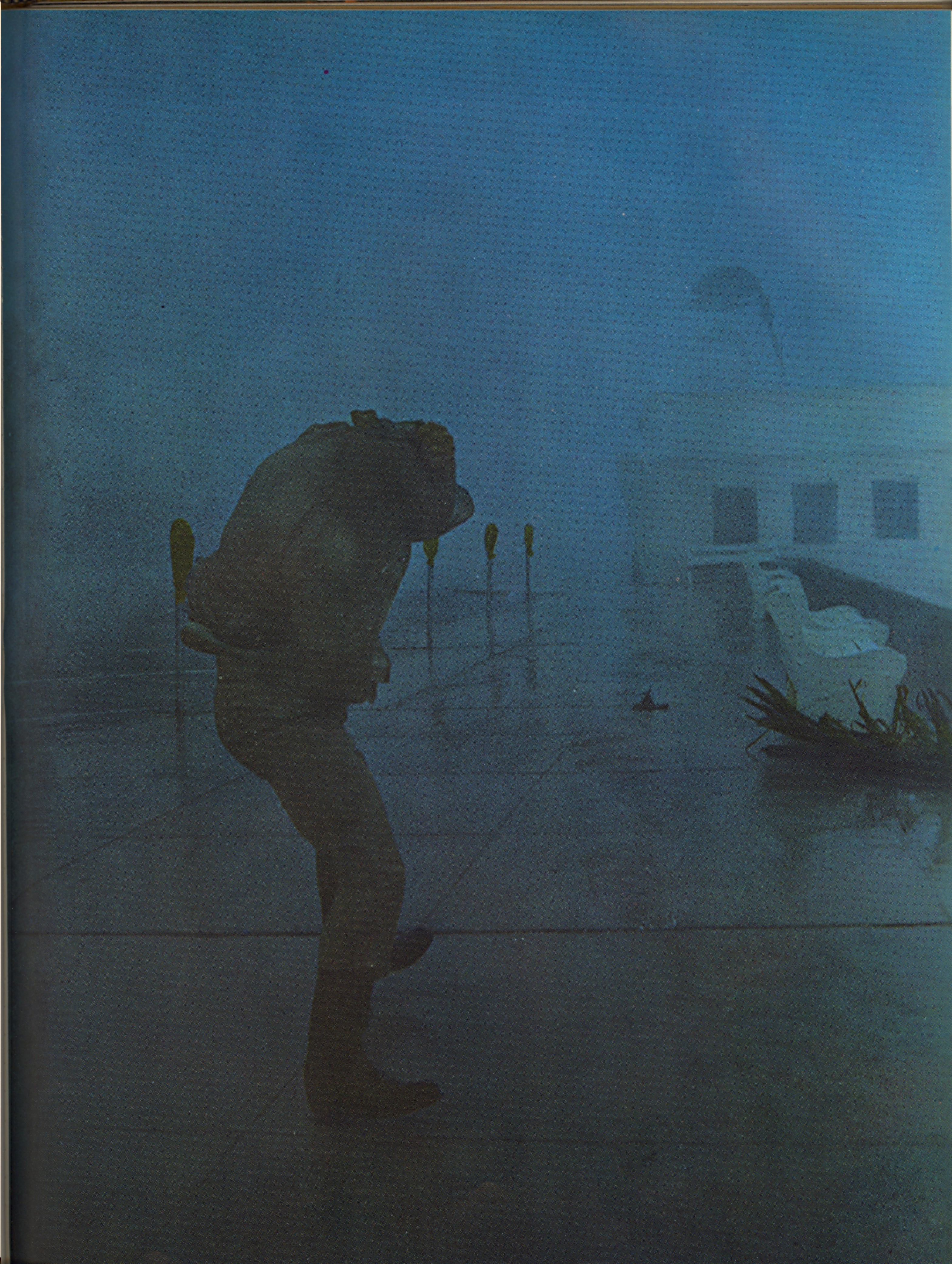
our heads. Often, not even the weatherman knows which one will win. The chief of the U.S. Weather Bureau made a celebrated slip in 1909, when he predicted clear weather for President Taft's inauguration and the ceremonies were caught in a howling snowstorm. His resignation did not solve the problems of the U.S. Weather Bureau. In 1916, a Congressman proposed abolishing the Bureau on the grounds that one of his constituents made better weather predictions with a sourwood stick. Unfortunately, both the constituent's name and his invaluable sourwood stick have been lost to history.

