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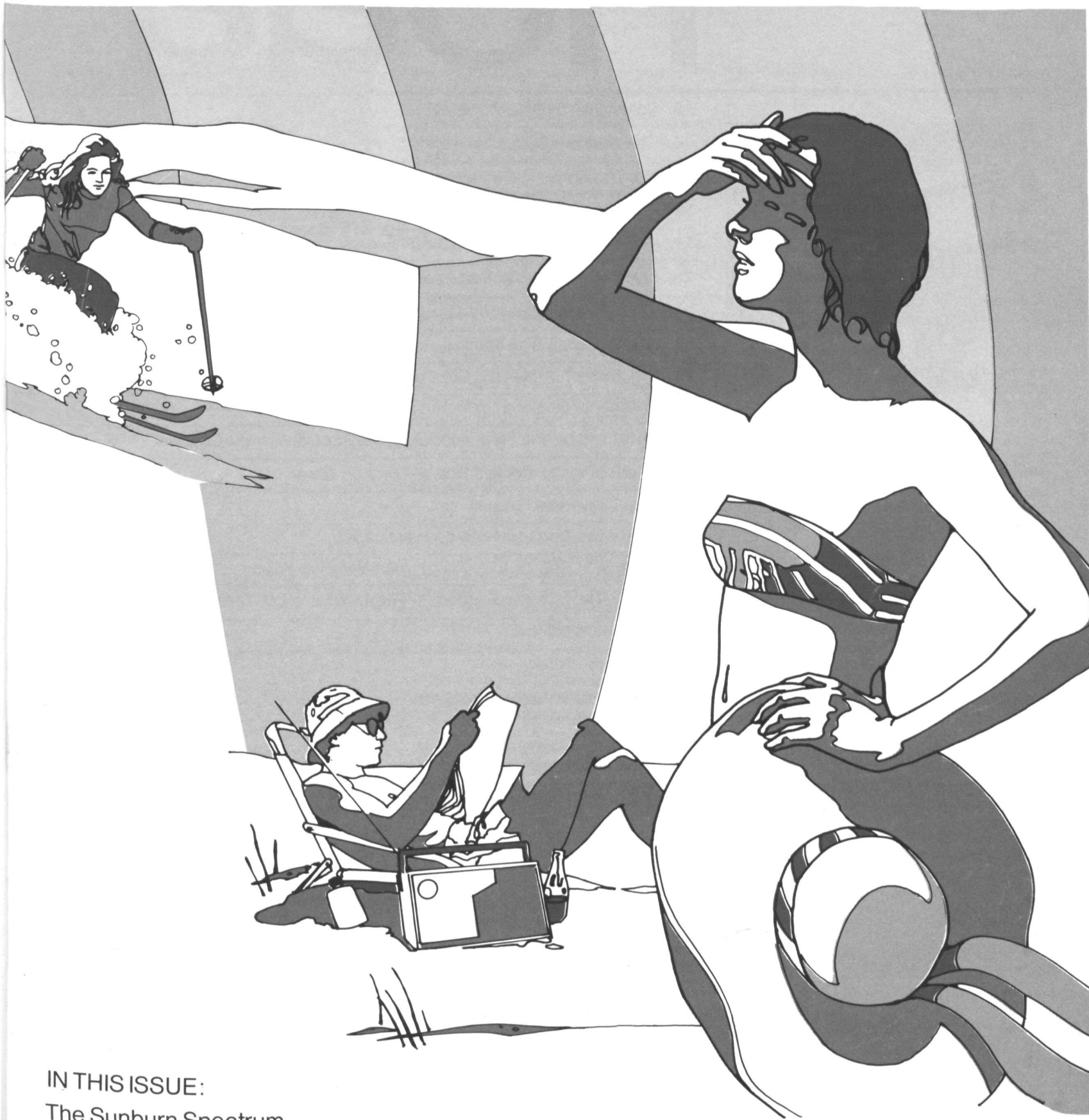

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The Sunburn Spectrum

National Oceanic and Atmospheric Administration

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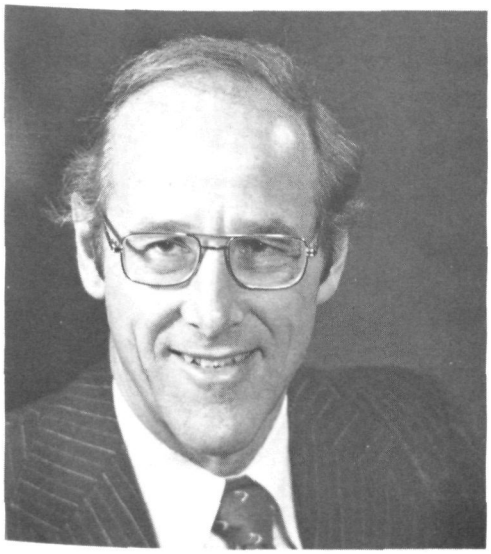
What's needed at the LOS Conferences?
That un-American quality

Patience



How do things stand with the Law of the Sea Conference, now six years old? Many Americans have written off that question: anything that has been going on for six years is a bore; get it over and done with quickly.

Sometimes our national impatience puts us at a disadvantage. Negotiators from countries where bargaining is a way of life quickly sense when the other party is in a hurry and as quickly take advantage of it. Once the U.S. delegation to the LOS Conference thought that a treaty could be carried home in a year or so. After a few bruises, we have learned better. Now the delegation is there to negotiate until there is a treaty that meets our needs.

If it takes ten more years, so be it.

Of the issues that are still unresolved, the most important for the United States are access to the minerals of the deep seabeds, and protection of the freedom of marine scientific research. Both are in difficulty.

Deepsea mining has been caught up in the swirl of North-South politics which tends to cast every issue as a political confrontation between developing and developed countries.

Developing countries have discovered that control of raw materials is their best weapon for obtaining a larger share of the good things of the earth. Their spokesmen have established in the United Nations the doctrine that the manganese nodules of the deep seas are the "common heritage of mankind." At the Law of the Sea Conference, they seek to take the next step to have them declared off-limits to private miners.

On the other side of the fence, the situation looks quite different. Most developed countries have run out of the manganese, copper, cobalt, and nickel found in nodules, if they ever had them. These metals are essential for making steel, the foundation of every industrial society. The developed countries see the vast amounts in the deep seas as an assured supply, free of the possible pressures and blackmail attached to land-based sources. Furthermore, these countries, and these alone, have the money and technology to raise the nodules from the seabed.

Add the fact that there are some 130 developing countries at the Conference, but only about 30 developed countries, and you can see why years of negotiation have failed to bridge the gap between the two sides. At least, however, a formula has been agreed upon. There will be a parallel system, with private companies working one half, and an international enterprise working the other half. But the all-important details are still far from agreement.

As to marine scientific research, the situation is in one sense more depressing. We have lost the fight for freedom of research on the high seas within 200 miles of the coast, the area where most of the living organisms are found and where much of the research is done. This work will be subject to the consent of the coastal State. The battle has been lost because the United States is practically alone in supporting this freedom.

All that can be done is to mount a salvage operation. If there must be coastal State consent, let it be based on reasonable standards and requirements, and predictable in its operation. A series of amendments has been proposed by the United States to achieve these goals. Even this limited objective cannot be taken for granted, but the delegation is putting up a hard fight, and there is hope.

Beyond the endless debates on detail, and all the posturing on principle, there is still the objective of a universal treaty. To fall short of this goal after so many years of effort would be a failure that would cast a shadow over many other efforts toward international cooperation. A great majority of the issues in dispute have been agreed upon. Some of this would be saved, but much would be lost if the effort collapsed.

Our job is to persevere, to hold fast, and not to give up.

Special Counsel to the Administrator
for Law of the Sea

A closer look at a war in space

The Sunburn Spectrum

By CDR. RICHARD E. NEWELL, NOAA CORPS

High above the tropics, ultraviolet rays wage a frontal assault on the atmosphere. Their primary obstacle is the earlth's abundant supply of oxygen, lifegiver and life defender. The ozone shield—oxygen's global stratospheric response to ultraviolet bombardment—blocks out the most harmful rays, but a damaging component still gets through. It is called UV-B, biologically active ultraviolet.

Neither seen nor felt, its effects on human skin show up plainly, in the form of burning, aging, and cancer.

In the wake of suspicion that various by-products of human technology may be opening the ozone window wider to UV-B, NOAA scientists are helping to lay the groundwork for a better understanding of its variations and biological effects. NOAA's Air Resources Laboratories (ARL), with support from the Environmental Protection Agency and assistance from the Temple University Medical School, operate a network of UV-B meters in the United States and around the world. The meters measure the total ultraviolet energy in the sunburn spectrum, sometimes called erythemal radiation. Many medical and biological scientists consider this to be the same energy band responsible for skin cancer.

Ultraviolet rays are sandwiched between visible rays and x-rays in the electromagnetic spectrum. Being weaker than x-rays, they penetrate large organisms only far enough to produce surface effects. These effects would be much greater than they are were it not for the fact that, like the earth itself, living things have radiation shields. The skins of plants and animals are the secondary ultraviolet shields of the terrestrial ecosystem; they screen out much of the biologically active UV that survives the ozone layer.

The shielding system of each life form is unique. Every kind of plant or animal—and to some extent each individual—has its own ultraviolet skin response, its own sunburning curve.

Take the case of human skin. Just as the global ozone layer is believed to thicken eventually after an upsurge in solar radiation, human skin tends to toughen up after absorbing a heavy dose of ultraviolet. Whether by direct tanning or in the course of surface burn-and-peel, the subskin thickens and pigment forms. But Caucasians, especially the light-skinned Celtics, are at a disadvantage. Their personal sunburning curve peaks high, because most of their pigment develops below the sensitive epidermal cells, rather than being scattered among them.

People with their roots in the British Isles, for example, are the product of many generations of sun-screened living due to generally cloudy skies. Transplant them to a country with strong radiation, where the sun shines high and bright, and those with soaring exposure rates are likely to run into trouble down the road. The Celtic factor helps to explain why sunny Australia leads the world in skin cancer incidence.

The "Celts" of the plant world suffer too, not only in terms of sunburn, but also in reduced growth and sluggish photosynthesis. However, little has been done to determine which of the earth's 250,000 advanced plant species fall into this high-risk category. Although skin cancer is getting most of the attention now, some scientists believe that ultraviolet's effects on plant life will turn out to be even more serious.

Investigators will soon begin to get a handle on some of these problems, thanks to NOAA's UV-B network and a UV-B climatology atlas now being prepared from its data. Considering the very limited history of ground-based ultraviolet observations, this publication promises to be very important.

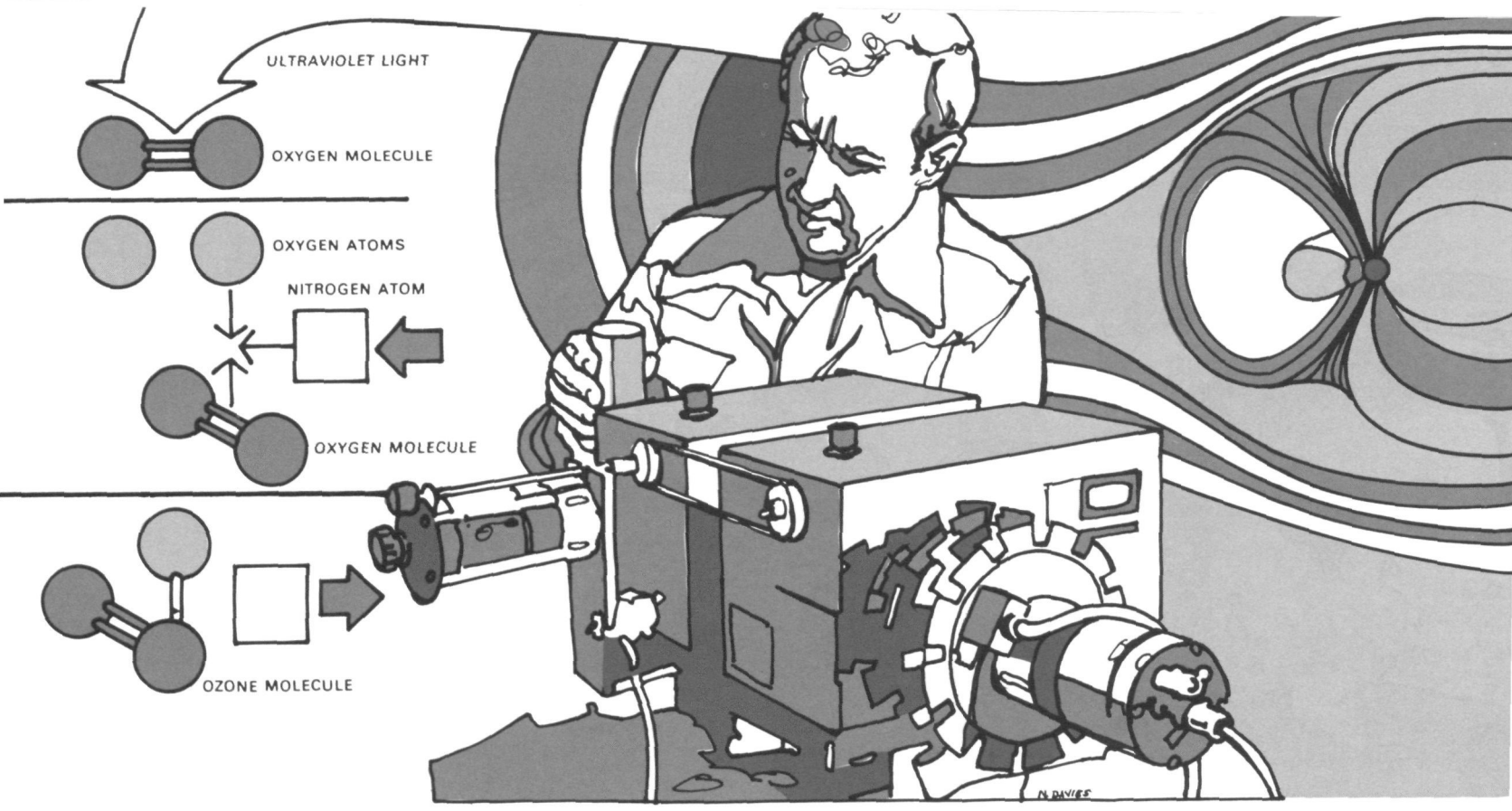
In the past, almost any instrument that could sense ultraviolet was used. Researchers had no common measurement scale, and few long-term studies were carried out. But since the early 1970's, when concerned individuals and groups began to put the ozone layer on their "endangered list," biologically active ultraviolet observations have carried a higher priority.

The NOAA network is an example of how to gather high-quality data on a large scale in what is still a very instrument-limited research field. The approach was to build a sophisticated UV-B instrument to use as a "standard" for the Robertson-Berger meter, designed by Dr. Donald Robertson of Australia and built by Dan Berger of Temple University. This was an inexpensive, rugged meter that had already been field-tested, but not scientifically calibrated.

The elaborate standard meter was developed by Walter Komhyr, a senior researcher with ARL's Global Monitoring for Climatic Change group in Boulder, at the urging of ARL's Director, Dr. Lester Machta.

In order to measure the UV-B accurately, Komhyr's instrument had to absorb ultraviolet much as white human skin does, over a specified wavelength interval, peaking somewhere near the middle and going to zero at the endpoints. Not only that, it had to present them in standard units that all scientists could understand and use.

He turned to the Dobson spectrophotometer. This instrument disperses solar radiation into a wave spectrum and blocks out all but selected wavelengths. By applying a few innovations,



Komhyr took this screening process a few steps further. The result was a sophisticated device whose absorption characteristics could be tailored to fit any desired UV-B curve.

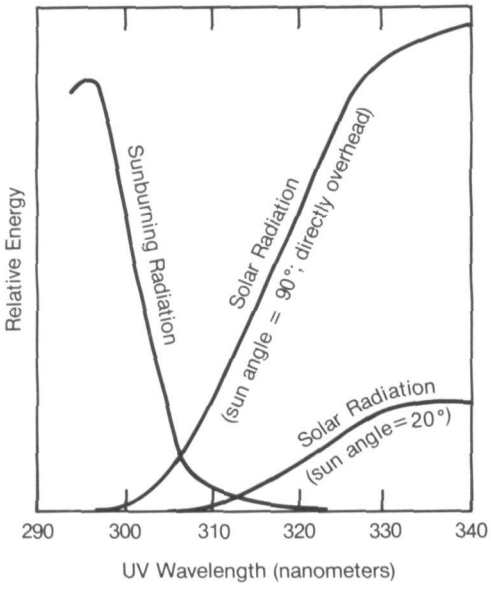
Side-by-side tests completed early in 1974 showed that data from Komhyr's instrument and the R-B meters were highly correlated. This provided a simple means for converting the meter readings into standard radiation units and cleared the way for the R-B meters to be used in a worldwide, scientific UV-B monitoring network.

Today there are 14 of these meters scattered across the contiguous United States and 9 more located around the world, all registering UV-B continuously and clicking off integrated readings every half hour. These join the greater global network of about 80 Dobson spectrophotometers, including ARL's 14, that monitor the ozone layer.

Back in 1961, Komhyr took charge of the U.S. ozone network and began to upgrade its quality, just as he would eventually help to upgrade the worldwide network. Ten years later, his analysis of ozone data from many parts of the world provided the first suggestion that the global ozone layer was undergoing long-term changes; he found that the ozone shield had probably been intensifying throughout the 1961–1970 observation period.

Komhyr had no way of knowing that the amount of ozone actually reached a maximum in 1970 and had been decreasing since, possibly responding to the long-term rhythms of the sun. Nor was it known that 1970 would also be remembered as the year the seeds were planted for a general awareness that human technology, too, may influence the ozone layer.

That same year, scientists in this country began to question whether chemicals from supersonic transport exhaust in the stratosphere could change the amount of ozone there, with effects on UV-B and even global climate that could upset the balance of life on earth. These reservations influenced Congress to decide against developing a supersonic transport aircraft and led it, instead, to authorize the Department of Transportation to undertake the four-year, interagency Climatic Impact Assessment Program, original sponsor of the present UV-B network. The enemy of ozone at issue at that time was nitric oxide, produced in internal combustion engines and from nitrous oxide, a byproduct of nitrogen fertilizers. (Recent research indicates that nitric oxide produced at supersonic aircraft altitudes is not as effective in destroying ozone as was once believed.)



A different approach toward understanding our impact on the ozone layer was unknowingly taken in 1970 by British scientist James Lovelock. He built an instrument that measures gases at concentrations of less than one part in a trillion parts of air, and used it that summer to make the first atmospheric measurements of chlorofluoromethanes, commonly known as fluorocarbons, in south-west Ireland.

Two University of California chemists used these observations, and subsequent global ones made by Lovelock and others, to sound the alarm in 1974 that the chlorine released from these synthetic compounds constituted an important new hazard to the ozone shield. This announcement led to Congressional hearings on the subject of stratospheric ozone depletion, culminating in the 1978 ban on the national manufacture of fluorocarbons for use as spray can propellants. However, the ban affects only about one-fourth the worldwise use of these compounds.

In the light of evidence that the effect of fluorocarbons on ozone is much greater than first expected, a leading scientist predicts that even with existing and expected regulations fully in effect, the related ozone layer thinning, over the fluorocarbon atmospheric lifetime of 50 to 100 years, will eventually come to about 15 percent. This may increase UV–B at the earth's surface by 30 percent.

Fluorocarbons work on the ozone layer in an insidious way. The general process, not fully verified but backed by an impressive combination of theory, laboratory tests, and stratospheric evidence, proceeds as follows: the gas escapes into the atmosphere from refrigerators, air conditioners, and some spray cans and foam products, and slowly diffuses upward. It does not break down by reacting with other chemicals, it is not rained out in the

weather layer, and only a little of it is dissolved into the sea.

After years of wandering onward and upward through the general circulation of the atmosphere, it reaches the ozone layer, which has until then shielded the gas from its most important enemy, short-wave ultraviolet radiation. There in the stratosphere, at altitudes of 25 to 40 kilometers (15 to 25 miles), the fluorocarbon molecules are broken up by the high-energy UV, and chlorine atoms are released. The same UV action that releases single oxygen atoms (0) from their molecules (0_2) to recombine with other oxygen molecules to form ozone (0_3), also frees these chlorine atoms, which very quickly react with the ozone to turn some of it back into oxygen. What makes the process so critical is that the chlorine atoms survive this reaction to destroy more and more ozone molecules until they finally diffuse back down to the lower atmosphere, in a different molecular form, and are rained out.

The ozone layer manages to weather this chemical onslaught. It is accustomed to surviving under attack, since the ultraviolet radiation that produces ozone also destroys it, but at a slower rate. As Machta puts it, "Ozone is being formed and destroyed constantly. What we observe in the atmosphere is the balance between the two processes. When we add interacting chemicals such as chlorine, this equilibrium is upset."

The ozone network lumps this equilibrium shift together with the much larger ones caused by natural processes such as high-level wind patterns, and records the total ozone change above each station. Then the UV-B network tallies the results of ozone interplay with sun angle, cloudiness, and other variables, in terms of energy received in the sunburn spectrum.

Any human-induced equilibrium shift now in force is believed to be hidden in the records of these two networks—lost in the commotion of nature's more vigorous fluctuations. But because such a shift could boost the average UV-B level, it could still produce a noticeable effect.

Scientists believe that a given percentage increase in UV-B will eventually raise skin cancer incidence by the same amount. To learn more about this relationship, they are now gathering facts about skin types, life-long sun exposures, and skin cancer incidence of U.S. residents to compare with the UV-B. A second approach being undertaken by NOAA on behalf of other government agencies is to look at the UV-B spectrum in more detail.

Dr. John DeLuisi, another senior researcher at ARL-Boulder, is using an instrument that fans out the sunburn spectrum, much as a prism breaks up visible light into its components. This provides a closer look than the Robertson-Berger meters allow.

"The instruments now being used in the field measure the total integrated radiation in the UV-B band," Dr. DeLuisi explains, "but because the radiation comes to a peak somewhere within that band, we really need spectral measurements—measurements that show us what's going on at all wavelengths. Biologists and physicians tell us that spectral measurements are crucial for a real understanding of the UV-cancer relationship. My research is directed toward comparing spectral observations with what the Robertson-Berger meter records, and seeing how the spectral picture changes through the day."

The instrument DeLuisi is using is a highly sophisticated "double monochromator" constructed by Dr. Richard Lehman of NOAA's Office of Ecology and Conservation, for somewhat similar purposes. It is one of just two now scanning UV-B data in the United States, and was built at moderate cost from standard components. Whereas the R-B Meter gives a single reading, much as the light meter of a camera, DeLuisi's instrument will show, among other things, how the intensity and wavelength of peak UV-B radiation changes with varying solar and atmospheric conditions. Nevertheless, it is a prototype—good for preliminary observations, but not able to take a really fast-action shot of a UV-B profile that is constantly changing as the sun arcs through the sky, much less measure the sudden spectral changes caused by clouds passing overhead.

This requirement for high-speed data scanning and recording is one of the dilemmas facing spectral researchers, and the development of effective, reasonably priced spectral instruments, either in the form of scanners or multiple-band "light meters," is an important goal of UV-B research.

In the long run, DeLuisi envisions spectral instruments being flown aboard satellites, for global scanning of surface-reflected UV-B; satellites have been using simpler UV instruments to help monitor the ozone layer since 1970. He would also like to dip a spectral scanner into the ocean someday, to probe the sea-life sunburn spectrum.

While the quest for spectral data is being pursued in Boulder, the first in-depth analysis of standard UV-B data is taking place at ARL headquarters in Silver Spring, Md. William Hass is preparing a UV-B Climatology Atlas of the United States, based on the first four years of records from the national network.

The Atlas, to be completed early this year, will show how UV-B varies across the United States from season to season. Hass has been contacted by many prospective users, especially epidemiologists and bioscientists—people interested not only in skin problems, but also such things as eye inflammation and cataracts.

In addition to UV-B data, the Atlas will include information about some of the shapers of the UV radiation profile. Atmospheric consituents that affect incoming UV are ozone—low in total mass, but a powerful absorber and by far the strongest regulator of UV-B in clear air, air itself—a poor absorber but a strong diffuser and high in total mass; and particulates—moderate to strong absorbers as well as diffusers and often highly concentrated, mainly in the form of dust, smoke, or clouds.

Other common indexes of incoming ultraviolet—sun angle, station altitude, and latitude—are all tied in with the basic shapers described above. Sun angle and station altitude hark back to air mass, because the amount of air traversed by the ultravioilet is greater near sea level than high in the mountains, and much greater still when the sun is low in the sky. The latitude effect, whereby UV-B decreases poleward, ties in with both air mass and ozone. Stratospheric ozone, though produced mainly in the tropics, drifts down and away toward the poles and collects there; and the amount of air bucked by solar rays is greater toward the poles, too, simply because the sun is lower in the sky there.

Two final terms in the UV-B equation deal with the ways that air and earth redirect this radiation—ways that multiply its angles of attack. The first is diffuse sky radiation; about half of the UV-B we receive comes to us indirectly, from the sky, after being scattered away from the direct solar beam by air molecules. The other term is the earth's albedo, its surface reflectivity; for example, snow-covered ground returns a good part of the incoming energy upward to amplify the diffuse sky radiation, thereby raising the UV-B tally by as much as 20 percent.

All of these interacting effects help to explain why skin cancer incidence is so high in Australia—located at low latitudes, yet clear of the cloudy equatorial zone; and in the southern Rockies—still at fairly low latitudes, near snow, and up where mile-high living means about 25 percent more UV-B than at sea level.

The more common forms of skin cancer are easily treated and rarely fatal—nearly 99 percent of the cases are considered curable. However, almost half of the 9000 or so individuals in the United States who each year develop the more deadly form, malignant melanoma, will die of the disease.

Since the skin responds irreversibly to the cumulative effect of UV-B, probably everyone would develop skin cancer if they lived long enough. Wider opening of the ozone window, as may have occurred in recent years, would produce the disease at an earlier age, thereby increasing the number of people that develop it. The fact that reports of skin cancer incidence have been increasingly lately may be due to a combination of better reporting and increased outdoor recreation, rather than to increased UV-B, whose cancerous effects will lag a given UV-B increase by many years.

As for the role of manmade substances, many compounds can threaten the ozone layer besides fluorocarbons and nitrogen oxides. Scientists have reported that hundreds of chemicals are potential destroyers of ozone. While most are released in quite small amounts, their combined effect could be dangerous. Recent atmospheric samples indicate that one chemical, methyl chloroform, is rising out of the ranks of these "unknowns" at the alarming growth rate of about 20 percent per year.

It appears that many of the harmful products and byproducts of human technology that we don't directly assimilate still manage to rise up and smite us. How we cope with this problem depends in part on NOAA's continuing effort to monitor and understand UV-B variations. □

Sea Grant tackles a national problem

Our Disappearing Shore

By JAMES C. ELLIOTT

Athelstan Spilhaus, Renaissance man and father of the Sea Grant concept, often points out that we know more about the back side of the moon than about our own shoreline.

His opinion is widely shared in the marine community, a group keenly aware that if the promise of the oceans is vast, so are its mysteries, which begin at the shore and continue in abundance to the sea bottom.

Science, however, is making a start at solving some of these riddles, and turning its new knowledge to useful account. In a dozen years of existence, NOAA's National Sea Grant College Program has played a major role in supporting research to accomplish this.

By providing funds to scientists in leading colleges and universities throughout the Nation, the Department of Commerce's program has developed significant advances in fishing, food processing, diving, coastal development, marina operations, boat building, oil spill studies, and in many other important areas, including the development of drugs from the sea.

While Sea Grant's more than 800 projects continue to investigate everything from algae to zooplankton, one of the major efforts currently being pursued offers high hope of bringing better understanding of what is taking place along our shorelines and making a significant dent in the deficit that exists between our knowledge of space and the oceans.

The project is known as the Nearshore Sediment Transport Study, or NSTS, and it is Sea Grant's first attempt at organizing a research effort to find solutions to a "national" problem. The project is focused on the nearshore, primarily the surf zone adjacent to the beaches, hence the name. It is an area of our shorelines that poses monumental problems to coastal planners and managers because of shore erosion, which endangers recreation, business, and family living; and changing depths of channels, which can preclude the active pursuit of seagoing commerce.

The objective of the project is to develop enough scientific knowledge so that more accurate predictions can be made about how the sediment, or sand, is moved on the sea floor by currents and waves and what generates them.

The significance of the problem can be found in a 1971 study by the U.S. Army Corps of Engineers which showed that 2700 miles of U.S. coastline are in critical erosion condition, or in such bad state that actions to halt the erosion to protect public interest may be justified. Estimated cost to remedy those conditions along the 2700 miles was estimated at $1.8 billion. More importantly, however, the study showed that periodic renourishment would be required in many cases, and the study estimated that the cost of renourishment would run $23 million annually.

At the time of the Corps of Engineers' study, 17 shore protection projects over 171 miles of shoreline were under way at an estimated cost of $423 million. About 65 percent of those costs, or $279 million, was provided by the Federal Government, the study showed. One expert extrapolated from these costs the idea that if a five percent savings could be realized from research, annual savings of $21 million could be realized. Even a one percent savings on total cost would amount to $4.2 million, the expert contended.

Generally, observers agree that shoreline deterioration has grown in the seven years since that study was published, and that the continued coastal construction and wider use of the shorelines by the public since that time have increased the areas of critical erosion along the Atlantic, Pacific, and Gulf Coasts and the Great Lakes.

Recognition of the seriousness of the problem, coupled with an increased interest among scientists to perform research in this vital area and a push in the Congress for Sea Grant to develop a "National Project" are factors that moved the Sea Grant programmers toward the establishment of its first coordinated concentration on a national problem. By design, the Sea Grant program provided support for research of local and regional problems, which until the law was changed in 1976 was its legislative mandate. Thus, the initiation of a "National Project" meant a departure from the strictly localized programs Sea Grant had pursued since its establishment in 1966.

Sediment Transport Study lead scientists and Sea Grant officials confer on the progress of the national project and future plans for further experimentation and research.

Because the Sea Grant Program support is devoted primarily to applied research, investigations of specific problems for specific solutions, many Sea Grant researchers already had embarked on scientific studies involving problems in the nearshore area. As would be expected, however, most of those studies were devoted to a local problem.

The question, then, became one of incorporating existing research being undertaken into a national effort and of developing new research aimed more directly toward nearshore problems nationally.

"To accomplish that," explained Arthur G. Alexiou, Sea Grant's Associate Director of Program Management and head of that office's Division of Non-Living Resources, "we developed a new and experimental management plan. Because of the project's national scope, we were faced with something entirely new to Sea Grant: that was to bring the diverse scientific efforts at a number of widely distributed institutions into one program."

Significantly, he continued, the project marked the first time that Sea Grant would have scientists from many different institutions working together in experiments in the field. During the early stages, for example, scientists from the Scripps Institution of Oceanography, the University of Washington, the University of Delaware, M.I.T., the State of California, and the U.S. Navy worked on the project.

To do this, Sea Grant established a steering committee of leading scientists, with strong track records for conducting experimental work in the laboratory and in the field. That committee, headed by Dr. Richard J. Seymour, oceanographer for the California Department of Navigation and Ocean Development, was given responsibility for determining what experiments were needed, what instrumentation was available for the experiments, what field sites might be used, and for making many other decisions. Additionally, Sea Grant established a review panel, composed of scientists in government and academia not on the steering committee, for passing judgment on the proposals suggested from the steering committee.

Sea Grant chose Dr. David B. Duane, associate program director with the Sea Grant office in Washington and a scientist with long experience with coastal processes, to monitor the project for the National Office.

In describing the project, Alexiou underlined that it is a "large, ambitious undertaking that is too big to be handled by one institution." By taking what he described as "the very best scientists, people who have a very high degree of experience and competence," the program offers considerable promise for success.

There are a number of major problems facing the scientists, he explained. One of them is instrumentation. Measuring devices currently available are considered inadequate to meet the standards established for the project.

"We just don't have a high degree of confidence in measurements that have been made in the past," Alexiou said, "because the surf zone measurements are extraordinarily difficult to make."

For that reason, he continued, scientists at the Universities of California and Washington are working on prototype devices that might overcome some of the limitations of available instruments.

Instrumentation development and selection is one of the prime tasks in the project. Others include wave transformation studies and selection of field sites. Field site selection alone is difficult, because the scientists want to make certain that the sites will provide them with the data that is needed and that the data acquired will be translatable to other sites along the Nation's shoreline.

The first major field experiment took place last November at Torrey Pines Beach, just north of La Jolla, Calif. Principal investigators on the project, their assistants, and many volunteers from nearby Scripps Institution of Oceanography spent nearly a month, many of them living in trailers on the beach, making measurements of almost everything that moved in the surf zone. In addition, they constructed a seagoing, radio-controlled tractor for measuring the profile of the surf zone.

Preliminary analysis indicates that the experiment, though immensely complicated, was successful, according to the bearded and bespectacled Seymour.

"We had some problems," he explained, "but basically the experiment resulted in the finest data collection of the dynamics of the surf zone that has ever been made."

Using a wide variety of instrumentation, the scientists measured longshore current, offshore current, rip currents, tidal effects, sand movement, the surf zone profile, the wind, waves, and many other factors concerning the complicated interraction of those elements in the surf zone.

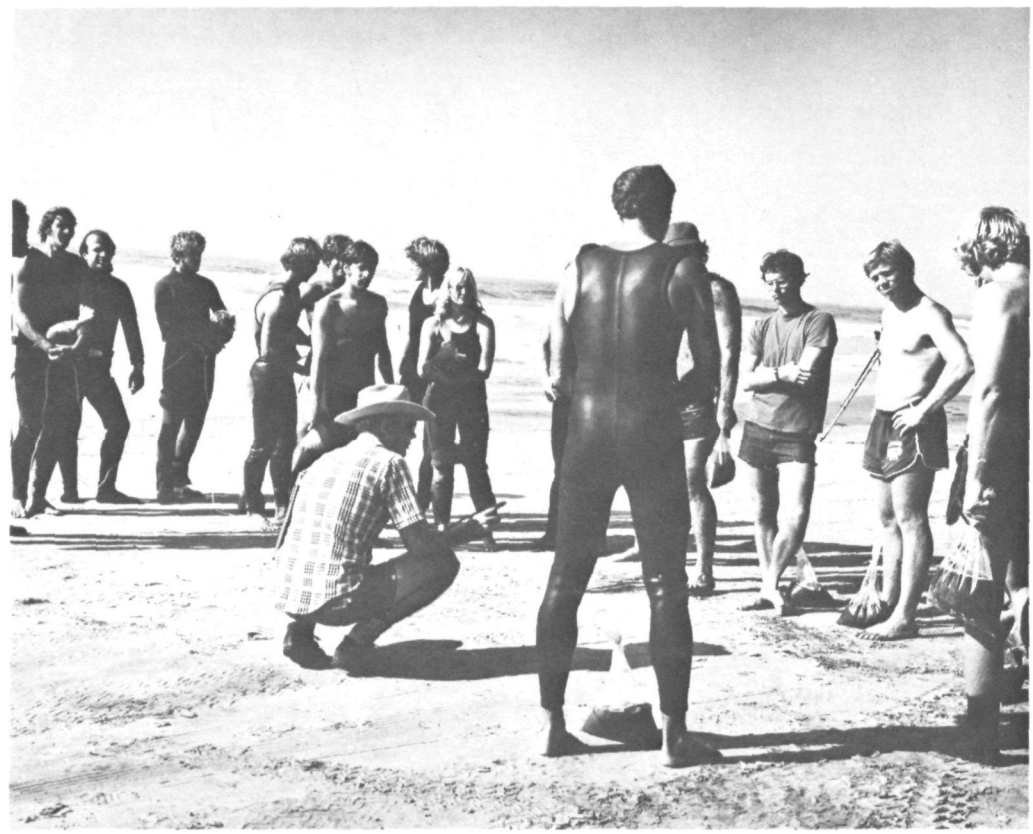
At this writing, much of the data still remains to be analyzed. Early reviews appear to indicate that some of the existing theories about the surf zone may not be true. Additionally, the experiment ended with what one scientist described as "a lot of 'I don't knows.'" But that, too, is part of advancing knowledge.

Later this year, the scientists will conduct another field experiment. This one will be at Santa Barbara, Calif. Later experiments are planned for the Atlantic Coast and possibly the Great Lakes. These additional field experiments will provide the scientists with an even greater data base for finding solutions to the problems along our shoreline.

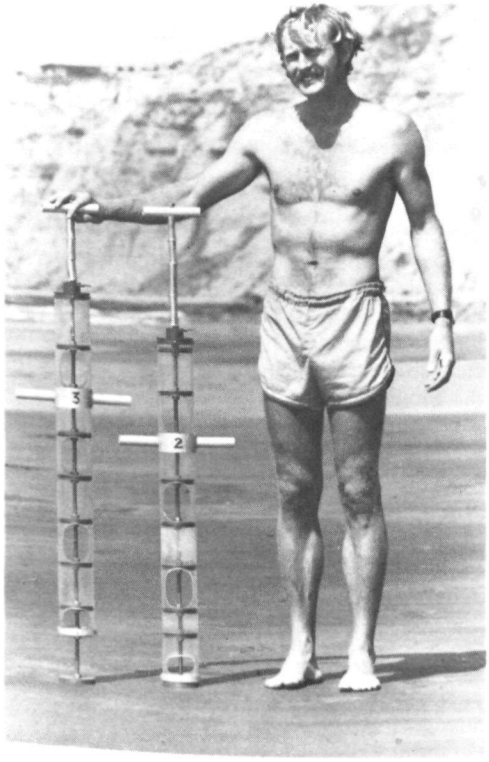
Whatever solutions they develop, the answers will not come easily, the scientists agree.

"You've got to remember," explained Duane, "that we're dealing with natural processes that have been with us since water first appeared on the planet. Those processes will continue until there is no water on the planet."

