Taking Jupiter's Picture in the Infrared

JAMES A. WESTPHAL

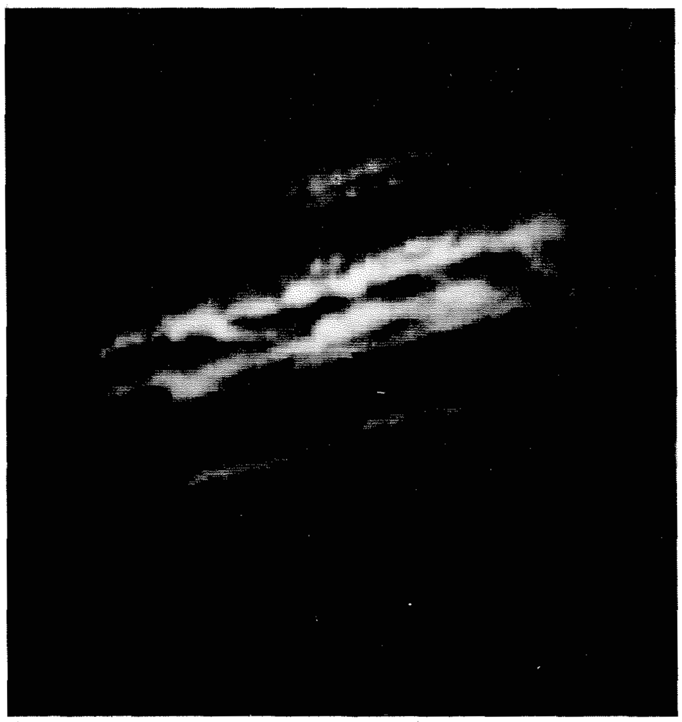
These unusual pictures of Jupiter may lead to a more complete knowledge of the meteorology of the planet

A new addition to the 200-inch Hale Telescope at Palomar Mountain has allowed my colleagues—Richard Terrile, Keith Matthews—and me to collect some very useful and spectacular "pictures" of Jupiter. These pictures are made by slowly moving the image of the planet over a very small photocell in a series of north-south "scans" while moving the whole 200-inch slowly eastward across the planet, thus building up a picture much like that produced by a television camera.

The new addition is an electronically controlled Gregorian secondary mirror. It is attached to the prime focus pier of the 200-inch, which can be "wobbled" in step with an electrical signal sent up from the Cassegrain observing station in the cage on the bottom of the telescope tube some 65 feet away. The Gregorian mirror focuses the light from the planet collected by the 200-inch mirror onto a liquid nitrogen cooled photocell that is sensitive to light with a wavelength about 10 times longer than visible light.

This photocell, also a new development, converts the 5-micron-wavelength infrared light into a very small electrical current, which can be amplified, converted to a digital value, and recorded on a digital tape recorder. The tape can be read directly by the Caltech IBM 370/158 computer, and the 16,384 numbers representing the 5-micron light intensity at each of 16,384 points in the picture can be corrected for various calibration factors by the computer. A new digital tape can then be written by the computer, and it can be played back in our laboratory to produce a photographic picture of the planet at 5 microns.

Earlier studies of Jupiter at 5 microns at the Hale Observatories and at the University of Arizona had shown that the 5-micron energy was coming from very localized areas of Jupiter. We had concluded that these were probably places where the visible cloud deck in the Jovian atmosphere was unusually thin or perhaps had holes through which we could see the 5-micron infrared light from the hotter lower clouds or haze below the clouds.



With the "wobbling secondary" and the new photocell, we were able to make a picture every 168 seconds, with a sharpness limited only by the turbulence in the earth's atmosphere. Since last fall we have collected over 500 of these pictures along with occasional Kodachrome color pictures to compare the visible features with the 5-micron pictures, as in the examples above.

It is easy to see that the dark features (which are blue or purple on the original Kodachrome, left) are regions of high 5-micron intensity (bright regions on the 5-micron picture, right).

If indeed the 5-micron light is coming through holes in the clouds, it should be possible to learn something of the nature of these holes—perhaps their sizes, shapes, and depths.

To do this, we consider not only the amount of light, but the way in which the light from an individual hole changes as the hole moves across the line-of-sight to the earth as Jupiter rotates about its axis each 10 hours. Richard Terrile is studying this problem by comparing models of the clouds with the observations by using a computer.

We are now extending this technique to studies of other planets (so far, Venus and Saturn), and to other wavelengths. We have great hopes that such high-resolution pictures will lead to a more complete knowledge of the meteorology of the planets. □