Every once in a while a northbound mass unexpectedly holds off a southbound one—or the other way around—ushering in an Indian summer in October, a thaw in February or a week of cool nights in July. The collisions and interactions of air masses generate winds, rains and thunderstorms from Cape Cod to San Francisco. Temperatures in Chicago or Butte typically shuttle over a range of 40° in any given month: they usually vary that much within a week, and often within a single day.

As Mark Twain warned, "Weather is a literary specialty, and no untrained hand can turn out a good article on it." The transfer of the world's supply of heat that produces weather is cumbersome, inefficient and turbulent. It is the bane of the weatherman; for the rest of us it is sometimes a sower of despair, and sometimes a delight.

Man against Hurricanes

The hurricane—sometimes called typhoon, willy-willy, *baguio* or tropical cyclone —is nature's most destructive force. A whirling windstorm of enormous power that is spawned mysteriously and suddenly in the otherwise gentle-weathered tropics, it goes roaring northward to wreak its capricious will across thousands of miles of sea and shore. In the Atlantic and Caribbean, about 10 hurricanes are born every year. Since 1900 they have cost the lives of 12,000 U.S. citizens and destroyed some $15 billion of U.S. property. The loss might have been less if men knew more about hurricanes—why, when and where they are formed, and why they veer in the directions they do. Weathermen are making urgent efforts to solve these puzzles, so they can give warning early enough to allow citizens to batten down or flee. One day, perhaps, man will know enough about hurricanes to stop or steer them. Until then, about all he can do is take cover.



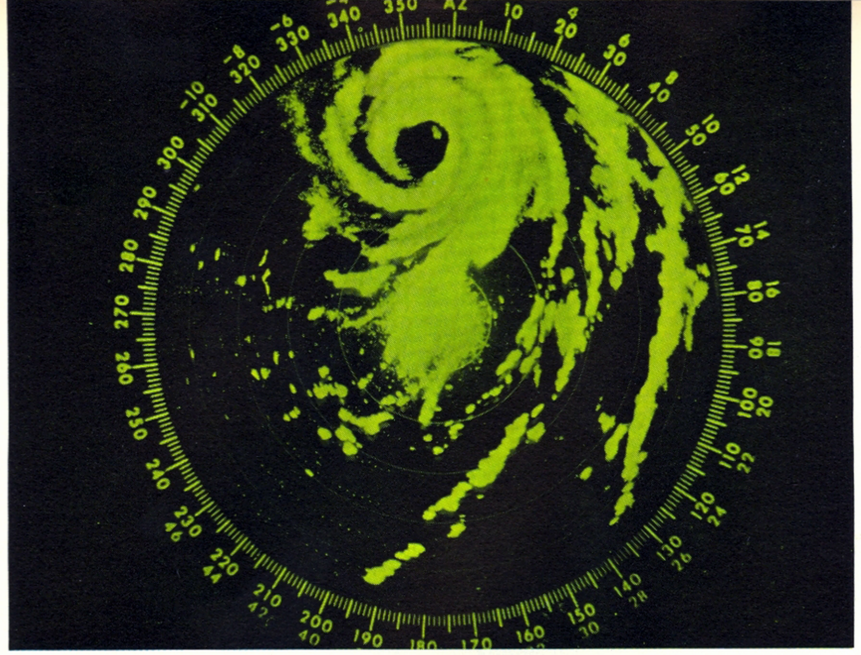
MAN MEETING HIS MATCH
A lone man rocks off balance as a hurricane batters the waterfront at Palm Beach, Florida. When this picture was taken, winds were gusting to 100 miles an hour, with highest winds still to come. At a storm's peak, winds may hit 150 to 200 miles an hour—striking with such force that clothes are ripped from people's backs, cars swept from roads, trains brushed off their tracks.

Seeking to Know the Enemy

United States hurricane research began in a small way in the Spanish-American War, when the storms so threatened U.S. forces that President McKinley commented, "I am more afraid of a West Indian hurricane than of the entire Spanish Navy."