So long as that water is around, however, it will continue to present challenges for mankind. If the dedicated Sea Grant scientists are successful in finding answers to the problems they now are studying in the surf zone, some of those challenges will have been resolved and . . . perhaps, just perhaps . . . we will have had a significant beginning in knowing as much about our shoreline as we do about the back side of the moon. □



Volunteer University of California graduate students listen as Dr. Douglas L. Inman explains the students' roles in carrying out the sediment transport study at Torrey Pines.



At Torrey Pines experiment: (bottom and clockwise) dumping dyed sand; gathering suspended, dyed sand; wet-suited scientists and volunteers bring in sand samples; sign keeps beachgoers from site of experiment.

"The coming decade can be as exciting as any in the history of the atmospheric sciences."

The Weather and the 1980's

In a recent address before the 59th annual meeting of the American Meteorological Society, NOAA Administrator Richard A. Frank foresaw improved weather services, major changes in the Nation's climate and weather modification efforts, and more cooperation between public and private sectors.

Following are the highlights of his speech.

WE ARE at a jumping-off place for innovative efforts in the areas of weather prediction, weather modification, and climate analysis. These and other developments will lead to substantially increased cooperative efforts in the atmospheric sciences among the Federal Government, academic institutions, research laboratories, and other elements of the private sector.

The United States now has one of the world's best weather services. I have had an opportunity to visit services in a number of other countries, and take great pride in our accomplishments. We provide vast public benefits—and we do so with lower per capita budgets and personnel.

Despite this fine record, we in NOAA believe that over the next decade revolutionary improvements in weather observation and dissemination will lead to substantial improvements in our ability to provide short-term weather predictions to the public.

Over the next decade, I expect a major improvement in atmospheric observations, resulting from the application of new ground-based and satellite remote sensing techniques:

- Ground-based infrared radiometers will measure continuously the temperature and water content of the atmospheric column.
- Doppler radars will determine the three-dimensional wind field over an area of thousands of square kilometers.
- Laser probes will measure visibility, cloud height, and perhaps precipitation rates.
- A new generation of satellite-borne sensors will provide more frequently and accurately than now possible, atmospheric soundings of temperature and humidity. This will allow us to forecast the development of severe storms far better than we can today.
- Specialized acoustical remote sensing equipment, now being tested in the field, will detect and measure dangerous wind shear in aircraft landing paths.

Over the next decade, advances in communications will greatly improve public dissemination of forecasts and warnings. We will be able to get the weather information we want, when we want it, displayed in a more informative manner.

- New communications techniques will permit more information to be carried over conventional channels, directly to members of the public. In the near future, systems in England will carry detailed weather information directly onto home television screens. NOAA and the Department of Agriculture are now conducting tests of our "Green Thumb" system to display similar material in the home or to the farmer or the fisherman.

- Animated color TV displays of current weather are already being used, with enormous increases in the information received by viewers. For example, digitized color television presentations of precipitation maps, transferred directly from weather radar, now in commercial use can be made available in improved form directly to the public.

Many NOAA components—the National Weather Service, the Environmental Research Laboratories, the National Environemntal Satellite Service, and the Environmental Data and Information Service—are already analyzing the systems required to make these new services available. The combined benefits of improved short-range forecasts (in the range from zero to 12 hours) and particularly improved dissemination techniques appear to be considerable. We will have better public warnings of impending severe weather, such as tornados and flash floods. We will also have better forecasts of common weather events that affect all of us.

A recent survey carried out for NOAA to gauge the benefits of such systems in just one locale estimated that improvements in forecast ability would result in direct savings of more than $30 million per year in the aviation, agricultural and ubran sectors. Admittedly, these projected savings are approximate and speculative, but they are large enough to be impressive when extrapolated to the major urban areas throughout the country.

The capability for improving short-term forecasts will create a demand for such forecasts. A key consequence of this demand will be a reexamination of the relationship of public and private meteorology. Congress is already exploring this relationship. For example, under the able leadership of Congressman George Brown, the House Subcommittee on the Environment and the Atmosphere has held several workshops on this and related matters.

This technological revolution will, I believe, enhance the constructive relationship that exists between NOAA and the private sector. Over the years the relationship between the National Weather Service and industrial meteorologists has become a generally smooth one, and we have benefitted from it. The Federal Government must continue to prepare both general and special forecasts for the public—on the weather tomorrow as well as how this affects specialized interests such as agriculture. It must also continue to issue severe storm warnings.

On the other hand, the private sector has already performed the valuable role of extending these services to customers with specialized needs. The new technologies will increase the demands for both kinds of services.

We cannot yet foresee the details of where these changes are leading us. We can see the chance to create an effective and highly efficient local weather service system that includes private meteorologists as full partners. We hope the private sector will work with us to solve the policy problems that arise as we pursue these exciting developments.

Another current development that raises important national policy issues relating to the atmospheric sciences involves the subject of weather modification. Secretary of Commerce Juanita Kreps has been directed by Congress to conduct a comprehensive study of the status of weather modification science and technology, and to submit to the President and the Congress a report on the findings, conclusions, and recommendations of the study.

As part of the process of developing her report to Congress, Secretary Kreps established

a Weather Modification Advisory Board to provide independent advice on the wide range of issues required to be addressed. That Board has completed its work and has issued a unique, competent and thought-provoking report. I agree with the essence of that report, particularly with what it has to say about the high importance and potential of weather modification in the United States.

First, we badly need a clear national policy regarding weather modification, and a well-coordinated, long-term national program for research into the scientific basis for management of our weather resources. We still need to learn much more about the atmosphere to intervene in complex atmospheric processes with predictable results. The cost of such a program will be substantial, but still modest by most Federal Government standards. It will require at least a doubling, and probably more, of our current expenditures over a period of several decades. But the potential economic benefits of such a program are immense—for agriculture, for power and water supplies, and for mitigation of the damages from hurricanes and other severe storms.

Second, we cannot pass over lightly a basic philosophical question here—whether and to what extent society, and in particular Government, should seek to control our environment.

A recent letter I received on this subject reports the views of the Commissioner of the New Jersey Department of Environmental Protection. He said "Don't fool around with Mother Nature." He sent neither a bolt of lightning nor a sample of margarine, but we should not fail to heed this message.

The Board has recognized—and I agree—that learning more about the atmosphere is only part of the task, even though it is the most important part. We need to know much more about the benefits and costs, about the specific short-term and long-term environmental and societal impacts, and about the potential for negligence and recklessness, in creating deliberate changes in the weather. And as the Board also stressed, deliberate weather modification must be designed and carried out after full consultation with the people likely to be affected. I compliment the Board for translating this concern into action—they held a number of public meetings around the country to make sure that all interested citizens could be heard. As someone who has spent part of his career representing environmental organizations, I am particularly sensitive to these problems. But I think these concerns are widely shared.

Finally, the Board highlighted an important issue that is relevant not only for weather modification, but also for many other Federal scientific endeavors. In brief, the Board concluded that we have organized the Federal research effort in such a manner that it is destined to fail. To quote its report: "We are tackling 20-year problems with 5-year projects staffed by short-term contracts and funded by 1-year appropriations. It is not good enough." We have compounded this problem by dividing funding among a number of Federal agencies with differing missions and priorities, resulting in what is inevitably submarginal funding. All weather modification efforts presently employ the same basic technology and can benefit from a centrally focused research effort. The Board concluded, and I agree, that all such research and development efforts should be centralized in one Federal agency.

The Board's report highlighted a number of other key policy issues. For example, it recommended that the Federal Government license weather modification operators and formulate project guidelines. And it recommended a strong and autonomous organization to carry out the national program. Such licensing will inevitably be required. To the extent a prudent form of autonomy or other institutional means of increasing the visibility and effectiveness of a national program can be constructed, we need that as well.

The distinguished Chairman of the Board, Harlan Cleveland, stated the most important conclusion succinctly in his letter of transmittal to the Secretary of Commerce: "The Federal Government does not have a policy in this field . . . . The time for adopting a policy stance, backing it with a coherent program, and organizing seriously for a longer term effort, is now." I agree, and I intend to work vigorously to achieve those goals.

President Carter recently signed into law the National Climate Program Act. I would like to touch on one set of issues that have been resolved in a unique manner. These issues relate to how the program is to be administered.

Congress and the President have made clear that while NOAA is to lead the program, it is to be a multiagency effort, and that an important part of our job is to encourage broad participation in the program. This does not apply only to the rest of the Federal bureaucracy. State governments, universities, the private sector and others concerned with applied research and advisory services must be involved.

We are taking a number of steps to ensure that the spirit of the legislation is carried out:

- The National Climate Office is being staffed by professionals from a number of Federal agencies and from non-Federal institutions. For example, we are already being assisted by a state climatologist from Colorado State University, a scientist from the National Center for Atmospheric Research, and personnel from NASA and the Department of Agriculture.

- The legislation requires a program of cooperative Federal and State climate study and advisory service activities, and authorizes grants to states for such activities. We are now planning this program.

- The Legislation also requires the establishment of experimental climate forecast centers. We intend to seek out the best people and institutions to create and operate a small number of research centers, whether they be found in universities, industry, or elsewhere.

A preliminary version of the first 5-year climate plan is to be delivered to Congress soon. I know the private sector will work with us to create a plan that implements the partnership of interests that Congress had in mind.

My discussions with a wide variety of scientists and other individuals have convinced me that NOAA's relations with our nation's academic and research institutions must be enhanced. The academic and research communities can provide thought and research of high quality—in some cases the best thought and research available—thus permitting NOAA and the rest of the Government to fulfill our mandates in the best possible fashion. Greater NOAA support of these communities would strengthen them and permit them to continue to provide outstanding services. And more reliance on the academic and research communities would enable NOAA to use its increasingly limited personnel resources more effectively.

I am therefore issuing a directive to all NOAA managers that will include the following guidelines:

- NOAA will aim to increase substantially its use of academic and research institutions for performing research in support of our mandates. While the basic criteria will still have to be who can perform the research best and who can do so in the most cost-effective manner, and while we must still maintain a high-quality research nucleus of our own, we will be setting specific goals for each of our components to make sure that outside research is substantially increased.

- Collaboration between NOAA and the academic community will be fostered by locating NOAA facilities near or at academic institutions. Henceforth, whenever NOAA plans to build a new research or related facility, or to relocate such a facility, a presumption will exist that it will be located near or at such an institution.

- NOAA presently has several kinds of cooperative agreements with academic institutions across the country. All major NOAA research facilities which do not have such agreements will be asked to examine whether any such arrangements should be useful. NOAA policy will be to have such arrangements when they will induce or facilitate the cooperation we are seeking.

- To coordinate our relations with the academic community, we are planning to hire a Director of University Relations, who will report directly to our Associate Administrator, George Benton. As a distinguished meteorologist and former President of the American Meteorological Society, Dr. Benton is admirably qualified to oversee our thrust in this area. The Director will develop policies and programs designed to improve NOAA's relations with the academic and research communities and to facilitate the exchange of scientists with those communities. The Director will also serve as a focal point for inquiries from the academic and research communities, and will coordinate the implementation of the new policy guidelines.

We are entering a decade of challenging public policy issues in the atmospheric sciences. In the coming years rapidly changing technologies will create new opportunities for public and private meteorology. We will be engaged in comprehensive programs of weather modification and climate research. The Federal Government, academic and research institutions, and the private sector will be cooperating in these efforts in unprecedented ways.

The coming decade can be as exciting as any in the history of the atmospheric sciences. □

Monitoring the foreign fleet

A Month on a Japanese Trawler

By JANET M. WALL*

Through my binoculars I watched the large ship as it approached the bay at Dutch Harbor, a lonely fishing town in the Aleutians. As it rounded the point, I could count the three crane supports of the superstructure (marking it as a large stern trawler), and pick out the call letters painted on the side—JDXF. It was indeed the Koyo Maru No. 3, the Japanese trawler I was to spend one month aboard as a fishery observer. The trawler anchored in the outer bay to await my arrival by skiff.

On the way out, I took a last look around at the stark beauty of the Alaskan landscape—the snowy peaks leading into barren cliffs that plunged abruptly into the sea. The water was fairly smooth inside the bay and I watched the finned backs of the harbor porpoises arching out the water. A little farther out, however, we hit heavy swells with a bang, and I feared for the safety of my box of sampling equipment and duffle bag of clothes perched on the cabin roof.

As we drew closer to the Koyo Maru, I saw the rope and wood ladder hanging down the side and the line of men at the rails watching our approach. I was more than a little excited at the prospect of being one of the first women fishery observers on a Japanese ship in the Bering Sea, but I had some misgivings as well. What would life abroad be like for an American woman among 87 Japanese men? Would my presence aboard be resented? Would the Japanese—in an attempt to discourage future women observers—make my sampling duties difficult by withholding the cooperation they normally afford male observers, or by placing restrictions on my work activities in the name of my safety? Although I had been working for the Foreign Fishery Observer Program at the National Marine Fisheries Service in Seattle for more than a year, and had seen many observers come and go, this was my first chance to serve as an observer myself, and I was anxious to do a good job.

Prior to the enactment of the Fisheries Conservation and Management Act (FCMA) of 1976, my supervisor, Robert French, had repeatedly approached representatives of nations involved in the west coast fisheries and asked if women observers could be accommodated aboard their ships. They all gave various reasons why they did not want women, and since at that time observers were placed aboard by invitation of the host country, he was not in a position to press the issue. With the advent of the FCMA, however, foreign vessels fishing within the 200-mile Fishery Conservation Zone were required to accept observers, so it was appropriate to bring up the subject again.

Poland was the first country to state that it could accommodate women, and in the summer of 1977, the first female observer, Leslie Watson, boarded a Polish ship fishing for hake off the Oregon-California coast. She received a good deal of attention, as might be expected, for there are no Polish women crewmembers, but she had no major problems and she had no trouble performing her sampling duties.

The Koyo Maru No. 3, Japanese trawler on which NMFS biologist Janet M. Wall spent a month as a fishery observer.

At about this time we heard that women observers were being placed aboard ships of various nations off the east coast of the United States. Armed with this news, and using the argument that Poland had agreed to accept female observers, we were finally able to get the Soviets and the Japanese to agree to accept women.

I awoke from my reverie as we pulled up to the side of the Koyo Maru No. 3. The huge trawler, of more than 3,000 gross tons and a length of 102 meters (335 ft), completely dwarfed the 20-foot U.S. boat. I scarcely had time to take a deep breath before grabbing the dangling ladder and beginning the long climb. The motion of the ship and the flexibility and verticality of the ladder made the climb more difficult than I had expected, but I finally ar-

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From the bridge of Koyo Maru No. 3, observer Janet Wall searches the surrounding sea for marine mammals.

rived at the top and scrambled over the rail and blurted out one of the few Japanese phrases I had managed to learn: "Konnichi-wa," a greeting.

A short, somewhat plump man with a broad smile approached me, introduced himself as Captain Toshimasa Minami, and welcomed me in quite passable English. After I watched my baggage hauled aboard and stowed in my cabin, I was invited to the captain's lounge where I was offered tea and introduced to some of the other officers. Captain Minami read my resume, told me something about his own history—he had been a captain for almost 15 years—and offered to take me on a tour of the ship. The tour included the bridge, with an explanation of the various instruments; the radio room; the dispensary; the officers' and crew's mess halls; the galley; and the toilet and bath facilities.

A complete tour of the fish processing factory and the holds would come the next day, but first I was treated to an excellent meal of soup, rice, tempura-fried fish, sliced cabbage, green peppers, sukiyaki, and green tea. After unpacking, I treated myself to a Japanese hot saltwater bath—very relaxing.

That night in my cabin, as I mused about the differences in customs I was experiencing, I reflected on what brought ships so far from their own countries to fish off our coastline, and the history of the foreign fishing.

The Bering Sea, with its vast continental shelf, is one of the world's richest seas in bottom-dwelling creatures. The gulf of Alaska and the shelf off the western coast of the continental United States also have plentiful fishery resources that were long eyed with interest by other nations. As early as the 1930's, Japan conducted a fishery in the eastern Bering Sea for walleye pollock, which was converted to fish meal and oil, and a tangle-net fishery for king crab. In the early 1940's Japanese motherships went to the same area for yellowfin sole, packed and frozen in blocks for human consumption.

World War II interrupted these fisheries, but after the San Francisco peace treaty went into effect in 1952, fishing restrictions were removed and in 1954 Japan reentered the Bering Sea fisheries. The Soviet Union began fishing for flatfish, herring, and king crab in the eastern Bering Sea in the winter of 1959, and later expanded its operations into the Gulf of Alaska and off the Washington-Oregon-California coast.

During the fifties and sixties, there was a rapid expansion of foreign fishing in Alaskan waters, and the ships began targeting on arrowtooth flounder, Greenland turbot, sablefish (black cod), Pacific cod, Atka mackerel, herring, and Pacific ocean perch as well as the pollock and yellowfish sole. Off the California-Oregon coast, the USSR and Poland began catching large quantities of hake and jack mackerel.

The Koyo Maru had had a fisheries observer the previous year, so the officers knew what type work I would be doing. They quickly had a work table built for me in the factory, and a board to hold the plastic strip used to measure fish. My main duties as a biological observer were to estimate daily catch rates by species, determine the incidence of halibut, crab, and

salmon in the catches, and gather information on the size and age structure of the dominant species in the catch.

As the time slipped by, I soon developed a daily routine adjusted to the fishing operations. An early morning haul would often have me out of bed, dressed in my oilskins, boots, and hard hat, and out on deck by 5:30 a.m., watching as the trawl net was dragged up the stern ramp. As the catch was slowly emptied through a metal grid into the below-deck bins, the trawl crew and I would try to grab any halibut, crab, or salmon present in the catch. Fishery regulations make it unlawful for foreign vessels to retain these species, so if they are caught they must be returned to the sea as soon as possible, whether dead or alive. The only exception to this rule is when an observer is aboard, in which case he or she is allowed to gather information on these species before they are thrown overboard.

U.S. fishermen for many years were deeply concerned about the number of halibut, crab, and salmon caught incidentally by the foreign trawlers, because these were of commercial importance in the United States. Moreover, in the 1960's Bering Sea populations of yellowfin sole and Gulf of Alaska populations of Pacific ocean perch experienced a rapid decline owing to extensive foreign fishing. Rising concern for the species of current or potential commercial value spurred the negotiations for several protective agreements.

Under terms of the International North Pacific Fisheries Commission established in 1953, Japan abstained from fishing for halibut in the eastern part of the Bering Sea. A setline fishery for halibut was permitted in the mid-sixties, but after 1968 was discontinued.

Observers were placed on some trawlers to determine the quantity of incidental catch of halibut, crab, and salmon. In addition, seasonal area restrictions were imposed to protect halibut stocks during the periods when they are most vulnerable to capture by trawl.

Following separate bilateral agreements with Japan and the Soviet Union, foreign fishing for king crab was greatly reduced, and by 1975 the catch of king crabs went entirely to the United States. In the meantime, the Japanese crab fleet shifted its target to Tanner crab, but agreed to certain catch limits, and refrained from keeping female crabs. The Soviet Union agreed to discontinue targeting on Pacific ocean perch in the Washington-Oregon-California fishery, to avoid trawling in areas known to have high perch concentrations.

Although these measures provided some degree of protection, most U.S. fishermen and fishery analysts did not consider them adequate to manage all the fishery resources off our coasts. An answer to this problem was the Fishery Conservation and Management Act of 1976, which requires foreign vessels fishing in the 200-nautical-mile conservation zone to permit "duly authorized United States observers" on board.

I measured the length of the wildly flapping halibut as soon as they were found, then slid them down the stern ramp into the sea. Crab were collected in a plastic basket and carried to my work table down in the factory, along with any salmon or dead halibut. At my work station I would count and weigh the Tanner and king crab and note how many were alive. Salmon and halibut were measured and weighed, and, if dead, dissected to determine their sex. In addition, the species of salmon was determined and a sample of scale removed so that I could later find out the age of the fish.

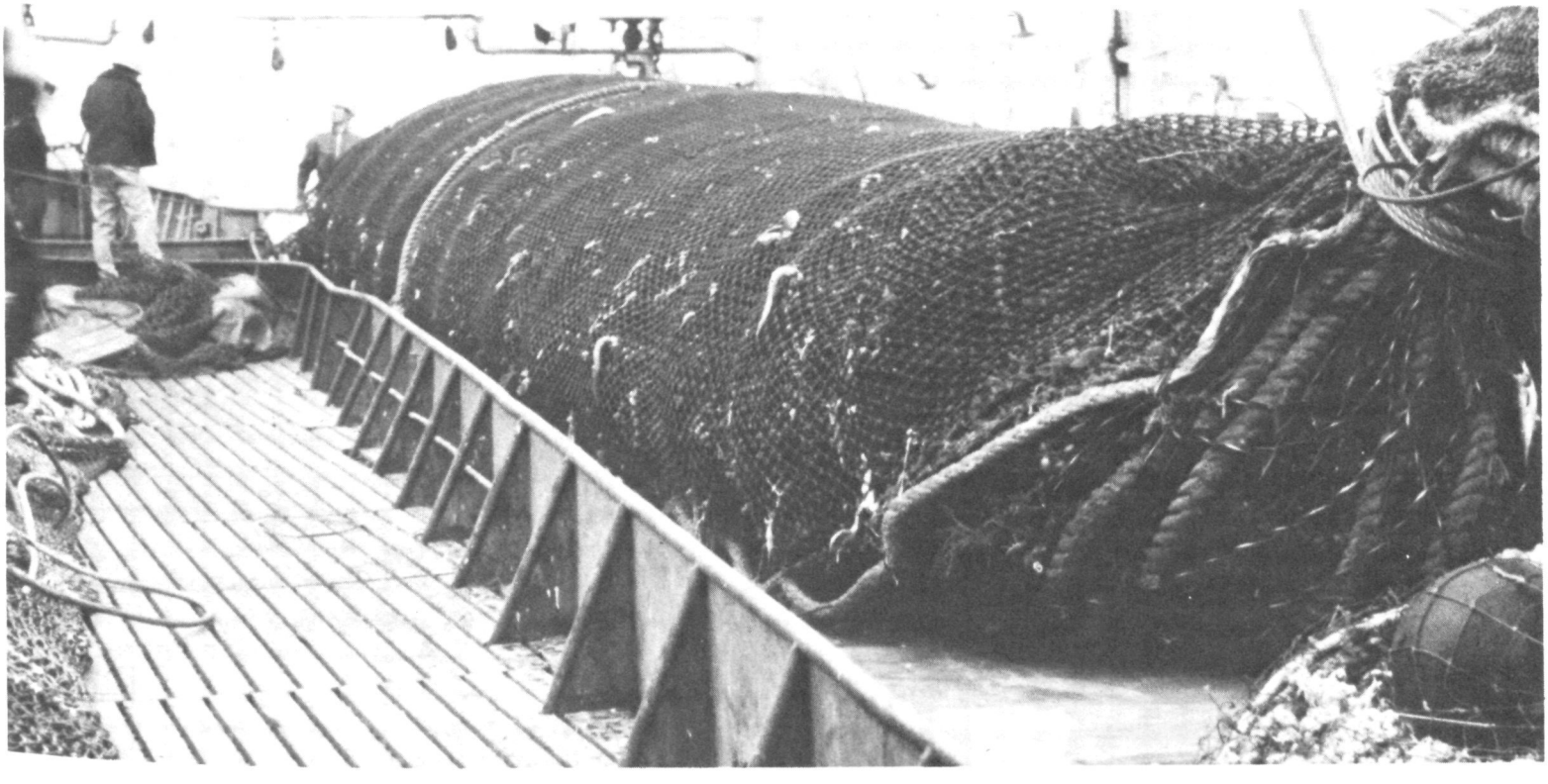
Observer Wall heads up ladder on mast of Japanese trawler, where she will be afforded wider view of the ocean and overall shipboard operations on deck.

As soon as I finished with a specimen I dropped it through a nearby outwash hole into the ocean.

Following this task, I would climb over the top of my sampling table and crawl about 20 feet along a few wooden boards placed over a moving conveyor belt. This was necessary in order to get to the fish bins where the catch had just been dumped. Using a tape measure, I determined the depth of fish in the bins—later, I would calculate the metric tonnage of the haul using the fish depth, the bin dimensions, and the density of the fish.

The schedule of my next work procedure depended upon whether the factory crew was still busy processing a previous haul. If so, I might have to wait as long as six hours to sample that haul, so I would take advantage of the break to eat breakfast, take a short catnap, observe fishing operations from the bridge, or work on my data forms.

The factory manager would let me know what time the crew would begin to process the fish from the haul I wanted to sample. Conveyor belts moved the fish out of the bin and past my sampling station. By holding a plastic basket at the point where the fish spilled from an upper conveyor belt to a lower one, I could obtain a sample of the catch. Next I weighed the sample, counted the walleye pollock (the



Counting and weighing pollock in the factory of Koyo Maru No. 3 was one of tasks of fishery observer Wall (upper left); adjoining photo shows bag of Tanner crab being weighed. Below, a trawl catch of approximately 70 metric tons of pollock is hauled aboard the trawler.

Observer Wall takes a break in her cabin (above), at right, Japanese crew members bait hachi in preparation for making a longline set for sablefish or Pacific cod.

predominant species in the catch), and identified, counted, and weighed all the other species in the basket.

I repeated this process in order to obtain ten samples of about 40 kg (88 lbs) each from different parts of the haul. At the same time I would keep an eye on the factory worker sorting the catch on the other side of my sampling table to make sure that he saved for me any crab, halibut, or salmon that may have been missed by the trawl crew when the catch was dumped into the bin. When I was not basket-sampling for species composition I would help the sorter to insure that none of the prohibited species was missed.

I saved a random sample of about 150 pollock daily, which I then separated by sex and measured. Approxiately twenty of those fish I individually weighed and removed the otoliths (ear stones) so that by the end of the cruise I had a collection of 350 for age determination later. A large trawl catch would keep me busy in the factory for several hours.

When I finished my work in the factory, I would change out of my raingear and go up to the bridge to obtain the position, beginning and ending time, depth, trawl speed, and catch size of all of the hauls that day. On this particular ship, usually four 5-hour trawls were made daily, with the haul catches varying in size from 7 to 70 metric tons each. I usually tried to sample at least two of those hauls, adjusting my sampling time so as to sample hauls from different times of the day and night, as the Japanese fish 24 hours per day. Part of my time was spent at the desk in my room entering my data on keypunch forms. Once a week I prepared a radio telegram which was sent to the NMFS office in Seattle on the estimated catch by species for the week.

There was little spare time on such a busy ship, but occasionally I could take tea on the bridge with the ship's officers, or find time for a little needlepoint in my cabin.

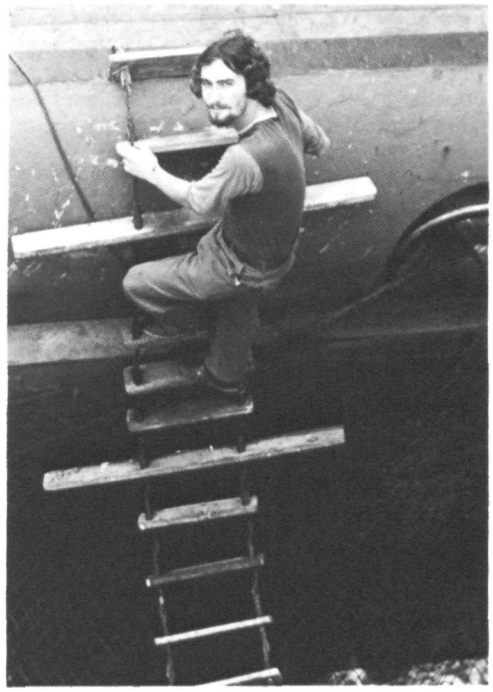
Three times a day I also conducted watches from the bridge for marine mammals, and I also noted whether any sea lions or seals were caught in the trawls. Sea lions, which often congregate around fishing vessels, are sometimes caught in the net and drowned. Observers are instructed to measure dead marine mammals and bring back the canine teeth of pinnipeds for age and sex determination, but to stay away from live animals (one observer who was chased all around the deck by an enraged sea lion now has a healthy regard for their teeth and their ability to move fast when angered).

What good was all of the data I was gathering, and how would it be used to help manage the fisheries? As my weekly summaries were received in Seattle, they were keypunched and entered into a computer at the Northwest and Alaska Fisheries Center along with the data from the other observers on foreign ships at that time. Fishery observers are placed on pollock, yellowfin, and crab motherships; independent crab catcher boats; small and large stern trawlers; and longliners. Data from observers on vessels of the same nation, vessel type, and fishing area were combined and applied against the total number of ships in that same category that were fishing on the grounds. In this manner, the sampling information is used to estimate periodically the total catch by species for each foreign fleet, and to predict when each nation will reach the quota allotted to it.

These estimates are refined after the observer's return to Seattle when the more detailed haul-by-haul species composition data is substituted for the weekly summary. Similarly, the incidence rates of crab, halibut, and salmon (number per metric ton of catch) are applied to the catch of the entire fleet so that the total incidental catch of these species can be estimated. Annual growth rings on the scales and otoliths brought back by observers are counted by specialists at the Center, and this information, together with the individual fish weights and length frequencies give analysts an insight into the age and size structure of fish populations.

The total quantity of information is voluminous. Fishery observers placed on various vessels for periods of one to six months gather data on all the major commercial species. In 1978 alone, data collected on 130 observer trips amounted to approximately 18 observer-years of data, as an average of 18 observers were at sea at any one time. It means that no longer are we forced to rely so heavily on statistics provided by the fishing nations themselves. The advent of the 200-mile Fisheries Conservation Zone means that not only are we able for the first time to control the quantity of fish caught, but now we can more accurately determine long-term trends of the fish populations, an essential item in the management of the oceans' resources.

The days passed quickly, and it was soon time for me to return home. The Koyo Maru No. 3 steamed to the appointed transfer spot outside Dutch Harbor, then dropped anchor. Soon I was climbing down the ladder of the big fishing vessel and into the awaiting boat. As we pulled away from the trawler, I looked back and saw people waving from all parts of the ship. I had made good friends during my time aboard, had steeped myself in a totally different culture, had marvelled at the quantity of the catches, and in all, had had an experience I would never forget. □



A sampling of activities and experiences of NMFS fishery observers on foreign ships (clockwise from top left): ice coats an entryway onto the deck of a Japanese ship in the Bering Sea in winter; three NMFS observers sorting and measuring fish on a foreign trawler; observer Robert Kneller verifies the weight of boxes of processed Tanner crab, under close Japanese scrutiny; observer Neil Richmond transfers from one Soviet ship to another, using rope ladder looped between the two ships; observer Karen Teig measures fish in the factory of Polish trawler Tunek.

Today's Ali Baba uses aircraft and computers

Open Sesame!

By CARL A. POSEY

The command evokes the tale of Ali Baba, the medieval Arab who learned how to open a door to the riches cached by forty thieves. If the fable were to be retold in today's terms, its setting might be the southern plains of the United States, Ali Baba would be a research meteorologist, and the riches he hoped to reveal with this command would be the closely held secrets of what scientists call mesoscale weather—weather ranging in size from mid-latitude cyclones to tornadoes and the microweather of metropolitan areas; weather so pervasive, and so destructive when severe, that it can be likened to the forty thieves.

SESAME today is the acronym for Severe Environmental Storms and Mesoscale Experiment—the first serious, large-scale attempt to measure and monitor and learn to predict weather in the middle ranges of meteorological time and space. SESAME 79 which begins in April and runs through May, is centered on NOAA's National Severe Storms Laboratory in Norman, Okla., with a province of investigation that reaches from Albuquerque to Nashville, Chicago to Victoria, Tex. The roll call of participants is virtually a roster of Federal agencies and universities, with NOAA and the National Science Foundation providing much of the money required to transform a score or so of individual mesoscale experiments into the larger composite of SESAME.

The April SESAME will focus on a regional scale, nominally a square some 1,800 kilometers on a side. Within that large region, National Weather Service rawinsonde stations have been supplemented by 20 special SESAME sounding sites; between them they will provide rawinsonde soundings of the atmosphere every three hours when the evolving weather systems set the experiment in motion. At the same time, SESAME scientists will scrutinize concurrent data from GOES, NOAA's geostationary satellites, for high-resolution, high-frequency pictures of the study area; and from TIROS-N and NOAA-A polar-orbiters, with their temperature-sounding systems. SESAME researchers hope to get at least three 24-hour-long case studies of storm systems at this scale—an objective that sounds easy, but has never been achieved.

A small air force—from the National Center for Atmospheric Research (NCAR), the University of South Dakota, and the National Aeronautics and Space Administration—has been attracted to Oklahoma for the experiment. Some will fly thunderstorm penetrations, perhaps the roughest flying of all.

In May, SESAME will contract to a storm-scale square 400 kilometers on a side, still centered on the Norman Laboratory. While existing rawinsonde stations in the regional scale network will continue to provide three-hourly soundings on experimental days, some of the special rawinsonde sites will draw inward into a dense network covering much of Oklahoma and northern Texas. Other aircraft from the U.S. Air Force and the University of South Dakota, will join the SESAME squadron for thunderstorm studies. As many as seven Doppler radars—the two large Dopplers operated by the Norman laboratory, two from NCAR, one from the University of Illinois, and two from the University of Miami—will sweep an area dotted with a dense network of automated surface weather stations. Any storm system crossing this minefield of instrumentation will be measured, probed, and remotely dissected to an unprecedented degree.

From this storm-scale work, scientists expect to gain a more complete view of the pre-storm environment and the origins of severe thunderstorms and tornadoes, related boundary layer processes, the role of shortwave troughs in triggering or intensifying convective storms, how the storm interacts with the atmospheric environment, and the harsh dynamics within the evolving storm. It is a large order for an experiment that, like its subject, falls in the middle ranges of size and complexity.

For the 1979 version of SESAME is not the massive experiment initially proposed, but a more modest effort made possible by important compromises.

"Meteorologists interested in the mesoscale have waited a long time for this," said Dr. Douglas Lilly, the NCAR scientist who chairs the SESAME Steering Committee, and a prime mover in transforming SESAME from a slender proposal to a major field experiment. "Proposals for something like SESAME have been coming in for about 20 years. But they never got very far, even when money was easier to get. The proposed instrumentation costs were just too high."

Then, a year or two ago at a meeting in Boulder, National Severe Storm Laboratory director Dr. Edwin Kessler suggested that the mesometeorological community do what could be done with what it already had, plus a little additional funding for SESAME. "That made it work," said Lilly.

That, and the fact that technology had caught up to the SESAME concept. "Recent developments helped us considerably," Lilly acknowledged. "There's now a much higher degree of automation and data-management ability of all kinds. Surface stations record digitally and telemeter their data. Doppler radar is a major addition. We have satellites like GOES and TIROS-N. Data handling systems have finally come up to sensor performance."

Thus, SESAME moved toward reality, incorporating within its larger framework the seasonal field programs conducted annually by the Norman laboratory. Given this centerpiece, SESAME had enough reality to start the coalescence of other related mesoscale studies: boundary layer studies, thunderstorm research, applications.

SESAME 1979 is about a $3.5 million program, in which a score or so of participants are also receiving support from their own organizations to do their experiments within the larger framework. "Most of what will happen during SESAME 79 would have happened anyway," explained Dr. Stanley Barnes, the NOAA researcher who chairs the Storm Scale Working Group. "But SESAME provided the additional ingredients that made it possible for them all to happen at the same time and place." This permits greater interdependence among the various experiments, and makes SESAME 79 considerably more than the sum of its parts.

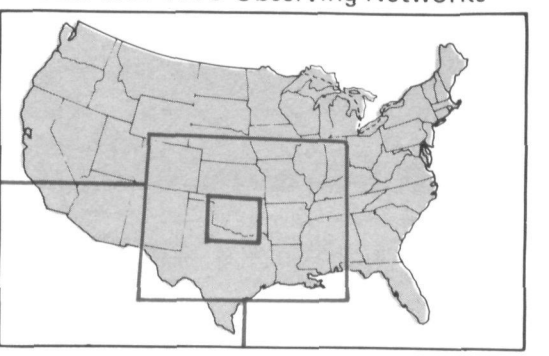
Dr. Ron Alberty, the National Severe Storms Laboratory scientist who manages the SESAME field program, is more than half satisfied with half a loaf. "But I think it's important," he said, "that someone realize sometime in the future that the more completely we observe a given number of cases, the more likely we are to unravel the interactions between scales. In SESAME 79, we're only looking at regional and storm scales; right now we can't afford to probe other important scales thoroughly."

