NDBO, including assigning to it 15 officers full time (one of whom is the Deputy Director).

In addition, the Coast Guard provides extensive ship support including a dedicated ship—the USCGC Acushnet and crew—at Gulfport, Mississippi. Maintenance support for buoys is provided by the Coast Guard at its bases on the east and west coasts, as well as data communications support at Miami, Florida, and San Francisco, California.

By agreement with NOAA, the Coast Guard furnishes a wide range of ships and services to help in the work, including:

- Suitable vessels to deploy, service and retrieve buoys built for both test and operational purposes;
- Routine servicing and maintenance of buoys at sea;
- Aircraft services, when available, for test purposes, aerial inspections, and search operations inolving buoys; and
- Communications between buoys and NOAA-designated shore terminals.

NOAA Data Buoy transmits sea temperatures, wind speed, atmospheric pressure and other information to aid Weather Service in its forecasts and warnings.

ships, providing anti-submarine protection for supply vessels, during wartime. The Taney served during the Korean conflict and as a part of a Coast Guard squadron in Vietnam. When she is not serving as Ocean Station HOTEL, Taney often participates in search and rescue operations, both in the Atlantic and the Pacific. Even during her duties as a weather outpost, Taney sometimes is called upon for rescue at sea.

Ocean Station HOTEL occupies the full time of two ships—one to patrol and one bring supplies or fresh crews. The Coast Guard estimates the cost of Ocean Station HOTEL to be $4.5 million annually.

The high-endurance cutter Taney is the only station left of several ocean weather patrols of the past. With the advent of satellite images and sounding and increasingly sophisticated data buoys, manned ocean observation ships were replaced by large buoys capable of automatic sensing and transmitting ocean data—sea temperature, winds, pressure and other information needed for forecasting.

One of the NOAA data buoys, in place in the Gulf of Mexico, alerted Weather Service forecasters to the intensity and storm surge potential of Hurricane Eloise as it headed for the Florida mainland this past year.

Also last year, a Large Navigational Buoy (LNB)—dubbed "mechanical monster" by Coast Guard personnel—replaced the famous Boston lightship. These LNB's have all the warning capabilities of lightships. They are equipped with a fog signal and a beacon, and emit a signal that can be picked up for 100 miles, and a radio beacon with a 50-mile range. Weather Service wind speed remote sensing systems are installed on some of the LNB's, and are eventually planned for all.

The very first Weather Service forecasts however, were made not for ocean conditions but for Great Lakes weather. Great Lakes ice storms and frozen shipping channels had long been a concern of mariners in the nation's largest inland waterways.

Traditionally, ore boats and other Great Lakes commercial vessels could expect the shipping season to end during the cold winter months. Few cared to venture out and risk being icebound. The introduction of icebreakers—ships built to plow a path through frozen waters—kept the channels open longer. But there was a real problem in estimating the thickness or consistency of the ice that lay ahead.

In the early 1970's, efforts were stepped up to extend the Great Lakes shipping season. "Project ICEWARN" was initiated in 1974—a joint project involving the Coast Guard, NOAA's National Weather Service, Environmental Research Laboratories, and National Environmental Satellite Service, and the National Aeronautics and Space Administration (NASA).

Using the NASA Side-Looking Airborne Radar (SLAR)—a way of "seeing" a surface obliquely which varies the perspective—scientists are learning to use the new information to estimate the kind and depth of the ice covering the lakes. Coupled with satellite photos and surface weather observations, the data promise to add a new dimension to Great Lakes shipping.

Scheduled to continue for at least another year, the project has already reported measurable success. For the first time in its history, the Coast Guard reported the maintenance of open shipping lanes in the Great Lakes for the entire year of 1975.

To assist in its icebreaking duties, the Coast Guard reported the delivery in January, 1976, of the first new icebreaker it had acquired since 1954—the Polar Star. The Polar Star, and her sister ship, the Polar Sea, still under construction, are the largest and most powerful icebreakers ever to sail under the American flag. Each is more than 400 feet long and displaces about 12,200 tons.

With its 250 ships, 160 aircraft, 2,000 small craft and 37,000 active duty personnel, the Coast Guard collects thousands of observations that become a part of National Weather Service publications. The monthly "Mariners Weather Log," prepared by NOAA's Environmental Data Service, and "gulfstream," prepared by Weather Service's Ocean Services Division, are greatly assisted by Coast Guard data. The Weather Service's "Weather Marine Services Charts," published and distributed in cooperation with NOAA's National Ocean Survey, are used by yachtsmen and merchantmen alike to pinpoint the location of each Weather Service or Coast Guard marine weather advisory service available.

At a recent Marine Data Acquisition Conference held at Weather Service Headquarters in Silver Spring, Md.—which included participants from major line components of NOAA, Department of Defense, Department of the Navy, Department of the Air Force, Canada's Atmospheric Environment Service, the National Weather Service and the Coast Guard—Cdr. Martin Moynihan, chief of Coast Guard's Marine Science Branch, summed it all up.

"The Coast Guard's cooperation with the National Weather Service covers a broad spectrum of weather collection and dissemination," he said. "Our main concern is to continue to maintain the high quality of weather observations and the rapid communications that are necessary for this program. This is relevant because the Coast Guard uses the National Weather Service forecasts in conducting its missions in the marine environment."

The World Ocean Is Their Laboratory

The U.S. Coast Guard is protector and patroller of the nation's coastal waters and consequently is vital to all marine activities. But it helps out in many other ways that are not so well known. For instance, it lends ships and aircraft to NOAA's Environmental Research Laboratories, and sometimes participates in NOAA research projects.

Oil spills are an important case in point. ERL and USCG have cooperated on several aspects of this problem.

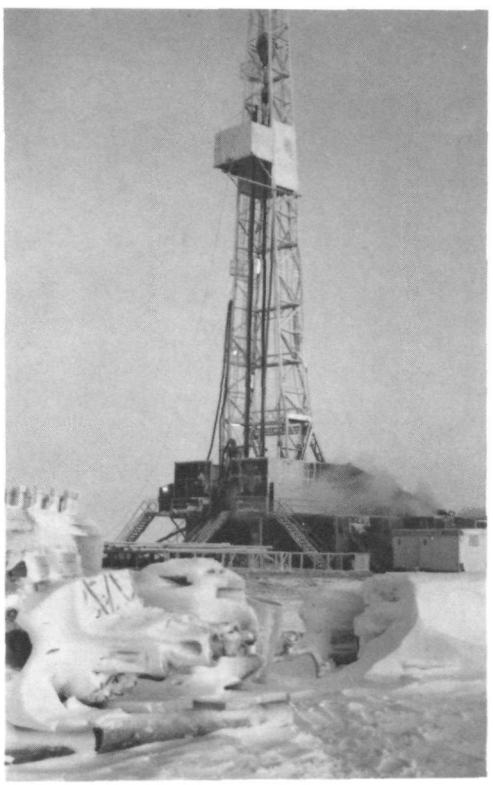
When the supertanker Metula went aground in the Straits of Magellan nearly two years ago, a team of scientists from NOAA's Marine Ecosystems Analysis program office, the Environmental Protection Agency, and Coast Guard began a detailed study of the impact.

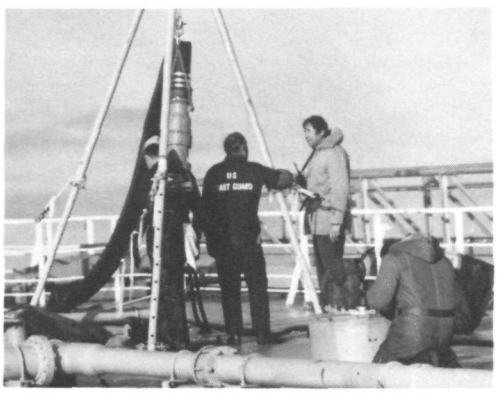
At the request of the government of Chile the Coast Guard had helped pump much of the Metula's unspilled oil onto smaller tankers. A Coast Guard consultant, Dr. Roy Hann of Texas A&M (now Director of the Texas A&M Sea Grant Program), was the first scientist on the scene to make a preliminary evaluation of the ecological damage. Later, Hann, Charles Gunnerson, head of the Marine Ecosystem Analysis program, and two others went to the Straits of Magellan to study the second biggest oil spill ever.

The group surveyed the extent of the oil, made bird counts, and collected soil, sediment, and tissue samples (from mussels), to be tested later for petroleum hydrocarbons. The Coast Guard provided samples of oil from the Metula for comparison with hydrocarbons found in the tissue and soil samples.

The Coast Guard plays an important role in a major NOAA study of the ecological effects of oil drilling in the Gulf of Alaska. The Environmental Research Laboratories' Outer Continental Shelf Environmental Assessment program office is conducting the study for the Interior Department's Bureau of Land Management.

Coast Guard participation ranges from providing radio communications to carrying out research studies. The Coast Guard Radio Station Barrow provides communications links with NOAA ships in the Gulf. The NOAA researchers needed a 24-hour radio watch in this hazardous area throughout their operating season, March 1 through November 30. The station normally operates for a shorter period, but the Coast Guard has extended its coverage for the NOAA project.





Looking into oil's impact on the environment is a common concern of NOAA and the Coast Guard, from Alaska's North Slope (l.) to the Metula oil spill in the far-south Straits of Magellan (rt.).

With drilling on the Continental Shelf will come increased danger of oil spills. It is important to know, therefore, the current patterns in the waters, to help predict the path of any spills.

This summer, a Coast Guard oceanographer is making a study of the surface water motions in the northern Alaskan shelf region as part of the NOAA project. He studies currents in the top meter of water and the way the water moves along the edge of the pack ice, to develop a model for predicting surface water movements in the Beaufort Sea continental shelf.

Though the study will be conducted in late August, pack ice can encroach any time on that part of the Beaufort Sea, so the Coast Guard icebreaker Glacier will be used. From the ship, a team led by Gary Hufford of the Coast Guard's Research and Development Center in Connecticut will deploy expendable current probes between Barrow Point and Demarcation Point along Alaska's North Slope. The probes will be launched from the ship's helicopter as it hovers less than 50 feet above the water. After dropping a probe, the oceanographers will take the helicopter up to between 600 and 1,000 feet, and photograph the movements of the dye patch released by the probe. Pictures of how the dye spreads, combined with records of the helicopter's altitude and position, will be used to calculate the speed and direction of the currents.

The group will make 80 transects of the 300-by-40-mile study area, dropping ten dye probes on each transact. The ship's crew will also make continuous weather measurements and set up portable weather stations along the coast during the study.

Scientists with the Coast Guard and the NOAA Outer Continental Shelf project are presently working out a plan to study oil spills in the Gulf of Alaska. The Coast Guard, which is responsible for cleaning up spills and would be among the first to hear of one, would notify the NOAA scientists when a spill occurs. A NOAA team would then rush to the site to study the spill. The aim of the investigation will be to test a model that Dr. Jerry Galt of ths Pacific Marine Environmental Laboratory is developing to predict the course of oil spills under various environmental conditions.

On the opposite coast, in the New York Bight, Marine Ecosystems Analysis program researchers have high praise for the cooperation they have received from the Coast Guard. There, NOAA scientists are studying the marine environmental effects of the dense population in the New York metropolitan area.

"The spirit of cooperation has been outstanding" says Charles Parker of the MESA New York Bight program. "They have given us ship and aircraft support at bargain rates, and sometimes gratis."

Coast Guard helicopters and amphibious aircraft have been used to drop bottom drifers for current studies in the Bight. These simple devices float near the bottom of the Bight, some eventually drifting ashore. Each carries a postcard on which the finder is asked to fill in the place and time where it was found and mail it to project headquarters. The Coast Guard's navigational system is very precise, so it is possible for the researchers to know exactly where each drifter was dropped.

The Coast Guard also lends the services of helicopters for collecting water samples. As the helicopter hovers over a selected site, a sampling bottle is lowered into the water on a line and then retrieved. Both helicopters and Coast Guard ships were involved recently in a major multi-platform test to evaluate remote sensors. A wide variety of sensors were flown over the Bight, while helicopters and ships made actual measurements at the surface of the water.

An essential part of the NOAA study is to keep track of materials that are dumped into the Bight, to see where they go and what their effects are. Here, the Coast Guard's responsibility for enforcement of dumping regulations comes in handy. Anyone dumping materials into the Bight must report their activities to the Coast Guard, and the Coast Guard in turn provides these data on request to the NOAA scientists.

The cooperation works both ways, of course. The Coast Guard has a representative on the user panel of the formal advisory committee that oversees the New York Bight project. Through him and in other, informal ways, much of what is being learned about the Bight is passed on to the Coast Guard. Current and water property measurements, for example, provide valuable input to ocean models that the Coast Guard uses to guide their search and rescue program.

"These are just some of the highlights that come to mind," says Parker. It would be difficult to recount every occasion when the Coast Guard has helped out in the New York Bight. The same can probably be said for all the Environmental Research Laboratories' marine programs.

Waterfront Service With A Smile

In Grays Harbor, Washington and Eureka, California, in Texas and Maine and Florida, an unusual partnership with a most important goal has been developing over the past three years. The partners: the U.S. Coast Guard and NOAA's Marine Advisory Service. The goal: making the coastal areas of the country better and safer places to work and play.

The Coast Guard and the Marine Advisory Service are oceans apart in history and organization. For most of us, the Coast Guard conjures up images of sleek, white cutters and hard-working buoy tenders, of rescues at sea, of captains and admirals and boatswain's mates—in short, of an organization that is the oldest uniformed service in the Nation and that oversees thousands of miles of coastline and employs thousands of men and women. NOAA's Marine Advisory Service could not be more different by contrast. University-based and consisting of Boston Whalers, Mercury outboards, and some 200-odd field agents "in hip boots," the Advisory Service is young, widely scattered, and generally more concerned with helping a Brownsville shrimper who's having trouble figuring out his income tax than with seeing to it that a foreign trawler doesn't fish in forbidden waters.

Fortunately for many of America's coastal users, however, the disparity between the two organizations is not really so great. The Coast Guard and the Advisory Service are in their different ways vitally concerned about the safety and convenience of a wide variety of water users, from commercial fishermen to weekend boaters. Acting cooperatively, they bring a large number of persons information, expertise, and guidance. For example, starting last year in small fishing villages in Northern California and in Oregon, special joint workshops were held to inform commercial fishermen of the important changeover from LORAN-A to LORAN-C.

LORAN (for LOng RAnge Navigation) is a system of aids to navigation consisting of radio transmitters—maintained by the Coast Guard—all along the U.S. coast. When equipped with a proper receiver and the appropriate charts, a fishing vessel can determine its location even when many miles out at sea. LORAN-A came into general use after World War II. The transmitters, however, are limited in their range, adversely affected by atmospheric conditions like fog or rain, and can pinpoint a location only to about one-half a mile.

LORAN-C, on the other hand, is far more accurate than the old LORAN-A transmitters. But fishermen had to be informed about what the advantages of LORAN-C are, when the new transmitters are scheduled to go into operation, and what new equipment will be needed on their boats. The cooperative Coast Guard-Advisory Service workshops proved the ideal forum. Fishermen turned out in large numbers to ask questions and make suggestions of their own, and advisory agents and representatives of the Coast Guard were present to provide the fishermen with vital information on the changeover.

Other Coast Guard-Advisory Service cooperation is sometimes less formal. In Florida, for example, the Advisory Service at the University of Florida frequently has an article in one of its newsletters on boating safety, aids to navigation, or some other subject of general marine interest. The Coast Guard has been encouraged to reprint these stories in its own publications. And the Florida Advisory Service, in turn, regularly reprints articles that originally appeared in local Coast Guard publications. The result is obvious: a much larger audience is getting information on marine matters. And with a minimal increase in cost and effort.

"The great thing about all this collaboration," says Robert J. Shephard, Program Manager for NOAA's Marine Advisory Service in Washington, "is that it developed quite naturally. There wasn't any formal, bureaucratic directive from on high saying 'You shall cooperate.' The local advisory services and the Coast Guard both perceived a need and on a very informal basis got together to help each other and their mutual constituents. It was as clear and as simple as that."

Extended Jurisdiction—What Is It?

Many persons are relatively unfamiliar with the structure of the new extended jurisdiction law. What will it mean to fishermen, processors, and others involved in the Nation's fisheries?

Following are answers to some of the most-asked questions about this law:

Management Authority

Q. What is the "fishery conservation zone" established by the Act?

A. The U.S. fishery conservation zone adjoins the territorial sea (the 3-mile limit); its outer boundary is 200 nautical miles from the coast.

Q. What fisheries are affected?

A. The United States will exercise exclusive fishery management authority over:

1. All fish found within the fishery conservation zone;
2. All anadromous species that spawn in U.S. waters, throughout their migratory range beyond the zone, except during the time they are in another nation's territorial sea or fishery conservation zone that the U.S. recognizes;
3. All U.S. continental shelf fishery resources that extend beyond the zone, such as coral, crab and lobster, clams and abalone, and sponges.

Q. What fisheries are NOT affected?

A. Highly migratory species of fish, defined in the Act as tuna.

Q. When does the exclusive authority take effect?

A. March 1, 1977.

Q. Why so long?

A. To permit renegotiation of fisheries agreements with other nations, and establishment of Regional Fishery Management Councils.

Foreign Fishing

Q. Once the law takes effect, will foreign fishing vessels be permitted in the 200-mile zone?

A. Yes, but only under the following conditions:

1. If a treaty or international fishery agreement already exists, foreign fishing will be permitted until the treaty or agreement expires or is renegotiated, and each foreign vessel must have a registration permit issued by the Secretary of State.
2. If none exists, then the foreign fishing vessel must have a permit.

Q. How does the Secretary of Commerce issue permits to foreign fishing vessels?

A. The Act gives a detailed account of this procedure. In brief, this is what must happen:

A. A foreign nation must first enter into what is called a Governing International Fishery Agreement (GIFA) with the United States;

2. Under such an agreement, the foreign nation must apply each year for permits for all of its fishing vessels that wish to fish for species covered by the Act.
3. When the Secretary of State is satisfied that the permit application complies with the requirements of the Act, he will send it to the Secretary of Commerce, the Secretary of Transportation, the appropriate Regional Fishery Management Council, and designated committees of Congress;
4. The applicable Regional Fishery Management Council has 45 days to comment on the application;
5. After taking such views into consideration, and after payment of fees, the Secretary of Commerce may then approve the application.

Q. Will there be a fee for foreign fishing vessels?

A. A "reasonable" fee may be charged; such fees must apply without discrimination to all foreign nations, and their costs may take into account the cost of management, research, administration, enforcement, and other items.

Q. How much fish will foreign vessels be permitted to take?

A. Only a portion of the optimum yield of a fishery, if any, that will *not* be harvested by U.S. fishermen.

Q. What is "optimum yield"?

A. Optimum yield is defined as that part of a fishery that will provide "the greatest overall benefit to the Nation, with particular reference to food production and recreational opportunities . . ." In other words, a variety of economic, social, and ecological factors are taken into account as well as biological factors.

Q. Who determines optimum yield?

A. The optimum yield for each species will be specified in a fishery management plan drawn up by the Regional Fishery Management Council in whose area the species is found.

Q. How will enforcement officers of the National Marine Fisheries Service and the Coast Guard know whether a particular foreign vessel has a valid permit?

A. Every foreign fishing vessel must display the permit prominently in its wheelhouse; the permit will contain a statement of all the conditions and restrictions attached to it.

Q. What happens to violators?

A. Civil and criminal penalties are provided in the Act. In addition, if the fines are not paid, the permit for the vessel, or for all vessels of that nation, may be suspended.

Regional Fishery Management Councils

Q. What are Regional Fishery Management Councils?

A. Regional Fishery Management Councils are the basic tool for management and conservation of America's fisheries within the 200-mile zone and otherwise as specified by the Act.

Q. What do they do?

A. Duties and responsibilities of each Council are:

1. To develop fishery management plans and amendments to them;
2. To submit periodic reports to the Secretary of Commerce;
3. To review and revise assessments of optimum yield and allowable foreign fishing;
4. To conduct public hearings on development of fishery management plans and on the administration of the Act;
5. To establish scientific and statistical committees and necessary advisory panels;
6. To undertake any other activities necessary to carry out the provisions of the Act.

Q. What Councils are called for in the Act?

A. There are eight, as follows:

1. New England Council, consisting of the States of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut; with 17 voting members.
2. Mid-Atlantic Council, consisting of the States of New York, New Jersey, Delaware, Pennsylvania, Maryland, and Virginia; with 19 voting members.

3. South Atlantic Council, consisting of the States of North Carolina, South Carolina, Georgia, and Florida; with 13 voting members.

4. Caribbean Council, consisting of the Virgin Islands and Puerto Rico, with 7 voting members.

5. Gulf Council, consisting of the States of Texas, Louisiana, Mississippi, Alabama, and Florida; with 17 voting members.

6. Pacific Council, consisting of the States of California, Oregon, Washington, and Idaho; with 13 voting members.

7. North Pacific Council, consisting of the States of Alaska, Washington, and Oregon; with 11 voting members.

8. Western Pacific Council, consisting of the State of Hawaii, American Samoa, and Guam; with 11 voting members.

Three States—Florida, Washington, and Oregon—have voting members on more than one Regional Council.

Q. Who are voting members of the Councils?

A. Voting members are:

1. The principal State official with marine fishery management responsibility and expertise, as designated by the State Governor;

2. The regional director of the National Marine Fisheries Service for the area concerned;

3. At least one "qualified individual" from each State, selected by the Secretary of Commerce from nominations by the State Governors;

4. Additional "qualified individuals" who will be appointed at large; the number of these varies with the number of States in the Regions. They too will be appointed by the Secretary of Commerce from nominations by the State Governors.

Q. Who are non-voting members of the Councils?

A. Non-voting members are:

1. The regional or area director of the U.S. Fish and Wildlife Service;

2. The Commander of the Coast Guard district;

3. The executive director, if any, of the appropriate Marine Fisheries Commission;

4. One representative of the Department of State.

In addition, the Pacific Council has one nonvoting member appointed by the Governor of Alaska.

Q. Where will the Councils be located?

A. Each Council will decide that for itself, in accordance with uniform standards.

Q. How will the Councils operate?

A. Each Council will be free to operate as it sees fit, in accordance with uniform standards that may be prescribed by the Secretary of Commerce.

Q. Then, once established, the Councils are quite independent?

A. True. They are not arms of the Federal or of any State Government.

Fishery Management Plans

Q. I have heard about "preliminary fishery management plans" and "fishery management plans." What's the difference?

A. A "fishery management plan" is a plan prepared by a Regional Council, designed to provide conservation and management of a particular species of fish found within the geographical area of the Council.

A "preliminary fishery management plan" is a plan prepared by the Secretary of Commerce. Such plans will be prepared only in cases where a foreign nation has applied for a fishing permit and the Regional Council cannot prepare its plan by the deadline (March 1, 1977).

Q. Will preliminary fishery management plans apply to U.S. fishermen?

A. No. Only to foreign fishermen.

Q. How long will a preliminary plan be in effect?

A. Only until a plan prepared by a Regional Council is implemented.

Q. What, if any, guidance will there be for the Councils in drawing up the plans?

A. The Act establishes seven "national standards" that every plan must be consistent with, as well as requirements for contents of every plan. The Secretary of Commerce will also provide guidelines based on the national standards.

Q. What are the national standards?

A. They are:

1. Conservation and management measures shall prevent overfishing but achieve optimum yield from each fishery;

2. These measures shall be based on the best scientific information available;

3. To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range;

4. Conservation and management measures shall not discriminate between residents of different states;

5. The measures shall, where practicable, promote efficiency in the use of fishery resources;

6. They shall take into account and allow for variations among fisheries, fishery resources, and catches;

7. And, where practicable, they shall minimize costs and avoid unnecessary duplication.

Q. What are fishery management plans required to contain?

A. Each such plan must contain:

1. Conservation and management measures applicable both to foreign and U.S. fishing;

2. A description of the fishery, including such information as the number of vessels involved, type and quantity of gear used, revenues, recreational interests, and other specified items;

3. An assessment of present and probable future condition of the fishery, including both maximum sustainable yield and optimum yield;

4. An assessment of the extent to which U.S. fishermen will harvest the optimum yield, and of the portion of the optimum yield that can be made available to foreign fishermen.

Q. Anything else?

A. In addition to the required items, there are a great many optional items, such as:

1. Requirements for permits and fees that the Secretary of Commerce should levy on U.S. fishermen;

2. Designation of zones and periods of time when fishing should be limited, or banned;

3. Establishment of limits on the catch, based on area, size, weight, or other factors;

4. Establishment of a system of limited access.

Q. Do the Councils have any regulatory authority with respect to the Fishery Management Plans?

A. The Councils may prepare and submit to the Secretary of Commerce any proposed regulations that they feel are necessary to carry out any fishery management plan.

Q. How high can the domestic permit fee be?

A. These fees are not to exceed the administrative costs of issuing permits.

Q. What happens to a fishery management plan once it has been prepared by a Regional Council?

A. The plan is submitted to the Secretary of Commerce. He has 60 days to review it and notify the Council of his approval, disapproval, or partial disapproval. If he disapproves in whole or in part, he has to give the reasons why, in detail, with suggestions for improvement.

Q. If the Secretary approves, what happens?

A. He publishes it in the Federal Register. After hearings, objections, and other administrative actions, the plan is put into effect.

Q. Suppose the Secretary disapproves and tells the Council why?

A. The ball is back in the Council's court, to come up with changes to meet his objections.

Q. Suppose the Secretary and the Council can't come to agreement?

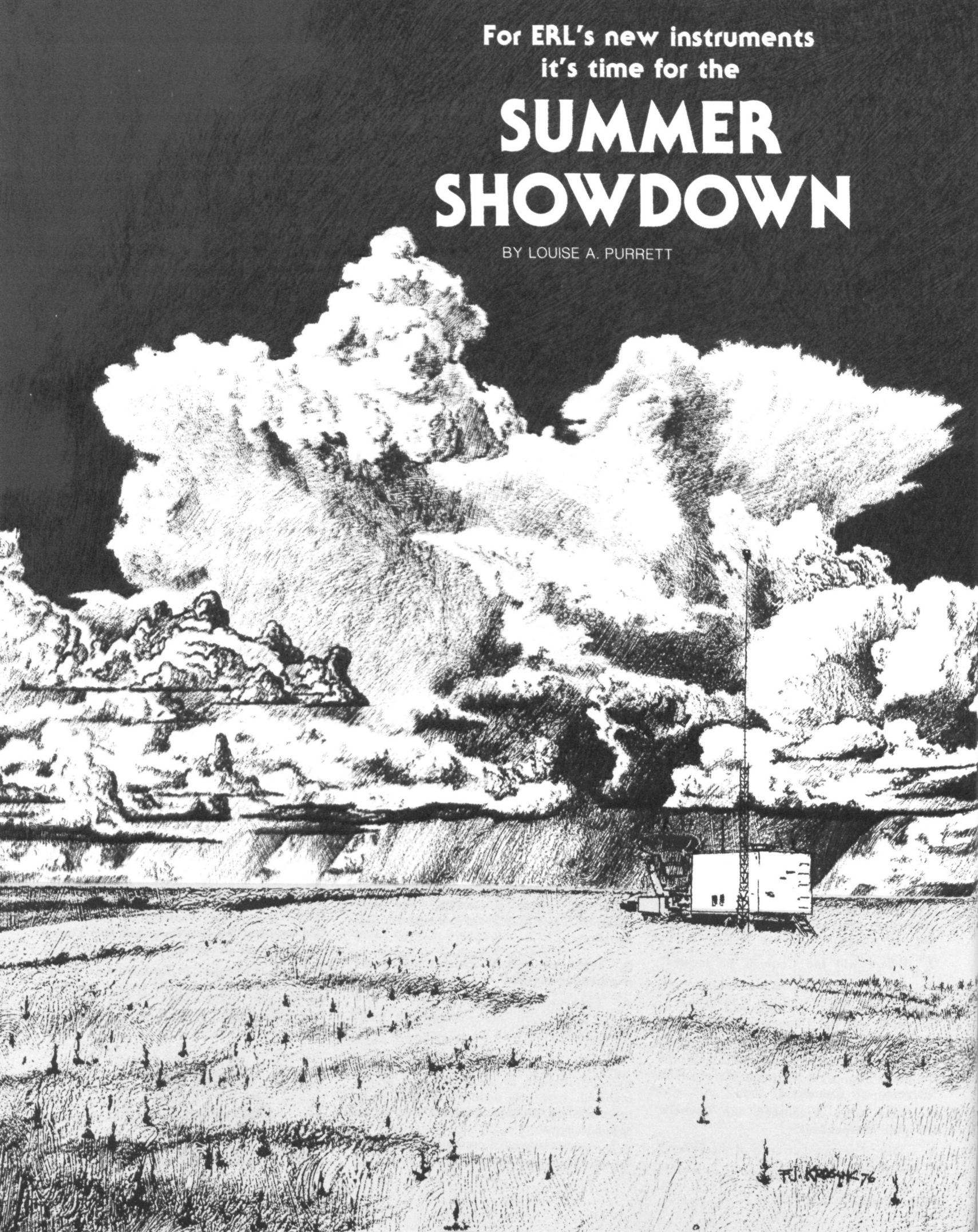
A. The Secretary can then put into effect his own plan. However, he cannot establish any kind of limited entry system unless it is approved by a majority of voting members of the pertinent Council.

noaa and the coast guard

For ERL's new instruments it's time for the

SUMMER SHOWDOWN

BY LOUISE A. PURRETT



For scientists in NOAA's Wave Propagation Laboratory, summer means field work, a time when the variety of instruments they have been designing to probe the atmosphere can be tested and applied. It means long, hot, tedious weeks at small prairie towns. For some, "in the field" means literally that—being stationed in a trailer or radar van in a wheat field far from everything except sun, wind, blackbirds and locusts.

This year, they are in the field in greater numbers than usual. Several teams of scientists from the laboratory, which is part of the Environmental Research Laboratories in Boulder, Colorado, have hauled their equipment to the northeastern part of the state, where Colorado meets the corners of Wyoming and Nebraska.

Some of the NOAA scientists are participating directly in the National Hail Research Experiment, an annual project sponsored by the National Science Foundation. Directed by the National Center for Atmospheric Research, the experiment has the ambitious long-term goal of understanding the summer thunderstorms that bring devastating barrages of hail. The knowledge they gain may someday be applied to suppressing damaging hail.

Dr. C. Gordon Little, Director of the Wave Propagation Laboratory, conceived a program that would allow other NOAA scientists to take advantage of the concentration of instruments and scientists in the hail experiment to test new instruments or obtain different types of measurements to compare with and supplement their own.

Many of these scientists are preparing for another major experiment, the Severe Environmental Storms and Mesoscale Experiment (SESAME), the first observational stages of which are scheduled to begin in 1978. The project, which will probably be jointly sponsored by NOAA and the National Science Foundation, will try to define the relationship between severe convective storms and the larger environment, construct models of storm development that can be used for prediction, and refine observation techniques to provide the data for these models.

As part of the hail experiment, a pair of doppler radars operated by Dr. Earl Gossard's Meteorological Radar group has joined forces with two similar radars operated by the National Center for Atmospheric Research to focus on wind patterns in the same storm from four sides. The large, transportable radars are posted in a huge rectangle 25 by 30 miles (40 by 40 kilometers), with one radar at Lindbergh, Wyoming, one southeast of Kimball, Nebraska, another east of Grover, Colorado, and the fourth in the Colorado prairie miles from anywhere. L. Jay Miller in Gossard's group is directing the NOAA end of the research.

From near Grover, the headquarters for the National Hail Research Experiment, a large long-range radar scans the vicinity for storms. When it detects one that experiment managers decide would be a good subject for study, they feed the coordinates of the storm into a computer. The computer disgorges directions which are radioed to each of the four radars, telling them when to begin scanning, how wide an arc to cover, and how rapidly. "The radars have to be perfectly synchronized," explains Miller. "They have to begin scanning at precisely the same time, and scan the storm in approximately the same time interval. This can be very complicated. For example, if one of the radars is very close to the storm it has a wider area to cover, which means it has to be scanning more rapidly than the radars that are farther away. For them, the storm is a smaller target."

Fortunately the radars can be controlled completely automatically. Each radar is equipped with a mini-computer that guides the radar's movements in accordance with the central computer's directions. The operators of the widely scattered individual radars communicate by radio, setting their radars in motion at the same instant by voice signal.

Two doppler radars, viewing it from different positions, can obtain a three-dimensional wind field of a storm. But to do so, explains Miller, a lot of assumptions must be made, and to that extent the result has an element of uncertainty. Four radars give a much more complete—and certain—pattern.

The doppler radars cannot perceive the movements of clear air; there must be some windborne tracer from which the winds can be inferred. For full-blown storms, says

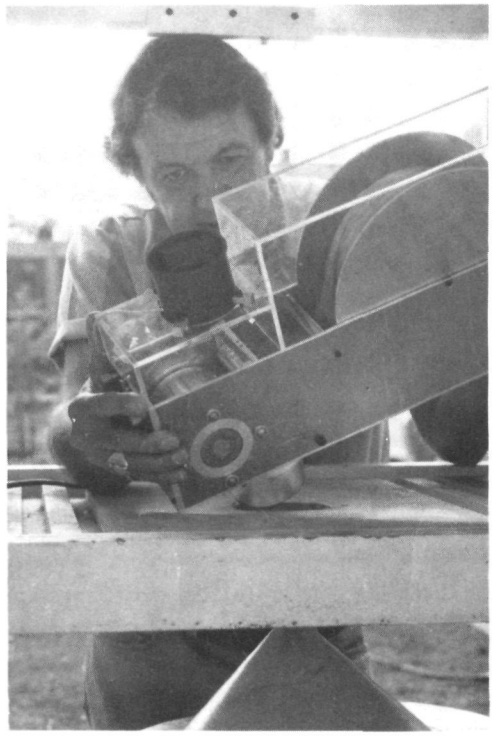
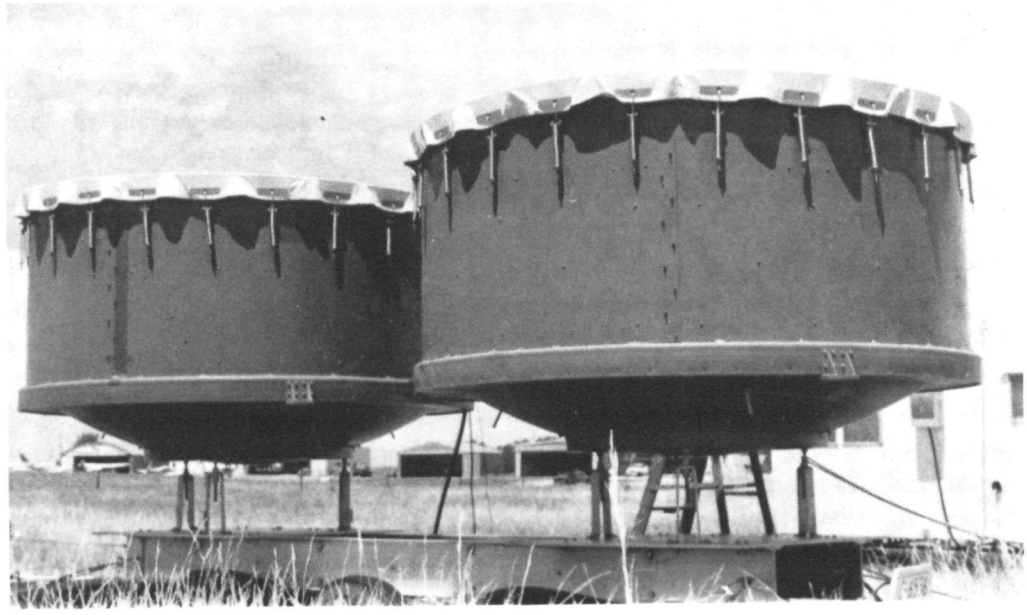
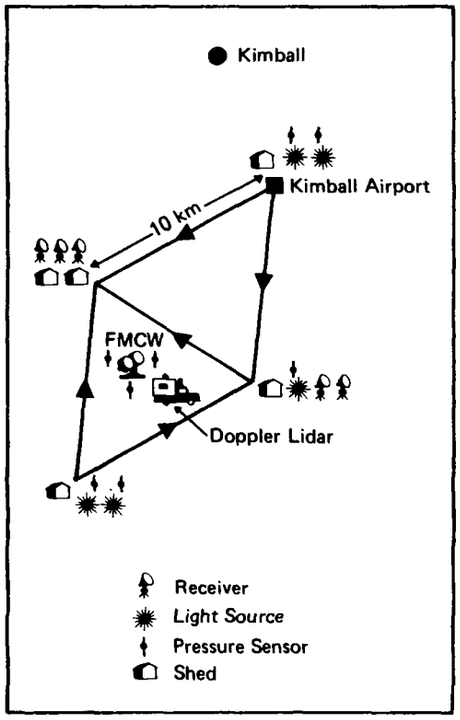


Photo: Fritz Hoelzl

Technician Jack Hanchett assembles chaff dispensing apparatus (1). Wind-borne chaff is tracer for doppler radar tracking air motions, while another type (below) senses movements of clear air. Technician Glen Miller (above) uses plumb lines to align mirrors in optical wind sensor.





