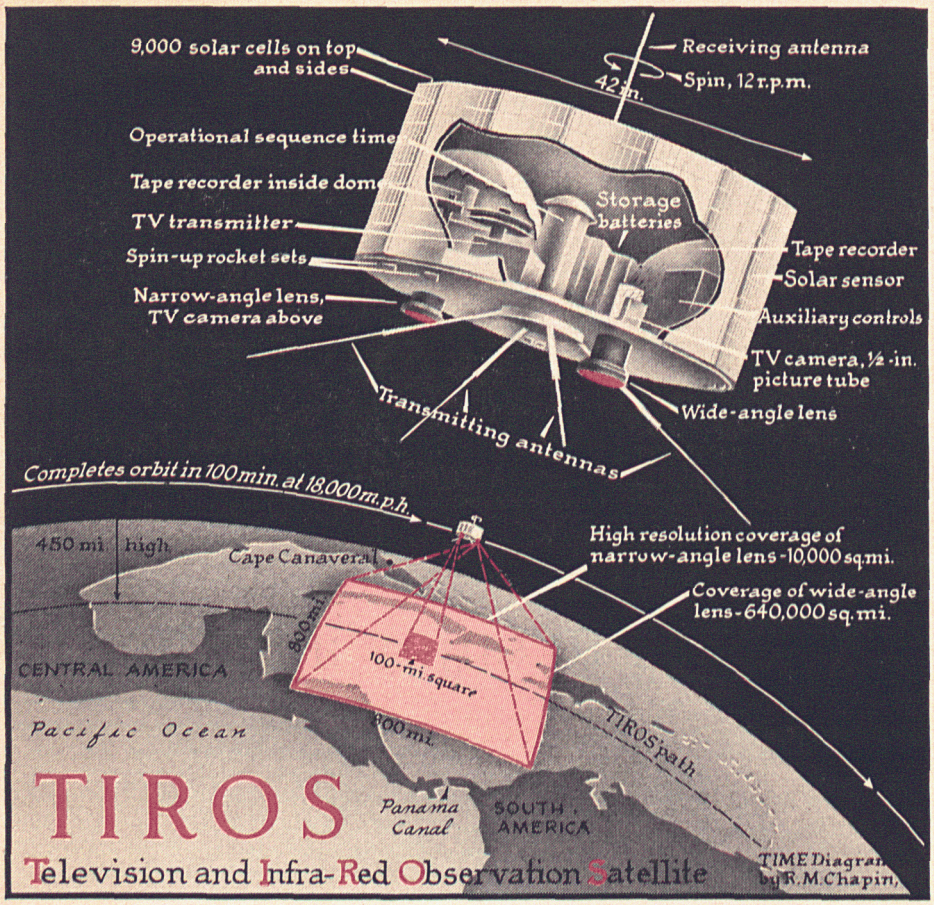


Weather by Satellite

With a huge gush of smoke and flame, the three-stage Thor-Able rocket last week roared from its Cape Canaveral launching pad, soon to swirl its 270-lb. package into orbit around the earth. To the scientific skeptics who claim that satellites are little more than spectacular stunts, that package provided a spectacularly practical answer: looking down from hundreds of miles in space, it could take and transmit pictures of the earth and its cloud-splotched atmosphere. At the very least, it ushered in a new era in meteorological science.

The weather satellite Tiros I (from Television and Infra-Red Observation Satellite) went into an almost perfectly circular orbit that will keep its cameras at an efficient picture-taking distance. Its farthermost point of 468 miles from the earth is only 32 miles higher than the low point. The feat of orbital precision, unequaled by either U.S. or Soviet satellites, was accomplished by a special Bell Telephone Laboratories guidance system in the rocket's second stage.

Cameras & Beacons. Tiros I is drum-shaped (diameter 42 in., height 19 in.), and is spangled on top and sides with 9,000 small solar cells that yield about 19 watts of electricity to keep its storage batteries charged. From its top and bottom jut five radio antennas and the lenses of two TV cameras. The inside is packed with micro-miniaturized electronic equipment that can seemingly perform miracles.

Almost as soon as Tiros was safely in orbit, two small weights swung out from its rim and slowed its spin from 136 to 12 revolutions per minute. This strikingly simple trick, like a whirling skater slowing his spin by raising his arms, made photography possible. Two beacon radios called out the satellite's position, reported its inside temperatures and the condition of the apparatus on board. Solar cells topped off the batteries. Nine small instruments observed the bearing of the sun, and another reported the position of the earth's horizon.