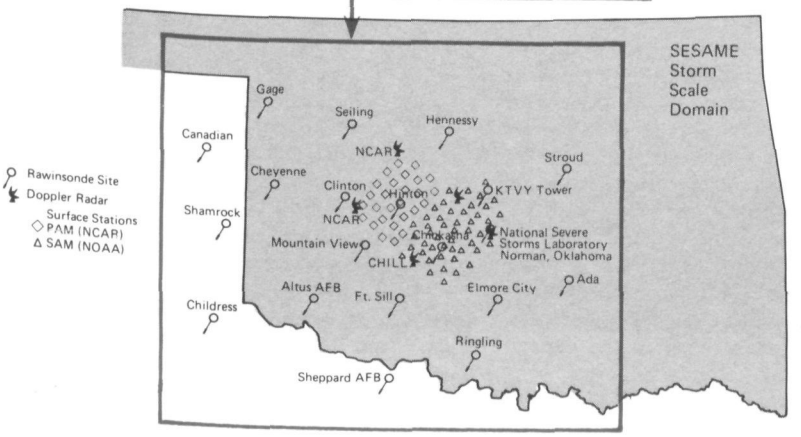
Still, for Alberty and his colleagues from other government offices and universities, it is exciting and challenging to see SESAME

NCAR Photo

SESAME Regional Scale Domain

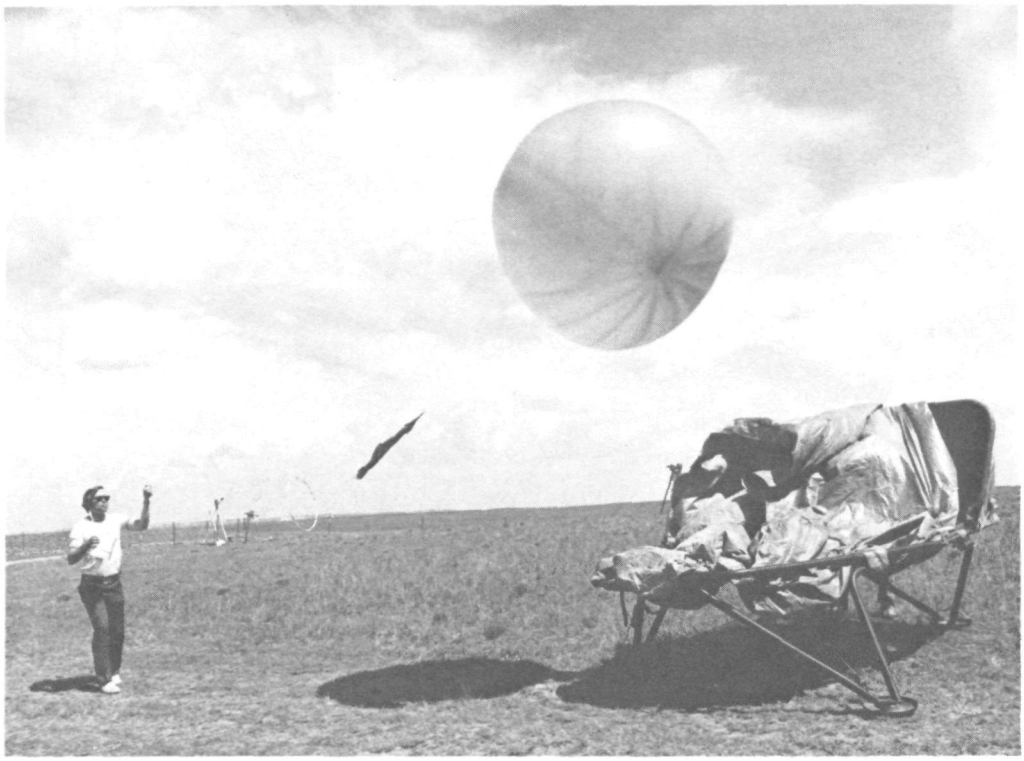
SESAME 1979 Observing Networks





SESAME Storm Scale Domain

Doppler radar (at top) of National Center for Atmospheric Research, one of five radars used in SESAME 79. Maps show the regional scale and storm scale operational areas of SESAME (left), and location in the south central United States.



(Clockwise from upper left) Dr. Douglas Lilly is NCAR scientist who chairs the SESAME steering committee, and was a prime mover of the mesometeorological experiment; balloon-borne rawinsonde packages provide the vertical soundings for SESAME; Dr. Ron Alberty (1.) of the National Severe Storms Laboratory talks with Dr. Stan Barnes, chairman of storm-scale working group; NCAR Queen-Air with gust probe mounted on nose takes boundary layer measurements. (Photos: NCAR and Chuck Clark).

about to metamorphose from a paper project to a major experiment, with all the complexities, successes, and frustrations of all many-pieced experiments conducted in the natural laboratory of the atmosphere. The experiment will beat to the tempos of advancing squall lines and storm systems, of scientists weighing atmospheric forces, of aircraft taking wing, of men and women in darkened radar rooms watching some of the atmosphere's destructive children bloom, destroy, and die. In an experiment like SESAME, there is always the persistent sense of having to mount quick offensives against large forces.

The day will begin with a meteorologist reviewing standard data, evaluating how nearly conditions in the atmosphere will match what the experimenters need. The forecaster will weigh weather products, satellite information, the rawinsonde soundings launched near sunrise. From these elements, SESAME meteorologists can determine what kinds of weather systems are expected in the area—the enormous area of the April regional-scale program, and the smaller area of the May storm-scale work. With that information, Alberty and scientists representing other areas of SESAME research—storm dynamics, boundary layer, large mesoscale squall lines—decide the prospects for running a particular experiment on that day, given weather conditions and the state of readiness of the complex data-gathering equipment used in the experiment.

"By mid-morning," Alberty said, "we should be able to tell where we are, and whether we should go or not. If we go, the airplanes will take off in the early afternoon from Tinker Air Force Base and Westheimer field in Norman. We'll also make an early decision to send out the storm intercept vans. But we expect to have many days when we'll be in a less intense state of wait and see. We just can't predict this kind of weather that well."

Improving such predictions is SESAME's reason for being, and much of the applications side of the experiment has to do with applying what is learned here to attain those improvements. "One of the first priorities of SESAME 79," said Barnes, "is to study development of convection from its very early stages, trace its evolution and decay, and follow development of complete storm systems. This will certainly

Portable Automatic Meteorological (PAM) station, one of many established in the SESAME storm scale network. (NCAR photo)

contribute to scientific understanding of these events. But I also look for some short-term benefits."

Among these benefits are tests of newly developed mesoscale predictive models at NOAA, NCAR, and several universities, using SESAME data, improvements in cloud modeling techniques, and what Barnes calls a pipe dream: "Eventually we'd like to be able, given initial conditions in the morning, to provide detailed severe weather forecasts over periods of six to twelve hours. What information do we need to do that? Should we expect convection, and if so, what kind, where, when? Will there be tornadoes, flash floodings, severe hail? The forecasts put out by the National Severe Storms Forecast Center in Kansas City are good, but they're also art. We'd like to make it possible for less specialized meteorologists to be able to make forecasts of that quality, using a more highly quantified system derived from SESAME research."

One of the important tests of SESAME data, in fact, will come at NSSFC, source of severe storms guidance for the United States. "Six months or so after the fact, NSSFC will rerun some simulated storm days, with forecasters using both conventional and enhanced data for each day, to determine what impact it has on operations," explained Lilly. "It isn't a double-blind experiment, and forecasters have long memories for weather. But it will help tell us whether SESAME has made an impression on the operational community."

The importance of that impression is heightened, Lilly believes, by evolutionary changes he detects in the field of meteorology. "While government meteorological services still have the statutory responsibility for weather warnings, they are beginning to regard themselves as *wholesalers* of weather information. The private sector is rapidly becoming a primary *retailer* of weather information." This rise in private, as against Federal, meteorology will emphasize weather service at the mesoscale, which is the scale of weather that most frequently touches most of our lives. The impact SESAME makes on mesoscale meteorology is also vital, Lilly believes. "The primary consumers of the SESAME data," he said, "are of course the principal investigators. But there is an important, invisible constituency in the graduate students who are still in school, who will be using SESAME data for years, and advancing mesoscale meteorology as they do."

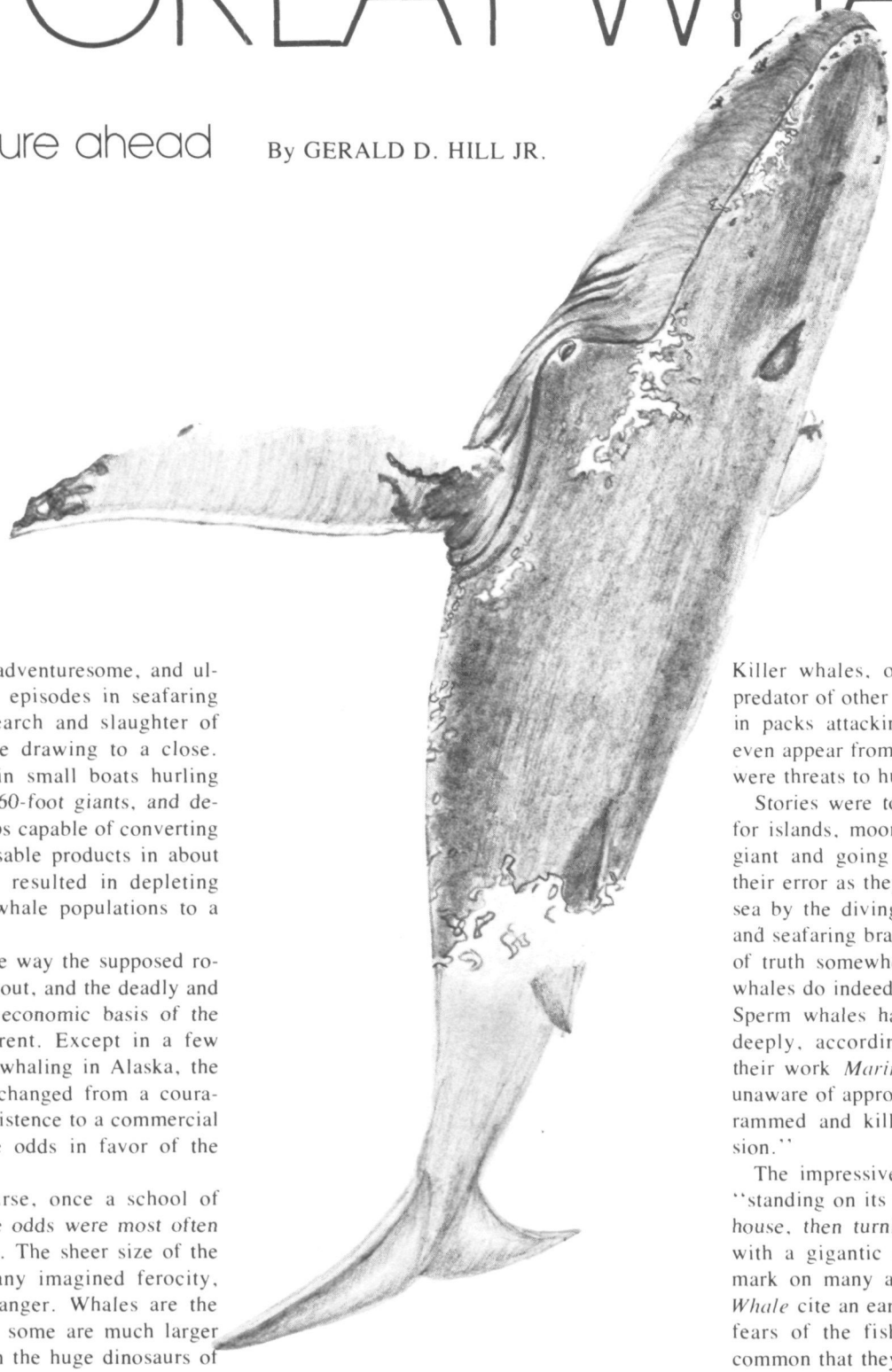
At the same time, the discipline itself is coming of age, as resources begin to flow into this somewhat starved corner of the atmospheric sciences. "Support," Lilly pointed out, "comes with recognition that mesometeorology has the maturity and ability to use it effectively."

For SESAME—for the SESAME concept of a concentrated study of weather at the mesoscale—recognition and support could mean a more complete experiment along larger lines in the early 1980's, one that would bridge both to the larger and smaller scales of time and space not spanned this year. In the meantime, SESAME 79 will open such doors as it can to reveal the secrets of atmospheric processes at the mesoscale. □

The GREAT WHALES

Brighter future ahead

By GERALD D. HILL JR.



One of the most adventuresome, and ultimately tragic, episodes in seafaring history—the search and slaughter of whales—appears to be drawing to a close. Beginning with men in small boats hurling harpoons at awesome 60-foot giants, and developing to factory ships capable of converting a 100-foot whale to usable products in about an hour, whaling has resulted in depleting some of the world's whale populations to a dangerously low level.

Somewhere along the way the supposed romance of whaling died out, and the deadly and presently unnecessary economic basis of the practice became apparent. Except in a few cases such as Eskimo whaling in Alaska, the character of the hunt changed from a courageous struggle for subsistence to a commercial enterprise with all the odds in favor of the hunters.

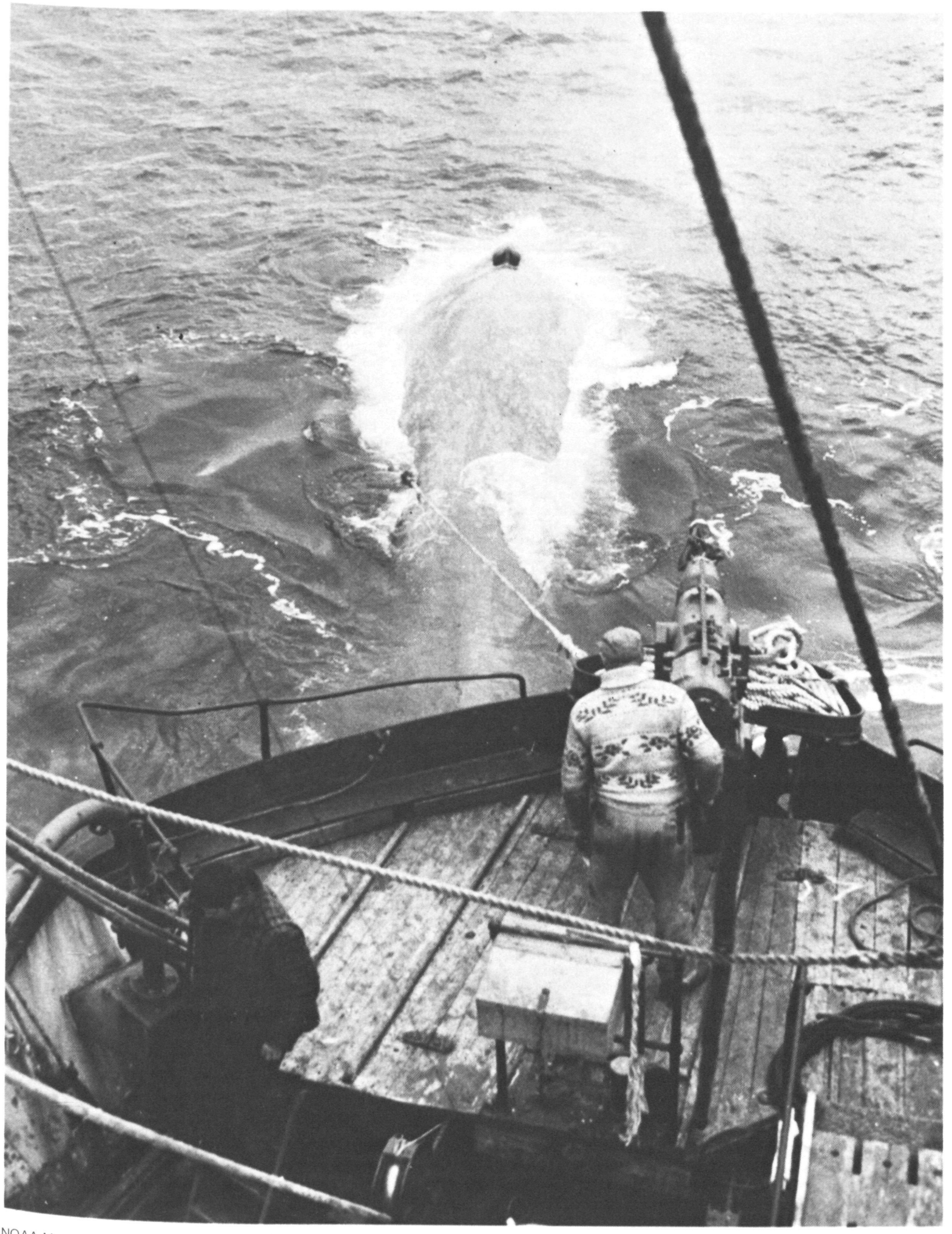
In actuality, of course, once a school of whales was sighted the odds were most often in favor of the hunters. The sheer size of the animals, rather than any imagined ferocity, created most of the danger. Whales are the largest creatures alive; some are much larger in size and weight than the huge dinosaurs of prehistory. Air-breathing mammals, they must spend time at the surface of the water, and several species spend many months near the shores of continents where they are susceptible to attack from small boats.

In spite of the fact that it was humans who attacked whales and not the other way around, many legends circulated about good and bad whales, with the sperm whales and others that have teeth considered the more evil. In earlier days sailors lived in such fear of whales that it was taboo to mention the name on board ship. Killer whales, once thought to be the only predator of other whales, were apparently seen in packs attacking solitary whales. It would even appear from some legends that all whales were threats to humans.

Stories were told of men mistaking whales for islands, mooring their boats to a sleeping giant and going "ashore" only to discover their error as they were being carried into the sea by the diving whale. As in most legends and seafaring braggadocio, there is an element of truth somewhere. Here, it is the fact that whales do indeed sleep floating at the surface. Sperm whales have been known to sleep so deeply, according to Harrison and King in their work *Marine Mammals*, that "they are unaware of approaching vessels and have been rammed and killed on more than one occasion."

The impressive sight of a breaching whale "standing on its tail" higher than a two story house, then turning slightly and falling back with a gigantic splash, must have made its mark on many a sailor. The authors of *The Whale* cite an earlier writing that indicated the fears of the fishermen. "They all have in common that they are full of greed and fierceness. They are never satisfied in their killing as they ply the oceans looking for ships. They leap into the air so that they can move easily, sink the ships, and totally destroy them. Those fish are not edible and on the contrary are destined to be the enemies of mankind."

These mammals of the sea have nostrils at the top of the head through which they breathe and as they exhaled they announced their presence to prospective whalers. The foglike sprays are both audible and visible and are often distinctive enough in shape to enable the



whalers to know which kind of whale it is. Another way of determining the species of whale at a distance is its diving pattern while traveling. Sperm whales run on the surface for a while, breathing every two or three minutes, then dive deep for 30 to 60 minutes, returning to the surface close to the original point of departure. Other whales, such as the fin, blue, and humpback, travel along at the surface briefly for two or three minutes breathing or blowing at half minute intervals, diving (sounding) for about 10 or 15 minutes, but surfacing at a distance from the original diving place. Large whales usually swim along about two to six miles per hour, but when chased a blue whale can attain a speed of about 20 to 25 miles per hour over a short time.

At times whales beach themselves or float ashore and die without any obvious reason. The causes of these strandings are just now becoming understood; some scientists believe that parasites in the inner ear may cause the animals to become severely disoriented. Strandings probably gave ancient people their first opportunity to realize the value of the great beast for its oil for lamps and lubricants, and perhaps for its meat. With this incentive they ultimately took up the chase on the open sea.

Scientists are not in total agreement, but there are believed to be about 75 species in the order of whales (Cetacea) which include not only the "great fish" as they were once called, but also the dolphins and porpoises. (The term whale is usually reserved for the 10 or so larger species.) There are about nine of the true giants and 66 smaller members such as the porpoises and killer and pilot whales.

There are basically two kinds of whales: baleen and toothed. The toothed whales range from five to 60 feet and include a wide variety of smaller forms like the commonly known bottlenose dolphin, and the most agressive cetaceans, the 25 to 30 foot killer whale, and the sperm which, at 55 to 60 feet, is the largest toothed whale. The diet of the sperm whale consists primarily of squid, which inhabits the greater depths of the ocean. The baleen whales probably do not go deeper than 500 feet, but the sperm will dive to depths in excess of 8,000 feet to catch its prey.

Baleen whales have no teeth but, instead, where the teeth would be, there is a huge brush or "curtain" of baleen, known more commonly as whalebone. These fibrous plates are not bone at all, but a strong, flexible keratinous material similar to that in human fingernails and hair. When the whale opens its mouth it takes in huge amounts of water and planktonic organisms; the water is then forced out of its mouth through the strainer, or baleen plates, leaving the meal entrapped inside.

Baleen whales include the largest of all, the great blue whale, plus the fin, sei, Bryde's, humpback, gray, right, bowhead, and the smaller minke. While the sperm whale and its toothed cousins eat squid and fish, the baleen whales feed primarily on zooplankton and krill—shrimplike animals that congregate in immense numbers in colder waters.

The cold waters nearest the poles are rich in nutrients, which rise to the surface near zones of convergence with warmer waters. During the 24-hour-long summer days, minute plants called phytoplankton develop and serve as food for krill. Sometimes this rich harvest awaits the whales in such abundance that the color of the water changes as does the color of the whales. The whales eat literally hundreds of tons of krill during the summer months.

Whales have other ways to get a meal together. Roger Payne and Sylvia Earle report in the January 1979 issue of National Geographic Magazine of studies done by Charles Jurasz on humpback whale feeding behavior. These animals sometimes swim in a circular pattern about 50 feet below the surface, releasing air bubbles as they do so. As the bubbles rise they act as a kind of corral, causing the small krill or fish to congregate closer together. The whale surfaces with mouth open for the catch.

The great whales are of such size that captivity for study is all but impossible. Not until World War II did observation of dolphins or porpoises (the smaller members of the family) in marine centers reveal the ability of the animals to communicate with one another with underwater squeaks and beeps. In recent years larger species, such as the gray whale of Baja California and the humpback whale in Hawaii and southeastern Alaska, have been observed sonically in their natural environment. This has proved difficult, expensive, and time consuming, but has sometimes yielded significant new information.

The two investigators have discovered other interesting information regarding whale "singing." They say that the humpback whale emits "rumbling bass passages and squeaky treble phrases, arranged in complex sequences . . . which if the song is sped up 14 times, sounds surprisingly like a bird's song." The sound patterns may vary from year to year and change completely over a five-year period. The reason for the sounds in unkown although it is suspected that it is a mating call. Payne and Earle report that hearing the whale calls from a wooden boat, which tends to pick up and transmit the sounds of the deep to its occupants, "is both frightening and awesome. You actually feel the song, it is so intense."

One interesting investigation is the study of the sperm whale's giant head, to try to discover the purpose of the huge spermaceti organ and other structures. One theory is that it allows the whale to stay neutrally buoyant (body having the same density as the surrounding water). This assumes that the sperm whale has the capacity to maintain a certain depth level over a period of time, yet floats when it is dead. The sperm whale is known to move at a speed of four or five knots in a dive, and spends about 30 minutes searching for its prey, large squid. The theory assumes that the sperm goes down to the dark depths where most of the other squid predators do not venture; even though there is little or no light it may sense the squid, as some varieties are luminescent.

Large whale courtship of some species has been observed in warm-water breeding grounds. It is a time of frolicking about in the sea, with much social activity including nudging and patting with fins. Baleen whale females are usually pursued by several males but, gradually, without any fighting, all but one will drop off and leave. Sperm whales normally have a harem of 15 to 20 females.

After having bred, the baleen female joins the migration to cooler feeding grounds while her unborn calf develops. And migrates back to warmer waters again for the birth. A calf born in cold Arctic waters could die for lack of sufficient protective blubber.

The gestation period of whales ranges from 9 to 15 months, and a calf is produced which will measure, depending on species, from a third to a quarter of its mother's length. A newborn blue whale weighs about two tons and is 25 feet long. Cetacean young usually are born tail first. This eliminates the need for the first breath of air until the birth process is complete and the mother gently and quickly pushes the calf to the surface.

The baby whale stays very close to its mother, often traveling beneath her. Since a very young calf can stay underwater only for a minute at a time, its feedings are short and frequent. To help the calf, the mother squirts the milk into its mouth from nipples tucked just inside a narrow opening in her streamlined body.

Baleen, or whalebone, was the commonest known whale product. It was used for ladies' corsets and hoops as well as for many other items both stiff and flexible, such as shoehorns and the "ribs" of umbrellas. Almost every part of the whale was found to be a profitable item including the teeth, which were scrimshawed with interesting scenes of centuries past, and which in the South Seas were fashioned onto jewelry.

The profits from whaling voyages built many fortunes over the 16th to 19th centuries. But as technology expanded to produce synthetic products equal to or better than those of the whales, such as petroleum and the light bulb, profits began to fall. Oil was left as the primary product, until that market collapsed in 1931 as part of the Great Depression. However, whale oil remained an economic product when large numbers of whales could be caught in a relatively small area.

Up until the mid-1800's man and beast were perhaps in relative balance, owing to the size of the oceans. However, the early 1900's saw the beginning of pelagic (open sea) hunting with the development of the harpoon cannon and steam-powered boats. Longer expeditions began to harvest the fast rorquals (blue, fin, and sie) and took the hunters into the rich Antarctic areas where in the 1920's whaling was heavy enough to bring on the first fears of overexploitation. Baleen which is soft at birth, doesn't begin to harden and grow until the calf is weaned 6 to 10 months later on the feeding grounds.

Like other mammals, the whale mother ordinarily will not leave her baby in time of trouble. Early whalers sometimes used this knowledge to catch the mother by first harpooning the calf.

Ever since it was discovered from beached whales that the products were of sufficient value to justify hunting them, the whale had been an object of economic consideration. Oil was used as a fuel for lighting lamps, as a lubricant, and—depending on the processing

and the species—as a food, in the form of margarine and shortening. Whale meat, a favorite item in Japan, has a distinctive flavor very comparable to beef. Insulin was extracted from the pancreas for some years, but this is no longer done now that beef insulin has been found to be a better source. The Japanese process pharmaceuticals from the organs.

Ambergris, which is used as a fixative in fine perfumes, is found in the lower part of the large intestine of the sperm whale. For centuries in the Far East it was prized for its supposed aphrodisiac possibilities. Until the development of synthetic substitutes, ambergris was considered quite valuable. A story is told of a small whaling company which, about to go bankrupt, caught a sperm whale containing one of the largest lumps of ambergris ever found. The 1,003-pound chunk sold for about $70,000 and saved the company.

World War I did not give the whales even a brief respite, and the 1920's saw the beginning of whale processing aboard stationary floating factory barges. Fleets of catcher boats working from them could operate for long spells at a time. In 1930-31, 41 factory ships and 205 catcher boats took 37,500 whales. With 570,000 tons of oil on the market, the price plummeted, and whaling companies decided to set quotas to limit its production. This did not prove effective—new competitors, Japan and Germany, and new technologies, particularly powered factory ships, came into the business.

During the second quarter of the 20th century it became apparent that the faster whales—the blue, fin, humpback—were not being caught in the usual quantities. Even before then, it was suspected that the right whales and the bowhead were nearly wiped out. Those are the two that were so easily caught for so many years in northern Europe and Greenland. Concern was expressed, but the whaling continued relatively unhampered.

In 1937 the League of Nations set up an agreement protecting right whales, setting minimum lengths for blue, fin, humpback, and sperm and closing to pelagic whaling all oceans north of 40° S. latitude to the Equator. But by 1938 the catches were back up to the same tonnage of oil.

The five-year period of World War II might have provided a time of rebuilding the stocks of whales, but it didn't. Even larger whaling fleets were on the ways and ready at the end of the war.

In 1946 an international conference met in Washington, D.C., and the International Whaling Commission (IWC) was formed. The member nations agreed to meet annually and continued to prohibit taking of gray, right, and bowhead whales. Only a meager supply of information was available with which to determine the status of the stocks. Scientific data had been limited in years before due to the immensity of the oceans, lack of interest, and the difficulty of studying the habits of the migrant whales.

Even today, the migratory pattern of the sperm whale is not satisfactorily understood. It is known for example, that they move generally from warmer to cooler waters for feeding during summer, with the females staying in more temperate and tropical waters.

The 1962-63 Antarctic season showed the rapid decline in catch that had been predicted by a scientific committee of the IWC. The

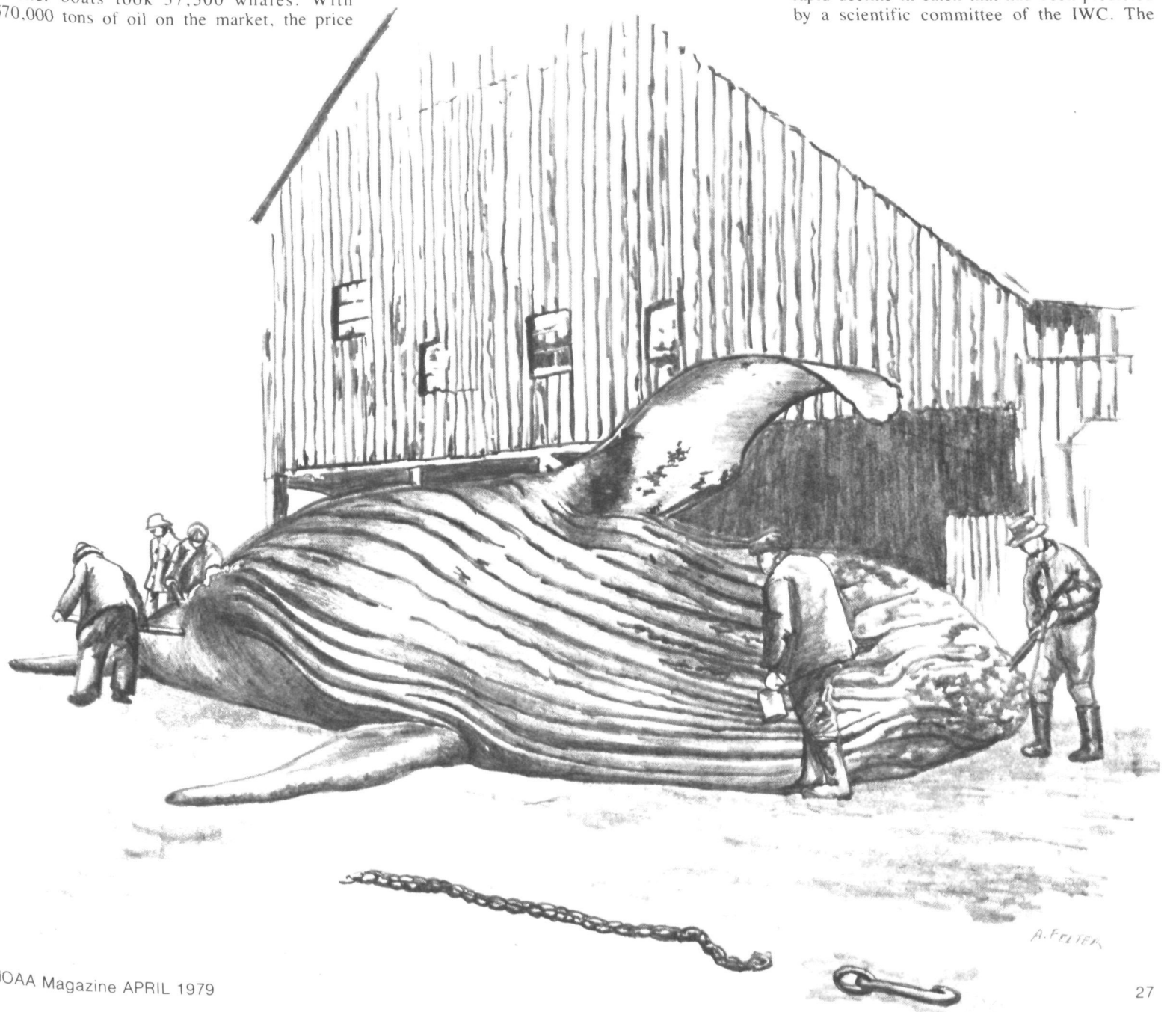


Table 1: Current Estimates of Whale Stocks

	Southern Hemisphere	North Pacific	North Atlantic	Total
Fin	84,900[1]	17,000[9]	10,000 (Central and Western only)	103,000+
Sei	20,000[3]	9,000	2,800 (Western only)	31,800+
Bryde's	No estimate	19,700 (Western)[3] 10,000 (Eastern)[3]	No estimate	——
Sperm—Male	111,300[2]	71,000[2]	22,000	628,700
—Female	299,400[2]	125,000[2]	(male & female)	
Minke	110,000[3]	No estimate	20–40,000 (1 of 4 stocks)	150,000+
Species Completely Protected by the International Whaling Commission (IWC)				
Blue (including pygmy blue whales)	10,000[4]	1,700[5]	scarce	12,000+
Gray	never there	11,000[6]	extinct	11,000+
Humpback	3,000[4]	2,500[5]	1,250[7]	6,750
Right	3,000[4]	250[5]	scarce	3,250
Bowhead	never there	2,264[8]	scarce (eastern Arctic)	2,264 948,764

Source (except were noted): Chapman, D.G. 1975. Estimates of Stocks (Original, Current, MSY Level and MSY) as revised at Scientific Committee Meeting June 1975. IWC Rep. 26: 44–51.

[1]SC/28/Doc 37 Estimate updated by Chapman and Breiwick at 30th Annual Meeting, June 1978, London, England.

[2]As revised by IWC Scientific Committee, 29th Annual Meeting June 1977, Canberra, Australia.

[3]As revised by IWC Scientific Committee, 30th Annual Meeting June 1978, London, England.

[4]IWC Scientific Committee Report. IWC Rep. 24, P.42. Based on sighting data of Japanese scouting boats—1973. No conclusion on probable trends.

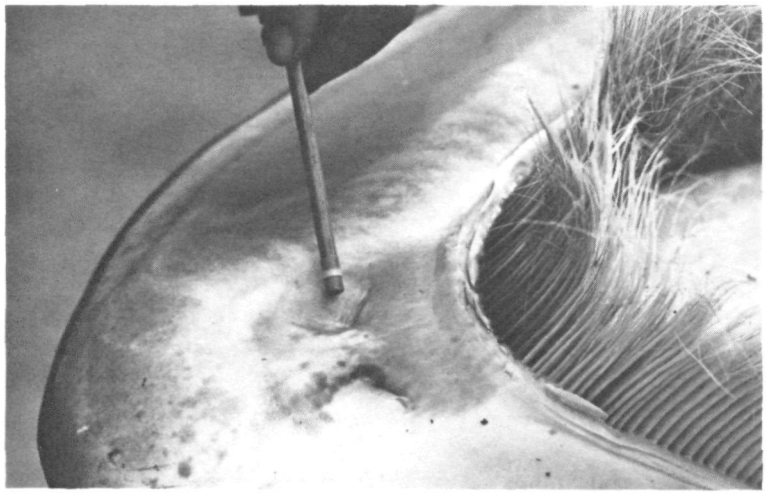
[5]Wada, S. 1976. Indices of abundance of large-sized whales in the North Pacific in 1974 whaling season. IWC Rep. 26: 382–391.

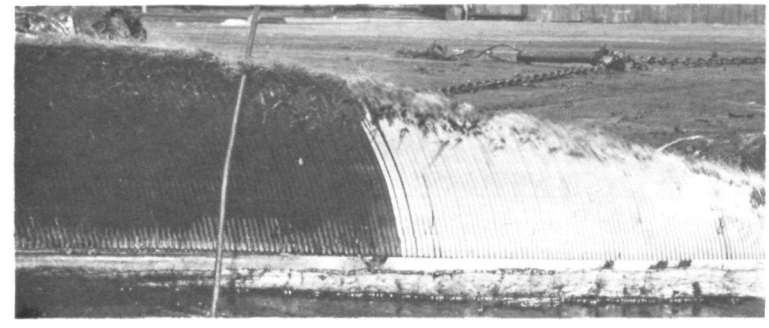
[6]Rice, D.W., and A.A. Wolman, 1971. Life history and ecology of the gray whale (*Eschrichtius robustus).* Amer. Soc. Mammal. Spec. Publ. 3. 142 p.

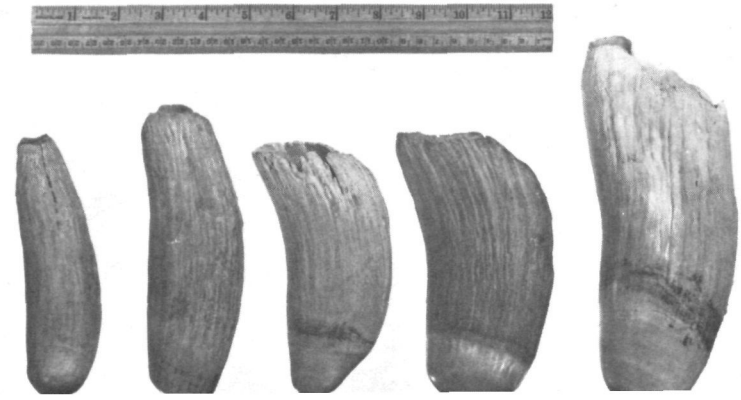
[7]Mitchell, E.D. 1973. Status of the world's whales. Nature Canada 2 (4). Based on census estimates over period 1966–69.

[8]A Special Report to the IWC on Bowhead Whales, U.S. Department of Commerce, NOAA, June 1978.

[9]Estimate for 1976. Allen, K.R. 1977. Updated estimates of fin whale stocks. IWC Rep. 27, p. 221.







Photos at left and right above show portions of finback whales; at left, a female, with pits just within upper jaw believed to have function related to detecting odors in the water; right above, baleen of male. Photo at right below shows sperm whale teeth.

work of the committee eventually led to an IWC prohibition against the catching of blue and humpback in 1966, leaving only the sperm, fin, sei, Bryde's, and minke whales available to the hunters.

Maintaining whaling fleets has always been an expensive proposition. When IWC quotas were reduced in the 1960's, lower profits resulted, and some of the great whaling countries, such as Norway and Britain, dropped out.

By 1968-69, the Soviet Union and Japan were the major contenders in the business. The United States, engulfed in concern for various species depleted by man, included eight of the great whales on its endangered list. The United States closed its whaling industry in 1971 and banned importation of whale products into the United States in 1972.

In 1971 Congress passed the Pelly Amendment, which gave the President the right to embargo fishery products of a foreign nation that conducts fishing operations detrimental to the effectiveness of any international regulatory board such as the IWC. Use of this right was seriously considered in 1973 when Japan and The Soviet Union decided to exercise their right under the Convention to object to certain quotas that they felt were too restrictive. They set their own quota and took nearly 8,000 minke whales, an excess of about 3,000 whales over the IWC agreed quota.

However, under the threat of the Pelly Amendment, the two countries took a more amenable position during the 1974 IWC meeting and neither country has objected to any quota since 1973.

Nations that have traditionally hunted whales, such as Japan and Iceland, have argued against a United States proposal for a general 10-year moratorium on whaling, on the grounds that regulation should be done by individual species and stocks. However, because of a 1975 compromise, a modified moratorium has been set up to take effect for any stock of whales when its numbers drop below an IWC predetermined level.

