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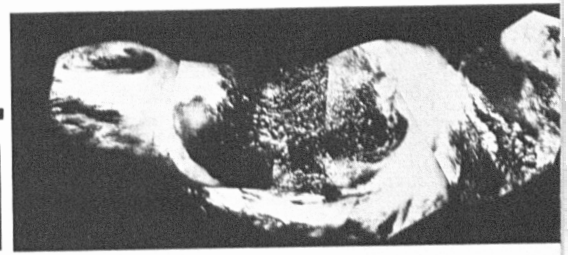
# THE METEOROLOGICAL SATELLITE PROGRAM



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# National Oceanic and Atmospheric Administration
# TIROS Satellites and Satellite Meteorology

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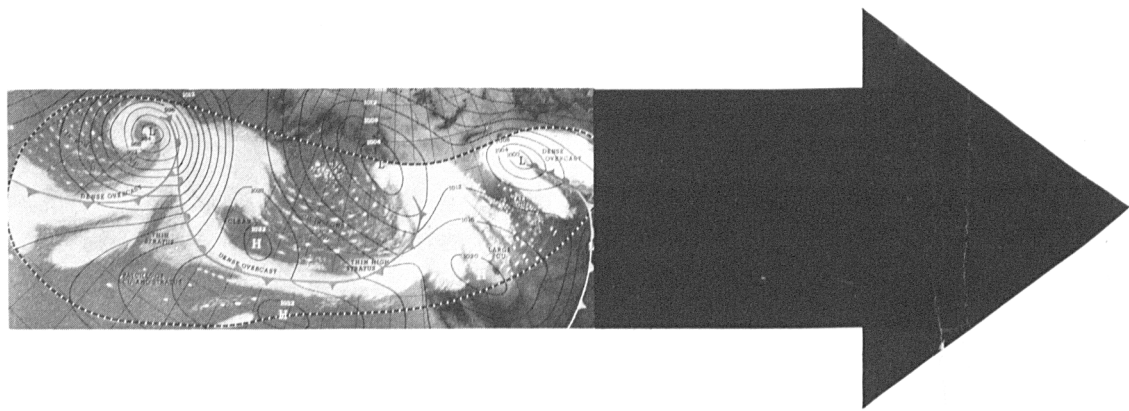
"Mosaic" of cloud photographs viewed by TIROS I superimposed on a weather analysis map of the North Pacific Ocean and North America.



# KEEPING A WEATHER EYE OUT IN SPACE

The Meteorological
Satellite Program

U.S. National Aeronautics
and Space Administration

Washington, D.C. / 1963

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Weather is defined as "The state of the air or atmosphere with respect to heat or cold, wetness or dryness, calm or storm, clearness or cloudiness, or any other meteorological phenomena."

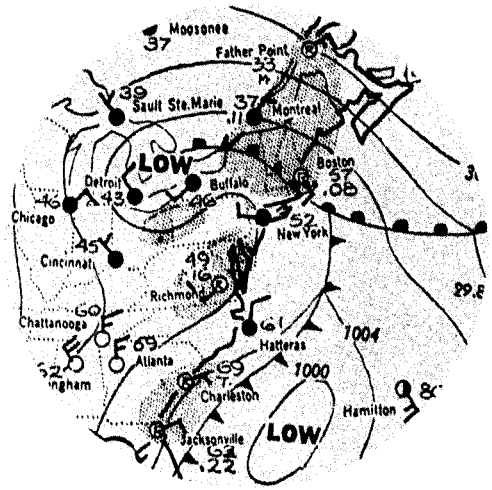
That pretty well sums it up, but not quite.

Of all the forces of Nature, weather, more than any other, has a direct, day-to-day influence on our lives and our livelihood. It affects the way we feel, how we make our living, and our vacations. We may not be able to *do* much about it, but we can come to understand it better, and by becoming "weather-wise" we may eventually be able to learn the secret of controlling it.

