

Casting some (star)light on Jupiter's atmosphere

University of Texas astronomers are mounting an expedition to photograph Jupiter's occultation of Beta Scorpii on May 13

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Jupiter expedition scientists Tull, Van Citters, Nather, Evans and Wells.

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Astronomers have studied the solar system for centuries, but they still cannot agree on how the planets originated. Many theorists assume that the planets were formed from material thrown off by the sun, either as a result of a near collision with some other star or by another means, but even those who agree on this cannot agree on whether the planets were ever hot bodies or whether they were formed by cold accretion and were never much warmer than they are now.

Jupiter is the largest planet of the solar system, and it has been suggested that it may not be made of solar material at all. Some astronomers believe that Jupiter is a dead, or almost dead, star that the sun has captured into orbit.

Such a situation would be by no means unique in the universe. In our Milky Way galaxy there are many examples of binary or multiple stars, in which two or more stars are bound together by gravitational forces and revolve around each other. In many of these cases bright stars have dark, cold companions.

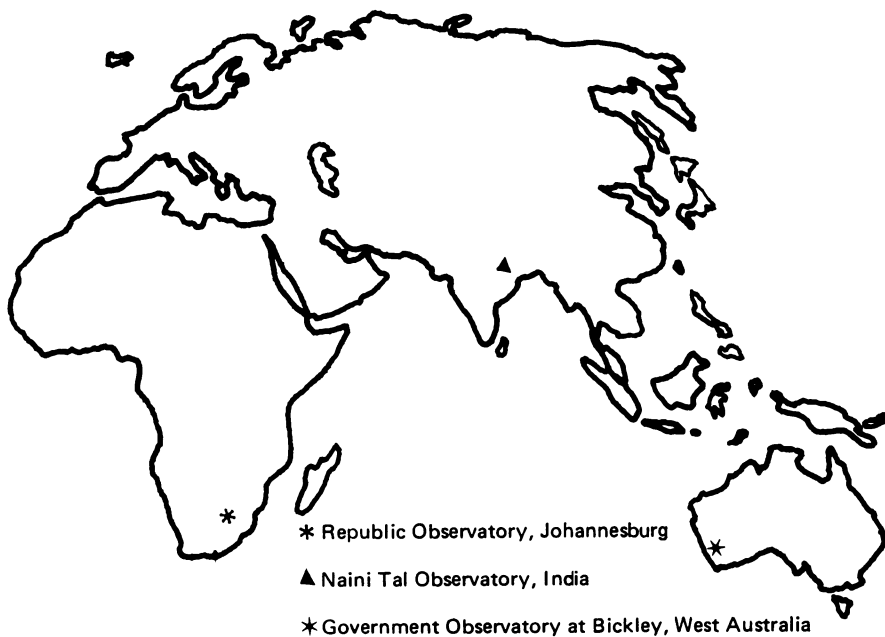
In Jupiter's case the planet's composition tends to support the idea that it may be a star. Hydrogen and helium are the two most prominent constituents of the planet's mass. These elements are abundant in stars, but they are almost lacking in the terrestrial planets, Mercury, Venus, earth and Mars, which are almost certainly not originally stars. The other large planets, however, Saturn, Uranus and Neptune, have compositions that are in many ways similar to Jupiter's, and they may share a common origin with it.

Jupiter's radiation also tends to support the notion of independent stellar origin. The light received from planets is reflected sunlight, but Jupiter's radio emission shows the planet to be a few degrees hotter than heating by the sun can account for. This circumstance has led some astronomers to suggest that in the center of Jupiter, under layers of frozen hydrogen and helium, is the dying remnant of a stellar core that is still producing a little surplus energy.

Those who would argue that Jupiter is a planet made from accretion of material thrown off by the sun point out that the elements hydrogen and helium are abundant in the sun and would be abundant in any cloud expelled by it. They are abundant in the larger planets, this argument goes, because the outer planets are large enough to have the gravity to retain them. The terrestrial planets, whose main constituents are the heavier elements iron and silicon, were too small to retain the light gases.

Nobody explains why the terrestrial planets are small and the outer planets large. Pluto, the farthest planet, re-

Three Observation Sites



mains an enigma. It appears to be small and heavy like the terrestrial planets. Its orbit gives some indication that it may be an escaped satellite of Neptune.

One way that may tell whether Jupiter is a star or a planet is to determine the proportions of hydrogen and helium in its atmosphere. In May the University of Texas plans to mount an expedition that hopes to determine this by observing from three countries Jupiter's occultation of the star Beta Scorpil.

Jupiter occults, passes in front of, faint stars from time to time. Beta Scorpil, the second brightest star in the constellation Scorpil, has a magnitude of 2.65. The last time Jupiter occulted a star that bright was in 1952, says Dr. David S. Evans, leader of the observing group. A similar opportunity will not occur again for 50 years.

As the star passes behind the atmosphere of Jupiter, the observers hope to measure the refraction of the star's light. Knowing the index of refraction they can calculate the molecular weight of the atmosphere and from that the proportion of hydrogen to helium. Beta Scorpil is a double star, so the observers will have four chances to make the measurement, two as Beta Scorpil goes behind Jupiter's solid disk and two as it emerges. Each such passage will last about 30 seconds, says Dr. Evans. The whole event will take about two hours.