Although a large number of whales have been taken in past years, current estimates indicate that close to a million now inhabit the oceans. Not all species of whales are threatened, therefore, but certain ones are.

Statistics from some research efforts suggest that the blue whale population has not yet shown a significant increase, but evidence indicates that the small South African right whale stock is rebuilding and the gray whale has shown a definite if not complete recovery. A moratorium on commercial taking has been in place on gray, right, and bowhead whales ever since the first international agreement came into being in 1935. Controversy remains over whether or not the bowhead should still be taken by native people in Arctic areas long accustomed to this traditional hunt.

Noting the increasing number of whaling crews, the unregulated nature of this hunt, and the increasing problem of whales being struck and lost, the IWC banned the hunting of bowheads in June 1977. However, in December 1977, the United States described the role of the bowhead whales to the social, cultural, and nutritional needs of the Eskimo communities, and presented a detailed conservation plan that persuaded the IWC to permit a regulated hunt in 1978 in which 12 whales could be landed or 18 struck.

At the 30th annual meeting of the IWC in June 1978, the United States presented a new population estimate of 2,264 bowhead whales in the Bering Sea stock. Based on this thorough scientific assessment, the IWC increased the 1978 quota to 14 landed or 20 struck, and set a 1979 quota of 18 landed or 27 struck.

In addition, under the impetus of findings by the scientific committee and support from the U. S. delegation, at a special IWC meeting in December the quota on sperm whales, which in 1978 had been 23,700, was reduced to 3,800, and other quotas were further reduced. "The achievement was real." said Richard A. Frank, U.S. Commissioner to the IWC, "but we still have far to go. People who want the whales saved cannot be complacent."

It is a slow process, but whaling on a large scale appears to be coming to an end. With careful monitoring, the moratoria, and continuing support from the United States and other nations for greater restrictions on whaling, the stocks should continue to rebuild. Nor is it likely that we shall ever see the large scale pelagic expeditions again. Content that this phase of history is over, we shall nevertheless keep our heritage of picturesque places like New Bedford and Nantucket, Mass., which blossomed during the 18th and 19th centuries, and appreciate novels such as *Moby Dick* and the other great stories and pictures of the era of sailing ships and weathered whalers. □

Table 2 Bowhead Whale Catch Statistics

Season	Landed	Struck & Killed	Struck & Lost
1973	37	0	10
1974	20	3	28
1975	15	2	26
1976	48	8	35
1977	29	3	79

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poisson grand : qui est certes vn grand secret, & curiosité digne d'estre imitee, veu que les anciens, quelques grands recercheurs qu'ils ayent esté, ne l'en sont onc dõné garde, comme moy, voire ny les modernes, quoy qu'ils ayẽt fait profession de nous escrire & monstrer l'histoire des poissons. La femelle de ceste Belüe ne fait iamais qu'vn petit à la fois, lequel elle met hors tout ainsi que fait les Quadrupedes, sans œufs, au rebours du naturel de tout autre poisson. Au reste, la Baleine alaite son petit Balenõ, apres qu'il est dehors : & pour cest effect elle porte des mamelles au ventre soubs le nõbril : ce que ne fait aucun poisson, soit en mer ou en eau doulce, si ce n'est le Loup marin, ou le Comiaco, poisson fort grãd, qui se prend en la mer rouge, & au grand lac d'Alexandrie d'Egypte. Et de telle espece me suis trouué auec bõne compagnie d'Arabes qui nous estoient domestiques en prendre plus de cinquante pour vn iour, & quelque autre de qui i'ay fait mẽtion cy deuant. Au reste, la Baleine c'est vne beste d'vne dangereuse rencõtre pour les nauigans, à cause de sa monstrosité, ainsi que sçauẽt bien les Baionnoys, & Espaignols, qui l'experimentent souuẽt, & qui font mestier coustumier de les prẽdre, auec certains instrumens & machines, desquels ils la ferissent, & estant blessee la poursuyuẽt auec quelques moyens vaisseaux iusques à ce qu'elle aproche la terre & soit morte, où lors elle est cramponnee & tiree pres de terre: & alors Dieu sçait le peuple qui est emploié à la mettre en pieces, & en remplir plusieurs vaisseaux: & de la chair & gresse de laquelle ils trafiquẽt auec les estrangers, comme vous voyez par ce present pourtraict qui vous appert cy dessus. Et à ce propos me souuient, que lors que i'estois vers l'Antarctique, aduint qu'vn marchãt, lequel passoit sur son basteau d'vne terre en l'autre, auec quatorze mariniers, pour trafiquer, il fut submergé par la rencontre de cest animal marin, qui at-

VVVVV

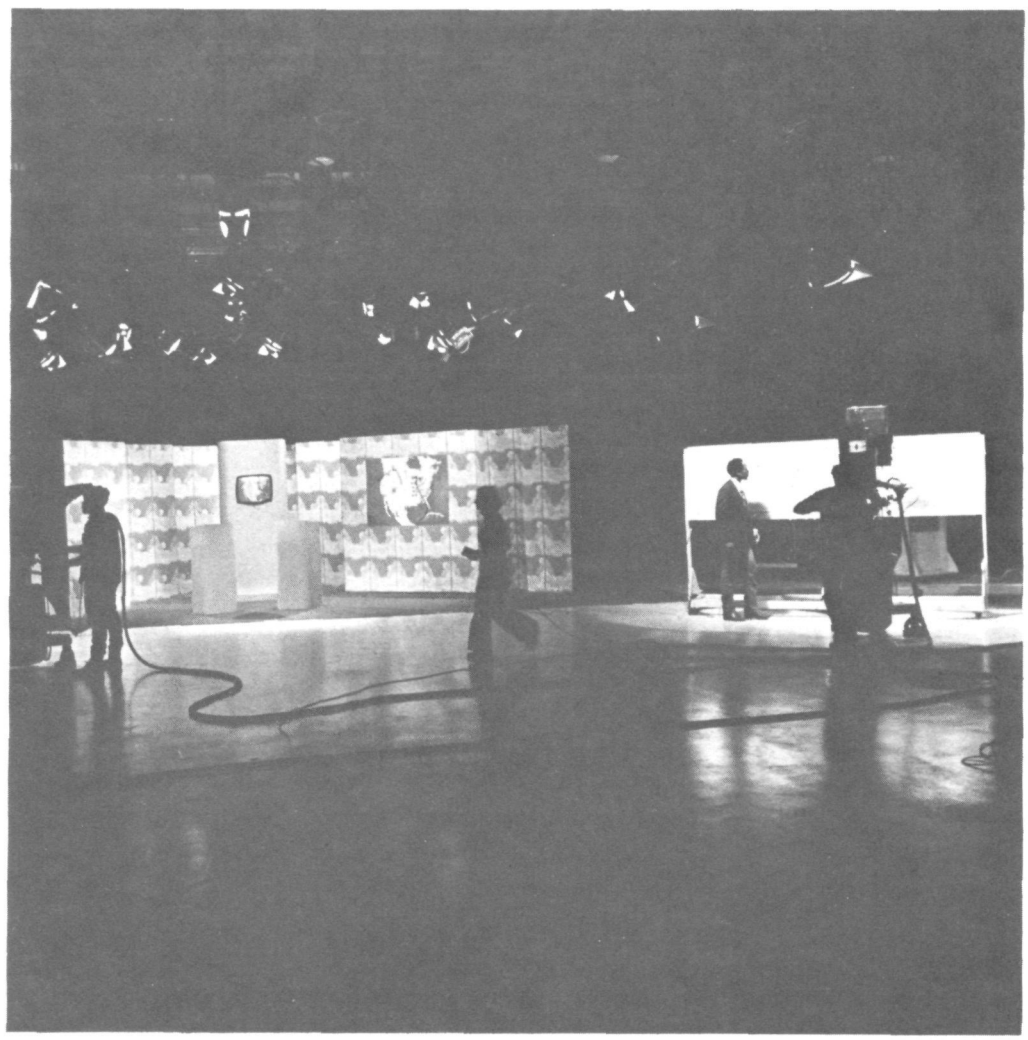
Comme on prend la Baleine.

Engraving (above) from 1887 publication of U.S. Commission of Fish and Fisheries shows boat fastened to whale by harpoon and line while whaler prepares to kill the animal with a bomb-lance. A French book dated 1575. contained description and illustration of fishermen cutting up a whale for various by-products (right).

Credit: Library of Congress

Your morning TV weather report

NOAA's Early Bird Special



Rich Warren lines up a television camera during the production of the popular satelite loop segment of A.M. Weather. The show's performers help with production chores whenever they can.

At right, the show is underway. Mike Tomlinson has just finished one segment of weather news and readies himself for his next stint as floor manager Karen Bond moves quickly to cover Rich Warren at a similar map board to the left of the main set.

Photos: John Roseborough

"A.M. Weather," a nationally televised program devoted exclusively to weather news, is carried by about 200 Public Broadcasting Service (PBS) stations from Maine to California. The 15-minute, early morning show, funded by the Federal Aviation Administration and the Aircraft Owners and Pilots Association's Air Safety Foundation, is designed to assist pilots in flight planning and to help insure flight safety. But an increasing number of non-flyers are finding the weather information useful for daily planning. Early risers across the Nation have become avid A.M. Weather watchers.

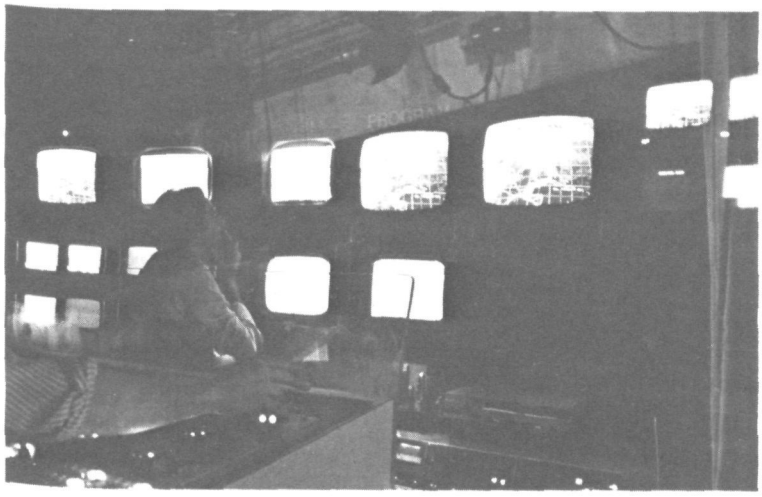
The program's "stars" are three NOAA meteorologists, Rich Warren, Mike Tomlinson, and Dale Bryan, who, up until the show's beginning last October, had practiced their trade in a more traditional way.

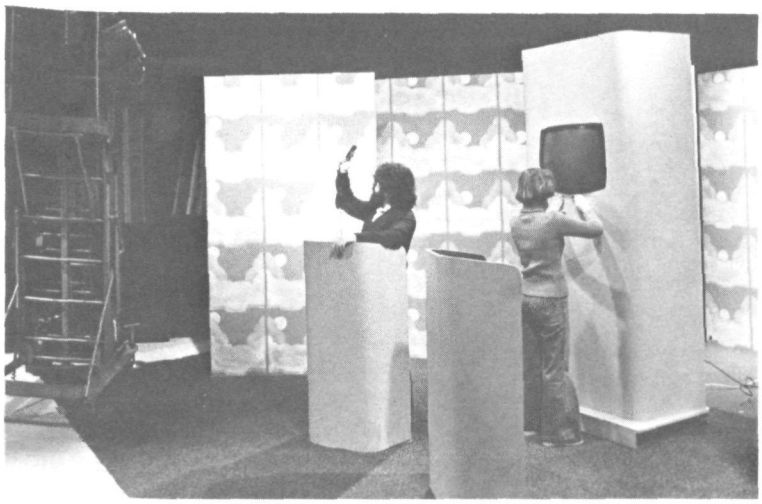
NOAA Magazine visited the Maryland Center for Public Broadcasting to watch these men at work, looking, perhaps for a little of the glamour of television. To be sure, the jargon and tools of the trade are rather exotic, but we found that for every minute of "show biz" there are 40 minutes of demanding work off camera by a staff of dedicated professionals.

The Maryland Center for Public Broadcasting is in the rolling countryside out north of the Baltimore Beltway, not really "in" Owings Mills, though that's the Center's address.

Bumping and winding out Bonita Avenue, the visitor watches carefully so as not to miss the driveway in the dark. It's always dark when the A.M. Weather staff gets to work—an unending series of graveyard shifts, Monday through Friday. The drive circles up to the

By CHARLES G. THOMAS





Clockwise from left, last minute preparations to the A.M. Weather set include adjustments to studio lighting and a television monitor; Rich Warren and the show's producer/director Doug Clark, watch a pre-recorded tape on control booth monitors; and Warren and Tomlinson get ready for a rehearsal.

modern, stone facaded building, its handsome reception area and front offices unlighted at this time of the morning, and then around back. Around back it's different.

It's not unlike the set in a television studio. Behind the impressive front lies the nitty-gritty of the operation. Like a studio set with tangled cables, unpainted flats, and sweat-shirted technicians just out of the public's view, here out of sight of the main driveway in a super-size trailer a show is being put together.

The trailer has been tacked on to the main building with a boardwalk floor and enclosed walkway and a promise of better quarters when a new building goes up next year.

The main area is almost filled by a long work table at which both meteorologists and artists work. The rest of the trailer is taken up by two small offices for the production staff and a room devoted to the teletypewriters and facsimile equipment that bring in the pounds of meteorological data which are distilled into the 15-minute television show.

There are three NOAA meteorologists on the A.M. Weather staff but only two work each show.

It's 3:00 a.m. Three artists, Jerry Pilachowski, Alvin Jasper, and Ken Schroder wait around the work table for Mike Tomlinson of the National Weather Service who is roughing in features of a weather map he has torn off the nearby facsimile machine—strengthening important features by marking with a crayon over its washed-out sepia lines. In a back office, producer-director Doug Clark reads mail. Tomlinson finishes his map and tosses it to Pilachowski, the head artist, who checks it over briefly and then assigns it to one of the other artists who immediately begins tracing the features on an acetate base map of the U.S. At his disposal are art-type paste-ons with numbers and special weather symbols.

Shading is added with patterned transfer sheets.

It's 3:30 a.m. The Weather Service's Rich Warren, slightly wet but cheerful, bursts in. It has started to rain and some of the artists wonder if it could become snow on that cold January morning. Warren confidently predicts absolutely not. He sits at the work table and begins to analyze a map, drawing in prominent features as Tomlinson is doing. The meteorologists and artists work quickly. By air time there will be as many as 15 different maps to illustrate the Nation's weather. As the show has a segment slanted toward aviation, many of the charts are for winds and turbulence high in the atmosphere. There are current and forecast charts (called progs, short for prognoses) all carefully put together with isolines, colored transfer sheets and ready-made symbols.

There's chatter about the table as the work progresses, mostly about the success (or failure) of the day-before forecast.

"Bad on the temperatures here and here," says Warren. "We looked at that the day before . . . two warm fronts chugging along. One's got to disappear, right?"

Tomlinson gives him the expected answer to his rhetorical question: "Still there?"

"Right," says Warren with a rueful head shake. "Hey, look at that. It says it's freezing in Atlanta right behind that front. Do you see that?"

And so on, as they crank out map after map and pass them to the artists. A radio plays in the background. Doug Clark rambles out of the back office and shows a visitor a big stack of mail on the work table. "Over 6,000 letters since we started A.M. Weather a couple of months ago," he says. "Of course they aren't all fan mail. We make an on-the-air offer to send viewers a kit of information if they'll write. But 6,000 letters shows they're out there watching us and most of them have something nice to say about the show too. These weather guys seem to have something more than tremendous sex appeal."

Amidst guffaws from around the room, Warren chimes in in a semi-serious vein:

"I think they may recognize that the weathercaster is really putting a lot of himself into the show. I mean, the news anchor looks at his prompter copy. He reads it verbatim. The biggest thing he has to worry about is the floor director saying, 'Camera three,' and then on the next story, "Camera four," and he's looking this way and then back that way—back and forth. The sportscaster is the same way.He's got teleprompters. He reads everything he says. But the weatherman . . . you're winging it.

"I call it one of the toughest jobs of all the so-called talent on a news show. Because the weathercaster is a performer."

Maybe so.

It's 4:00 a.m. As Tomlinson continues with the map products, Warren sits at a light table and prepares to put together the daily satellite loop.

"What we do is start with picture number one—our first picture from last night, 2130 Zulu it should be . . . (Warren says "twenty-one thirty" in the language of the 24-hour clock, which starts normally enough through the morning hours, but after noon continues logically into thirteen instead of 1:00 p.m. fourteen, and so on, to 2400, twenty-four hundred, at midnight.

He riffles through a pile of films, each about as big as a sheet of typing paper. Printed on each is a satellite image of most of the Earth's northern hemisphere received from NOAA's Geostationary Operational Environmental Satellite. The shots, taken a half hour apart, show vast areas of cloudiness over the North American continent.

Warren takes the earliest shot and lays it on a light table.

"These are actually negatives," producer Clark says as he and a visitor watch Warren. "The negatives are easier to register and we have a device on the television camera so we can reverse the polarity of the camera to make them come out right when we shoot them for the show."

Using the earliest picture as a base, Warren proceeds to line up subsequent pictures as exactly as possible so that when they are edited into an animated picture the Earth disc and land masses will appear stationary and the only movement from frame to frame will be in the clouds. The lining up is not as easy as it might seem.

"Now with the number two picture—the 2200 shot—we lay it over the first picture and start looking for some features that are recognizable so we can register them. Then we do the same thing with each subsequent picture, registering number three with number two, number four with number three, and so on.

"Today there's not one heck of a lot here that's recognizable," Warren frowns. "I see a river—the St. Lawrence Seaway up here. That's something. And this could be the Gulf of Mexico coastline. Nothing else is a very good lineup at this point. So let's see what we can come up with. Let's match this river and the Texas Gulf coast . . . this isn't working. We're going to have a problem today. There aren't many clear cut features here. Wait a minute: We've got Hudson Bay and that may save us. These were made fairly early when the Sun was still out yesterday. Now when the Sun goes down . . ."

Warren stops in mid-sentence, a grin spreading over his face. Now, patting his hands in a syncopated drum beat on the table he begins singing . . . "When the Sun goes down, and the Moon comes out . . ." It's infectious and soon the artists, producer, everyone in the room joins in ". . . people gather round, and they all begin to shout, Hey, Hey . . ."

When order is restored, Warren continues. "After the Sun goes down and the Earth starts

Warren and Tomlinson share a light moment in the A.M. Weather production trailer. Their easy-going approach to the show masks a dedication to their work.

cooling off, a lot of these features start showing up better and they're easier to register."

Warren continues with the laborious job of lining up the satellite images—25 negatives covering a 12-hour period which will only run about 25 to 30 seconds when the finished product is shown and repeated once on the show.

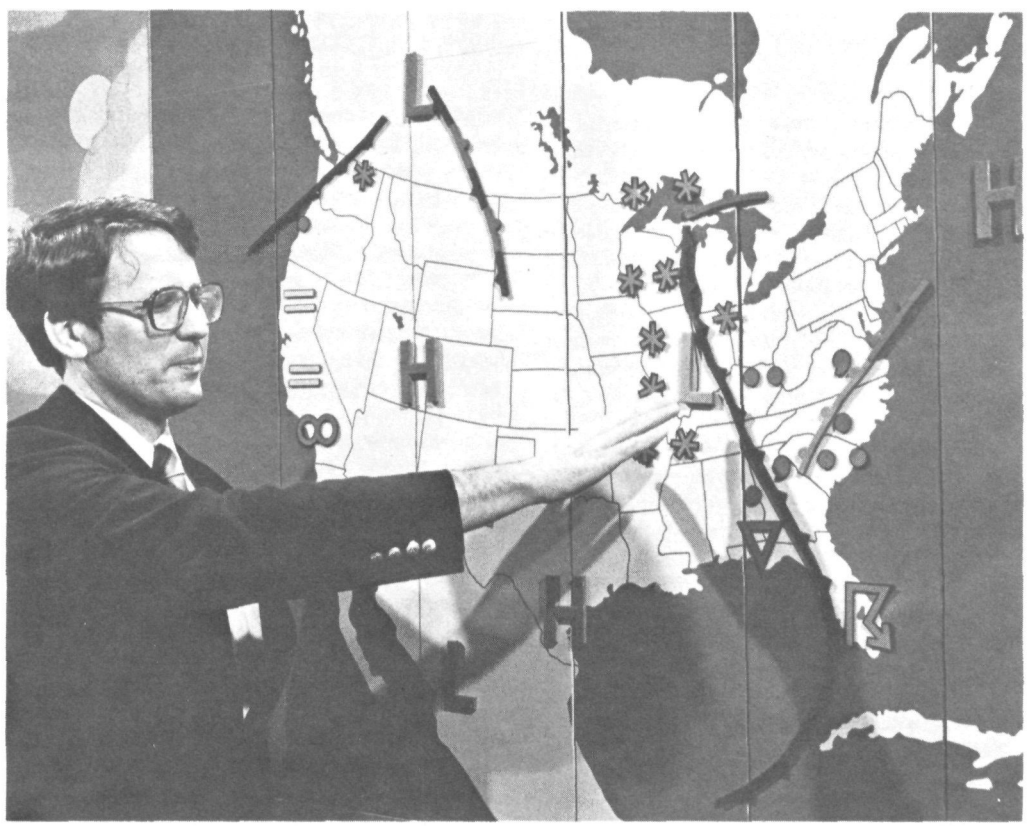
It's 4:30 a.m. Tomlinson is checking the material feeding into the small room filled with teletypewriters and the Laserfax which brings in the images from the satellite.

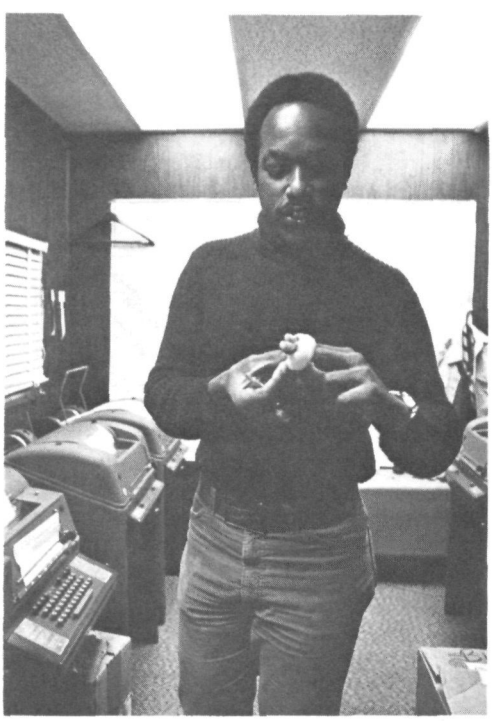
There's barely room for Tomlinson and a visitor who asks how a person with degrees in science, chemistry, meteorology, and oceanography gets into show business.

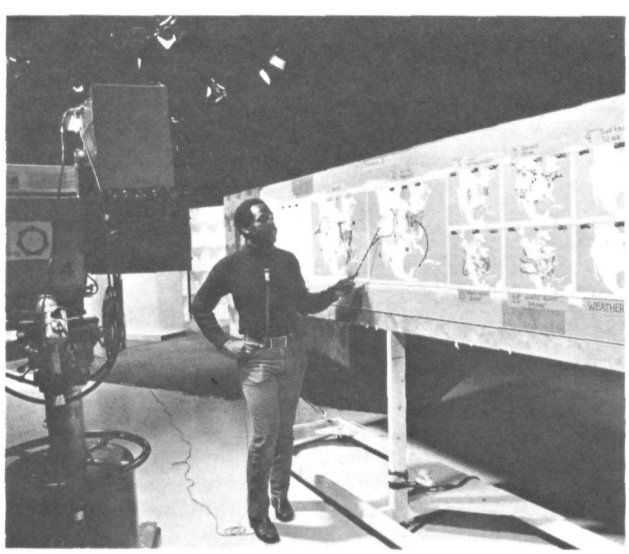
"It's partly the challenge. Overcoming nervousness, developing self-control, that sort of thing. I had some experience in broadcasting before I came to the A.M. Weather show. I worked for a couple of months as a meteorologist in commercial radio up in New York before joining the Weather Service. Then I worked with Dr. Frank Field of WNBC-TV on how television weather presentations are made. So I jumped at the opportunity when the spot opened up down here.

"I see A.M. Weather as a great way to educate the public on what's probably one of the most misunderstood sciences in the world," Warren chimed in. "We do it a little at a time. Maybe just instilling the meanings of the terms 'Watch' and 'Warning' as they're used by the National Weather Service is enough for a start. Maybe the science will come later. We're working on two levels here. One right out front and the other quite subtle." He peers out of a window into the still pitch-black night. "Here it comes. Looks like a real frog-strangler!"

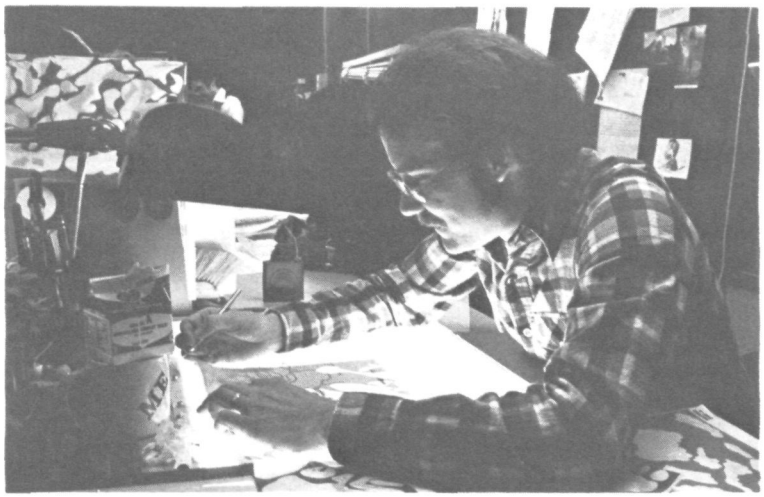
It's 5:00 a.m. A torrent of rain roars on the makeshift roof of the corridor leading from the A.M. Weather production trailer to the main building. Rich Warren, carrying the carefully aligned Laserfax satellite film images, makes his way to the studio where they will be "shot" one by one—the images recorded for later playback—in much the same way that animated cartoons are produced. Most of the building is still dark—it's some hours before the regular office staff is due to arrive—but along his route he passes lighted rooms filled with electronic equipment that almost defies description to the layperson. There are "things" (how better to describe them?) that look as though they were taken from the bridge of the Starship Enterprise—banks of electronics floor to ceiling, incredibly complex to the eye, esoteric stuff with names like multiplexer and film island, hundreds of small



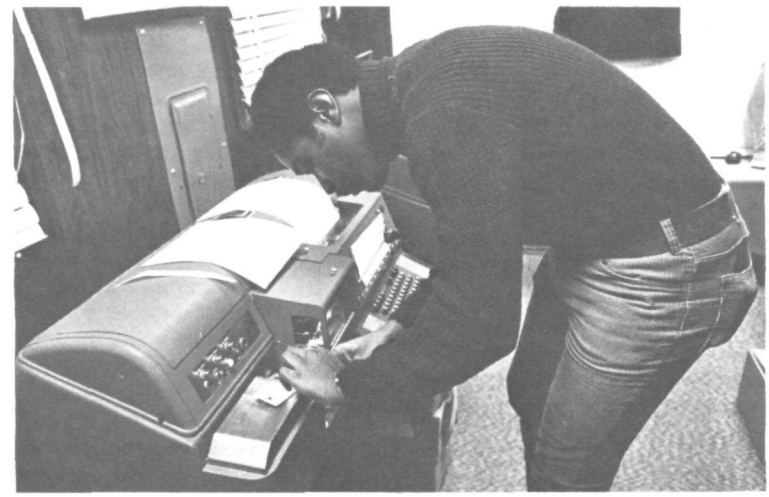




Clockwise from left, Mike Tomlinson at rehearsal and in the production trailer; Rich Warren talks about the educational aspects of the show; and Dale Bryan tells viewers of a snow situation in the Midwest.



A.M. Weather art director Jerry Pilachowski prepares one of the maps used on the show at a light table. He is shading an area with the aid of a transfer sheet.



Mike Tomlinson adjusts the tape on a teletypewriter machine which brings the latest National Weather Service information directly to the A.M. Weather production trailer.

television screens showing test patterns in lines and columns and all shades of the rainbow.

Warren stops at an almost empty studio and hangs his satellite images on a chest-high panel. He swings around and off-handedly rolls a television camera into place, using various handles and levers to shift its height, zoom, and focus. A station camera operator takes over, and Warren moves to the control booth to check the taping with the show's director.

Warren's easy familiarity with the equipment is not surprising when you consider that before he came to the A.M. Weather show he was a senior instructor on the Weather Service's Automation of Field Operations and Services (AFOS) program. AFOS is designed to speed up weather office operations through the use of minicomputers and television-like displays. Warren also has presented weather reports on a show called Up On The Farm, a half hour weekly program also aired by the center for agricultural interests in Maryland.

"I'm about 98 percent ham," Warren says immodestly. "That's how I got into this business. When I see that little red light go on (a signal light telling the performer that a camera is "on"), I get a tremendous buzz. I love television.

"Starting out, I prepared for it. I went to broadcasting school, and I took every chance I could to make video tapes. Any kind of exposure I could get I got into. It worked—I got the job."

"A.M. Weather was an idea whose time had come. Everybody was into it and really pushing for such a show. There was the Weather Service, the Federal Aviation Administration, the Aircraft Owners and Pilots Association, the Maryland Center—all of these showed a tremendous amount of enthusiasm and got this show on the road.

"The public needs to gain a bit more understanding of what a forecast really means. We may come up with an excellent forecast, but quite frequently the interpretation and how it gets to the public leaves something to be desired. The meteorologist may be talking on levels that are quite beyond the understanding of the average person. There may be a lot of emphasis on 'probability' or 'chance of snow.' Now what do those terms really mean? We tend to throw them out indiscriminately, but they really don't give much detail. I feel that we need more communication between the meteorologist and the public. This is basically what A.M. Weather is all about. It's to try to give an accurate look at the weather and our best estimate of what's going to happen in simple, easy to understand language—and I don't mean we have to talk down to the people. Regular viewers will soon become knowledgeable about meteorology without knowing how it's happening. They may find themselves saying, 'Oh, there's that low pressure center. Mike and Rich have been talking about its being associated with an upper-level low pressure trough moving through.' They will understand, through having heard it a number of times, that surface systems are associated with upper-level systems. Our 3-hour preparation is important, but one 15-minute presentation is everything."

It's 5:30 a.m. The rain has not let up and some late (or early) arrivers at the station are talking of flooding on some of the country roads leading to the station. The pace is quickening a bit. There's no sign of nervousness, but people move just a bit faster. In the A.M. Weather trailer, the artists are putting the finishing touches on the last maps. Singly and in groups the maps are carried to the studio containing the A.M. Weather set and carefully hung in place. The studio is the largest of three at the Maryland Center for Public Broadcasting.

All activity is centered on the weather show's set. It's bathed in bright light as a technician is rolled around on a high, wheeled scaffolding to adjust dozens of lights suspended from rails near the ceiling. Directions come from the lighting director, who moves here and there about the two small speaker's stands that flank a central column containing a television monitor. The background is a series of blue flats patterned with stylized yellow suns, each partially hidden by pale blue clouds. To the right and left stand the chart boards, which are rapidly filling with the day's weather maps. Only the space needed is used and the weather setting seems to end abruptly after its 26-foot wide by 8-foot high limits.

There are no star-on-the-door dressing rooms for the A.M. Weather performers. Warren goes to the men's room to apply makeup. Tomlinson is working on last minute changes in the Weather Watch portion of the show which highlights areas of possible severe weather around the Nation. There's a rehearsal set for 6:15 a.m.

It's 6:00 a.m. Tomlinson asks if he has time to make up before rehearsal. Make up includes dressing up a bit too. Both meteorologists will change from casual clothes to pastel dress shirts (white won't do; something about the television lighting), neatly knotted ties, and matching conservative sport coats.

All of the display maps are finished by now, the satellite loop is ready, and Doug Clark moves into the studio control booth—from there he will direct activity on the set, making the final decision as to just what will go out on the air to A.M. Weather viewers. Art director Jerry Pilachowski is in the booth looking at the monitors to see if there is any problem with the art work as it is actually seen by the television cameras. Kathie Ferrari, the show's project assistant, sits at a desk with stop watches and timers, talking on an intercom system with the station's engineer several rooms away. Rene Diggs, the show's sound technician, sits in front of a panel with scores of knobs and switches, her fingers moving quickly here and there making tiny adjustments as she watches a long row of dials whose needles flicker with each live or recorded sound produced by the show.

Rehearsal starts promptly at 6:15 a.m. Tomlinson is in his makeup but hasn't had time to change clothes and appears in corduroys and a sweater. But dress isn't important this time as the run-through is for timing and technical purposes. If the meteorologists

fluff their lines there is laughter and aside remarks to the camera operators. All in all the rehearsal runs smoothly.

Now there are a few minutes for left-over details. Tomlinson rushes to the dressing room while Warren talks over some timing problems with Clark. One studio camera is wheeled to an open delivery bay and pointed at the rain splattering on the blacktop outside. The camera will stay there throughout the morning, the rain scene being used as a background for introductory titles.

Suddenly, it's almost time, and everyone tightens up a bit. It's not nervousness, but rather a sense of getting control—the deep breath of the basketball player at the foul line before shooting.

Then everything is ready. Clark and Diggs are in the control booth, the camera operators have lined up their first shots. Warren and Tomlinson strap microphones around their necks and wait at the set lecterns.

It's 6:44:30 a.m. ". . . and we're on slate," says Clark. "Ready black, and . . . Black! Ready with the countdown, ready VTR Number 3. Start 3, please. Mike will do the tease? All right, Mike's the one. Sound 3 . . . up on it! Ready with some music, ready Camera 1 . . . and Music! Sound 1! Mike: Cue!"

"Heavy rains invade the East; some severe weather could be in store for Florida. Details this morning on A.M. Weather." Mike Tomlinson's "tease" read over the show's opening theme music begins a quarter hour of nonstop action unseen by viewers.

The show's format is unvarying. The meteorologists take turns with each segment of the program.

A National overview of the weather, the satellite loop, the radar report, the 12-hour surface level forecast . . . Floor manager Karen Bond, the control booth's link to the performers, scuttles back and forth from one side of the set to the other, dodging cameras, hopping over cables. "Speed them up," the control booth says, and, standing just out of camera range, she signals the performer. "Five minutes," the control booth says, and she shows the performer a little flip card reading "5 MIN."

Today's high and low temperatures, 24-, 48-, and 72-hour surface forecasts, flying weather—current and forecast . . . In the control booth, Clark sits behind an instrument panel, his hands flitting over the buttons, levers, and switches. He seems to play them by touch much as an organist, now looking at the stage set through the booth's soundproof glass, now sweeping his eyes across the battery of television monitors which line the wall in front of him, keeping up an almost continual chatter into his headset, talking, cajoling, demanding in a stream-of-consciousness monolog to his floor manager, camera operators, sound technician, video engineer. His directions are almost lyrical. When he orders a slow fade, he carols, "Deee-sollllve" in a dissolving tone of voice. He shifts the "outgoing" picture from camera to camera using fades and wipes, he brings up the music, he speeds up the pace, he starts and stops everything, moving along electronically to produce a show exactly 15 minutes in duration with all of its elements perfectly blended.

Winds aloft at 5,000, 10,000, 18,000, and 34,000 feet . . . And now, with only a few minutes left, they wind it down.

The giveaway announcement (22 seconds), Weather Watch and National recap (1 minute), close (40 seconds "Say goodby, gentlemen.") the funding credit and the A.M. Weather logo (20 seconds), and finally a local (Maryland) weather summary by an offcamera meteorologist (50 seconds) . . . "Ten, nine, eight," Clark's countdown is echoed on the fingers of Karen Bond waggling in front of the meteorologist reading the local forecast. "Seven, six, five, four." Clark's finger hovers over a button which will signal the show's end. "Three, two, one." Incredibly, the last word of the presentation falls almost exactly as time runs out. But it isn't coincidence, it's practice. "Okay, we're away," crows Clark,and the first show is over.

And now they all troop back to the production trailer. There's time for breakfast. They can relax. The first show was taped and will be rebroadcast at 7:45. Then they've got to do another live show at 8:45 with a slight western bias. That one's repeated at 9:45. So an early morning A.M. Weather show is presented for each time zone. But, for now, the pressure's off. With another rehearsal before they go live again they've pretty much got the hard part licked.

Dale Bryan of the National Environmental Satellite Service meets them back at the trailer. It's his "administrative" day and he's dropped in on his way to the World Weather Building to pick up some data. On the days he is not actually doing the show, Bryan works on new ways to present satellite data effectively on television. He stays behind as the staff go roaring off into the still-heavy rain to find breakfast.

It's growing light now as Bryan talks of a notice passed around the Satellite Service telling of the show and inviting those interested to take a screen test.

"Rich talks about being a ham and all that, but I don't think that's it. We're all really interested in the educational aspects of the job. I don't think I'd go for a commercial television position but this public broadcasting sounded interesting, and it was a new experience, something I hadn't done before. It wasn't the ham but, rather, the educator coming out when I tried out for A.M. Weather."

And now that the show has been on for a while and seems to be meeting with a certain amount of success, what directions might it take, a visitor asks?

"Well, of course, it isn't up to me, but I'd like to see a weekend weather show. We're only on five days a week, but the weather's there all of the time. There's a big potential audience for a Saturday and Sunday show. Then we've all thought about a P.M. Weather show. Maybe an evening program on the next day's weather would help people who don't want to get up in the morning only to be told it's going to be a rotten day and they might as well go back to bed. And we carry features when it's a really quiet weather day, but if the show were expanded to a half/hour, we could spend more time on weather details and maybe run some educational stories, too. Or we might go into other areas than our present aviation weather specialty. The Agriculture Department has expressed some interest in our type of show. We've had a lot of letters from farmers, so we might put up some charts for farming operations."