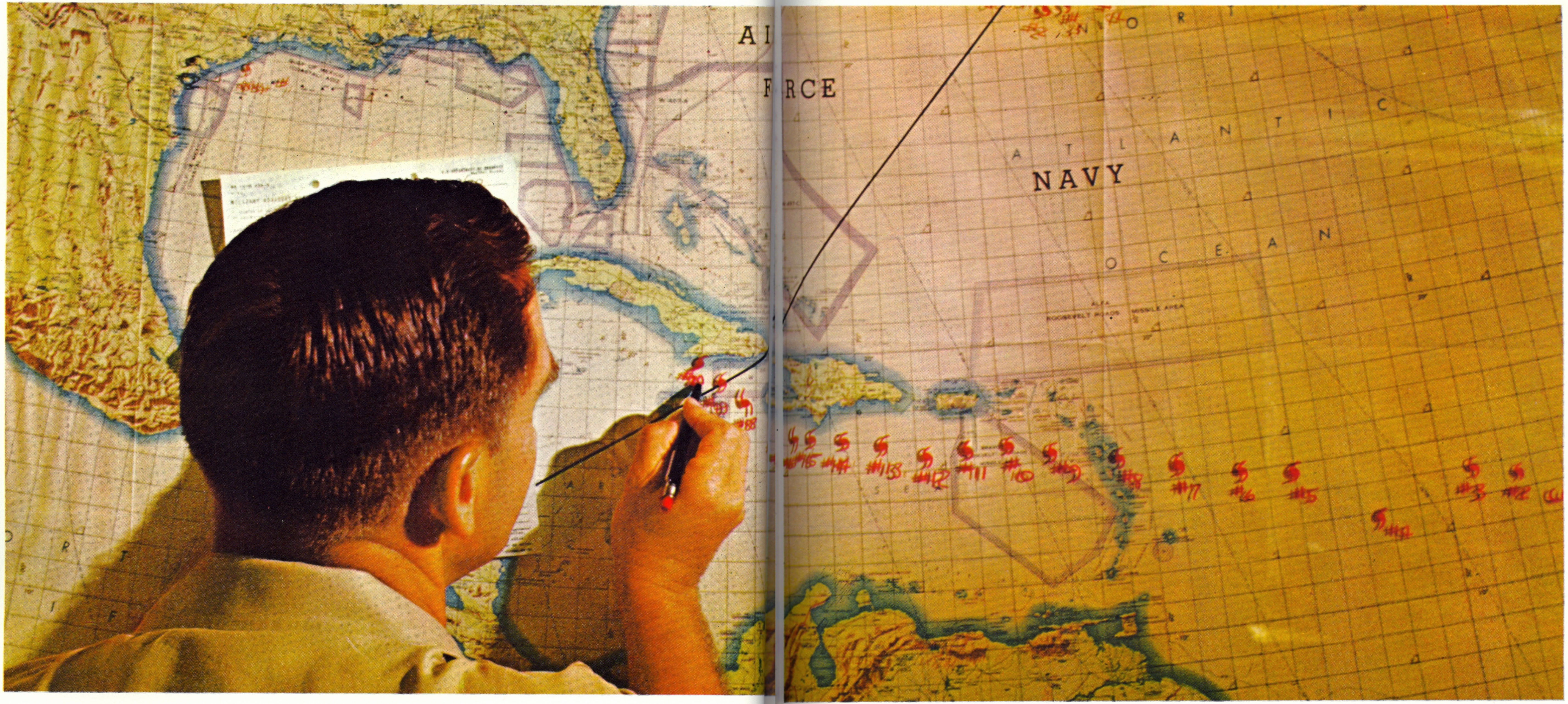
But no large-scale hurricane studies began until 1955, when Hurricanes Connie and Diane smashed an unprepared East Coast, costing billions of dollars in damage. After that the National Hurricane Center was set up at Miami, with the job of locating and tracking hurricanes, and, if possible, learning to predict their paths and perhaps controlling them.

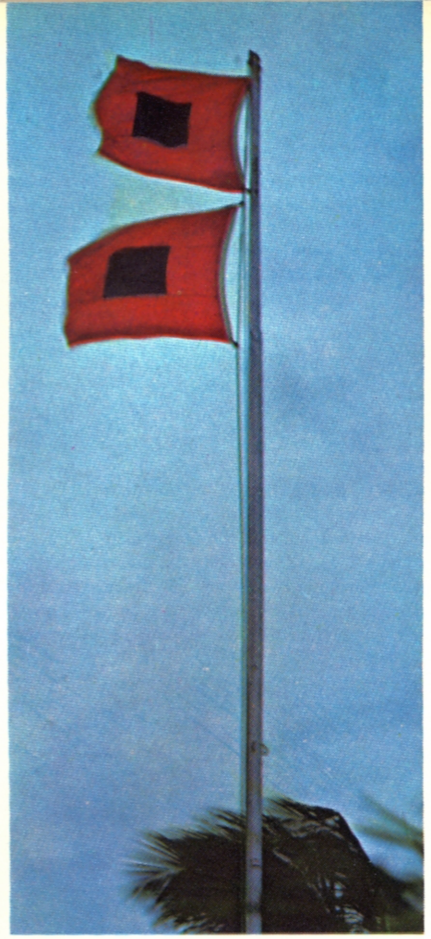
Today, hurricanes are usually spotted at sea by passing ships or by one of the "hurricane-hunter" airplanes that patrol the Caribbean-Atlantic seedbed of storms. After locating the hurricane, the meteorologists make an intensive effort to chart its course and warn those in its path. Such warnings are not issued lightly; it costs Miami's Dade County about three million dollars to batten down—mainly in lost business. But an unannounced hurricane might cost a third more in property damage—and, more important, the lives of hundreds.