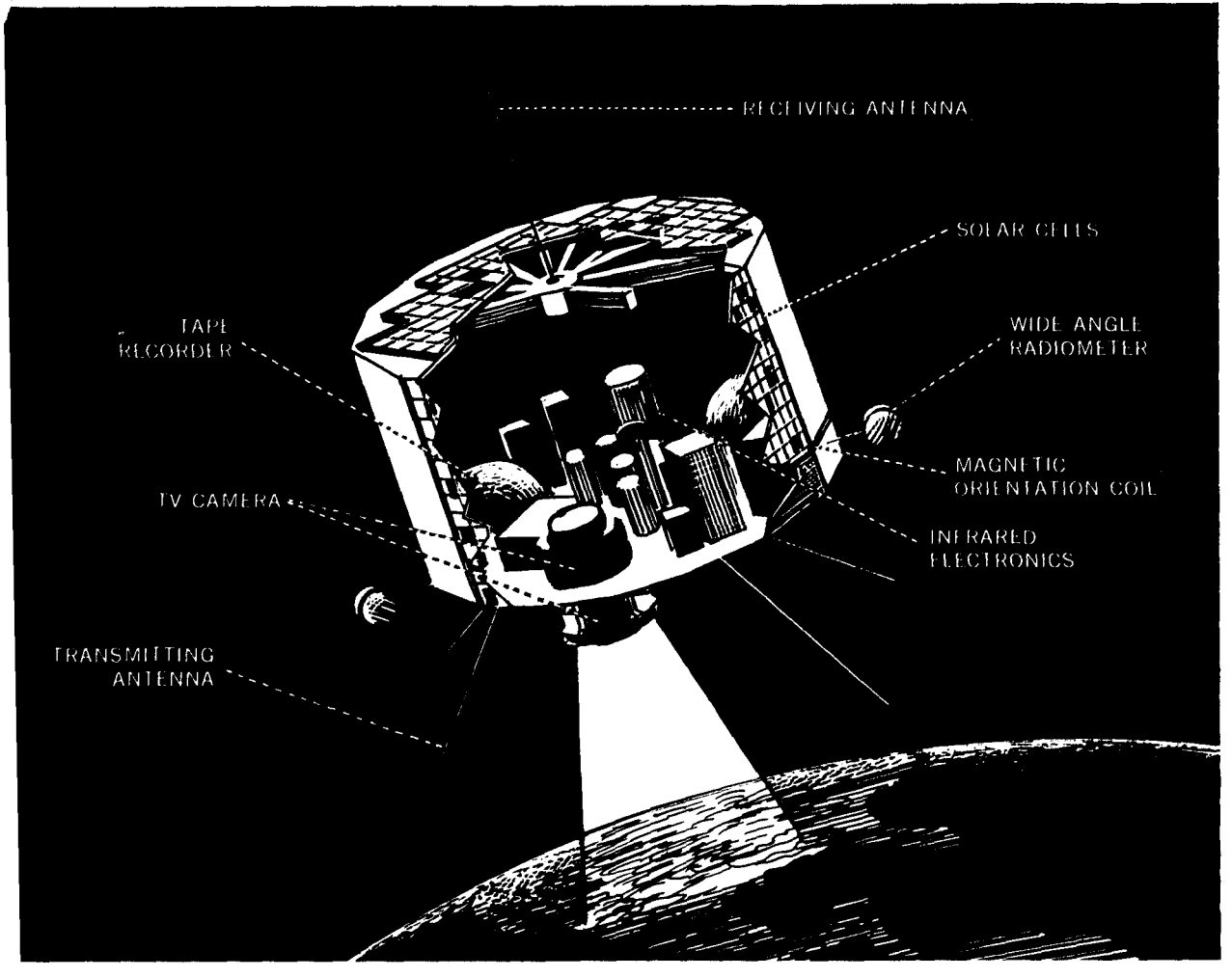
Although man has always talked about the weather, only in the past century has he done much in the way of scientific weather investigation: to observe and analyze it over large areas of the earth, and to use this information as the basis for forecasting what the weather will be like tomorrow or the day after.

Until the advent of the space age, weather observations were limited to areas relatively close to the earth, with vast gaps over oceans and sparsely populated areas. The ideal, as far as meteorologists were concerned, was a tool able to see large areas of the earth from space in order that a hemispheric knowledge of weather could be obtained.

The satellite, with cameras and special sensing devices, moved weather scientists out of the horse and buggy era. With it, they have opened the door to a fuller understanding of weather and the forces that affect it.




*Whether it's cold or whether it's hot,*
*we're going to have weather, whether or not.*
—OLD PROVERB




# TIROS
## The First Weather Satellite

TIROS is the world's first weather satellite. Its development was directed by NASA's Goddard Space Flight Center, Greenbelt, Maryland. The term TIROS is an acronym for *T*elevision *I*nfra-*R*ed *O*bservation *S*atellite. To date, its success record is unmatched by any other satellite system.

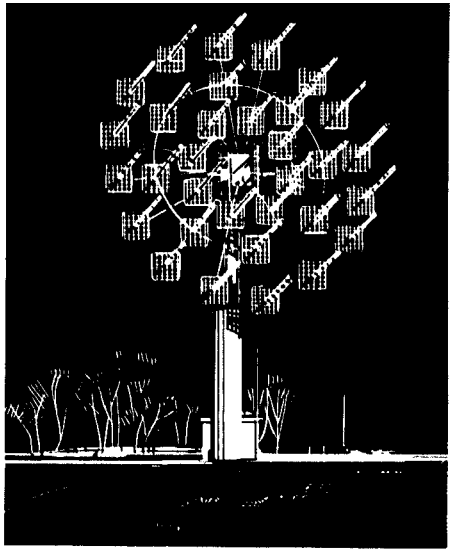
Just what have we bought with our investment in TIROS?

