Badger Space Researchers Probe

Beyond the Sunset

by James A. Larsen

WHEN TENNYSON stretched his imagination to envision the outermost limits of the exploratory ambitions of Ulysses, he could write that the Greek voyager's purpose held "to sail beyond the sunset and the baths of all the Western stars, until I die."

Yet Ulysses greatest voyages evidently failed to take him beyond the confines of the Mediterranean, and somewhat short of the "baths" of the Western stars. Not until many centuries later did mariners begin to sail their cockleshells great distances westward, beginning the series of explorations which have given us the knowledge we now have of the world's seas and continents.

It is with considerable sense of wonder, then, that we now watch great Atlas Agena rockets hurl their instrumented payloads skyward to seek information of the earth's atmosphere, of the moon, and even of the earth's sister planets. And man himself is now orbiting beyond the earth's envelope of air, at heights where the stars shine with a steady glow and it is the lights below that flicker and twinkle.

University of Wisconsin scientists are among the leaders in several little-heralded but basically extremely important fields of space research—notably the use of satellites to study the earth's weather and climate and as platforms for telescopes to study the distant stars.

Both Atlas Agena rockets and the X-15 rocket planes are to be employed by Wisconsin astronomers to carry orbiting astronomical observatories beyond the shielding atmosphere to obtain new information on stellar phenomena. In charge of the Wisconsin project to establish observatories in space are Arthur D. Code, director of Washburn Observatory, and Theodore E. Houck, chief of the Wisconsin Space Astronomy Laboratory.

"The special field of interest and experience of the Wisconsin astronomers is in the ultraviolet light given off by stars," Code points out. "The use of photoelectric devices to observe the behavior of light from stars was largely pioneered at Washburn and is one of the basic research techniques employed today."

The instrument package devised by the Wisconsin space astronomy team is a 500-pound, remote-controlled battery of seven telescopes.

"These will sweep the sky from an orbiting satellite and will radio information on ultra-violet light from the stars to recording instruments on earth," Code adds. "The method will provide more accurate measurements of the brightness of sky objects never before attainable."

Three such telescope "packages" will be launched into space under the direction of the National Aeronautics and Space Administration. The first will be the Wisconsin battery of seven telescopes, with launching scheduled for some time in 1965.

The data to be obtained by these telescopes in space...
will help answer many long standing problems. These are problems unsolved because of certain physical properties of the atmosphere affecting starlight during its journey from the fringes of space into the astronomers' telescopes. It is conceivable that the information to be obtained will aid astronomers describe the nature of birth, life-cycle, and death of many kinds of stars—and perhaps even of galaxies or of the universe itself.

Even the atmospheres of far distant stars—and the closer planets—are to be studied by Wisconsin scientists. Astronomers will attempt to decipher the characteristics of the "atmospheres" of distant suns. Perhaps more surprising, Wisconsin meteorologists have already pioneered studies of the probable atmospheres to be encountered on earth's sister planets—information perhaps to be of some considerable importance to space teams in the not distant future.

Using known facts concerning the heat radiation along the planet Mars' equator and the density of its atmosphere, Heinz Lettau of the Wisconsin meteorology department has described Mars as a "land of freezing cold, howling winds, and blinding dust storms."

Surface temperature at noon on the equator reaches 70°F, while air temperature at a height of three feet is closer to 10°F. "Thus, your feet would be comfortable, but your stomach would freeze," Lettau comments.

Conditions at dawn are more severe—with surface temperatures at -100°F and air temperatures at -70°F. The Martian atmosphere is known to be thin and this, in part, accounts for the extremes of temperature, but the surface additionally must be covered with a poor conductor such as fine sand, and wind speeds must attain averages 30 to 40 percent higher than on earth, Lettau explains.

Not only Mars but also the moon has been the subject of Lettau's investigations.

"On the basis of available radiation measurements it has been concluded that the visible lunar surface cannot consist of bare rocks but must be covered by an extremely poor heat conductor, such as a layer of fine powder, or porous forms like pumice," Lettau points out.

"Radio-wavelength radiation studies have contributed to our knowledge of the physical properties of the lunar surface material," Lettau continues. "They indicate that a good conductor, like solid rock, underlies the uppermost porous layer."

As the astronomical observatory program undergoes the final stages of planning, another Wisconsin space research program—also the pioneer in its field—is actively under way, with data from instruments on the Tiros satellites now being processed in the Wisconsin meteorology department under the direction of Verner Suomi. It is a study of the heat and energy balance that powers the earth's weather and climate.