Rich Warren carefully lines up a satellite image with landmarks on one below it during the preparation of a satellite loop which will show a "movie" of cloud motion over the Nation.

He gestures to the large pile of mail lying on the worktable waiting to be answered. This is "viewer response," and it tells even the casual reader something about the A.M. Weather audience and what it thinks of the show. Some samples:

"I use your show as a private pilot, and just for general weather information. You have a great program."

"I am president of a flying club. Your program helps me advise students, and helps me plan our schedules."

"We appreciate very much your program. We are farmers in the Arkansas River Valley and your information is most useful to us. Also, my husband is a private pilot."

"I watch your show before flying. It takes some of the work load off the local Flight Service Station, as the pilot already has synopsis and winds aloft information plus the likelihood of significant weather. A good way to start your flying day."

"A.M. Weather is an excellent briefing and we use it every morning prior to launching our Nationwide charter flights."

"Many pilots are viewing it as we live in an area with unusual weather due to the 'lake effect.' I am certain that you are saving lives with your comprehensive presentation."

"I've found A.M. Weather not only useful in flying, but also very educational. By watching as often as I can, I continue to gain a better understanding of weather systems."

And there it is! Information and education. The reason given by all three meteorologists for getting into television weather. This is the sort of response that must ease the burden of A.M. Weather's early-rising staff. Maybe all of those graveyard shifts are paying off.

The rain has slacked off and it's full daylight when the A.M. Weather crew returns for the next show. □

State CZM programs after five years

Progress on America's Coasts

By CAROL SONDHEIMER*

In just five years, coastal zone management programs covering nearly one-third of the Nation's shoreline and almost half of its people have been planned, approved, and put into action. Before 1979 passes into history three-quarters of our coasts will be covered by State programs approved by the Secretary of Commerce on NOAA recommendation.

The accomplishments of the coastal States and territories are significant and real. They are a reflection of the basic soundness of most of the principles contained in the Act.

As of early 1979, 13 States had approved coastal management programs. By the fall, another seven to eight States are expected to have approved management programs. Fully 75 percent of the Nation's shoreline will be covered by Federally approved management programs at that time.

But these figures alone tell very little about the quality of coastal management. What, in fact, do these programs do?

While it is still too early to make a full assessment of the effectiveness of the programs being approved—the average approved State program has been in effect less than a year, and a good number of programs are yet to be approved—it is not too early to make a preliminary assessment of what State programs already are doing in terms of substantive management results.

There are four major areas where substantive results are expected. Foremost among these is protection of significant natural resources such as wetlands, beaches, dunes and barrier islands. Second is minimizing loss of life and property resulting from improper development in floodplains, erosion-prone areas, areas of subsidence and salt water intrusion, and promoting better management by giving priority to coastal-dependent development and by dealing with energy facility siting needs. A third major focus of the Act is on increasing access to the coast for recreational purposes, including the protection and restoration of historic, aesthetic, and cultural resources. Fourth, there is an emphasis in the Act on increasing inter-governmental cooperation and coordination, with an expected result in greater predictability and efficiency in public decision-making.

Photo: Bob Williams

In terms of protection of significant natural resources, an initial review by the Office of Coastal Zone Management shows the following:

Twenty-three of the 35 eligible States and territories have new wetlands statutes and regulations, or have improved the implementation of existing laws designed to preserve wetlands.

While the enhanced implementation, through CZM funding, of existing wetlands statutes such as Oregon's is impressive and certainly worth noting, even more impressive is the enactment of new wetlands laws or the issuing of new regulations directly attributable to a State's participation in the national CZM program. For example:

- For years, bills aimed at tidelands management were introduced into the South Carolina legislature; all failed. In 1977, however, the South Carolina Coastal Management Act passed with only a single dissenting vote in each house. It is stronger and more comprehensive in tidelands protection than all the previous bills that failed.
- As a condition of program approval, the Massachusetts Executive Office of Environmental Affairs issued rules and regulations to carry out the Commonwealth's Wetlands Protection Act and Coastal Wetlands Restriction Act. They are critical to implementation of these Acts, but were delayed for 5 years previously.
- The 1976 Alabama Coastal Act required rules and regulations to protect wetlands and submerged grassbeds—the first effort of this type in the State. Such regulations have been drafted. They prohibit all activities that might degrade wetlands and submerged grassbeds beyond their ability to support present levels of plants and animals.
- Guam now requires permits before development may occur in any of the Territory's 12 major wetlands.
- In Rhode Island, the Coastal Resources Council helped re-route a transatlantic telephone cable away from a wetland that was a prime fisheries habitat.
- And in Damariscotta, Me., a wetland destined to become a parking lot was saved because of CZM efforts.

**As Chief of Policy and Program Evaluation for the Office of Coastal Zone Management, Carol Sondheimer has had an intimate view of the accomplishments of State programs.*

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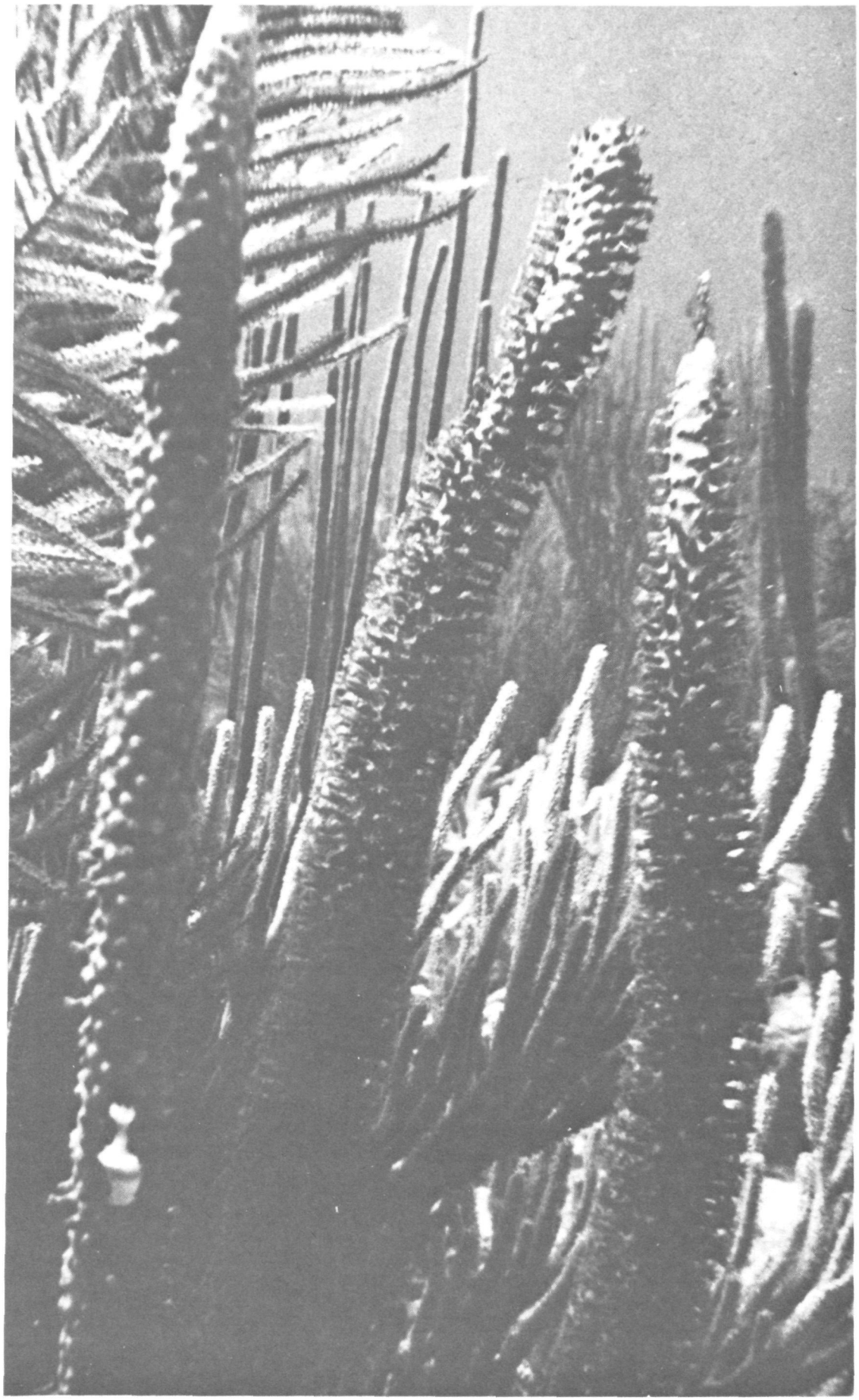


Tiny polyps "blossom" on stalks of soft coral off Caneel Bay, protected by the Virgin Islands' coastal management program.

Sixteen States have special protection measures, beyond wetlands statutes, dealing with important, unique, or endangered flora and fauna.

Five States have or will incorporate their own Endangered Species Acts into their coastal management programs. The additional funds provided through implementation grants should contribute to better enforcement of these Acts.

Beyond this, several States have protective policies for unique species or have identified their habitats as areas of particular concern. As an example, under Maine's Critical Areas Program, more than 200 areas important to flora and fauna, such as colonial bird nesting sites, have been identified and registered. Information about these areas has been used by the State Department of Transportation to avoid environmentally sensitive areas, by private owners in preventing irreparable damage, and by Tenneco in assessing the environmental impact of its proposed pipeline project.

Twenty States are dealing with the need to protect beaches, dunes, and barrier islands.

Thirteen States have beach protection or shoreline setback laws that limit or prevent development on the beaches and frontal dunes.

Two States protect their dunes and beaches through sand mining regulations.

In the 14 States and territories where protection of reefs is a significant issue, 11 have measures designed to protect reefs for their own intrinsic value and as major fish habitats. Coral reefs are important resources of all the islands in the Pacific and the Caribbean. Some of the accomplishments:

- The Virgin Islands prohibits the taking of coral;
- Guam protects its reef systems by regulating fishing methods;
- And three of Hawaii's marine life conservation districts contain important coral reefs that are protected by their inclusion in these districts.

In the Great Lakes Region, the concern with offshore reefs is primarily for their value as fish habitats. Illinois, Michigan, Ohio, and Wisconsin all protect these areas through their Lakebed Bottoms Permits, and all four States have used CZM funds to develop additional fish propagation projects around the reefs.

Ten States have measures regulating offshore sand and gravel mining or oil and gas extraction:

- In the Great Lakes States—Illinois, Michigan, Minnesota, and Wisconsin—lakebed permits cover all mineral extraction as well as oil and gas drilling.
- Massachusetts' Ocean Sanctuary Program—regulations for which have been adopted recently—identifies a number of offshore areas where pipelines and extraction activities will be regulated and, in some cases, prohibited.
- And the Alaska Coastal Zone Management Act of 1978 establishes a number of goals and standards (enforceable through State permits and local programs) for offshore sand and gravel mining, and oil and gas extraction.

In management of coastal development, the second major area where the national Act indicates substantive results are desired, we find the following:

Fourteen States address the potential for loss to life and property from inappropriate development in erosion-prone areas, primarily through setback requirements or beach and dune preservation laws.

Twelve States go beyond the Federal Flood Insurance Administration's requirements in order to control development in floodplains or storm surge areas, again through setback requirements, stipulations on permissible uses, and mandatory construction techniques in floodplains.

And several States have management controls over areas subject to subsidence or where development could lead to salt water intrusion.

Here is how some States are addressing these issues:

- Erosion is one of the major issues with which the Michigan program deals. Using the authorities provided in several existing Acts—the Soil Erosion and Sedimentation Control Act of 1976, the Sand Dunes Protection and Management Act of 1976, and the Shorelands Protection and Mangement Act of 1970— Michigan has used CZM funding to identify, designate, and more effectively manage more than 125 miles of high-risk, erosion-prone shoreline of Lake Michigan.
- Under authorities contained in North Carolina's Coastal Area Management Act, the State's Coastal Commission has identified and designated erosion-prone areas as Areas of Environmental Concern (AEC's). These AEC's now are subject to a permit before any development is allowed in these areas.
- As a direct result of the Guam Coastal Management Program, regulations were devloped governing the type and method of construction permitted in floodplains. The regulations have been adopted by the territory's Planning Commission, which must issue a permit for all construction on the island. In addition, the seashore reserve setback that runs around the perimeter of the island assures there will be no construction within 10 meters of the shoreline.
- Based on studies funded by CZM, the Maryland Legislature enacted two bills in 1976 that deal with managing development in the State's floodplains, the Flood Control-Watershed Management Act and the State Construction Projects Act, which prevents State-funded projects from increasing flood hazards.
- Prior to the initiation of the CZM effort in New Hampshire, development of Coastal Flood Insurance Rate Maps was a low priority for coastal communities. As a result of CZM efforts, all coastal communities in New Hampshire will be in the regular phase of the Flood Insurance Administration program 2 years earlier than previously anticipated.
- Salt water intrusion is a major environmental problem in Louisiana identified by CZM studies. Coastal Energy Impact Program funds have been directed at solving this problem in St. Bernard Parish, where a freshwater siphon is being built to divert water from the Mississippi River into a marsh. This is a prime oyster and shrimp producing area that has been hard hit by salt water intrusion.

There are two other important aspects in the management of coastal development that need to be looked at: what States are doing with energy facility siting, and what priority is assigned to water-dependent uses.

Ten States have expedited permit processing procedures, advance site designations, or advance purchase programs for energy facilities in the coastal zone. Thus:

- Unique among all the States is Maryland's program of advance designation of appropriate sites for power plants and acquisition of these sites when needed. This is probably the most ambitious and sophisticated of its type in the country. While the program was not initiated in direct response to the CZM Act, it is being incorporated as an integral aspect of the State's coastal management program in re-

Photo: Ted Butts

Photo: Ralph F. Kresge

Erosion-prone areas are being helped by rebuilding beaches (top) and grass-seeding dunes (below).

Photo: Ralph F. Kresge

High rise apartment buildings increase the population of coastal areas, prompting the need for programs on access to the shoreline, recreation, and protection of cultural and historical resources.

sponse to the new energy facility planning requirements added to the Federal Act in 1976.

- As part of its coastal management program, the Virgin Islands designated sites to be reserved for water-dependent heavy industry, including refineries.
- As part of its 10-year electric facilities plan, Wisconsin has identified sites necessary and appropriate for needed electric-generating facilities.

With regard to priorities for water-dependent uses, ten States use water-dependency or water-relatedness as a primary criterion for granting permits in the coastal zone.

- Oregon's legislatively enacted coastal goals give priority to water-dependent uses along the State's coast.
- Policies contained in coastal Acts in effect in South Carolina, Hawaii, and Alaska give similar priority to water-dependency.

Numerous States are using their CZM programs to promote such water-dependent uses as fishing and port activities. Worth noting is the high priority that has been assigned in the Maine Coastal Management Program to provide fishing facilities. As part of the State's plan, a cooperative effort between coastal communities, the State Department of Transportation, and the Governor's Committee on Coastal Development and Conservation was started that will result in a $8 million to $10 million bond issue to develop four new fishing piers and renovate or expand two existing ones, in the towns of Kennebunkport, Portland, Boothbay Harbor, Rockland, Vinalhaven, and Stonington.

The emphasis on cooperation among Wisconsin port cities is also noteworthy. With a financial boost from the Wisconsin Coastal Management Program, two State agencies with key roles and the directors of the four major ports have formed the State Council of Ports. This is the first time all the ports in the State have worked together on a comprehensive and unified port marketing campaign based on common goals.

Finally, in the related area of identifying and designating environmentally acceptable dredge spoil disposal sites, seven States have significant ongoing activities, including the following:

- Through studies financed by CZM, appropriate disposal sites for dredged materials from Calumet Harbor in Illinois, Duluth Harbor in Minnesota, and Superior Harbor in Wisconsin have been identified.
- The Wisconsin Coastal Management Council is working to reexamine and reconcile the differences between the State's policy on open water disposal of dredged materials and that of the Corps of Engineers.
- The States of Connecticut and New York, using CZM funds, have completed a Bi-State Interim Dredge Disposal Plan that identifies appropriate disposal sites, as well as acceptable disposal methods that are tied to the toxicity of the spoils.

The third major area where the Act anticipates progress is increased access to the shoreline for recreation purposes and for protection of cultural, historic, and aesthetic resoures. This is probably where accomplishments will be the most visible and where the potential exists to give the general public a sense of real benefit from coastal management efforts. If the States are to resolve the problem identified by the Coastal Zone Management Advisory Committee—the lack of a committed constituency—then it is through activities that afford the public greater use of the shoreline that such a constituency will be created. After all, when most people think of the coast, they think of recreational use and enjoyment—swimming, surfing, fishing, sailing, or walking along a beach.

Ten States require access to beaches as a condition for issuing permits.

- As a result of the requirements in the California Coastal Act, the Regional Coastal Commissions require that permits provide access to and along the State's shoreline. In the Malibu area alone, more than 125 access easements along the beach and more than a dozen from the public road to the beach have been secured.
- Five States and territories have Open Beach laws (Oregon, Texas, Guam, Hawaii, and the Virgin Islands).
- Through legal analyses funded by CZM, Delaware has been able to identify public lands along the shoreline that have been encroached upon by private development and actually are part of the public domain.
- A major legal survey is under way in Rhode Island to reestablish more than 70 public rights-of-way.

Fifteen States have projects under way that will create new urban waterfront parks and generally will make better use of their waterfronts for recreation purposes. For example, and exciting project is occurring in Detroit, Mich., where a chain of riverfront parks will be developed using CZM funds. The cost of constructing and landscaping these parks will be picked up by the Interior Department's Heritage Conservation and Recreation Service.

Six States are using their CZM programs to more effectively implement existing State historic preservation laws, and five States are in the process of preserving or restoring historic buildings and cultural sites, using CZM funds. Some of them:

- Historic restoration and preservation projects are under way in Wisconsin (the Flambeau Trail), Illinois (Evanston lighthouse restoration), Michigan (restoration of the Schoolcraft House at St. Mary's River, Fort Wayne in Detroit, and the Grindstone City Historic District), and Connecticut (Norwalk's historic seaport and park design).

Even in the exceedingly difficult area of protecting scenic views and enhancing visual access to the shoreline, seven States have activities under way.

• New Jersey restricts buildings that would cast a shadow on the beach and would be incompatible with surrounding development.
• The Virgin Islands has policies that promote visual access and seek to preserve scenic vistas.
• The California Coastal Commission and the Bay Conservation and Development Commission in San Francisco both review requests for development in light of their impact on views of the waterfront.

The fourth major part of the Act is aimed at simplifying and expediting governmental decision-making.

Ten States have established joint permit and public hearing procedures with the Corps of Engineers. Six States have consolidated several State permits and four States have permit clearinghouses or tracking systems that reduce considerably the time and effort involved in getting a permit decision. Some examples of this clearing-away of governmental log jams:
• In the Virgin Islands, where prior to passage of its CZM Act, permits were required from four different agencies, now only a single coastal permit from the Department of Conservation and Cultural Affairs is required.
• South Carolina has established a general permit to simplify the process for individuals who want to construct a private recreation pier or dock.
• And as a result of the South Carolina Management council's takeover of tidelands permitting, more than 30 applications pending at the time the South Carolina Coastal Act was passed have been resolved. Some of these applications had been pending for up to seven years.
• Both Massachusetts and Wisconsin have experienced a noticeable decrease in the time and effort required to process permit applications as a result of using CZM funds to staff district permit offices.

In Wisconsin, the average length of time needed to review water quality permits has dropped from 60 to 16 days, as a result of additional staff provided to three district offices.

Finally, in the Grays Harbor area in the State of Washington, an exciting process involves the Office of Coastal Zone Management. What is happening there can be transferred to other coastal States, and should contribute significantly to the process of intergovernmental coordination and permit simplification.

The Grays Harbor process involves;
• Partnership. A task force of Federal and State agencies, local governments, and the port have worked together for more than three years;
• Sound technical information. Decisions on the estuarine resources and local economic and development needs have been based on solid factual data.
• Conflict resolution. There has been a balancing of environmental and developmental needs; the Plan identified wetlands, mudflats, and other estuarine ecosystems to be protected and managed for their natural values, and also identified dredge spoil disposal sites and other areas needed to meet requirements for future economic development.
• Implementation. This involves amendment of the shoreline management plans by local governments, amendment of the State's coastal management program, and commitments from the Federal agency task force participants.

In essence the plan provides predictability about what can happen where. It includes priority for water-dependent uses along the shoreline. It has been an extremely difficult, complex, and time-consuming process. But if the Grays Harbor Plan results in a more rational coastal resource management process, it will have been time and effort well spent.

Five years have been devoted to working out the novel concepts contained in the Coastal Zone Management Act. These years have not been without controversy. This is inevitable for a new effort like coastal management. Disagreements were bound to arise over interpretation and implementation of important provisions.

In general, these shortcomings fall into two categories: provisions of the Act that have proven difficult to interpret and administer, and provisions that have not been fully effective in achieving substantive results.

The Office of Coastal Zone Management is considering administrative and legislative changes that could ease both these problems. Section 303 of the Act—the National Policy Section—could be modified to set forth in greater detail national policy objectives. These would include protection of significant natural systems, more effective management of coastal development, increased access to the coast for recreation, and greater predictability in public decision-making.

In addition, another modification is under consideration, changing Section 312 of the Act—the Evaluation provision—to measure a State's progress against these national objectives. Such a change would result in Federally supported State programs expending tax dollars in a manner aimed at achieving measurable national benefits.

Both these changes, like the Act itself, ultimately are aimed at strengthening the foundations of coastal zone management. The result should be what the law, in essence, calls for: a voluntary, but comprehensive process, implemented at the State level of government, that balances competing national concerns regarding the protection and development of significant coastal land and water resources. □

NOAA Magazine asked Robert W. Knecht, Assistant Administrator for Coastal Zone Management, for his views on the Nation's coastal problems and the progress that has been made by the States, as discussed in the accompanying article, and the needs for the future. Here is his reply:

Some important conclusions can be drawn from a review of the progress that coastal zone management programs have made in the past five years. It is undeniable that the foundation for improved management of our coastal resources is being laid by the States, working with the Federal CZM program. This foundation, given the proper support during the next several years, will be durable and capable of being built upon. Even now, with many of the States, working with the Federal CZM pleted, rewarding and substantive results can be seen. Furthermore, through the leverage offered by the Federal consistency provision of the Coastal Zone Management Act—that is, the requirement that federal actions be consistent with and, indeed, complement State management programs—and its subsequent reinforcement in the Deepwater Ports Act and the Outer Continental Shelf legislation, the coastal zone management concerns of the States are beginning to find their way into the Federal decision making process in a more effective way.

Nevertheless, some of the coastal problems that the Nation faces today and that it will face in the 1980s extend beyond the reach of even a fully successful State and Federal CZM programs. Clearly, there are limits to what we can expect of a relatively modest Federal grant program.

In my opinion, in addition to our work in strengthening the CZM effort, we need to focus attention on the following:

• Increased funding for improved recreational access to our shorelines, with special emphasis on the public acquisition of the 60 or so as yet undeveloped barrier islands. Planning and management alone cannot achieve this important national goal; money is going to be required.
• Certain aspects of the National Flood Insurance Program need further examination, and if, in fact, this program is actually stimulating development in hazardous coastal areas, revisions to it should be considered.
• Encouragement for the revitalization of the Nation's older urban waterfronts should become Federal policy, and Federal agencies should be encouraged to modify their regulations and funding priorities to facilitate this effort.
• Finally, we ought to learn from the Federal-State planning process on the use and management of the coastal oceans. A growing number of issues need attention. They range from sorting out juristictional conflicts between State and Federal governments in the territorial sea to the implementation of a fully comprehensive oil spill liability program, and should include further improvements in coastal fisheries management, especially concerning stocks that predominate in the territorial sea.

The great weather adventure

Longest Look Gets Under Way

World weather maps are being dramatically transformed by the Global Weather Experiment, a unique year-long international scientific effort to monitor all of the earth's oceans and atmosphere.

During a five-week intensive observing period completed in February, a massive array of aircraft, ships, satellites, instrumented buoys and balloons generated a torrent of unprecedented weather data from vast ocean areas of the tropics and southern hemisphere—areas where conditions that profoundly affect world weather have been virtually unobserved up to now.

The new information fills great gaps in the overall world weather picture, and will become part of the most complete global meteorological record ever assembled. With this 12-month record, scientists will try to gauge the practical limits of weather forecasting and design a world weather observing system to achieve these limits.

The Experiment, which got underway this past Dec. 1 and winds up on Nov. 30, is part of the Global Atmospheric Research Program, a joint effort of the World Meteorological Organization (WMO) and the International Council of Scientific Unions. All 147 member nations of the WMO are involved in some way, and scientists and technicians from 70 countries and five international organizations are direct contributors. The U.S. effort, which involves a number of Federal agencies and academic institutions, is being coordinated by NOAA.

During the intensive observing period, which ran from Jan. 15 to Feb. 20, U.S. Air Force and NOAA aircraft operating from Hawaii, the Panama Canal Zone, Diego Garcia in the Indian Ocean, and Ascension Island in the South Atlantic flew 171 sorties and launched 2,813 windsondes. These parachute-borne instrument packages, dropped at 217-mile (350-kilometer) intervals from as high as 42,000 feet (12,800 meters), provided data on winds, temperature, humidity, and pressure.

The greatest amount of new information came from the lonely reaches of the tropical eastern and western Pacific where Air Force C-141 jets flew 101 sorties and launched 1,740 windsondes. Flights from Diego Garcia were hampered somewhat by various problems, but during the 63 sorties flown, dropped 818 windsondes.

In the South Atlantic operations were sharply curtailed because of the unavailability of aircraft.

U.S. scientists from the National Center for Atmospheric Research (in Boulder, Colo.) released 153 constant-level balloons from Ascension Island and Canton Island in the western Pacific. The balloons, which float at about 46,000 feet (14,020 meters), were used to monitor high level winds in a 50-degree belt around the Equator. Transmissions from them were relayed by the polar-orbiting U.S. TIROS-N satellite to scientists in Toulouse, France, who calculated the wind data.

Other tropical wind, temperature and humidity readings came from an armada of some 32 oceanographic vessels from 13 nations. The ships were ranged across equatorial areas of the Indian, Pacific and Atlantic Oceans. Technicians aboard the vessels sent up balloons—usually twice daily—which carried instrument packages.

For the first time, large volumes of meteorological data came from the empty expanses of the southern hemisphere oceans. Before the start of the intensive observing period, ships from 14 countries deployed 193 instrumented drifting buoys approximately 621 miles (1,000 kilometers) apart in a broad belt from 20 to 65 degrees south. The 165 operating buoys transmitted sea surface temperatures and pressure readings that were picked up and later retransmitted by the TIROS-N satellite.

Aside from picking up and relaying signals from the drifting buoys and constant-level balloons, TIROS-N is supplying global day and night cloud images, for wind instrument, vertical temperature and water vapor profiles, and sea surface temperatures.

Five geostationary satellites are hovering approximately 60 to 80 degrees apart around the equator at fixed points about 22,000 miles (35,800 kilometers) from Earth. Three are from the U.S., one from Japan and one from the European Space Agency. These satellites are monitoring large scale atmospheric phenomena—primarily wind speeds and directions derived from cloud images—in a broad belt 50 degrees north and south of the equator. Except for the U.S. GOES-1 satellite stationed at 72 degrees east, the geostationary craft have been generating images twice an hour around the clock. GOES-2 at 75 degrees west, which had mechanical problems, was replaced by the backup U.S. SMS-1 craft.

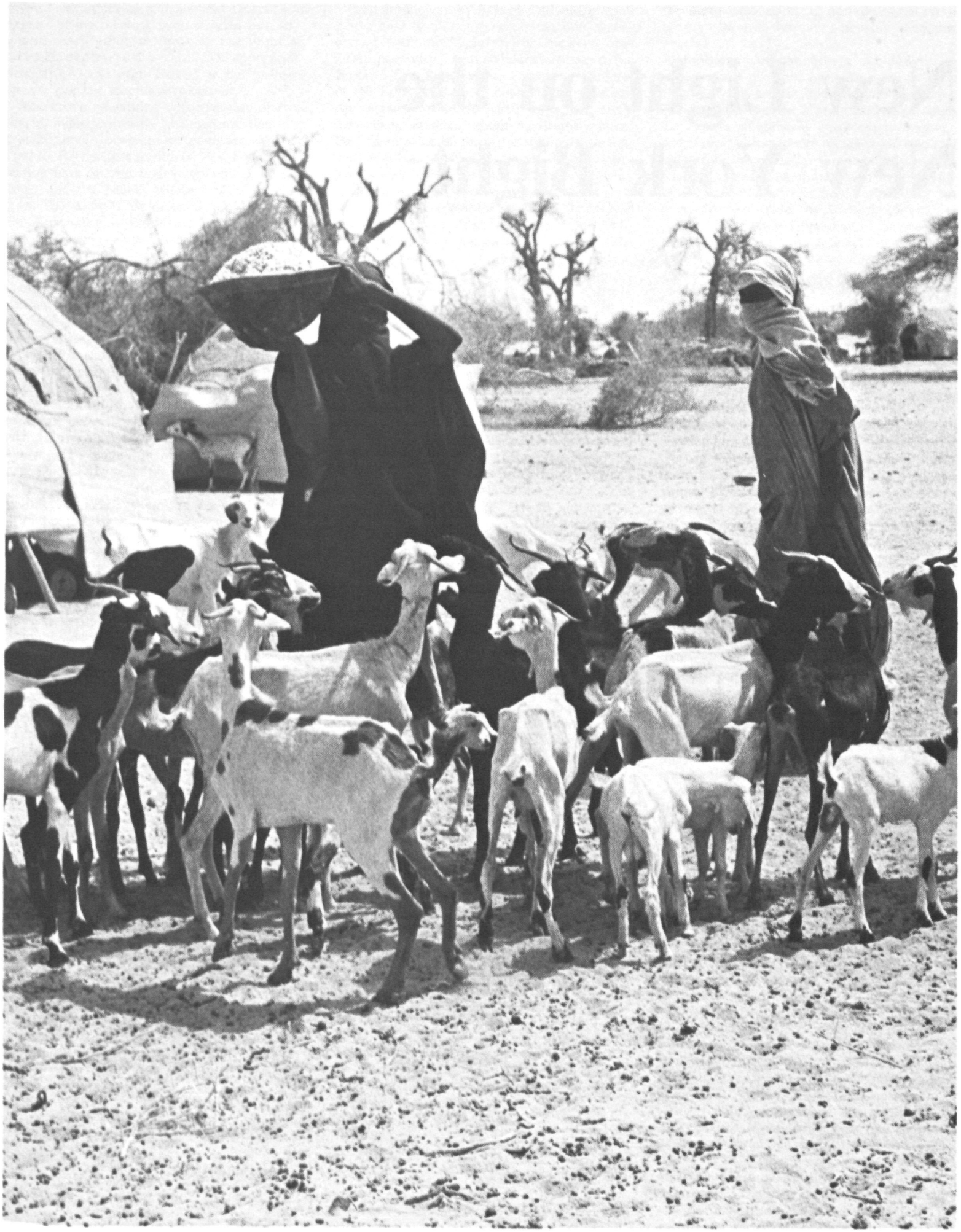
Additional wind, temperature, and pressure data are coming from commercial jets flying on worldwide routes. Five aircraft are equipped with instruments newly developed by NASA which transmit precise readings to one or another of the five geostationary satellites for relay to ground stations. Approximately 80 additional wide-bodied jet on international routes have units that automatically record a range of meteorological data on tapes which are sent to a facility in the Netherlands for processing.

Some of these special observing systems—the constant-level balloons and the ship and aircraft-launched windsondes—operate only during the two intensive observing periods. The other system will continue generating data throughout the year-long experiment. All of this additional information is augmenting the nearly 40,000 observations produced daily by the existing World Weather Watch.

Much of the new data takes considerable time to reach the scientists. But readings from the windsondes, the constant-level balloons, the drifting southern hemisphere buoys, some of the commercial jets, the geostationary satellites, and TIROS-N are received by meterologists within a matter of hours. Indeed, this mass of additional weather information, much of it new and unique, is already being used in drawing up large-scale forecasts.

According to NOAA official Thomas Kaneshige, director of the U.S. Operations and Coordinating Center for the Experiment, "we're absolutely getting more data than we've ever had before. We've seen some fantastic displays of information, noticeably over the Pacific, for example. It gives us a lot more to work with."

The total data flow seems equally successful. In a trial run, all the special observing system-generated weather data for the first fives days of the intensive observing period were collected, relayed to intermediate processing centers for refinement and quality control, and then funneled to the European Center for Medium Range Weather Forecasting in Bracknell, England. There, and at the U.S. Geophysical Fluid Dynamics Laboratory in Princeton, N.J., the data will be assimilated and analyzed by experts using giant super-computers. Dr. Rex Fleming of NOAA, director of the overall U.S. participation in the Experiment, reports that "scientists are very excited about the preliminary results in terms of data quality and quantity. They're concluding that the data are not only more voluminous than they've ever seen, but are also very good." □



FAO Photo

New Light on the New York Bight

By LOUISE PURRETT-CARROLL

A historic town reminiscent of what we think of as a simpler, cleaner past was the setting last fall for a meeting on how to deal with some of the environmental problems of our complex, crowded present.

In Williamsburg, Va., researchers who for the past five years have been subjecting the Atlantic waters between Long Island and New Jersey to close scrutiny met with planners and managers who can determine the fate of those waters. The meeting was part of, and a turning point in, NOAA's Marine EcoSystems Analysis (MESA) New York Bight Project.

The New York Bight Project began in 1973, in an effort to learn that body of water intimately—what chemicals its water contains, what lives there, what lies on the bottom, who uses it and how, where the water goes and how fast, what the weather is like all year around, and how all these things interact.

Scientists from NOAA, other agencies, universities, and private companies have logged thousands of nautical miles, crisscrossing the Bight, collecting water, sediment and biological samples, and emplacing buoys and current meters. They've tramped along the shores observing birds and floatable wastes, taken samples of ooze, sludge, chemical contaminants, and sand; collected counts of who catches how much and what kinds of fish. They've tried to find out what happens to dredged material and municipal sewage sludge barged out and dumped, where currents carry chemicals dumped in the Hudson, how fish adjust to underwater dredged materials and other wastes.

Over the years, some 30 monographs, part of the MESA Sea Grant series, have been published, dealing with such subjects as recreation, marine and coastal birds, fisheries, industrial wastes. Each stands as a benchmark study, examining in depth a particular aspect of Bight ecology.

Now the field phase is ending. The data are collected, but the job is far from over. In a way, the hardest part is just beginning. It is time to bring it all together into a cohesive picture of an ecosystem, to settle down amid the mountains of disparate research results, sort them out, and make sense of them—the kind of sense that others can apply in making decisions that affect the Bight.

It is also a time to seek more input from those who will use the results of the study. For, ultimately, this has not been just an exercise in basic research. The project has a pragmatic purpose: to provide the kind of information those who use the Bight need to guide their actions.

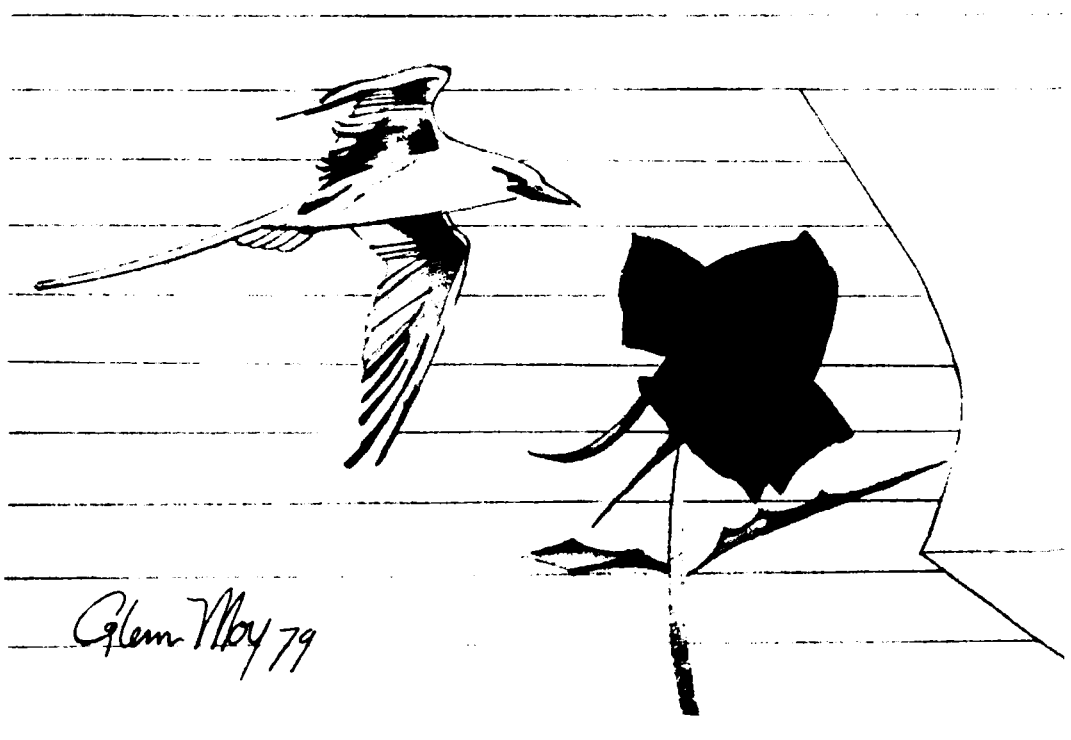
In opening the Williamsburg meeting, Project Manager Dr. Lawrence Swanson highlighted the thing that is really different about this project—what is done with the data. "You could just collect and archive the data, or perform extremely creditable scientific analyses and interpretation, or you could even further use it to develop a more cohesive understanding of the environment. But how do you make it useful for giving advice and creating awareness? How do you make it available to the public to force intelligent management decisions? That is our current task. Once we create awareness among the public, management decisions will come more easily."