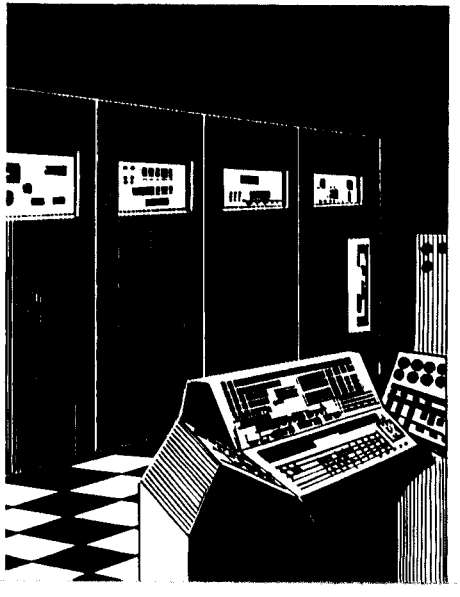
The answer is a 285-pound weather eye more than 400 miles in space that "sees" the earth's cloud cover with television-type cameras and other sensing devices. Physically, TIROS looks like a bass drum with needle-like antennas sticking out its sides.

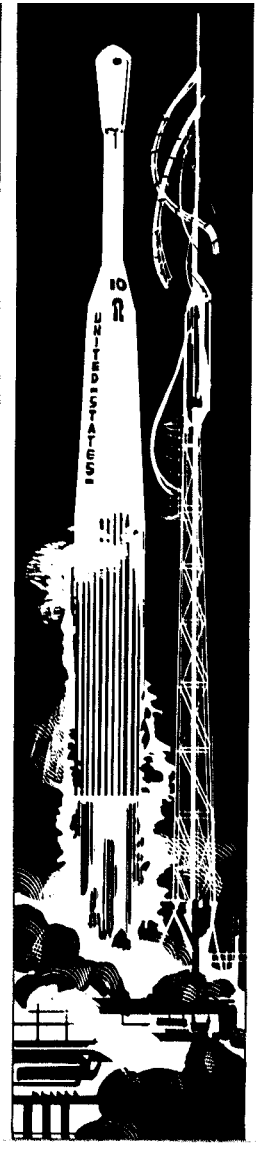
TIROS contains two independent television camera systems. One system has a wide angle lens which can photograph an area of more than 600,000 square miles at a time—roughly equivalent to twice the size of Texas. The other camera covers an area of more than 200,000 square miles.

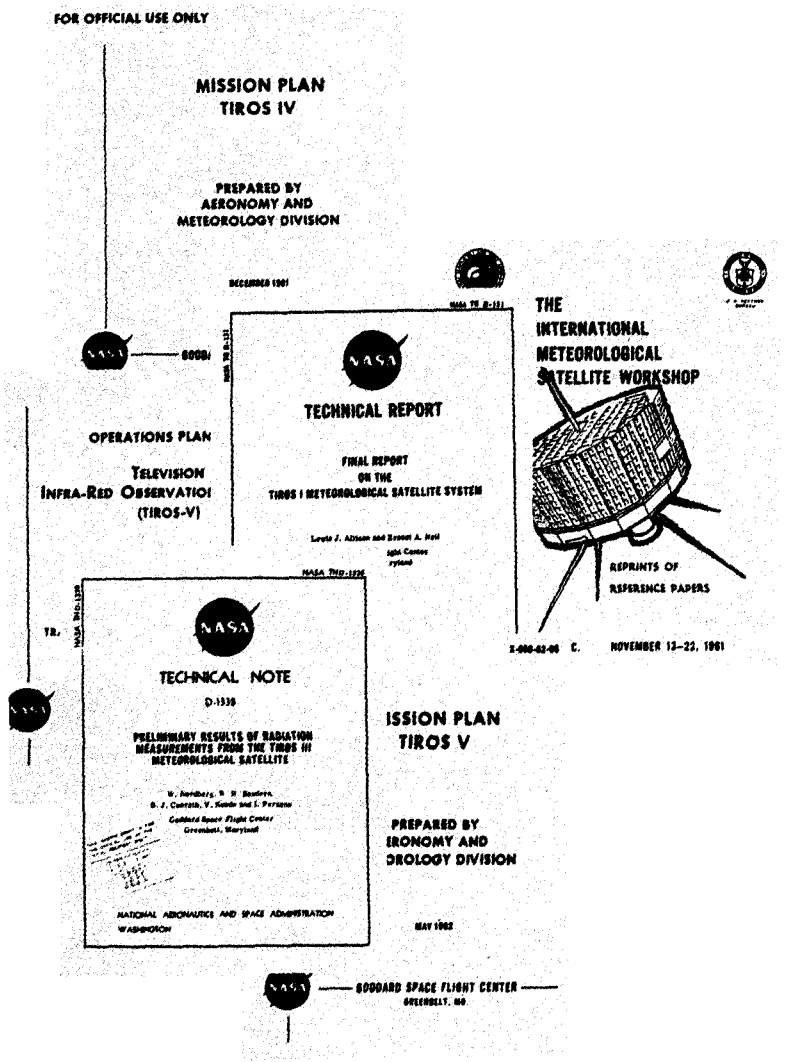
Both cameras have specially-developed one-half inch vidicon tubes which can store photographs temporarily. An electron beam converts these "stored" photographs into TV-type signals which can be sent directly to a ground station or recorded on a tiny tape recorder for read-out when the satellite is within a 1,500-mile range of a ground station. At the ground stations the pictures are flashed on special TV screens. They are then photographed by 35 mm. cameras. These photographs—actually of TV pictures—are used for making weather analysis.

