Something new under the sun: A flicker

Solar physicists used to think that over centuries, if not over billions of years, the sun was fairly stable. This week Lowell Observatory astronomers reported to the National Science Foundation evidence that seems to show that the sun's brightness may vary measurably. The data come from observations undertaken intermittently over the last 25 years.

The observations are not done by direct measurement from the ground. To do so would be to run the risk of having unknown fluctuations in the data from long-term changes in the stability of the receiver and the earth's atmosphere. Instead, the astronomers use differential measurements, comparing sunlight reflected from one of the outer planets with the light of a reference star nearby.

The first part of the project involved brightness measurements of Uranus and Neptune and was done between 1950 and 1966. The work was dropped until 1971 when John S. Hall, the observatory's director, revived it. Mikołaj Jerzykiewicz, a Polish astronomer who had worked on the project in its earlier years, returned to Arizona to start the new observations. In 1973 Wes Lockwood became the principal investigator. In addition to the two planets, the new studies included Saturn's largest satellite, Titan.

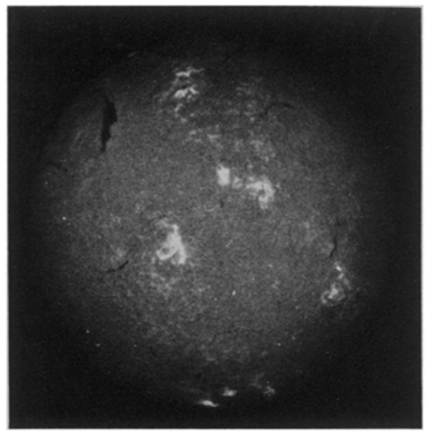
Lockwood reports that the early series of observations had shown that the brightness of Uranus and Neptune had varied in the same way, suggesting that the source of the changes was in the sun and not the two planets. The new observations are more complicated. Since 1972 Titan, Uranus and Neptune have all brightened, but not in the same way across the spectrum. Titan has become bluer, Uranus redder and Neptune unchanged.

Changes on the sun alone cannot account for such various changes in the planets' reflections. If Titan is discounted because the changes in its seasons as it revolves around Saturn introduce an uncertain factor, the Uranus and Neptune data suggest that the sun is varying in the visible spectrum by one or two percent.

Such an amount would affect the earth's energy balance sufficiently to be of interest to climatologists and to scientists working on dynamic models of the earth's atmosphere. By extension it could be of interest to those who try to predict world food production.

An alternative explanation, according to Lockwood, is that the sun may be constant in the visible region but vary in the ultraviolet in such a way as to cause the atmospheres of Uranus and Neptune to change in a way that alters their reflectivity.

Future observations of solar radiation from spacecraft may help to resolve the question and to determine better the amount of change that is going on. If variability is confirmed, solar physicists will have to build it into their models, and those models are in enough trouble already predicting things that can't be found, that they don't need this shock. In July 10 NATURE, A.J. Meadows of Leicester University in England, reviewing attempts to connect changes in the weather with variations of the sun (mainly sunspots) remarks: "If the sun's luminosity can no longer be regarded as a variable, attention must . . . turn to . . . magnetic fields, particle emission and high energy radiation." Well, now maybe not necessarily. □



Sun: Maybe its luminosity is variable.

Further signs of a lopsided universe

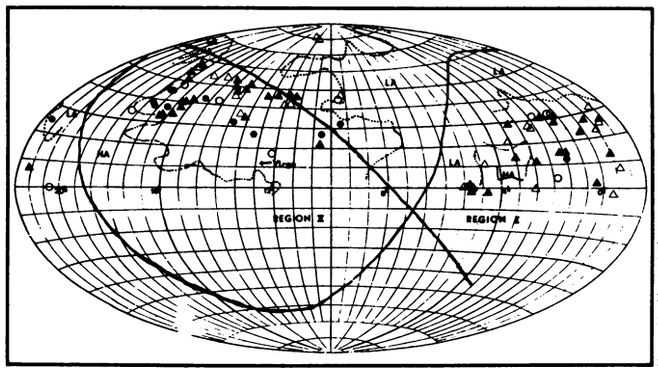
Even before Eratosthenes proved the earth was a sphere, Greek philosophers were sure it must be, because to them the sphere was the most perfect solid shape, and, therefore, the earth had to be one. A similar assumption (perhaps unspoken) seems to be made in theories of the expanding universe. The expansion is taken to be isotropic, the same in all directions. This leads to the simplest, easiest to handle model and is aesthetically pleasing to minds that prefer symmetry and neatness to raggedy edges.

We now know that the earth is not exactly a sphere, and much effort goes into charting its raggedy edges. Likewise, there seems to be developing a body of evidence that the expansion of the universe is somewhat lopsided. The data come from the relation between the redshifts in the light of various classes of celestial objects and their apparent luminosities.

The argument goes like this. In an expanding universe the distance between any object and any other object will always increase, and the further apart the two objects are to start with, the faster will the distance between them increase. (For a two dimensional analogy, experiment with a balloon with dots on its surface. As the balloon is blown up, the distance between any pair of dots will increase, and the farther two dots are apart, the faster will their distance increase, all measurements being made along the surface.) The relative velocity of recession between earth and distant galaxies causes a redshift in the light of the distant galaxies. If the expansion is isotropic, objects at the same distance should have the same speed and the same redshift.

It happens there is another way to check distance. If one has a class of objects of the same intrinsic luminosity (and one can be fairly sure of that if the class is narrowly defined), the apparent luminosity will decrease regularly with distance. For isotropic expansion there should be a relationship between redshift and apparent luminosity that is the same in all directions.

It appears that for several classes of objects the sky can be divided into two regions, and the relationship differs between them. First evidence came from a study of galaxies of the class ScI by Vera C. Rubin, W. Kent Ford Jr., and J. S. Rubin (SN: 8/18-25/73, p. 114). It has since been found for the brightest cluster galaxies, supernovas and Markarian galaxies. The latest addition is compact galaxies with absorption lines in their spectra. The observation is by T. Jaakkola of the Helsinki Observatory and H. Karoji, M. Moles and J. P. Vigier of the Institut Henri Poincaré in Paris and is published in the July 3 NATURE. □



Two regions of sky with apparently different redshift-distance relations. Various observed objects are plotted.