Instrument array in Wyoming, Nebraska, and Colorado detects air motions in three dimensions.

Miller, water, ice, and dust will serve as tracers. But the scientists also wanted to trace the surrounding wind fields that contribute to and attend on the storm. For these, they need artificial tracers. Chaff, fine, hairlike fibers coated with aluminum, will be released at the ground to serve the purpose.

A device developed by Alfred J. Bedard of the Geoacoustics group will trigger the chaff cutters. The gust front—the wall of gusting winds that travels in advance of a thunderstorm—causes a sharp increase in atmospheric pressure at the ground. Pressure sensors designed by Bedard can detect the increase. Five of his compact sensors, installed in protective cabinets and mounted on poles, will be coupled to chaff dispensers and spaced in a ring around the study area. When a gust front passes over, Bedard's sensors turn on the chaff cutters, which chop off half-inch-long sections from continuous strands on a large spool. The chaff cutters are housed in white cupboards on stilts. The chaff falls through a hole in the bottom of the cupboard onto a cone, which scatters it to the winds.

At the same time that it triggers the chaff cutters, the pressure sensors also send a radio signal to the radars, notifying the operators that a gust front has passed and chaff has been released so they can pick it up on the radars.

One of the main concerns of SESAME planners is how to measure horizontal convergence, the collision of air masses that is thought to trigger thunderstorms. According to current theories, converging air lifts the moist air in the boundary layer—the area where the atmosphere meets the earth—causing it to become unstable. The SESAME researchers, says project head Dr. Douglas Lilly of NCAR and NOAA, "want to observe this destabilization process on the theory that thunderstorms may be anticipated up to an hour and a half in advance, by watching for this."

So, many of the Wave Propagation Laboratory scientists are engaged in what Little calls pre-SESAME work, refining techniques for measuring convergence and other mechanisms for destabilizing the moist layer.

One novel technique that is being tried is with an optical wind sensor. This sensor, developed by scientists in the Optical Propagation group of the laboratory, can measure wind speeds by the distortions they cause in a beam of light or the image of an illuminated scene. Unlike conventional anemometers, the optical sensor measures the average wind over the entire distance between it and the light source.

This summer, Richard Fritz, technician Glen Miller, and others in the group have set up five of the tripod-mounted wind sensors, and an equal number of light sources—resembling automobile headlights—in northeastern Colorado. The instruments, sheltered in portable cabins that Miller and his assistants built in the laboratory, are spaced roughly six miles (10 kilometers) apart in two adjacent triangles. The northernmost corner of the lopsided square that is formed is at Kimball.

The wind sensors and headlights are arranged so that a light at one corner points toward a wind sensor at the next, corraling the area with light beams. The result is that the optical sensors, which measure winds moving at right angles to their line of sight, can detect the air motion through the beams and across all the sides of the triangles. Winds flowing into a triangle from all sides means convergence. "We think this is a scheme by which we can measure the strength of updrafts into a thunderstorm," says Robert Lawrence, head of the Optical Propagation group. "It will be a pretty good trick if we can do it."

Two types of radar will also be measuring the updraft that results from convergence. If chaff or some other radar reflector is present, the doppler radars at Lindbergh and Kimball can measure the updraft directly from a distance. And right at the center of the action is a new type of radar system that can sense updrafts in clear air.

Within the southern triangle is an FM/CW (frequency-modulated, continuous-wave) radar developed and operated by Gossard's group. Unlike the other doppler radars, which need a visible tracer, the FM/CW can gauge the velocity of structures in clear air. In an experiment directed by Dr. Russell Chadwick, the FM/CW scans in a circle to obtain direct measurements from which the net motion of converging or diverging air masses can be inferred. While the optical sensors can measure the inflow only at ground level, the FM/CW obtains velocities at different heights from the ground up.

Dr. Ronald Schwiesow, of Dr. Vernon Derr's Atmospheric Spectroscopy group, is stationed near the FM/CW radar with his infrared doppler lidar. The doppler lidar, housed in a truck-mounted camper, uses beams of laser light to gauge the velocity of winds. Schwiesow and his team are trying to measure directly the vertical motions of air that result from convergence. They are also measuring horizontal winds at intervals above Fritz's light beam "fence" to see how the structure of winds aloft is related to the measurements the optical sensors obtain along the ground.

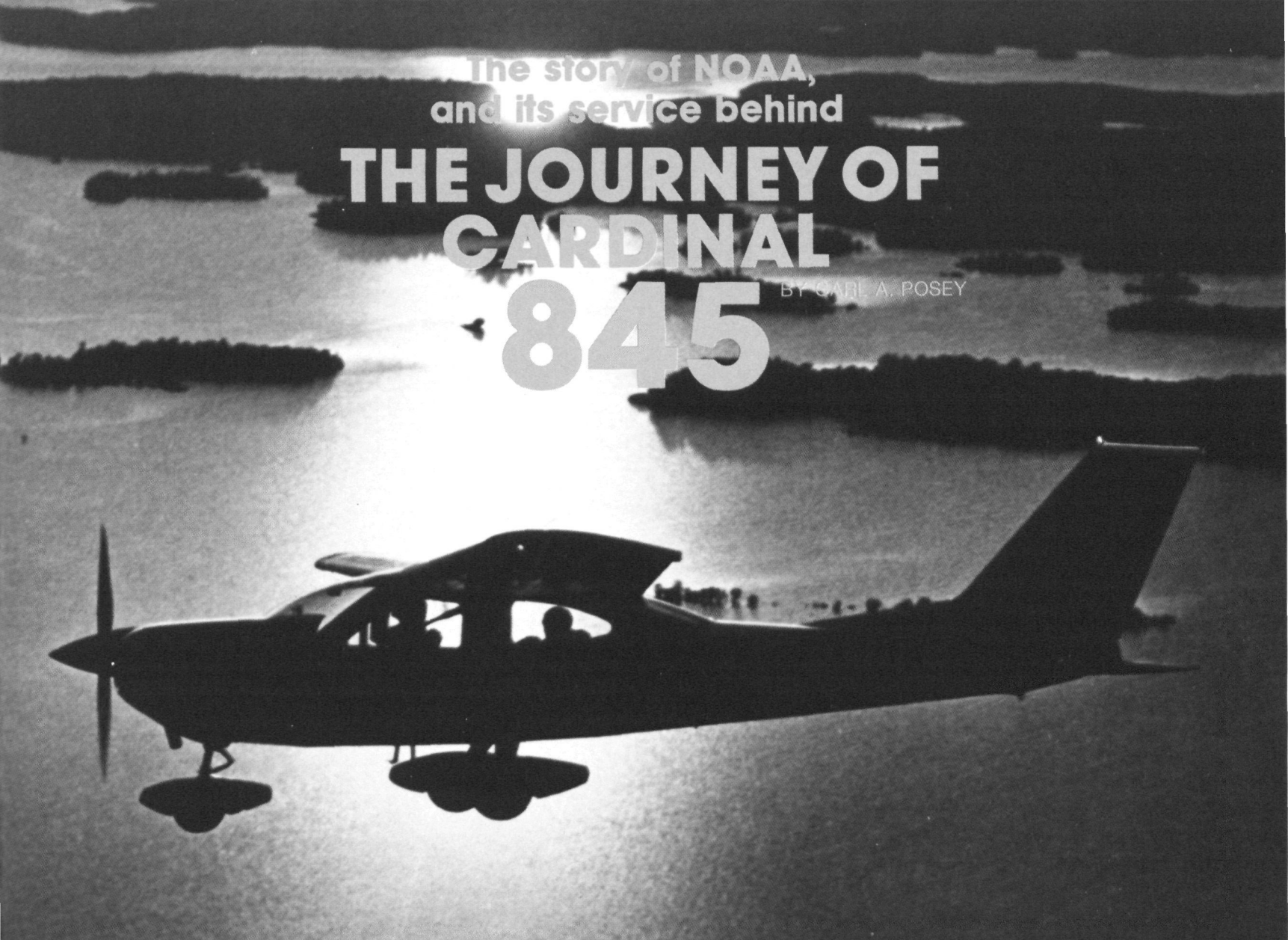
The measurements from all these types of probes will then be compared. Lawrence is especially interested in seeing how well an array of optical wind sensors at the ground can detect convergence. "The optical scheme is by far the simplest and cheapest, if it works."

Meanwhile, an array of Bedard's pressure sensors measures the changes in atmospheric pressure associated with wind flow into and out of the double triangle. Three of the pressure defectors ring the FM/CW within the optical sensor triangle to measure the pressure jump caused by an air mass flowing overhead. Other pressure sensors are located at the corners of the double triangle to keep a running tally of atmospheric pressure.

The scientists are hunting for gravity waves—long-period waves in the atmosphere. These undulations, generated by severe storms and other atmospheric disturbances, may travel for thousands of miles through the atmosphere to generate other storms. Gravity waves are thought to be a source of convergence. In fact, squall lines sometimes have a wave-like character. The gravity waves cannot be detected with an anemometer, which loses the long waves among the multitude of small local fluctuations in wind. But both the optical sensors and pressure sensors can filter out the local "noise" to detect the gravity waves. Jessie Young and others in the Geoacoustics group hope to learn something about the role of gravity waves in producing convergence by measuring them with two different methods simultaneously. Since much is already known about the behavior of waves, defining the relationship between gravity waves and severe storms may help scientists predict the movements of storms.

It all seems a hodgepodge, but it isn't. A variety of observational systems have been developed at different times by groups with diverse aims. Each group of researchers in the prairie this summer has certain things they want to learn about the atmosphere or about what each unique instrument can reveal.

But all are working together, as well, focusing on a single problem: the birth and evolution of large convective storms. Each bit of information that each team extracts in its unique way can eventually be fitted in, so that someday a whole cohesive picture will emerge.



The story of NOAA, and its service behind

THE JOURNEY OF CARDINAL 845

BY CARL A. POSEY

Thursday. Cardinal 34845 climbs away from runway 15 at Ft. Collins-Loveland airport, Colorado, flying a course just south of east, with a flight plan filed for Springfield, Missouri. If the earth were flat one could see Cleveland, so bright and clear is the atmosphere today. The nearest weather is several hundred miles away, in the form of a feeble cold front draped west to east across South Dakota and Iowa. The forecast calls for wind, but not weather, all the way to Atlanta.

Tuesday's weather picture had been grim.

"Looks like a system from the northwest'll come through here on Thursday," said Bob Walker from the aviation desk at Denver's Weather Service Forecast Office. On any given shift, his amiable voice conveys meteorological news to umpteen pilots trying to work the equation of getting from point A to point B in an airplane. Weather is the key term. "Then, as high pressure builds behind it we can expect upslope conditions and maybe a touch of snow." Worse and worse. Upslope conditions mean an easterly wind blowing moist air up the long ramp of flattish land that climbs some four thousand feet between the Mississippi River and Denver. As the air is lifted, it is cooled, often enough to transform scattered clouds over Kansas into Colorado's version of eastern bad weather—fogs and low stratus packed in against the mountains, drizzly rain, spectacular spring snows. "You've got a problem going to Springfield."

One thing about weather, the more time you give it, the more it will change. By Wednesday afternoon, Walker does not have to peer so far into the future. "That front we talked about is stalled and considerably weakened along the northern border of Colorado, and extends from the extreme eastern edge of Kansas down into southwest Kansas. It's pretty weak. Just scattered middle clouds and cirrus. The front should wash out tonight and tomorrow.

"The computer's holding on to the first front, and there's another front in central North Dakota and northern Mississippi, which the computer wants to drop south." The computer is the big machine at the National Meteorological Center, where mathematical models of the atmosphere give weathermen around the country the objective big picture—guidance, as it is called. "It looks like everything'll be north of your route of flight. Southern Iowa is your closest weather. The computer keeps high pressure over the whole area. Terminal forecasts show Denver clear, Goodland clear, Springfield clear. Worst is possible fog in the morning. But it looks like you've got a straight shot at Springfield tomorrow."

The winds? "You're better off lower. It'll be from about 330 degrees at 15 knots at 9,000. Kansas will have winds from 340 at 40. Springfield is 310 at 45. Friday you should have some help on in to Atlanta, with winds about 30 knots from the west and northwest."

An impeccable forecast. Now, booming along at 140 miles per hour, one thinks of this fine weather as a gift. "Here's your good weather, folks, courtesy of Bob Walker and the National Weather Service." Not an accurate assessment, of course, but the feeling persists.

Maybe meteorologists feel that way too. What they give their clients is completely dependent on how well the atmosphere is understood, and how advanced the tools are with which these men and women try to predict what the atmosphere will do. A small, unexpected disturbance somewhere

can throw weather systems north of their predicted path, or cause (or kill) predicted rainfall at some airport down the line, or change the flow of winds.

Try to think what it is like, predicting what weather will do over a period of twelve or twenty-four or forty-eight hours and all comparisons fall short. Like predicting how melting butter will move around on a heated, moving surface. Like predicting who will get the message in a bottle put into the Mississippi River at St. Paul. Weather is probably the toughest prediction problem around; it puts the meteorologist right up against the boundaries of science and art.

Then why take a good forecast personally?

Because it is a very personal service, or family of services. Ever since what is now the National Weather Service received its mandate to help aviators (in the Air Commerce Act of 1926), the objective has been to get the information to the pilot. So in today's maze of high-speed communications lines, computer-predicted wind fields, and a host of products tailored to the needs of aviators, one sees that central theme of a federal service moving closer and closer to the person who needs it most, wherever he is reachable—at airports, in flights, watching the tube Friday nights at home. It rests on imperfectly comprehended natural processes, and imperfect techniques. But it works.

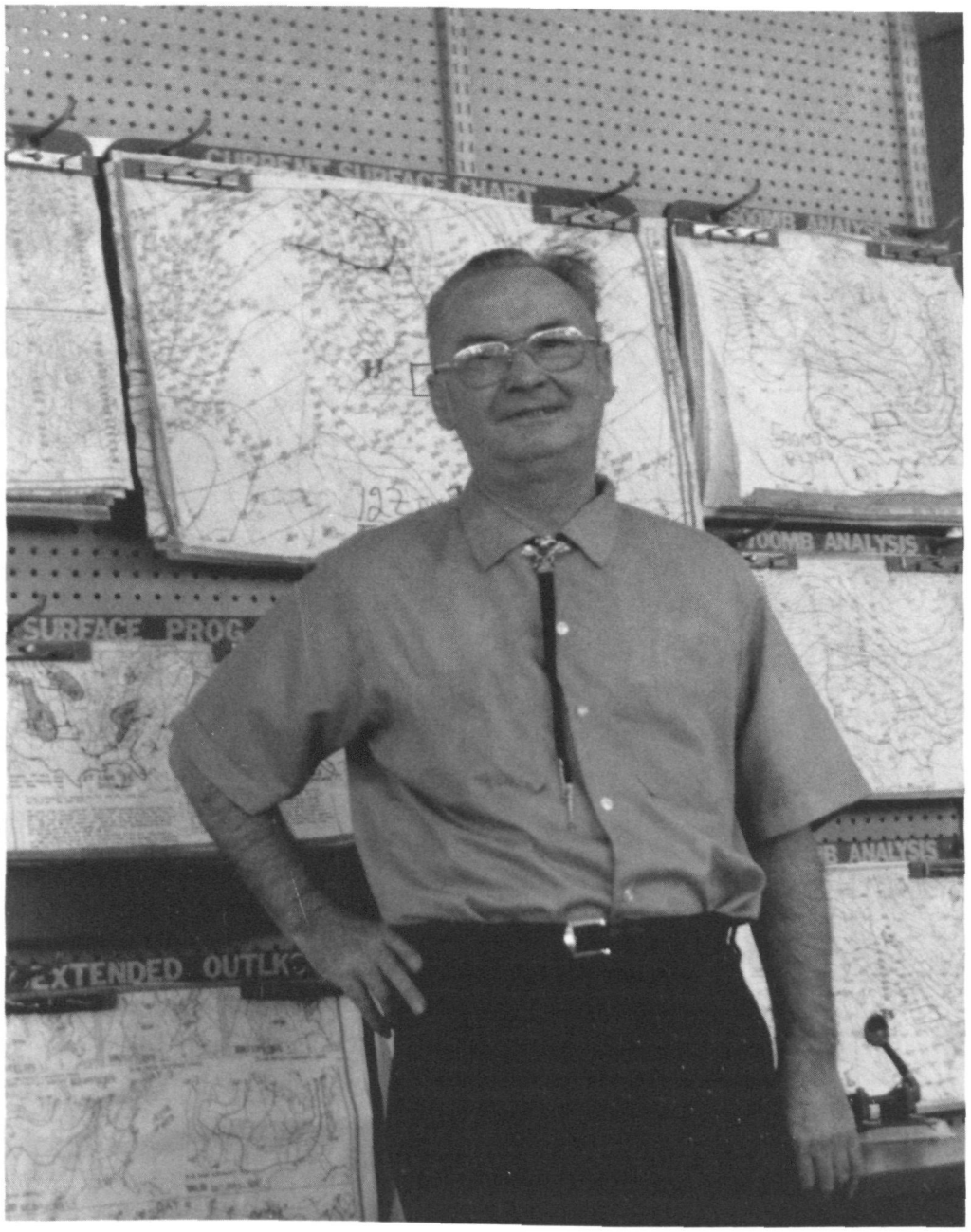
And today, very well indeed. Cardinal 845 is about two thousand feet off the ground crossing the Kansas line. We've elected to stay low to keep the flight smooth and the view interesting, instead of seeking the partial tailwind in the smooth, swifter currents higher up.

Crew check. Navigator retires the Denver sectional chart, opens Wichita. Co-pilot kneels in left rear seat, nose pressed to window, watching the isolated farms and ranches in their ocean of dust. The baby sleeps.

The black course line on the Wichita sectional angles gently southeastward across the Kansas prairie. In perhaps two hundred miles the land has dropped almost a thousand feet. Now, coming up on Goodland, we give the flight service station there a call and they tell us the winds, altimeter setting, active runway, and whether we have other traffic.

Flight service stations are where most aviators touch the government most often. Operated by the Federal Aviation Administration, these stations are scattered around the country about a hundred miles apart. At airports like Goodland's Renner field, they provide the guidance to aircraft activities around the airport (although not in the sense a control tower does).

Among other things, flight service stations are where you file your flight plan. This provides the ideal opportunity for a weather briefing by the FAA personnel there. Each station has drops for Weather Service wires and displays of current weather maps and winds and forecasts so knowledgeable pilots can brief themselves. Usually the FAA people at flight service stations are not meteorologists, although all have training in the use of Weather Service products. But many of them are pilots themselves, and the exchange is generally both factual and friendly.



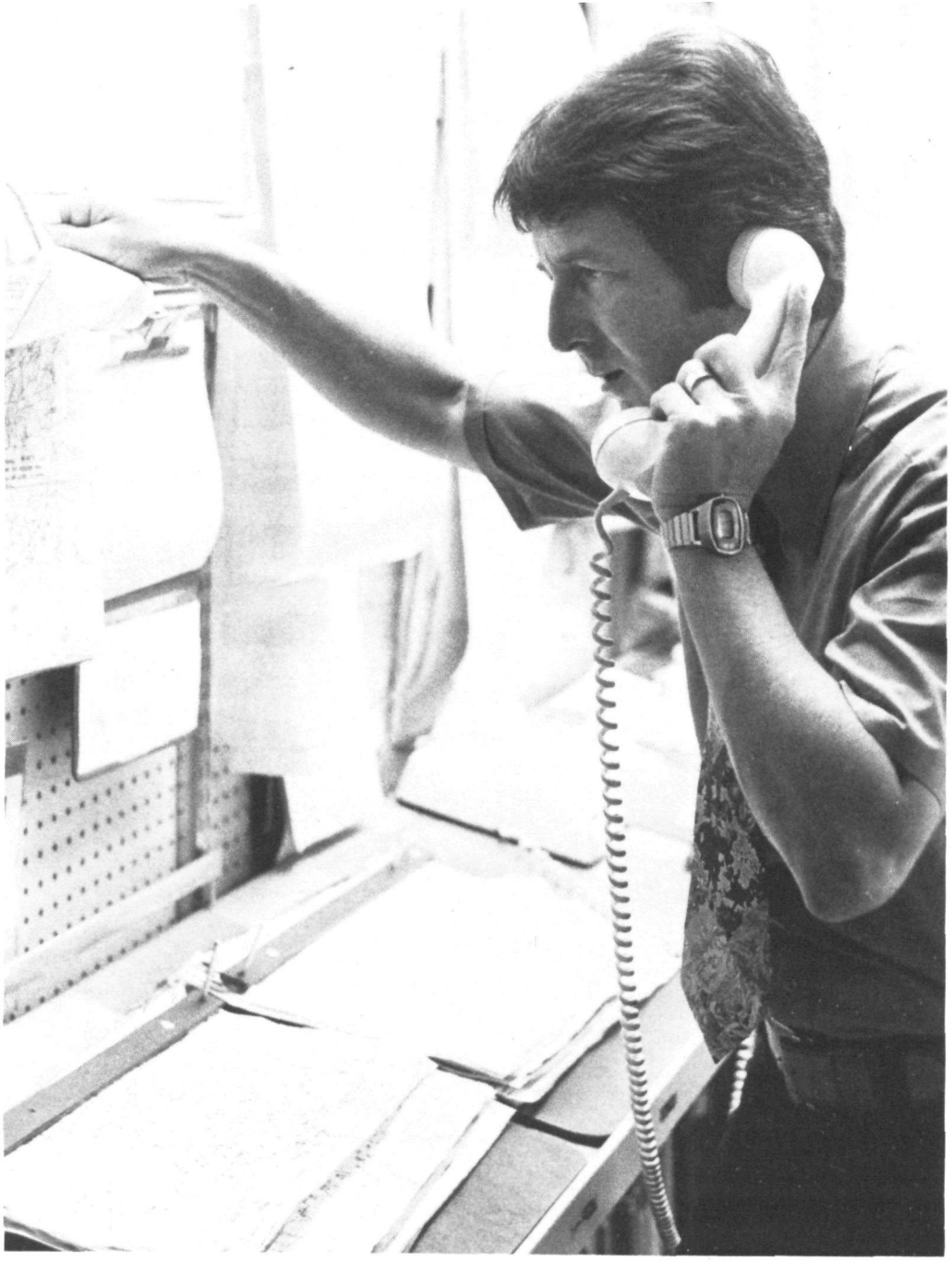
Warren Eckert, Weather Service Observer-in-Charge at the Goodland (Kansas) airport. NWS shares space there with the FAA flight service station.

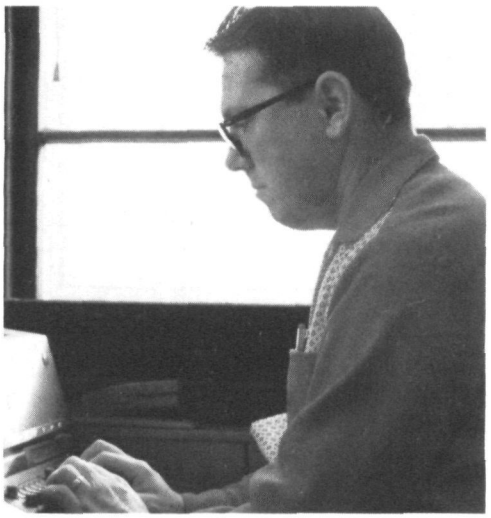
At some airports, the FAA shares its building with a Weather Service facility, and in many cities (like Denver) you can be patched through the FAA to the Weather Service across the field and talk to an aviation briefer. The service is called One-Call, One-Stop Briefing.

Goodland has a split Federal facility. One end of the low brick building is the flight service station. The other is the National Weather Service office, located here, as in most towns, at the airport because that was where you had the customers and communications when weather services were just going public.

Goodland does a good deal more than trundle aviation weather products across the aisle to their FAA colleagues. "We do three radio programs in town," says Warren Eckert, the Goodland Observer-in-Charge, or OIC. "And also some for northwest Kansas. We have 21 counties in our district, and we provide ag weather and other information for them. We're also a cooperative rainfall collection center for the Bureau of Reclamation, and we are tied into flood control work."

Eckert has been in Goodland, at what is now a seven-person weather station, for the past 19 years. "OIC is the top of that





Robert Walker, aviation forecaster at the Denver Weather Service Forecast Office (left), checks the weather picture. Gilbert Ullman (top photo above) and Douglas Casey man the radio and teletypewriter at the Emporia (Kansas) flight service station.

particular ladder," he explains. "You tend to stay where you are when you get there."

One of the more exciting prospects for change at the Goodland weather station is called "the Enterprise." It's a name one hears a lot at small airport weather stations these days, and refers not to an aircraft carrier but to one of those quantum jumps in equipment that come infrequently in the meteorology business: the Enterprise radar.

The new radars are designed to enhance the local warning capabilities of weather stations like the one at Goodland. The radars they replace were surplused off WB-50 weather reconnaissance planes—the successor to the World War II B-29—and gave a gross look at nearby storm cells. "The Enterprise will give us a better three dimensional view of storms," Eckert says, "better penetration, better tops, and contoured echoes to see where the heaviest activity is. We should get ours this summer."

What about Goodland weather?

"We're sort of on the borderland of different kinds of weather," he says, referring to their location almost at the western edge of the great plains and still better than four thousand feet above sea level. "We get as many tornadoes as anybody else, but usually not the big ones. Ours are more like thin ropes."

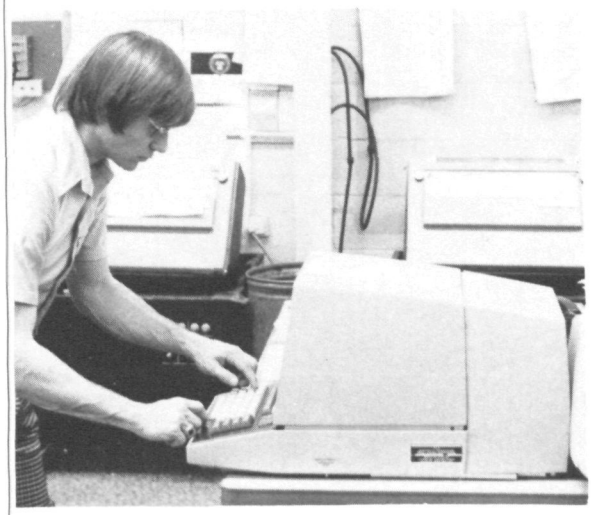
Today, the Goodland weather is a booming wind from the northwest that plucks 845 off runway 33 and hurls it to cruising altitude. A turn over the town and we're pointed east-south-east again. One thinks of those thin ropes over this sparsely settled center of America. Most of the time no one is there to see them, like the proverbial tree falling in the forest . . .

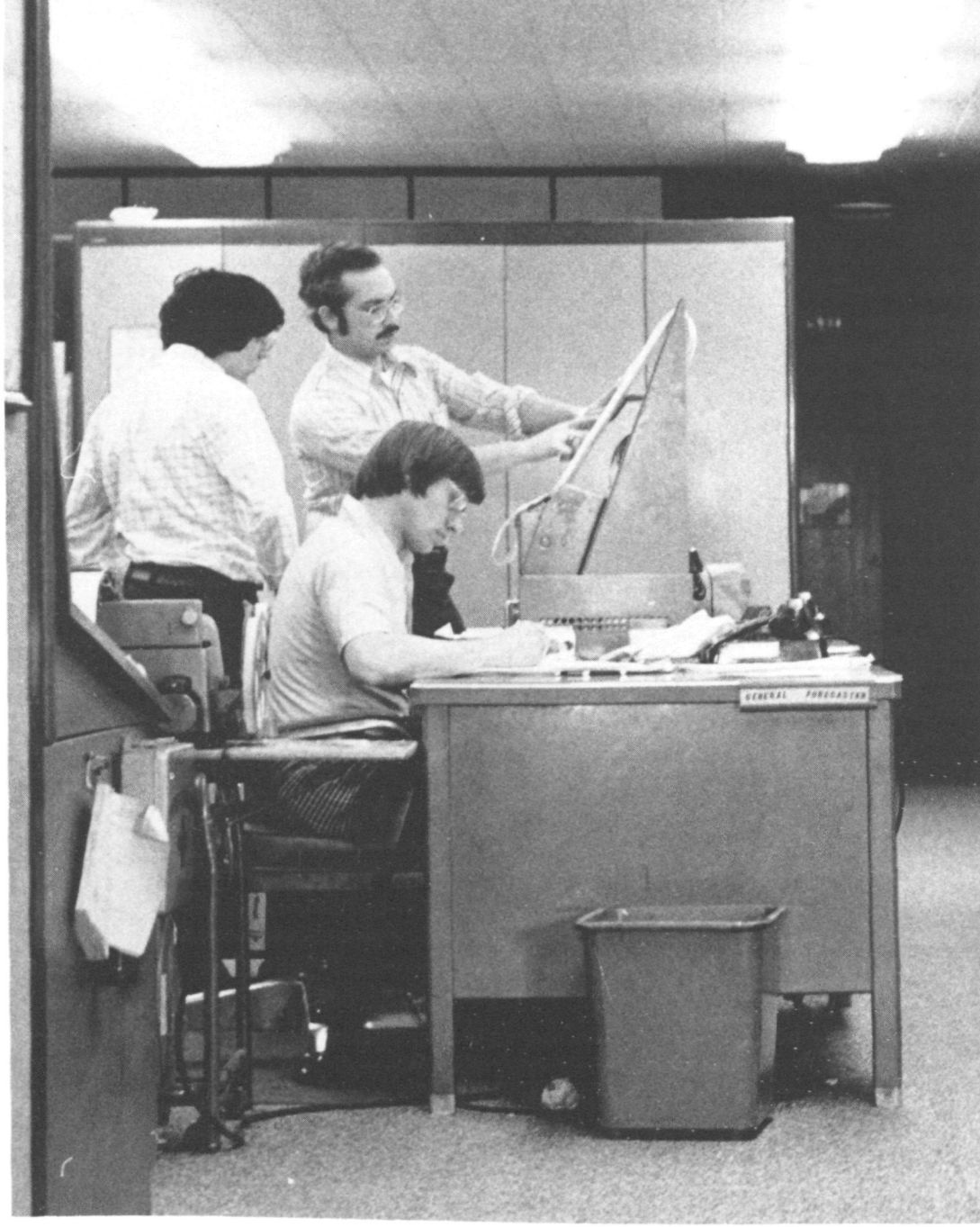
Salina, home of one of the country's big jet transport training fields, passes north of us. Hutchinson drifts by to the south. The towns are getting bigger and closer together. We have left the west. The Wichita sectional chart is folded and stowed. The Kansas City sectional comes out.

Finally we swing northeast of our course and call the flight service station at Emporia. They give us an airport advisory and traffic, and we descend into the hazy sea of golden light that covers the land at sunset.

Friday. Gilbert Ullman and Douglas Casey are the FAA men at the Emporia flight service station this morning. Casey was an Air Force weatherman for eighteen years, and thorough about weather briefings. A front is still draped west-to-east north of us. The computer has it coming down, but not while we're aloft. Some winds and turbulence predicted this afternoon for northern Arkansas, and the terminal forecast for Atlanta has 25-knot gusting northwest winds for our estimated time of arrival. En route, winds from the northwest—21 knots at 9,000 feet—should push 845 along like a light twin. Yesterday's Denver forecast is a gift that keeps on giving.

While Casey concludes the weather brief-





Atlanta flyways are busy, and the Weather Service Forecast Office reflects the many demands of aviation. John Zimmerman (top photo above), lead forecaster, operates remote terminal tied to FAA experimental aviation weather system while William Lerner, aviation forecaster, checks data. At right, Zimmerman and Lerner ponder prediction.

ing. Ullman is at the radio, reporting local and en-route weather and airport conditions to such traffic as there is today. This Emporia flight service station is a typical small-airport facility. It shares several rooms in the main hangar with the local fixed-base operator, and offers current weather wire information and facsimile weather maps.

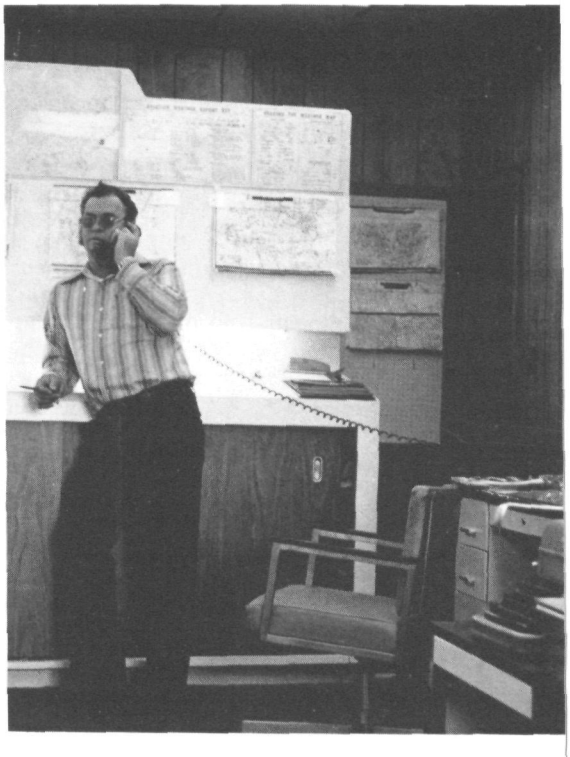
As we climb away from Emporia we chat back and forth with Ullman, giving one another radio checks and opening a flight plan to Atlanta.

Emporia is about twelve hundred feet above sea level—we're descended some four thousand feet since Loveland, and almost three thousand since Goodland. One becomes aware for the first time that the Mississippi valley is a *valley* and we are flying down the western face of its long, sloping sides. The airplane feels the dense air down here too. The navigation is fastidious; we fly the charted line like a toy on a string.

This kind of navigation is called pilotage. It is the time-honored way of getting somewhere in an airplane, flying the contours and rivers and railroad tracks and highways and towns. So we follow a line drawn on a National Ocean Survey sectional chart. (Our radio navigation equipment backs up our pilotage.) Its more interesting than flying the omni (short for Very High Frequency Omnidirectional Radio—VOR's—which are located around the country, making air navigation easier than it has ever been) and keeps us current on where we are. If the engine begins going pocketa-queep instead of pocketa-pocketa, we know where the nearest airport is. So the rationale for pilotage is about equal parts safety, efficiency (we fly a straight line), and fun.

There is another element. Spread out in the navigator's lap is one of the prettier cartographic products drawn by modern man. It is the Memphis sectional chart, showing the land and towns and roads and highways, with superimposed aviation information like airport heights, layouts, radio frequencies, airways, VOR stations, and radio beacons, controlled airspace. What is now the National Ocean Survey began developing products like this sectional under the same 1926 legislative mandate that brought us aviation weather services.

Just as there are weather services tailored to the kinds of flying people do, there are charts for every mode of flight. Sectionals are for people flying "contact"—able to see the ground—with the speed and altitude capabilities of a ship like 845. The sectional is a convenient scale. Each inch represents about seven nautical miles, and the chart is hatched with 30-nautical-mile squares of longitude and latitude. Towns are yellow freeforms generally resembling the shape of communities. Airports and their runway configuration (but alas! no runway numbers) are shown. Purple patches enclose restricted and warning areas—areas like the



Cardinal 845 waits at Tulsa International; radome in background houses antenna for new Enterprise radar. Dan Mondella (above) is on duty at Meridian (Miss.) Weather Service Office.

intensive student jet training grounds which cover the American southeast.

Efficiency aside, sectionals are things of beauty. On a long trip like this one, the land below changes color along with the contoured surface on the chart. We began at Loveland, Colorado, which lies on the five-thousand foot contour of elevation. From the high Rockies of the Divide, done in harsh orange-browns and grey shadows, the charted land fades to a warm intermediate shade between nine and seven thousand feet, and to an even lighter, warmer tan down to the five-thousand foot contour. Thereafter, this sere color—the color of this country without the trees—becomes a kind of khaki, the color of Kansas in winter. At Hays, it hits the two thousand foot contour, and goes to pale green; so does the land.

Today, not half an hour southeast of Emporia, the charted surface passed through the thousand-foot contour, and becomes an even paler green, although the land itself shades into the rich, dark flood plain of the river which cuts the country vertically from near its northern border to the Gulf.

On the Memphis chart, this monument to rivers is a great blue serpent, its boundaries shown indefinitely, so much does it shift its bed on the long, squirming, southward course. We drop down to cross the Mississippi near Blytheville, some 60 miles north of Memphis.