In addition to its camera eyes, TIROS also has infra-red equipment which is used to provide information on how the sun's energy is absorbed and reflected by the earth's atmosphere. Data from the infra-red equipment is also recorded on tiny tape recorders for playback on command by a ground station. A remarkable system of weights, balances and tiny rockets helps keep TIROS stabilized in its orbit around the earth.










# TIROS ACHIEVEMENTS

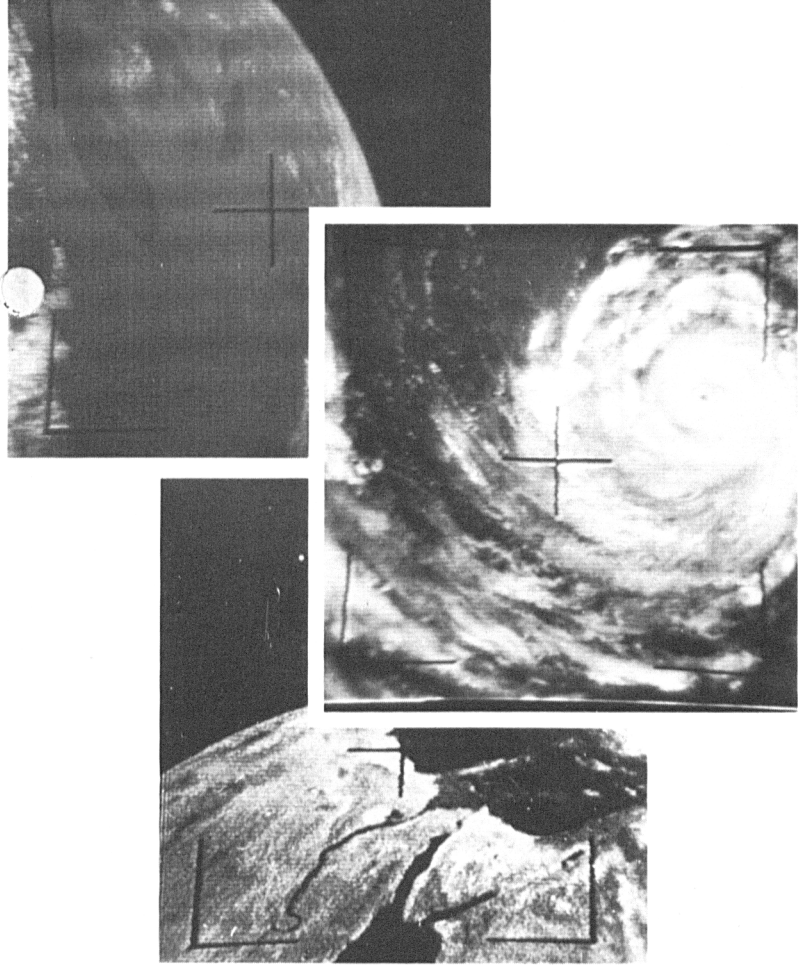
Demonstrated that the meteorological satellite is practical as an engineering system, and opened a new era in weather observation.

Proved that meteorological data obtained could be used on a "real-time" basis for daily weather analysis.

Identified hurricane cloud patterns, located them with respect to land masses and followed their movement.

Distinguished itself as a vehicle for ice study and ice reconnaisance over polar regions.

Obtained needed information for the study of the radiation balance of the earth's atmosphere.



## THE TIROS LAUNCH RECORD

TIROS I, April 1, 1960.