Tiros was now ready for business, and business soon came. At Fort Monmouth, N.J., a 60-ft. dish antenna of the Army Signal Corps picked up the satellite's radio beacon as it came over the curve of the earth. Up from the ground went a coded signal that made the satellite's innards spring into frantic activity. A shutter opened and closed. Electronic pulses flashed through tangles of hair-thin wire. Then down from the satellite over a TV channel came a picture of northeastern North America, spotted with white swirls of cloud. Fort Monmouth experts made hasty versions of the picture (which hurt its quality) and sent them to Washington by messenger. There Dr. Keith Glennan, director of the National Aeronautics and Space Administration, took it to the White House and showed it to President Eisenhower.

Electronic Images. The Tiros' electronic wizardry was accomplished with apparatus designed by the Army's Fort Monmouth scientists, working closely with Radio Corp. of America. Tiros' primary parts are two TV camera tubes, each ½ in. in diameter, that take up to 32 still pictures, one every 30 seconds. The pictures, which are at first electronic images on the tube's screen, can be scanned and transmitted directly, or they can be recorded on magnetic tape. The satellite's masters on earth can tell it what to do. From Fort Monmouth, for example, they can tell it to start taking pictures when it is over Czechoslovakia a few minutes later. They can also select which camera to use. One camera has a wide-angle lens and takes pictures of an 800-mile square of the earth. The other camera has a narrow-angle lens that pictures, in more detail, a smaller area. The narrow lens camera has an obvious potential for military reconnaissance—so some details about it were therefore last week being kept under security wraps.

Steady Axis. Since Tiros I spins like a top, it is gyroscopically stabilized, keeping its axis pointed in a single direction as it circles the earth. This means that its cameras will point away from the earth much of the time. The ground operator, before he sends his signal, must calculate when the cameras will be looking at something interesting. The satellite's orbit shifts slowly around the earth, allowing all parts that do not lie farther north than France to be photographed. On the second day of its orbiting, it sent to Fort Monmouth cloud-pattern pictures of the Mediterranean region.

First originating with the Department of Defense, the Tiros project was turned over last year to NASA, which has under-

A PICTURE TAKEN BY TIROS I:

standably high hopes for it. Since clouds are the tattletales about weather and weather-to-come, the world's meteorologists have long been desperate for cloud-pattern pictures of the entire earth. A single Tiros cannot keep watch on all the earth's clouds—but seven, orbiting simultaneously, could do the job. When that happens, man may be within range of controlling the weather, which now controls his life.

Space Director

As Tiros I spun skyward last week, a stocky, dark-thatched man sat in NASA's Washington headquarters, scanning electronic returns and helping nurse the new space baby into orbit. He was Abe Silverstein, NASA's director of space flight programs, and a living answer to the notion that able scientists do not enjoy working for government. Silverstein has been employed by the U.S. government for 30 of his 51 years, and he still likes his job well enough to stay at it for ten or eleven hours a day and for six days a week during peak periods.

As NASA's space flight boss, Silverstein directs the planning of U.S. space missions, the payload design and development, and the research operation once a satellite or probe has been fired. His qualifications are ample. Born in Terre Haute, Ind., Silverstein graduated from hometown Rose Polytechnic Institute in 1929 and, although he had several better-paying offers, took an engineering job with NASA's predecessor, the National Advisory Committee for Aeronautics, at $2,000 a year. Starting at Virginia's Langley Aeronautical Laboratory, he helped design the first full-scale wind tunnel, moved to Cleveland's Lewis Laboratory in 1943 and plunged into jet-engine research. Today's F-100, F-101 and F-104 jet aircraft all have components designed at Lewis. Indeed, says a Silverstein aide, "there is hardly a plane flying that does not have a piece of Abe in it."

A hard-driving administrator with a sharp tongue, Silverstein moved from Cleveland to NASA's Washington headquarters in 1958, bringing with him ten Lewis Laboratory scientists. Recalls one: "We didn't really want to come to Washington. We came purely because Abe asked us to." Since then, most of Silverstein's relaxing pastimes have vanished into space: about all he has time for is taking his three children to the Washington zoo on Sunday mornings. But for Abe Silverstein, dedicated public scientist, the job is worth it.

CAT's Claws

Among those still discussing and analyzing the cause of the Lockheed Electra crash (63 dead) near Tell City, Ind. last month, there appears an ominous possibility: that the aircraft was torn apart in mid-air by a phenomenon which airmen and meteorologists have taken to calling CAT—for "clear air turbulence." If the theory proves to be true, pilots will have to find ways to keep their ships out of CAT's claws.

Every pilot is familiar with ordinary turbulence, which is generally caused by thunderstorms or some other violent weather disturbance in the lower atmosphere. Pilots avoid the worst bumps by dodging the thick clouds in which vertical air currents hide. Radar helps by spotting the veils of rain or hail that mark the violent heart of a storm. But clear air turbulence is invisible both to human eyes and to any known kind of radar. The unhappy airliner that flies into it is shaken from nose to tail without any warning whatever.

