that consumer representation be brought into the FDA decision-making process; that the FDA be given "scientific independence" from industry by setting up a well-funded research laboratory or a referral board that might act as an umpire in judging scientific claims; and that the FDA "regain the confidence of its own scientists" by easing the rules of publication, using university professors as science adviser ombudsmen, and allowing scientists a more direct part in FDA decision-making. The students particularly urge that the FDA seek to enforce the law rather than simply try to persuade industry to obey the law. A basic theme of the whole report is that the FDA's "faith in industrial self-regulation" has been misplaced.

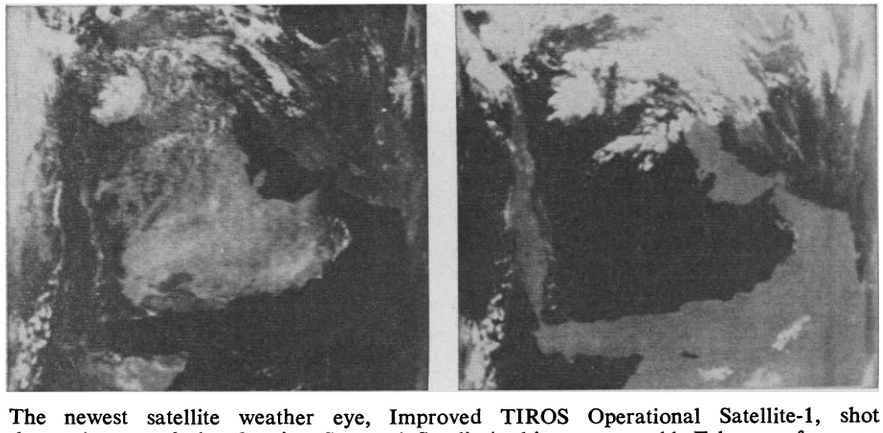
What is one to make of this outraged, sweeping attack on the FDA? To begin with, one must note that the report was put together by young people, students mostly, who presumably came to Washington expecting to find out how the system had gone wrong. There is thus a possibility that the report contains errors resulting from youthful inexperience or from the blindness that sometimes afflicts those with a preconceived notion of what they might find. Yet Nader, over the years, has developed a reputation for accuracy that few reformers can match. And while Nader did not participate directly in the study of the FDA, he has emphatically endorsed the task group's report. At the press conference last week, he said the report documents "a story of truly massive deception" by the FDA and industry.

The report has few, if any, kind words to say about FDA. It thus reads more like an indictment than like a balanced appraisal. But the function of the report is to point out shortcomings and to goad the agency into reform. For that purpose an indictment is probably more effective than an "on-the-one-hand-this . . . on-the-other-hand-that" approach. In answering previous attacks the FDA has tried to shift the blame to Congress for failing to provide the agency with sufficient funds, staff, and authority to carry out its responsibilities. The students will accept that explanation only in part. "The real heart of the failure," they say, "is the agency's misdirected leadership" and the "destructive intervention" of the political appointees who supervise the agency. The report is overwhelmingly negative in tone. But if even half of the charges made by the students are true—and Nader's batting average is reputedly much higher than that—then the FDA is unquestionably in need of a major overhaul.—PHILIP M. BOFFEY

Weather Services: Working toward Worldwide Forecasts

Weather prediction for public consumption in the United States began in the 1850's with a group of amateurs, linked by telegraphy, observing storms in the Great Lakes area in order to warn ships. Today the government is on the threshhold of participating in two new giant international experiments, designed to fill gaps in the understanding of the world's weather system.

The two experiments, plus the results of an earlier one, may lead to a truly accurate and complete global network of weather forecasting. A World Weather Watch (WWW) was formally established in 1968, but the name denoted a goal rather than a fact (*Science*, 16 June 1967). The WWW is a global observation network and data-processing and telecommunications system with three centers—Moscow, Washington, and Melbourne. But weathermen do not have adequate facilities all over the globe—observational facilities are particularly lacking in underdeveloped countries and on the oceans—and weathermen do not completely understand tropical weather. The two projected experiments are designed to help fill the gaps.



The newest satellite weather eye, Improved TIROS Operational Satellite-1, shot these pictures of the Caspian Sea and Saudi Arabia area on 11 February from an altitude of about 920 statute miles. The photograph at the left was shot during daylight hours; the one at the right was shot during total darkness by a scanning radiometer. For the first time, relatively inexpensive ground stations all over the world are receiving nighttime as well as daytime cloud cover pictures from ITOS-1.

The two new experiments were discussed at a conference in Brussels late in March, attended by delegates from 25 nations, which was sponsored by the World Meteorological Organization (WMO) and by the International Council of Scientific Unions (ICSU). Robert Mayer White, administrator of the U.S. Environmental Science Services Administration (which includes the Weather Bureau), led the American delegation.

The Brussels conference agreed to begin a "Tropical Experiment" in the fall of 1973 or 1974 in the tropical Atlantic region—from about 15°N to 10°S. The participating nations tentatively volunteered to donate up to 24 oceanographic and meteorological vessels and ten instrumental aircraft. Britain and France each said they hoped to have new satellites in orbit to aid the experiment.

A Tropical Experiment Board was appointed to manage the experiment,

White said. It will have its first meeting this spring, in the United Kingdom. WMO will soon begin approaching nations in the tropical Atlantic region—Venezuela, Nigeria, Gabon, Brazil, and others—on plans to set up stationary bases. Participating countries will decide before next January what funds, men, and equipment they will donate.