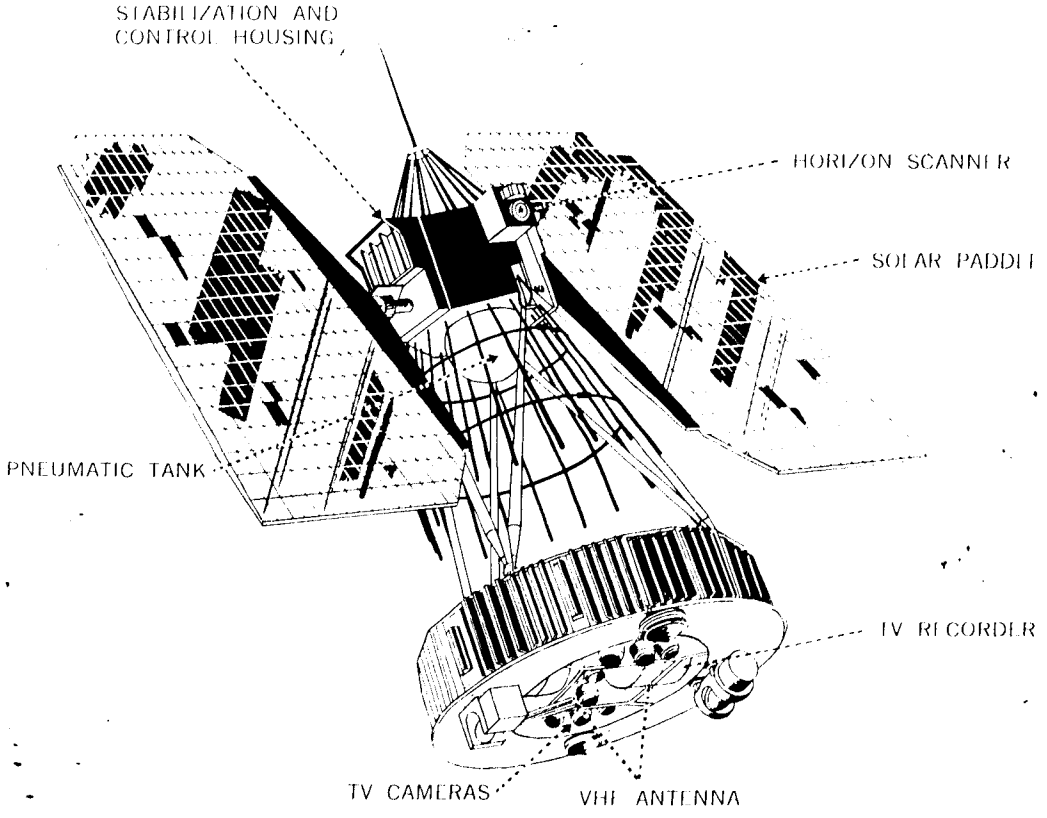
TIROS II, November 23, 1960.

TIROS III, July 12, 1961.

TIROS IV, February 8, 1962.

TIROS V, June 19, 1962.

TIROS VI, September 18, 1962.


STABILIZATION AND
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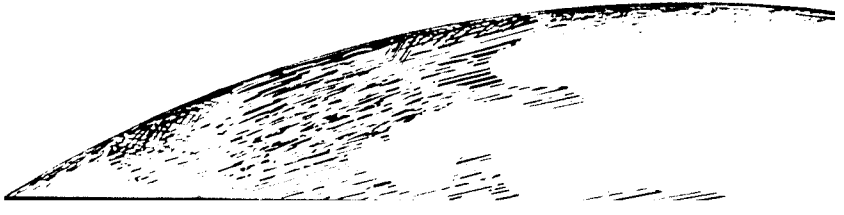
HORIZON SCANNER
SOLAR PADDLE
PNEUMATIC TANK
TV RECORDER
TV CAMERAS
VHF ANTENNA



# THE NIMBUS WEATHER SATELLITE

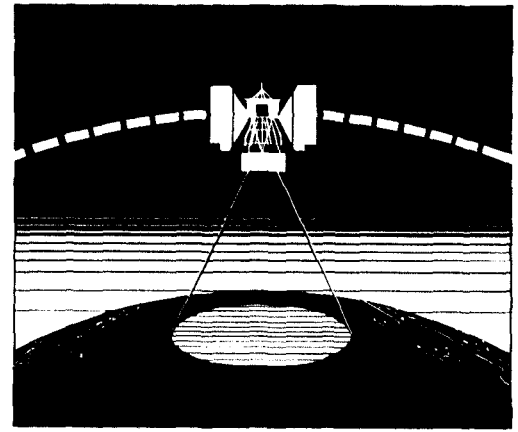
TIROS has been the pioneer in the weather satellite program. It has paved the way for a more advanced weather satellite called the Nimbus.