The Williamsburg meeting was one approach. Nearly a hundred scientists, mathematicians, engineers, economists, and administrators pooled their information, ideas, and perspectives. Some had been with the project since its beginning; others were just being introduced to it.

Such a meeting is, unfortunately, unusual, said its organizer, Joel O'Connor of the New York Bight project office. "An all-too-frequent approach is to conduct an environmental study, write a long report, and say to the manager, 'do with it what you will.' Here, NOAA took the initiative to link its expertise with other agencies at other levels," to make sure that the research results are useful, and even to help implement them. "The whole idea of the project was that it would have specific goals and a finite life."

Out of the science/management interactions at the Williamsburg meeting will come part of a book summarizing some of the results of the New York Bight project. More than a research summary, it is intended to be a handbook, or manual on the Bight, outlining in layman's language the main things that have been learned about the Bight and the effects various actions are likely to have. "It should be," said Swanson, "a book people will *want* to read." The information must not just *be* there, it must be in a form that busy managers, who don't have time to pore through a two-foot-thick atlas, can use."

The Williamsburg meeting was to work on chapters dealing with seven areas of concern,



seven environmental management issues. The experts at the meeting were divided into subgroups, each group to focus on one problem; members represented a variety of appropriate disciplines, and each looked at the problem from his or her special perspective.

The group examining consequences of continued industrialization and urbanization was typical. Joel Goodman, an engineer with the Fred R. Harris Corporation of New Hyde Park, whose main interest is development of coastal areas, led the panel. Mitchell Moss of New York University's Graduate School of Public Administration is interested in shifting patterns of growth—how production and industry have vacated the waterfront, leaving it free for other uses, such as housing. Saverio Copello, manager of industrial development for the Port Authority of New York and New Jersey, an economist, examines the potential for renewal in the older central city. George Casler, an agricultural economist at Cornell, studies the effects of agriculture on the pollution of lakes and rivers. "We used to assume that by the time the pollution got to the ocean, it simply provided necessary nutrients, and we didn't concern ourselves with it."

Jean Boddewyn of Baruch College in Manhattan said he is not a specialist, but is concerned with the "tenous link between economic activity, industrialization, and the Bight." Lee Koppelman, Executive Director of the Long Island Regional Planning Board, one of the most active participants, had originally been skeptical about the Bight project. He'd seen a lot of scientific studies with limited usefulness to him. Now he's enthusiastic. He wanted to look at the planning of human settlements in their ecological setting.

Copello had submitted a list of changes or trends that could affect the Bight. One well-known trend is migration to the suburbs. The older core areas, such as the Bronx, Brooklyn, Newark, and Jersey City are losing population, while outlying areas such as Suffolk County are gaining. The trend is expected to continue through 1985. By then the suburbs will be filled, and the tide of humanity can return to the city.

The city area has been losing manufacturing, as well, Copello added. Between 1953 and 1976, this meant a loss of 600,000 jobs. For the future, he sees a continued shift of manufacturing to other areas, growth in entertainment and cultural activities, shift to energy-efficient transport, housing, and production.

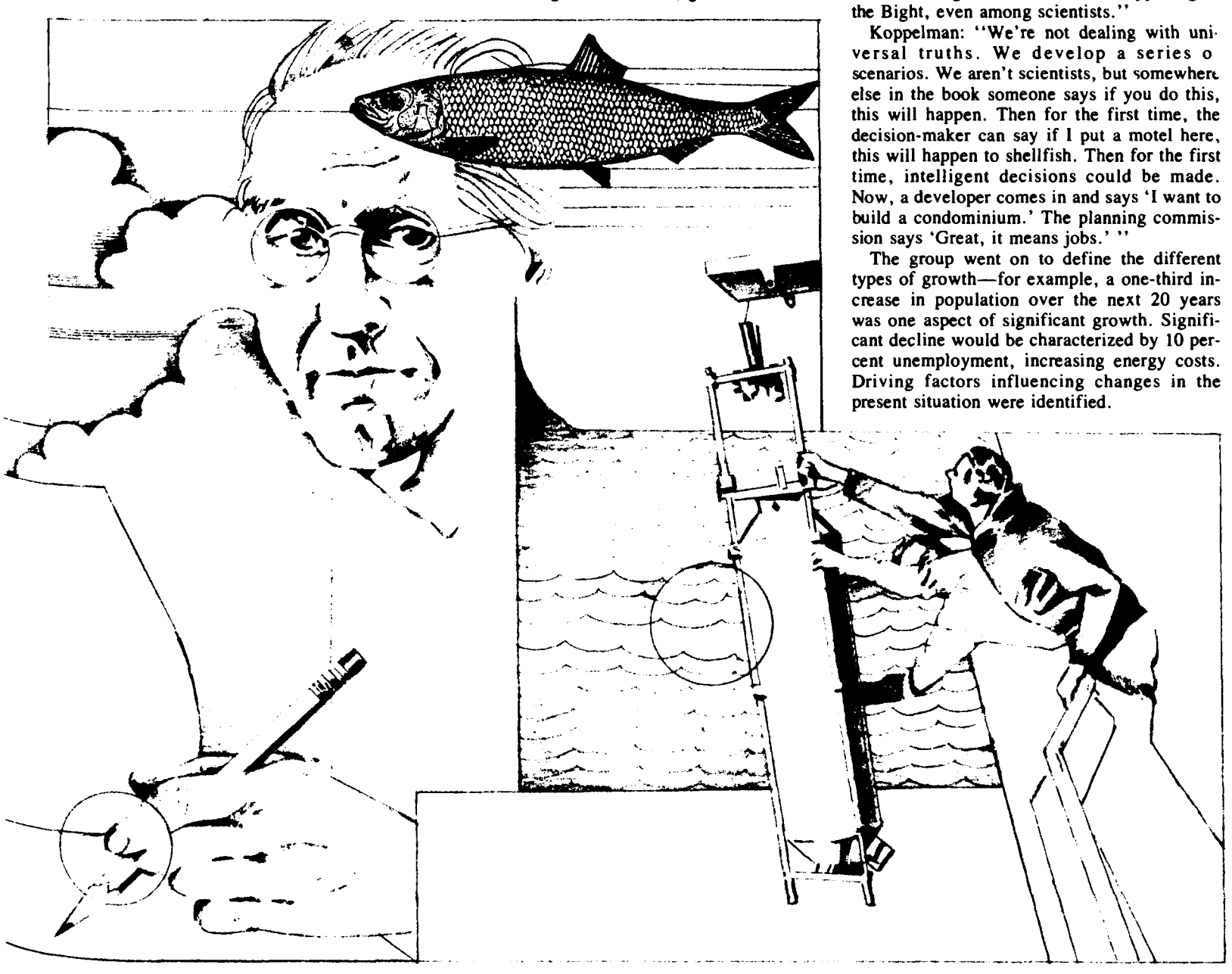
Goodman and the others decided to approach their problem by setting up different "scenarios of growth," or alternative futures. The meeting became a brainstorming session. To a base of general knowledge, members added new information or ideas. Koppelman pointed to the potential impact of offshore oil leasing. Copello mentioned that three-fourths of the area's energy is now supplied by imports from outside the United States, and perhaps as much as 80 percent of the traffic on the Bight is petroleum related. Moss thought that "we're not going to see a lot of industrial growth; we're consuming raw materials, not producing them."

One participant emphasized that they must avoid making decisions or judgments of what government should do. "The book is *for* decision-makers. We should show the things that could occur and the consequences. To the extent that the book includes specific judgments, it will be a failure."

Moss added, "Let's stick to what we know. There's no agreement on what's happening to the Bight, even among scientists."

Koppelman: "We're not dealing with universal truths. We develop a series o scenarios. We aren't scientists, but somewhere else in the book someone says if you do this, this will happen. Then for the first time, the decision-maker can say if I put a motel here, this will happen to shellfish. Then for the first time, intelligent decisions could be made. Now, a developer comes in and says 'I want to build a condominium.' The planning commission says 'Great, it means jobs.' "

The group went on to define the different types of growth—for example, a one-third increase in population over the next 20 years was one aspect of significant growth. Significant decline would be characterized by 10 percent unemployment, increasing energy costs. Driving factors influencing changes in the present situation were identified.



Questions came up as to whether the present transportation system is adequate; if more refineries could be built in New York, and where, and whether liquid natural gas tanks on Staten Island will ever be used.

The first question facing another group, the one dealing with prediction of environmental crises, was whether their task was even possible. Environmental crises in the Bight have included wash-ups of garbage and trash on the beach, oxygen depletion leading to fish kills, and other short-term major events. Can crises be predicted? Eventually, the group arrived at a kind of consensus. It agreed that the future is inherently and irrevocably uncertain.

In chairman Saul Saila's words, "uncertainty can't be eliminated, but we can increase our ability to cope. We can't predict the unknown, but we have to cope with uncertainties. The challenge facing management is not to predict environmental crises but to deal effectively with unknowns." As Dana Kester of the University of Rhode Island put it: "Acceptable uncertainty is related to the magnitude of the consequences."

The next problem was equally slippery: What constitutes a crisis? Annemarie Hauck Walsh of the Institute for Public Administration suggested that, for Long Island, it's if the beaches close because of algae. Saila believes the definition of crisis lies in peoples' perceptions. "A crisis is not a constant, it's variable, depending on what people think and expect. To predict crises is to predict changes in human values." Others agreed that it depends on what people think, and what they notice.

Sometimes a "crisis" is something that's built up gradually over months. Kester: "You don't get a sudden flood of metals in the water unless something blows up. They build up until someone says, 'Hey the metals in the fish are pretty high.' " Gregory Han of NOAA's Atlantic Oceanographic & Meteorological Laboratories added that "DDT wasn't a crisis until someone said, 'look at this.' How could that have been predicted? There would have had to be a model to predict eggshell thinning." Walsh concluded that perhaps, as with the problem of predicting, they'd have to live with some uncertainty. "We may have to overcome the need to have a precise definition, because the definition is human-related and subjective." Han: "That's what managers have to deal with."

Given these inherent uncertainties the group discussed various mathematical means of predicting the probabilities of crises. Even so, they decided, one can get a recurrence rate of some event, but never a prediction of when it will occur again. Han believes that, "you can't say that if '76 (when there was a massive die off of fish in the Bight) happens again, we'll be ready."

By the third day, the various teams had settled down to the private chore of writing what they had agreed on. Some went to their rooms or to libraries to tackle the chore alone; others remained in the meeting rooms, where the quiet shifting of papers was interrupted occasionally by a comment or question.

At the end of the week, each chairman made a progress report to a general session of the conferees.

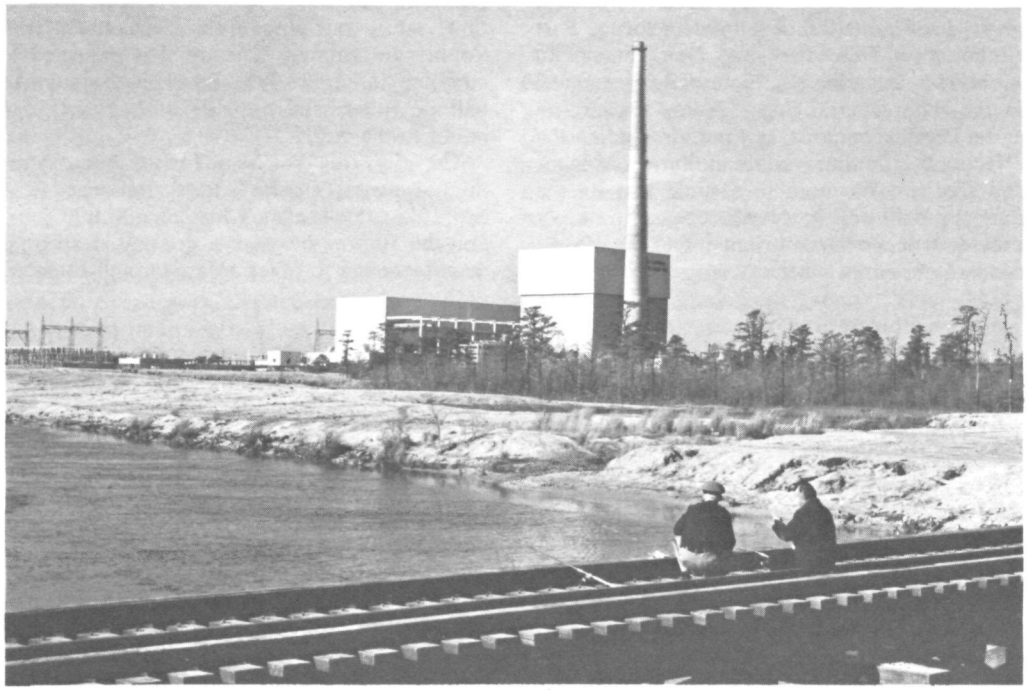
Goodman's industrialization/urbanization team had concluded that the major fluctuations that would be discernible would be those related to population, rather than industry. Basic primary industry would probably remain as is or decline slightly. Manufacturing would grow, or, in the worst case, remain stable. Significant technological factors would be energy and transportation.

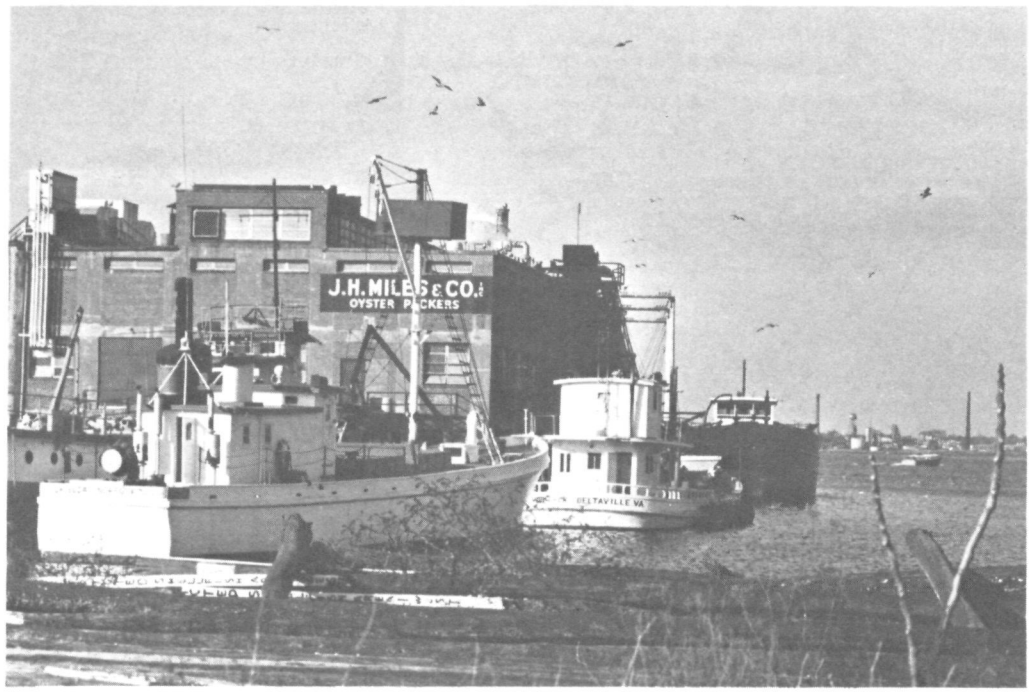
The main problem, says Goodman, is how to convert economic and demographic decisions into effects on the Bight. "So far, we don't see how they can be linked." But the Bight is obviously degraded because of population increases and demographic changes.

The group dealing with urban discharges of waste had reviewed reports on the amounts and composition of such discharges, deciding, for example, that mercury is less of a problem than had been believed. They developed a framework to calculate the quantity of heavy metals that could react with other materials: "We have pounds-per-day associated with each of Goodman's scenarios."

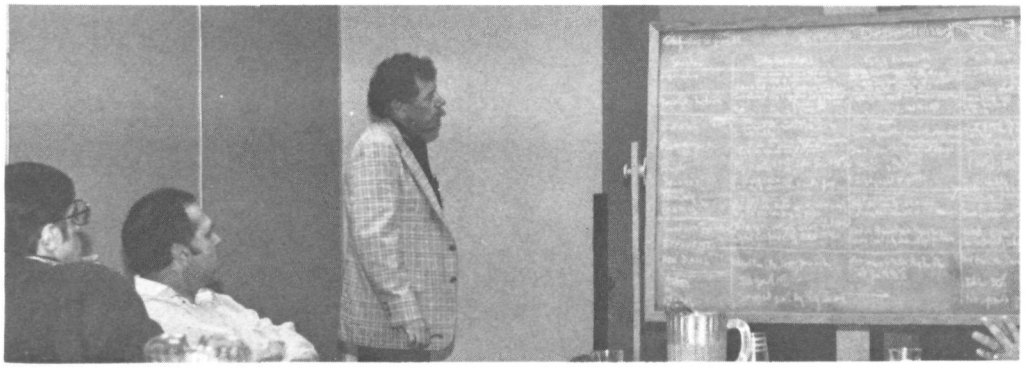
They then dealt with how to control inputs—the technology available, costs of treatments with those technologies. They considered regulatory institutions and those that provide treatment.

Those charged with examining the consequences of the proposed changes to the es-





The Bight shoreline will be included in a manual that will help environmental decision-makers balance the many uses of the waters, shoreline, and tributaries.



tuary, the twilight zone between land and sea, looked at the connection between the Bight proper and the connecting estuaries. What effect would water diversion in the Hudson, tidal locks, sand and gravel mining, or disposal islands, have on efforts to rehabilitate the Bight? How should these estuarine activities be managed in view of their effects on the Bight? One can clean up the estuary, but that won't automatically clean up the Bight: some things are dumped directly in the Bight.

Another group, concerned with the shoreline itself, focused on the barrier island system that extends along most of the 250 miles of shorefront from between Cape May, N.J., and Montauk Point, N.Y. Three main forces affect these islands: natural changes, suburban development from New York City and Philadelphia, and recreation—the coast is within three hours' drive of the largest urban concentration in the country. They looked at the consequences for such issues as shore erosion of a number of alternative strategies aimed, for example, at improving esthetic values. They decided that not much action could be taken at the level of the local homeowner, so they would aim their section of the Bight manual at managers.

The experts studying impacts of human activity on fisheries identified some of the resources—some 60 species in all—and picked nine that represent the main habitats and fishery types to serve as key or index species. One member, J. L. McHugh of the State University of New York, had summarized the condition of the fisheries: "The most worrisome prospect is whether adequate controls can be placed upon the recreational fisheries, which take four to five times as many food finfishes as the commercial fisheries."

One problem in "quantifying environmental insults," reported the chairman, is that statistics on fish landings are for States as a whole, and can't be applied to specific areas. Nor are they broken down as to how many are taken in the Bight, how many in rivers, or how many fish native to the Bight are landed elsewhere.

There are also jurisdictional problems in fisheries management. Though the regional fisheries management councils control the area from 3 to 200 nautical miles out, there is no good management scheme for fisheries within the 3-mile limit.

The group dealing with the effects of present and future contaminant levels focused on the Apex of the Bight, the northwest corner. The flushing rate, the rate at which water flows through the area, was found to be slowest in the early fall. At that time of year, a contaminant introduced into that part of the Bight would take about 10 days to make the passage.

At the Williamsburg meeting, (top to bottom) Drs. Joel Goodman, Larry Swanson, and Joel O'Connor worked with scientists and managers who will contribute to the manual on the New York Bight.

A total of 5 billion metric tons of new water enter the Bight each day. With this volume, the experts decided that contaminants entering the Bight in quantities of greater than a ton would merit scrutiny. Two contaminants that they thought might need to be controlled are cadmium and PCB's. Because of high levels of the latter, fisheries for striped bass are closed in the harbor. But, they point out, there's not much dilution between the harbor and the Apex, and it is not known how much of this pollutant reaches the Apex and contaminates fish there. In such cases, they concluded, the crucial management issue comes down to a personal decision: "Should I eat it?"

Saila's panel decided to define a marine environmental crisis as an imbalance sufficient to stimulate demands for action—a society definition, and very subjective; the definition of crisis changes with the public's sensitivity. They settled on a mathematical technique for simulating, and predicting, "crises" from spills of toxic and floatable materials, and planned to test the method on movements of floatable materials.

The midshelf region of the New York Bight, the panel decided, can be considered relatively pristine. Inshore of this, and particularly in the Bight Apex, the marine environment is severely degraded.

The Hudson-Raritan estuary is the greatest source of contaminants to the Bight. Pretreatment of industrial wastes now entering these waters might be necessary. The combined storm sewer outfalls are a major source of the more exotic contaminants. Replacement of these combined sewers or at least major modifications to these are essential. The costs, however, of both pretreatment and resewering are enormous.

Multiple uses of the environment—for transport, for fishing, for recreation, for waste disposal—at times causes interactions among impacts and between uses. Contingency plans should be developed to cope with the conflicting uses superimposed on the highly variable natural system. For example, can the fishing industry be prepared to increase its catch in advance of a predicted oxygen depletion event instead of permitting the resource to be lost through fish kills?

Hope for future improvement of Bight waters at this time is not bright, many panelists felt. The U.S. must be willing to change from a throwaway society and to place adequate resources towards the effort of reducing or eliminating toxic materials in the marine environment. Only then can there be significant improvement in marine water quality.

In the meantime, the scientists will continue to try to understand better the role of contaminants in marine ecosystems and to monitor trends of pollutants. These efforts will be valuable aids in tracking the severity of degraded ecosystems and in assessing management options for disposal activities.

When society is prepared to pay the costs for a cleaner marine environment, the scientific knowledge will be at hand to take corrective action. □

Chesapeake Bay research pays off in bayou country

Squelching The Cholera Scare

By ANN GREER

Good thinking last year by a Louisiana medical technician, and a quick follow-up by Louisiana State officials and a Maryland Sea Grant microbiologist, led to quelling of a cholera scare, restoration of confidence in an important industry, and re-emphasis on the importance of proper food handling.

It also contributed to a growing scientific realization that the bacteria that cause cholera are much more widespread than previously believed, and indeed may be important contributors to a healthy environment.

The word "cholera" can throw a scare into people, associated as it is with outbreaks, particularly in tropical regions, that in the past have resulted in many deaths. The name itself stems from the French *colere,* anger, because people who contracted cholera often turned pale, as if they were icily angry.

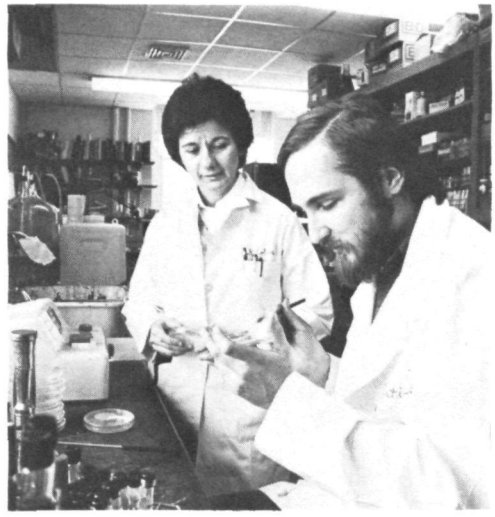
Actually, cholera is a disease of short duration ranging from being so mild that medical help isn't needed to being so severe that, untreated, death can follow in about a day. It does not normally occur when reasonable sanitary conditions are present, and it can be treated easily by replacement of body fluids and salts, plus antibiotics.

The medical technician, in Abbeville, La., became curious about a culture taken from a patient and identified it as a kind of bacteria called *vibrio*. He thereupon sent it to the Louisiana Department of Health and Human Resources where it was identified as *vibrio cholerae,* cholera bacterium.

Prior to this incident there had been only two cases of nonimported, nonlaboratory-acquired cholera reported in the United States since 1911. State officials were naturally puzzled and alarmed, the more so as ten more cases were identified after the first, None of the patients died; indeed, two did not even show any symptoms of the disease. All had consumed home-prepared crabs, which provided the clue to the source and which led briefly to an unwarranted loss of confidence in the industry.

The cholera *vibrio* was subsequently isolated from cultures taken in three other Louisiana towns, but there were no cases of the disease, illustrating that the bacteria can be present without harming humans.

Officials from the Department of Health and Human Resources and from the Lafayette, La., regional laboratory of the Center for Disease Control investigated the outbreak. Because the evidence pointed to an environmental source of the cholera, Dr. Henry Bradford and Dr. J.T. Hamrick of the State agency contacted Dr. Rita R. Colwell of the University of Maryland to develop a collaborative research project.



Dr. Rita S. Colwell, University of Maryland Sea Grant Director (1.) and James Kaper, graduate student, in laboratory where they studied incidence of cholera bacteria in Chesapeake Bay.

Dr. Colwell, Director of the University's Sea Grant program, and her associates have conducted several studies on the identification and description of various *vibrio* bacteria, including *vibrio cholerae*.

Sea Grant officials at Louisiana State University also launched a program of related research and of efforts to stem any public concern brought about by the problem.

Michael W. Moody, seafood technologist with the Louisiana Cooperative Extension Service, obtained cooperation from industry, the university, and State and Federal agencies such as the Environmental Protection Agency, the Food and Drug Administration, and the National Marine Fisheries Service, to outline the direction of the research, which the State of Louisiana funded.

At the same time Gereald Horst of NOAA's Marine Advisory Service, working with service representatives in all Louisiana parishes, visited industry representatives, developed workshops for crab processors, and—together with the Louisiana Fisheries Federation in Baton Rouge—recommended guidelines on cooking times and handling procedures.

Basic research on the identification and classification was funded by the National Science Foundation, and the study of the ecology of marine and estuarine *vibrios* was funded by NOAA.

Dr. Colwell is well aware of the sense of foreboding that cholera disease brings to mind.

"I can vividly remember reading a passage from Rudyard Kipling in which a description is given of several people in India who had died from cholera. The scene portrayed an abandoned dinner table and bodies lying in the courtyard," she said in a recent interview. "But incidents like that happened because of conditions that have been corrected almost totally in the United States today—lack of sanitation, lack of proper sewage and water treatment, and improper food handling."

Then what caused the situation in Louisiana? The problem was an old one—improper food handling. Cooked crab had been stored for several hours without refrigeration in the same baskets they had been held in while alive. The cholera bacteria had increased at a logarithmic rate, doubling every 20 minutes until the numbers of *vibrios* reached millions per gram.

"If seafood is not handled and cooked properly, it can become a medium in which bacteria harmful to people may grow," Dr. Colwell said. "But this is no different from what will occur if pork or a cream pie is handled or cooked improperly. All food should be cooked and refrigerated after cooking, if not consumed immediately."

As a result of the incident in Louisiana, Dr. Colwell, Dr. Bradford, and Ms. Nell Roberts in Louisiana have initiated a collaborative research effort into the distribution, function, and role of various disease-causing *vibrio* bacteria in estuarine and brackish waters and in shellfish.

Dr. Colwell has conducted her research on

various *vibrio* bacteria in the Chesapeake Bay. As a result of the work, she and her associates suggest that these *vibrio* species are important in the ecology of brackish and marine aquatic ecosystems because of their ability to mineralize organic matter and digest chitin, a major structural component of many aquatic invertebrates.

"Many people believe that disease-causing bacteria are out there only to do harm to humans. But bacteria perform an important role in the ecosystem and may produce substances that enable them to compete successfully in the environment but, that by chance, may also be toxic to humans," Dr. Colwell said.

Vibrio cholerae was one of the bacteria found by Dr. Colwell and James Kaper, a graduate student at the University of Maryland, to occur in unpolluted areas of the Chesapeake Bay. It was isolated in a distinct pattern dependent chiefly upon salinity and, apparently, inversely related to pollution. Sixty-five strains of this bacterium have been recovered from water, sediment, and shellfish samples on the basis of biochemical characterization.

The type of *vibrio cholerae* widely accepted by epidemiologists as causing disease, called serotype 01, also was found. Based on their genetic work with DNA (deoxyribonucleic acid) sequences and tests for pathogenicity, Dr. Colwell and her associates are advancing the idea that both the 01 and non-01 serotypes are disease-causing strains.

"If *vibrio cholerae* strains present in the Chesapeake Bay have the potential for causing disease, as our genetic and pathogenesis research indicates, more cases of undiagnosed diarrhea might be recognized as cholera," Dr. Colwell said.

The research findings demonstrate that an organism not considered to be epidemiologically significant in the United States is indigenous to the Chesapeake Bay, a major natural water system. The work of Dr. Bradford and Ms. Roberts has illustrated the presence of the organism in Louisiana's estuaries as well. The numbers of enterotoxin-producing *vibrio cholerae* found in the Chesapeake Bay, however, were very low. Work on the Louisiana isolates is now in progress.

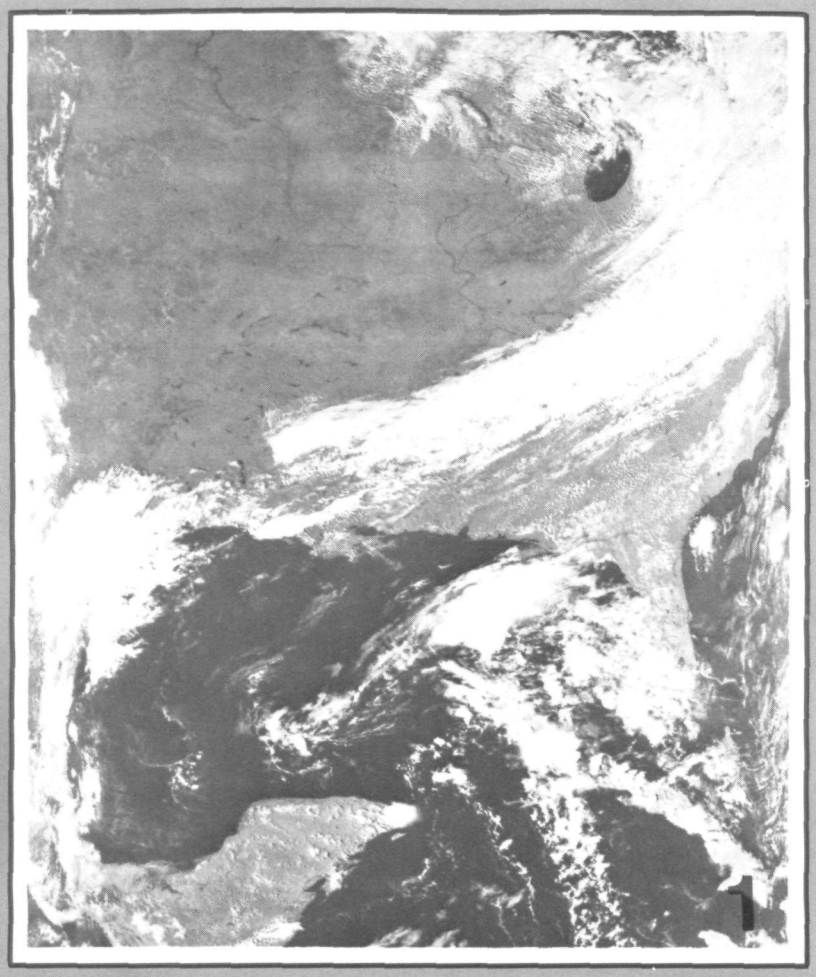
Work currently is underway in Dr. Colwell's laboratory to develop techniques for rapid identification of *vibrio* species. If successful employment of *vibrio* species as indicators of water quality can be achieved, these researchers believe that evaluations of brackish, estuarine, and coastal aquatic environments will be greatly improved and accidental outbreaks of cholera, such as the one which occurred in Louisiana, will be avoided. □

Here are some tips on how to keep the crabs you eat free of harmful bacteria:

- Before you begin cooking, take a hint from watermen who know that crabs have to be alive and kicking.
- Cook the crabs for about 15 minutes in boiling water. Be sure to stir the crabs while they are cooking, so none will float on top where heat penetration may not be as deep in the crab.
- Always refrigerate if the crabs are to be stored after cooking. Cooked crabs may be safely kept for about two or three days. If the crabmeat is stored longer than a day, it should be frozen in a home freezer or put in the freezer compartment of a refrigerator.

THE VIEW FROM SPACE

The first of a pair of polar-orbiting satellites, inaugurating a new series of environmental monitoring spacecraft for NOAA, was launched last October 13. TIROS-N is in orbit at 540 miles (870 kilometers), and will be joined this spring by NOAA-6. The "TIROS Twins" are expected to improve greatly the quality and quantity of information previously provided by satellites of the ITOS series. Several images on these pages are from TIROS-N, demonstrating the clarity of imagery provided by the new spacecraft's instruments.



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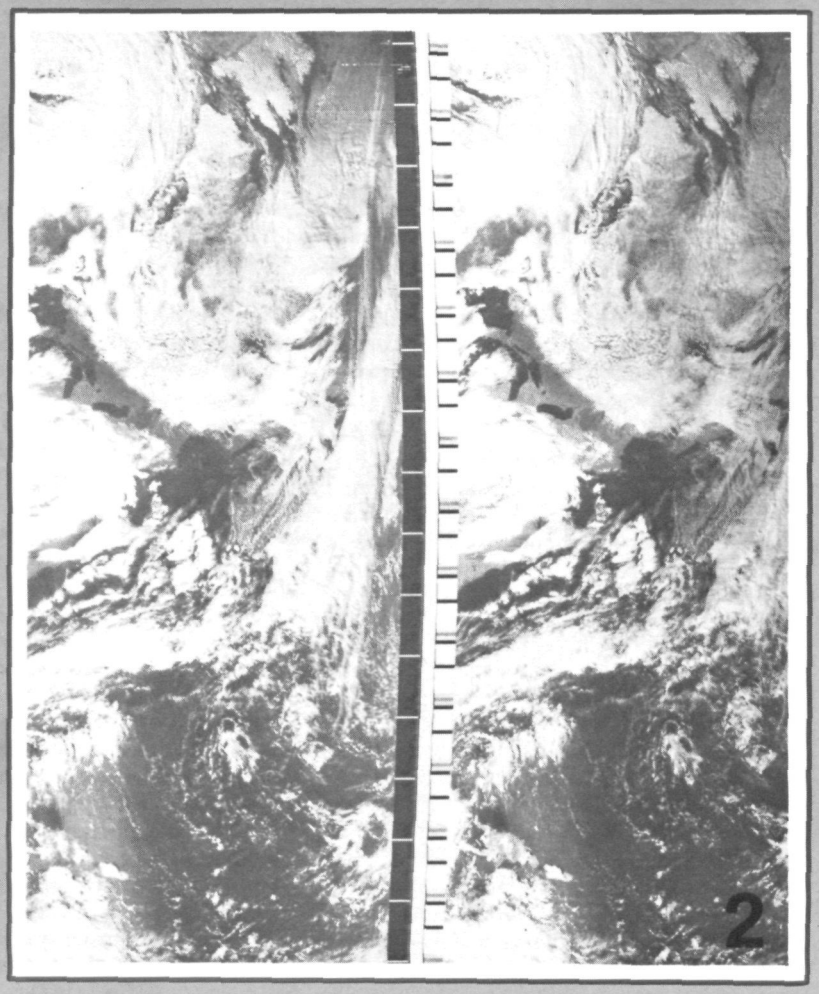

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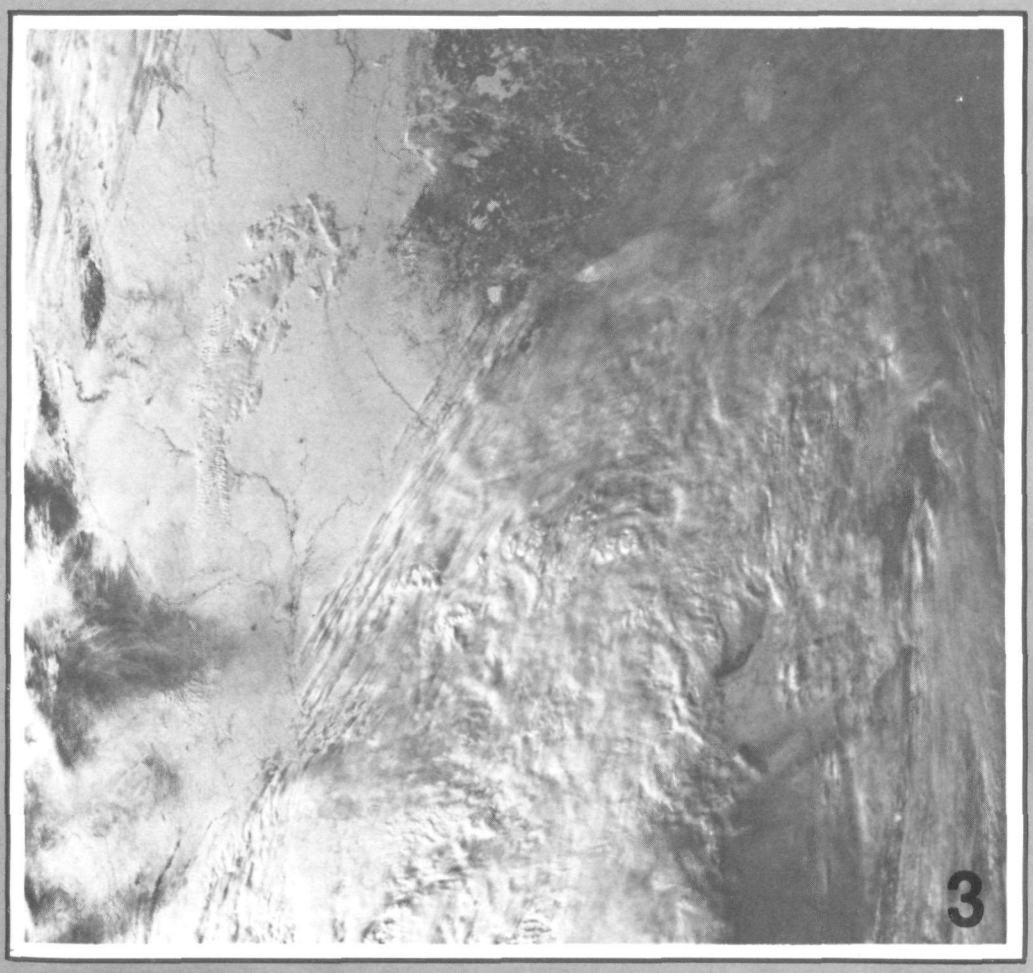
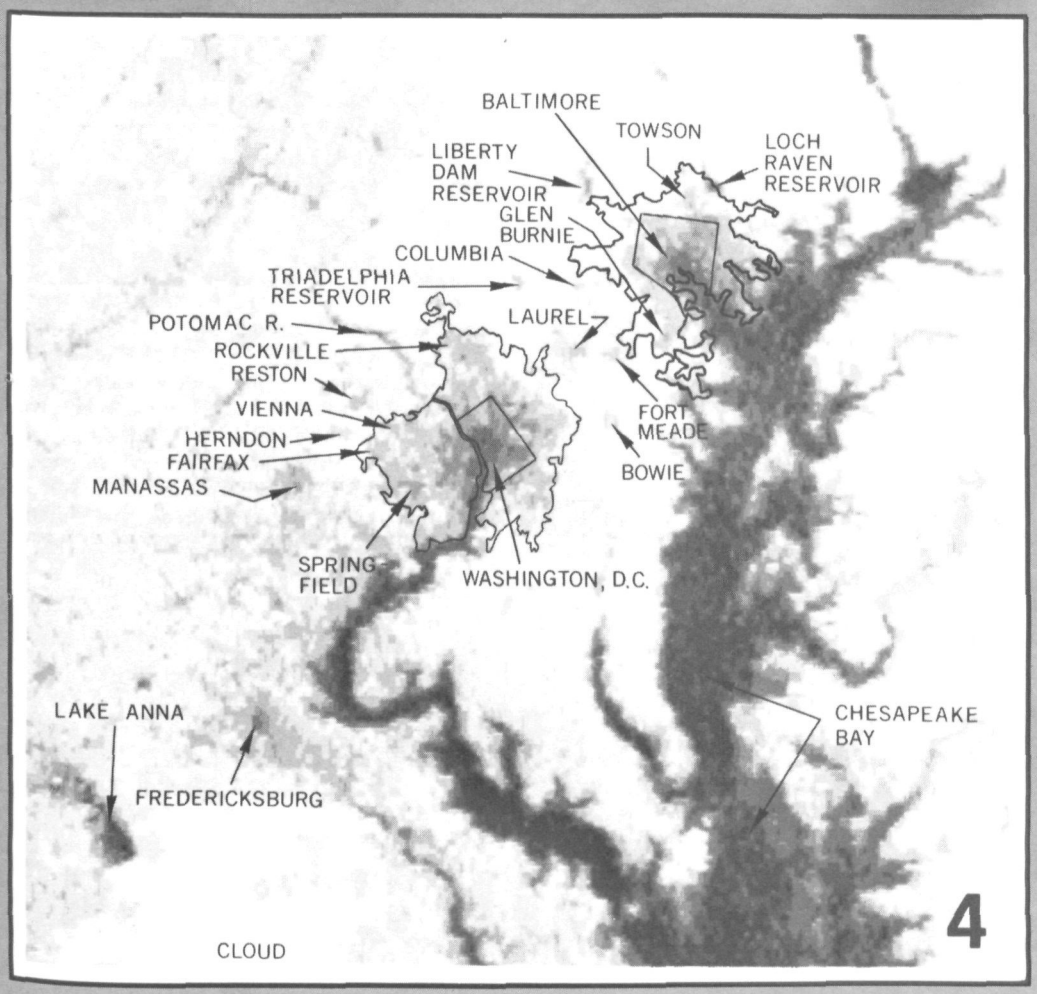


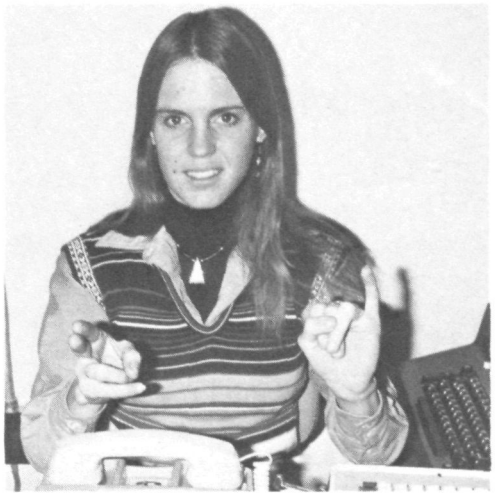
1 While clouds obscure much of the East Coast, the Midwest is crystal clear in this 1-kilometer, near-infrared image from TIROS-N. The Mississippi and Missouri Rivers stand out sharply, as dose the Yucatan Peninsula in the Gulf of Mexico.