The occultation will occur on May 13. It will be at the zenith over the Indian Ocean. To be triply sure of observations members of the team will observe from the Republic Observatory in Johannesburg, South Africa, (Dr. Evans and graduate student Wayne Van Cit-

ters), from the Naini Tal Observatory in India (Drs. R. E. Nather and Brian Warner) and from the Government Observatory of West Australia at Bickley (Dr. Robert G. Tull and graduate student Donald Wells). Dr. Paul Vanden Bout will be ready to substitute for any of the others in emergency and the data will be sent to Dr. William B. Hubbard, a specialist in the theory of planetary atmospheres.

The observations are being done by the University of Texas, says Dr. Evans, because the staff of the university's McDonald Observatory is particularly experienced in the observation of swift astronomical events. The first optical pulsar was confirmed by observers at McDonald (SN: 2/1/69, p. 111), and the observatory has also specialized recently in observation of rapidly varying stars and occultations of stars by the moon.

Since Jupiter shares many characteristics with the other outer planets, there is interest in making similar observations of them. Opportunities should occur in the future, but Dr. Evans does not know offhand the dates of any. Prediction of such events requires painstaking and extremely accurate calculation and is not routinely undertaken by compilers of astronomical almanacs. There was an indication some time ago that Pluto would occult a star, but the calculations were slightly off and the occultation didn't happen. In Jupiter's case, the planet's disk is so large and the mathematics so good that observers are sure of the occultation. Nevertheless, says Dr. Evans, "we had only six months notice of this one, and we've been flat out ever since." □

films OF THE WEEK

RADIOISOTOPE TECHNIQUES. Eighteen Super 8mm film loops, color, each between 2 and 4 min. Titles include: Autoradiograph Sandwich Technique; Developing Autoradiography Film Packets; Handling Radioactive Materials; Disposal of Radioactive Wastes; Determining Half-Life of Radioisotopes; Radiation, Intensity and Density; Radiation Intensity and Exposure Time; Drosophila; Exposing to Radioactivity; Transport of Phosphate in Plants; Transport of Phosphate in Plants—With Stem Girdled; Comparison of Redistribution of Calcium and Phosphorus in Plants; Uptake and Utilization of C¹⁴O₂ During Photosynthesis, Parts I and II; Colors of Light and Photosynthetic Efficiency; Distribution of Phosphorus in a Frog; Distribution of Phosphorus in a Mammal; Growth and Chemical Activity in Roots; and Decontamination Techniques; Radioactive Materials. Purchase information from Encyclopedia Britannica Educational Corp., Dept. SN, 425 N. Michigan Ave., Chicago, Ill. 60611.

PHOTOSYNTHESIS: THE BIOCHEMICAL PROCESS. 16mm, color or b&w, sound, 16 min. Clarifies the nature of photosynthesis through a series of inductive step-by-step laboratory demonstrations. Time-lapse photography illustrates the response of chloroplasts to varying conditions of light and moisture, and electron micrography reveals their structure. Engelmann's classic experiment showing that different wavelengths affect photosynthesis differently is demonstrated, as is the Calvin Cycle. Throughout, the film supports the findings in the biological sciences with evidence from the disciplines of chemistry and physics. Audience: high school, college. Purchase color \$210 and b&w \$105 from Coronet Films, Dept. SN, 65 E. South Water St., Chicago, Ill. 60601.

THE ADVOCATES: ON ABORTION AT WILL IN THE FIRST TWELVE WEEKS. 16mm, b&w, sound, 57 min. Advocates and opponents of legalized abortion argue whether or not a woman has the right of self-determination in having her own pregnancy terminated during the first three months. One view asserts that ready accessibility to abortion would reduce the numbers of unwanted children. Studies cited show that these children run a greater risk of being socially maladjusted or mentally ill. The opposing side believes that the embryo is a human being even though it is not able to sustain life independently and that women often only "think" they want an abortion. It is emphasized that most abortions are sought by married women. Audience: secondary, college, adult. Purchase \$265 or rental \$12.25 from Audio-Visual Center, Dept. SN, Indiana University, Bloomington, Ind. 47401.

THE TRAGEDY OF THE COMMONS. 16mm, color, sound, 26 min. Based on the article of the same title in the Dec. 13, 1968, issue of SCIENCE. Draws an illustration from an 18th century England, where farmers shared the benefits of a mutual pasture for their animals. Profit motive competed with limited space, and the commons failed. The film goes on to develop the analogy between the destruction of the commons and our current dilemma of rapidly diminishing resources, overcrowding, and stress on a finite earth. Content of the film has been so arranged that there are convenient places where the film should be stopped for extended student-to-student interaction. Audience: high school. Purchase information from King Screen Productions, Dept. SN, 320 Aurora Ave., N., Seattle, Wash. 98109.

Listing is for readers' information of new 16mm and 8mm films on science, engineering, medicine and agriculture for professional, student and general audiences. For further information on purchase, rental or free loan, write to distributor.