CLEO'S RADAR SIGNATURE
A radarscope in the Miami Weather Bureau becomes the most useful plotting instrument after the storm has approached within 250 miles of the mainland. Here the scope shows the pinwheel of 1964's Hurricane Cleo about 77 miles north of Miami (at the center of the scope).

CHARTING THE ADVANCING THREAT
A weather observer in the National Hurricane Center *(below)* plots the latest position of Hurricane Cleo, as radioed in by an Air Force airplane flying in the storm. The Navy also tracks hurricanes; the line on the map shows the division of responsibility between the two services.





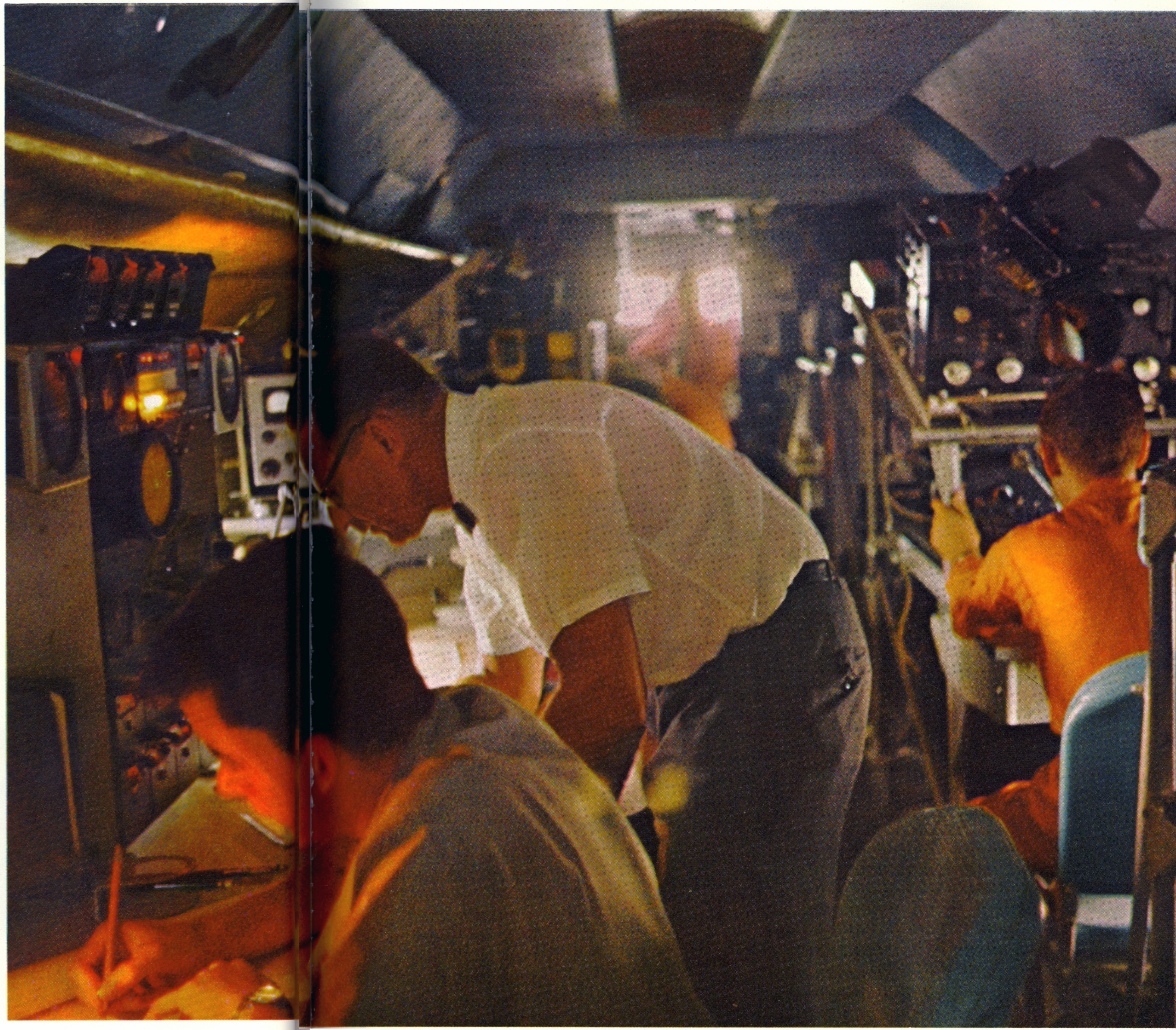
RED FLAGS OF DANGER
Red and black hurricane warning flags fly at Miami before a storm passes over the city. Although hurricane flags are still required by international maritime convention, their purpose—to warn shipping of the approaching storm—has now been largely taken over by radio.