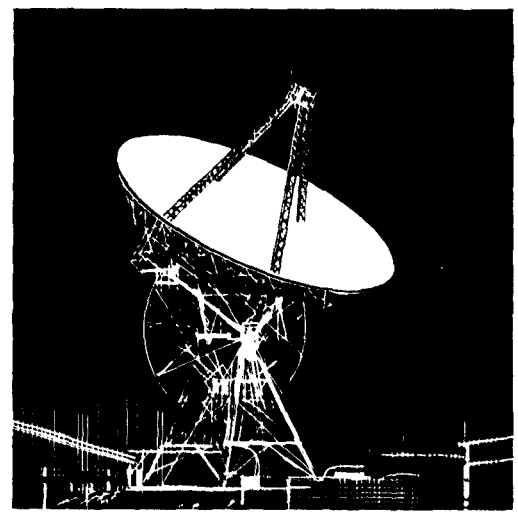
Nimbus will take advantage of many new advances made possible by TIROS. First, it will keep its cameras facing the earth at all times, thanks to a unique horizon sensing system. It will be placed in a polar orbit, thus giving coverage of clouds over every portion of the earth each 24 hours. Finally, it will transmit photographs continuously to inexpensive ground stations anywhere in the world.

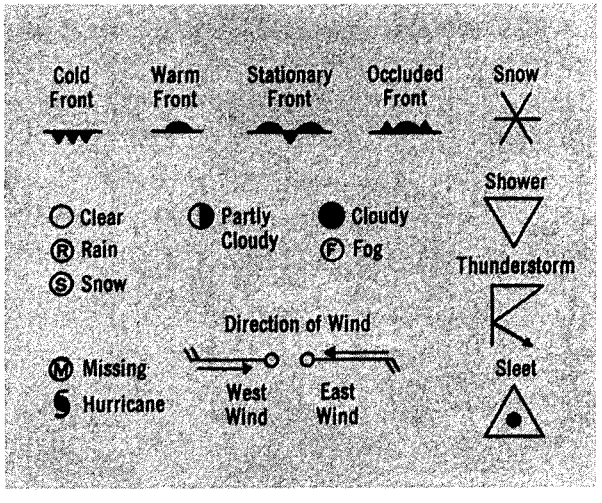
The Nimbus spacecraft dwarfs TIROS. It stands more than ten feet tall and with its solar paddles extended it is more than 13 feet wide. It weighs almost three times more than TIROS. It is scheduled to be placed into a 600-mile circular orbit by a Thor-Agena rocket.

The Nimbus program calls for research and development spacecraft as well as operational spacecraft. Nimbus development is under the direction of the Goddard Space Flight Center.

The base section of the spacecraft will contain all camera and radiation-sensing equipment and other experiments. The upper section will contain power and stabilization systems. Its two solar cell paddles will be pointed continuously toward the sun. The first Nimbus launching is scheduled to occur in 1963.





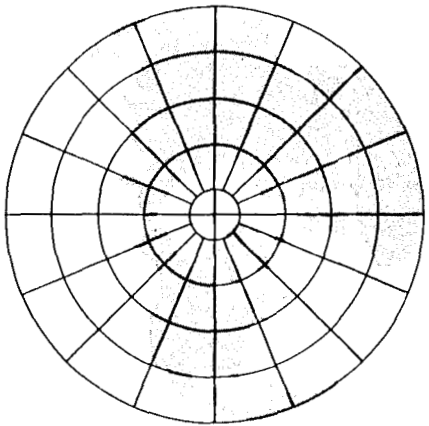



# NATIONAL AERONAUTICS AND SPACE ADMINISTRATION -U.S. WEATHER BUREAU METEOROLOGICAL SATELLITE RESPONSIBILITIES

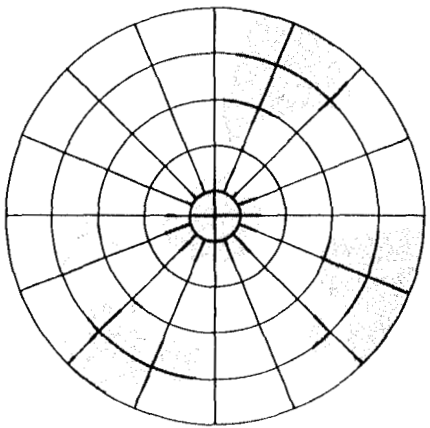
The Meteorological Satellite Program is a joint NASA-U.S. Weather Bureau undertaking. The NASA phase, directed by the Goddard Space Flight Center, is concerned with the (1) development of the spacecraft and launching into orbit; (2) establishing ground stations; (3) data acquisition; (4) tracking and orbit determination; (5) programming and command control of the satellite.

The U.S. Weather Bureau, an agency of the Department of Commerce, is charged with (1) determination of the meteorological requirements; (2) processing the satellite meteorological data; (3) analyzing, disseminating and storing the data; (4) forecasting; (5) research and climatological use of data.

Jointly, both NASA and the U.S. Weather Bureau cooperate in data analysis and processing the support research and development on spacecraft, ground stations and use of the data.