Now the chart shows more and more sky-blue patches, denoting the big rivers and manmade lakes of northern Alabama, Huntsville goes by and we cross those old, weather-rounded eastern mountains. Then, the western sun below our wing, we see the incongruous bump of Stone Mountain, lying in the pine forests around Atlanta like a giant-thrown rock, instead of an outcropping raised from within. Atlanta is a densely trafficked control, a hive approached and deserted by scores upon scores of large, swift, metal bees. The FAA radar helps us pick our way to Peachtree-DeKalb airport, in suburban Decatur, where we land hard in the gusty surface winds Doug Casey warned us about in Emporia this morning.

Saturday. The Atlanta Weather Service Forecast Office is located in hangar one at the city's busy Hartsfield International Airport, a terminus best approached by automobile. John Zimmerman is lead forecaster today, and, after exchanging a NOAA handshake, he yields up some unfavorable weather: a front drifting cast from Texas will be over us tomorrow. It is vigorous and will probably spawn thunderstorms, and it will lie between us and Miami all day Sunday.

With the bad news out of the way, we look for the good. Another reason to visit the Forecast Office here was to see AWANS, the acronym for the FAA-developed Aviation Weather and Notam System —"Notams" are notices to airmen. The experimental system isn't here after all, but over at the FAA's flight service station at Fulton County (now called Charlie Brown) airport; however, the Atlanta weathermen have a remote display that does some of the same thing—that is, it gives them a video display of Weather Service graphics and other products out of Washington, and most weather data for the United States from a center in Kansas City, Missouri.

Aviation is a big responsibility in the Atlanta office, which is a meteorological prime mover in this corner of the country. They prepare terminal forecasts for their location plus Athens, Augusta, Macon, Columbus, Albany, Savannah, Valdosta, and Brunswick. Radars at Athens and Waycross sweep the Georgia atmosphere for interesting weather.

But aviation is just the beginning. "We do specialized work for forestry people," Zimmerman says, "and ag-weather. We're also a river district office in the flood warning program." Their days of working in hangar one are just ending; soon they will move into town.

One sometimes wonders how NOAA meteorologists regard the approach of automated systems like AWANS, and its meteorologically more versatile cousin, AFOS, the Automation of Field Operations and Services System now being brought to readiness by the Weather Service. Zimmerman is a good person to ask. "I was in one of the early groups to work with AFOS," he says. "You have to develop some new skills, of course, because you're drawing the salient facts from a very large mass of information. But I'm looking forward to AFOS, as I think most of us are."

Sunday. The forecast is on the mark. Last night the ceiling lowered, the wind

blew, and it began to rain, hard, in Atlanta. It is still raining today, and 845 stands down. With so much weather around, it seems a good time to go look at the wave of the future out at Charlie Brown airport.

We had noticed a difference getting weather updates from the flight service station people in Atlanta. Usually, you state your needs and there is some shuffling of papers and movement, as the briefer sifts through weather maps and wind printouts and other oddments held on tacks and clipboards somewhere nearby. But here the answers to any weather question come back immediately—fronts, winds along the line of flight, wind velocities aloft, terminal forecasts.

At the Atlanta flight service station we see why.

The room is curtained, dimly lighted, filled with warm wood-colored conso.es and the dark cyclopses of cathode ray displays, where luminous green words and numbers bloom and disappear. Along one wall 10 television screens display the remoted sweep of distant radars, synoptic surface and upper air weather maps of the United States, and other graphics electronically piped in from the National Meteorological Center. FAA briefers at perhaps a dozen consoles do their quiet work with a computer keyboard and television screen. A world of timely weather data from a central collection point in Kansas City is at their fingertips, and what they can do, compared to briefers at little stations like the one at Emporia, is Faustian.

Suppose, for example, that you want to fly from Atlanta to Seattle. The briefers, in milliseconds, can whistle up current and forecast winds and weather for every terminal along your route of flight. They can give you this information for a ten-mile or fifty-mile or hundred-mile band along your route. They can call up images from the radars at Athens and Albany, and many more. There seems no weather information they can't give you. And they can punch a button and have the entire mountain of data printed out as hard copy for later reference in the cockpit.

This afternoon they say today's weather over Atlanta will be gone late tonight, and we should have a clear but windy flight to Miami in the morning. We nod, dazzled and dazed by this visit to the future, then go back out into the rain to see how close they come.

Monday. The weekend rains are just a steamy memory, and 845 is at three thousand feet and turning south out past the strange lump of Stone Mountain by 9:30. The front, now pushed eastward and out to sea, has strong northwest winds behind it. How strong, we learn a few hours later at Sanford, Florida, where the lineman gives us a report on yesterday's local winds along with fuel. "They blew over some planes here. One was a P-51. I sure did hate to see that P-51 get blown over."

Miami Beach comes up on our right flank toward sunset, and we turn in toward the crowded pattern at Opa-Locka.

Friday. The Miami Weather Service Forecast Office perches on the University of Miami computer building, which it shares with NOAA's National Hurricane and Experimental Meteorology Laboratory (among others).

Glenn Schwartz is aviation forecaster today, and, in terms of the tools available to him, straddles two generations of aviation weather services. On the one hand, he uses the various facsimile maps and satellite photos tacked to his bulletin board. On the other, he has a terminal similar to those we saw in Atlanta. "They're forerunners of AFOS," he explains. "We use them for aviation, marine, and other public weather work. Mainly we're learning how to bring this kind of system into our operational routines."

This is like AWANS in that Schwartz can call up any scrap of weather information for the United States, and get terminal reports and forecasts for any city in the world if he knows its call letters. This is important, for weather services offered to Miami pilots need a generous seasoning of international data. Miami is a terminus for flights to and from just about everywhere, including the unscheduled routine of a huge tramp fleet plying trade routes to the south.

The major difference between what Schwartz is using and the FAA's experimental system in Atlanta is that it performs as a full partner in the forecasting routine. Reports and forecasts and warnings are both transmitted and received on the video display here, doing in a few broken seconds what the high-speed teletypewriters clacking away next door need tens of seconds to do.

As Schwartz pecks at the keyboard, green glowing letters and numbers flash upon the screen. They are a kind of numerical puzzle, composed of the data a forecaster needs to prepare a terminal forecast. (The Miami Weather Service Forecast Office, like the Atlanta Office, has a wide beat, preparing terminals for a dozen cities in Florida.) Schwartz pushes more keys and the computer behind the glowing display produces another field of green digits. "The computer does some of its own writing," says Schwartz. He touches the keys again and the computer writes the Miami and vicinity forecast. This is just the beginning of the computer's literary career. Future refinements will give the automated system more and more forecasts to write. "Sometimes the idiom is not quite right," the human forecaster explains. Today the electronic diction is faultless.

The good news, for lightplane pilots heading north, is mostly in how well the equipment works. The weather deteriorates the farther one flies from Miami today, for a front is driving in from the northwest. Behind it the isobars look like the ribcage of a giant creature lying on the land between Alabama and the Rockies. Down south, where the ribs are close together, the winds will be fierce and angled in from the

FAA pilot-briefer calls up Athens (Georgia) radar on television display (above); Glenn Schwartz, aviation forecaster in Miami, uses satellite photos to work up forecasts on computer terminal (below). FAA's experimental system at Charlie Brown airport in suburban Atlanta is far cry from small flight service stations.

west and northwest enough to retrieve from 845 some of that grand groundspeed we had coming south. Then, as the ribs spread out some, the wind should gentle to the perpetual buffet that sweeps the high, dry states west of the Mississippi.

By nine a.m. 845 is turning northwest out of the Opa-Locka pattern. Scattered clouds become broken over the peninsula, the altocumuli forming on a northward-climbing ramp. Their tops, just beginning to build under the tropical sun, climb as fast as the Cardinal—four thousand-foot tops go to six, then to eight. In the distance we see our first real barrier to flight, the great wall of the predicted front, still hundreds of miles away, and the plume of cirrus just drawing a high horizontal curtain across the blue dome of sky.

The type of flying you do influences the kind of weather information you need—and, indirectly, the quality of the information you receive. This is a VFR—for Visual Flight Rules—flight, and maintaining VFR

is the chief constraint on how we conduct ourselves and 845. VFR doesn't mean a pilot must wait for a calm, cloudless day, for VFR conditions can still take you into some awful weather. You can fly at night, or in terrible winds, or light rain, or haze. But you must regard all cloud as being made of granite, and keep clear. The higher you are, the clearer you must keep. You must also be able to descend without penetrating the white stuff. In uncontrolled airspace you must have a ceiling (the vertical distance from the ground to the base of an overcast) of at least a thousand feet above the ground and forward visibility of at least a mile; in controlled airspace, as where airways converge near an airport omni station, a thousand-foot ceiling and visibility of at least three miles. These are not great conditions—think of driving down a two-lane road that is everywhere open to other vehicles, at one hundred fifty miles an hour, able to see a mile (or 24 seconds) ahead of your hood ornament.

Aviation weather information for VFR flight tends to be on the mark, and serves the pilot well as long as he plays the game and avoids weather where it is marked by cloud. The alternative is to venture into the instrument side of flying—what used to be called "flying blind"—where the demands on the pilot, and the weatherman, increase exponentially.

Instrument flight in effect puts the pilot where the meteorologist needs to be, but can't: inside the weather. While a weather forecaster can tell where thunderstorms are, and even identify the worst cells, he is limited by scale and that old devil, state of the art. A small airplane can be turned into as many pieces as a two-pound fryer by intrasystem weather too small or too transient to make much of an impression meteorologically. Wind shear conditions—the turbulent boundaries between currents of wind moving in different directions, at different speeds—are difficult to predict now, but can be a notable hazard to airplanes without regard to power, speed, or weight. Icing conditions wax and wane inside clouds, governed by moisture and temperature processes occurring down to the microscopic scale.

Aviation weather forecasters do what they can do to get all the information they can into the cloudbound cockpits of instrument-flying pilots. As the state of the art advances they will do more and do it better. But this will always be one of the truly difficult tasks in meteorology—providing information from outside the weather that pilots in with all that wind, rain, lightning, and ice, find useful.

Our forecast put the front across the line of flight, and for a time this is the only wild card. How will a weather system, slipping across the rotating planet on inclined planes of atmospheric density, move? They accelerate. They stall. They know nothing of meteorology. We're filed to Tallahassee, where we will try to sit on the ground while the front goes through.

But there is another joker in today's deck. The sea fog reported for places like Panama City and coastal areas to the southeast is persisting, and now extends some distance inland. The cloud below us is less broken than it was. We decide to get down where we can get off the radios and back on the railroads and highways, before the cloudy crevasses seal us on top. We spiral down to about a thousand feet, careful not to brush the untouchable white billows on either side. Down here we are VFR now, but that is about all. We call the St. Petersburg flight service station. He comes on, tells us about sea fog moving in. As he speaks we see the low-level haze turning opaque ahead of us. We radio the listening FAA man that conditions at our position are exactly what he described, and change our flight plan to fly the edges of it as far north as we can before the ceiling forces 845 to rest. The front, St. Petersburg says, probably won't come through until tonight.

We turn to the northeast to move clear of the sea fog, and the cirrus peak of the approaching front becomes visible through

large breaks in the cloud. But soon we're back beneath solid overcast at about two thousand, and we check in with the flight service station at Gainesville. They give us additional weather information—mainly, the front still lags the forecast. We turn northwest again, planning to run under the cloud as far as we can. The navigator keeps us on a line, one airport at a time. At Lake City the ceiling is about fifteen hundred. We press on to Live Oak, where we have a thousand feet and just a pinch more, and put 845 down at the Suwannee County airport. By the time we get to town there is some windy rain ahead of the front. Late that night we hear the howls and bumps and whipping rains of a frontal passage.

Saturday. Cardinal 845 is up and out of Live Oak not long after the front goes through, rising on a strong buffeting wind from the northwest. We expect the weather to improve, although the winds are forecast to blow ill for everybody headed northwest today. On the whole, we are optimistic about the prospects for better weather.

This optimism derives from the involuntary spending of a rainy night in Live Oak, a small north Florida town east of Tallahassee we understand is the watermelon capital of the world, in season; but which, on this night, was a small island in that panhandle countryside, where a stalled front and other permutations could pin us down for days. Moreover, in Live Oak you are in one of those occasional dead zones between very-high-frequency radios, which, like television signals, follow a line of sight. Coming in yesterday we found ourselves unable to contact or hear the flight service stations at Valdosta, Georgia, to the north, or Gainesville, to the south, or Tallahassee, to the west. Our links with aviation weakened, along with the prospect of continuing the trip today.

Given such downbeat feelings, whence came today's optimism?

From a program called *Aviation Weather*, viewed on the pale grey rectangle of the motel television last night at eleven. In Live Oak, we got *Aviation Weather*, which was produced jointly by the National Weather Service and the FAA, from WJCT Channel 7, Jacksonville's public television station. For those who look at something else late Friday nights, *Aviation Weather* was a weekend summary of what aviators can expect from Friday afternoon through Sunday, plus some "back-of-the-book" training features. If there was an occasion when this very useful program was more useful than at other times, it was when a VFR airman was pinned down by weather in a town like Live Oak, barely into a two-thousand-mile journey, and out of radio contact with the aviation weather system.

The program explained what happened with Friday's weather, and confirmed that Live Oak was the place to place 845 on the ground—the weather ahead of us quickly went to the murky conditions of IFR (instrument flight rules), just as it seemed to be doing. Saturday a.m. the weather ahead would improve. Sunday would be fine. A body can sleep after that kind of briefing, and be out past Tallahassee early, full of optimism.

By mid-morning we're crossing the Alabama country that resembles England from the air. There is enough wind to keep us at maneuvering speed, and enough headwind aloft to make it worthwhile, flying in the turbulence at a thousand feet. By Mississippi, all the weather is behind us, and even the little rotors the wind spins up along the dome of an inversion have been absorbed into the big clear atmosphere covering the United States today.

Key Field at Meridian is the lunch stop, and a place to get some additional weather. It is an interesting field, where general aviation planes and airliners mix with a Mississippi National Guard squadron of F-101's.

Daniel Mondella has the con at the Meridian weather station today, which is located in the terminal next door to the FAA flight service station. "They do most of the pilot briefing over there," he says, "but we do some special standup briefings for the Guard unit when they're flying a mission." The six people at the Meridian office, where native Charlie Gray is meteorologist-in-charge, also provide various weather services to ten Mississippi counties. Today Mondella takes us around, between answering weather questions on the telephone that rings from time to time. He has been in the weather business for 20 years, counting his military service, and comes to Meridian from an upper-air unit at Lake Charles, Louisiana. He shows the old WSR-3 radar in a dark little room off the main area and says, as others have, "We're expecting to get an Enterprise this summer."

Sunday. The night was spent in Hot Springs, Arkansas, where 835 arrived as the first horserace of the season let out and Memorial airport was launching big twins and bizjets like a carrier at Midway. Today is another early start, climbing over the mountains and thirty-mile-long Lake Quachita, a surprising little ocean in the Arkansas hills. The pale green of the charted lowlands begins to give way to the darker greens and browns of elevation, as the land climbs the mile toward Colorado. The weather continues to be everything *Aviation Weather* and the Valdosta flight service station said it would be.

Passing Fort Smith we see our first military jets—an aging F-86 whips across our bow a couple of hundred yards away. Then, two thousand feet below us, three F-101's in battle dress zip past like arrows. We comfort ourselves by repeating, "845 is *not* a tricycle!"

Tulsa International comes up near lunchtime. We enter its radar control 20 miles out and are guided into what turns out to be a big-city airport, alive with jet liners and aviation of all types and sizes.

The Weather Service office here is a big operation, as is the FAA side of a building shared by feds and a fixed base operator. Melvin Reed is the duty Weather Service specialist this Sunday, along with Arthur Kline. Here we get to see our first Enterprise radar. Reed who has spent many years with weather radars at Oklahoma City and Tampa, is enthusiastic.

"It's a five-point-four-centimeter radar," he explains, referring to the wavelength of the radar pulse, "and all solid state. It gives us a 250-nautical-mile range and it has the VIP capability." VIP is an acronym for Video Indicator Process (or contouring). "This lets us pick out our heavy thunderstorms, and search stormy areas for extremes. It also gives us better tops than we've had before."

Tulsa needs this kind of sophisticated reach. They cover 20 counties in northeastern and eastern Oklahoma. On the aviation side, they back up the busy flight service station and brief pilots who want forecasts out beyond the normal 24-hour terminals.

Tulsa is deep in the heart of tornado country, and this gives their radar and their day-to-day spring and summer meteorology a special focus. Part of this focus is what may be a unique direct warning set-up that lets them take severe storm, tornado, and other warning information as close to the people of Tulsa as their nearest radio talk show.

"We go directly into broadcasting stations on the public access telephone line," Reed says, "and are broadcast either live or taped a few seconds later." That is the merest tip of the tornado preparedness iceberg. The Weather Service Office has also recruited about 150 volunteers who live around Tulsa and in the other counties served by the Weather Service Office here.

"They're all licensed ham radio operators," says Reed, "not just citizen's band-trained, and they give us reports on conditions in the path of severe weather. In a way, they're the other half of our radar capability, because they can verify what we're seeing in a severe storm cell on radar —hail, for example—is actually occurring in that area. They really do a job."

The rest of the trip is a race. First we race the wind, now from the southwest, and a fuel needle dropping toward Empty over the uncrowded plains of Kansas, where we get our last tankful at Dodge City, from a fixed base operator with the sobering name: Boot Hill Aviation. Then we race a setting sun.

The automatic direction finder senses the radio beacon at Fort Collins-Loveland airport minutes west of Dodge City. Soon Pikes Peak raises its hump down to the southeast, and seems to move with us for awhile, like the moon. The other mountains push out of the horizon, and slowly swallow the sun.

We come in over the early lights of the Denver metropolitan area. Ahead of us the airport beacon winks green-white, green-white. The runway lights come on. The navigator folds her sectionals and checks the sleeping infant passenger. The co-pilot stirs. And 845 returns to earth.

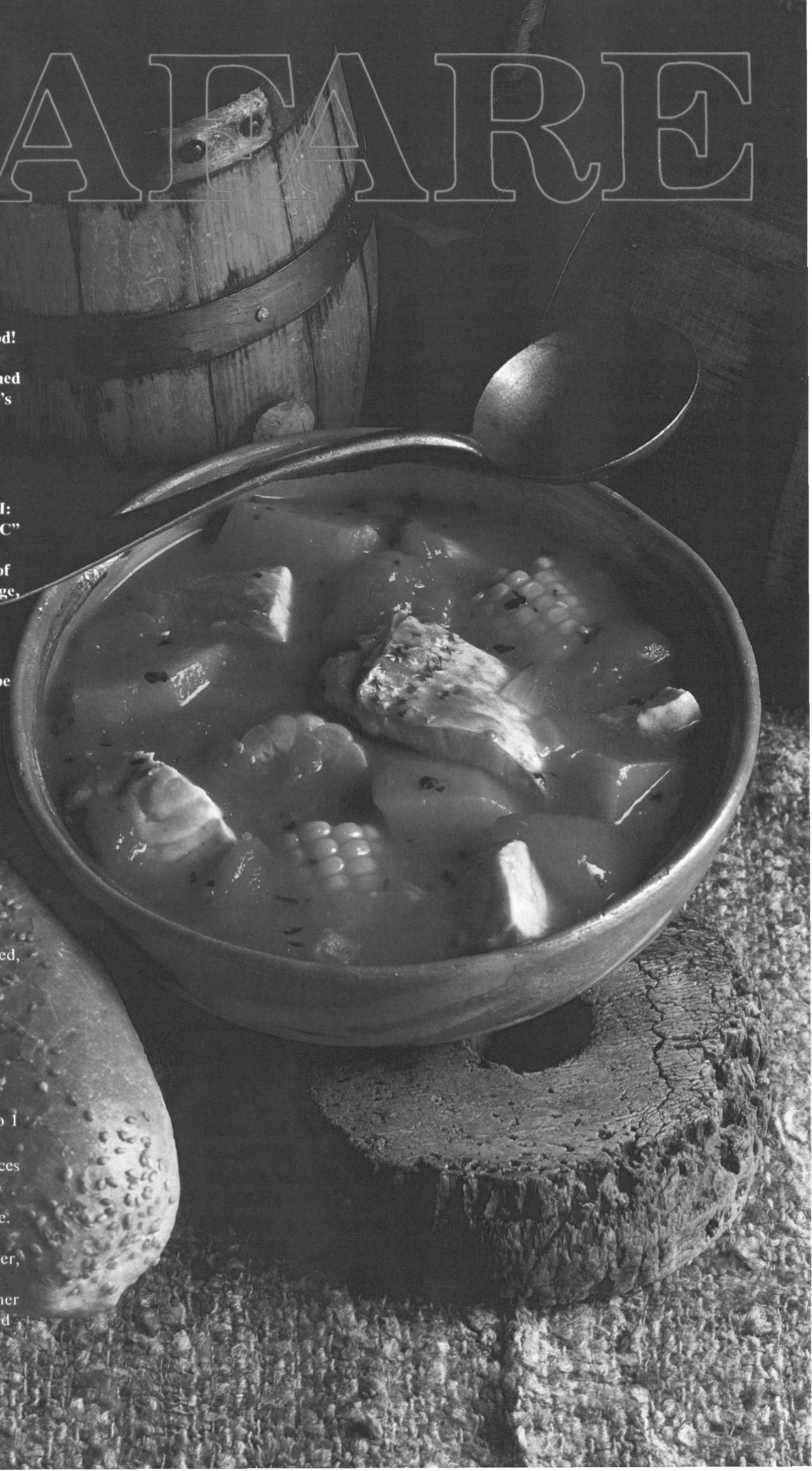
SEAFARE

Bicentennial Spectacular

Celebrate America's birthday with seafood! This is the message from the new three-volume set of heritage cookbooks published by the National Marine Fisheries Service's National Fishery Education Center.

"A Seafood Heritage, Volume I: FROM PLYMOUTH TO THE PRAIRIES," presents the first region of America's first industry. "A Seafood Heritage, Volume II: FROM THE PLAINS TO THE PACIFIC" depicts the simple fare of the rugged pioneer era as well as the elegant dishes of the developing cities. "A Seafood Heritage, Volume III: FROM THE RAPPAHANNOCK TO THE RIO GRANDE" presents the Southern seafood cuisine.

The just-published cookbooks will soon be available from Government bookstores and the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.



Portuguese Fisherman's Stew

- 2 pounds striped bass fillets or other fish fillets, fresh or frozen
- 1 tablespoon margarine or butter
- 1 cup chopped onion
- 1 clove garlic, crushed
- 2 cans (1 pound each) tomatoes, undrained, cut up
- 3 cups water
- 1 teaspoon leaf basil
- 1 teaspoon leaf thyme
- ¼ teaspoon crushed red pepper
- 1 tablespoon salt
- 4 cups pumpkin or winter squash, cut into 1 inch cubes
- 2 ears corn, cut crosswise into 1 inch pieces

Thaw fish if frozen. Cut fish into 1 inch cubes. In a large saucepan melt margarine. Add onion and garlic and cook until vegetables are tender. Add tomatoes, water, basil, thyme, red pepper, salt, pumpkin, and corn. Cover and bring to a boil; simmer for 10 to 15 minutes or until pumpkin and corn are done. Add fish and continue to cook for 5 to 10 minutes or until fish flakes easily when tested with a fork. Makes 12 cups.

Creole Jambalaya

1½ pounds raw, peeled, and deveined shrimp, fresh or frozen
2 tablespoons margarine or butter
¾ cup chopped onion
½ cup chopped celery
¼ cup chopped green pepper
1 tablespoon chopped parsley
1 clove garlic, minced
2 cups, cubed, fully cooked ham
1 can (28 ounces) tomatoes, undrained, cut up
1 can (10½ ounces) beef broth plus 1 can water
1 cup uncooked long grain rice
1 teaspoon sugar
½ teaspoon dried thyme leaves, crushed
½ teaspoon chili powder
¼ teaspoon pepper

Thaw shrimp if frozen. Melt margarine in Dutch oven. Add onion, celery, green pepper, parsley, and garlic. Cover and cook until tender. Add remaining ingredients, except shrimp. Cover and simmer 25 minutes or until rice is tender. Add shrimp. Simmer uncovered to desired consistency and until shrimp are cooked, about 5 to 10 minutes. Makes 6 to 8 servings.

Minted Trout

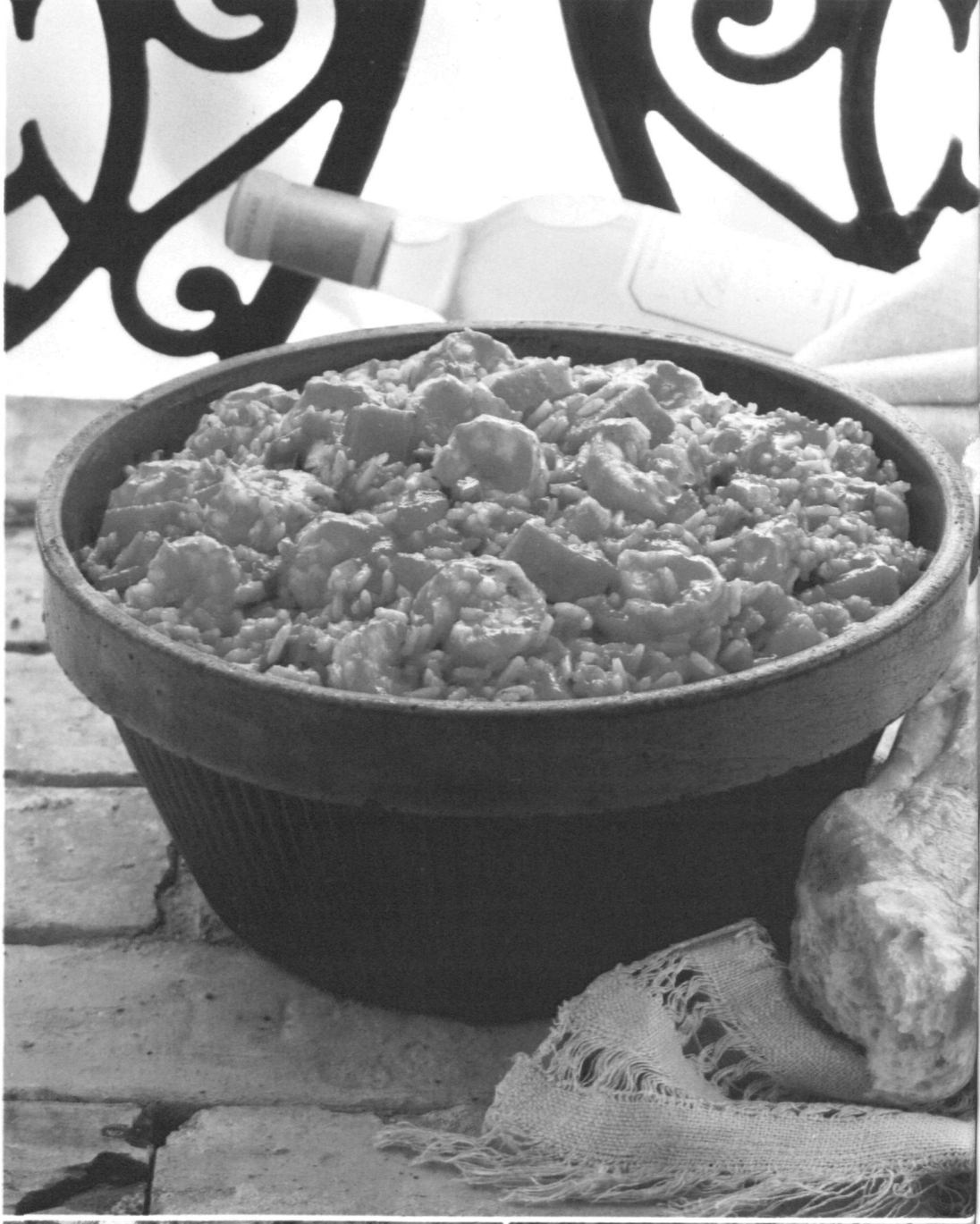
6 dressed trout or other small dressed fish, fresh or frozen
3 cups fresh mint leaves, lightly packed or
¾ cup crushed dried mint
1 tablespoon salt
¾ cup olive or salad oil
6 strips of bacon

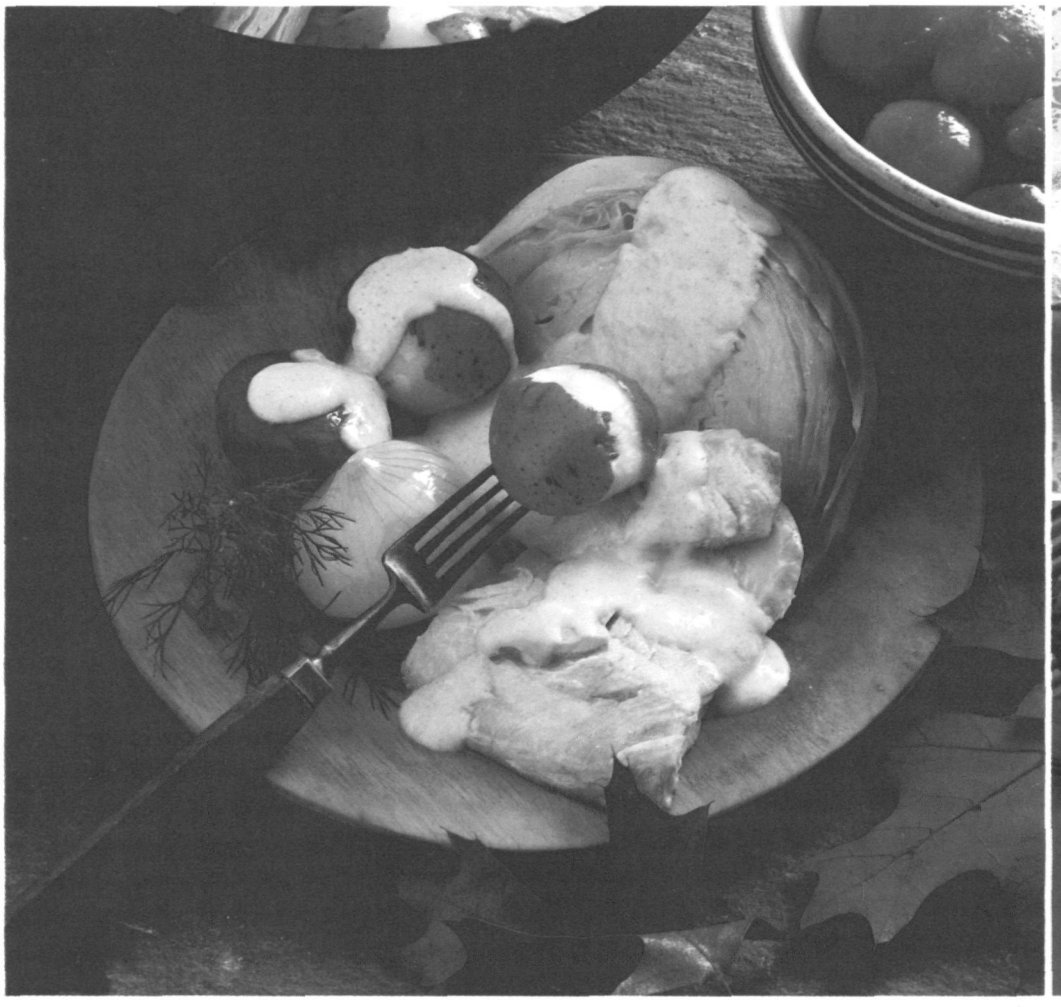
Thaw fish if frozen. Clean, wash, and dry fish. Mash fresh mint with salt to release the flavor; add oil. If using dried mint, mix it with salt and oil. Fill the cavities of the fish with mint mixture. Wrap each fish with one strip of bacon; secure with toothpicks. Broil over hot coals or under broiler, 4 to 6 inches from source of heat, for 4 to 5 minutes; turn and cook 4 to 5 minutes longer or until fish flakes easily when tested with a fork. Makes 6 servings.

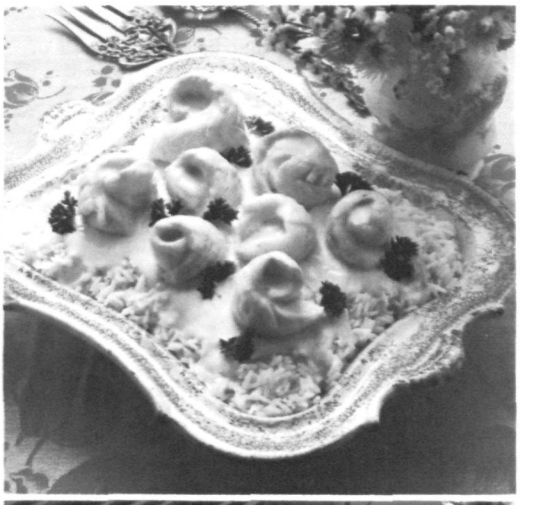
Florida Red Snapper

2 pounds red snapper flllets or other fish fillets, fresh or frozen
¼ cup grated onion
2 tablespoons orange juice
2 tablespoons lemon juice
2 teaspoons grated orange rind
½ teaspoon salt
⅛ teaspoon nutmeg
⅛ teaspoon pepper

Thaw fillets if frozen. Cut fish into 6 portions. Place in a single layer, skin side down, in a well-greased baking dish, 12 x 8 x 2 inches. Combine onion, orange and lemon juice, orange rind, and salt. Pour over fish; cover and place in refrigerator to marinate 30 minutes. Sprinkle flsh with nutmeg and pepper. Bake in a moderate over, 350° F., for 25 to 30 minutes or until fish flakes easily when tested with a fork. Makes 6 servings.







Door County Fish Boil

2 pounds whitefish or other fish fillets, fresh or frozen

10 cups water

1/3 cup salt

12 small red potatoes

6 medium onions, peeled

6 wedges cabbage

1 can (1 pound) small whole beets

Horseradish Sauce

Chopped parsley

Thaw fish if frozen. Cut into serving size portions. In a large pot heat water and salt to boiling. Remove a ½ inch strip of peeling around middle of potatoes. Add potatoes and onion to water; simmer 30 minutes or until fork tender. Add cabbage wedges; simmer about 10 minutes until tender. Add fish and simmer 3 to 4 minutes or until fish flakes easily when tested with a fork. Remove vegetables and fish to a serving platter and keep warm. Add beets to water and heat. Remove beets to platter with other vegetables and fish. Pour Horseradish Sauce over vegeables and fish. Garnish with finely chopped parsley. Makes 6 servings.

Horseradish Sauce

½ cup prepared horseradish

1 tablespoon all-purpose flour

¼ teaspoon paprika

½ teaspoon salt

1 cup half and half

In a small saucepan combine horseradish, flour, paprika, and salt. Stir in half and half. Cook until thickened, stirring constantly. Makes approximately 1½ cups sauce.

Perch Turbans a la Newburg

2 pounds ocean perch or other fish fillets, fresh or frozen

1 teaspoon salt

¼ teaspoon pepper

¼ cup melted margarine or butter

2 cups cooked rice

Paprika

Thaw fish if frozen. Skin fillets and cut into serving size portions. Sprinkle with salt and pepper. Roll fillets into a turban and secure with a toothpick. Place turbans on end in a well-greased baking dish, 8 x 8 x 2 inches. Brush with melted margarine. Bake in a moderate oven, 350° F., for 15 to 20 minutes or until fish flakes easily when tested with a fork. To serve, remove toothpicks from turbans and place on a bed of rice. Spoon Newburg Sauce over turbans. Garnish with paprika. Makes 6 servings.

Newburg Sauce

½ cup margarine or butter

¼ cup all-purpose flour

½ teaspoon salt

⅛ teaspoon cayenne pepper

3 cups half and half

6 eggs yolks, beaten

1/3 cup sherry

In a saucepan melt margarine. Stir in flour, salt, and cayenne. Add half and half gradually and cook until thick and smooth, stirring constantly. Stir a little of the hot sauce into the egg yolks; add to remaining sauce, stirring constantly. Remove from heat and slowly stir in sherry.

Sanddabs, Grant Avenue

3 pounds dressed sanddabs or other dressed fish, fresh or frozen

1 tablespoon peeled, grated ginger root

2 teaspoons salt

4 whole green onions

1 quart boiling water

1/3 cup salad oil, heated

1/3 cup soy sauce

½ cup diagonally sliced green onions and tops for garnish

Thaw fish if frozen. Clean, wash, and dry fish. Arrange fish on heat-proof platter; sprinkle with ginger and salt. Place whole green onions on top of fish. Place platter on a trivet or rack inside a steamer or large roaster containing the boiling water. Cover and cook over boiling water for 5 to 10 minutes, or until fish flakes easily when tested with a fork. Remove fish from steamer. Discard onions and drain any water from the platter. Combine oil and soy sauce and pour sauce over fish; garnish with diagonally sliced green onions. Makes 6 servings.