Keeping a Weather Eye Peeled

Once a hurricane begins to bear down on the mainland, the best defense against it is information. The main data-gathering arm of the National Hurricane Center is the fleet of planes and pilots supplied by the armed forces and the Weather Bureau. After the hurricane is located, these planes make several penetrations each day into the maelstrom's heart—the quiet eye of the storm, around which whirl turbulent 100- to 200-mph winds.

These risky flights pinpoint the exact location of the storm's center and help determine its force and the various factors that will govern its path and lifetime.

With this information in hand, Hurricane Center forecasters advise threatened coastal areas to hoist hurricane flags, and issue press, radio and TV warnings. When the warnings go out, inhabitants of low-lying areas are advised to seek shelter above the highest predicted tide levels, to stock up on drinking water and foods that need no refrigeration, to store loose objects and to tape windows.



A HURRICANE HUNTER AT WORK
Engines turning over at the Miami airport, a Weather Bureau plane *(above)* prepares to take off for a research flight on a hurricane. Inside the plane *(right)* researchers record data while actually flying in the storm's eye. Banks of dials at left show temperature, humidity, pressure and winds. The seated man at right watches a radarscope that tells the shape of the storm.

Piercing a Hurricane's Heart

Until 1943, no aircraft had ever flown into a hurricane. That year an Army Air Force colonel, Joseph P. Duckworth, piloted a single-engine trainer into a hurricane's eye. "The only embarrassing episode," he later commented in his report, "would have been engine failure, which, with the strong ground winds, would probably have prevented a landing, and certainly would have made descent via parachute highly inconvenient." Since then more vicious hurricanes than Duckworth's have severely damaged hurricane-hunter aircraft, and one such plane was never heard from after it entered a storm.

Once a plane ventures into a hurricane it endures a few minutes of pounding winds and waterfall rain—and then it enters the eye. Like a sheltered lagoon, the eye is devoid of all the terrors of the surrounding wall of clouds. The sun or stars may be out and gentle breezes may be blowing. But there is no way of leaving this peaceful haven without meeting the storm's full fury once more.

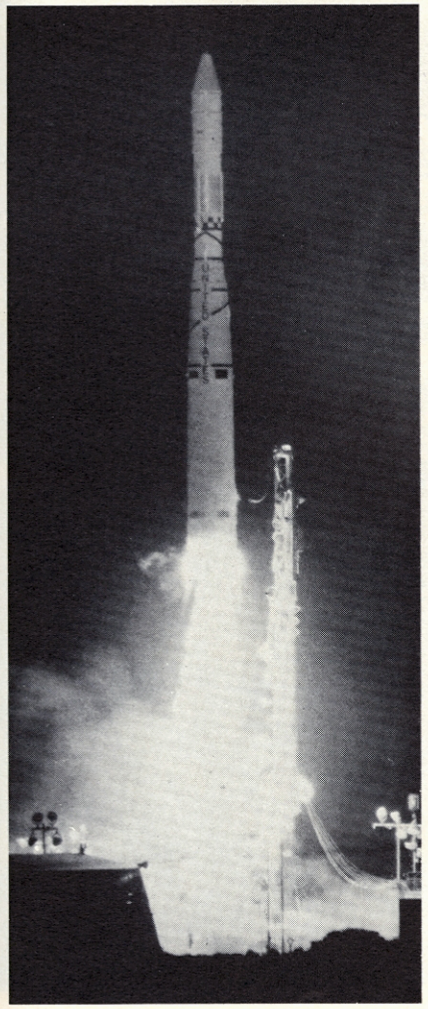
A MAELSTROM'S PEACEFUL INTERIOR
A hurricane's eye looks like this from an altitude of 18,000 feet with blue sea visible below through broken clouds. The swirls at left are clouds torn from the wall of the eye and swept into the center, where gentle winds prevail.