# TOWARD INTERNATIONAL COOPERATION



Because it is global in scope, the U.S. meteorological satellite program has as one of its primary objectives the establishment of a cooperative international weather program.

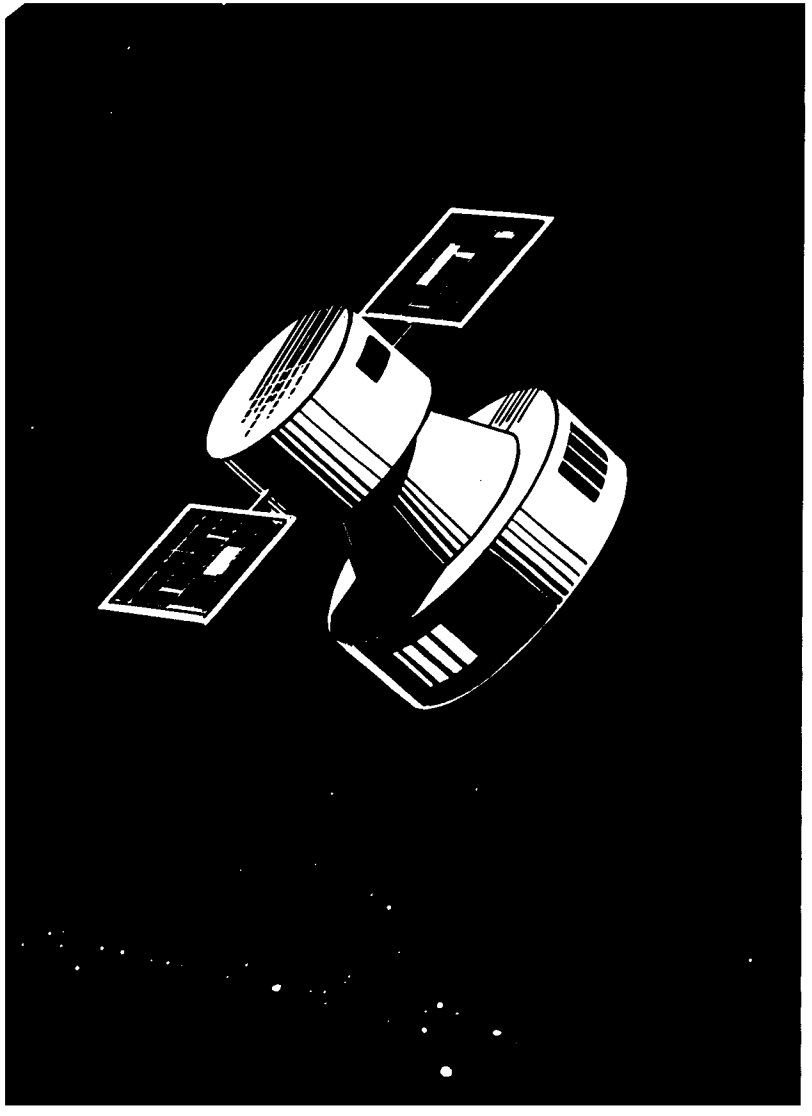
An initial step in this direction occurred in November 1961, when representatives of 30 nations gathered in Washington to attend the first International Meteorological Workshop, jointly sponsored by NASA and the Weather Bureau.

The three-fold objective of the workshop was to:

(1) Acquaint weather scientists of other nations with meteorological satellites and the data derived from them for use in future analysis programs national observation support efforts.

(2) Familiarize the world meteorology community with the TIROS program.

(3) Put current achievements in proper perspective for future operational programs.