True Cod Kebabs, Teriyaki

2 pounds true cod or other fish fillets, fresh or frozen
1 can (16 ounces) pineapple chunks
¼ cup reserved pineapple juice
½ cup soy sauce
¼ cup sherry, optional
2 tablespoons brown sugar
1 tablespoon fresh grated ginger root or 1 teaspoon ground ginger
1 teaspoon dry mustard
1 clove garlic, crushed
1 green pepper, cut into 1-inch squares
3 cups cooked rice, optional

Thaw fish if frozen. Cut into one-inch cubes. Drain pineapple; reserve ¼ cup of liquid. Combine pineapple juice, soy sauce, sherry, brown sugar, ginger, mustard, and garlic. Pour marinade over fish; cover and refrigerate for at least one hour. Drain fish and reserve marinade. Thread fish, pineapple chunks, and green pepper alternately on skewers. Cook over hot coals or under broiler, 4 to 5 inches from source of heat, for 4 to 5 minutes. Baste with marinade. Turn and cook for 4 to 5 minutes longer or until fish flakes easily when tested with a fork. Serve as a main dish on a bed of rice or alone as an hors d'oeuvre. For an extra festive touch, impale a flower on the end of each skewer after cooking. Makes 6 entree servings or 18 to 20 hors d'oeuvres.

Pilgrim's Clam Pie

3 dozen shell clams or 3 cans (8 ounces each) minced clams
1½ cups water
¼ cup margarine or butter
½ cup sliced fresh mushrooms
2 tablespoons minced onion
¼ cup all-purpose flour
¼ teaspoon dry mustard
⅛ teaspoon liquid hot pepper sauce
¼ teaspoon salt
⅛ teaspoon white pepper
1 cup reserved clam liquor
1 cup half and half
1 tablespoon lemon juice
2 tablespoons chopped parsley
2 tablespoons chopped pimiento
Pastry for a 1-crust 9 inch pie
1 egg, beaten

Wash clam shells thoroughly. Place clams in a large pot with water. Bring to a boil and simmer for 8 to 10 minutes or until clams open. Remove clams from shell and cut into fourths. Reserve 1 cup clam liquor. (OR: If using canned clams, drain and reserve 1 cup liquor.) In a skillet melt margarine. Add mushrooms and onion and cook until tender. Stir in flour, mustard, liquid hot pepper sauce, salt, and pepper. Gradually add clam liquor and half and half. Cook, stirring constantly, until thick. Stir in lemon juice, parsley, pimiento, and clams. Pour mixture into a 9-inch round deep-dish pie plate (about 2 inches deep). Roll out pastry dough and place on top of mixture in pie plate; secure dough to the rim of the pie plate by crimping. Vent pastry. Brush with beaten egg. Bake in a hot oven, 370° F., for 25 to 30 minutes or until pastry is browned. Makes 6 servings.

WEATHER...AND THE REVOLUTIONARY WAR

Aug 27, 1776
North wind prevents British fleet from entering the East River and cutting off movement of Washington's troops between New York and Brooklyn during Battle of Long Island.

Dec 1775-Jan 1776
Snow and ice used by Henry Knox to help move fifty captured cannon and mortars by sledge from Ticonderoga to Boston.

Dec 31, 1775-Jan. 1, 1776
Richard Montgomery depends on snowstorm in ill-fated American attempt to seize Quebec.

April 19, 1775
Fighting begins at Lexington—clear sky and east wind.

March 5-6, 1776
Storm disrupts British plans to attack American-held Dorchester Heights.

Aug 29-30, 1776
Fog helps Americans evacuate Long Island after defeat there.

Aug 11-12, 1778
Storm scatters and severely damages French and British fleets off Newport.

Dec 1779-June 1780
Washington winters at Morristown in coldest weather of the campaign—January without a thaw, rivers and bays frozen solid, 4 feet of snow on the ground.

June 28, 1778
Battle of Monmouth is fought in heat so extreme that 37 Americans and 62 British reportedly die of sunstroke.

Dec 1777-June 1778
Continental Army winters at Valley Forge and loses one man in four.

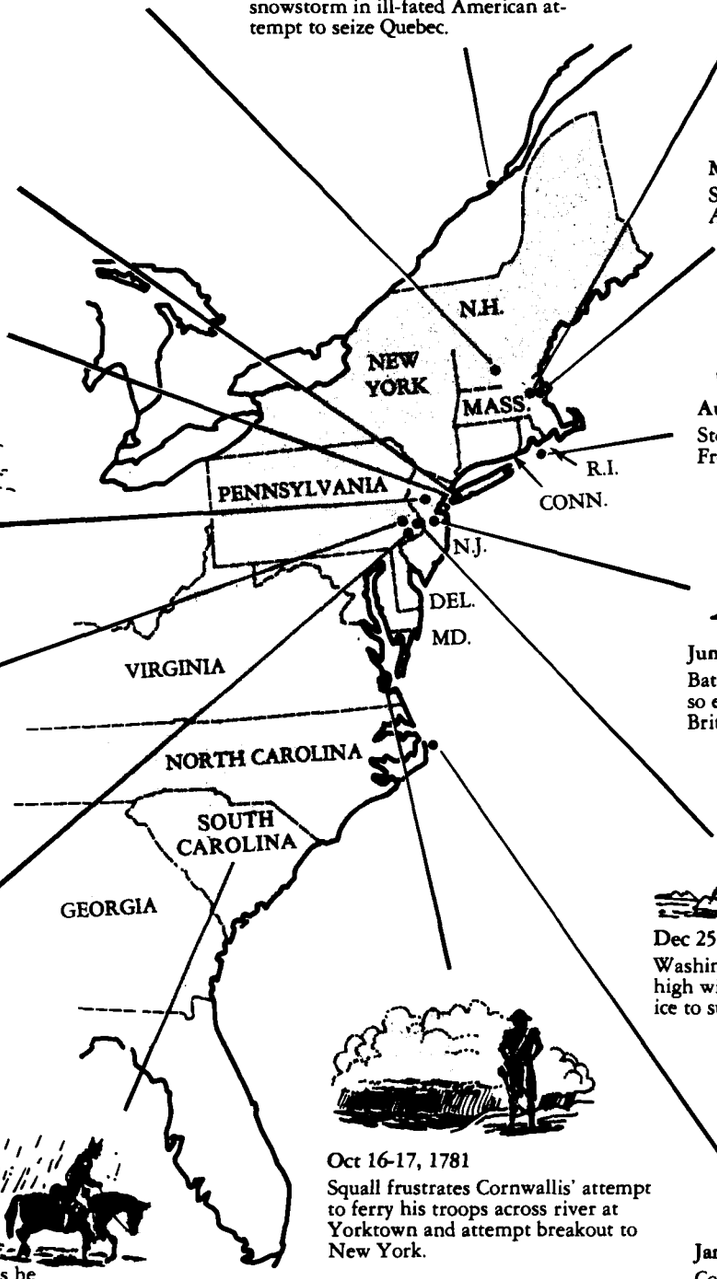
Dec 25-26, 1776
Washington crosses Delaware amid high winds, snow, rain, and drifting ice to surprise and take Trenton.

Oct 4, 1777
Heavy fog at Germantown confuses the fighting; Americans accidentally fire on Americans.

Oct 16-17, 1781
Squall frustrates Cornwallis' attempt to ferry his troops across river at Yorktown and attempt breakout to New York.

Jan-Feb 1781
Heavy rains slow Cornwallis as he unsuccessfully chases Daniel Morgan following surprise American victory at Cowpens.

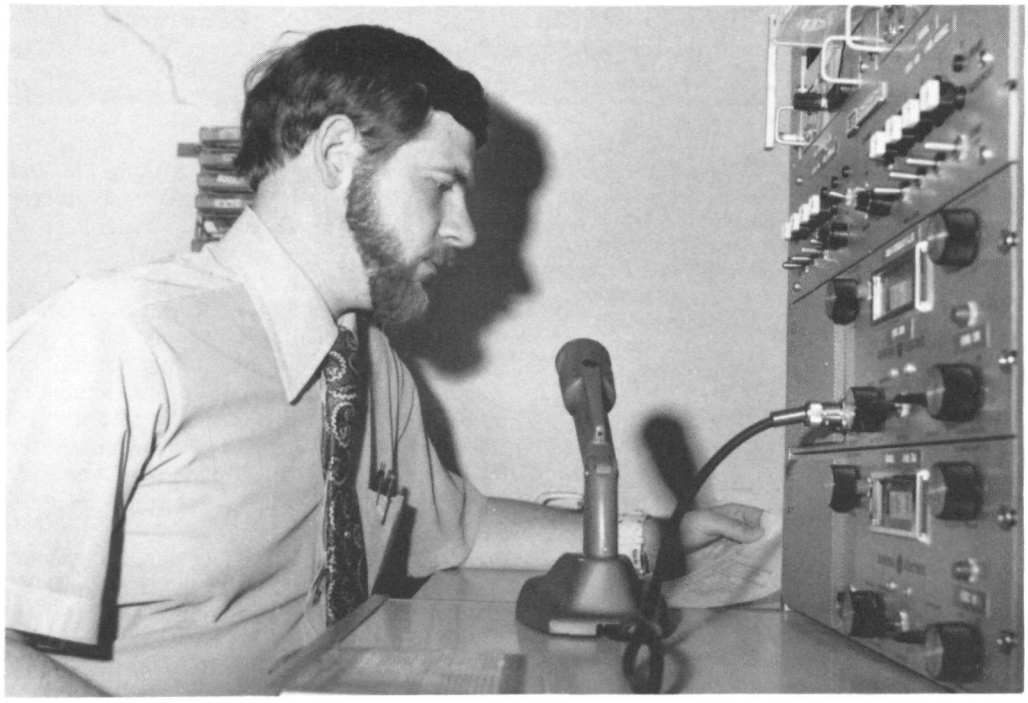
Jan 1780
Coastal storms disperse and sink vessels in British expeditionary force en route from New York to Charleston.



NOAA's expanding weather radio

STORMALERT '76

BY EDWIN P. WEIGEL



Meteorologist Larry Bach of the Washington, D.C., Forecast Office prepares a tape recording for broadcast of NOAA Weather Radio information over KHB-36, the station which covers the nation's capital from a transmitter near Manassas, Va. At left:a major hurricane batters Miami, Fla., September, 1945.

The need: A method for swift alerting of entire populations of metropolitan areas to fast-breaking weather such as tornadoes and flash floods—situations where seconds saved can mean lives saved.

The answer: NOAA Weather Radio.

From a system established in the 1960's by the National Weather Service to provide marine weather forecasts and warnings to recreational boaters, NOAA Weather Radio has grown into the primary means by which the Weather Service plans to spread storm and flood warnings rapidly throughout the nation.

Now numbering more than 100 stations nationwide, the network is expected by 1980 to total well over 300 stations, capable of serving about 90 percent of the U.S. population.

NOAA Weather Radio also serves an important routine function.

During good weather, the weather broadcasts come by tape recordings to listeners directly from Weather Service offices, 24 hours a day, seven days a week, with the latest weather observations and forecasts. The taped messages ordinarily last four to six minutes, and then are repeated without a pause. They are revised every two to three hours, more frequently when appropriate. Effective broadcast range is about 40 miles, but varies somewhat, depending on the terrain and quality of receiver.

When severe weather threatens, forecasters interrupt the routine broadcasts and substitute storm warnings, taped or "live." They also activate specially designed "warning alarm" receivers that have been left in a muted but electronically active state. The activating mechanism is a high-pitched tone or pair of tones that sound inside the receiver when the forecaster presses a button. In some receivers, this triggers a siren that alerts the listener to turn up the volume; in others, it automatically brings the receiver up to full volume so that the forecaster's voice is heard, delivering the warning.

Such warning-alarm receivers are especially valuable for schools, hospitals, nursing homes, factories and other places where large numbers of people congregate who are unable to monitor weather broadcasts themselves. They also are the best means for public safety agencies and news media offices to get warnings of severe weather from Weather Service offices with the absolute minimum of delay.

Because of its unique warning capability and because purchase of a receiver is voluntary, NOAA Weather Radio was designated in January 1975 by the White House Office of Telecommunications Policy as the sole Government-operated radio system to provide warnings directly into people's homes, for both natural disaster and nuclear attack. In the event of enemy attack, NOAA Weather Radio warnings will supplement—not replace—warnings by sirens and by commercial radio and television. NWS is now making arrangements with the Defense Civil Preparedness Agency (the former Office of Civil Defense) to include NOAA transmitters in the attack-warning system.

People who want to hear NOAA Weather Radio broadcasts must purchase special, highband receivers, because the frequencies used—usually 162.40, 162.55, and sometimes 162.475 megahertz—are considerably above the frequencies used for commercial FM broadcasts, which end at 108 megahertz. Weather-frequency receivers are now available in a variety of types, ranging from inexpensive single-purpose models that provide "instant weather" at the push of a button or the twist of a dial, to high-grade commercial receivers with great sensitivity and selectivity. Some have a two-tone activation system which guarantees reception of "warning alarms" with no chance of false triggering. Also on the market are multipurpose radios which offer standard AM/FM frequencies plus the so-called "weather band" as an added feature. These usually are not warning-alarm types.

Photo: Carol A. Silberg

Tornadoes and flash floods are the types of fast-paced weather events where the automatic warning-alarm feature of NOAA Weather Radio can save lives. At above left is a tornado near the Denver, Colo., airport on May 18, 1976. At right is a flash flood which occurred in Maryland on July 15, 1975, after 3.3 inches of rain fell over a small watershed in only 90 minutes.

Until a few years ago, all tone-activated Weather Radio receivers were commercial-grade models costing well over $100. Now, however, there are several on the market or being designed which sell for $50 or less—a price range attractive to many householders.

Quality of performance varies considerably and the Weather Service advises potential customers to be alert for possible problems before buying. Some receivers work well in some settings but not in others. Because of the high frequencies involved, transmission is by line of sight, and, like television, may be blocked or interfered with by hills, large buildings, or nearby commercial transmitters. Sometimes, in fringe areas, such problems may be overcome or range may be extended by use of high, outside antennas.

Because of the uncertainties involved, the Weather Service advises prospective buyers to make final acceptance of a receiver conditional upon a test in the setting in which it is to be used, and urges institutional buyers to select a high-grade commercial receiver.

In addition to its provision of weather reports 24 hours a day, plus the automatic storm-alerting feature for those who want it, NOAA Weather Radio offers a variety of specialized weather information tailored to the needs of listeners in each area. Stations along the seacoasts and Great Lakes provide forecasts for boaters, fishermen, surfers and others engaged in marine activities. River forecasts are given where flooding or waterway navigation are important. Stations in key agricultural areas provide special weather information for farmers, orchardists, and ranchers.

The growing popularity of NOAA Weather Radio is shown by a new type of sponsorship in which states share the cost of installing and maintaining a system with the National Weather Service. Kentucky was first.

In an agreement signed last March by Kentucky Governor Julian M. Carroll and Weather Service Director George P. Cressman, state and federal officials set in motion a plan by which Kentucky obtained eight Weather Radio transmitters—enough to blanket the state—within a few months.

Before, Kentucky had none.

Other states in the South quickly perceived the advantages of a Kentucky-style agreement and launched similar efforts. By late spring, Mississippi Governor Cliff Finch had signed legislation authorizing such a plan, and Alabama and South Carolina were not far behind.

Another boost to NOAA Weather Radio—especially in areas where tornadoes and hurricanes are a chronic threat—has been extension of the broadcasts by retransmission over cable television. The technique has been used for some years now at Corpus Christi and Galveston, Texas, and at Lake Charles, La. The broadcasts are relayed over designated but otherwise unused channels on home television sets. A further refinement allows the NOAA Weather Radio signal to be split off and fed into a conventional FM radio receiver.

Recently, equipment has been placed on the market to provide cable television with a weather-warning capability. With this the cable operator offers subscribers a supplemental service to alert them any time the Weather Service activates its tone signal. A small, boxlike device electronically recognizes the tone and produces a "beep beep" sound loud enough to awaken sleeping occupants. This alerts them to tune to the appropriate cable-TV channel and receive the warning. The alarm works regardless of whether the TV set is on or off, or tuned to any particular channel.

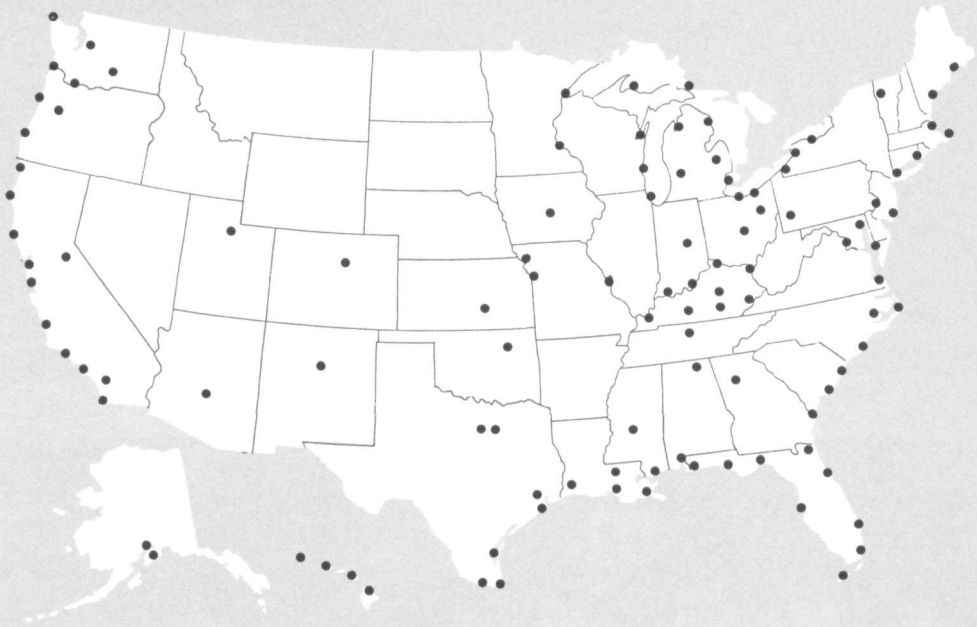
A complementary offering is a voice override by which local public-safety officials can blank out the audio portion on cable-TV channels and issue instructions to cope with a weather emergency. This system also works whether the television set is on or off, and on all channels. It is particularly valuable when local storm spotters report a tornado moving toward a city, because it allows public safety officials to issue warnings immediately, without having to wait for re-issuance of the tornado report by the Weather Service.

Carl Reber, executive officer of the Southern Region of the National Weather Service, says: "This self-help concept is consistent with what we've been trying to promote with disaster-preparedness planning." He adds:

"Retransmission of NOAA Weather Radio broadcasts by cable TV has enormous potential for expansion of the system at essentially no cost to the Weather Service and relatively little to cable-TV operators. This potential will be vastly increased as NOAA Weather Radio is implemented nationwide."

In January, 1976, the Weather Service delivered to the U.S. Senate a report detailing siting plans for the entire NOAA Weather Radio network. Officials explained that the plan is based on population concentrations and on the amount of severe weather to be expected. The proposed network of stations covers all population centers of 50,000 people or more. Implementation will take place, where possible, according to relative incidence of tornadoes, hurricanes, flash floods and winter storms, over a period of several years, thus introducing NOAA Weather Radio's life- and property-saving warnings in the sequence in which they will do the most good.

NOAA WEATHER RADIO OPERATING LOCATIONS Mid-1976



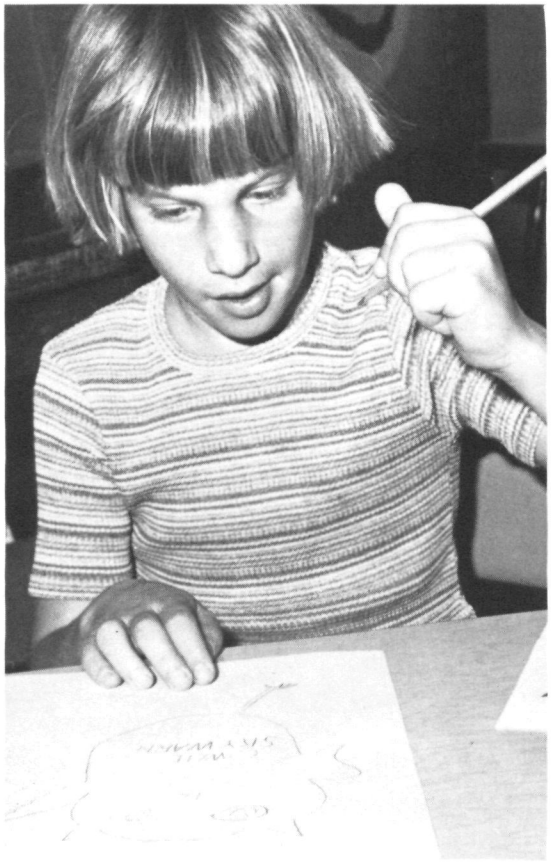
Transmitter Site	Call Letters	Frequency
Alabama		
Huntsville	KIH-20	162.40 MHz
Mobile	KEC-61	162.55 MHz
Alaska		
Anchorage	KEC-43	162.55 MHz
Seward	KEC-81	162.55 MHz
Arizona		
Phoenix	KEC-94	162.55 MHz
California		
Coachella	KIG-78	162.40 MHz
Crescent City, Calif./ Brookings, Ore.	KIH-37	162.55 MHz
Eureka	KEC-82	162.40 MHz
Los Angeles	KWO-37	162.55 MHz
Monterey	KEC-49	162.40 MHz
Point Arena	KIH-30	162.40 MHz
Sacramento	KEC-57	162.40 MHz
San Diego	KEC-62	162.40 MHz
San Francisco	KHB-49	162.55 MHz
San Luis Obispo	KIH-31	162.55 MHz
Santa Barbara	KIH-34	162.40 MHz
Colorado		
Denver	KEC-76	162.55 MHz
Connecticut		
New London	KHB-47	162.40 MHz
Florida		
Daytona Beach	KIH-26	162.40 MHz
Jacksonville	KHB-39	162.55 MHz
Key West	KIH-25	162.40 MHz
Miami	KHB-34	162.55 MHz
Panama City	KGG-67	162.55 MHz
Pensacola	KEC-86	162.40 MHz
Tallahassee	KIH-24	162.40 MHz
Tampa	KHB-32	162.55 MHz
West Palm Beach	KEC-50	162.40 MHz
Georgia		
Atlanta	KEC-80	162.55 MHz
Savannah	KEC-85	162.40 MHz
Hawaii		
Hilo	KBA-99	162.55 MHz
Honolulu	KBA-99	162.55 MHz
Kokee	KBA-99	162.40 MHz
Mt. Haleakala	KBA-99	162.40 MHz
Illinois		
Chicago	KWO-39	162.55 MHz
Indiana		
Evansville	KIG-76	162.55 MHz
Indianapolis	KEC-74	162.55 MHz
Iowa		
Des Moines	KEC-75	162.55 MHz
Kansas		
Wichita	KEC-59	162.55 MHz
Kentucky		
Ashland	KIH-39	162.55 MHz
Bowling Green	KIH-45	162.40 MHz
Covington	KIH-42	162.55 MHz
Hazard	KIH-40	162.475 MHz
Lexington	KIH-41	162.40 MHz
Louisville	KIH-43	162.475 MHz
Mayfield	KIH-46	162.475 MHz
Somerset	KIH-44	162.55 MHz
Louisiana		
Baton Rouge	KHB-46	162.40 MHz
Lake Charles	KHB-42	162.55 MHz
Morgan City	KIH-23	162.475 MHz
New Orleans	KHB-43	162.55 MHz
Maine		
Ellsworth	KEC-93	162.40 MHz
Portland	KDO-95	162.55 MHz
Maryland		
Baltimore	KEC-83	162.40 MHz
Salisbury	KEC-92	162.40 MHz
Massachusetts		
Boston	KHB-35	162.40 MHz
Hyannis	KEC-73	162.55 MHz
Michigan		
Alpena	KIG-83	162.55 MHz
Clio	KIH-29	162.40 MHz
Detroit	KEC-63	162.55 MHz
Grand Rapids	KIG-63	162.55 MHz
Marquette	KIG-66	162.55 MHz
Sault Sainte Marie	KIG-74	162.55 MHz
Traverse City	KIH-22	162.55 MHz
Minnesota		
Duluth	KIG-64	162.55 MHz
Minneapolis	KEC-65	162.55 MHz
Mississippi		
Gulfport	KIH-21	162.40 MHz
Jackson	KIH-38	162.40 MHz
Missouri		
Kansas City	KID-77	162.55 MHz
St. Joseph	KEC-77	162.40 MHz
St. Louis	KDO-89	162.55 MHz
New Jersey		
Atlantic City	KHB-38	162.40 MHz
New Mexico		
Albuquerque	KIG-84	162.40 MHz
New York		
Buffalo	KEB-98	162.55 MHz
New York City	KWO-35	162.55 MHz
Rochester	KHA-53	162.40 MHz
North Carolina		
Cape Hatteras	KIG-77	162.55 MHz
New Bern	KEC-84	162.40 MHz
Wilmington	KHB-31	162.55 MHz
Ohio		
Akron	KDO-94	162.40 MHz
Cleveland	KHB-59	162.55 MHz
Columbus	KIG-86	162.55 MHz
Sandusky	KHB-97	162.40 MHz
Oklahoma		
Tulsa	KIH-27	162.55 MHz
Oregon		
Astoria	KEC-91	162.40 MHz
Coos Bay	KIH-32	162.40 MHz
Eugene	KEC-42	162.40 MHz
Newport	KIH-33	162.55 MHz
Portland	KIG-98	162.55 MHz
Pennsylvania		
Erie	KEC-58	162.40 MHz
Philadelphia	KIH-28	162.475 MHz
Pittsburgh	KIH-35	162.55 MHz
South Carolina		
Charleston	KHB-29	162.55 MHz
Myrtle Beach	KEC-95	162.40 MHz
Tennessee		
Nashville	KIG-79	162.55 MHz
Texas		
Brownsville	KHB-33	162.55 MHz
Corpus Christi	KHB-41	162.55 MHz
Dallas	KEC-56	162.40 MHz
Forth Worth	KEC-55	162.55 MHz
Galveston	KHB-40	162.55 MHz
Houston	KGG-68	162.40 MHz
Pharr	KHB-33	162.40 MHz
Utah		
Salt Lake City	KEC-78	162.55 MHz
Vermont		
Burlington	KIG-60	162.40 MHz
Virginia		
Manassas	KHB-36	162.55 MHz
Norfolk	KHB-37	162.55 MHz
Washington		
Neah Bay	KIH-36	162.55 MHz
Seattle	KHB-60	162.55 MHz
Yakima	KIG-75	162.55 MHz
Wisconsin		
Green Bay	KIG-65	162.55 MHz
Milwaukee	KEC-60	162.40 MHz

OWLIE SKYWARN GOES TO SCHOOL

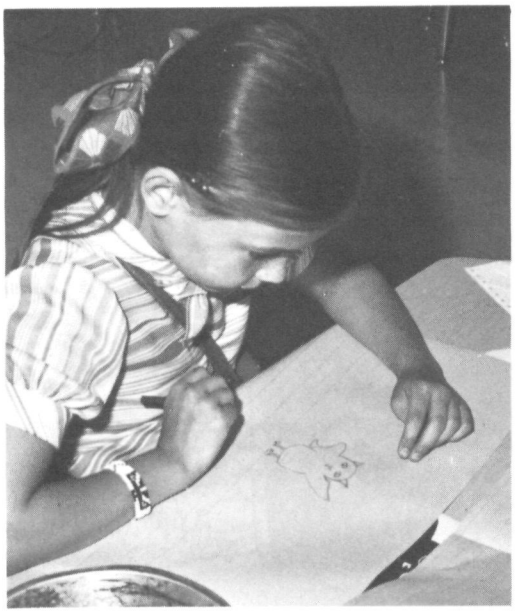
Kendell Mathews' first grade class

The students of Bel Pre Elementary School in Silver Spring, Md., recently enjoyed a visit from Owlie Skywarn, the National Weather Service's main character in a new tornado safety campaign. Owlie visited in the form of a 16-page, two-color booklet which describes in words and pictures how tornadoes form, the chief dangers from these powerful storms, and how a school child should behave in a tornado emergency. Students from Kevin Smith's third grade class, Linda Beard's second grade class, and Kendell Mathews' first grade class, are shown here enjoying the booklets.

Third graders reading the booklets

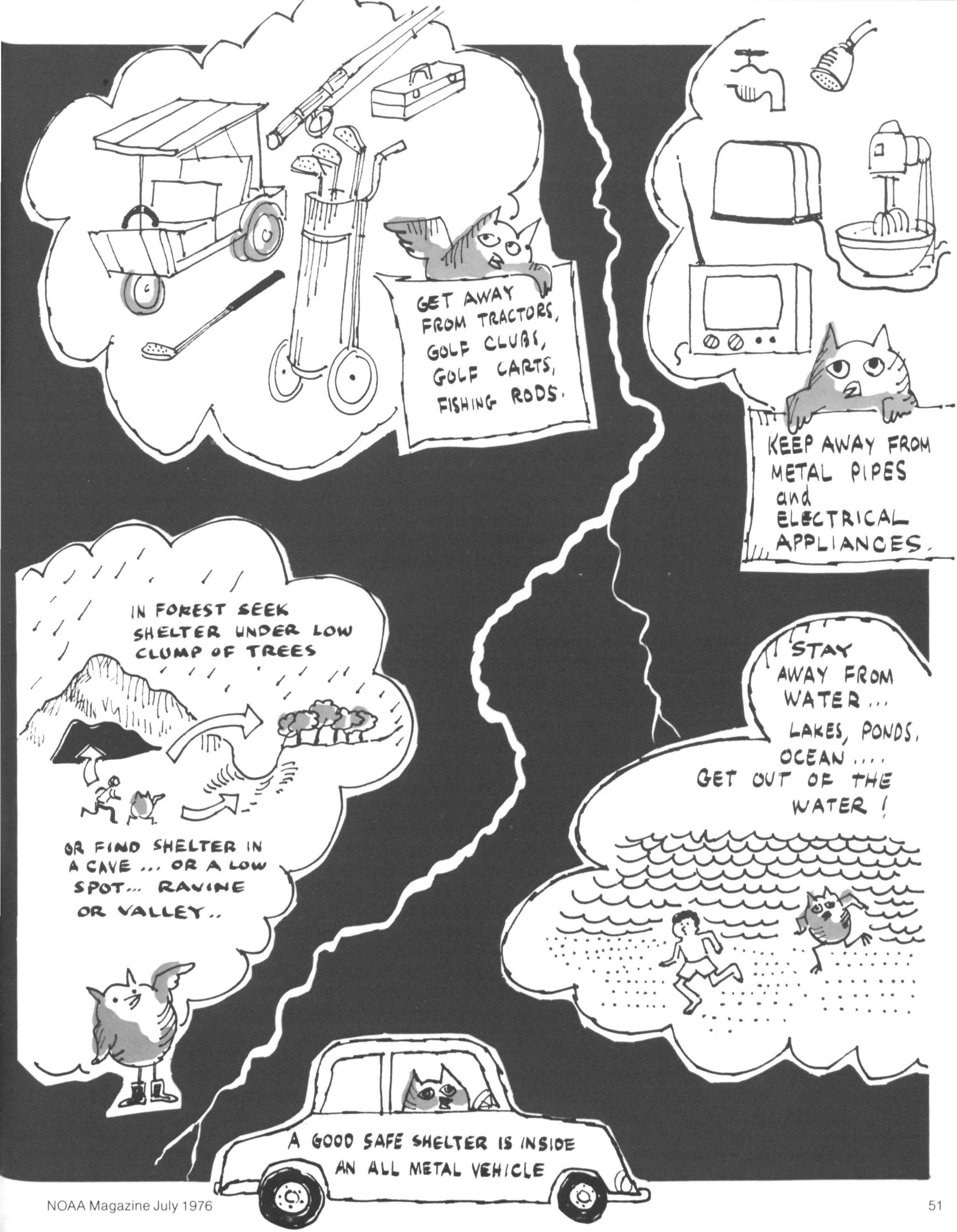


Second graders demonstrating the position to take during a tornado.



Child at work

Owlie's Tips on Lightning Safety
LONE TREES ARE TARGETS. STAY AWAY!
INSIDE A HOME, STAY OFF THE TELEPHONE, EXCEPT FOR EMERGENCIES!
WATCH THE SKY. PLAN A SAFE PLACE TO GO WHEN STORM APPROACHES
GET INSIDE A HOME
OR LARGE BUILDING
SINCE 1944 LIGHTNING HAS KILLED 7000 AMERICANS. LIGHTNING KILLS MORE PEOPLE THAN TORNADOES, HURRICANES OR FLOODS.


GET AWAY FROM TRACTORS, GOLF CLUBS, GOLF CARTS, FISHING RODS.
KEEP AWAY FROM METAL PIPES and ELECTRICAL APPLIANCES.
IN FOREST SEEK SHELTER UNDER LOW CLUMP OF TREES
OR FIND SHELTER IN A CAVE ... OR A LOW SPOT... RAVINE OR VALLEY..
STAY AWAY FROM WATER ... LAKES, PONDS, OCEAN .... GET OUT OF THE WATER !
A GOOD SAFE SHELTER IS INSIDE AN ALL METAL VEHICLE

Engineers answer a call for help

Safer Side Trawling For New England's Fishermen

BY S. BRONWYN HURD *

Fishermen on board New England's side trawlers working the Gulf of Maine and Georges Bank are accustomed to facing danger. Rough weather conditions common to the North Atlantic combined with trawling gear that may have been designed more by custom than by engineering sense have often led to injuries, sometimes serious, among fishing vessels' crewmen. As a result, insurance premiums paid by boat owners for liability coverage have risen sharply; and reduced productivity—exacerbated by declining fisheries resources—has exposed the inefficiency of the dangerous gear.

Seeking solutions to gear problems, fishermen asked several agencies for help, and NOAA—through New England's Sea Grant programs and the National Marine Fisheries Service—responded, as did the Massachusetts fisheries commission. When the Sea Grant Program of the Massachusetts Institute of Technology approached the region's fishing industry late in 1972, offering to undertake research projects that could directly benefit the industry, several fisheries representatives suggested a study to improve the traditional hook-up block. Both James Ackert, then Executive Secretary of the New England Fisheries Association, Inc., and Gayle B. Charles, at that time Manager of Provincetown Co-Operative Fishing Industries, Inc., stressed that a redesigned block could better safety conditions on New England's small draggers.

At this point it should be explained that hook-up blocks—a nagging fisheries hardware problem for many years—are used on side trawlers to guide the two big cables that tow the fishing nets. A hook-up block is attached to the boat's side near the stern by a short heavy chain, and encircles the heavily-loaded net tow cables. As the trawler steams forward, the hook-up block (also called "towing block") prevents the cables from wrapping around the vessel's propeller or whipping over the rail onto the deck. It also provides a common towing point near the trawler's stern, so that the towed net will hold a fairly constant position even while the boat turns.

Blocks and cable under stress, a common sight on fishing boats (above). Crewman on Vinci N., a Gloucester (Mass.) side trawler, begins hooking up, using grappling hook to bring net tow cables to the side of the vessel (right).

By nature a heavy and clumsy device, the old hook-up block had a poor safety record. Urging the M.I.T. Sea Grant Program to conduct research on the device, Charles stated that an improved block could "not only overcome operational problems many fishermen are not even conscious of, but would result in reduction of injury potential and ultimate savings in insurance premiums when stricter fishing vessel safety measures are instituted." Moreover, solving this gear problem "might establish a better understanding between fishermen and mechanical engineers"—much to be desired in an industry that needs engineering know-how to improve its operations.

Sea Grant's hook-up block research began in July, 1973, and first on the agenda for the project's principal investigator, Professor Stephen P. Loutrel of M.I.T.'s Department of Mechanical Engineering, was a lesson in the process and techniques involved in side trawling. He and Dean A. Horn, Executive Officer of the M.I.T. Sea Grant Program, met with Ackert, who described the side trawling operation and explained how the use of existing blocks requires "the positioning of men in areas of the vessel that are dangerous to them during the shooting and retrieving of the nets."