Tiros-4 gave the Wisconsin meteorologists the first good look at the heat budget of the earth on a global basis. While it was not continuous for a whole year—
something scientists would have liked—it turned up some very interesting observations concerning the events that power weather changes over the entire surface of the globe.

The net effect of difference in absorption of sunlight from place to place on the globe is that the atmosphere must transport heat from equator to pole—and this it does along rather well-known atmospheric wind patterns.

But the data from Tiros gave meteorologists an extremely important new factor to consider; the equator-to-pole differential is greater than previously anticipated.

“The result,” says Suomi, “is that the atmosphere must transport more heat—from 50 percent to twice as much—as we previously believed.”

The earth’s weather machine, therefore, must operate faster by an equivalent magnitude to balance the heat budget—and there is, thus, twice as much energy involved in atmospheric changes than scientists have hitherto expected.

The Tiros satellites have also shown meteorologists that the high thin veils of cirrus clouds may have a much greater influence than was previously believed to be the case. Satellite data has indicated that these thin clouds act as very efficient mirrors, trapping heat energy from the earth in the so-called “greenhouse effect,” and raising the temperature of the air masses below these clouds to higher levels than adjacent air masses under clear skies.

Storms are the result of interaction between air masses of critically different temperatures—and, therefore, the apparently innocuous cirrus may play an important role in the generation of storm conditions in the atmosphere.

The scientists have also extended their theoretical considerations of the influence of cirrus clouds to the realm of aviation—and here they emphasize that in this realm their statements represent speculation and conjecture and are as yet unsupported by solid observation.

But they speculate that jet aircraft may also play a part in weather generation. Because high-flying jets frequently leave behind a contrail of condensed vapor—which slowly spreads out over the entire sky under some conditions—they may constitute a very real contributor to the present-day formation of cirrus over large portions of the earth, perhaps triggering storm conditions.

“Conjectures come and go,” says Suomi, “but good observations are hard to come by. So we must wait for more information and testing of mathematical models in our computers before we can say with assurance that this picture represents the real conditions in the atmosphere in any way.”

**BRUTE FORCE** tactics have often been suggested for weather control—such as the use of nuclear devices to warm giant air columns—but the magnitude of the effort involved has so far discouraged scientists.
from hoping that such methods would have tangible results.

"It's hard to compete with nature on this scale," Suomi points out, "but we might be able to do so if we can find weaknesses in the atmosphere where we can get a lot of effect for a little expenditure of energy—as might be possible with synthetic cirrus clouds."

As another scientist puts it: "We're probably doing something about the weather all the time without knowing it."

Another satellite project soon to be launched under the direction of Wisconsin scientists concerns the detection of thunderstorms by means of radio static—or "sferics" as the particular static caused by thunderstorms is called.

Sferics detectors mounted on satellites circling the globe could give meteorologists information on the total number of areas with thunderstorms and their location on the globe.

Most measurements of sferics have been made from the ground. At the frequencies in which atmospheric scientists are most interested, however, such measurements are difficult because of the ground effects on radio wave propagation, says Stig Rossby, director of this space project.

"As sferics have not been studied at high altitudes, observations from satellites and high-flying balloons should give us a great deal of needed information," Rossby adds.

The first space weather forecast was made by Astronaut Cooper during his initial orbits of the earth, Rossby points out.

As Cooper passed Australia he reported thunderstorm activity to the west of his monitoring station and was able to see lightening and to hear sferics on the radio equipment. The station below reported cloudless skies. But on Cooper's next pass, the storm had moved directly over the monitoring station—and Cooper's report had vividly demonstrated the value of satellite observation to weather forecasting.

In an expanding world program of space research, the University of Wisconsin is, thus, playing a major role—both in looking outward at the distant stars and the moon and the planets, and in looking backward at the earth to give mankind improved information concerning his own planet.

Where these exploratory adventures will take us, we, of course, do not know—but the exploratory impulse seems to be instinctive in all life, and none stronger than in the human species.

As the unmapped regions of the earth dwindle to pinpoints, man turns to the new frontiers of the unknown—to space, to the interior of the atom, to the chemistry of life—in his efforts to understand the universe around him. The instinct to explore is deeply impressed in the living substance—evidently with practical goals, for it is demonstrated repeatedly that the more we know, the better off we are.

As science pursues the adventure of exploration in the new frontiers, toward as yet dimly foreseen lands, perhaps Tennyson's words describe the excitement of the quest, as when he sent Ulysses "to follow knowledge like a sinking star, beyond the utmost bound of human thought."

Wisconsin Alumnus