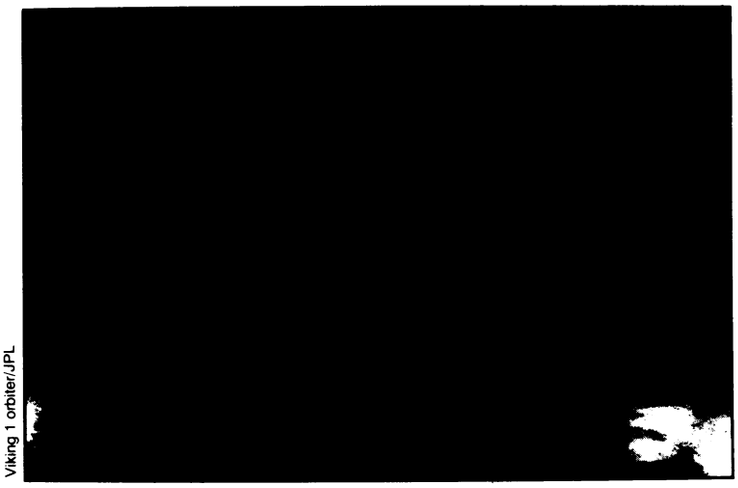
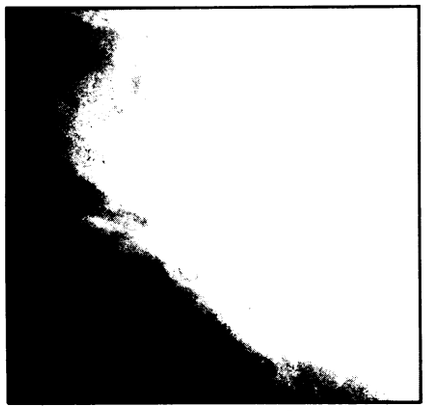


Viking 1 orbiter/JPL

Viking 1 orbiter photographed these two apparent cyclones on Mars, first evidence for baroclinic waves in the north polar region's summer. Smaller, more northerly storm is at top.



sons, also occur in summer."

The first and most striking of the features was seen at 81°N (160° longitude), almost to the edge of the north polar cap. Infrared measurements showed a steep surface temperature gradient across the area, ranging from 237°K just to the south, to about 230°K directly beneath the presumed cyclone, to about 215°K to the north. "These are precisely the effects which are expected for such a system," the researchers report in NATURE (278:531), "since the waves which give rise to these disturbances occur in the polar front which separates the frigid arctic air from the warmer mid-latitude atmosphere." The characteristic spiral cloud formation, probably composed of water ice, seems to be about 4 km above the ground, with wind speeds of 31.5 meters per second at the cloud and an estimated 12.6 near the surface. Data are more limited for the second circulation pattern, which was located closer to the equator at 66°N (227° longitude). It too resembles water ice, with an altitude (calculated from ground shadows) of 6 to 7 km and wind speeds of 23.1 meters per second in the cloud and an estimated 9.2 near the ground.

There has also been evidence of baroclinic systems passing over the two Viking landers, whose meteorological instruments have both been operating for more than a 688-day Martian year, although the lander cameras have the wrong viewpoint to see such storms' actual shape. □

Something weird in the Milky Way

Many of the new objects discovered by astronomers in recent years cause astrophysicists a major worry: Where does their energy come from? Arguments over the best energy mechanism for quasars or Seyfert galaxies or various kinds of X-ray sources are a persistent feature of astronomical conferences. In the case of the newly prominent object SS433, questioning has tended to become at least for the moment a throwing up of hands.

SS433 is by its own testimony one of the oddest objects in the sky. It has "one of the strangest sets of astrophysical spectra ever observed," says Bruce Margon of the University of California at Los Angeles. Margon was speaking this week at a meeting of the American Physical Society in Washington, D.C.

SS433, as Margon recited its known history, was discovered and catalogued under that number more than a decade ago, but nothing out of the way was noticed then. Early last year, observers at the Anglo-Australian Observatory found an object with a remarkable spectrum that was then determined to be SS433. Coincidentally it was found to be a strong radio source (an unusual thing for the ordinary classes of star), and now the HEAO-1 satellite has found it as an X-ray source, though as Elihu Boldt of the Goddard Space Flight Center told the APS meeting, there seems to be nothing particularly unexpected so far about the X-ray spectrum.

The optical spectrum contains a number of strong emission lines, "enormous emission lines at unidentifiable wavelengths," as Margon puts it. The first approach of astrophysicists in such a case is to make the wavelengths identifiable by trying on the proposition that these are emissions of familiar atoms that have been Doppler-shifted to the red by motion in the source. Such an assumption is complicated by motions of the lines in SS433's spectrum: They change wavelength. Some lines in the blues went through a change that would indicate an alteration of velocity by 3,500 kilometers per second in three nights of observing. Another line moves up and down the spectrum in three nights. If these are Doppler shifts, they would require a significant amount of mass to be accelerated at 1 gravity for 40 days and to move in opposite directions. This is astrophysically implausible.

So Margon and his collaborators, Holland Ford, Jonathan Katz, Roger Ulrich and Karen Kwitter of UCLA and R. P. S. Stone and Arnold Klemola of the Lick Observatory, thought up a number of "strange and bizarre" explanations that they presented at the Texas [sic] Symposium on Relativistic Astrophysics in Munich in December. Since then, SS433 has come out from behind the sun, and renewed observations have shown that the changes in the wavelengths of the emission lines come in cycles that last 160 days. Margon now essentially says to disregard Munich communication; the shifts are Doppler.

What it seems to be is a system of familiar emissions of hydrogen and helium in triplicate: Each line appears at essentially its rest wavelength, once blueshifted and once redshifted. The redshifts and blueshifts move back and forth in a correlated way. Such behavior is characteristic of the spectra of rotating objects, and so the first trial model was the most ordinary of these, a binary star system. Dynamically it doesn't work. It requires an object with 2 billion times the mass of the sun (one percent of the galaxy's mass). If a compact body with that mass were hanging around the edge of the galaxy, it would have been known before it was ever seen.

What Margon now favors is a single central rotating body spewing well-collimated streams of ionized gas in opposite directions, like, as he puts it, a double-ended rotating garden hose. The velocity of the stuff coming out of the hose is 80,000 kilometers per second, a quarter the velocity of light. For the central object some have suggested a black hole, but because of the dynamics and the temperature of the outflowing gas, Margon tends to favor a neutron star. But the luminosity of the object has to come to about 2,000 times the sun's, quite bright for an object of this sort. "Where does the energy come from?" he asks.

Continuing observations are obviously necessary. Margon reported some done at the Lick Observatory 12 hours before he spoke. They show that the Doppler shift movements have just turned another cycle. The more cycles that are recorded, the more readily will astronomers believe that there is a regular cycle and not some more complicated variation. At the same time, the International Astronomical Union, through the circulars that it sends every few days to observatories all over the world, appealed to astronomers who could give it some time to concentrate effort on SS433. □