2 The identical view, but with important differences to the trained eye, are shown here. At left is visual imagery from Channel 1 of the TIROS-N Advanced Very High Resolution Radiometer, while at right is Channel 2 imagery. Comparison of data from the two channels permit analysts to obtain an indication of ice/snow melt inception. The Great Lakes may be seen in the upper left portion of the images, and those with really sharp eyes—or magnifying glasses—will be able to spot Cape Cod. Chesapeake Bay also is visible through a break in the clouds.

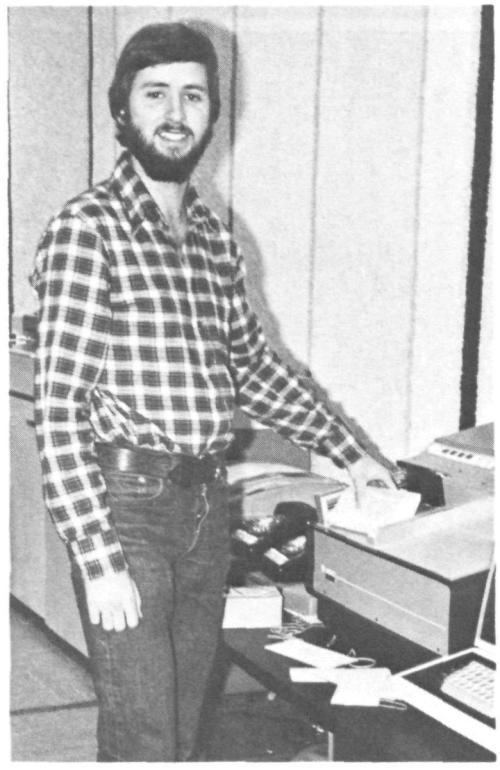


3 Snow covers the left portion of this January 29 TIROS-N image of the Midwest, but you should see what's under the enormous cloud formation on the right half! Among other things, there's Chicago, with record-breaking snow depths. Omaha and Lincoln, Neb., may be seen as black spots.

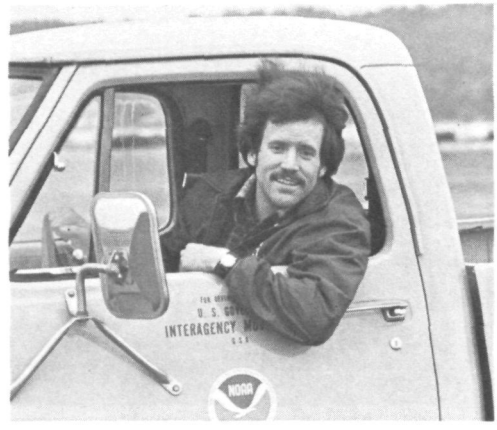
4 Computer-enhanced, infrared imagery of the Washington-Baltimore area lets satellite analysts "see" where population growth is taking place. The darker sections are areas of most intense heat—generated by industrial plants, automobiles, residences, and the like; where human activity is the most intense. While this image is from NOAA-5, the new TIROS-N series of spacecraft will be able to provide similar pictures. This image was obtained at nighttime, when the waters of Cheseapeake Bay and the Potomac River were warmer than that of the rural earth.



Karen Park, a clerk-typist in NOAA's Boulder, Colo., Personnel Office, demonstrates "hi" in sign language; she is deaf, and uses portable telephone-teletypewriter in front of her to send and receive messages with a conventional telephone receiver.



Jim Sheppard is a computer aide with EDIS in Boulder; he attended National Technical Institute for the Deaf in Rochester, has become avid downhill skier.



Ann Cooley (above), also deaf, is clerk with EDIS in Boulder; she found out about career opportunities with NOAA through her job counselor in Rochester, N.Y. Richard Perry (below) has a hereditary allergy to the sun's ultraviolet rays; operating a motor vehicle for PMEL in Seattle accommodates his disability better than the solar exposure he received at his Colorado home.

Richard is allergic to sunlight.
Paul "reads" with a tape recorder.
Annette talks with her hands.
Philip gets around on a two-wheeler.
All have some disability.

And all are part of a pool of eminently hireable, talented individuals, as NOAA people in Boulder have learned. The lesson has come from an active employment program for the handicapped designed to show supervisors that this reservoir of talent is there to be tapped, if the prospective employer will just use a little creativity.

It is not a question of good works. On the contrary, there are hard, practical reasons to hire the handicapped. For one thing, there is the opportunity to bring in some exceptionally able people. For another, in the sometimes convoluted world of Civil Service regulations, handicapped people may be easier to employ and easier to keep than their unhandicapped fellows.

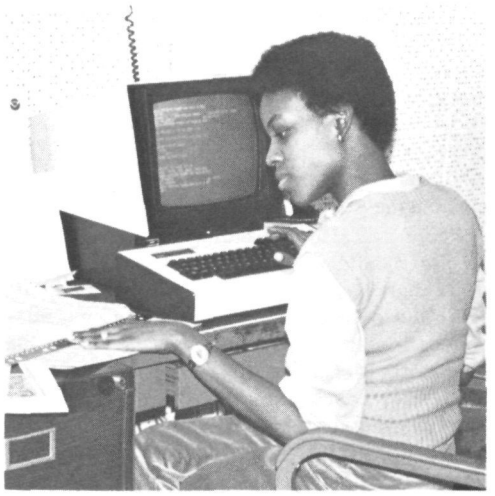
As a general rule, supervisors must hire prospective Federal employees from the Civil Service register, but a little-known regulation permits them to hire persons with disabilities through a separate "short cut" process. This 700-hour appointment allows these people to demonstrate their employability. When the time period is expired the agency can apply to the Civil Service Commission for approval to convert the employee to a permanent appointment—called a Schedule A-(u) appointment.

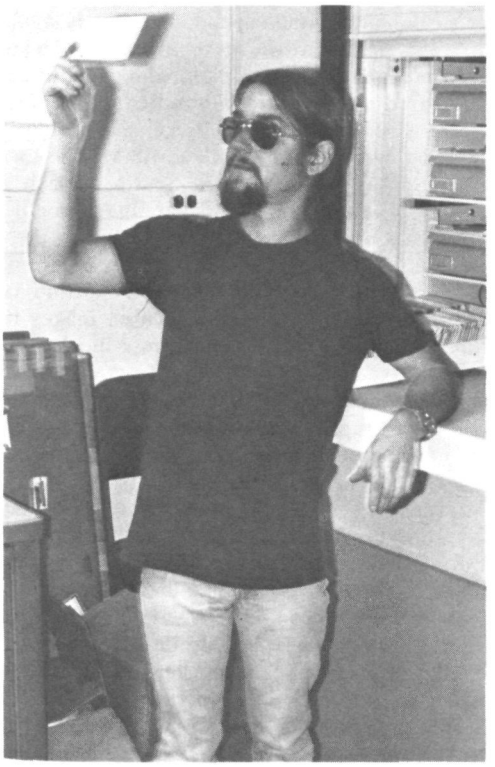
"A Schedule A-(u) appointment gives all rights and benefits of a permanent employee with the exception of freedom to change jobs without prior approval of the Civil Service Commission," explained Lois McCoy, who is in charge of the handicap special employment program at the Environmental Research Laboratories.

Carl Abston of the National Geophysical and Solar-Terrestrial Data Center, in the Environmental Data and Information Service, is one supervisor who decided to apply a little creativity to his hiring problems.

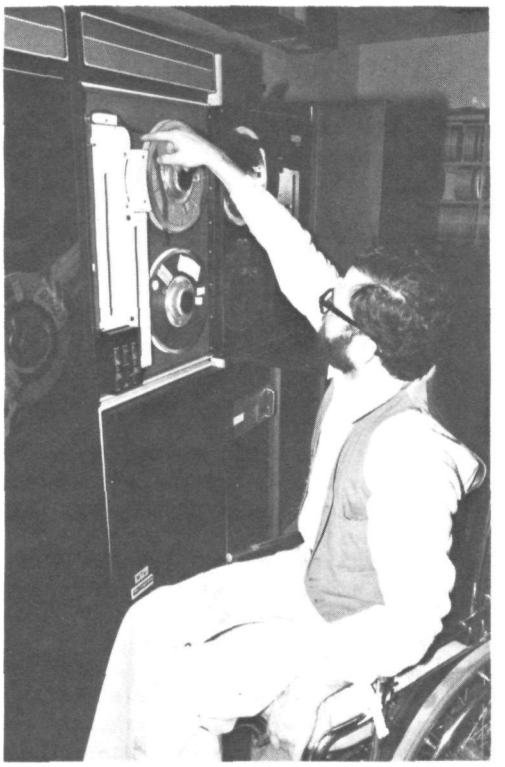
For several months, Abston—who heads the Automated Processing Division—had tried unsuccessfully to hire two temporary employees as a computer aide and a keypunch operator from the register. He was then given permission to hire "outside" applicants if he could find persons who were willing to go back and be certified by the Civil Service Commission—a process leading to further delay.

Disabilities Don't Have to be Handicaps

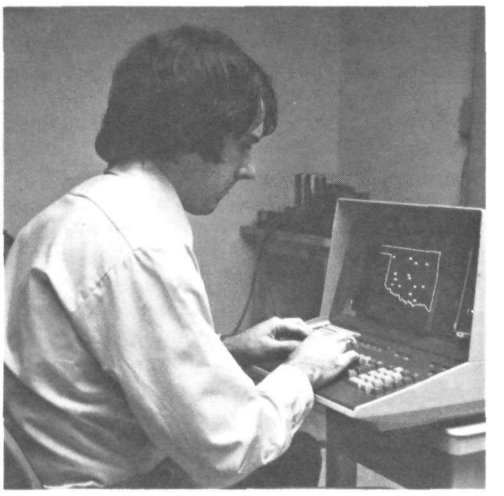




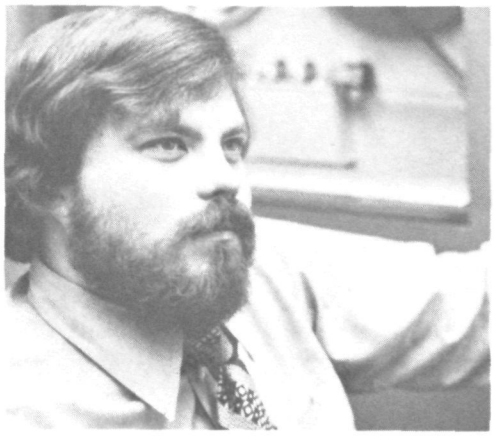
Two staff members of National Solar-Terrestrial and Geophysical Data Center in Boulder; Annette Gales (above), lost her hearing at age six because of a high fever, is now learning COBOL computer language; Warren Thomsen, who is allergic to paper and dust, works in the dust-free microfilm laboratory with no difficulty.

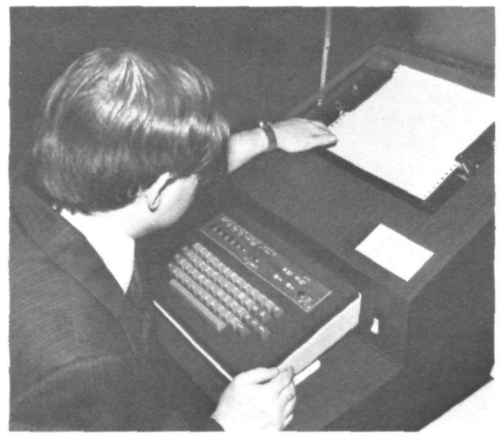


Jon Nestor (above), ERL computer programmer, is almost totally blind from a fall when he was 16 months old; he came to NOAA from seven years as business programmer with Blue Cross-Blue Shield and Indiana National Bank. Keith Levinson (below) is blind physical scientist with National Ocean Data Center in Washington, D.C., where he operates a computer terminal that can produce Braille printout.



Paul Lorenson (top) is University of Colorado graduate in molecular and cellular biology; he is blind, a physical scientist with Wave Propagation Laboratory in Boulder. Sam Whittle (center) is deaf computer programmer with EDIS in Washington. Richard Clark is blind meteorologist with National Severe Storms Laboratory in Norman, Okla.





Michael Simmons (left), a computer specialist with EDIS in Washington, D.C., is a paraplegic who was injured in an accident. Philip J. Preis (above), a paraplegic who also is deaf, is a computer aide with EDIS in Washington; drives his own van, runs a calcomp plotter, and conducts sign language school during lunch hour.

At that point he decided to try to hire two qualified handicapped persons through McCoy on the 700-hour appointment. This procedure would allow him to evaluate their performance and then decide whether they could handle the job on a more permanent basis under the Schedule A-(u) appointment when the time period expired.

Abston decided that deaf persons would be more suitable for keypunching and digitizing jobs than people with other types of physical disabilities who would not be able to reach the tape racks or do the plotting required. After one deaf employee, referred by McCoy, seemed to be working out, Abston contacted the Boulder Center for People With Disabilities for assistance in recruiting more deaf employees.

As a result of these referrals, Abston has hired several deaf persons in the past two years. So far he has taught the new employees key punching and how to digitize magnetograms—records which indicate variations of the earth's magnetic field—and has shown them how to submit job streams to the computer.

"There are only about 200 deaf computer programmers in the United States," Abston says. "We would like to add to that number within another year."

To communicate in technical language with the new deaf employees, Abston asked for help from the two leading educational institutions for deaf people in the United States—the National Technical Institute for the Deaf, a part of the Rochester Institute of Technology in New York State, and Gallaudet, a liberal arts college in Washington, D.C.

In addition to spending considerable time teaching computer programming to the deaf members of his group, Abston has learned sign language and sent 11 of his 12 hearing staff members to an onsite sign language training course.

The onsite sign language course was offered through the training office in NOAA Personnel and was conducted by a counselor for the deaf from the Boulder Center for People with Disabilities. Out of concern for the number of deaf employees now working at NOAA in Boulder, McCoy suggested that a sign language course for hearing employees would provide greater integration of deaf employees into the work force. A total of 20 people completed the eight-week course, which was offered two days a week for one and one-half hours.

"A lot of communication within the group is now done in sign language," he says. "Two or three of us are good enough to get the point across so that we don't have to write anything down anymore!"

Another innovation which has made the work environment more comfortable for everyone is a device known as a TTY—a teletypewriter-telephone combination—which transmits a telephone message via a television screen or printout to and from the sender. Several are now in NOAA offices and laboratories throughout the country.

McCoy believes that government agencies have a legal and a moral responsibility to employ and provide assistance on the job to qualified handicapped persons.

"There is some reluctance to allow handicapped individuals an opportunity to enter the work force and demonstrate their ability to do the job," she said. "This reluctance is based, in part, on a fear we all share in dealing with something or someone we don't understand. This feeling, and not the handicap, is the biggest block to considering handicapped job applicants."

To surmount this obstacle, McCoy suggests, supervisors and co-workers should become closely acquainted and involved with the individuals concerned.

"It just requires that first step," she said.

The nondisabled supervisor may see a task to be performed from only one point of view while a handicapped person has had to adapt his or her abilities to compensate.

"Handicapped individuals themselves are the best authority to tell supervisors how they can adapt to a situation. They are very creative."

For example, the Wave Propagation Laboratory in Boulder hired Daryl Pracht, a computer technician, who was physically handicapped as a result of polio. Because he used crutches, his supervisor was concerned about how he could transport computer tapes and readout sheets back and forth to another computing facility across town. The employee assured his superiors that was no problem. He used a back pack and had a specially equipped automobile that he could drive. As a result, he remained at the ERL laboratory for two years and now has gone into business for himself.

There are also limitations that people put on the handicapped person—the generalizations that they make about the handicap itself, McCoy explains. If it is a common misconception that many people have about the handicap, McCoy invites someone from the Center for Disabilities in Boulder or another local organization to talk to the group or invite people with similar disabilities to tour the laboratory so that co-workers can see there is not as much of a problem as they envisioned.

While some handicapped individuals have obvious disabilities, there are others who have no apparent disabilities, who can still be classified as "severely handicapped" for hiring purposes. Richard Perry, a motor vehicle operator with ERL's Pacific Marine Environmental Laboratory in Seattle, Wash., was born with a very rare hereditary condition known as EEP or "erythropoietic protoporphyria" which, in general terms, means he is allergic to sunlight. This condition is caused by an enzyme defect which makes it impossible for him to rid his blood of a photoactive chemical. The result: the enzyme has no place to go in his body and causes severe skin eruptions and intense pain when the skin is exposed to heavy doses of ultraviolet radiation from the sun.

Because of the thin atmosphere at 5,500 feet elevation at his home in Longmont, Colo., Perry decided to look for employment in the Northwest where more clouds block out the sun's dangerous rays. As a result, he was hired under the special 700-hour appointment by the NOAA laboratory there in February 1978.

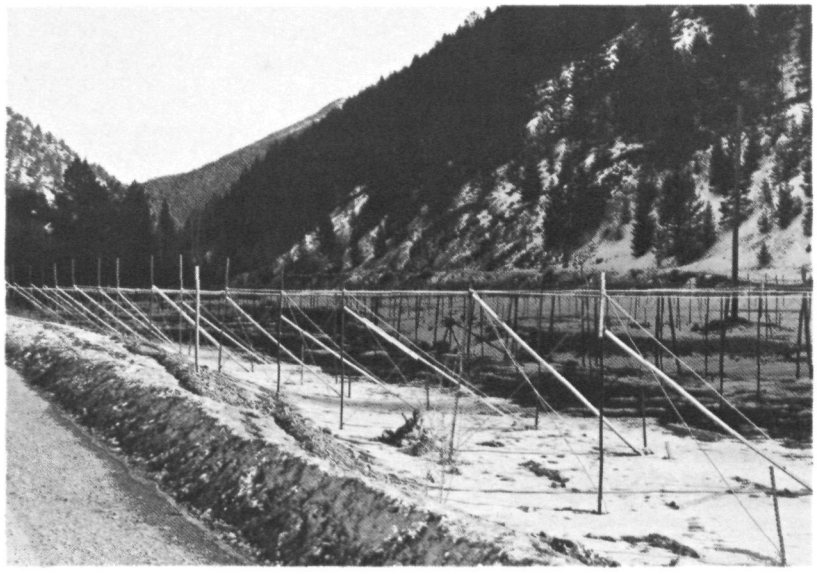
Warren Thomsen is a similar example. He has been employed on a temporary basis with NOAA's National Geophysical and Solar-Terrestrial Data Center in Boulder. Before he joined the Environmental Data and Information Service, he had been forced to quit jobs with International Business Machines and Neodata because of an allergy to dust and paper. When McCoy first learned of his problem, she realized that he should have no difficulties if he worked at the Data Center's microfilm laboratory, which is free of dust under very controlled conditions. Thomsen photographs seismograms, the printed images of earth tremors recorded by seismographs from throughout the world. He is also responsible for filing the microfiche product in data banks for answering requests.

"The Personnel Department can urge its management to hire the people with disabilities and special abilities, but the real impact is made when a supervisor tries the process and finds it's successful," says Nancy Thorton, an area personnel officer for ERL and EDIS in Boulder.

Supervisors such as Carl Abston have proved that the process can work and benefit all of us. □

Big Eye in Sunset Valley

By JOAN VANDIVER FRISCH



The Big Eye in Sunset Valley consists of parallel rows of coaxial cables supported by yards of nylon clothesline strung between six-foot high steel fence posts.

A CENTURY AGO Sunset, Colo., was a bustling gold miner's town. The Greeley, Salt Lake & Pacific provided railroad service to the outside world, and prospectors panned in the creek and drilled holes in the mountains in search of the precious metal. Today, Sunset is a ghost town, almost completely abandoned to the elements.

Almost, but not quite. Modern-day "prospectors" from the Environmental Research Laboratories, using a huge antenna and a computer, are in search not of gold but of the very elements to which the town had been abandoned—the blustering winds, the turbulence, the atmospheric waves that affect the weather of the area.

Scientists from the Aeronomy Laboratory have transformed two acres of the narrow, picturesque valley into an unusual type of wind-sensing Doppler radar. Doppler radars are those that sense the change in frequency—the Doppler shift—caused by a target's movement toward or away from the radar. The versatile very high frequency (VHF) system, constructed by a group under the leadership of John L. Green, can measure both horizontal and vertical winds and can record turbulence at altitudes up to 60,000 feet (20 km.) in clear or cloudy weather.

This unique all-weather capability stems from the radar's unusually long wavelength—7.4 meters—which permits echoes to be obtained from the air itself without interference from rain, snow, or clouds. By comparison, Green explained, conventional Doppler weather radars have wavelengths of about 10 centimeters and usually receive echoes only from water droplets and other airborne targets.

"Ever since radar has been used to probe the clear atmosphere, scientists have debated about the nature of the mechanisms responsible for the observed echoes," said Dr. Kenneth Gage, a physicist with the NOAA radar group. "Two physical mechanisms were offered by scientists as alternative explanations."

According to Gage, these alternatives were either scattering of radio waves from turbulent irregularities of humidity and temperature, or reflection from stable, horizontal layers of the same weather elements. A long-wavelength radar such as that at Sunset can be used to study both, by pointing the antenna in different directions. One result has been that NOAA scientists discovered that what were thought to be alternatives both turn out to be true—that the observed echoes are caused both by the turbulent scattering and by the stable layers.

At all radio wavelengths from centimeters to meters, turbulent scattering is usually the dominant echoing medium. At the longer wavelengths, however, when the radar is pointed vertically, echoes from the stable layers can be much stronger than from turbulence.

The existence of stable layers had previously been inferred from radio propagation studies, said Gage. That is, the same mechanisms that are responsible for vertical radar echoes at long wavelengths are also responsible for the over-the-horizon propagation of short radio waves. But because the Sunset radar observes the layers in the vertical, it provides a great deal more information about the structure of the reflecting layers.

Doppler radar echoes also can be used to study the nature of turbulence in the atmosphere. The echo strength is a measure of the strength of the turbulence so that the variation of echo strength with height and time can be used to describe the occurrence of turbulence.

These turbulent or layered structures of humidity and temperature cannot easily be observed directly by aircraft or balloons, Gage said, but similar structures have been observed directly in the ocean during the past decade. He pointed out that, in fact, the very existence

of analogous structures in both the atmosphere and oceans provides a unifying theme for the development of turbulence theory.

Since turbulent irregularities move with the wind, radar measurements of the motion of turbulence—from the Doppler shift of the echoes—provide a measurement of the wind. The NOAA scientists have compared the radar wind speed with those recorded by instrumented weather balloons called rawinsondes sent aloft from Denver's Stapleton International Airport about 35 miles southeast of Sunset. They found the balloon-measured winds agreed closely with the radar wind speeds at altitudes higher than about 18,000 feet (6 km) above sea level. Below that, the winds differ because of the nearby Rocky Mountains.

The overall goal of the Aeronomy Laboratory's atmospheric dynamics group, according to program leader Dr. Thomas VanZandt, is to help understand the small- and middle-scale (that is, microscale and mesoscale) dynamics of the atmosphere. These are the scales that Doppler radars of this type are particularly suited to study. They include not only the basic structures, turbulence and layers, but also a wide variety of other important phenomena.

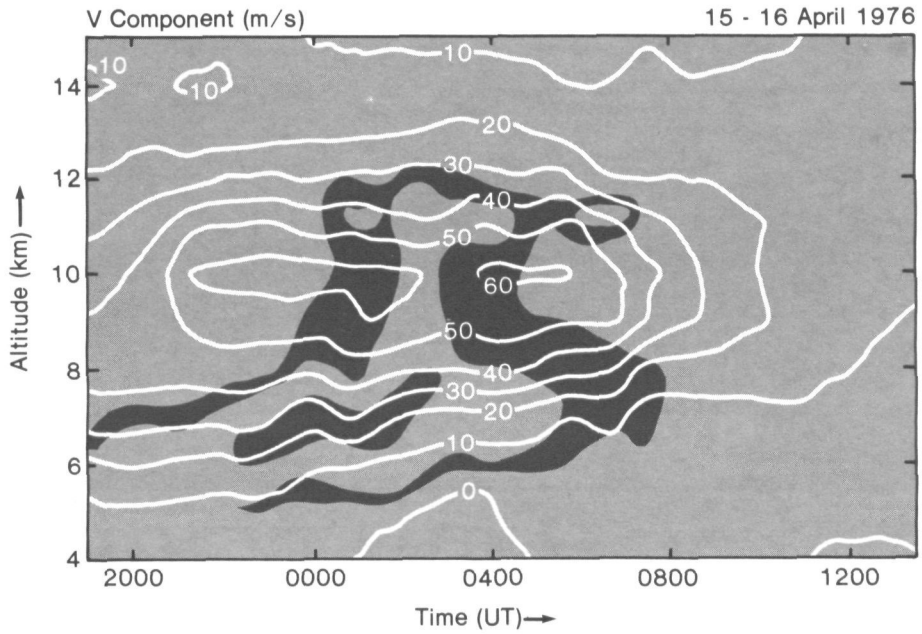
For example, the transport of trace chemicals and radioactivity between the stratosphere—the almost weatherless region of the atmosphere above 30,000 feet (10 km)—and the troposphere, the stormy region in which we live, is a subject of particular interest. One transport mechanism carries stratospheric air into the troposphere in a narrow region near the jet stream. These motions can be observed in considerable detail by radar. The chemical effects of stratosphere-troposphere transport are also subject to intensive study by other groups in the Aeronomy Laboratory and elsewhere in NOAA.

VanZandt and his colleagues began to pursue this goal by starting construction of the Sunset radar—the first Doppler radar to be designed specifically for studying the clear atmosphere—in 1973. Since 1976 they also have used other radars in Peru, Puerto Rico, and Alaska, to explore the limits of the Doppler radar technique.

Dr. Ben Balsley of the group is presently building a radar similar to Sunset but much larger, at Poker Flat, Alaska, near Fairbanks. With this "Mesosphere-Stratosphere-Troposphere" or MST radar he will be able to study the atmosphere at all heights from near the ground up to about 60 miles (100 km), just below the height where the aurora borealis puts a great deal of energy into the atmosphere. Since the Sunset radar was constructed, more or less similar radars have been built in Illinois, Massachusetts, and Germany, and others are planned in Norway and Japan.

The Sunset radar is spread over two acres of a forested valley 7,500 feet (2,300 mm) above sea level and consists of six identical sections, each measuring 100 feet by 200 feet (30 mm by 60 mm). A total of 700 steel poles sunk three feet into the ground and exposed six feet above ground are connected by rows of half-inch diameter coaxial cables supported by 20,000 feet (6,000 mm) of nylon cord.

To make a measurement the radar's antenna is electronically "pointed" to the east or west as radio pulses, one-millionth of a second long, are emitted skyward. Typically about 300,000 pulses are averaged to make one measurement. The radar transmitter power during the pulse is 100,000 watts—as much as that of a typical television station transmitter.



Wind velocity and clear air turbulence intensity as measured by Sunset radar from passage of a jet stream over the instrument.

The Sunset radar, according to Green, can "see" disturbances above a thunderstorm cloud to 60,000 feet, suggesting that a part of the storm's energy is leaking off to the upper atmosphere—although this has not yet been directly observed.

By comparing reports of clear air turbulence (CAT) encountered by aircraft flying over Sunset with radar measurements of turbulence, the NOAA scientists have found that they can measure the severity of CAT, regardless of whether it is dangerously strong or very weak.

"We are measuring CAT and wind velocities from about 12,000 feet (4 km) to about 40,000 feet (13 km)—the altitude most commercial aircraft fly," Green explains. "At present the only warning airline pilots have of impending CAT is the word-of-mouth report of another pilot who has already endured the rough ride. By detecting turbulence with our radar, we hope eventually to warn pilots of turbulent conditions or winds on a minute-by-minute mode in real time. Our radar observations have also enabled us to develop a theoretical model so that we can calculate the intensity of turbulence (and CAT) from balloon observations of wind and temperature. With this model the severity of CAT can be determined at every rawinsonde station."

"We also see wave-like oscillations in wind velocity similar in appearance to ocean waves," VanZandt explained. "These waves transmit momentum or energy away from jet streams or thunderstorms, and may provide an important mechanism for linking the lower and upper atmosphere. On a larger scale, they may influence the organization of snow squalls and severe storms and lend an element of predictability to short-range weather forecasting."

In the future, radars similar to the Sunset radar may revolutionize the way in which the upper atmosphere is observed by providing continuous automated observations that in turn would dramatically change weather forecasting.

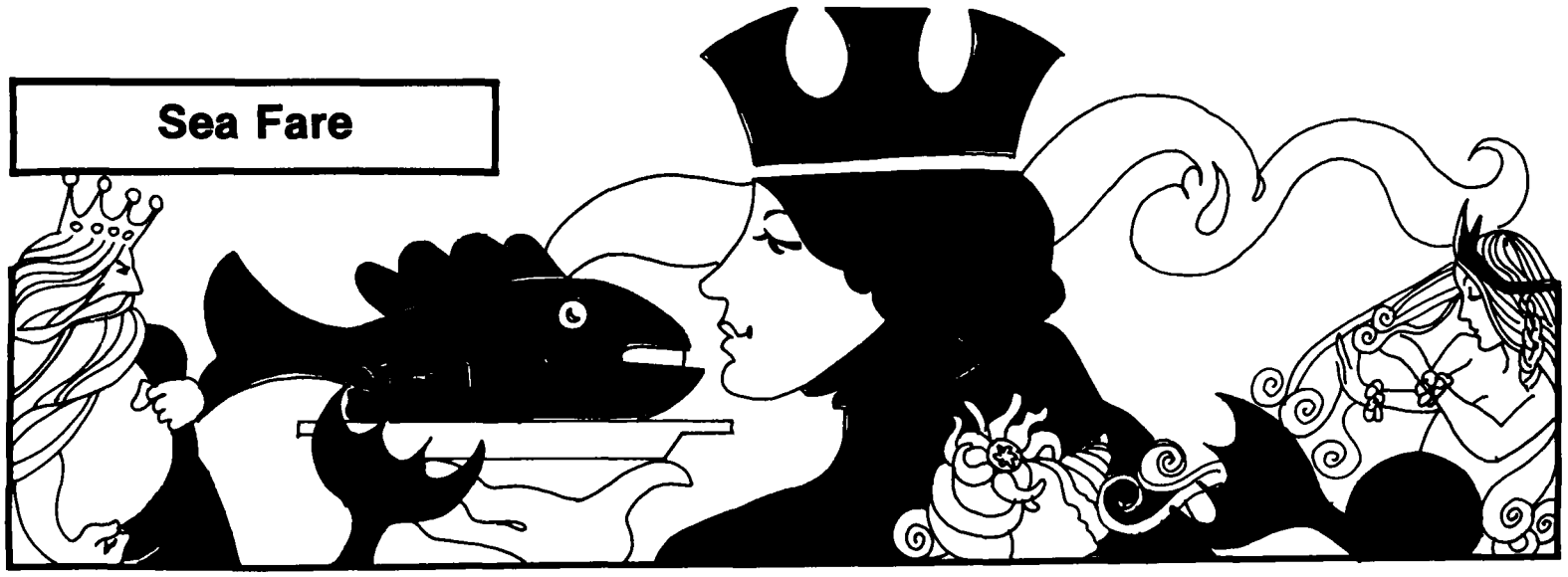
The primary meteorological ingredients fed into numerical weather forecasts are observations of wind, temperature, and humidity. They are now routinely obtained by a nationwide network of NOAA weather stations, which send instrumented balloons aloft each morning and evening. With the advent of satellite observations, meteorologists have looked forward to the day when remote sensing techniques could provide the weather information for numerical model forecasts by replacing the function of the balloon soundings.

"One of the difficulties with the development of this approach is that winds can't be easily obtained from satellite observations," Gage said. "Another difficulty is the coarseness of the temperature profiles returned from satellite radiometer observations." To solve these problems, longer wavelength radars such as the Sunset instrument can contribute remote wind measurements and can provide auxiliary information such as the height of the tropopause which, when used with satellite data, could lead to better temperature retrievals. Thus, many of the ingredients necessary for replacing the rawinsonde balloon soundings are already available and could be used in a combined radar-satellite system.

According to the NOAA scientists, a cooperative program is already underway between the Aeronomy Laboratory and the Wave Propagation Laboratory to accomplish this objective.

"Eventually this combination could replace the rawinsonde balloon measurements so that the weather-gathering information could be completely automated," VanZandt said.

When this change occurs, NOAA's Aeronomy Laboratory radar group can shift its sights to solving other weather problems with the versatile Sunset radar. □



SAVORY SEAFOOD FIT FOR A QUEEN — LET THEM EAT BAKE

Time is the most valuable thing a person can spend. For busy people who prefer not to spend it in the kitchen, but who must eat nevertheless, we recommend that they turn on their ovens and bake a fish or two.

***Baking is one of the easiest ways to cook fish and shellfish, which are tender and tasty and require just a little cooking. A few simple rules help: keep the fish moist and flavorful with a sauce or topping; bake in a moderate oven; and* do not overcook.**

Fish is cooked properly when these signs appear: the flesh loses its translucent appearance and becomes opaque; the juices are milky colored; and the flesh is easily pierced with a fork and will separate into flakes. Always test the thickest part of the flesh, where it takes the longest to cook. Overcooking fish will toughen the flesh, dry it out, and impair the delicious flavor.

