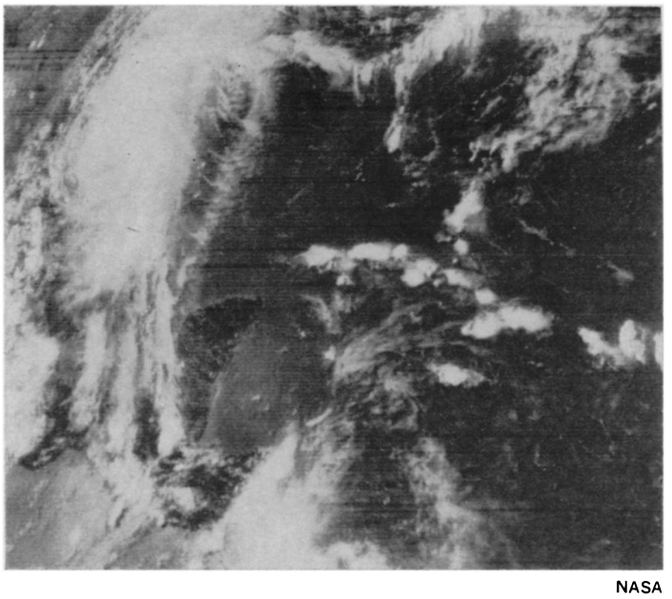
Weather probe set near Barbados

U. S. launches the largest air-sea project ever devised in search of weather origins



NASA

ATS view: Hurricane Candy over Gulf of Mexico in 1968.

by Ann Ewing

Most of the sun's heat is stored in the tropical oceans between the latitudes 30 degrees on either side of the equator. But the earth loses heat by radiation almost uniformly at all latitudes.

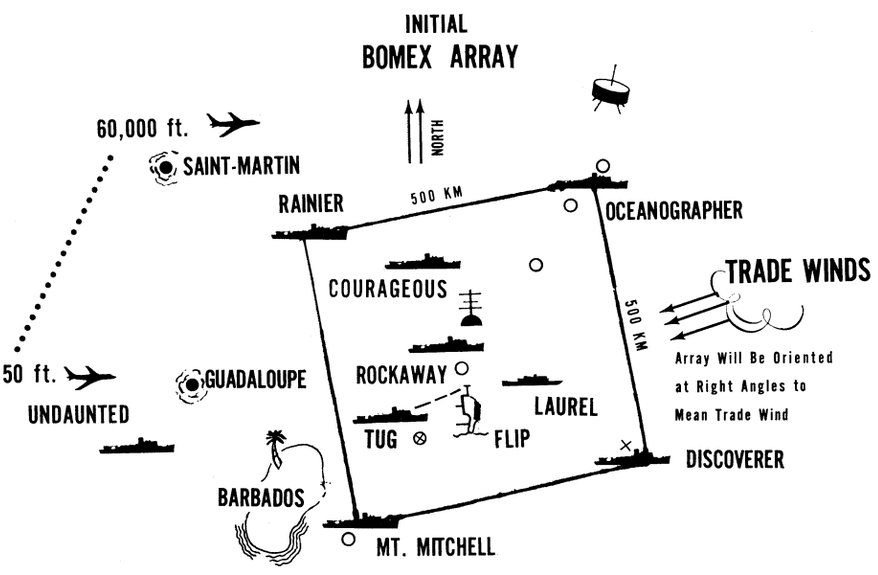
So the heat has to be transferred from equatorial regions to more northerly latitudes and the poles. This transport of heat occurs mainly in the atmosphere by processes about which very little is known. But it acts as the engine that moves the world's weather.

From what they have observed, weather scientists conclude that heat transport occurs in three stages.

First, the energy in the ocean transfers to the atmosphere in a turbulent boundary layer about 6,000 feet thick, a giant version of the roiling steam visible above the surface of a slowly boiling pan of water. This energy moves from oceans to air as latent heat in the form of water vapor. It then finds its way from the turbulent boundary layer to the upper layers of the troposphere. Finally it is transported to higher latitudes by fast-moving air currents, sometimes in the nature of globe-circling jet streams.

At all times the atmosphere contains some 3,100 cubic miles of water, recycling from the top layers of the oceans and other large bodies of water to the atmosphere every 10 days. Its movement is so little known that weather cannot be predicted accurately by more than two days for most land areas.

