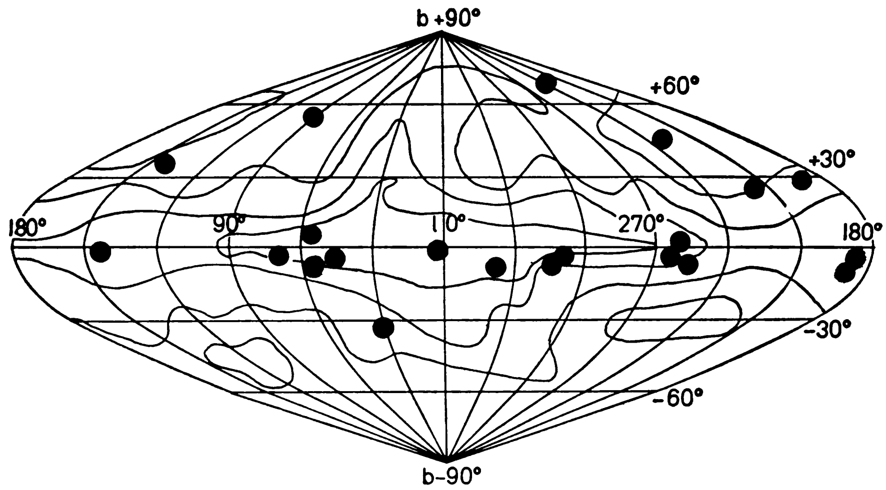

Distribution of the 21 known pulsars is concentrated near the galactic plane.

PULSARS

The list swells

Six more pulsars have been discovered by Australian radio astronomers, bringing the known total to 21.

Chances are good that this number will be doubled by the end of February, the anniversary of the public announcement of the first pulsar. As fainter and ever shorter period pulsating radio sources are detected, the count could rise as high as 200.

Considering that there are some 100 billion stars in earth's home galaxy, however, even that figure means pulsars are relatively rare.

An apparent clustering of many pulsar periods around certain values, according to Dr. Frank Drake of the Cornell-Sydney University Astronomy Center in Ithaca, N.Y., is "tantalizing but not significant."

Nevertheless, all but five of the 21 known pulsars blast out their radio signals near multiples of 0.25 seconds.

One reason so many new pulsars have been discovered since August—only five were known previously—is that radio astronomers had to modify their equipment to detect the rapid but regular variations at radio wavelengths. That adaptation took them about six months.

The discovery of two with pulsations of less than one-tenth of a second, both associated with known remnants of supernovas (SN: 10/12, p. 363), has strengthened the theory that pulsars are connected with neutron stars, stars that have exploded their gaseous outer shell into space, leaving a concentrated core of matter that weighs perhaps a billion tons per cubic inch. Such neutron stars would not be visible optically because of their small size.

Further support for the theory that pulsars are rotating neutron stars comes from the observation that the period of the fastest one known—33-thousandths of a second for NP-0532—is slowing down (SN: 12/7, p. 574). A neutron star is surrounded by a cloud of plasma whose drag would tend to slow down the rotation. If the neutron star theory is correct, this would mean that the 21 pulsars so far detected are older supernovas.

NP-0532, detected with the 300-foot radio antenna at the National Radio Astronomy Observatory in Green Bank, W. Va., was confirmed as being in the Crab Nebula by radio astronomers at the Cornell-Sydney University Astronomy Center using the 1,000-foot dish near Arecibo in Puerto Rico. The Crab Nebula is a known supernova whose explosion was observed on July 4, 1054, and the tiny slowing down observed in the rate of pulsations from NP-0532 jibes with an age of about 900 years for the supernova.

If the slowing down in the radio pulse rate is also found in other sources—scientists around the world are now searching for a change in the ticking rate as well as for new pulsars—then the neutron star theory would become the accepted one. In this model the generation of the pulsating radio waves results in a slowing of the neutron star's rotation rate.

Until new pulsars are discovered, however, the best place to listen for a slowing down is from the pulsar known as PSR-0833, which sends out its signals every 0.089 seconds and is the remnant of another known supernova in the constellation of Vela, visible only from the Southern Hemisphere.

The identification of neutron stars would open up a new realm of astrophysical exploration, not only of very dense matter, but of extremely high magnetic and gravitational fields.

TRANSURANIC

Hopping to stable elements

Next year's Federal science budget will be tight. The effort to keep present programs going will not leave much room for new starts.

Yet, if the reported enthusiasm in the National Science Board carries through, the fiscal 1970 budget may include funds for one significant and fairly costly start, an accelerator for heavy ions in the one billion to three billion electron volt range.

Three or four groups at different laboratories have plans for machines of this type. Among them is the Lawrence Radiation Laboratory's Omnitron (SN: 3/18/67, p. 257), which would cost $25 million. A spokesman for the Atomic Energy Commission says the commission would like to fund Omnitron—if it can get the money.

The purpose of such an installation is to produce beams of heavy ions—essentially heavy atomic nuclei—and drive these against targets of similarly heavy elements in the expectation that some of the beam and target nuclei will fuse into even heavier nuclei. The science board's enthusiasm has apparently been kindled by the hope of finding stable elements heavier than uranium, a hope which has been growing among nuclear scientists over the past few months.

Uranium, with 92 protons and 146 neutrons, is the heaviest known stable nucleus. Stability depends on the balance between the attractive nuclear forces and the repulsive electric forces between the constituent particles. In general, the larger a nucleus is, the less likely it is to be stable. Nuclei have been discovered or manufactured up to proton number 103, and a Russian group has a disputed claim to 104, but all above 92 are highly unstable.

Recent suggestions that stability, or relative stability, may exist at higher numbers than these is based on what people in the field call magic numbers. According to the shell model, which sees a nucleus as a series of concentric shells, a nucleus whose outermost shell is full of neutrons and protons will be relatively stabler than its near neighbors in the periodic table whose outermost shells are incomplete.

This idea leads to a series of magic numbers, shell by shell, that represent stable configurations. Theorists now hope that by extending the magic numbers beyond uranium they may point out for experimenters hypothetical nuclei that, if not absolutely stable, will be long-lived with respect to their neighbors.

Soviet scientists, says Prof. S. G. Nilsson of Lund University in Sweden, have followed this reasoning and "put before us a star of hope, really a red