FILLETS are the sides of the fish, cut lengthwise away from the backbone. They are ready to cook as purchased.

STEAKS are cross section slices from large dressed fish cut ⅔ to 1 inch thick. They are ready to cook as purchased.

DRESSED FISH are scaled and eviscerated–usually the head, tail, and fins are removed. The smaller size fish are called pan-dressed and are ready to cook as purchased.

Bake Sole Gourmet

2 pounds skinless sole fillets or other fish fillets, fresh or frozen
1 teaspoon salt
Dash pepper
1 package (10 ounces) frozen asparagus spears
1 can (10½ ounces) condensed cream of celery soup
1 tablespoon lemon juice
1 teaspoon Worcestershire sauce
2 tablespoons grated Parmesan cheese
2 tablespoons toasted, blanched, slivered almonds

Thaw frozen fillets. Cut fillets into 6 portions. Sprinkle fish with salt and pepper. Cook asparagus according to directions on package. Place asparagus spears on fish. Roll fish around asparagus. Place fish in a well-greased baking dish, 12×8×2 inches. Combine soup, lemon juice, and Worcestershire sauce. Pour sauce over fish. Sprinkle with cheese and almonds. Bake in a moderate oven, 350° F., for 20 to 25 minutes or until fish flake easily when tested with a fork. Makes 6 servings.

California Baked Fillets

2 pounds skinless flounder fillets or other fish fillets, fresh or frozen
½ cup flour
1 teaspoon salt
Dash pepper
¼ cup roasted, diced almonds
¼ cup butter or margarine, melted
¼ cup lemon juice
1 tablespoon granted lemon peel
¼ cup chopped chives
Lemon wedges
Parsley

Thaw frozen fillets. Cut fillets into 6 portions. Combine flour, salt, and pepper. Roll fish in flour. Place fish in a single layer in a well-greased baking dish, 12×8×2 inches. Combine almonds, butter, lemon juice, and lemon peel. Pour sauce over fish. Bake in a moderate oven, 350° F., for 20 to 25 minutes or until fish flake easily when tested with a fork. Sprinkle with chives. Garnish with lemon wedges and parsley. Makes 6 servings.

Lemon Rice Stuffed Fish

3 pounds dressed fish,* fresh or frozen
Salt
Pepper
Lemon Rice Stuffing
2 tablespoons butter or margarine, melted

Thaw frozen fish. Clean, wash, and dry fish. Sprinkle inside with salt and pepper. Place fish on a well-greased bake-and-serve platter, 18×13 inches. Stuff fish loosely. Brush fish with butter. Bake in a moderate oven, 350° F., for 45 to 60 minutes or until fish flakes easily when tested with a fork. Makes 6 servings.
**Pike, red snapper, rockfish, trout, or whitefish.*

Lemon Rice Stuffing

¾ cup chopped celery
½ cup chopped onion
¼ cup butter or margarine, melted
1⅓ cups water
2 tablespoons grated lemon peel
1 teaspoon paprika
1 teaspoon salt
Dash thyme
1½ cups precooked rice
⅓ cup sour cream
¼ cup diced peeled lemon

Cook celery and onion in butter until tender. Add water, lemon peel, paprika, salt, and thyme. Bring to a boil. Add rice and stir to moisten. Cover and remove from heat. Let stand 5 to 10 minutes or until liquid is absorbed. Stir in sour cream and lemon. Makes approximately 4 cups stuffing.

Fish-Cheese Burgers

6 frozen fried fish portions (2½ to 3 ounces each) or
12 frozen fried fish sticks (¾ to 1¼ ounces each)
6 buttered hamburger rolls
⅓ cup chili sauce
6 slices cheese

Place frozen fish in a single layer on a cookie sheet, 15×12 inches. Bake in a hot oven, 400° F., for 15 to 20 minutes or until fish are heated through and flake easily when tested with a fork. Place one fish portion or two fish sticks on bottom half of rolls. Top with chili sauce, cheese, and top half of roll. Bake for 5 to 10 minutes longer or until cheese melts. Makes 6 servings.

Variation: Quick tartar sauce may be substituted for chili sauce. Combine ¼ cup mayonnaise or salad dressing with 2 tablespoons drained sweet pickle relish.

Baked Salmon Salad

2 cans (16 ounces each salmon)
2 cups thinly sliced celery
1 cup chopped green pepper
½ cup chopped onion
½ cup mayonnaise or salad dressing
1 tablespoon lemon juice
2 teaspoons Worcestershire sauce
½ teaspoon salt
Dash pepper
1 *cup coarsely crushed potato chips*
Paprika

Drain and break salmon into large pieces. Combine all ingredients except potato chips and paprika. Place salad in 6 well-greased individual casseroles or 6-ounce custard cups. Sprinkle with potato chips and paprika. Place casseroles on a baking pan, 15×10×1 inches. Bake in a hot oven, 400° F., for 15 to 20 minutes or until brown. Makes 6 servings.

Saucy Sardine Rollups with Mustard Sauce

2 cans (3¾ or 4 ounces each) Maine sardines
1 can (8 ounces) refrigerated crescent dinner rolls
Mustard Sauce

Drain sardines. Unroll crescent dough and separate into 8 triangles. Place sardines on the wide end of triangle and roll up. Place rolls on an ungreased baking pan, 15×10×1 inches. Bake in a moderate oven, 375° F., for 12 to 15 minutes or until lightly browned. Serve with hot Mustard Sauce. Makes 8 sardine rollups.

Mustard Sauce

½ cup sour cream
1½ tablespoons prepared mustard
2 teaspoons butter or margarine
½ teaspoon parsley flakes
⅛ teaspoon salt

Combine all ingredients. Heat, stirring occasionally. Do not boil. Makes approximately 5 cup sauce.

Opulent Oysters

2 cans (8 ounces each) oysters
¼ cup light cream
1 can (3½ ounces) French fried onions, crushed
2 tablespoons grated Parmesan cheese
2 tablespoons butter or margarine

Drain oysters. Place oysters in 24 well-greased small shells. Pour cream over oysters. Combine onion and cheese. Sprinkle over oysters. Dot with butter. Bake in a moderate over. 375° F., for 8 to 10 minutes or until lightly browned. Makes 24 appetizers.

Shrimp Pizza

3 cans (4½ ounces each) shrimp
⅓ cup chopped onion
3 cloves garlic, finely chopped
½ cup melted fat or oil
3 cans (6 ounces each) Italianstyle tomato paste
⅓ cup chopped parsley
1½ teaspoons oregano
3 unbaked pizza crusts, 9 inches each
¾ pound Mozzarella cheese, thinly sliced

Drain shrimp and rinse with cold water. Cook onion and garlic in fat until tender. Add tomato paste and simmer for 5 minutes. Remove from heat and add parsley and oregano. Place pizza crusts on well-greased cookie sheets or pizza pans. Cover each crust with 1/3 of the sauce, 1/3 of the shrimp, and 1/3 of the cheese. Bake in a hot oven, 425° F., for 15 to 20 minutes or until crusts are lightly browned and cheese melts. Makes 6 servings.

Deluxe Baked Scallops

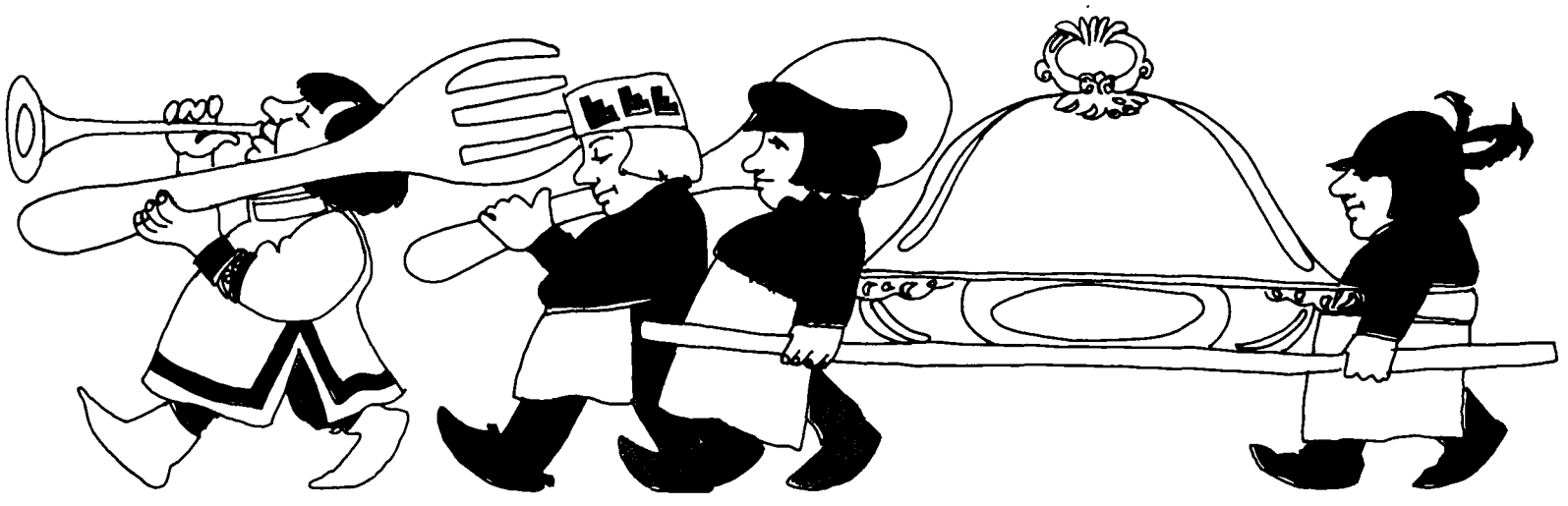
2 pounds scallops, fresh or frozen
1 quart boiling water
2 tablespoons salt
1 can (10½ ounces) condensed cream of mushroom soup
¼ cup sour cream
2 tablespoons frozen orange juice concentrate
2 tablespoons chopped parsley
1 tablespoon lemon juice
1 tablespoon grated onion
½ teaspoon salt
¼ cup dry bread crumbs
1 tablespoon butter or margarine, melted

Thaw frozen scallops. Rinse scallops with cold water to remove any shell particles. Place in boiling salted water. Cover and simmer for 2 to 3 minutes, depending on size. Drain. Cut large scallops in half. Combine all ingredients except crumbs and butter. Place in 6 well-greased individual shells or 6-ounce custard cups. Place shells on a baking pan, 15×10×1 inches. Combine crumbs and butter. Sprinkle over scallop mixture. Bake in a moderate oven, 350° F., for 20 to 25 minutes or until brown. Makes 6 servings.

Shrimp De Jonghe

1 pound cooked, peeled, cleaned shrimp, fresh or frozen
or
4 cans (4½ ounces each) shrimp
¾ cup toasted dry bread crumbs
¼ cup chopped green onions and tops
¼ cup chopped parsley
¼ teaspoon crushed tarragon
¼ teaspoon crushed garlic
¼ teaspoon nutmeg
¼ teaspoon salt
Dash pepper
½ cup butter or margarine, melted
¼ cup sherry

Thaw frozen shrimp. Drain canned shrimp and rinse with cold water. Combine crumbs, onion, parsley, and seasonings. Add butter and sherry. Combine crumb mixture and shrimp. Place shrimp mixture in 6 well-greased individual shells of 6-ounce custard cups. Place shells on a baking pan, 15×10×1 inches. Bake in a hot oven, 400° F., for 10 to 15 minutes or until brown. Makes 6 servings.



NOAA Opposes Portsmouth, Va., Refinery Site

Building an oil refinery in Portsmouth, Va., poses a grave threat to the Chesapeake Bay's $87 million shellfish industry and therefore should not be approved, NOAA Administrator Richard A. Frank has informed the Chief of Engineers of the Corps of Engineers.

In a letter to the Chief of Engineers, Frank said that an oil spill in the area could have severe adverse effects on the living marine resources, recreational uses, and the related economy of the area. Studies have shown that sediment-bound petroleum in estuarine areas can contaminate the area for more than 10 years. Said Frank, "Construction and operation of the Portsmouth refinery and terminal facilities pose a significant risk of substantial harm, including many lost jobs, to the Maryland and Virginia fishing industries, and thus, to the economies of those States. In my view, on the facts presented, these risks are not justified."

The Corps of Engineers announced its intention to issue a permit to the Hampton Roads Energy Company (HRECO) to build a marine terminal and operate a refinery on the Elizabeth River. The refinery is designed to refine 175,000 to 250,000 barrels of petroleum a day. In addition, the company would be permitted to dredge a tanker and barge approach channel and mooring areas, and to dispose of dredged material at the Craney Island Diked Disposal Area.

In the letter to the Chief of Engineers, accompanied by a 79-page report, Frank indicated that the risks of petroleum spills from the increased number of barges and tankers in the area had not been adequately considered in the decision on the refinery. Frank cited data to show that the accident rate of large tankers, of the size to be used by HRECO to transport both crude and refined products, is more than nine times greater than the overall tanker accident rate for the Hampton Roads area. Moreover, Frank noted, the Hampton Roads accident rate for these larger tankers is more than twice that of tankers of a similar size, worldwide.

Engineering Computer Optecnomics, a consulting firm which analyzed the risks of oil spills for NOAA, projects there probably would be a product barge or tanker accident resulting in the loss of more than 5,000 barrels of petroleum in the area about every five years. In the letter, Frank emphasized this is a conservative estimate that does not include a major accident such as a sinking.

If the HRECO refinery is built, Frank said, it is estimated that the volume of petroleum moving through Thimble Shoals would increase as much as 331 percent. Petroleum movements throughout the Hampton Roads and the rest of the Chesapeake Bay and its tributaries are expected to increase by 35 percent over and above the 1975 level.

An Interagency Task Force formed by the Chief of Engineers to evaluate potential sites for refineries indicated that there were 17 sites along the Eastern Seaboard more environmentally sound than the Portsmouth location.

Climate Book Covers San Francisco Bay

The second in a series of brochures on coastal resort areas of the U.S., emphasizing climatological information, has been published by NOAA's EDIS and the Sea Grant Marine Advisory Service of the University of California.

This brochure, entitled "San Francisco Bay—A Recreational Climate," provides information on the Bay Area's weather, slanted toward the vacationer and recreational users of the Bay, including sections on sailing and boating; and on recreational facilities, including a detailed chart and listing of public and private marinas, piers, and yacht clubs. There is also a section on sport fish, their seasons and locations.

The first brochure in the series was "Rhode Island's Vacation Climate." Future sites include coastal North Carolina, New York's Lake Erie, and the Michigan coast of Lake Michigan.

Copies of "San Francisco Bay—A Recreational Climate" may be obtained free of charge from Marine Advisory Program, Extension Wildlife and Sea Grant, University of California-Davis, 544 Hutchison Hall, Davis, CA 95616.

Copies of the Rhode Island brochure are available from the Rhode Island Department of Economic Development, Tourist Promotion Division, One Weybossett Hill, Providence, RI 02903.

NMFS Man Receives Diving Safety Award

William L. High, a fisheries biologist with the Northwest and Alaska Fisheries Center in Seattle has been awarded the Leonard Greenstone Diving Safety Award for 1978.

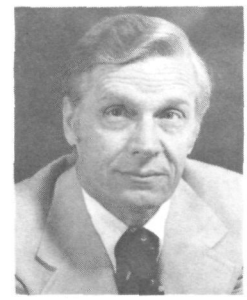
The award, considered by many to be the most prestigious of its kind, is made by the National Association of Underwater Instructors.

The award consists of a 29 inch tall bronze statue, which is retained for one year, and a $500.00 cash award. High also won numerous other gifts, including an all expense paid diving trip in Hawaii.

In bestowing the honor, the NAUI cited High's contributions to diving safety over the past ten years.

Hallgren Heads NWS; Cressman Joins NMC

Dr. Hallgren



Dr. Cressman

Dr. George P. Cressman, Director of the National Weather Service for 13 years, has returned to research at the National Meteorological Center. Dr. Richard E. Hallgren has been named the new Weather Service Director.

Cressman assumed his new position as research meteorologist at NMC on January 15. Commenting on Cressman's resignation, NOAA Administrator Richard A. Frank said, "Dr. Cressman has stimulated and guided major improvements in the NWS. His leadership and wise counsel will be sorely missed. He has made an immense contribution to NOAA, to the atmospheric sciences, and to the Nation."

Cressman said that "the action is one I have desired for several years and will give me an opportunity to use the powerful computational and meteorological tools at NMC to study some of the classical problems of meteorology."

Hallgren, the new NWC Director, was formerly Acting Assistant Administrator for Oceanic and Atmospheric Services. He is internationally known as a major contributor to global weather programs, and in the United States as an innovator of concepts and systems designed to speed the acquisition, processing and dissemination of weather information. Hallgren was Deputy Director of the National Weather Service from 1973 to 1977.

In related action, the position of Acting Assistant Administrator for Oceanic and Atmospheric Services was assumed by David S. Johnson, Director of the National Environmental Satellite Service.

Satellite with Lidar Could Give Wind Data

A laser radar (or "lidar") installed aboard a satellite 500 miles above the earth's surface would be able to measure winds in the atmosphere around the globe. NOAA scientists, Dr. T.

Rhidian Lawrence, Freeman Hall, Milton Huffaker, and Peter Mandics, of ERL's Wave Propagation Laboratory in Boulder, Colo., hope to have such an instrument ready for feasibility testing aboard the Space Shuttle in 1984.

The lidar, the scientists reported, would increase the utility of present environmental satellites, and could help improve weather predictions.

Instruments aboard current satellites like NOAA's polar-obiting and geostationary spacecraft allow wind velocity analysis to be done, but only where clouds are available.

"Our study indicates that a carbon dioxide laser-powered lider, or optical radar, could measure wind speed with an accuracy of one meter per second, and wind direction to within 10 degrees," Lawrence said.

He added that the lidar measurements also would provide valuable information on the depth of the planetary boundary layer and the intensity of atmospheric turbulence, neither of which is now available from satellite instruments.

The study was conducted under an interagency agreement between the Commerce Department, the Air Force Space and Missile Systems Organization, and the Defense Meteorological Satellite Program.

NMFS Opens New Charleston, S.C., Laboratory

Touring the newly dedicated NMFS Charleston Laboratory are (l to r) Pat Fair, fishery nutritionist; Secretary of Commerce Juanita Kreps; U.S. Senator Ernest F. Hollings; Warren Kane of the Senator's staff; Harry Seagran, Laboratory Director; Frank Raines, Associate Director for Economics and Government, OMB; and NOAA Administrator Richard A. Frank.

A new fisheries utilization and research laboratory was dedictated in October at the National Marine Fisheries Service's Southeast Fisheries Center, Charleston, S.C.

Situated at the South Carolina Marine Resources Center, the new Charleston laboratory is being leased to the Federal Government by the State, which constructed it at a cost of $3.8 million.

The 45,000 square foot facility is a part of the Southeast Fisheries Center, which includes seven laboratories from South Carolina to Texas.

The laboratory is concerned with the rational use of fishery stocks, the quality and safety of seafood products, and aquaculture nutrition research. It assists State and other Federal agencies, as well as industry, recreational groups and the general public, by providing them needed information.

Currently the laboratory is working closely with the South Carolina Sea Grant program in mariculture research on the Malaysian prawn, *macrobrachium*, which holds promise as a useful addition to local seafood resources.

Frank Seeks Stronger NOAA, Academia Ties

Administrator Richard A. Frank has announced a vigorous new policy to assure that NOAA benefits fully from people and resources available in the Nation's academic and research institutions.

Guidelines set forth by the Administrator call for actions to be taken by NOAA managers to:

- Increase their use of academic and research institutions in conducting NOAA research;
- Give prime consideration to locating new NOAA research facilities, and existing ones requiring relocation, at or near appropriate academic institutions;
- Effect additional cooperative agreements between NOAA research facilities and academic institutions;
- Make greater use of consultants from academic and research institutions, consistent with Federal employment policies, in the planning and implementation of NOAA research programs.
- Involve experts from academic and research institutions more broadly in significant policy making;
- Use innovative methods, including short-term (one to two years) employment, to attract a greater number of highly qualified individuals from the academic and research communities to NOAA.

Four Marine Sanctuary Sites Scrutinized

Three sites off the California coast have been selected by NOAA for possible designation as marine sanctuaries and one Texas site is being studied.

The California sites—Monterey Bay, an area around the Santa Barbara Channel Islands, and Point Reyes and the Farallon Islands—encompass some of the most ecologically important waters along the state's coast.

"Our studies so far," said Robert W. Knecht, head of NOAA's Office of Coatal Zone Management, "indicate that the three locations abound in values the marine sanctuary program is intended to preserve, including critical protection of marine mammals and seabirds, among them several endangered and threatened species."

The California Coastal Commission will hold hearings on these sites, Knecht added, and NOAA will incorporate the results in its evaluation.

A study of one of the most biologically diverse areas in the Gulf of Mexico 100 miles off the Louisiana-Texas coast, the Flower Garden Banks coral reef, will include work on a draft Environmental Impact Statement, one of the first formal steps in considering marine sanctuary status for the reef.

The study will analyze the pros and cons of marine sanctuary status for the Banks, including such aspects as petroleum development, refuse disposal and protection of the coral.

When completed, the study will help Federal officials reach a final decision on the Banks designation, and will ensure that State and Federal agencies, private industry, and the general public will have an opportunity to review the government's preliminary findings and respond to them.

NOAA Meteorologists Will Help at Olympics

A team of meteorologists with personal experience and interest in winter sports has been formed by NOAA to provide weather support to the U.S. Winter Olympics Committee as it prepares to host the 1980 Winter Olympics at Lake Placid, N.Y.

Four weathermen—three from NOAA's National Weather Service and one from the New York State Department of Environmental Conservation—will establish a temporary weather office in Lake Placid during the Olympics in the winter of 1979–80.

NOAA was asked by the U.S. Committee to provide weather forecasting support in view of the fact that the Olympics are expected to attract hundreds of thousands of spectators to the Lake Placid area.

The numbers of spectators expected, as well as Olympic Committee arrangements for handling them, call for frequent short-range, small-scale forecasts. This will enable highway snow removal crews, State and local police, and other authorities to operate at greatest efficiency.

The team, operating from temporary quarters in the Lake Placid Arena as a satellite operation of the National Weather Service's forecast office in Albany, will also provide meteorological information to competitors in the winter games.

Seven New Members Join CZ Committee

Seven new members have been appointed by Commerce Secretary Juanita M. Kreps to serve on the National Coastal Zone Management Advisory Committee.

The new appointees are Joseph Bodovitz, a consultant from Mill Valley, Calif., and formerly executive director of the California Coastal Commission; Ogden Doremus, an environmental attorney from Meter, Ga.; Patrick W. Kelly, head of the American Petoleum Institute's Coastal Zone Management Task Force, from Dallas; Steven A. McMillan, vice president of Earle, McMillan, and Niemayer, from Bay Minette, Ala.; Michele Perault, coastal coordinator for the Sierra Club, from Berkeley, Calif.; Dr. Shirley H. Taylor, chairwoman of the Sierra Club Task Force on Coastal Zone Management, from Tallahassee; and Henry Wheatley, president of Ocean Environments, Inc., from St. Thomas, Virgin Islands.

They will join the four other members of the Advisory Committee, which was established by the Coastal Zone Management Act of 1972 to make policy recommendations to the Secretary of Commerce on such matters as proposed legislation, Federal regulations, and the administration of the coastal zone management program.

For Outstanding Work

Volunteer Weather Observers Receive Awards

The National Weather Service has nearly 12,000 volunteer observers who make and record daily weather observations in all parts of the United States. The information they gather becomes a valuable part of the nation's weather history.

For their dedication and contribution to the Nation, 36 observers have been honored this year. Seven received the Thomas Jefferson award originated in 1959 for NWS to honor volunteer weather observers for unusual and outstanding achievements. It is the highest award the National Weather Service presents to volunteer observers. The award is named for Jefferson because the statesman-scientist made an almost unbroken series of weather observations from 1776 to 1816.

Twenty-nine observers received the John Campanius Holm Award, created in 1959 by NWS and made annually to honor volunteer observers for outstanding accomplishments in the field of meteorological observations. The award is named for a Lutheran minister who is the first person known to have taken systematic weather observations in the American colonies. The Reverend John Campanius made records of the climate without the use of instruments, in 1644 and 1645, near the present site of Wilmington, Del. These observations were published in Sweden by his grandson, Thomas Campanius Holm, in 1802.

Thomas Jefferson Awards

J.H. Conger, Edenton, N.C.
William H. Cumming, Houlton, Me.
Gertrude Harbison, Highlands, N.C.
Mary F. Harker, Heron, Mont.
Richard J. Hoge, Watertown, Wis.
Wade D. Moody, Pattonsburg, Mo.
L. Wayne Warner, Harrisburg, Neb.

John Campanius Holm Awards

Paul L. Burman, Wakefield, Neb.
Harry Burns, Millington, Miss.
Jack A. Campbell, Carlinville, Ill.
Robert M. Cantrell, Bonham, Tex.
Adrian Chamberlain, Thompsonville, Miss.
Donald S. Courson, Holly Springs, Mass.
Percy E. Dreher, Oaknolia, La.
Norbert Embke, Neillsville, Wis.
Berry A. Ferguson, Stilwell, Okla.
Ray L. Ford, Vona, Colo.
Philip E. Gerber, Danbury, Wis.
William J. Hicken, Gothenberg, Neb.
Carrie V. Hoover, Centerburg, Oh.
Louis A. Malarkey, Parker, Pa.
James M. Miller, Leesville, La.
Thomas A. Nichols, Santa Rosa, N.M.
Loyd C. Oleson, Crete, Neb.
Mabel Ramsey, Hot Springs, N.C.
Gilbert H. Reier, Warren, Pa.
Ward D. Reineke, Oakland, La.
Marguerite Riebe, Strawn, Tex.
Walter J. Schwarz, Worden, Kans.
Velmaine R. Solomon, Hiawatha, Kans.
Louise E. Swinney, Lexington, Mass.
O.J. Wall, Lustre, Mont.
Carl A. Wilson, Traer, La.
Gordon M. Wilson, Hebron, Neb.
John H. Wilson, Wooster Exp. Farm, Oh.
Ralph H. Wright, Redrock, N.M.

U.S. Fishery Product Exports to Japan Could Reach $1 Billion in Five Years, Frank Says

U.S. fishery product exports to Japan could reach $1 billion in five years and will approach $500 million in 1979, more than double the 1977 figure, Richard A. Frank, NOAA Administrator, has predicted. The prediction was made after a U.S. Export Development Mission headed by Secretary of Commerce Juanita M. Kreps in October returned from Japan.

Government officials and fishery industry leaders from Alaska, the West Coast, the Gulf and South Atlantic States, and New England discussed opportunities for expanding fishery imports from the U.S. with Japanese business and government leaders for five days.

"Progress was made at the meetings, but work remains to be done," said Frank. "Trade barriers must be reduced before we can consider the problem close to solution."

At the outset of the Tokyo discussions, Frank indicated that Japanese action on trade barriers to U.S. fisheries product exports would be a factor in U.S. determination of 1979 allocations to foreign nations wishing to fish for resources in the U.S. 200-mile Fishery Conservation Zone. The allocations will be made by the Department of State during the next several weeks. U.S. law requires that trade considerations enter into the making of allocations to foreign nations.

Frank stated that there are excellent opportunities to market many of the species in Japan, if we can reduce some of the trade barriers that limit market access. The U.S. has a $2.1 billion deficit trade balance in fishery products and a $14 billion overall trade deficit with Japan. Implementation of the U.S. 200-mile fishery conservation zone has created opportunities to expand U.S. production and exports of fish products.

Developing Nations Get NOAA Research Grants

NOAA has announced a program of international cooperation in marine research with a number of developing nations to aid their efforts and to promote exchange of information on oceanic and coastal resources.

Under the program, funded by $913,400 in grants from NOAA, seven U.S. academic institutions associated with the agency's Sea Grant College Program will undertake cooperative marine programs with counterparts in Chile, Costa Rica, Malaysia, Mexico, Israel, and Colombia.

Primary emphasis will be on education and training, Dr. Ned A. Ostenso, Director of NOAA's National Sea Grant College Program, said. Research and advisory service functions will also be included. The program was authorized by legislation in 1976, and is coordinated with the U.S. Department of State.

The University of Delaware Sea Grant College Program received a two-year, $303,500 grant for a cooperative marine studies program with the University of Costa Rica; while a $199,900, two-year grant was awarded the University of Miami to support a marine resources and environmental sciences training program in cooperation with several educational institutions in Colombia, and coordinated with the Colombian Oceanographic Commission.

The Sea Grant Program at the Virginia Institue of Marine Science (VIMS) is using a $131,400 grant to train personnel in Israel in wave measurement and modeling techniques and to improve Israeli marine advisory services in wave information and coastal zone planning. The VIMS project is for a two-year period.

The University of Rhode Island Sea Grant College Program has received $95,000 for a one-year project in Malaysia with the University of Malaya and the University Pertinian Malaysia. This project will develop academic programs in fisheries management, coastal zone management, and related fields, plan future research projects, and outline a structure for a local marine extension service.

The Oregon State University Sea Grant College Program is assisting Latin American nations in the development of appropriate levels of competence in marine resource conservation with its $90,000, one-year grant. Chief participating institution in Latin America is Catholic University of Valparaiso in Chile.

An award of $72,000 to the New York Sea Grant Institute is strengthening marine science capabilities in Chile. The two-year project, carried out with the University of Concepcion, concentrates primarily on training faculty members of the Department of Marine Biology and Oceanography in coastal zone mangement techniques.

The Louisiana State University Sea Grant College Program has been granted $21,600 for a one-year project in Mexico. Among the tasks there are identification and quantification of the ecological associations between Terminos Lagoon at Campeche and the fisheries.

New Office to Oversee Pollution Programs

Dr. Ferris Webster, Assistant Administrator for Research and Development, has established a Marine Pollution Office to serve as focal point for all relevant activities within his area of responsibility.

Headed by Capt. R.L. Swanson, the Office reports directly to Dr. Webster and exercises line authority over the Marine Ecosystems Analysis (MESA) program, Outer Continental Shelf Assessment program, Hazardous Materials Response program (an outgrowth of the Spilled Oil Research teams), long-term effects research under the ocean dumping act, and NOAA research initiated under the 1978 ocean pollution act.

Capt. Swanson of the NOAA Corps has headed the New York Bight project of the MESA program for several years, bringing together a varied and diffuse group of research interests to focus on the problems of a body of water heavily impacted by the Hudson and Raritan river outflow and the huge populations of the area. Under his leadership, the citizens, municipal authorities, and governing bodies of the area have been able to focus on the problems of ocean dumping and pollution in what is perhaps the most stressed estuary in the U.S.

Cooperating in this effort have been the National Marine Fisheries Service, Sea Grant, the National Ocean Survey, and many others within and outside NOAA.

IWC Sets Whaling Quotas for Current Year

The International Whaling Commission has agreed to eliminate sperm whaling completely in one area of the Southern hemisphere and also voted to reduce sperm whale quotas drastically in the North Pacific.

Calling the results of the December meeting in Tokyo "a significant victory," Richard A. Frank, U.S. Commissioner to the IWC and NOAA Administrator, stated: "We are pleased that the Commission has acted vigorously to curb whaling for sperm whales. The United States would have preferred and strongly urged a complete elimination this year of sperm whaling in the North Pacific. However, we believe that the substantial reduction voted by the Commission will mean the end of pelagic whaling in this region by Japan."

In 1978, sperm whale quotas were set at 561 for Division 5 of the Southern hemisphere (an area from the equator to the Antarctic, and 90 degrees east longitude to 130 degrees east), and at 6,444 in the North Pacific. The Commission's action set a moratorium on whaling in Division 5 and reduced North Pacific quota to 3,800 for 1979, a cut of more than 40 percent. The Commission further established a zero quota for female sperm whales in the North Pacific, although it did allow an accidental catch of slightly more than 400 females to be counted against the total quota.

The Commission also passed two strongly worded resolutions introduced by the United States, calling for a prohibition of trade in whale products and implementation by the member and non-member nations. "If fully adhered to," Frank predicted, "these resolutions will go a long way toward bringing all whaling operations under effective international regulations."

Frank expressed caution and optimism about the possibility of future conservation gain in the Whaling Commission: "The progressive reduction in quotas is encouraging. Progress in the Commission to achieve a total moratorium on whaling is not as fast as we would like, but the Commission is continuing to move in the right direction for reducing quotas and thus providing better protection for the great whales."

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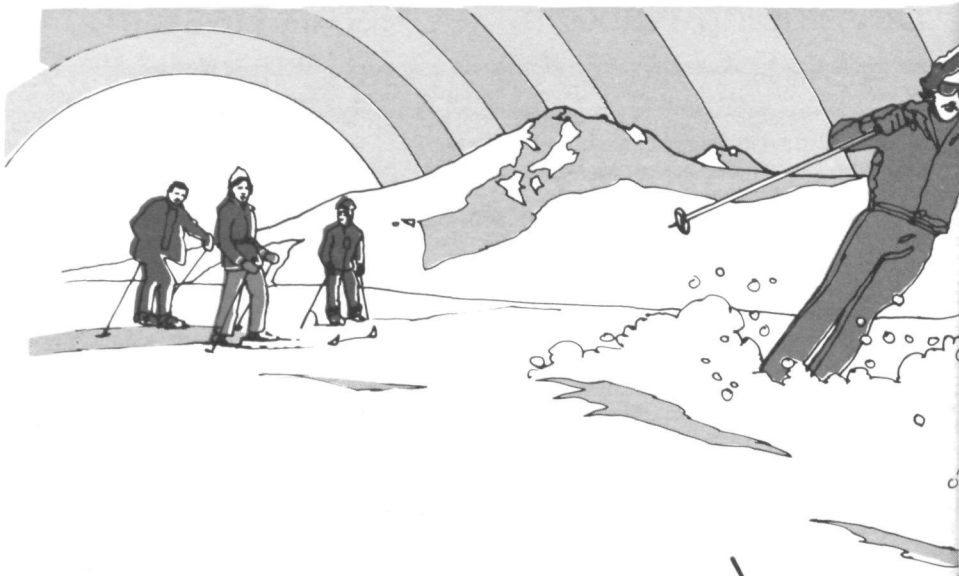

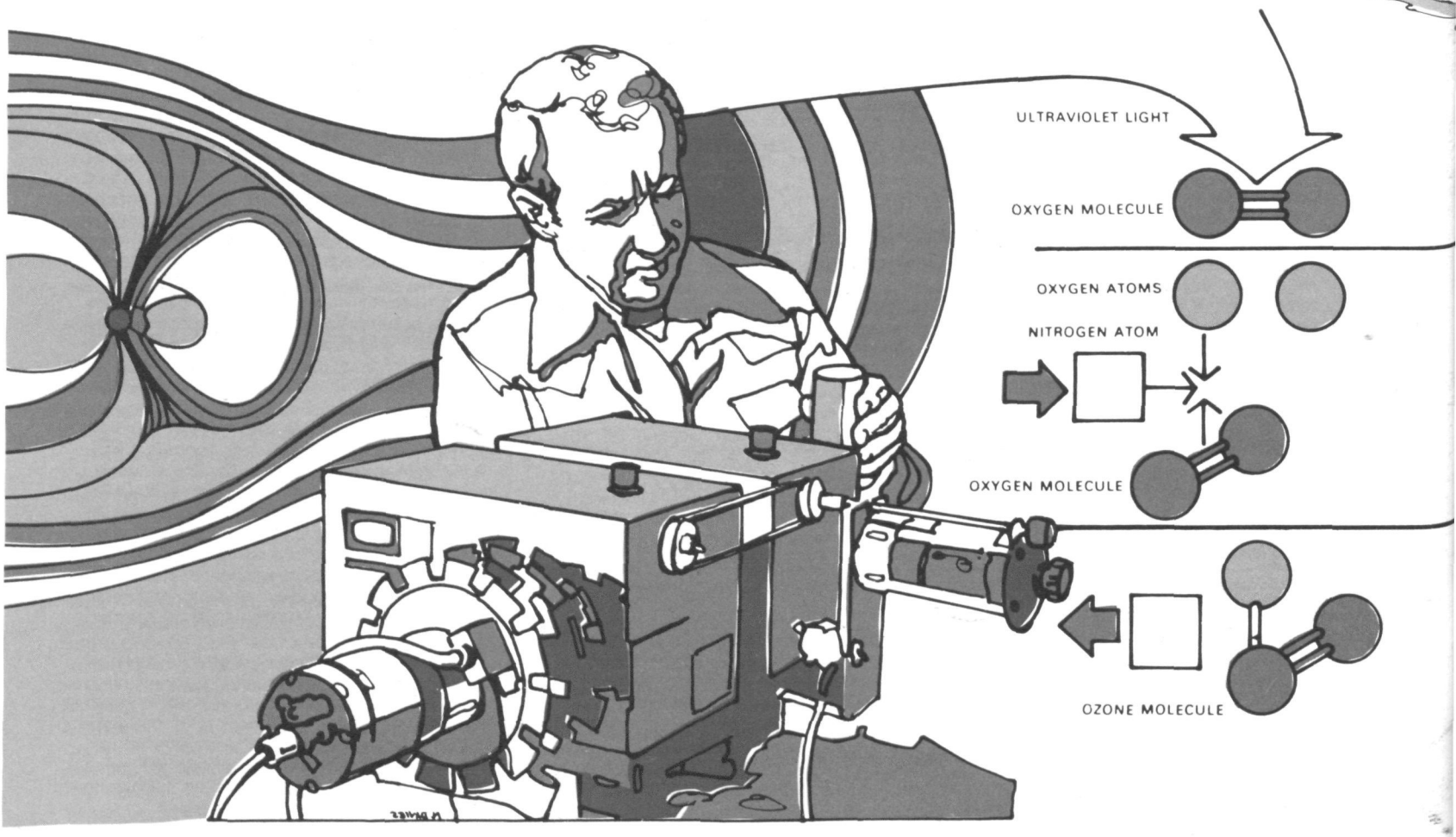

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