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.

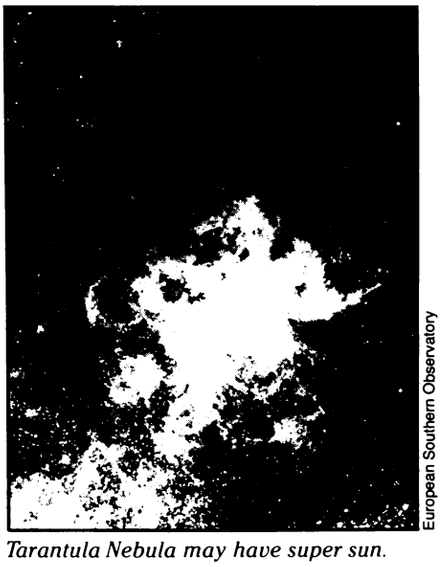
The Tarantula Nebula is the brightest region of ionized hydrogen (HII region) visible in the local group of galaxies. To sustain the amount of ionization necessary to provide its brightness requires radiation from an extremely powerful source. That could be a cluster of stars, but it might be a single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



European Southern Observatory

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

which the $60,000 became a fixed fee covering the tracking-network activities, while the other work would be financed by NASA itself.

The landing craft, meanwhile, is programed to operate through 1994, providing occasional photos and an ever-lengthening meteorological data base. "I'm confident that [contributions from the Fund] will continue to be an annual thing," says its founder, California aerospace engineer Stan Kent, who estimates that as much as an additional $40,000 has already been received. Contributions (to the Viking Fund, 357 Saratoga Ave., Santa Clara, Calif. 95050) have averaged about $10, he says, ranging from 25¢ to $100 or more, and are tax-deductible. "The space program is coming alive again," says Kent, bolstered by the grass roots support at a time when many scientists fear for the future of planetary research. "It's coming out of the doldrums." □

Three cloned mice? It depends...

The publication this month of a scientific paper reporting the first successful nucleus transplant in a mammal caused quite a stir in the press. Were the three mice born after micromanipulation truly mammalian "clones"? As first reported in SCIENCE NEWS from a meeting at Jackson Laboratories (SN: 7/28/79, p. 68), the genetic material for each mouse was moved in its nucleus from cells of young embryos and injected into a fertilized egg, taken from another mouse. The genetic material originally present in the egg was removed, and the egg was then implanted in an unrelated mouse foster mother. Karl Illmensee and Peter Hoppe, working at the University of Geneva, report that one of the resultant animals died after 7 weeks, but the other two reached adulthood and were bred. Their progeny showed the hereditary characteristics expected from the transplanted nuclei.

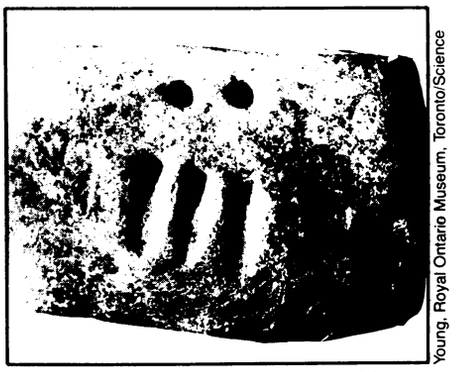
Whether this feat of experimental embryology ought to be called cloning is a matter of fine definition. There is no question that each mouse was created asexually from a single individual, but that individual, an embryo, was destroyed in the process. Another objection that has been raised is that true cloning must produce more than one genetically identical individual. The three mice described in this month's CELL each derived from a different embryo. In more recent work, more than one nucleus taken from a single embryo has been successfully transplanted — giving a "clone" of mice, according to the Jan. 8 New York Times, but the details have not been reported yet. If your idea of cloning, however, is to mass-produce copies of an adult animal, the mouse work is just one very significant step along the way. □

Token impressions mark early writing

Impressed markings made on clay tablets dug up around the Euphrates River in Mesopotamia are believed to be the earliest examples of writing. These crude signs, which date to about 3,000 B.C., appear to be a logical step in the evolution of a system of record keeping that began approximately 11,000 years ago. A new decipherment of these seminal writing samples supports and broadens this theory.

Denise Schmandt-Besserat of the University of Texas reports in the Jan. 16 SCIENCE that the signs stand for units of grain and land measurement, animal numeration and other economic and trade units. They were formerly thought to be numerical signs, devoid of content, but Schmandt-Besserat now suggests that the impressed tablets dealt with small amounts of food and commodities and were used as receipts for payments to individuals and to the government and religious temples.

This work grew out of previous explorations into the meaning of clay tokens reported by Schmandt-Besserat in the June 1978 SCIENTIFIC AMERICAN. She hypothesized that the first tokens appeared early in the Neolithic period around 8,500 B.C. because a newly developing agricultural economy required a recording system, especially for food storage. Fourteen tokens of different shapes, plus several others, were analyzed for their references to food, goods and numbers.



Young, Royal Ontario Museum, Toronto/Science

Early writing on impressed clay tablet.

Significant changes in the recording system occurred early in the Bronze Age, between 3,500 and 3,100 B.C., as the development of an urban economy, rooted in trade, brought about a more complex business accountancy. Parallel lines and perforations, explains the researcher, began to appear on tokens, and some tokens were strung together as records of transactions.

Images of tokens impressed on clay tablets soon replaced tokens themselves. Schmandt-Besserat says she studied about 200 impressed tablets from excavations in Iran, Iraq and Syria, and suggests that the markings are precise measurements rather than numerical notations. She has begun to make an inventory of the clay impressions, grouping them in content categories. But she told SCIENCE NEWS that much work needs to be done in this area, including the continued examination of tokens and tablets stored in museums throughout the world. □

New cancer detection test announced

Though early detection of cancer is a crucial factor in the ultimate outcome of therapy, there are currently no general screening tests for early, unsuspected cancer. Pennsylvania State University researchers, however, have just announced the development of a blood assay that identifies the presence of cancer in patients with known malignancies, and they are optimistic the test will prove capable of detecting cancers before any malignant growth becomes apparent.

The assay tests for the presence of a glycoprotein given off only by cancer cells. The researchers looked at blood from 330 cancer patients, 170 cancer-free persons, 28 patients with a recurrence of cancer and 80 patients in remission. The test proved 96 percent accurate in identifying active cancers, with a false positive rate of two percent, the researchers said in Washington this week at a press conference sponsored by Warner-Lambert. The company plans to develop the test for marketing either as a cancer screen, an indicator of treatment success or a diagnostic tool.

There are already 16 cancer detection tests available, but each is specific for a particular kind of cancer. Like the current tests, the new assay identifies a substance given off by cancer cells, but the glycoprotein the Penn State researchers isolated appears to be given off by most types of cancer. The test works for four major categories of cancer — cancinomas, melanomas, sarcomas and Hodgkin's disease — the researchers say.

Because the amount of glycoprotein in the blood correlates with the amount of cancerous tissue, the researchers expect the test will prove accurate in detecting cancer in its earliest stages. "Early detection is still the most effective means for dealing with malignancies," says Eugene A. Davidson, who developed the test with Sally D. Bolmer. Measurements of the accuracy and potential of the test are "extremely encouraging," he says.

The test will have to be refined and proved before it hits the market, which could be in three to three and a half years, if the testing goes well, a Warner-Lambert official reports. The Penn State researchers are currently working on a monoclonal antibody against the glycoprotein for use in the assay. □