SCIENCE NEWS OF THE WEEK

Massive Stellar Mass

Astronomers tend to use the sun as a standard star (even though in some instances one can argue that it is not). The luminosity of the sun, the mass of the sun, the color and spectrum of the sun are all used as units or average standards of comparison in talking about more distant stars.

Astronomers customarily measure the masses of other stars in units of the solar mass. Many are less massive; many are more massive. The question has arisen how much more massive than the sun can a star be and still exist and be a star. There had been various answers, philosophical and theoretical. People have postulated objects of a million or more solar masses as power sources for quasars, but these can hardly be called stars. For stars that really are stars, practical astronomers have postulated some dozens or hundreds of solar masses as the upper limit. Anything larger—though there are theoretical calculations that go to the thousands of solar masses — would have immense trouble forming and would probably break up immediately if it did form.

At the meeting of the American Astronomical Society in Albuquerque this week three astronomers from the University of Wisconsin at Madison, Joseph P. Cassinelli, John S. Mathis and Blair D. Savage, reported their belief that they have found a star with the preposterous-sounding mass of 3,000 times the sun's. This would make it by far the most massive star on record. It would be 60 times as massive as the previous weight record — the star cataloged as HD47129.

The supermassive star is cataloged as R136a and lies in the center of the Tarantula Nebula in the Large Magellanic Cloud. The nebula is also called 30 Doradus.

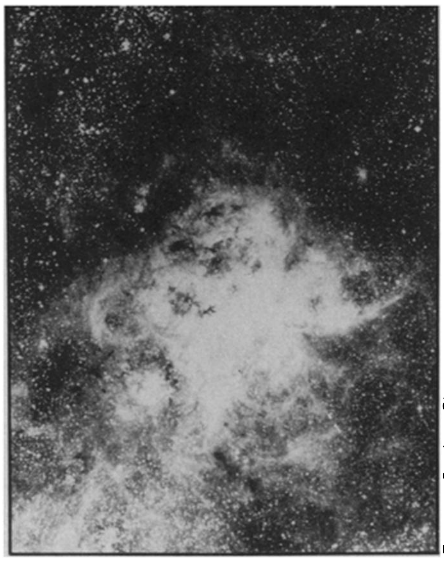
The Tarantula Nebula is the brightest region of ionized hydrogen (HII region) visible in the local group of galaxies. To sustain the amount of ionization necessary to provide its brightness requires radiation from an extremely powerful source. That could be a cluster of stars, but it might be a single object.

A German group observing the central region of the Tarantula Nebula found that up to three-quarters of the necessary radiation must come from an area no wider than one light-year across. Yet the amount of radiation is equal to the output of 40 stars of the class 03, the brightest stars in our galaxy. It seemed unlikely — Cassinelli's word is "absurd"—that such a group should have found itself in such a small area.

The Wisconsin group obtained the services of the International Ultraviolet Explorer Satellite to do observations of the Tarantula Nebula in the ultraviolet range. These observations determined a temperature of 60,000 K for the central object of the nebula—that means 100 million solar luminosity units — and also found that it has a stellar wind, an outflow of gas, that goes at the prodigious rate of 3,500 kilometers per second, equivalent to 7½ million miles per hour. In Savage's view the clinching evidence is the temperature. With that temperature the satellite could not be looking at a superposition of spectra of several stars—dozens perhaps. It would have to be a single star.

From the luminosity of the central object it is possible to conclude that its mass — if it is a single star — must be at least 3,000 solar masses. The radiation pressure from that luminosity would break up any single object with less mass and therefore less self-gravitation. Furthermore, a theoretical calculation of what a star of 3,500 solar masses would be like based on the theory of stellar interiors gives a temperature of 65,000 K so everything adds up, give or take a little.

Such an object should be extremely unstable, and this one with its fierce wind seems to be. It is losing mass at about one solar mass a century so that within its lifetime it should dissipate most or all of its mass. The next step, these astronomers say, is to watch this object for variations of output. Variation is characteristic of single objects. Clusters don't vary much on the average. More such supermassive stars can also be sought. There are HII regions in other nearby galaxies that are likely candidates. A space telescope could provide the necessary optical definition to see if they seem to have single objects in their centers. There is no candidate in our galaxy. □



Tarantula Nebula may have super sun.

The Viking Fund: Martian grass roots

The four Viking spacecraft that reached Mars in the summer of 1976 were designed and constructed over nearly a decade by a veritable army of scientists, engineers and technicians amounting to more than 10,000 people. Now another 10,000 people are taking part in the Viking project. Some of them may even have been members of the original contingent, but more indicative of the new group's diversity are 72-year-old Elizabeth Hawkins, a secretary with an Oregon construction firm, and, from Mesa, Ariz., Echo Wood — aged 5.

The first 10,000 were paid as employees of the National Aeronautics and Space Administration and its hundreds of Viking contractors and subcontractors. Hawkins, Wood and associates paid the government instead. They are contributors to the Viking Fund, a privately organized entity that for the past year has been accepting donations from private citizens who wish to support Viking's research, still being carried on by the surviving landing craft on the Martian northern plains. And on Jan. 7, outgoing NASA administrator Robert Frosch received for his agency the Fund's check for $60,000.

In response, this coming July and August—the fifth anniversaries of the Viking spacecraft arrivals at Mars — have been designated by NASA as "Viking Fund Months." During that period, the costs of acquiring the lander's data through the NASA deep-space tracking network (and of processing the results) will be borne by the Fund's contribution. The space agency emphasizes that the lack of $60,000 would not have caused the lander to be shut down, but the project is running on a relative shoestring, and the additional money will free some of Viking's limited funds for several other activities. A 10-month span of the lander's weather data (including its first Martian winter and two global dust storms), for example, was gathered when problems with a sensor left a troublesome ambiguity in wind-direction measurements. Resolving the ambiguity had a low enough priority that the work might not have been funded at all. The money freed by the Fund will also enable completion of a global albedo map of the planet, and wider distribution of a special, all-Mars issue of the JOURNAL OF GEOPHYSICAL RESEARCH.

Arranging for the Viking Fund transaction was not simply a matter of NASA's holding out its hand. Federal agencies are allowed by law to accept only unrestricted contributions, so NASA lawyers had to consider a number of possibilities such as contracts before they hit on a way of ensuring that the money would be used for its intended purpose. The final solution was a "reimbursable agreement" between NASA and the Fund's parent organization, the American Astronautical Society, in