A separate meeting brought Professor Loutrel, graduate students John C. Wall and Nicholas Mango, and Arthur B. Clifton, Sea Grant's Marine Liaison Officer, together with James Boord, at that time Captain of the Corsair Canyon (Gloucester, Mass.), for discussions on block design. Capt. Boord agreed with the project investigators

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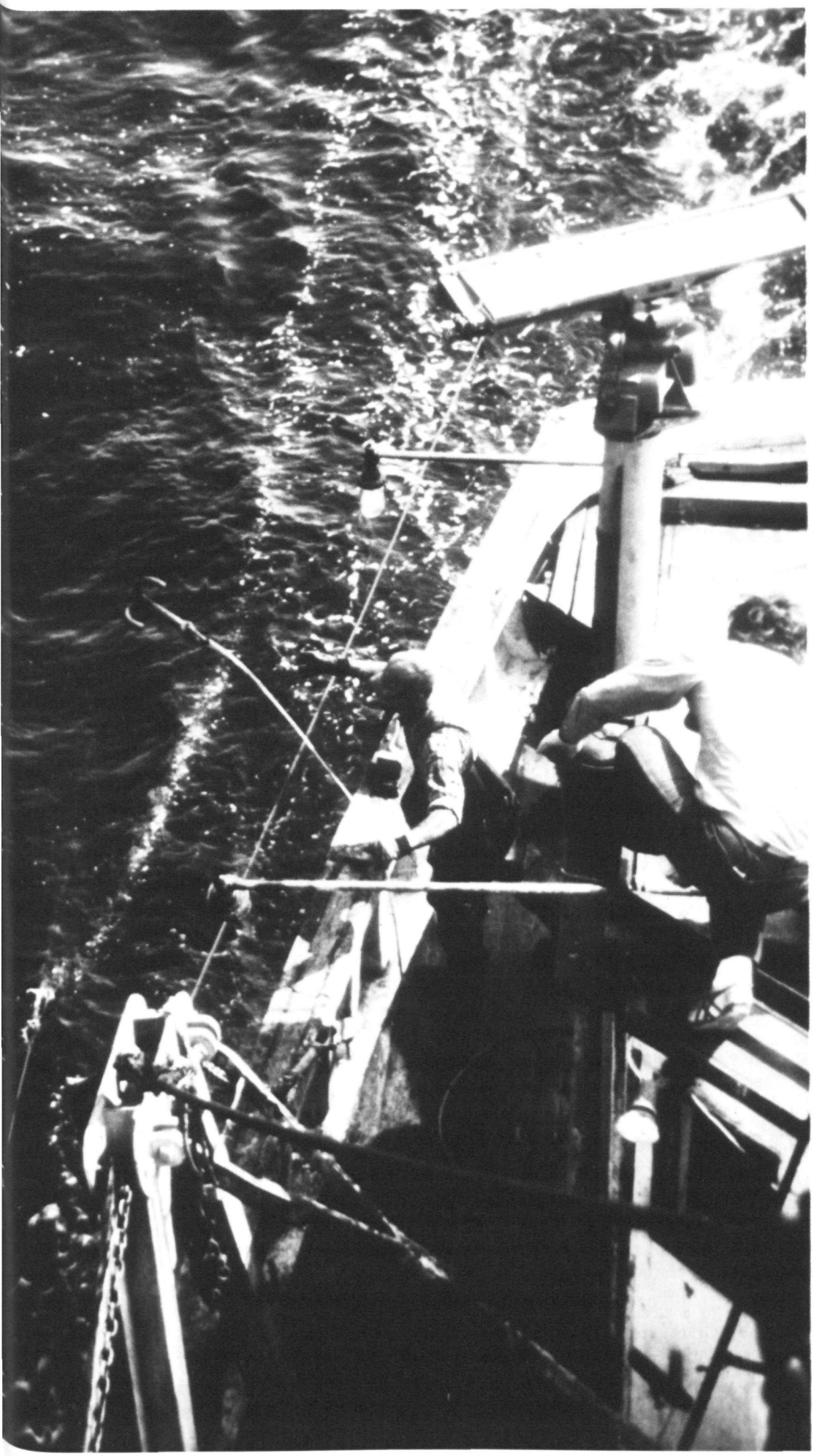
**S. Bronwyn Hurd is Communications Officer in the Sea Grant Program, Massachusetts Institute of Technology*



that automatic opening and closing should be a design concept incorporated into the new block.

Working with Capt. Joseph Novella on board the Vincie N., out of Gloucester, the Sea Grant research team began studies at sea, observing side trawling procedures and the hook-up block's vital role in the setting out and retrieving of the nets. When starting a towing run, they found, the fishing vessel steers in a wide turn to the cable side as the nets are lowered over the rail amidships; the two towing cables attached to the net run out from two gallows frames at the vessel's side. After enough cable has payed out and the net is in towing position, a crewman throws a grappling hook over the two cables and pulls them close to the side of the boat for insertion in the hook-up block.

Typically, it is the green hands who are given this risky job of hooking up. The fisherman has to lean far out over the rail to encircle the heavily stressed cables with the block, a difficult and dangerous position if seas are running high. Unbalanced, and supporting the weight of the block with one hand while fastening it with the other, the man can be thrown overboard, or the rolling of the boat can crush hands and arms between the cables and the vessel's side.

When the trawling run is finished, the cables must be released from the hook-up block so that the full nets can be hauled on board. The crewman again leans out over the boat's rail, inserts a crowbar between the links and pries the block apart. Suddenly released from cables held taut by tons of fish, the block may flip back toward the crewman who has freed it. Many fishermen have been struck and seriously injured by the flying block.

In studying the problem, the M.I.T. researchers looked at alternatives to the block for restraining the side trawlers' cables. However, said Wall, they decided that "since the towing block was already in such widespread use, improvements in the block itself would be more valuable (and more likely to be implemented soon) than any drastic changes in the hook-up operation involving fullscale modification of the boat." Sea Grant's solution therefore is a simpler, safer hook-up block, that can easily replace those currently in use.

Planned and constructed in a series of three prototypes, the new Sea Grant hook-up block meets the design requirements of fast securing and remote releasing of the net tow cables. When the net tow cables are drawn up to the side of the vessel by the grappling hook, the crewman simply steps to the rail and drops or pushes the new block down onto the cables. A gate lever deflects inward, then swings closed to hold the cables securely. The fisherman can attach the new block quickly, in a fraction of the time necessary for the old hook-up operation, and he need not encircle the stressed cables with his arms.

To release the block, the crewman steps

back from the rail, and yanks a lanyard tied to a release lever. The lanyard pulls the lever out, allowing a catch lever to rotate and clear the gate, which then swings open to release the cables. Because the main body of the hook-up block remains motionless in this process, the opened block on its chain usually falls against the trawler's side. Even if it does spring back toward the vessel's rail, the crewman is safely out of harm's way.

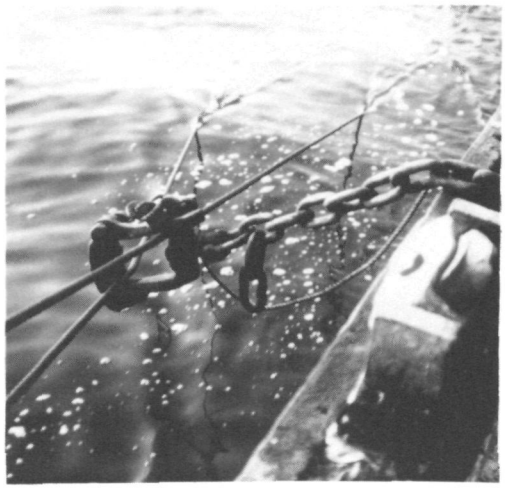
In addition to its obvious safety advantages, the new block quickens the hook-up operation, permitting more efficient use of the trawler's time.

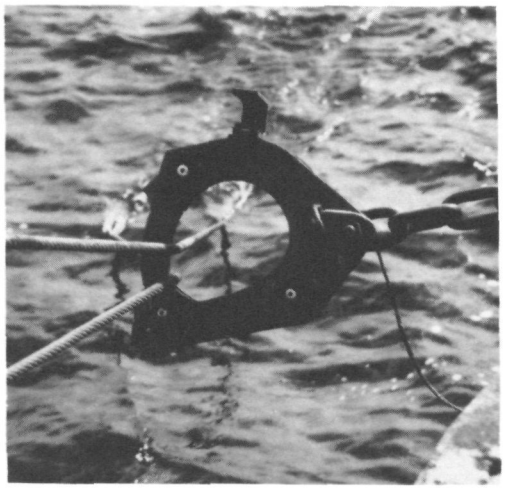
The engineers also aimed for low cost and minimum maintenance. Research on the hook-up block and development of a successful design were the basis for Wall's master's thesis in mechanical engineering at M.I.T.

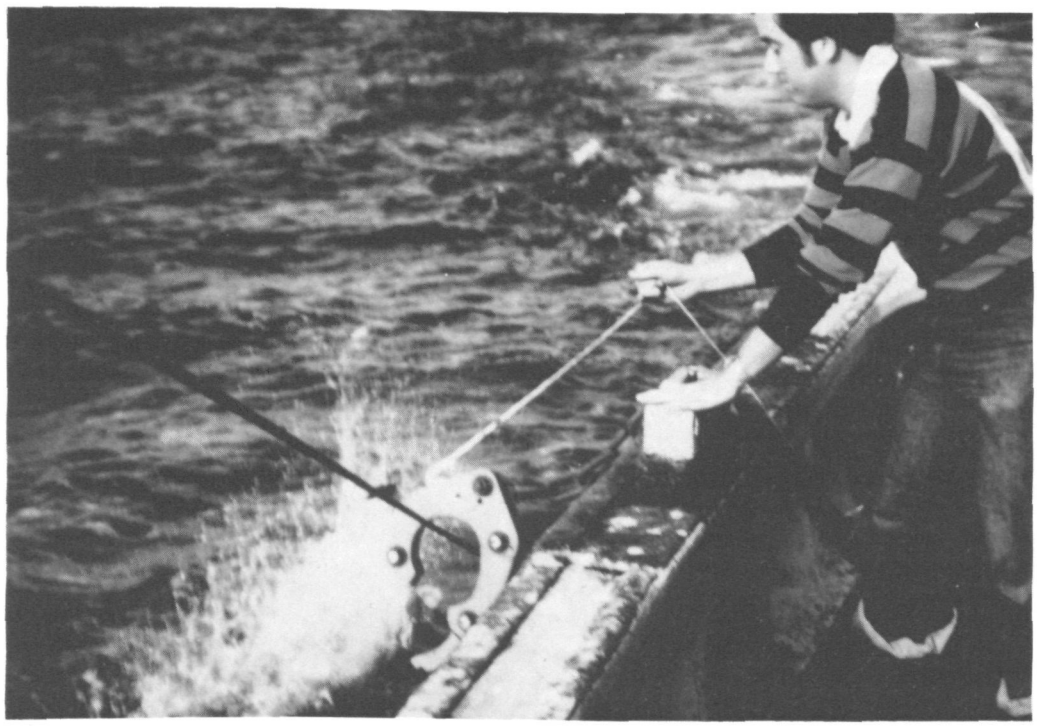
Following laboratory testing, the first prototype hook-up block went to sea in the late summer of 1974 on Capt. Novello's Vincie N. Actual working conditions necessitated several modifications in the original design and a third, definitive prototype installed on the Vincie N. remained there throughout the winter of 1974-1975. Capt. Novello and his crew found it a real success, and he has become one of the staunchest supporters of the block's adoption by New England's fishing vessels.

Encouraged by Capt. Novello's enthusiasm, Wall and Clifton presented the new hook-up block to fishing industry representatives at the April 1975 meeting of the New England Fisheries Steering Committee's Safety Advisory Service Committee. Amidst general interest from the fishermen present, several questioned whether the new block would really improve the crewman's safety in hooking-up, and noted that the prototype was just as heavy as the traditional block. Wall pointed out that commercially made blocks would of course be lighter, and that Capt. Novello could attest to the safety advantages of the new block. Following this meeting, Thomas Norris, then Chairman of the New England Fisheries Steering Committee, and Bradley O'Hara of F. J. O'Hara and Sons, Inc., Boston trawler operators, took a copy of the third prototype for further at-sea trials on board the Massachusetts, out of Boston, one of the largest side trawlers in New England.

Although the prototype hook-up block had been overdesigned for the medium-sized Vincie N. by three to four times the assumed maximum loads, the loading on the block during the Massachusett's trawling runs created a real test of the block's strength. At first the vessel's heavier chain prevented release of the block, until an intermediate shackle was installed. Then the Sea Grant block performed well over an estimated 120 hours of towing time, representing about forty settings of the vessel's nets. Although strained almost to the block's calculated breaking point, the prototype held, and the severe testing provided valuable information for future design changes.







Comparison of traditional and new Sea Grant hook-up blocks (upper left and right) on trawler Vinci N. M.I.T. graduate student John Wall (below) releases Sea Grant block with pull on lanyard; block will fall harmlessly to the vessel's side.

University - industry cooperation had proved important to the successful design of the new hook-up block. As the "clients" of the research project, continuously consulted and kept informed of progress by the researchers, fishermen and fisheries representatives were involved from the outset. However, when the project's research phase drew to a close in June 1975, the M.I.T. Sea Grant Program's goal shifted from developing an improved block to ensuring its adoption by the fishermen on board side trawlers.

True to the Sea Grant scheme of things, the time had come to transfer the results of research from the laboratory into the hands of users.

To do this, the M.I.T. Sea Grant Program's Advisory Services staff took the lead in the process of distributing the new hook-up block, and made sure that once again the fishermen and fisheries were heavily involved. In July 1975, Clifton led a meeting that brought together representatives from all sectors of the fishing industry to discuss the block's future in New England's fleet. Representatives of NMFS, the Massachusetts Division of Marine Fisheries, the New England Marine Advisory Service (NEMAS), two major manufacturers of marine equipment, Hathaway Machinery Company and Hancock Marine, Inc., the National Sea Grant Program, and a maritime insurer, Hull and Cargo Surveyors, Inc., joined Clifton, Norris, Ackert, Boord, Wall and Capt. Novello around the conference table.

The tenor of the gathering was one of approval. Dr. Robert Edwards, Director of NMFS's Northeast Fisheries Center, described the new block as "the sort of thing

Gloucester fishermen testing first prototype of MIT hook-up block.

that Sea Grant can do that will be of real and positive benefit to the fishing industry." Ackert noted that "the development of the block represents a good collaboration of industry, government, and academic institutions." Others seconded this and expressed their eagerness to help promote the block's use throughout the region's fleet of side trawlers.

All at the meeting saw three major advantages to using the M.I.T. hook-up block instead of the traditional block: improved safety for fishing boat crewmen, increased speed in hooking up, and reduced liability insurance premiums. Since operating the new Sea Grant block takes only seconds, according to Capt. Novello, a trawler using the block can maintain its speed, thus avoiding the problem of net collapse and tear-out on rough sea bottoms. Responding to fishermen's concern over high insurance payments, David McDevitt of Hull and Cargo Surveyors, Inc., said that the new block could influence insurance rates if a number of boats would adopt the block and notify their insurance companies of its use.

Lengthy discussions and numerous suggestions about how best to bring the block to the fishermen prompted James Ackert to organize a committee for promoting the block's distribution. The committee, chaired by Ken Hutchinson, NEFAS coordinator, included as members Ackert; Phil Coates, Assistant Director of Commercial Fisheries in the Massachusetts Division of Marine Fisheries; Arthur Hancock of Hancock Marine; Michael Corbett of NMFS's Northeast Fisheries Center; Eli Braley III of Hathaway Machinery; McDevitt, and Wall (who subsequently left the committee to devote full time to his studies and was replaced as technical advisor by Cliff Goudey, graduate student in M.I.T.'s Department of Ocean Engineering). The meeting closed with a mandate for the committee to develop design requirements for ten further prototype blocks that would be constructed and then placed as testing and demonstration models on key vessels in New England's fishing inrustry.

Goudey adapted the thirıı prototype design based on its testing on board the Massachusetts. Changes were also made to simplify the manufacturing process and to reduce maintenance time and costs—for example, use of standard, off-the-shelf bolts instead of the more expensive, custom-made bolts used in the prototypes.

As part of the continuing deve!opment, the Sea Grant researchers have specified two levels of hardness, each for five of the new prototypes, and will study the effects of loading during tows, number of tows over time, and relative hardness of the steel on wearing of the block and net tow cables.

Funding for the prototype blocks was obtained through a New England Regional Commission fisheries development grant to the Massachusetts Division of Marine Fisheries. Hancock Marine, Inc., was awarded the contract and has manufactured the new prototypes.

The committee, working with the New England Fisheries Steering Committee, is distributing them on a rotating basis, so that a number of New England trawlers will have the chance to try out this safer way of hooking up for tows.

From there, the fishermen will take over the job of getting the block onto their boats, once its worth in actual working conditions is demonstrated through the prototypes. Clifton anticipates that blocks whether manufactured by the marine machinery companies or hammered out by local, dockside welding shops, will be readily available to vessel owners. To ensure that the design remains in the public domain and is accessible to the fishing industry, M.I.T. has applied for patents covering both the block and the basic design concept, which appears to be applicable to other situations requiring restraint and release of cables, wires, or ropes.

The M.I.T. Sea Grant hook-up is certainly safer and more efficient than the traditional side trawler's block. But it is not just a step forward in the search for safety on board fishing vessels. Because the fishermen themselves joined in the research project from its inception, the M.I.T. Sea Grant Program now sees the firm beginnings of a working partnership between mechanical engineers and fishermen for solving other fishing vessel gear problems. Furthering this partnership, Loutrel and Goudey are working on another Sea Grant-funded project, with fishermen's assistance, to design and test an improved system for connecting and releasing the trawl doors on the fishing boats' nets. Moreover, the involving of fishermen and fisheries interests in the transfer of the new hook-up block from research product to practical use has meant a more willing acceptance of this new equipment by a traditionally conservative industry.

NOAA Profile

Shephard on the Scene

BY VALERIE ANDERSON

"The last thing I want is for local user groups and advisory agents in the field to identify me as a Federal bureaucrat from Washington. I firmly believe that you cannot administer a program of this sort sitting at a desk. To build a strong relationship with people on a local level we have to get out there and meet with them, try to understand their problems, and do what we can to help them."

That, in his own words, is the philosophy of Robert Shephard, Program Manager of NOAA's Marine Advisory Service. The most important part of his job, he feels, is personal communication. And he attempts to communicate face-to-face at every opportunity.

"Our job is to provide a link between researchers and experts in the field of marine-related problems and the people at the workbench or on the boat—the ones who need the most information," he says. "This is a person-to-person type of operation. The agent's first job is to become known in the community as someone to come to for help."

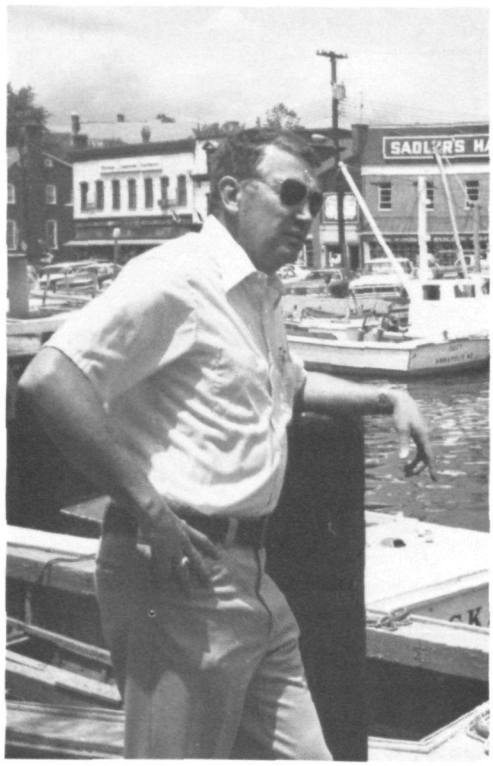
Learning the needs of commercial fishermen, resource managers, seafood processors, builders, marine science educators, and anyone whose interests and living lie along the water's edge is the first step in finding the answers to their problems.

The traditionally strong links between NOAA's Office of Sea Grant, Sea Grant people in the universities, and their contacts in state and local governments have put together the framework for an advisory service. The creation of the NOAA Marine Advisory Service gave it form and a lot of expertise.

In fact, the expertise available through the advisory service is unique and very likely its best feature.

The Marine Advisory Service provides a direct line between the local user and several thousand experts in marine environmental data, fisheries research and marketing, tides and currents, oceanographic research, charting, satellite technology, and a broad range of related fields.

This means there is a way of getting the results from marine researchers into the hands, boats, offices, blueprints, and nets of those who need them most—and who can use them best.



Shephard, above, goes out into the field as often as possible and is shown at right with Marine Advisory Service Agent Norman Bender (center) discussing oyster fishing with fisherman Donald Davy (left) of Annapolis, aboard his boat the Clara Don.

"The agent translates the needs of the user back to his resource base, an institution linked to NOAA's Sea Grant Program," explained Shephard. "It is really a closed-cycle system. We are there to help educate them and to help solve their problems. Whatever problems they come up with get translated back forming a link between the institution and the user."

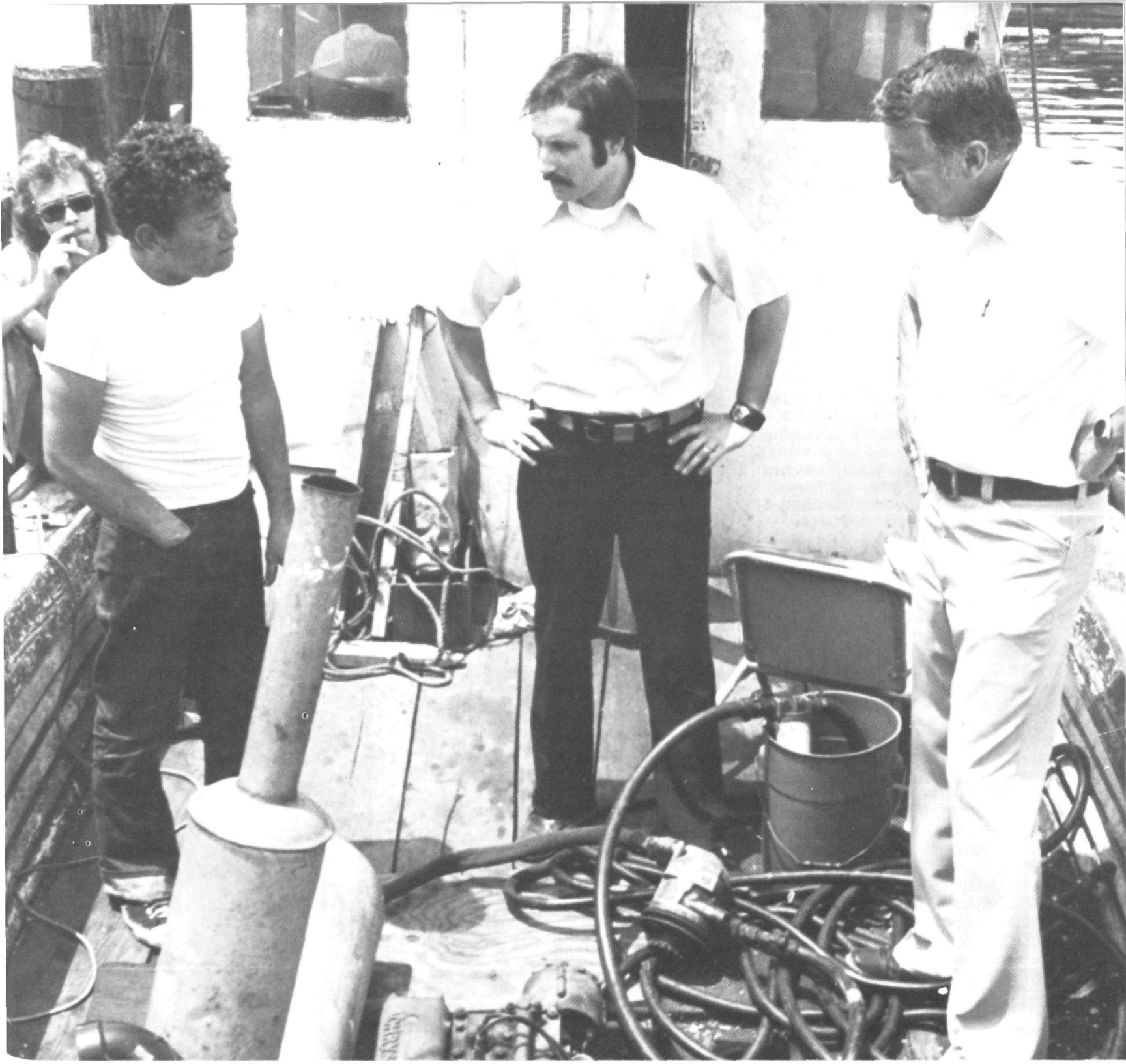
One example of this connection between researcher and user is the Marine Advisory Service's assistance to fishermen in Brunswick, Ga. Researchers at the University of Georgia developed a shrimp net consisting of two trawls instead of one, which could catch more shrimp. The local fishermen, skeptical about changing their ways, turned their back on the new idea. However, Marine Advisory Service agent David L. Harrington set out on a shrimping expedition with the local fishermen and used the new net. When the agent compared his catch to that of the local fishermen, they could see that the net caught more shrimp and they agreed to try it.

Also at the University of Georgia, researchers were presented with a jellyfish problem the local fishermen had during certain times of the year. Huge numbers of the pest foul their nets, and much time and energy is required to remove them. Through communication with the MAS agent and the local fishermen, the University developed a new net they call a "jelly-ball shooter." It is really a net-within-a-net which catches the jellyfish and "shoots" them out a hole at the top. Again the fishermen were skeptical. So the University developed a film describing how the net worked. The fishermen again were convinced and began to use the new nets.

As this connection between researcher and user broadens, new ideas, new problems, and new research begin.

Shephard points out the importance of this connection: "In turn we learn from the user. Knowing their problems defines the type of research that the institutions should be involved in. The institutions are involved in research, not getting the results of that research to the user. You need to have both. You can't have an agent without a research base, and you can't have a research base without someone to disseminate the information," he said.

The harbor of Dunkirk, N.Y.—located on an inlet of Lake Erie—became unusable at times when the water level of the lake was high, because of waves smashing into the docks and other facilities. Rob Patton of the Marine Advisory Service assisted Dunkirk in plans for a new breakwater to stop the waves. With assistance and technical information from the Goodyear Tire



Photos: Bob Williams, NOAA

Company, the people of Dunkirk strung together old tires to form a floating breakwater. The harbor is now being used.

Making an effort to keep the bond with his agents strong, Shephard has gone out into the field to meet as many of them as he could. He explains how he entered the program:

"The first thing I had to do was go through a learning period. I knew about the program, but I really didn't know the players in the field. Knowing how the program was structured and formed, I wanted to see how the advisory services functioned within the program. And the only way to do that was to go out and see for myself."

Getting out into the field, Shephard developed a feeling for the local users' problems and how he could assist them. He stresses the importance of the person-to-person relationship which is the basis of the Marine Advisory Service:

"Although I am a stranger to them, when I am introduced by someone these people have lived and worked with I am accepted. I couldn't do it if I just went out there by myself; they would turn their backs on me," he said.

"I try not to go out there during formal visits," Shephard explained, "because there's always tension. I try not to add to that. I prefer to spend my time working with them, visiting with them, and trying to help improve the quality of the programs."

One particular field visit underlined for Shephard the importance of meeting agents and users in an informal situation. The Port O'Connor, Texas, advisory service's quarterly meeting started typically with a keg of beer and consisted of an entire day and evening of just talking and discussing problems. Initially, Shephard felt the tension be-

cause of his presence. However, this tension vanished when Shepard became involved in the discussions, giving what advice he could, and became a part of the group.

"They made me feel very comfortable. I shared their concern over their problems," he said. "One particular problem involved a disagreement over the shrimp catch between the bay fishermen and the Gulf fishermen. I explained to them that they needed to organize within themselves before presenting their problem to Washington.

"Unfortunately, they had the impression that because I was from Washington I could solve any problem. However, I gave what advice I could and when I returned six months later their program had greatly improved."

Shephard feels a certain bond between himself and the local user, having had an interest in the sea for many years. Born in Boston, Mass., Shephard entered the Massachusetts Maritime Academy in 1954. However, he was not originally interested in making a career from the sea. Shephard travelled for eight years with his family at an early age.

He returned to Boston when he was 16, and again did not feel at home. He finished high school and entered a preparatory school hoping later to enter Massachusetts Institute of Technology.

He was not happy at prep school and left there to attend Northeastern University for six months, but felt lost among the many students. So he took a job as a checker at a local grocery store, and decided he would not go to college. However, something happened which was to change the course of his life.

"While attending mass one Sunday morning I ran into a friend wearing a uniform," he described. "When I asked which school he attended he said Massachusetts Maritime Academy. This intrigued me, although I had decided not to attend college. I went out and looked at the Academy and saw that it consisted of only one building and one ship. I decided to give it a try.

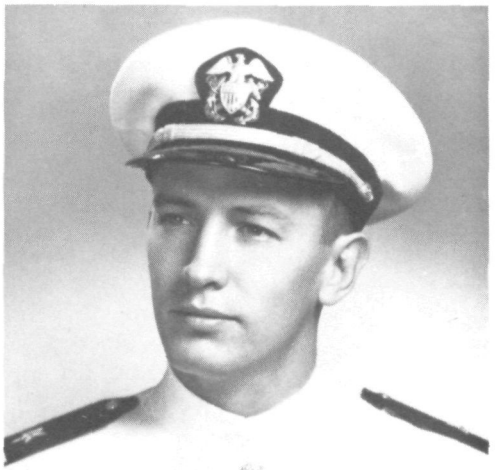
"At this time in my life I did not feel I had a handle on myself. This was to be my last change at college so I gave it everything I could. As a result, I became the Battalion Commander at the Academy."

Upon his departure with a degree in electrical engineering, he entered the Navy for two years. He thought he might make it his career:

"I loved the Navy. But I wanted to get command at sea. To do that, I would have to spend 13 of my 20 years at sea and away from my friends and family. So I made the decision to leave the Navy and look for something else."

Shephard went to work for Westinghouse Electric Corporation's Oceanographic and Underseas Division and remained there for 12 years. It was during this time that he became more interested in oceanography.

"With Westinghouse I became involved in field engineering, marketing, and especially deep submersibles. This kept me involved with the oceans which at this point I had fallen in love with," he said.



Shephard (above) with his future wife, Connie, at the Senior Prom in 1949; in uniform in 1954 (above right); and swabbing the deck at the Massachusetts Maritime Academy (right).

While with Westinghouse, Shephard was selected to be a staff member of the President's Commission on Marine Science, Engineering, and Resources, and participated in preparing that commission's report, "Our Nation and the Sea," which formed the basis for the creation of NOAA.

Between 1968 and 1972, Shephard was senior vice president and technical director of Trident Engineering Associates, an Annapolis, Md., research and development company engaged in ocean-related technological and safety analysis.

"This was another step to broaden my base of experience to a point where I could contribute something more heavily as I developed," he explained. "Trident kept me involved with the oceans and interested in the field I had chosen."

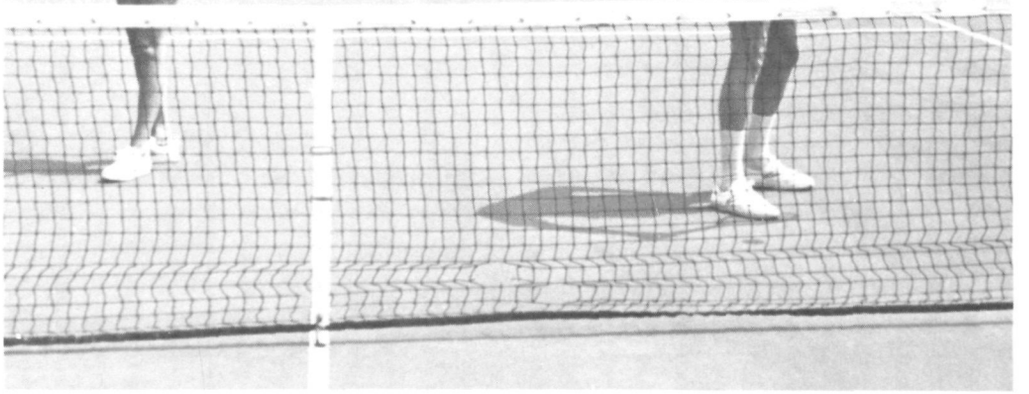
After four years there, he took over as president of Washington Technological Associates, a subsidiary of Quanta Systems Corporation.

"The unfortunate part of that job was that it was not related to the oceans," he said. "Most of it was related to NASA and its activities. We designed and fabricated experiments for NASA and their satellites. This was extremely interesting and exciting because it was an area I had not been exposed to. Yet, I felt kind of lonesome not being back into what I wanted to do."

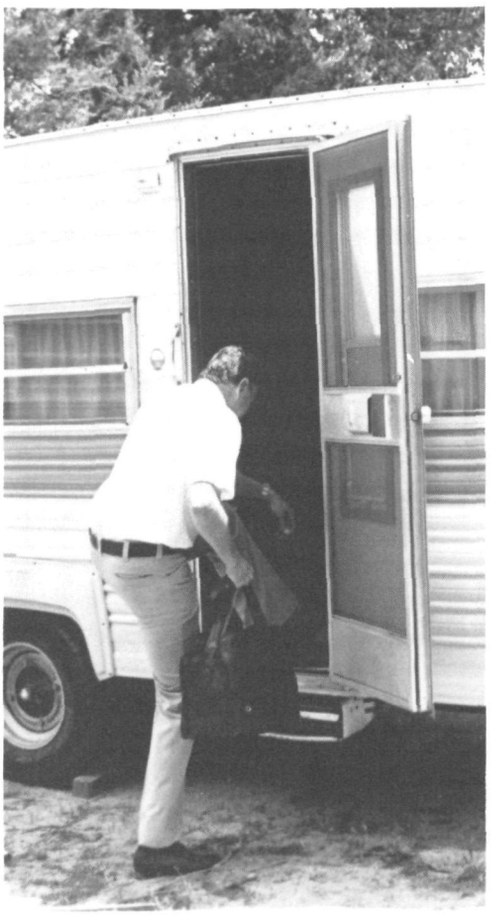
Anxious to get back into an ocean-related field, he came to NOAA's Marine Advisory Service last year upon the retirement of Howard Eckles.

Shephard lives in Crofton, Md., with his wife and two children. He travels more than 29 miles to NOAA each day. However, he enjoys living in Crofton because it places him geographically within a triangle of places he enjoys visiting. The three points of the triangle being Washington, Baltimore, and Annapolis, he can travel the same distance to the sea as he travels to the city.

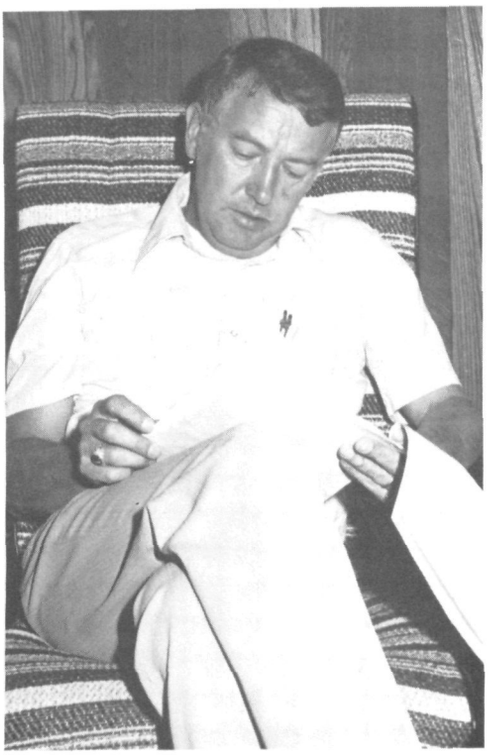
Shephard and his family enjoy a recrea-



Photos: Bob Williams, NOAA



Shephard spends his spare time playing tennis with his wife (top); travelling with his new camper (left); and relaxing at home (below).



tional life consisting of tennis, bridge, and camping.

"Tennis is my biggest mode of relaxation. I can never get enough of it. I play several times a week and enjoy trying to keep in shape," he said.

The Shephard family recently purchased a 17-foot camper and plans to do a lot of travelling.

"I enjoy the freedom of being able to go wherever I want. Instead of being boxed into a permanent residence, this will be my way of seeing the country and enjoying life."

This urge to travel is somewhat fulfilled in Shephard's position with NOAA. He has journeyed to 90 percent of NOAA's Marine Advisory Services in the field.

The biggest problem he faces is how to define which users to help. The Marine Advisory Service emphasizes its help locally, while educating the local users on problems related to a national interest such as coastal zone management, extended fisheries jurisdiction, the outer continental shelf, and marine recreation.

Oregon State University recently tackled a local problem that turned out to have national interest. The Marine Advisory Service agent found that most commercial fishermen in Oregon were having difficulty filling out their income tax forms and were not getting benefits available to them. The University developed classes and seminars to help the fishermen—an example of the agent serving as a link between the local user and the specialists. The fishermen then made a proposal to the Federal government to develop a special form and instruction manual for commercial fishermen. The Internal Revenue Service did not feel there were enough commercial fishermen to warrant the expense of developing this new form. However, the fishermen—through the advice of the agent—made the request again, stressing that although they were not great in number, the need was great. The IRS now puts out a "Tax Guide for Commercial Fishermen" with an acknowledgement to the Sea Grant Marine Advisory Service.