New Help from Science

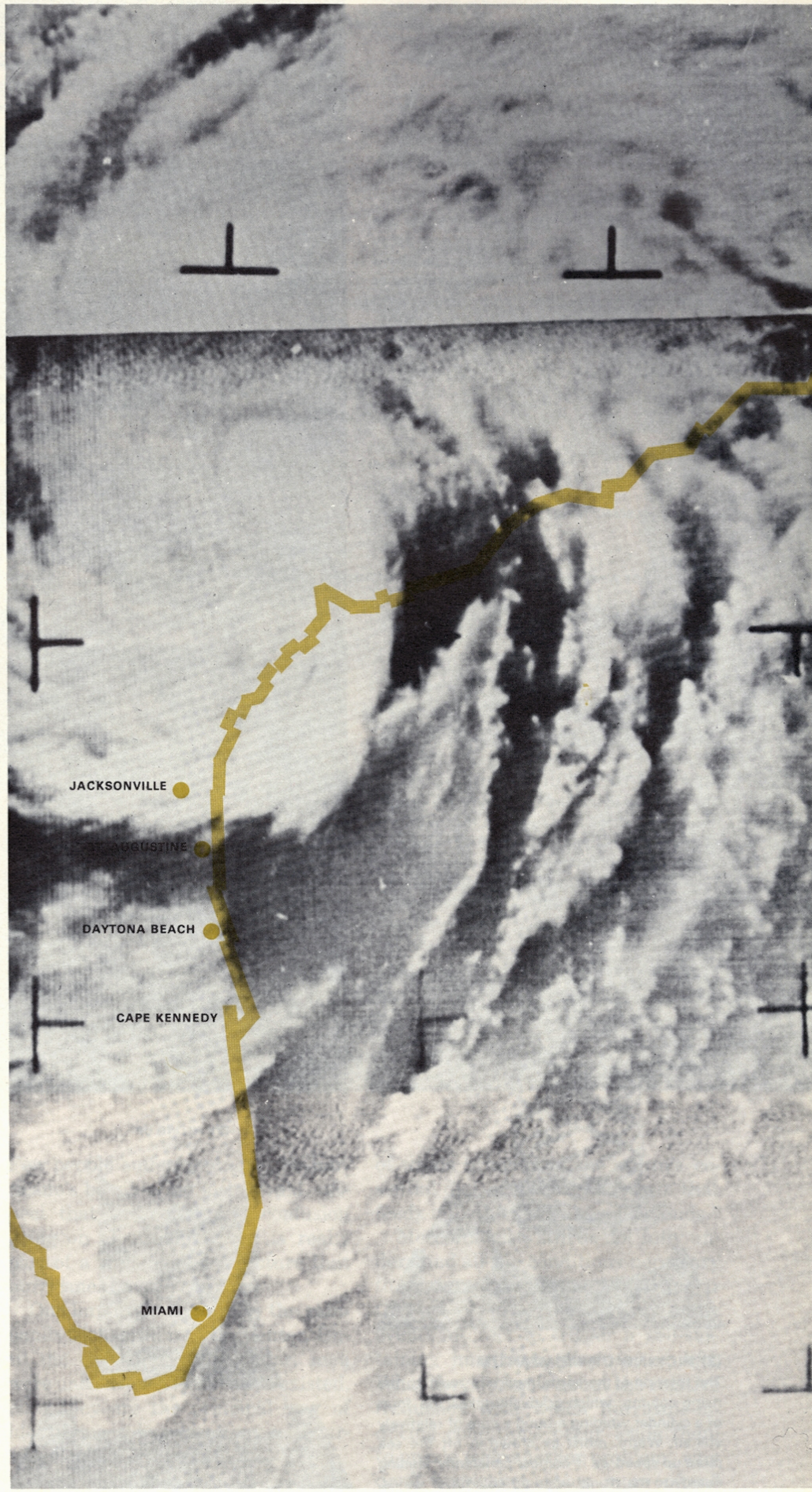
Meteorologists do not yet have a scientific theory that permits them to predict the paths of hurricanes with real accuracy. But several recent scientific advances offer hope. First, weather satellites like Tiros and Nimbus permit a reduction in the number of airplane flights being made to find hurricanes. In addition, electronic computers are helping forecasters juggle the immense quantity of data that must be considered when trying to decide where a hurricane will go next.

Finally, since 1961 a special U.S. Weather Bureau program called Project Stormfury has been investigating methods for reducing the hurricane's force. Most of Stormfury's hope is placed in the chemical, silver iodide. Crystals of this material released into hurricane clouds can sometimes cause the cloud moisture to freeze. It is hoped that this technique, when perfected, may interrupt the flow of air currents in and out of the storm sufficiently to break up the hurricane.