ROBERT PHILLIPS

PUBLIC SCIENTIST SILVERSTEIN

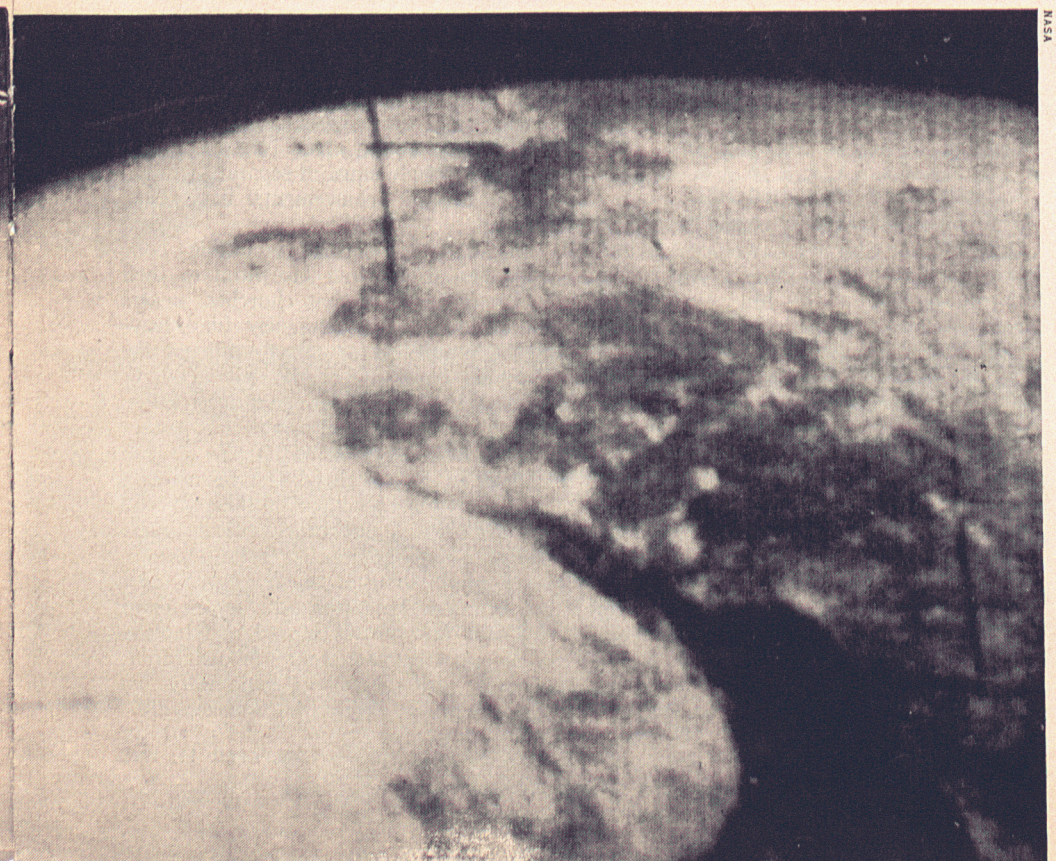
Snaking Around Earth. Dr. Harry Wexler, chief of research for the U.S. Weather Bureau, explains that CAT is generally caused by wind shear, the conflict of air masses moving at different speeds or in different directions. When such masses meet, a belt of swirls and waves appears in the boundary between them. A slow airplane can fly through moderate CAT with hardly any unpleasantness, but for a fast-flying jet the sensation is like driving a car over a cobblestone pavement with some of the stones missing.

The favorite habitat of CAT is close to the jet stream, the narrow belt of high-speed wind that snakes around the earth from west to east in mid-latitudes, often reaching 250 m.p.h. The turbulent region below the jet stream may begin as low as 15,000 ft., increasing in roughness as it nears the stream (which is not itself normally turbulent) at an average of about 30,000 ft. Another layer of CAT rides on top of the stream, reaching to 40,000 ft. There is normally some turbulence on both sides of the jet stream, but the north side is almost always the worst. No one knows why.

Waiting for Bumps. Saying that CAT surrounds the jet stream does not help detect it. The stream is capricious, whipping up and down and from side to side like a shaken rope. The only way at present to find belts of CAT is to fly an airplane through a region where it may be —and wait for the bumps to begin. The Weather Bureau intends to do this if it can get the money to fly its elaborately instrumented hurricane-hunter planes during hurricane-free seasons. Such a course of flying may suggest ways to warn pilots of CAT ahead.

Of all U.S. air disasters, the Tell City crash seems the most likely to have been caused by CAT. Otherwise, so far as is known, the worst that has happened is injuries to passengers, who got severely shaken. But jets are flying faster and higher, and when the jet stream is going their way, they make the best time by flying in it. So they meet more CAT and hit it harder.

NORTHEASTERN NORTH AMERICA SEEN FROM SPACE



NASA

National Oceanic and Atmospheric Administration
TIROS Satellites and Satellite Meteorology

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