Shepherd plans to continue to search out the needs that must be met locally.

"A user in Seattle said to me 'Thank goodness someone could come out and listen to our problems instead of just preaching.' I was under the impression they did not want us out there, but I was wrong. They never fail to thank me for coming out and showing an interest."

While Shephard was giving an address on NOAA's Marine Advisory Service to a group of graduate students in Galveston, Tex., a student raised the question: "Has the government changed its policy?"

Shephard asked him to explain the question and the student said, "Well, we always thought you Feds just sat in Washington and made decisions and never got out into the real world."

This is what Bob Shephard is trying to change.

Minnesotans Take to Mullet

BY RYCK LYDECKER *

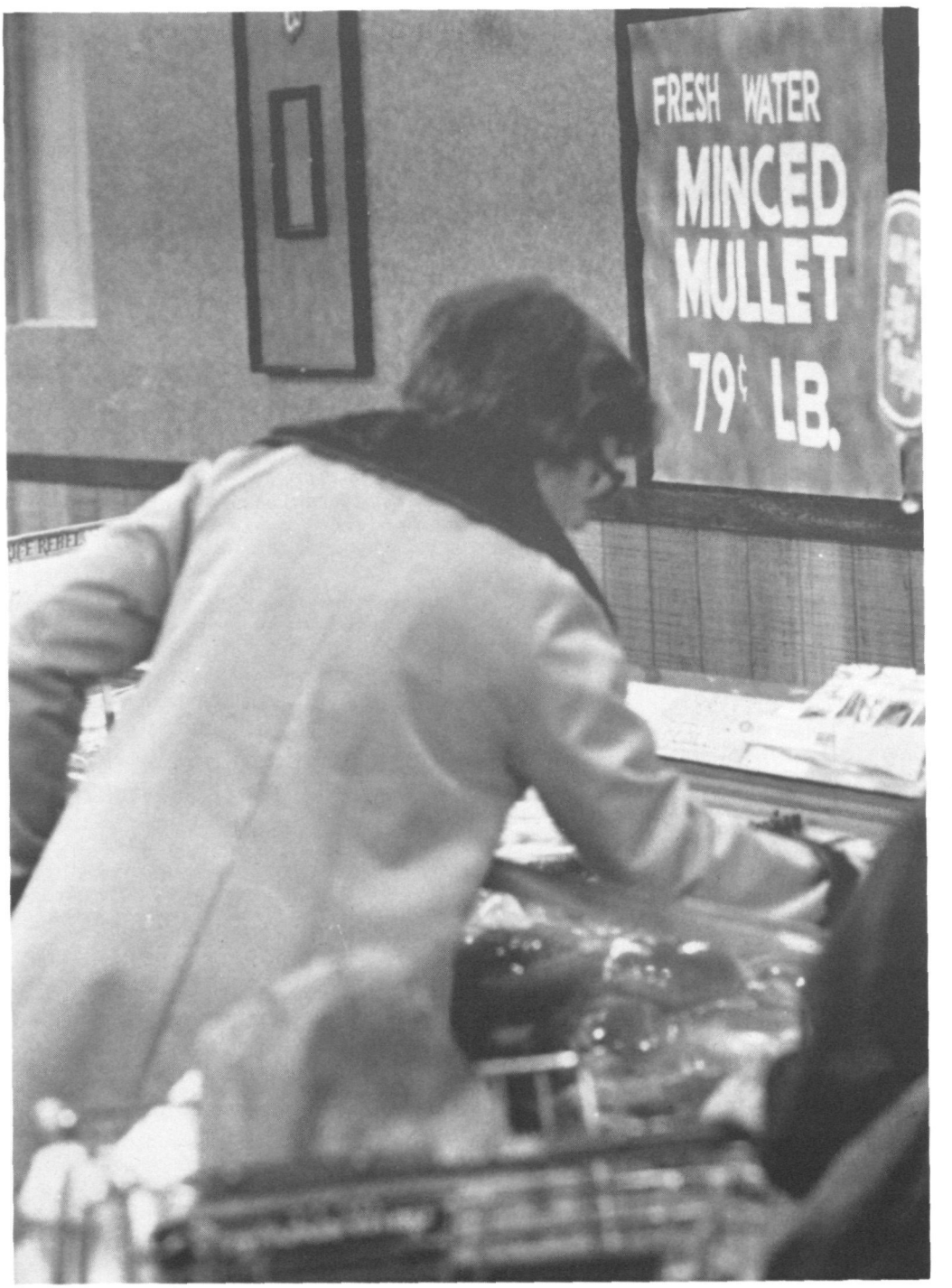
The little-known mullet may soon become a midwest seafood star, thanks to the combined efforts of fishery technologists, Lake Superior commercial fishermen and NOAA Marine Advisory Service market testing. Results of a program undertaken by the Minnesota Marine Advisory Service at the University of Minnesota-Duluth indicate that frozen, minced freshwater mullet can provide an inexpensive source of high protein meals for the homemaker and an additional market for commercial fishermen.

The program test-marketed mullet locally caught and processed. Much research and development has been carried on with Great Lakes underutilized species such as carp, sheephead, burbot and mullet (or sucker as it is more commonly called). Extensive programs sponsored by the Upper Great Lakes Regional Commission are now being carried out in Michigan, Wisconsin and Minnesota by Sea Grant and state agency specialists and National Marine Fisheries Service experts as well as NOAA Advisory Service agents.

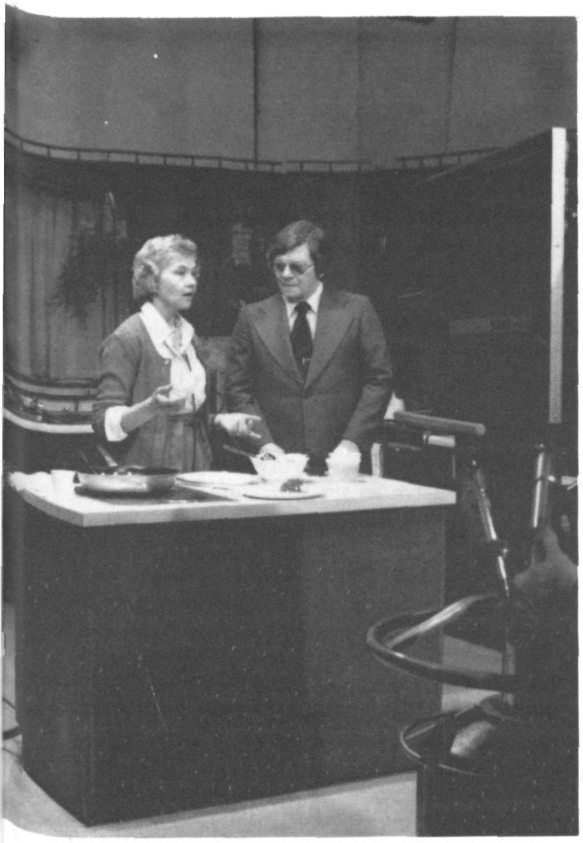
The Minnesota Marine Advisory Service test-marketed the raw, frozen fish flesh. Using Lake Superior mullet harvested and processed at Bayfield, Wisconsin, a food consultant conducted consumer surveys and in-store demonstrations coupled with a local publicity program.

Usually shunned by commercial fishermen owing to its low market demand, the mullet is a rather common, very bony fish. It is found in freshwater lakes and rivers throughout North America and three varieties are common in the Great Lakes: the short redhorse, the white and the longnose. The longnose is the most abundant in Lake Superior and is considered the best tasting by the few people who eat sucker. In some areas of the country, sucker are commonly used for home canning and smoking (the taste is often likened to salmon).

The bony character of the fish is its biggest disadvantage, but in recent years fishery technologists have developed mechanical



*Ryck Lydecker is Media Specialist with the Minnesota Marine Advisory Service.



Minnesotans loved mullet. . . as the housewife at left showed, reaching for a package at a Duluth supermarket. Home Ec student Jean Miller of the University of Minnesota at Duluth passes out samples during in-store demonstration (above), and food consultant Beatrice Ojakangas discussed the product on Duluth TV. (Photos: Ryck Lydecker)

processes for separating fish flesh from the bone.

A second big disadvantage is the name sucker, but another common name, mullet, was adopted in the Advisory Service marketing program with appropriate explanations offered in accompanying publicity.

Beatrice Ojakangas, a widely known Duluth food consultant, cooking instructor and author of three cookbooks carried out the project for the Minnesota Advisory Service. She was assisted by the St. Louis County (Minn.) Extension Service and by the NMFS Fishery Marketing office in St. Paul, Minnesota. Three basic recipes for minced mullet dishes were developed—a chowder, a loaf to be prepared much as a meat loaf, and fish patties. Then a test sample of 75 people were given one pound blocks of the frozen product, along with recipes and a questionnaire, and asked to serve mullet dishes in their homes. These fish were donated by the processor, Bodin Fisheries of Bayfield, Wisconsin.

Finally, the product was ready for the real test—sales. Frozen, minced mullet was stocked on a trial basis in two Duluth supermarkets. The fish was packed in round, plastic cups containing one pound net weight. The retail price was set at 79¢ per pound.

The Advisory Service assisted with local newspaper publicity and Mrs. Ojakangas was interviewed on two Duluth television "talk shows." On each TV appearance she briefly explained the mincing process and spoke of the high nutritional value and low fat content of the product while preparing one of her recipes on camera.

Home economics students from the University served as weekend in-store demonstrators. They passed out cooked portions of mullet prepared from the patty recipe and recipe flyer that included nutritional information. Because of recent—and somewhat inaccurate—reports of chemical contamination in Lake Superior fish, the flyer also pointed out that freshwater mullet is a "clean fish." Because of its low fat content mullet is relatively free of such pollutants as PCB, DDT and other contaminants that accumulate in fatty tissue.

The students also handed out survey questionnaires, which revealed that respondents generally approved of the product—most saying that they would serve it once a month if it were regularly available. Users also appreciated the lack of "fishy" odor.

More important to consumers than its relatively low cost was the product's low calorie, low cholestrol content and its high nutritional value. The fact that it was a locally produced product also seemed to have a favorable influence on sales—an important point for commercial-scale marketing.

"The project seems to have been quite successful," says Dale R. Baker, Director of the Minnesota Marine Advisory Service, "but much more work needs to be done to increase public acceptance of fishery products made from underutilized and undervalued species. The potential for harvest from the Great Lakes and our other inland waters seems great."

Which offers a renewed challenge to the Minnesota Marine Advisory Service.

The times, they are a-changing

Kathy and Robin and Caroline and Eloise and . . .

BY CONSTANCE A. ARNHOLS

All those bad jokes aside, women and hurricanes really do have quite a bit in common. Women, not always willingly, have found their names bestowed upon hurricanes for years. And when hurricanes strike, women share with men and children the death, destruction and sorrow they bring.

But to chase the greatest storms on earth? With very rare exceptions, this has been considered men's work.

Enter Kathy Chapman Doster and Robin Radlein at NOAA's National Hurricane and Experimental Meteorology Laboratory in Miami. Between them last year, they made nine flights into three very nasty hurricanes, observed two at first-hand on land, and participated in several significant research projects.

Kathy is deeply involved in cloud physics research. At 22, she is already a veteran of seven hurricane missions (into Caroline, Eloise, and Gladys), flown in NOAA's C-130 out of the Research Facilities Center in Miami. Her task was to operate and monitor an ice nuclei counter to collect data on background levels of ice nuclei in these storms. This information will, in part, guide scientists in carrying out NHEML's Stormfury program, a plan for hurricane mitigation.

Kathy's familiarity with the great storms began in her childhood when she and her family lived on the Mississippi Gulf coast. She remembers, as a student, being hastened along to a hurricane shelter by nuns, their white coifs filling, sail-like, in the strong winds. She has impressions of the beaches after a storm, of house foundations squatting clean and bare as though tidied by a giant broom, while the beach front sprawled in a chilling disorder of dead animals, personal possessions, and splintered wood. Once she stumbled on a doll buried just below the sandy surface. It seemed a sadly appropriate symbol of the Long Beach, Mississippi hurricane victims and their scattered belongings. An even more personal discovery came when Kathy found the very bottle that she had made for a friend lying unbroken about one mile from her friend's home. Experiences such as these have made Kathy respectful of hurricanes, but she is not easily alarmed by them.

Robin Radlein (above) in front on a synoptic pressure chart for September 2, 1950; and Kathy Doster (right) at her station aboard the C-130.

As for hurricane missions, she feels that "in general, flying into a hurricane is not as rough as flying through one of Florida's summertime cumulus clouds." (The reference is to flights made by NHEML's Cumulus for seeding purposes.) "In a hurricane," she says, "it is the longevity of the airborne time that is the hardest part."

On data collection flights, repeated passes are made directly into the eye through "bumpy" eyewalls for as long as 4 or 5 hours, a routine that requires as much stamina as one might need for 10 active hours on the ground.

There was only one occasion, on a flight through Gladys, when Kathy felt some concern (or perhaps it was just perplexity). Gladys mixed with a cold pressure system and became indistinct on the radar. Since flights are oriented according to the location of the eye, there were a few groping moments when eyewall and eye were blended into one hazy mass, and nobody was quite sure where the eye of the storm was.

"This flight might have been discarded as useless," says Kathy, "because the primary purpose of the mission involved flight plans drawn up relative to the hurricane eye.

"However, Dr. Robert C. Sheets, senior scientist on the mission, and the flight crew, quickly redesigned the patterns during the mission to investigate the unusual structure of this changing system. The data obtained on the flight are now some of the more interesting for the entire season."

Science and the humanities share equal footing in the Doster household. Kathy, with a degree in meteorology from Florida State University (1974), will start work toward a master's degree. At the same time, her husband John will pursue his master's in English literature.

They are parents to a chatty parakeet, and to a Siamese kitten who may, on occasion, answer to "Sebastian," a name that reflects Kathy's interest in playing classical piano pieces.

In the same laboratory, and only a few steps away, sits a green-eyed girl who is

well on her way to becoming a radar meteorologist.

Robin Radlein was introduced to severe storm forecasting at an early age when she lived in Okinawa. On this western Pacific island, the mysterious typhoon flower, a white, waxy bloom that resembles a crocus, is the harbinger of storms. If the normally closed flower should suddenly open, she was told, there is a typhoon on the way. A meteorologist might have explained the phenomenon as a manifestation of the excessive humidity that precedes a severe storm, but to a pre-schooler, magic.

Robin, who has moved about the world with her military family, has experienced a variety of weather conditions, not only in Okinawa, but in Hawaii, and a half dozen mainland states of the Midwest and South. She soon developed a keen interest in the atmosphere, and when she received a scholarship to Texas A & M, it seemed only natural to major in meteorology.

"I decided that severe weather, hurricanes, tornadoes, storms and all weather phenomena are interesting, and wanted to know what makes them tick," she says.

A few months after graduation in 1975, the 21 year-old Robin found herself, as a member of the NHEML, in a race with a hurricane. She and meteorologist Billy M. Lewis, of the same laboratory, hoped to record on magnetic tape the radar presentation of the meteorological targets in and around hurricane as it made landfall. They rushed to Victoria, Texas to await the storm's approach. At first, it seemed that Caroline would remain tantalizingly just out of radar range, but the hurricane finally veered in a more northerly direction, and they were able to capture data from two rainbands.

Hurricane Eloise developed in mid-September, scarcely two weeks after Caroline's demise. When it appeared that this latest storm would swing over the Florida panhandle, Robin headed for the Pensacola Naval Air Station and a National Weather Service radar weather station that is situated on a narrow peninsula that juts into Escambia Bay and the Gulf of Mexico. She barely made it to the station before rising bay waters cut off the point from the mainland.

On-the-spot briefings about Eloise's progress were given by Phyllis Polland, who is the Meteorologist in Charge of the Pensacola weather office, and who currently holds the distinction of being the only woman MIC in the Southern Region of the National Weather Service. Her reports during the storm were interrupted at one point by a compelling forecast from the radar operator who began shouting above the shriek and howl of Eloise's winds, "It's going to hit!" Feeling rather like passengers aboard a doomed ship, the hurricane observers awaited their fate. The storm passed about 48 miles to the east, however, across the Choctawhatchee Bay area, and they obtained some unique data for their efforts.

After Escambia Bay, Robin had a few days to catch her breath in Miami. Then she was Bermuda-bound, via hurricane Gladys, on NOAA's DC-6. Her job, to change the radar tapes during the flight, was complicated by a 93° cabin temperature, hours of jackhammer vibrations produced by the storm, and a tape mechanism that required intricate threading while at arm's length. All of these factors combined to give the usually smiling young scientist some tense moments and a very unhappy stomach. Robin has a stubborn streak, however; she stood by her station, keeping the tapes moving and obtaining her data.

There was respite in an overnight stay on land; then back to Miami through the shaky pathways of Gladys. On the return flight, the vibrant motion switched to roller coaster swoops from altitudes of about 1200 to 600 feet within seconds. Although Kathy Doster was aloft in Gladys three times, her flights, made at the high altitudes where ice forms, encountered less sustained turbulence than the DC-6, which carried its scientists near and below cloud base, a region of more continuous activity.

Was it worth all the discomforts? "Of course it was," says Robin. She is now analyzing her hard-won radar measurements of echo brightness (an indication of rainfall intensity) and cloud position to determine whether and how much the rain intensity changes as a hurricane approaches land. The data will be compared with the National Weather Service radar—adjusted raingage readings for the same times and areas, and these data, it is hoped, may be used to aid in the development of a hurricane flood forecasting method.

Kathy and Robin, asked for their advice to young people contemplating a career in atmospheric science, agreed that an early start in mathematics, and science courses will provide the firm basis needed to enter the field.

Robin added, "Be curious. And learn to communicate well through speaking and writing." She will be following her own recommendations as she begins studies for her master's degree.

Both say they have never encountered difficulties as females in a field still predominantly composed of men, and they would strongly encourage young women who are interested in meteorology to enter the science.

Saving the beaches: a must-win challenge

Don't Bring Your Submarine

BY MILTON SLOANE

The most attractive part of the country for fun outdoors, millions will tell you, is that fabulous playground fashioned by Nature where the land meets the sea. Armed with time, money and mobility, people are descending as never before on the coast to compete for the finite space available with particular intensity during weekends, holidays and in the summer.

They add their tremendous numbers to the more than 70 per cent of all Americans living within 50 miles of the seashore—a number expected to rise to 80 percent, or 25 million additional persons, by the year 2000. Meanwhile, the pressure for more farm-and-homesites, factories, highways, port facilities, oil and gas accommodations and a staggering multitude of other uses grows—and grows.

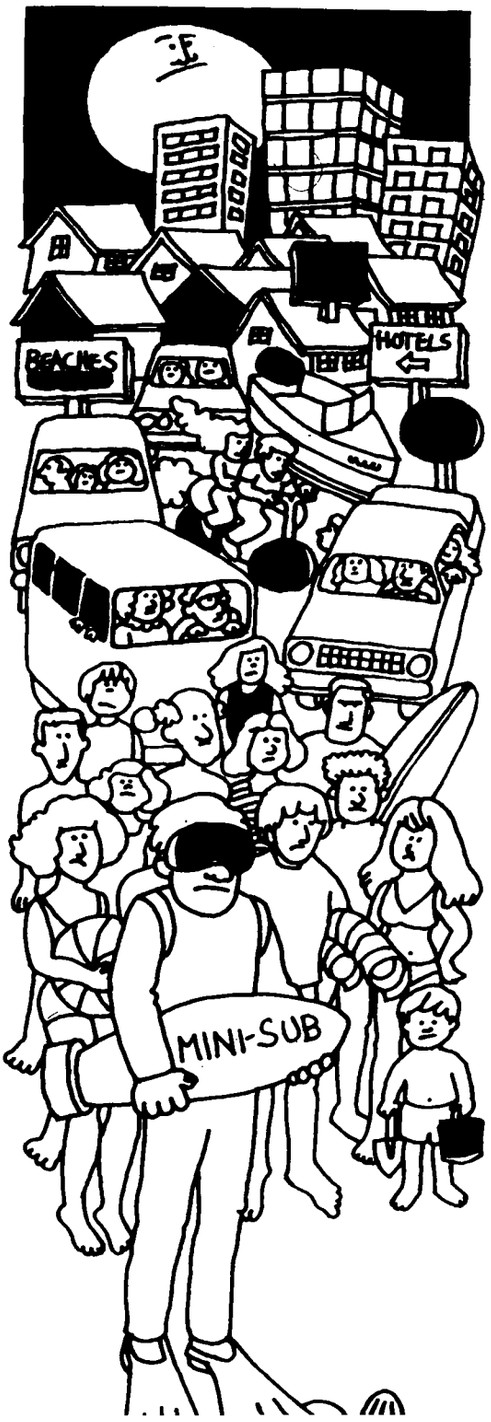
Some people think it's a wonder the coast doesn't sink into the sea.

In 1972, Congress decided to initiate action that will guide future coastal growth in a coordinated and balanced fashion. It passed the Coastal Zone Management Act and declared that effective management, beneficial use, protection, and development of the coastal zone is in the national interest.

The Act encourages states and territories, including Great Lakes states, to develop programs that when blended into a whole will result in the ecologically sound use of finite coastal resources. Authority to administer the Act was delegated to the Secretary of Commerce, who redelegated the authority to NOAA's Office of Coastal Zone Management. Under the Act, OCZM provides financial and technical assistance to coastal states to develop land and water use programs, and ensures federal compliance with state programs once they have been approved.

In two years, OCZM has awarded states more than $30 million to formulate their coastal management plans, with states contributing an additional $15 million.

In their programs, state and local officials are considering both the substantial impacts caused alongshore by certain recreation activities, and the growing list of unmet demands. On an annual basis, increases in the number of people using the coast for recreation now far exceeds the



population growth rate. During the five-year period from 1960 to 1965, for example, the percentage of people using the coast for swimming, boating, and fishing activities rose a combined total of 45 percent, while the population increased an estimated 8 percent. From 1965 to 1980, swimming alone in coastal waters is expected to climb 72 percent (to become the favorite national pastime), while the population will increase 29 percent.

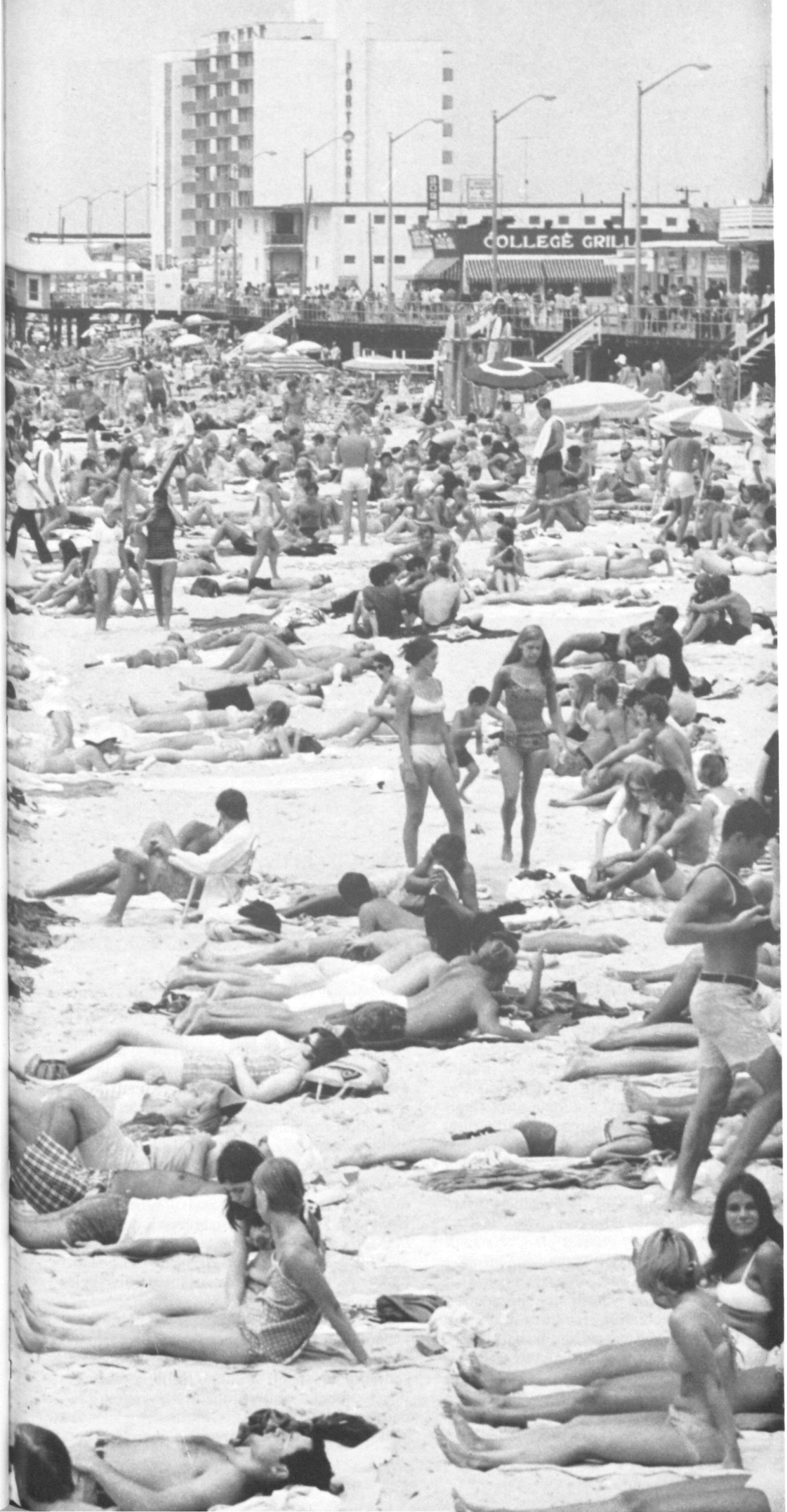
Another impact of coastal recreation is created by the number of facilities required to accommodate the heavy influx of people and their enormous volume of recreational equipment.

Robert W. Knecht, NOAA Assistant Administrator for Coastal Zone Management, recently indicated there are three key aspects of coastal recreation impacts. "Statistics show that an increased number of people . . . are looking to the coast to spend much of their leisure time and to seek relief from the tensions of modern living. The overwhelming demand for public recreation exerts substantial pressure on the coastal environment.

"Another of the principal problems, affecting coastal areas," he said, "begins with the way people get to the beach. People don't come to the beach alone anymore. They are bringing more and more of their hardware with them. Dune buggies, boats, trailers, campers, motorcycles, scooters, scuba gear, you name it. Soon perhaps it will be recreational submarines. The automobile is also a major problem. Like some of the other gear, it requires parking and other support facilities. The lack of parking spaces was the primary complaint at two "swimsuit optional" beaches under fire last year in San Diego and Cape Cod. Other facilities to support the people who want to go there just are not available.

"The third aspect of coastal impacts involves the fragile and dwindling coastal resource itself. Although more than 100 million people live within a day's drive of the coast, only two percent of the shoreline is publicly owned for recreation.

"The best and most attractive areas of the shoreline," Knecht added, "are being walled off by private development. Dredging



and disposal operations have caused the loss of many miles of public shoreline for use as potential recreation areas.

"In some instances, the fill has been beneficial—such as to replace land lost to currents and storms or to create sandy beaches—but more often it has reduced the size and attractiveness of existing recreation resources."

The amount of shoreline available for public recreation, Knecht said, is in critically short supply at a time when recreation demands are increasing dramatically. The entire Atlantic seaboard, he noted, has fewer than 340 miles of shoreland available for public recreation, despite having a considerable number of densely populated urban centers, while Chicago, with its more than 6 million residents, has fewer than 60 miles.

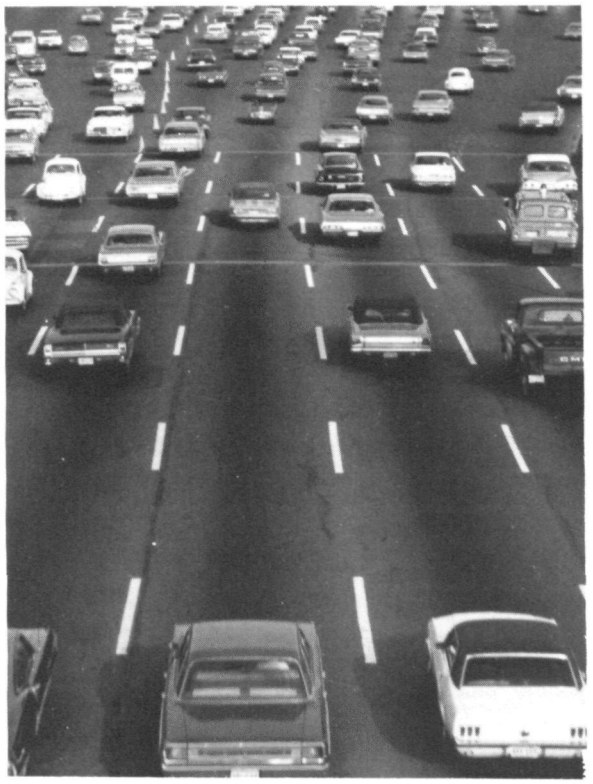
Even along those areas where there are publicly owned shorelands, simply getting to the beach poses yet another problem. A chain of natural and man-made barriers spread for miles along the coast has almost solidly blocked public right-of-way to the shore. Over 90 percent of the coast is privately owned and developed, severely restricting beach access and making it difficult and expensive to provide. In some areas along the coast, the public's only beach access route may be a short, narrow pathway carved out across private property.

Soil erosion caused by adjacent land use practices, particularly along the Great Lakes, has also reduced beach access for recreation through the filling-in of bays and valuable wetland areas. Other impediments to public access are rising gasoline and automobile prices, and the construction of highways, railroads, and other transportation systems. Transportation planning has forced many beachgoers to rely solely on cars to get to the beach, or to restrict their activities to nearby polluted urban waterfronts.

Now thanks to coastal management and increased environmental awareness, efforts are underway to improve public access. In their coastal recreation programs, state and local officials are considering innovative changes in mass transit systems and several significant strategies to enhance beach access and to control uses of beach areas through:

- outright purchase of beach property
- acquisition of certain land rights, rather than ownership
- public rights legislation, such as the Texas Open Beaches Act, which assert the public's inherent right to use the beach as a result of prior usage
- requiring land developers to consider public access routes in plans submitted for state and local permit approval
- requiring developers to deed a portion of each new development to the public for beach access
- tax deferral for agreeing not to develop property.

Tax breaks, NOAA indicates, provide an excellent incentive for donating lands



for public parks and other recreational sites by resulting in a tax credit in the amount of fair market value.

The private sector, too, can play an important role in public access by creating recreational opportunities at a price people can afford. A recent NOAA planning guide, "Coastal Recreation: A Handbook for Planners and Managers," notes, for example, that the charter fishing industry gives many people wider access to the nation's fishery stocks at a price well below that needed to buy one's own boat and related sport-fishing equipment.

The handbook speculates that private landowners and businessmen could help bolster beach access by providing access across their properties for a fee if necessary.

Paul Stang, head of OCZM's Technical Assistance Group, elaborated on the approaches being considered to increase public access.

"A variety of opportunities exist," he said. "Preferential taxation to encourage beach owners to maintain their property in a natural state or at a low development density is a rather painless mechanism for providing beach access. Mandatory park dedication ordinances put the onus on developers to ensure that a portion of subdivision tracts is available to the public.

"Another way of providing beach access, is through multiple use of recreational boats, which states can encourage by tax incentive or other means. Charter fishing boats provide an extremely effective vehicle for supplying recreational needs to people who can't afford their own boat.

"Overcoming the transportation problems that exist in coastal areas can be a significant first step in providing better access. Almost everyone on the East Coast is

familiar with the 10-to-15 mile traffic backups that occur during summer. Dealing with this 'peak use' problem necessitates more creative transportation systems.

"During working hours most public transportation systems are at high capacity, but remain idle during leisure hours. Capitalizing on this unused transportation capacity could provide a means for the public to get to beach areas in a way which would minimize rather than maximize congestion."

California, Stang said, is considering another approach to beach access.

"In its preliminary coastal plan," he said, "California describes the establishment of a coastal scenic parkway program in which coastal trail systems would link population centers with recreation facilities by using hiking, bicycle, and equestrian trails."

Coastal recreation generates tremendous economic benefits. It is a multi-billion-dollar industry that contributes significantly to local and state revenues. Annually, coastal recreation and tourism contribute more than $2 billion to California's economy, and about $3 billion to New Jersey's. Nationally, sport fishing in the coastal zone generates about $5 billion a year.

Coastal recreation brought the sale of over 1 million outboard motors and boats in 1973, and additional sales of close to $6 billion for fishing tackle, camping equipment, water skis, skin diving and scuba gear, recreational vehicles, pleasure boats and accessories. Hundreds of millions of dollars more are spent on other types of equipment, as well as for recreational clothing, lodging, food consumed during outings, and for gasoline used to drive to the beach.

As part of the development of their coastal management programs, state and local officials will attempt to evaluate the economic benefits of recreation in order that it can better compete with other economic shoreline uses for mineral mining, energy development, and timber harvesting, to name a few.

A key task of the program development

is the coordination of recreation planning activities with other existing federal, state, and local programs. In almost every coastal state and territory, efforts have begun to integrate coastal recreation planning with State Comprehensive Outdoor Recreation Programs administered by the Department of the Interior.

Under SCORPs, all 50 states are eligible for grant assistance to produce a program for facilitating standard outdoor recreation planning, land acquisition, and developmental activities through the Land and Water Conservation Fund Act of 1965.

NOAA sees the advantages of coordinating with the Interior Department program as being that SCORP planning can provide: valuable insight and experience through its 11-year existence; readily available data relevant to coastal zone planning—even if in limited form; and an already-developed public/private infrastructure necessary for coastal recreation.

Similar coordination related to coastal recreation is underway, or soon will be, with the National Park Service, for preserving and operating historic coastal recreation sites, such as national parks, monuments, lakeshores, and seashores; the Fish and Wildlife Service for providing public sightseeing, nature observation, and photographic activities in wildlife refugee areas; the Bureau of Land Management for providing recreational opportunities on federal land reserves; the Corps of Engineers for constructing small boat harbors and beach replenishment projects; NOAA's Sea Grant Program for marine resource information and technology concerning various coastal recreation aspects; the U.S. Coast Guard for small boat safety; and a variety of other agencies.

Through coordination, NOAA's Office of Coastal Zone Management has a unique method for insuring compliance with approved state programs to increase recreational use of shorelands and coastal water areas. The CZM Act requires that all federal agencies conducting, supporting, or licensing activities in or affecting the coastal zone must ensure that those activities are consistent, to the maximum extent practicable, with a state's approved program.

"One potential trade-off might be to relocate to inland areas activities which are not water-dependent or water-related," Stang believes. "Airports, tennis courts, playgrounds, baseball fields, certain industries and commercial facilities might be relocated from the coastline and still meet local demands.

"On the other hand, coastal flood zone areas which are rather hazardous for commercial buildings or residential housing are ideally suited for many recreational activities. Under any system of site selection, however, the questions of determining criteria for facility locations and which facilities are in fact water-dependent often are critical ones."

Knecht believes there are two options for bringing more people into the shoreline experience. "One," he said, "is to bring more people to the shore, and, two, to bring the shore to more people.

"To get more people to the shore, we could build more highways, widen more roads, but what do we do for people unable to go to the beach, such as the elderly, physically disabled, and less mobile segments of society?

"One possibility might be to establish seaquariums and other educational centers in urban areas, similar to the New England Aquarium in Boston and other complexes in California and Florida, to give more people the opportunity to relate to the coast in a meaningful and entertaining manner.

"Another possibility might be to rehabilitate the decaying urban waterfront areas into attractive recreational sites. Renewal of urban waterfronts could provide quick and effective access, and a corresponding opportunity for commercial development."

At long last,

The Truth About the Queen

BY CDR. HAL P. DEMUTH (RET.)

(Editor's note: From time to time, NOAA's National Ocean Survey receives inquiries from antiquarians and others, seeking to learn about Queen Lillihau, immortalized by monuments and plaques from Honolulu to Kodiak.

Here, with the expiration of the statute of limitations, in an article written by a safely retired Survey officer in terms carefully calculated to protect the guilty, is the true story).

During the spring of 1961, the Ship Surveyor was operating on a hydrographic survey off the Hawaiian Islands near Mauri, Molokai and Lanai. The operational schedule called for her to be in the project waters for two weeks and then steam to Honolulu to refuel, take some time off and re-supply before returning to Maui and the project.