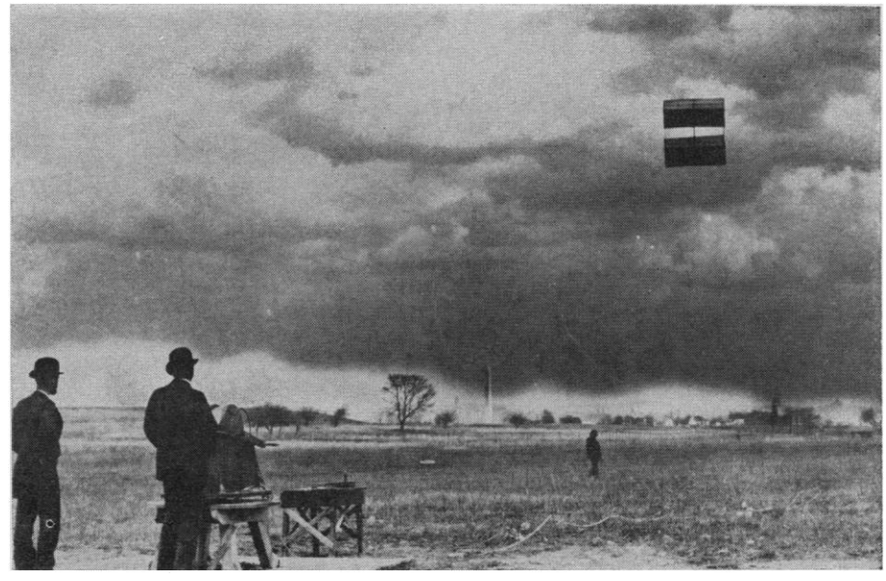
"The purpose of the Tropical Experiment is to examine and understand the energy transformation processes in the tropics," White said. He explained that weathermen cannot make truly accurate predictions unless they know and understand the weather all over the globe; satellites, beginning with TIROS I in 1960, have helped to provide such information, but there are gaps in coverage.

The Tropical Experiment will be the second large experiment of the Global Atmospheric Research Project, sponsored by WMO and ICSU. The first, the Barbados Oceanographic and Meteorological Experiment, took place during May, June, and July of 1969 in an area east of Barbados in the West Indies (*Science*, 28 March 1969).

The Brussels conference agreed that a third experiment would be carried out in a few years—probably some time after 1975, White said. The joint organizing body of WMO and ICSU was asked to come up with plans at another international meeting, to be held next year. Tentative plans call for around-the-globe simultaneous weather observations, designed to determine how efficient the existing weather observation system is and how it can be improved. All data would be fed into computers, and from them would emerge a 2-week forecast. This effort would require instantaneous transmission of data from even the remote parts of the world and the development of computers capable of turning out forecasts at very high speed.

The Brussels conference fell in the centennial year of the establishment of the United States weather service. In America, weathermen have progressed from simple observation, to theoretical models, to efforts to modify certain types of weather. The same pattern seems to be developing in the World Weather Watch.

American weathermen began by predicting storms on the Great Lakes and at sea, issuing frost warnings to farmers, warning of floods and hurricanes, and exchanging weather data with meteorologists in other countries. The first telegraphic network of weathermen was a group of amateurs, organized by Joseph Henry of the Smithsonian Institution in 1849.



Early 20th-century weathermen frequently used kites to carry instruments aloft. This site is near what is today Washington National Airport.

A series of terrible storms on the Great Lakes led to the official establishment of the weather service as part of the military establishment in 1870. The work of the weather service was transferred to the Department of Agriculture in 1890, as it became increasingly important to civilian life.

Early weathermen used balloons, kites, thermometers, and barometers to make their observations, which were communicated by telegraph. After 1900, weathermen acquired the use of wireless telegraphy, radio, and airplanes. In 1908 the weather service began weekly forecasts and a warning system for forest fires.

The first sophisticated theory of weather was the polar front theory, developed by Norwegian professor Vilhelm Bjerknes and his son Jacob during World War I. Their theory postulated interacting air masses and warm and cold fronts. In 1926 the Weather Bureau was given its first clear-cut authority to conduct research (in support of aviation); this function was expanded into a Meteorological Research Division in 1936.

In 1939 Professor Carl-Gustaf Rossby and his colleagues at the Massachusetts Institute of Technology developed a mathematical technique for forecasting the movement of planetary winds. The winds, now called Rossby waves, steer the cold and warm air masses that cause surface weather; the waves are hemispheric in scale and circle the globe.

Now, more sophisticated models of the many layers of the atmosphere are in use. Weathermen are assisted in making these three-dimensional models by computers, satellites, radar, and a wide range of new observational techniques.

By 1951, scientists of 30 nations, including the United States, were actively experimenting with weather modification. Artificial nucleation (seeding) techniques are used on clouds and hurricanes, for example. A snow modification project is being tried around lakes Erie and Ontario in an effort to spread inland some of the heavy snowfall in that region. Experiments are being conducted on modifying hail storms, fogs, and lightning.

On a global level, the international weathermen are still at the predicting and theorizing stage—and there are still many areas of the world where local weathermen base their predictions on rheumatic joints!

—NANCY GRUCHOW

Erratum: Due to an oversight, credit was not given for Fig. 1 of "Object-carrying by rats: an approach to the behavior produced by brain stimulation" by Anthony Phillips *et al.* (14 Nov. 1969, p. 903). The figure was modified from figures which appeared in J. F. König and R. A. Klippel, *The Rat Brain: A Stereotaxic Atlas of the Forebrain and Lower Parts of the Brain*, published by the Williams and Wilkins Company, Baltimore, Maryland, 1963.

Erratum: In "*Toxoplasma gondii* in cats: fecal stages identified as coccidian oocysts" by J. K. Frenkel *et al.* (6 Feb., p. 893), the last sentence of paragraph 1, column 3, page 894, should read "Two unfed kittens did not excrete oocysts, nor was *Toxoplasma* isolated from their fed feces or organ passages."