To help lay an observational basis for improving forecasts, and for understanding the transport itself, the United States from May to July this year will conduct the most exhaustive study of air-sea interaction ever undertaken over a large ocean region. The survey will cover an area 500 kilometers square east of the near-equatorial island of Barbados in the West Indies. It is called BOMEX, Barbados Oceanographic and Meteorological Experiment (SN: 11/9, p. 476).

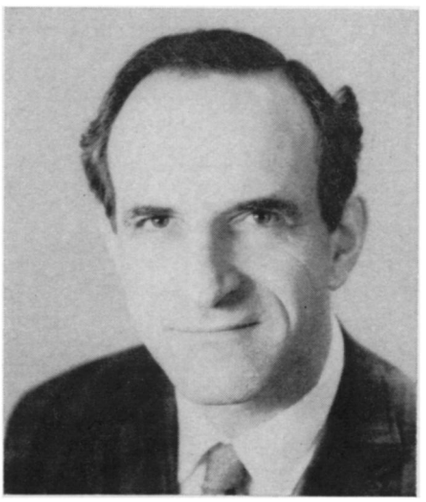


Until July 2, ships, buoys and planes will be on these stations for BOMEX.

BOMEX will employ a staff of about 1,500, 7 satellites, 24 aircraft, 10 ships and a dozen ocean buoys to probe the atmosphere up to heights of 100,000 feet and the Atlantic Ocean to its 18,000-foot floor.

The project is a planning and logistics nightmare, involving 7 Federal departments and agencies, 19 universities and 7 industrial laboratories.

BOMEX will explore the first two steps in the three-phase atmospheric energy transfer process, examining in detail the exchange of energy between ocean and atmosphere, as well as the vertical and horizontal spreading of these energies within the two regimes.



Holland: Like a museum guard.

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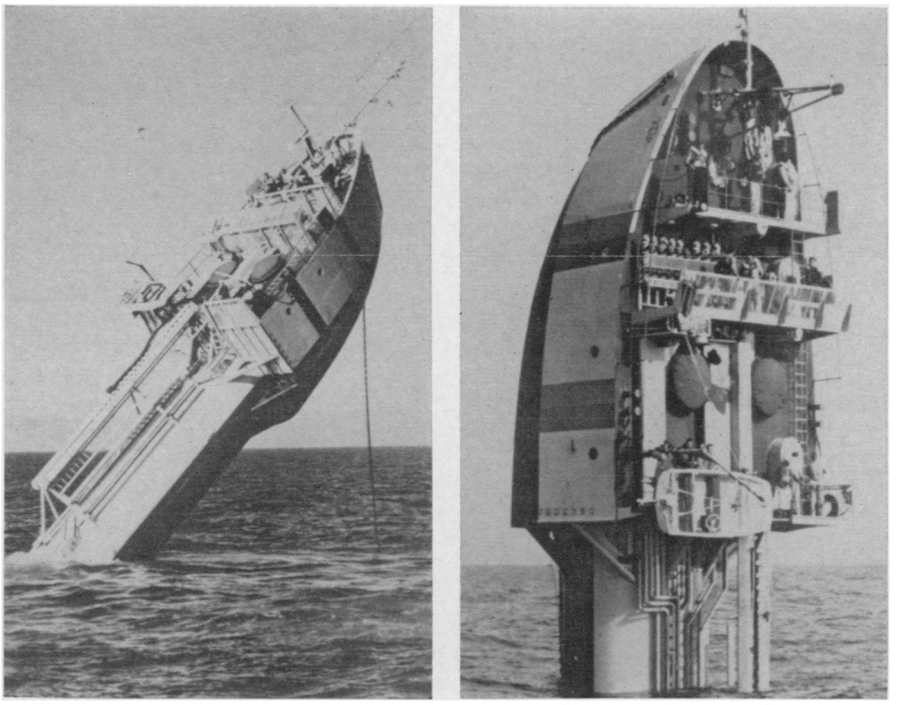
. . . Barbados weather watch



Scripps Institution of Oceanography

FLIP: Down into the sea again, for the first time in the Atlantic Ocean.