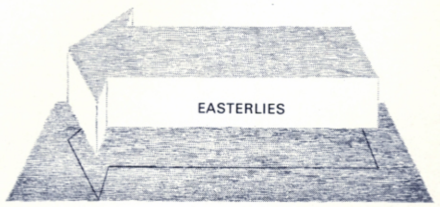
INTELLIGENCE CENTER AT WORK
During a storm, Miami hurricane specialists *(opposite)* use space-age information to keep the public informed. Xavier Proenza *(foreground)* pieces together satellite photographs to make a composite hurricane picture; forecaster Ray Kraft pores over a map before issuing warnings.



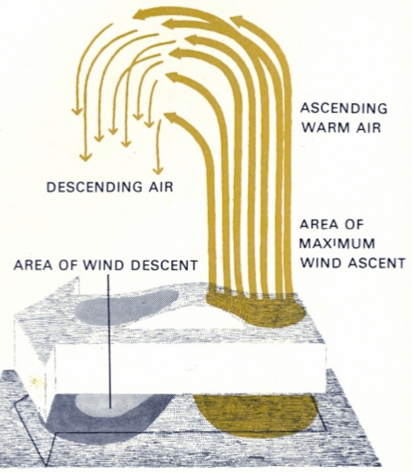
WEATHER SPY IN THE SKY
A Nimbus I experimental weather satellite *(above)* rides out to orbit from California atop a Thor Agena booster. During its lifetime of less than a month, the first Nimbus photographed the 1964 hurricanes Cleo, Dora, Ethel and Florence, plus Pacific typhoons Ruby and Sally.



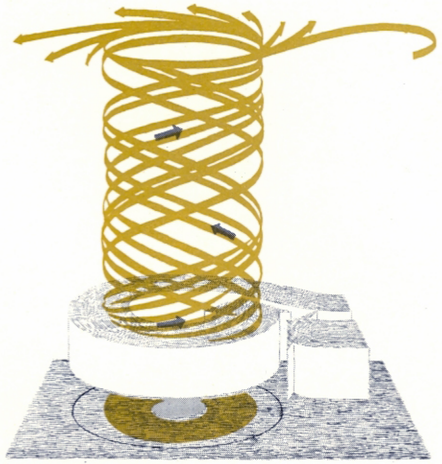
SPACE PORTRAIT OF A STORM
This Nimbus photograph *(right)*, with an outline map of Florida superimposed, one of a sequence of frames that were taken August 29, 1964, shows Hurricane Cleo. Less than four minutes after Nimbus pictures are taken, they can be viewed by ground-based weathermen.



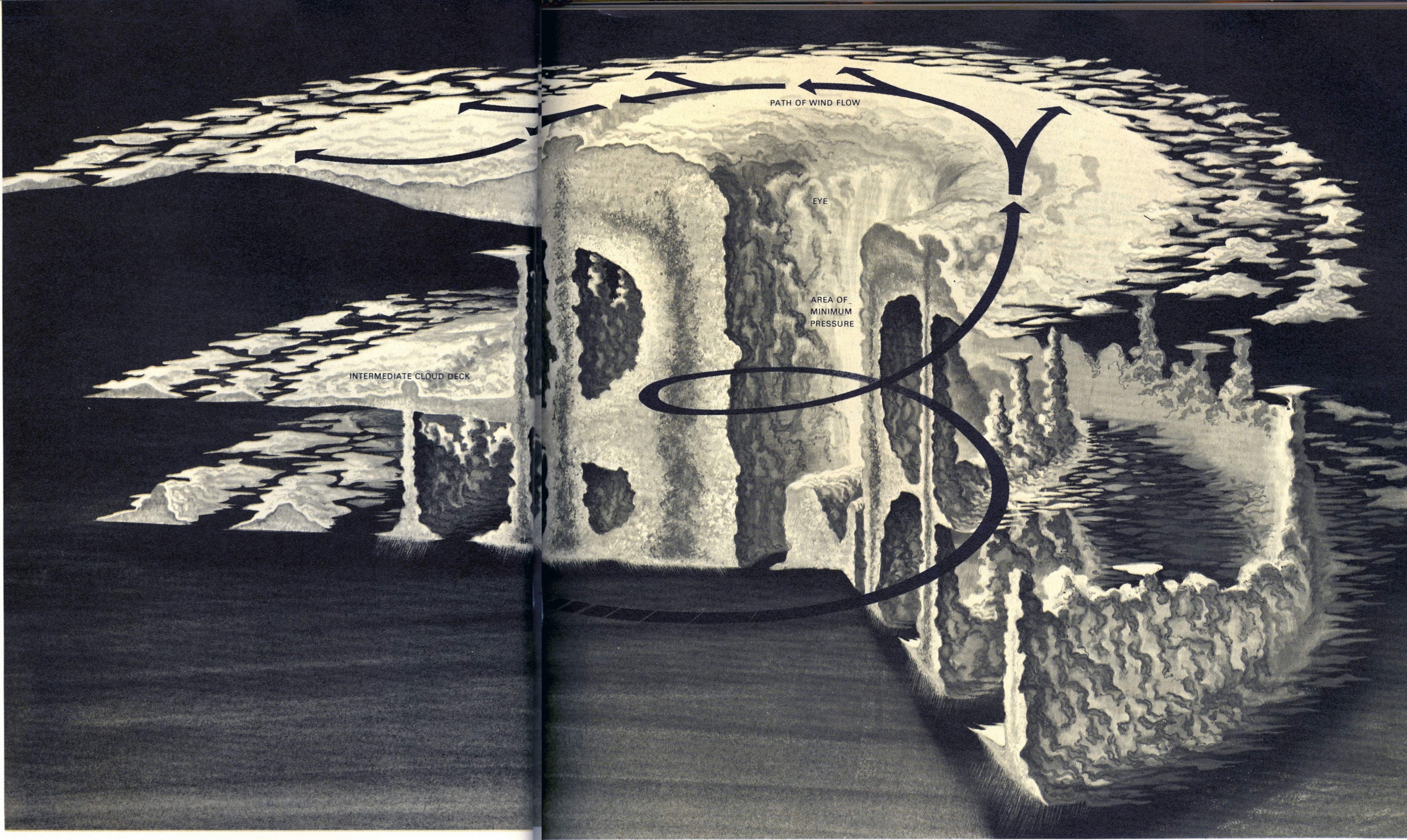
(1) THE STORM'S PARENT WIND
The four diagrams here and below illustrate one widely accepted theory of the birth and decay of a typical Atlantic hurricane. The arrow above represents the steady flow of the easterlies, or trade winds, as they blow in late summer over seas having a temperature of at least 80° F.