During these infrequent trips to Honolulu, the officers and men were given an opportunity to get ashore for sightseeing on Oahu, visiting the places of interest in and about Honolulu and Waikiki Beach. At that time, we had a number of officers stationed on Oahu assigned duties in operation of the Field Office, Pacific Tide Surveys and the Magnetic Observatory. The visiting officers aboard the Surveyor frequently met with these friends, often at dinner parties, sightseeing trips and swimming parties.

One evening while at the home of a commander, the general feeling of well-being brought about by an excellent dinner and good friends led to a discussion of what we, the Surveyor officers, could do to express our gratitude not only to the various friends who had entertained us, but to the islands in general. The ship's Executive Officer proposed that we establish some sort of lasting monument or marker in the area, expressing the feeling of gratitude of the Surveyor for the wonderful times we had had in the Islands. The suggestion met with instant approval, and a variety of plans were discussed by which such a tribute could be performed. When it was decided that a monument or memorial should be established, our host proposed a fixed donation of 10 cents per person, and that word of the project be spread around the island. The 15 or so guests at the party immediately produced their dimes, and the project was officially launched.

The next day a group of the officers visited the Bishop Museum in Honolulu—a museum devoted to the history and culture of the islands. Depicted on one wall is a family tree diagram of the kings and queens of the Hawaiian dynasty. This tree begins with the great king Kamehameha I (1758-1819) and continues through the various descendants to the final ruler, Queen Lilliuokalani (1838-1917). Our group examined this tree and decided that somewhere in Hawaiian antiquity a branch could be grafted to immortalize our newly-inherited ruler in the islands. Although Queen Lillihau never existed in Hawaiian history, her reign, designated by the officers of the Surveyor to be 1587 to 1617, was a "happy reign" and as such was more than suitable for a memorial.

The unnamed fund now had an identity, and donations for the Queen Lillihau monument poured in from a variety of sources, usually at officers' clubs during the after-dinner social hour. The pre-dinner "happy hour" provided no small portion, also. If a lady donated the required 10 cents, our Commander graciously offered to give a kiss in return.

In June our stay in the islands was drawing to a close. We were to return from Maui to Honolulu one last trip, wind up our projects and embark for Arctic waters for the remainder of the field season. It was time to establish our monument, time to provide the Islanders with our token of appreciation.

A top level meeting ensued, a plan of action hammered out, assignments of duty were made and the final stages of the project launched. A piece of bronze plate was obtained. The ship's electrician was commissioned to engrave a legend upon the plate because he had three attributes we needed—the electrician's shop, an engraving machine, and a knowledge of how to operate the machine.

He did an outstanding job and when completed, the inscription read:

Now the second phase of the action plan was to begin. We examined a number of sites, with careful regard to several features. The site must be public (why hide the monument?), it should blend in with the natural beauty, but not disturb the function of the area. It should also be given more official status than just a private memorial.

As Operations Officer, I outlined a plan to provide the memorial with everlasting stability. We would make it an official Coast and Geodetic Survey marker, and would make measurements from it that would endow it with the same status as a bench mark or triangular station. This suggestion was accepted, and I was instructed to proceed.

A site was selected in the center of lovely Ala Moana Park which is located between Waikiki Beach and the downtown section of Honolulu, bordering the main drive along the famous beach area. The park itself is mostly green lawn, with scattered groups of palm trees providing a restful setting to the active public business of the area. Tourists gratefully stop at the park, rest in the shade before continuing to the beautiful Waikiki Beach.

As in most municipalities, an official permit would be required from the Honolulu city government before construction could begin on the Lillihau monument. A lieutenant (jg) was assigned the task of obtaining permission from the Honolulu city government. He found the permit office, applied for and was granted a permit to emplace the monument with the only condition that the site be level with the ground to facilitate mowing the lawn.

Next, a survey team was organized which located and documented the position of the monument by using a Wild T-2 theodolite, a surveying instrument for measuring horizontal and vertical angles. By observing a series of established triangulation stations in the area of Ala Moana Park, the team computed the exact latitude and longitude of the station by means of the "three point problem" or triangulation method. When such triangulation stations are established their descriptions are furnished to the survey crew.

On the appointed day the survey crew, under the direction of the lieutenant (jg) set forth with shovels, concrete mix, water, the inscribed bronze tablet, four corner bolts to fasten the tablet to a concrete base, the theodolite and suitable personnel. The City of Honolulu sent a representative from the city's engineering office to inspect the work as well as a truckload of yellow sawhorses to block off the construction area.

It was proposed that the local Navy band be requested and that a suitable dedication ceremony be prepared. The band, however, was committed to another engagement.

The job was done, the tablet in place, the measurements made, the observations of position taken, and the station was officially named "Lillihau" and described as noted in official C&GS forms. The lieutenant and his crew returned to the ship (berthed at pier 39, Honolulu) and received congratulations on a job well done. A large contingent of the ship's officers and men witnessed the occasion, appearing in the Uniform of the Day, Tropical White, Long.

So it was done, and there in the serenity of Ala Moana Park a tribute to Queen Lillihau was placed to show the gratitude of the officers and men of the Surveyor who found Hawaii a calm and wonderful way of life where imagination and feelings for love and beauty are so harmoniously combined.

Upon arrival of the Surveyor in Kodiak, Alaska in July, 1961, we were greeted by a collection of ships berthed at the Naval Station for the Independence Day holidays. Present were three Canadian destroyers of the River class, several Coast Guard ships, among them the Bittersweet, the ice breaker Northwind, USC&GS Ships Pathfinder, Pioneer and Surveyor, and the Navy ice breaker Burton Island. The harbor was crowded, and berth space at a premium.

It was a Saturday, and various of the C&GS, Navy and Canadian officers decided that a meeting at the Officers' Club would be appropriate. The Surveyor officers discussed ways that they could contribute to the evening's enjoyment and a decision was made to combine this current Arctic project with the recent Hawaiian cruise—the concept of two of our newest states, hands across the sea, and all that. Queen Lillihau was chosen as the instrument for this project and additional background material was provided to her royal charter. She was assigned more territory to her domain; her realm was extended to include the entire North Pacific Ocean, including Kodiak Island.

The Chief Electrician, who promptly produced another bronze tablet, fired up his engraving machine and engraved another tribute to the good Queen. This one was identical to the first, with the addition of a line

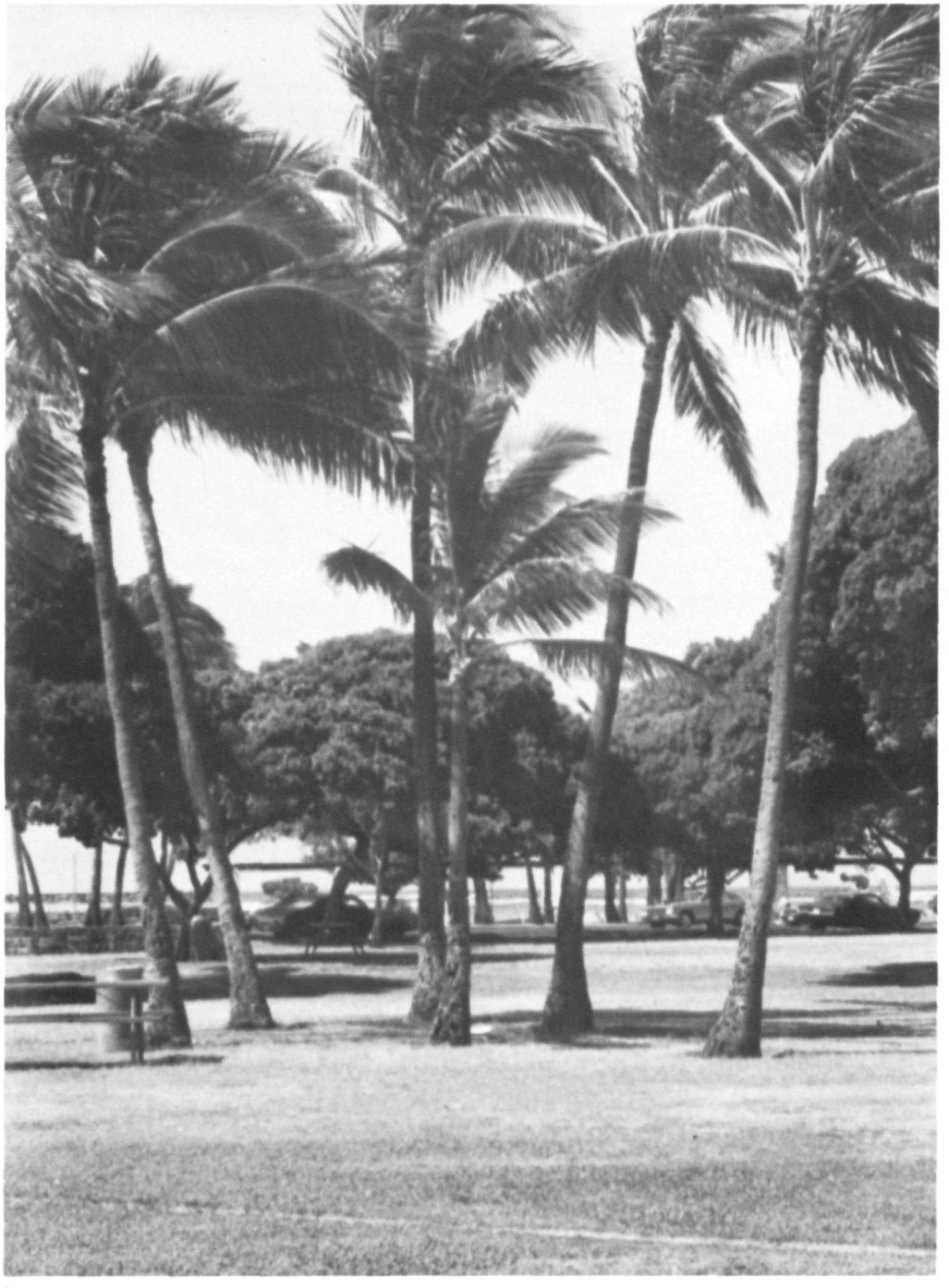
The Northern Boundaries of Her Realm

The manager of the Kodiak Naval Base Officers' Club, who agreed with our offer to present the tablet to the Club, arranged for a suitable spot, directly behind the main bar, for its permanent installation. The Queen Lillihau tablet was mounted in its place of honor before a large crowd, misty-eyed with the effect of the occasion.

The only loose end in this chronicle is the accounting of $13.00 collected for the memorial. Just prior to departing Honolulu for Alaska, the entire amount was used to purchase dozens of small Hawaiian flags, each mounted on a little staff fixed into a wooden base. These flags were displayed in most of the compartments aboard the Surveyor, reminding the officers and men of the wonderful times in the Islands. Later that summer, one of the flags was planted on an ice cake at the northernment extension of the ship's Arctic cruise, well to the north of the latitude of Point Barrow, above 72 degrees.

The flag may still be floating about up there, a tribute to Queen Lillihau and her happy reign.

A hui how kawa—until we meet again.



Among six sheltering palms in Honolulu's Ala Moana Park rests a tribute to Queen Lillihau.

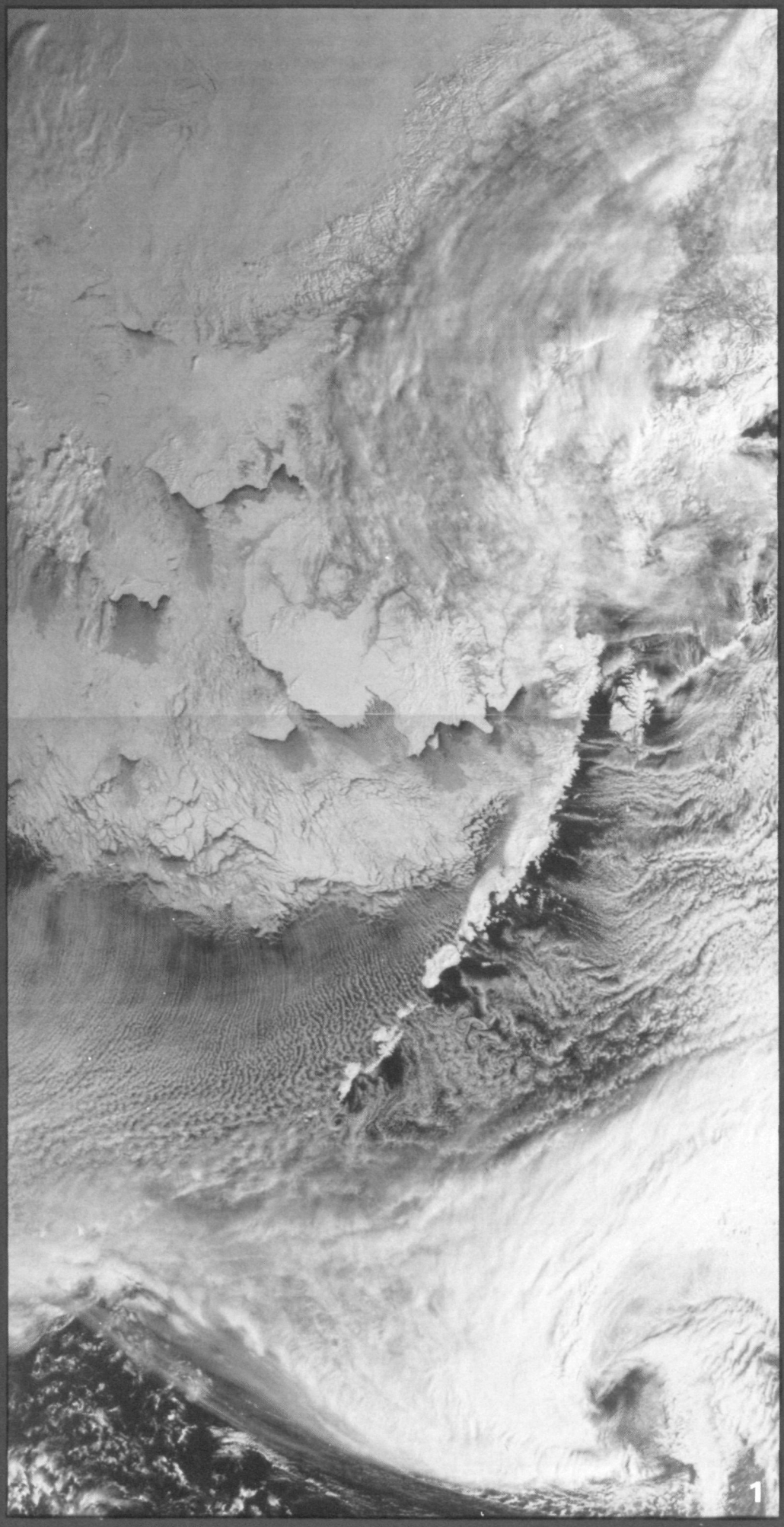
THE VIEW FROM SPACE

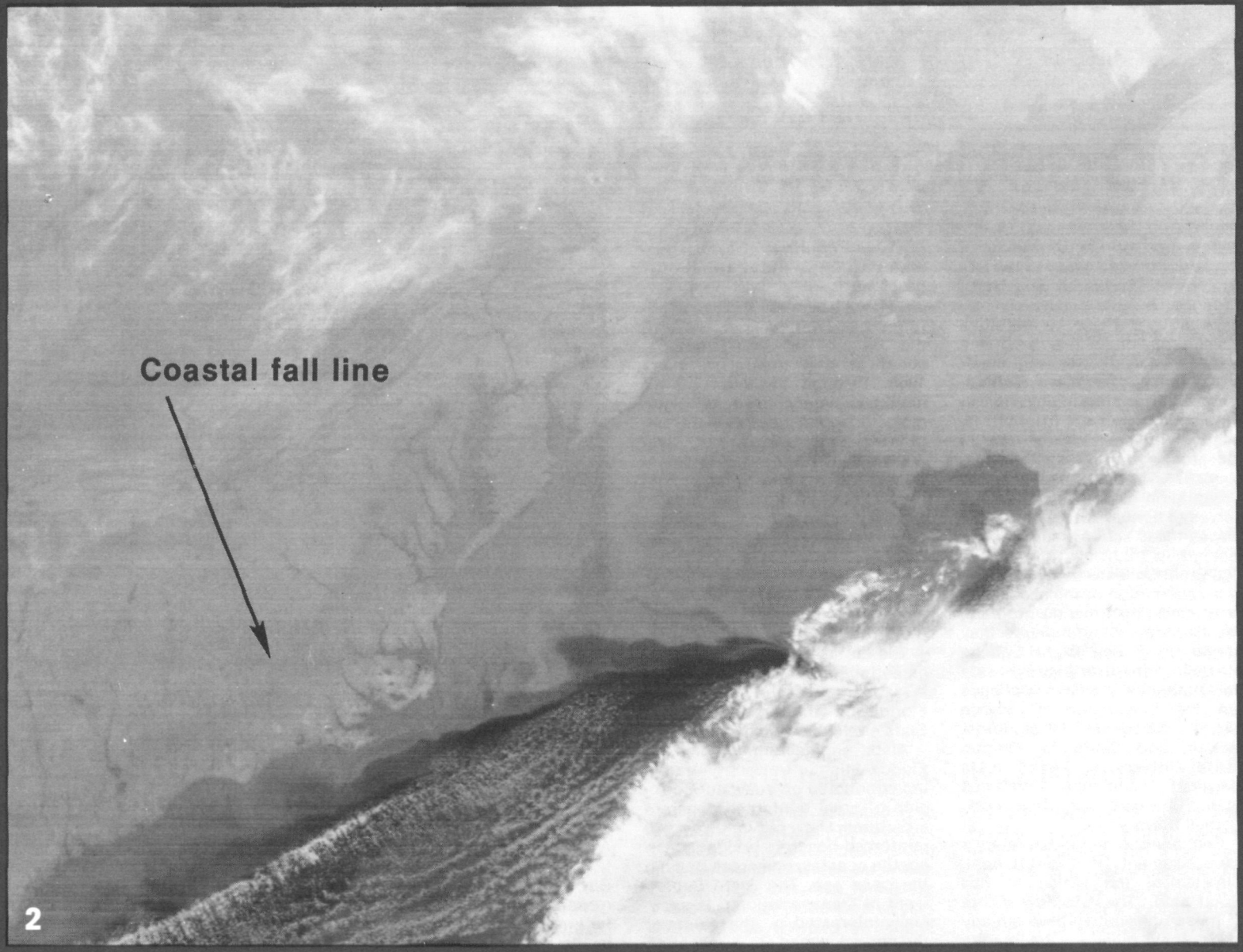
This issue's View From Space spans the United States; from the ice-bound reaches of Alaska to a view of the East Coast incorporating a most unusual feature, the coastal fall line. In between, two views of several of the Great Lakes, demonstrating what happens when the first warmth of spring touches these vast inland bodies of water. All pictures were taken by the polar-orbiting NOAA-4 spacecraft, from an altitude of about 900 miles (1440 kilometers).

1 *The awesomeness of the ice cap which locks off much of Alaska in winter is seen in this March 18 picture. But already signs can be seen that the long winter is ending; the suggestion of nearly open water along the southern coasts of Seward Peninsula and St. Lawrence Island. Clouds typical of those created when cold air flows across warmer water stream southward off the ice, and bubble over the Aleutian Islands and Alaska Peninsula.*

2 *A nighttime, infrared picture of the East Coast challenges the viewer's eye to spot the Outer Banks and a rarely seen geological phenomenon, the coastal fall line—the border between the soft rocks of the Atlantic Coastal Plains and the harder rocks of the Piedmont Province, seen as a delicate shadow paralleling the coast. The west wall of the Gulf Stream also is visible where the darker and lighter shades of gray meet offshore.*

3-4 *Two computer-enhanced images of Lakes Huron, Erie and Ontario show the difference 20 days can make to the ice in the Great Lakes. On Feb. 3 (left) Lake Erie is choked with ice; the northern half of Ontario also is ice-covered. But by Feb. 23 the only significant ice left is in the eastern portion of Erie. The Finger Lakes, just south of Lake Ontario, are ice-free their depth keeps them from ever freezing over.*





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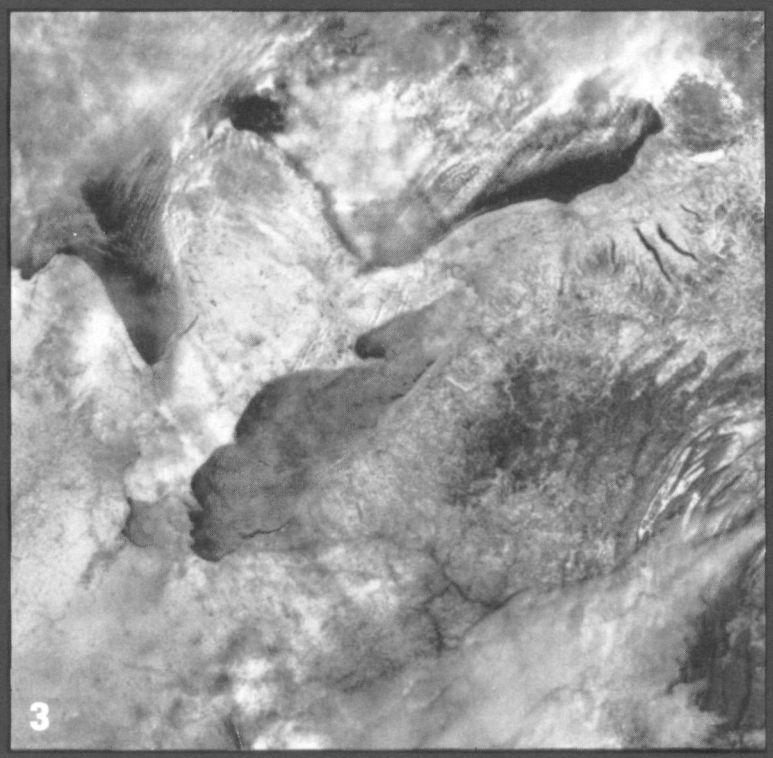

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TWO SEA GRANT COLLEGES DESIGNATED

Secretary of Commerce Elliot L. Richardson has announced the designation of the University of Delaware and the State University System of Florida as Sea Grant colleges.

"Although these universities have highly individual programs and serve very different regions of the country," Secretary Richardson said, "each has maintained an outstanding record of achievement in its programs of applied research, education, and advisory services in the marine field. The designation of Sea Grant College serves to honor those records and places these schools among a select group that now numbers 10 Sea Grant Colleges in the nation."

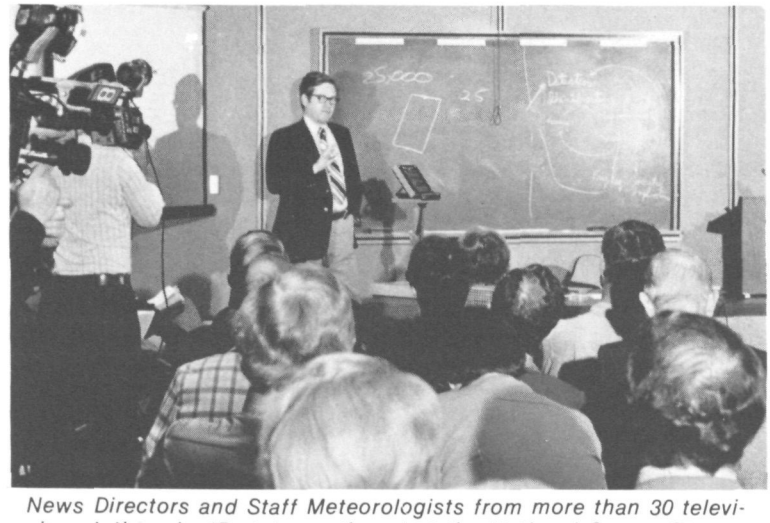
In recognition of the excellence of a university's marine program, the Secretary of Commerce may confer on it Sea Grant College status. Institutions previously designated as Sea Grant Colleges are the Universities of Rhode Island, Wisconsin, Washington, Hawaii, and California; Oregon State University; Texas A&M University; and the combined State University of New York-Cornell University.

Commenting on the Secretary's announcement, Dr. Robert B. Abel, Director of the Office of Sea Grant, said, "The individual efforts of these universities have already made their mark in the marine field. The pioneering advances in applied research through such projects as Delaware's unique shellfish aquaculture system and Florida's ocean engineering program will continue to bring benefits to a large and growing user group.

Delaware's shellfish aquaculture project is typical of the work the Office of Sea Grant has sponsored at that institution since 1968. Through the efforts of a multidisciplinary team of biologists, economists, chemists, engineers, and legal experts, Delaware's closed-cycle rearing operation shows promise of being able to produce fast-growing, disease-resistant clams and oysters in a controlled and totally self-contained environment. Using the system, the research team has successfully grown test oysters to market size four times faster than they grow in nature.

The Florida System's ocean engineering program will continue investigations at the University of Florida on the erosion of the State's valuable beach sand.

Also, engineering studies at Florida Atlantic University are being conducted on seawater corrosion of steel reinforced concrete structures. Many of Florida's 4,000 reinforced concrete bridges are in hostile coastal zone areas or even the open sea. The State Department of Transportation, is especially interested in the results of the project, aimed at discovering the best and most economical materials with which to build new bridges.



News Directors and Staff Meteorologists from more than 30 television stations in 15 states gathered at the National Severe Storms Laboratory for a seminar and news conference on the 1976 Severe Storm-Tornado Research Field Program recently. In addition to formal presentations on the latest findings on improved tornado detection and predictions, they toured the research area and facilities.

Automatic Tide Station on Bay Bridge Tunnel Opened

An automatic tide recording station, installed on the Chesapeake Bay Bridge Tunnel to serve as a research and development facility for improving technology involved in the measurement of tides and water levels, is now operational, the National Ocean Survey has announced.

The station, on one of the most important Atlantic Coast waterways, is the result of three years effort by the NOS, the National Weather Service, the U.S. Army Corps of Engineers, and the Chesapeake Bay Bridge Tunnel Commission. It will be maintained by the Survey's Atlantic Marine Center in Norfolk, Va.

NOS Director Rear Admiral Allen L. Powell said the Bay Bridge Tunnel station can operate up to 10 different types of tide gaging or scientific equipment simultaneously, providing the Survey with an "invaluable aid in the evaluation, testing, and improvement of techniques of various equipment essential to obtaining more and better knowledge of our oceanic environment."

The station's tide recorder will automatically telemeter water levels to the NWS at the Norfolk Airport, providing information to aid in warning the public of rising water levels from winds or heavy rains not only in the immediate area but also the Upper Bay areas where flood waters are a chronic threat to low lying sections.

Information transmitted to the U.S. Army Corps of Engineers in Norfolk will assist in the design of construction projects as well as allow additional time to establish precautionary measures during flood periods.

Effects Weighed

Nitrogen Fertilizers May Affect Ozone

Nitrogen fertilizers on the ground may be affecting the ozone layer at the top of the atmosphere—but not very much, reports Dr. Paul J. Crutzen of the Environmental Research Laboratories. He believes that the projected use of nitrogen fertilizer presents little immediate danger of large ozone reductions—that the real problem is human ignorance.

Dr. Crutzen used a numerical model of the atmosphere to calculate the effects on the ozone layer of increased input of fixed (chemically combined) nitrogen to the soil. He works in ERL's Aeronomy Laboratory and at the National Center for Atmospheric Research, which is funded by the National Science Foundation.

Ozone, a form of oxygen that sunlight manufactures out of the breathable variety, floats in a tenuous layer in the stratosphere that shields earth from hazardous levels of ultraviolet radiation. At the same time that it creates ozone, the sun also creates its chief destroyer, nitric oxide, from nitrous oxide. Microbes in soils and ocean waters convert fixed nitrogen—the kind in nitrogen fertilizer—to nitrous oxide and exude it into the air. In this way, nature returns the fixed nitrogen to the atmosphere.

A report by the Council for Agricultural Science and Technology states that the worldwide use of industrial nitrogen fertilizers in 1974 amounted to 40 million tons of nitrogen, and predicts that by the year 2000, this will increase to between 100 million and 200 million tons.

Some researchers have predicted dire consequences to this increased use of fertilizer, envisioning reductions of the ozone layer by as much as 30 percent. Dr. Crutzen reported he had found little evidence to support such fears. There are already about 1400 million tons of nitrogen in the form of nitrous oxide in the atmosphere, he pointed out, and the 40 million tons of fertilizer now annually spread on the soil add only about two million tons of nitrous oxide to the atmosphere. The remaining 38 million tons of nitrogen are returned as inert molecular nitrogen. "On this basis, man would be able to affect the nitrous oxide content of the atmosphere only over a period of several hundred years," he said.

Dr. Crutzen estimated that, if use of nitrogen fertilizers increases by about six percent annually until the year 2000, and levels off, by 2035 it will cause a decrease in ozone of somewhere between one and 10 percent.

noaa/update

Satellites Monitor Snowcover In Western U.S. River Basins

Geostationary satellites operated by NOAA can play a major role in monitoring snowcover in a number of western U.S. river basins, with numerous resulting benefits to mankind, according to National Environmental Satellite Service scientist Stanley R. Schneider.

Mr. Schneider came to these conclusions in a report on an analysis of NOAA's satellites, conducted with David G. Forsyth, also of NESS. The geostationary satellites, their analysis showed, are preferable in some respects to polar orbiting satellites used for snowmelt monitoring since 1973.

In a paper delivered at the spring annual meeting of the American Geophysical Union in Washington, D.C., Mr. Schneider pointed out that the melting snowpack is critical to irrigation planning, hydro-electric power generation, reservoir regulation, river stage forecasts, and flood warnings.

For the past three years, NOAA polar orbiting satellites have been used to monitor snowmelt, providing visual images once a day for a given area, from an altitude of 900 miles (1440 kilometers). The geostationary spacecraft, at 22,250 miles (35,800 kilometers) altitude, provides images every half hour. The increased frequency of images is valuable in the monitoring effort, Mr. Schneider said, because it increases the chances of obtaining a cloudfree view of the earth's surface.

Also, the geostationary satellite imagery was found superior in bringing out small bodies of water, such as lakes and reservoirs that might not be discernible on the other types of satellite imagery. Identification of such landmarks is necessary in order to register satellite images on base maps.

Pollutants Escape From Powerplants On Flyash

Such pollutants as sulphur, chlorine, and some metals may escape from coal-fed powerplants on microscopically small particles of flyash, according to an Environmental Research Laboratories scientist.

These pollutant-bearing particles are as breathable as cigarette smoke, and so small that most anti-pollution smokestack devices let them through, reports Dr. Rudolf F. Pueschel, who leads the nucleation work at ERL's Atmospheric Physics and Chemistry Laboratory.

The particles are also efficient condensation nuclei—the solids around which drops form in clouds—and light and stable enough to float in the atmosphere for weeks, according to Dr. Pueschel.

"Because they are produced in great quantities," he explained, "these small particles carry proportionately large amounts of pollutants into the atmosphere, and many miles downwind of the powerplant source. They appear to be linked to the persistent haze we see in such areas, and may affect downwind rainfall patterns. Because they are coated with sulfates and chlorides, they may affect the acidity of the rain they help produce."

Their small size, combined with their cargo of pollutants, could also pose a health hazard, according to Dr. Pueschel.

Dr. Pueschel reported on these particles and the newly developed ability to identify them at the recent American Geophysical Union meeting in Washington, D.C.

IATTC To Make Satellite Study Under Contract

The Inter-American Tropical Tuna Commission (IATTC) of LaJolla, Calif., will correlate data from satellites with color and thermal properties of the ocean that relate to areas where certain types of fish are most likely to be caught, under a NOAA contract.

In cooperation with the National Marine Fisheries Service, IATTC will collect ocean surface data such as temperature, chlorophyll concentration, and atmospheric soundings during a research cruise this summer in known high tuna catch areas off California's coast.

This data will be related to information collected by two NOAA satellites (NOAA-4 and GOES-1) and NASA's LANDSAT spacecraft.

A prime goal of the project, coordinated by the National Environmental Satellite Service, is to ascertain whether information on ocean color and temperature measured by satellite instruments can be applied to fisheries research and resource management.

Spotting Scope Saves NOAA Ship David Starr Jordan Rescues Fishermen

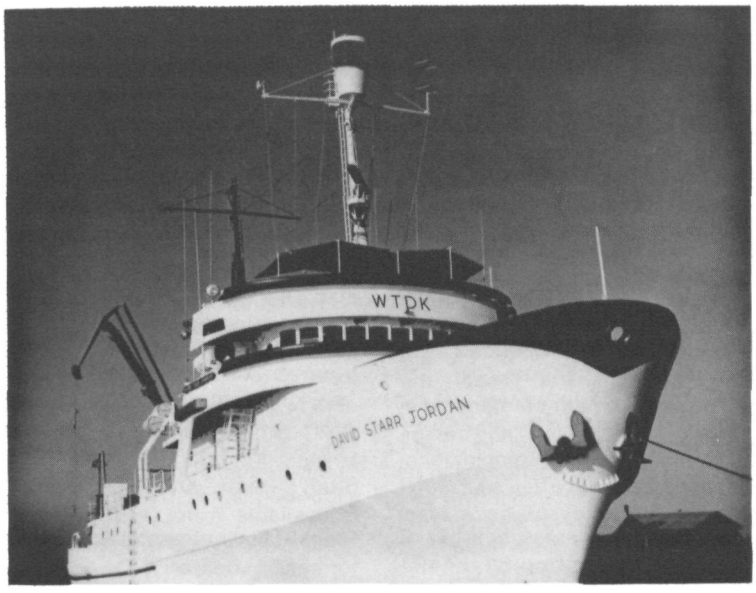
The NOAA Ship David Starr Jordan recently rescued two elderly fishermen whose small boat had foundered in the Gulf of Nicoya, off Costa Rica.

The boat and two men were first observed by Dr. Eric Barham, a National Marine Fisheries Service fishery biologist and head of the scientific party aboard the Jordan, while looking for marine mammals through a high-powered spotting scope.

The ship, under Master Charles W. Forster, slowed and changed course to approach the small boat, and on closer inspection observed the two men signalling for aid. Capt. Forster maneuvered the Jordan to bring the craft into position for rescue and a line was thrown. In reaching for the line one of the men capsized the small craft, throwing them and their gear into the water.

The fishermen, now clinging to the sides of their capsized boat, were only a few feet from the Jordan's side, yet seemed incapable of reaching the nearby Jacob's ladder. One man appeared to be drowning even though his head was clearly out of the water. Seaman Barry Adams, who was attempting to aid them from the bottom of the Jacob's ladder, jumped into the water and assisted the man to the ladder, which he managed to climb with the aid of helping hands from below and above. Once on deck the cause of his distress became evident. Although unable to talk, he gestured to a tracheotomy incision in his neck through which he had been taking in water and from which water was still gushing. The man remaining in the water appeared even weaker and had to be raised to the deck of the Jordan by a line slung under his arms. It was subsequently discovered he was badly crippled and partially blind.

With the aid of the winch aboard the Jordan, the small fishing vessel was righted and pulled up the stern trawling ramp and all baggage and equipment fished out of the water. During the short run to Puntarenas, Jose and Julio Aquilino, aged 81 and 77, respectively, explained that they were brothers, and that while attempting to cross the bay to the little village of Tambor after a shopping trip to Puntarenas, their vessel began taking on water. They had sat in their partially flooded craft for about three hours while several large fishing vessels passed close to them without taking notice of their plight. Capt. Forster stated that it was certain these two senior citizens of Costa Rica would have perished at sea had they not been rescued by the Jordan.



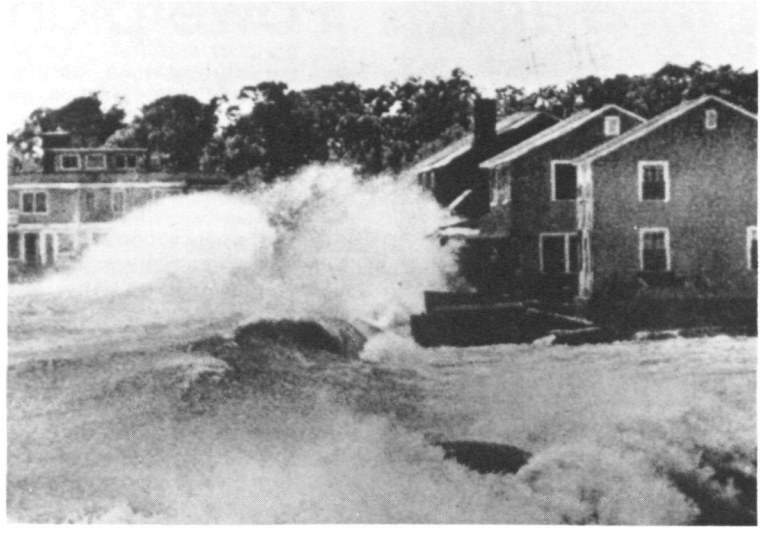
Ava, Camille and Eloise Model Storms

An Environmental Research Laboratories scientist has found unexpected order in the legendary chaos of hurricane seas and has applied this to developing a model that predicts a storm's worst waves.