So huge is the amount of data to be collected that Environmental Science Services Administration, the coordinating agency for BOMEX, is using the National Aeronautics and Space Administration's Mississippi Test Facility for the design, installation, maintenance and operation of computerized data-handling equipment for the project. Scientists and engineers there have developed and manufactured five units called SCARD, for Signal Conditioning and Recording Device, to be installed on five permanently stationed ships.

The tapes containing the data will be processed fast enough for the BOMEX director, Dr. Joachim P. Kuettner of ESSA Research Laboratories, to modify the observation program if this is required. "The core of BOMEX," says Dr. Kuettner "is the program to monitor the air-sea interaction."

Dr. Joshua Holland of the Atomic Energy Commission, who is chief scientist for this phase of the program, has likened the BOMEX program to a museum guard with a clicker counting the number of people who come in and out, except that what is being measured is heat transfer instead of people, and 90,000 square miles is a very large museum.

Observations and data collection are scheduled in four phases of about two weeks each, with a nine-day lapse between each to allow for supplying the ships in the port of Bridgetown, Barbados. During the first three phases the ships and buoys will be positioned to cover a square, with one ship in the center, from about 12 degrees north to 18 degrees north. For the fourth phase, from July 11 to 28, the array will be flipped five degrees to the south by reassigning the two northernmost ships to positions about 8 degrees north.

The experiments are timed to permit observations during periods of limited tropical depressions in the early portion, and of active tropical depressions, from which hurricanes sometimes form, in the later portion. July is a heavy hurricane time in the area: between 1901 and 1967 14 tropical storms passed through the area during the month.

To permit the five fixed ships to anchor at their stations, free-fall mooring systems have been devised, consisting of six-ton clump anchors and wire bales. Their use in BOMEX will mark the first time that ships of such size, 200 to 300 feet long, have anchored in 18,000 feet of water for such a length of time. Their exact positions will be determined using the Navy's Omega navigation system.

Each of the five is equipped with a tethered, dirigible-like balloon, 20 feet long and 10 feet in diameter, instrumented for low-level soundings to provide temperature, humidity and wind measurements at three levels close to the sea surface.

Also in a permanent position on the square will be FLIP, a 355-foot research platform operated by the Scripps Institution of Oceanography for the Office of Naval Research. This Floating Laboratory Instrument Platform will be

. . . weather watch

operating in the Atlantic Ocean for the first time since she was built in 1962. Since FLIP has no motive power, she is being towed horizontally to her assigned position at about 13 degrees north.

When FLIP reaches her work station, her ballast tanks will be flooded to flip her to the vertical position in which only 55 feet of the vessel is above the water line, the remainder extending 300 feet into the ocean. She provides a very stable platform: In 35-foot waves, vertical oscillations average less than three inches.

Seven satellites will be used full-time in BOMEX: ESSA 2, 6, 7, 8 and 9, and two Nimbus. And the National Aeronautics and Space Administration's ATS-3 satellite, to be used only for the fourth phase, will be moved during July from its position over the equator, at 73 degrees west, some 1,600 earth miles eastward to hover at 47 degrees west, still 22,300 miles above the equator.

The July observations will be concentrated on a study of tropical weather disturbances, with the specific objective of gaining information needed for improved mathematical models of the global atmosphere. One aim is to determine whether moderate disturbances are similar in structure to intense ones, such as hurricanes. For this portion of the experiment equipment will be installed on Barbados to receive photographs directly from the ATS-3. The continuous photographs acquired from this synchronous satellite will be used to select disturbances for study and to guide aircraft to them.

BOMEX is forerunner of a series of large-scale research projects planned by the nations of the world under the Global Atmospheric Research Program, and directed toward the development of the World Weather Watch in the mid-1970's.

Although BOMEX too was at one time planned as an international program, the planning and logistics became so involved that the U.S. decided to go it alone, with the cooperation of the Barbados authorities, who will furnish port facilities, housing and other services for the three-month-long experiment.

Dr. Jule G. Charney of Massachusetts Institute of Technology, chief scientist for the fourth phase of the BOMEX program and chairman of the U.S. committee for the global atmospheric effort, thinks the GARP experiment will add greatly to the storehouse of observational data on which physical understanding of atmospheric processes must be based.

"This storehouse," he says, "is now beginning to be exhausted and should be replenished." ◇