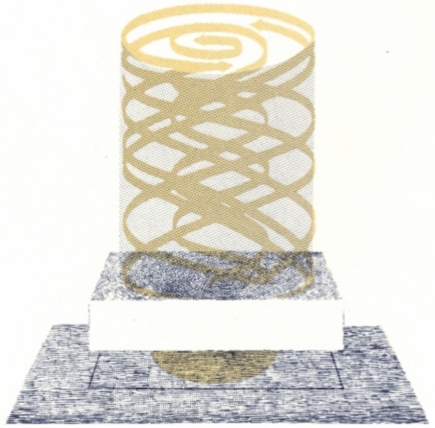
(2) A LIFT TO THE UPPER AIR
The first step in the birth of a hurricane usually occurs when a low-pressure disturbance diverts part of the easterly northward. The winds, squeezed at this curve, pile up on one another. Their warm air rises as high as 40,000 feet, releasing heat and moisture before descending.



(3) PICKING UP MOMENTUM
The rotation of the earth imparts a twist to the rising column, which gradually takes the form of a cylinder whirling around a core of relatively still air. Warm, moist air drawn in off the sea picks up speed as it comes, constantly feeding energy to the rising, whirling column of winds.



A HURRICANE'S ARCHITECTURE
A cross section of a hurricane (height greatly exaggerated) shows the cloudless eye, around which spiral ascending winds. The secondary cloud deck is an exit path for some of the rising air. Most of the heavy rain falls from rainbands that spiral in toward the storm's center.



(4) DYING OF STARVATION
The last stage in a hurricane's life begins when it moves over land or colder water. Without warm, damp air the storm loses its energy. The cooler air cannot climb so high. The winds drop off, gradually the eye fills in with clouds, and the hurricane expands in area and dissipates.

The Structure of a Giant Storm

Few people suffering under the hurricane's bewildering lash would suspect that the chaos and confusion going on all around them is really part of a well-defined structure that hurricanes have in common.

One important feature is the rainbands that spiral into the center. Until the development of radar, men were unaware that rainbands existed. Now they are the principal way of identifying a hurricane on a radarscope or satellite picture.

These rainbands indicate the paths of winds bringing in the storm's essential diet of warm, moist air that feeds into the central "wall clouds."

Meteorologists still do not fully understand all the conditions necessary to produce a hurricane. In particular they are mystified by the way many events interact to trigger a self-sustaining hurricane *(diagrams at left)*. What they do know about the relative frequency with which hurricane-inducing conditions occur leads them to puzzle over another problem: why don't hurricanes occur more often?