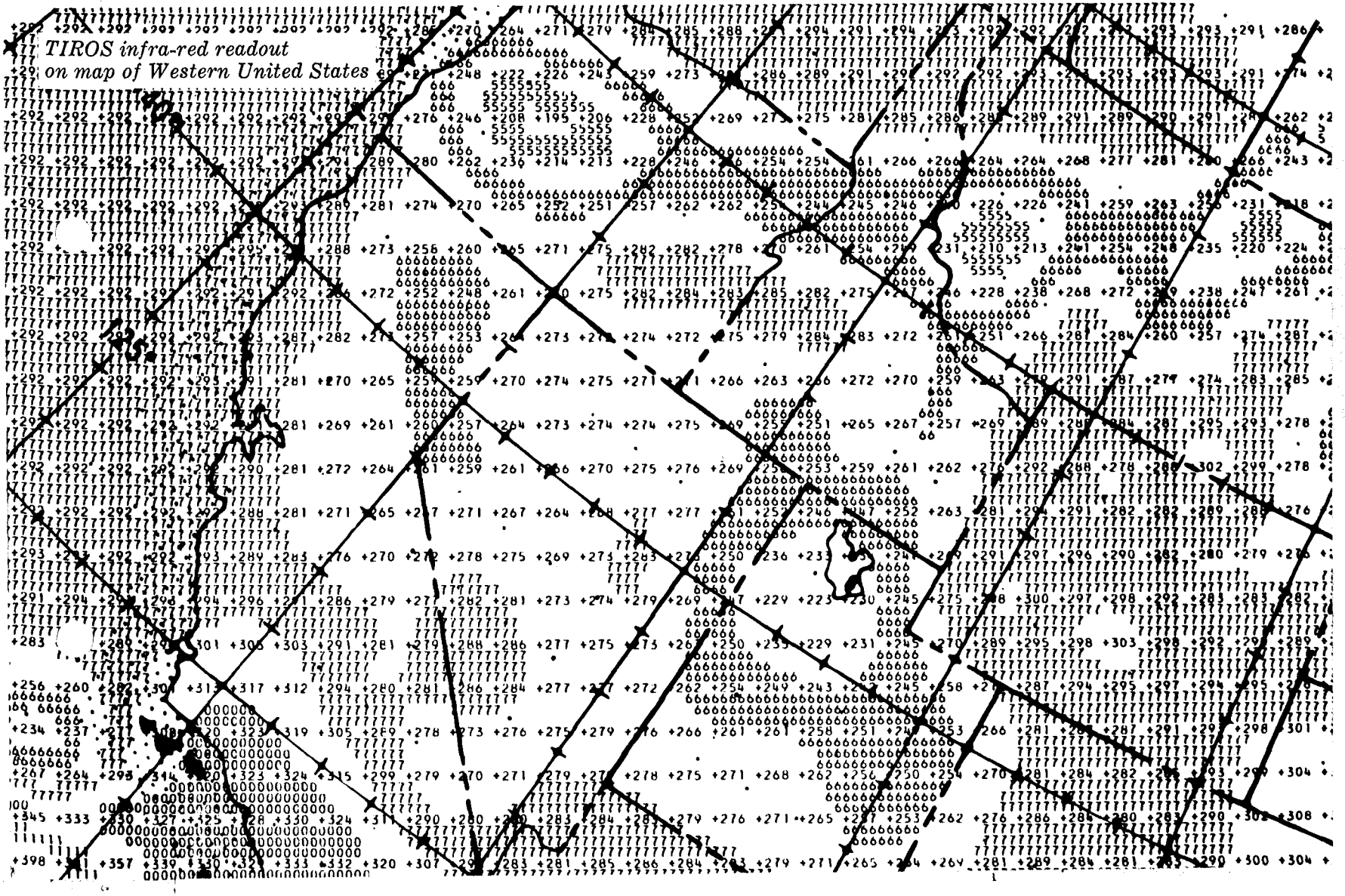


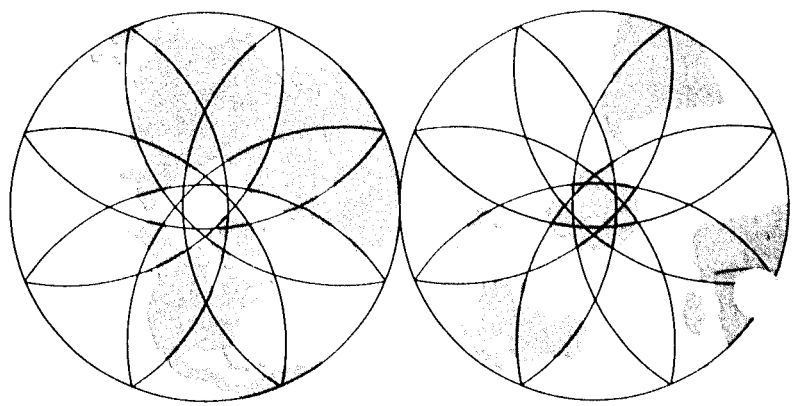
## FUTURE WEATHER SATELLITE OBJECTIVES

**Improve the satellite as an observation platform.**
**Increase frequency of observation of particular portions of the earth.**
**Increase the area of coverage.**
**Continue development of new weather detection equipment.**
**Continue to provide data for up to the minute weather forecasting.**
**Establish active international programs using data from meteorological satellites.**

## ADVANCED WEATHER SATELLITE

Beyond TIROS and Nimbus, a third meteorological satellite is under preliminary study by NASA. Such a satellite might be placed in an equatorial orbit around the earth at an extremely high altitude. It would remain in a stationary orbit at a given location over the Equator from which it will be able to make continuous observations over tropical and temperate latitudes. A satellite of this type could then observe about one-fourth to one-third of the globe at one time with its cameras.



*TIROS infra-red readout on map of Western United States*

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GODDARD SPACE FLIGHT CENTER/GREENBELT, MARYLAND