The model, described by Oceanographer Duncan Ross at an American Meteorological Society meeting in Seattle, Wash., is a gift from three violent hurricanes: Ava, the 1974 eastern Pacific storm that is still the most intense on record; Camille, the destructive 1969 Atlantic hurricane considered a "worst case"; and Eloise, the hurricane which struck the Gulf coast of Florida last year.

Mr. Ross, with ERL's Atlantic Oceanographic and Meteorological Laboratories, says the model is one of the first to be based on actual observations taken in hurricanes. Although it is not as detailed as some models, he believes it can specify wave heights in any quadrant of a hurricane where winds are 40 knots or greater and the storm is over deep water. And this simplified model can be applied without a large computer. "You can run it on a slide rule," he says.

"What the model predicts is the wave energy spectrum of the storm," Mr. Ross explains. "From this spectrum we can get the highest expected wave out of a thousand waves, and the statistics of progressively smaller waves, giving us a reasonable picture of the wave spectrum for most hurricanes. Of course, it still needs some additional testing and development to account for the forward velocity of a storm different from that which went into the development of the model."



Mize Receives Auto Maker's 1976 Conservation Award

Verna Mize, Secretary to the Director NOAA Corps, recently received an American Motors Conservation Award for 1976. The awards have been presented annually since 1954 to professional and nonprofessional conservationists for dedicated efforts in the field of renewable natural resources, with 10 awards in each category.

American Motors said Mrs. Mize serves as an inspiration for any citizen who wants to believe that an individual can have major impact on an important issue. For almost 10 years, she carried out a relentless campaign to arouse public concern about dumping of mining wastes into Lake Superior.

A native of Houghton, Mich., Mrs. Mize had grown up with the beauties of this magnificent lake, and when she learned of the threats to it, she decided to do something. She gathered information and facts, and then began a campaign of letters, of organizing petition drives, collaring state and federal officials, pressing for news coverage, and finally appearing before a Congressional committee. For part of the time she worked virtually alone, without financial or other aid from any organization.

But her perseverance paid off, and the taconite dumping issue attracted nationwide attention—from conservationists, the press, and state and federal governments.

Her efforts, perhaps as much as any other thing, led to intensive study of Lake Superior by the federal government and the governments of three states, and actions aimed against dumping of mining wastes into the lake.

The award included a bronze sculptured medallion and honorarium of $500.

TEXAS NATURAL AND MAN-MADE FEATURES PUBLISHED BY NMFS

A comprehensive description of the natural and man-made features of the Texas coast has been published by the National Marine Fisheries Service in cooperation with the Gulf States Marine Fisheries Commission.

Authored by NMFS Fishery Biologist Richard A. Diener, the 129-page document contains newly developed tables and maps depicting estuarine dimensions, submerged vegetation and tidal marshes, public oyster beds, leased oyster rearing areas, sources of pollution, navigation channels, and filled areas on the Texas coast. Published and unpublished information on geology and bottom sediments, temperature and salinity, artificial reefs, clam beds, stream discharges, commercial and sport fishing, hunting, population growth, and economic development is presented in new form.

NOAA Technical Report NMFS CIRC-393, "Cooperative Gulf of Mexico Estuarine Inventory and Study, Texas: Area Description", is available from D825, Services Branch, Environmental Science Information Center, NOAA, Washington, D.C. 20235.

Wash., D.C. Tide Gage Automated

The National Ocean Survey and the National Weather Service have cooperated in the automation of the Washington, D.C., tide gage.

An NWS Device for Automatic Remote Data Collection (DARDC) was installed on the NOS control tide gage; now anyone with an eight-level data terminal connected to a telephone can obtain the tide height by dialing the phone number assigned to the tide gage site.

The DARDC Tide installation was made to test the dependability of the system for operational collection of tide level information. If successful, it will increase both NOS and NWS capability to monitor the tide gage network for data collection or data quality.

DARDC Tide units interrogated via a dedicated communication system (telephone, radio, or satellite) could bring a new dimension to the collection and dissemination of tide information needed for both NOS and NWS ongoing programs, according to Robert W. Schoner, Marine Program Leader, NWS Data Systems Division.

GREAT LAKES INDEX GIVES DESCRIPTIONS

An index to more than 1,000 files of data concerning the Great Lakes is now available from the Environmental Data Service's National Oceanographic Data Center. The Great Lakes files are part of the 5,000 files described by the Environmental Data Index (ENDEX) system. ENDEX provides rapid, automated referral to multidiscipline environmental data files of NOAA, other Federal agencies, state and local governments, universities, research institutes, and private industry.

The Great Lakes index covers descriptions of environmental data on pollution, solar flares, meteorology, wildlife, aquatic biology, pesticides, and hydrology. The index contains no data, but does list each parameter measured in the data file, time periods, geographic area of data collection, data storage media (such as punch cards or data sheets), person to contact, and costs for obtaining these data.

noaa/update

Sirens Urged To Signal Disasters Nationwide

The Defense Civil Preparedness Agency and NOAA are urging communities throughout the nation to use sirens for both natural and man-made disasters.

"The DCPA and NOAA fully support a policy for maximum use of sirens for disaster warning purposes," states a joint position paper signed by DCPA Director John E. Davis and Dr. Robert M. White, NOAA Administrator.

"Authorities and procedures for using sirens for natural disaster warning should be specifically documented in community preparedness plans," the paper provides. In addition, it recommends that the wailing siren tone should be used only as an attack warning signal, while a steady siren tone would be used to indicate the threat of natural disasters such as tornadoes and flash floods, or other events that may have a serious impact on the community.

The statement proposes that authority to sound warning sirens be given to more than one local government office to insure 24-hour coverage.

The joint statement emphasizes that sirens should not be the sole means of disaster warning. Community preparedness plans should include utilization of television, radio, and other communication systems. Warnings to specific individuals and such large-scale protective actions as evacuation of an area remain the responsibility of local authorities.

A statement on National Policy for the Use of Telecommunications to Warn the General Public issued January 1975 by the Office of Telecommunications Policy in the Office of the President established that NOAA and DCPA would develop plans and procedures for incorporating the civil defense siren system into the consolidated warning system.

ERL Studies Puget Sound Circulation in Seattle, Wash.

A search for clues to the uncommon ability of Puget Sound and other deep, cold-water estuaries to digest pollutants—and the limits of that capacity—is being conducted by Environmental Research Laboratories scientists in Seattle, Wash.

Using a moored string of seven current meters suspended beneath a subsurface buoy, they are developing the first detailed three-dimensional view of water circulation in the Sound. From the information collected, they expect to learn why the Sound, although bounded by large population centers, remains relatively unpolluted.

They also expect to be able to develop and refine models used in predicting circulation in Puget Sound, which, with modifications, could be applied to other deep, cold-water estuaries.

The year-long current-measuring effort is being conducted by ERL's Pacific Marine Environmental Laboratory as part of a new Marine Ecosystems Analysis (MESA) Puget Sound project. The MESA program seeks to determine the impact of human activities on marine life and environment.

"We're mainly concerned with determining behavior of the Sound, and the impact of wastes," explained Dr. Glenn Cannon, who is directing these field studies. "The current-meter mooring is near the largest of four sewer outfalls entering the Sound from the greater Seattle area. This is an area where we've made measurements previously, so we have some continuity."

Understanding how Puget Sound removes pollutants by mixing will do much to help environmental managers preserve this unique estuary. It will also provide a useful tool for local governments as they make the costly decisions on how to bring their waste-treatment systems up to present Federal standards.

The Puget Sound study has special implications for Alaska, where oil exploration and development will bring increasing population—and increasing environmental pressures—on the northern state's deep bays and inlets.

Ocean Surface Data System, SCUDS, Developed by EDS

The Environmental Data Service's National Oceanographic Data Center (NODC) has developed a storage and retrieval system called SCUDS (Surface Current Data System) for a new file of ocean surface current data spanning the period from the early 1850's through 1974 that was acquired from the U.S. Naval Oceanographic Office. It contains more than four million set-and-drift observations made by seamen of the Netherlands, Japan, Great Britain, France, and the United States. They are supplemented by several thousand Geomagnetic Electrokinetograph (an instrument which measures currents) observations, of Japanese origin.

The new file replaces and basically includes the nearly 3.2 million U.S. and Netherlands observations which in the past constituted NODC's surface current data file. Observations for the 19th century were collected primarily by the Netherlands; those of the 1960's through 1974 (about 64,000 records) are primarily from U.S. collections.

NOS Publishes International Nautical Chart

Publication of the third of five international nautical charts has been announced by the National Ocean Survey.

The chart, INT 513, covers the southern portion of the Bering Sea, including the Aleutian Islands, and is issued as part of a multination program sponsored by the Monaco-based International Hydrographic Organization (IHO).

The IHO program will provide a standard series of charts for the entire world which can be used by all nations. Each IHO member nation is authorized to reprint charts in its own language, but must employ the same form of navigational information, such as depth curves, sounding spacing, aids to navigation, and nautical symbols.

"Conshelf Drifter"
DRIFTING BUOYS TO TRACK OCEAN CURRENTS

The National Ocean Survey has awarded an $80,000 contract to the Polar Research Laboratory, Inc., Santa Barbara, Calif., to develop low-cost, expendable, drifting buoys for ocean current measurements in continental shelf regions.

Designated the "Conshelf Drifter," the system is designed to track ocean current circulation at a prescribed depth, according to the NOAA Data Buoy Office. Information obtained from the system will assist in offshore oil and gas exploration and determining the movement of pollutants and biological organisms along the coast.

The buoys also may be programmed to give surface and subsurface current data during severe weather events in order to establish survival design criteria for offshore structures, as well as information useful to the scientific community in validating water circulation models.

The Conshelf Drifter will operate initially with NASA's NIMBUS-6 polar-orbiting satellite, providing position-fixing information for tracking purposes. Subsequent development may include the addition of environmental sensors, and the capability to operate with the TIROS-N polar-orbiting satellite system scheduled for launch in 1978.

Twelve of the buoys are being purchased for several engineering and scientific experiments.

DUST DEVILS: SLOWPOKES, NOT WHIRLING DERVISHES

Dust devils, far from being the whirling dervishes they may appear when seen dancing across a prairie, are in fact relative slowpokes.

This is one finding of recent research on dust devils conducted by scientists from the Environmental Research Laboratories who are studying them because their characteristics and behavior may be similar to their destructive cousins, tornadoes.

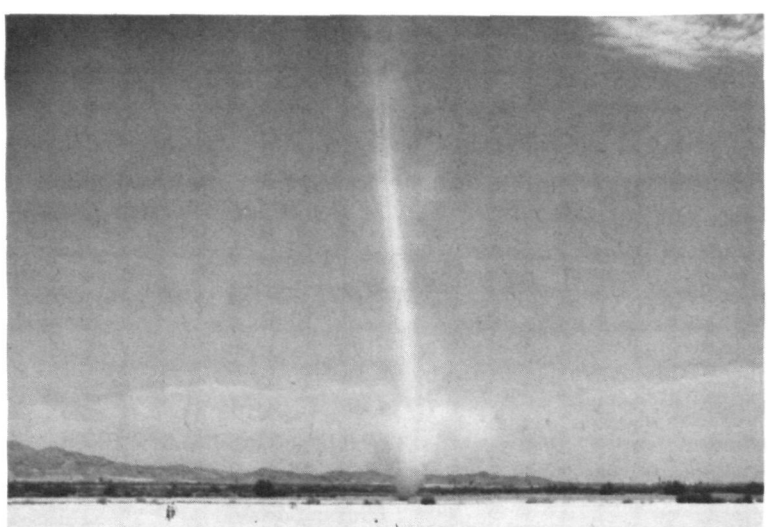
Using a beam of laser light from a novel wind sensor, the scientists have made what they believe are the first remote measurements of wind velocities in dust devils. They found dust devils whirl with a slow and stately bearing, and some carry mini-whirlwinds within their main vortices.

The researchers traveled to desert sites with a portable wind sensor. The recently developed system—an infrared doppler lidar housed in a truck-mounted camper shell—measures wind velocities by the change in frequency (or doppler shift) of a laser-generated beam of infrared radiation scattered from wind-borne particles—in this case, dust.

On the Gila Indian Reservation near Phoenix, Ariz., and the Energy Research and Development Administration's Navada Test Site, Dr. Ronald L. Schwiesow and Richard E. Cupp probed passing dust devils with the laser radar. Simultaneously, they filmed with a movie camera to obtain visual images for comparison with the lidar readings. In all, they observed over 40 dust devils.

They found that the horizontal flow of winds in dust devils is fairly slow, with the highest velocity measured at 47 miles (79 kilometers) per hour. Certain vase-shaped dust devils had smaller and slower vortices within the main vortex.

Such measurements may reveal some secrets of that most violent of atmospheric vortices, the tornado. Though dust devils and tornadoes are generated by different processes, once underway their characteristics and behavior may be similar, and scientists hope that by studying the more numerous and accessible desert denizens they can learn more about tornadoes.



DOMES Continues; Second Research Cruise in Pacific

Scientists from NOAA and other organizations have embarked on the second of a series of major research cruises in the Pacific Ocean as part of NOAA's Deep Ocean Mining Environmental Study (DOMES).

The researchers will be conducting studies preliminary to investigating the extent of environmental impact that might be expected as a result of deep ocean mining.

Mining interests already are gearing up to retrieve deposits known as manganese nodules from the deep ocean floor. These deposits contain manganese, copper, nickel and cobalt in quantities which will greatly augment the U.S. domestic supply from traditional land sources.

The present cruise aboard the NOAA Ship Oceanographer will take more than a score of scientists to an area 2,500 miles (4,000 kilometers) southeast of Hawaii, where manganese nodules are believed to exist in commercial quantities. The scientists from NOAA, the U.S. Geological Survey, Texas A&M University, and the Universities of Hawaii and Washington, will be at sea for three months.

Automated Chart System Contracted

Construction of the final link in an automated nautical charting system designed by the National Ocean Survey has been started for Planning Research Corporation's Information Science Corporation, McLean, Va.

The firm is preparing an automated information process to store and retrieve nautical chart information and allow NOS cartographers to compile charts using computer-generated graphics interacting with a nautical chart data base.

The new charting system, expected to become fully operational by 1980, will replace the present day manual system, which prints approximately three million charts each year for coastal areas, estuaries, harbors, and the Great Lakes.

R. Adm. Allen L. Powell, NOS Director, said the information system is the final link in NOAA's $25 million nautical chart automation program that includes the automated acquisition, storage, and retrieval of chart data, compilation of charts, and chart negative production.

"Once the program is fully operational," he said, "most data now appearing on nautical charts will be available in digital form for the computer. These data can then be recalled, not only for charts, but for other purposes as well."

Sea Grant Funds Aquaculture at University of NC

The University of North Carolina will conduct research aimed at the preservation and management of that State's substantial marine resources and will continue work in an unusual aquaculture program under a $535,000 Sea Grant.

The NOAA grant will be augmented by more than $267,000 in matching funds from a variety of non-Federal sources, including direct appropriation from the State and from private industry.

One of North Carolina's most prominent marine resources is its two and one half million acres of estuaries, sounds, and marshes behind its barrier islands. These salt water areas are the foundation for a large commercial and sport fishing industry, and support substantial tourist activity, as well.

Under this year's funding, scientists will study the build-up and erosion of the shoreline from eastern Albemarle Sound to southern Pamlico Sound, try to discover what makes some areas more vulnerable than others, and suggest methods for dealing with coastal erosion problems. Special "erosion potential maps" will be drawn to help implement the State's Coastal Zone Management Act.

Michigan Institute Awarded Contract

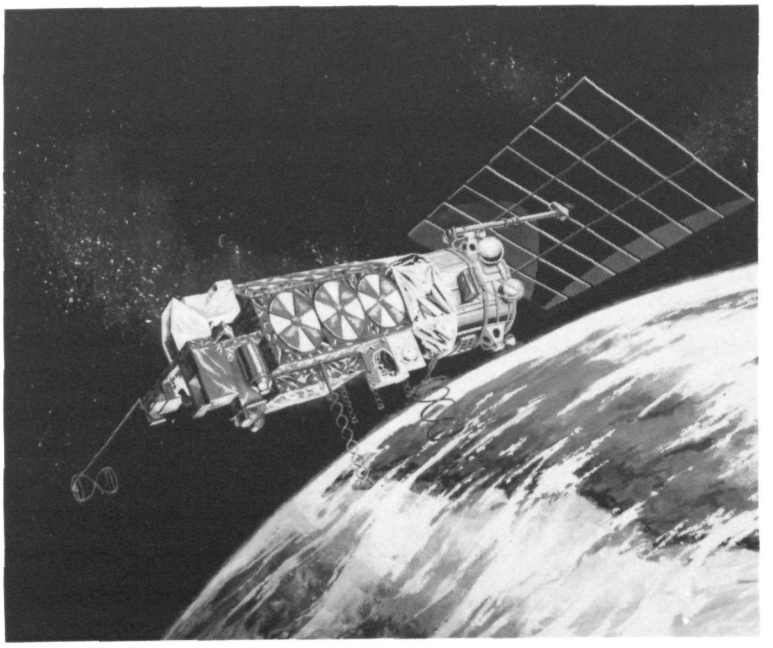
The feasibility of mapping water characteristics—sediment, pollution, algae, and the like— using instruments aboard spacecraft will be studied under a series of contracts awarded by NOAA to the Environmental Research Institute of Michigan (ERIM).

The contracts, totaling $93,493, also support study on use of a multispectral scanner—an instrument which measures radiation in the various wavelengths of the electromagnetic spectrum—for improving measurements of water depths from satellites.

The research will contribute to the selection of appropriate spectral bands for water penetration for future NASA LANDSAT spacecraft.

In the water characteristics study, according to David S. Johnson, Director of the National Environmental Satellite Service, ERIM is conducting tests of a modified electronic scanner aboard an airplane flying over Lake Michigan and the Pacific Ocean off California.

At the same time this instrument records water surface data related to pollutants, sedimentation and the like, Mr. Johnson said, personnel on boats in the test area take actual samples. The readings from the scanner and the samples are correlated to determine scanner accuracy.



$10 Million in Contracts Awarded for Satellites

Contracts totaling more than $10 million have been awarded companies in Santa Monica, Calif., and Baltimore, Md., to produce data acquisition and processing subsystems for a forthcoming generation of operational environmental monitoring satellites.

The new series of satellites, known as the TIROS-N, is being designed to replace existing polar-orbiting satellites, operated by NOAA, to provide more accurate data for environmental monitoring and predictions.

System Development Corp. in Santa Monica will produce the data processing and services subsystem of the TIROS-N satellite ground system. Westinghouse Defense and Electronic Systems Center Baltimore, will build the data acquisition and control subsystem portion of the TIROS-N program.

The National Aeronautics and Space Administration will fund the development and launching of the first TIROS-N spacecraft, while NOAA will finance subsequent spacecraft and their launches, establish ground facilities, and operate the satellites in orbit.

The new series of satellites and their supporting systems will permit the acquisition of environmental data at a much higher rate than is presently possible, calling for a fully digital system.

Additionally, TIROS-N satellites will be capable of more precise atmospheric and oceanographic measurements and broader monitoring of space phenomena having to do with energy distribution in the near-earth space environment.

The new generation also will be able to receive, process and retransmit to earth data transmitted from monitoring platforms on land, in the air, and in the ocean.

To a large extent, already existing facilities and equipment now used for the current polar-orbiting satellite system will be converted to accommodate the new TIROS-N system, officials of the National Environmental Satellite Service said.

Wis. Sea Grant Program Researching Lake Trout

A new variety of lake trout will be used to stock southern Lake Michigan's deep water reefs.

Ross Horrall, a University of Wisconsin-Madison zoologist, is researching lake trout and whitefish reproduction for the University of Wisconsin Sea Grant Program.

Researchers believe that this fish—the southern deepwater lake trout—may be extremely important in restoring a naturally reproducing lake trout population to southern Lake Michigan. Since 1965, 25 million lake trout have been planted in the lake and still the fish aren't reproducing naturally.

The southern deepwater lake trout was one of many varieties of lake trout that were wiped out when the parasitic sea lamprey invaded Lake Michigan in the 1950's, says Horrall, who was largely responsible for finding 800,000 of the supposedly extinct deepwater trout in a Michigan fish hatchery.

Carlos Fetterolf and other members of the Great Lakes Fishery Commission, and fishery biologists at the Wisconsin Department of Natural Resources believe the deepwater trout may offer the best chance yet of restoring naturally-reproducing trout to southern Lake Michigan.

According to fishermen and official records, the southern deepwater trout populations once made up over half of the trout catch in Lake Michigan. Found only in the southern part of the lake, the trout spawned primarily on the Milwaukee and Sheboygan reefs. There the fish deposited their eggs in deep water on a clay bottom.

"The Lake Superior and Canadian lake trout we have been using to restock Lake Michigan spawn in shallower water and will probably never be able to reproduce successfully on these reefs," says Horrall.

"Before the lamprey invasion there were numerous varieties or races of lake trout in Lakes Superior, Michigan and Huron. Several still survive in Lake Superior but the five major races which once inhabited Lake Michigan were completely eliminated by the lamprey," Horrall adds.

It now appears that the genetic makeups of these different races are important in restoring trout to the Great Lakes.

U.S./U.S.S.R. Data Exchange Experts Hold First Meeting at Eds Hdqs

The first meeting of the U.S./U.S.S.R. Experts on Data Exchange was held at Environmental Data Service Headquarters in Washington, D.C. The group is one of several established by the U.S./U.S.S.R. Joint Committee on Cooperation in World Ocean Studies, to implement U.S./U.S.S.R. projects under the June 19, 1973, Nixon-Brezhnev Agreement on Cooperation in the World Ocean.

At the meeting, the experts agreed upon general principles and procedures for the exchange of data and made recommendations for consideration and approval by the Joint Committee on Cooperation in World Ocean Studies during its forthcoming third session (Fall 1976).

They agreed that:

Formal exchange of data should be accomplished at the national level between national centers and subsequently through the World Data Centers.

On completion of a project under the Agreement, a general inventory of all observations and samples should be submitted for exchange between the National Oceanographic Data Centers.

A more detailed inventory should be prepared for all data not well suited to exchange or which must undergo time-consuming processing before exchange.

All fully processed data should be submitted to the appropriate repositories within the U.S. and U.S.S.R. and be promptly exchanged with counterpart centers.

Technical details of exchange arrangements will be developed by experts within the project.

The recommended carrier for digital data exchange is one-half inch, nine track, 800 BPI magnetic tape in the agreed formats.

Official publications with data or analyses should be exchanged through national centers.

NY State Department To Develop Coastal Management Program

The New York Department of State has received a Coastal Zone Management grant to coordinate development of a coastal management program that will qualify for Federal approval.

Under the grant, the State planning division has been designated the State agency responsible for developing a broad-based program to achieve prudent use of the coastal environment. State officials will work closely with citizens and public agencies in designing a program that protects the coast through long-term management and balanced use.

The grant will be used to expand and intensify work initiated during the state's first year of grant study, including identifying the coastal boundary; generating greater citizen involvement in program planning; and analyzing coastal resources, permissible land and water uses, and existing laws for implementing the management program.

noaa/people

Dr. Norman A. Phillips, Principal Scientist at the National Weather Service National Meteorological Center in Suitland, Md., has been elected a member of the National Academy of Sciences (NAS).

Dr. Joseph Caponio, Director of the Environmental Data Service's Environmental Science Information Center, has been appointed chairman of the Federal Library Committee's special technical group.

George L. Josephs, who has been Official in Charge at the National Weather Service Office in Marquette, Mich., for the past two years, has been named OIC at International Falls, Minn. He replaces **Earl E. Belanger**, who has retired.

Marvin D. Shimp has replaced Mr. Josephs as OIC at WSO Marquette.

Walter W. Gossage is the new Chief of the Program, Production and Resource Management Staff, NOS.

Raymond Cardascia has been named Chief of the Requirements and Technology Staff, NOS.

Edward L. Paquet recently received a Department of Commerce Bronze Medal.

A Group Special Achievement Award was presented recently to the members of the Distribution and Warehousing Group at the Central Logistics Supply Center in Kansas City, Mo.

Dr. Edward R. Meyer has recently joined NOAA as an ecologist for the Environmental Data Service's Deep-water Ports Project Office.

Charles B. Ellis has been appointed Assistant Chief of the NOS Physical Science Services Branch.

Janice K. Flagg has been named Chief of the new Editorial and Publications Section in the same NOS Branch.

Robert J. Learson, Supervisory Research Food Technologist at the National Marine Fisheries Service Northeast Utilization Research Center in Gloucester, Mass., recently received the Arthur S. Flemming Award.

Capt. Leonard S. Baker, Director of the National Geodetic Survey, was elected president of the American Congress on Surveying and Mapping at its recent annual convention in Washington, D.C.

Jack R. Cooley has been named to succeed **Marshall Soderberg** as Meteorologist in Charge of the National Weather Service Office in Grand Rapids, Mich.

Dr. William D. Bonner has been selected as the new Director of the National Weather Service Eastern Region. He succeeds **Silvio Simplicio** who has retired after 35 years of Federal service.

Dr. Wilmot N. Hess, Director of the Environmental Research Laboratories, has been elected a member of the National Academy of Engineering.

Dr. Robert E. Stevens has been named Endangered Species Coordinator for the National Marine Fisheries Service.

Dr. John R. Apel has been appointed Director of the Pacific Marine Environmental Laboratory in Seattle, Wash.

Robert B. Swink recently received the Elmer Neumann Award for 1975.

Joyce H. Gnagy recently received a Special Achievement Award for her outstanding contribution to the Outer Continental Shelf Energy Assessment (OCSEAP) research program in Alaska.

Dr. Ronald L. Lavoie, Director of the Environmental Modification office at NOAA headquarters in Rockville, Md., and **Dr. Helmut K. Weickmann**, Director of the Environmental Research Laboratories Atmospheric Physics and Chemistry Laboratory in Boulder, Colo., have been elected Fellows of the American Association for the Advancement of Science.

Dr. Warren A. Hovis, Jr., has been appointed Director of the Satellite Experiment Laboratory of the National Environmental Satellite Service.

R. Adm. Eugene A. Taylor, Associate Director of the National Ocean Survey Office of Fleet Operations, recently was presented the National Safety Council's Cameron Award in New Orleans, La.

James Churgin, Director of the Environmental Data Services' World Data Center A, Oceanography, was elected Chairman of UNESCO's Intergovernmental Oceanographic Commission's (IOC) newly established Group of Experts on the Marine Environmental Data and Information (MEDI) System.

Dr. Charles B. Archambeau and **Kendall L. Svendsen** of NOAA have been elected chairman and secretary, respectively, of the Front Range Branch of the American Geophysical Union in Boulder, Colo.

William F. Frank has been named Meteorologist in Charge at the National Weather Service office in Lake Charles, La. He succeeds **Don B. Munro,** who has retired.

Marvin J. Walsh, National Weather Service Pacific Region Supervisory Electronics Technician, was recently honored as the Outstanding Supervisory Federal Employee of the Year in the Pacific Basin at the 20th Annual Employee of the Year Awards Luncheon.

Rear Admiral Robert C. Munson was sworn in as Director of the National Ocean Survey's Atlantic Marine Center in Norfolk, Va. He succeeds **Rear Admiral A. C. Holmes** who has retired after 29 years of service.

Birta Johnson, an accountant in the Finance Division at NOAA's Rockville, Md., headquarters, recently won the Western Maryland Division of the Toastmasters International Speech Contest. She previously had won the NOAA Club contest and one of the Washington Metropolitan Area contests.

John Herkert, Howard Sparks, Oscar Stone, and **Steve Talabac** of the National Environmental Satellite Service Geostationary Data Acquisition Section, recently received a NOAA Unit Citation for their exceptional effort in expanding the Geostationary Operational Environmental Satellite data acquisition system, originally designed for one spacecraft, to handle incoming data from three spacecraft.

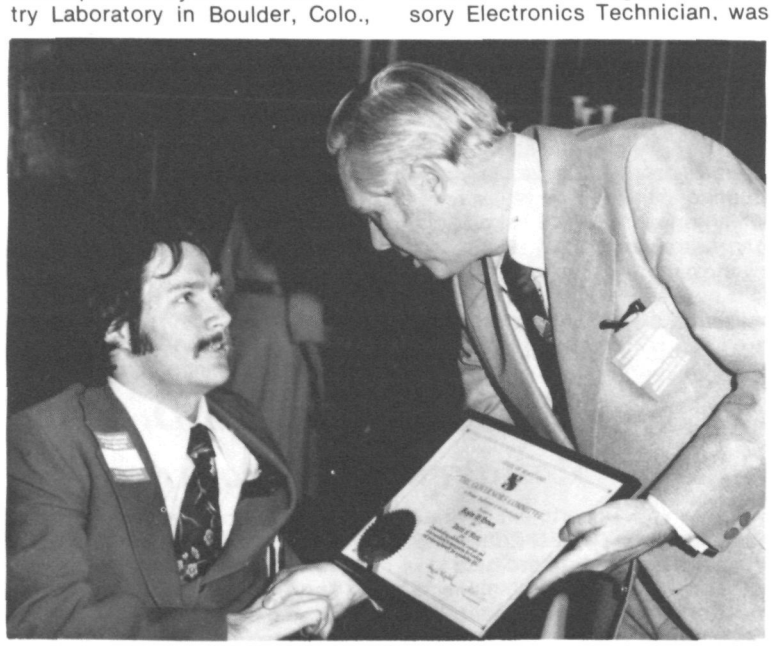
Michael A. Waller, Kenneth A. Edwards, and **Cecil C. Britt** recently received Special Achievement Awards for work which contributed materially to the successful reactivation and initial oceanographic operations of the NOAA Ship Discoverer in Alaskan waters.

Harry L. Bahr recently received a Special Award in recognition of his many contributions to the National Weather Service Agricultural and Aviation Service Programs during more than 45 years as a Weather Service Specialist at Fresno, Calif.

Donald C. Gaby, Manager of the National Environmental Satellite Service Satellite Field Services Station in Miami, Fla., is the author of two manuscripts selected for inclusion in the Official Florida Bicentennial Commemorative Book, *Born of the Sun.*

Harvey L. Moore, recently retired Assistant to the Regional Director of the National Marine Fisheries Service Northwest Region in Seattle, Wash., received a Department of Commerce Bronze Medal.

Ralph P. James, Chief of the Aviation Branch of the Meteorological Services Division at National Weather Service Headquarters in Silver Spring, Md., has been awarded the 1975 Edgar S. Gorrell Award of the Air Transport Association (ATA) of America.



An Award of Merit from Maryland's Governor's Committee to Promote Employment of the Handicapped was presented recently to Roger W. Brown, a Voucher and Accounting Technician in NOAA's Washington Field Finance Office, in Rockville, Md., in recognition of the outstanding courage and determination he has demonstrated in overcoming his handicap and preparing himself for a productive life. The Award was presented by the Awards Committee Chairman, John F. Strahan, M.D.

Satellites Assist in Air Rescues

The amount of time Civil Air Patrol air search and rescue pilots spend finding downed aircraft in the rugged mountains of California has been substantially reduced through information provided by two environmental monitoring satellites operated by NOAA.

Lt. Col. James D. Bigelow, Director of Operations for the CAP's California Wing, said pictures from NOAA's spacecraft showing weather conditions in the areas where light planes have become lost have vastly improved search mission efficiency. In addition, he said, NOAA satellite information has made the search operations themselves considerably safer.

During the past year, when the California Wing flew some 58 search missions for lost aircraft, all but two were found within 48 hours. The year before, CAP pilots generally spent more than a week searching for the sites.

Most search and rescue missions for missing aircraft in California involve planes which get into trouble because of bad weather en route to their destinations, he said.

Jack Bottoms, manager of the National Environmental Satellite Service office in San Francisco, said that upon CAP request he immediately provides satellite pictures of the general area where the missing plane is thought to be.

Personnel at the NESS station interpret the pictures, (which come from the NOAA-4 polar-orbiting spacecraft, and SMS-2 geostationary satellite), for the general area where the missing aircraft was last reported, and recommend for search concentration areas in which the weather was bad at the time of the crash.

BALLOONS TRACK URBAN POLLUTANTS

A giant balloon gives birth to little ones over St. Louis, Mo., as part of a study of how rapidly urban pollutants disperse into the atmosphere. The paths the five-foot-long, kite-shaped balloons follow as they drift away from the mother balloon above the city tell Dr. James K. Angell of the Environmental Research Laboratories something about diffusion processes. Dr. Rudolf Engelman of ERL was chief on-board scientist for the flight.

Dr. Engelmann (1), DaVinci crew check gondola before flight

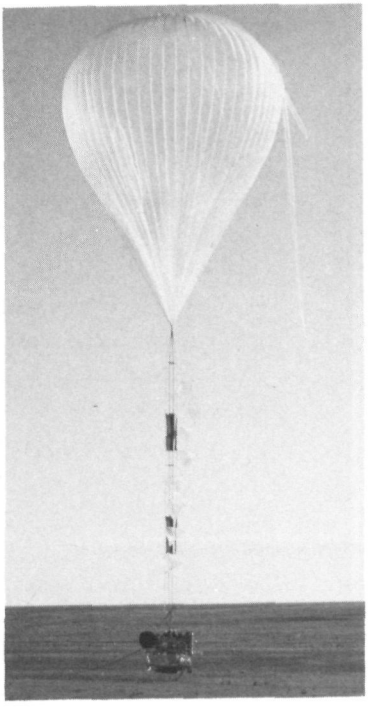
As part of Project Da Vinci, an instrumented balloon flight lifts off from an airport just west of St. Louis. A helium-filled balloon 70 feet (about 20 meters) in diameter carries aloft a 10-foot-square gondola, a crew of four, and more than a ton of instruments. The gigantic array, some 15 stories tall from top to bottom, float northeastward over the city and beyond, following its plume of pollutants for many miles downwind.

The flight, second in the Da Vinci series, is a joint effort of the Energy Research and Development Administration and its Sandia Laboratories, the National Geographic Society, the Environmental Protection Agency and NOAA.

Instruments placed on the gondola by Dr. Rudolf Pueschel of ERL's Atmospheric Physics and Chemistry Laboratory filter minute particles, or aerosols, from the air along the balloon's path. These are analyzed later by electron microscope, to determine particle size, shape, and composition, and are also tested for their potential effects on weather.

Dr. Peter Kuhn of APCL has placed an infrared radiometer aboard to study the radiative properties of aerosols in the St. Louis pollutant plume and of the land surfaces beneath the balloon.

Information from these experiments will help scientists predict the rate of dispersal of pollutants or radioactive clouds from their sources, and some of the effects of these contaminants.



ERL Scientist Says Bacteria Could Trigger Precipitation

Oceanic bacteria may be the marine atmosphere's main source for triggering precipitation, a scientist from the Environmental Research Laboratories reported to an American Meteorological Society meeting in Seattle, Wash.

Dr. Russell Schnell, a postdoctoral researcher in ERL's Atmospheric Physics and Chemistry Laboratory, and two fellow researchers have found that these tiny marine organisms appear to act as an active source of ice nuclei—the particles around which moisture in a cloud freezes to produce precipitation.

The bacteria live in association with marine phytoplankton (minuscule floating plant life) according to Dr. Schnell, and are "shot" into the air by seafoam bubbles bursting on the surface of the waves. Certain of them, he believes, find their way high into the air and become the core, or nucleus, around which supercooled water droplets freeze. They fall to the surface of the earth as rain or snow.

Scientists have long known that ice nuclei come from land—particles of dust and possibly decomposed vegetation. Dr. Schnell and his colleagues think that a major part may also come from the sea.

Dr. Schnell, Dr. Jayne F. Carney, of Biospherics, Inc. and Cristine E. Carty of Rutgers University have isolated the particular bacterium but not yet identified it.

NMFS Census

Calif. Gray Whale Population Remains About 11,000

A recent count of California gray whales, conducted at observation points off California indicates the total population of the species is still about 11,000. The census was conducted by the Marine Mammal Division of the National Marine Fisheries Service Northwest Fisheries Center, Seattle, Wash.

NMFS observers watched between 7 a.m. and 5 p.m. from vantage points at Granite Canyon in Monterey County and at Point Loma in San Diego County. Though there was an increase in the number of gray whales sighted this year, the increase is believed to be due largely to better observing conditions than to a marked increase in the population.

The number of whales passing per hour during darkness and periods of bad weather when visibility is poor is assumed to be the same as during daylight hours,

The nine annual counts at the Granite Canyon site indicate that the stock has remained fairly stable over the past nine years.

Gray whales migrate farther (up to 11,000 miles each year) than any other species. From the end of May through September, the California stock feeds in the northern and western Bering Sea, Chukchi Sea, and the western Beaufort Sea. From October through January, they move south, probably through Unimak Pass in the Aleutian chain, following the coastline through the Gulf of Alaska, down to the lagoons of Baja California.

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