physical sciences

NUCLEAR CHEMISTRY

Transuranics in meteorites

Since the construction of the first nuclear reactors in the 1940's, physicists and chemists have engaged in a continuing attempt to discover or manufacture elements heavier than uranium, the heaviest known stable element. Lately they have been excited about finding elements heavier than they ever thought possible, atomic numbers 110 and up (SN: 12/14, p. 592).

Drs. Edward Anders of the University of Chicago and Dieter Heymann of Rice University now suggest that elements 112 to 119 may have existed in meteorites and left behind evidence of their existence.

They say, in the May 16 SCIENCE, that the xenon in meteorites and that on earth differ in the relative abundances of two isotopes, atomic weights 131 and 136. They attribute the difference to the past presence and fission of now-extinct transuranic nuclei in the meteorites.

For some classes of meteorites Drs. Anders and Heymann feel that plutonium 244, a long-known element, is probably responsible. For the old meteorites known as chondrites, they find the situation "less clear-cut." There are fission products present, but the patterns do not fit progenitors among the actinides, atomic numbers 89 to 103, or the transition metals between 104 and 111. They suggest a more volatile progenitor, most likely one of the super-heavy elements between 112 and 119.

NUCLEAR PHYSICS

Fallout

In August and September 1968 the French conducted nuclear explosive tests near Tahiti at latitude 21 degrees south, longitude 137 degrees west. Fallout from these tests has been observed at Arkadelphia, Ark., reports Dr. B. D. Palmer of Henderson State College in Arkadelphia in NATURE for May 10. Iodine and barium isotopes with half-lives of 8 and 12 days took about three weeks to go from the South Pacific to Arkansas.

PULSARS

Testing for simultaneity

Now that astronomers have found a pulsar that pulses in both visible light and radio (SN: 2/1, p. 111), they want to determine whether pulses at different frequencies occur at the same time. In pulsar theories such as Dr. Thomas Gold's (SN: 5/31, p. 522) that say radiation of different spectral ranges should be produced at different levels in a plasma surrounding a neutron star, a difference in the arrival time of radio and light pulses should appear as a consequence of the different distances from the observer to the points of origin of the emissions.

Simultaneous radio and optical observations of the pulsar NP-0532 done by Drs. E. K. Conklin and H. T. Howard of Stanford University and Drs. J. S. Miller and E. J. Wampler of Lick Observatory show that the radio and optical pulses are emitted simultaneously with an uncertainty of six milliseconds. The uncertainty arises from uncertainty in the estimates of the density of interstellar electrons, which affect the passage of the radiation.

When the electron density is better known, they say in the May 10 NATURE, their data may be good enough to determine simultaneity within a quarter of a millisecond. The full six milliseconds would mean a distance of about 1,800 kilometers between the points of generation, a quarter millisecond would mean 75 kilometers. In Dr. Gold's theory, NP-0532 should have plasma 1,600 kilometers deep.

PULSARS

Vela object in visible light

The confirmed discovery of the first pulsar in visible light (SN: 2/1, p. 111), NP-0532 in the Crab nebula, has led various astronomers to search for others. A team working in Australia now reports that the pulsar in the constellation Vela seems to appear in visible light.

The Crab pulsar is the fastest known pulsar; the Vela one is the second fastest. A theory propounded by Dr. Thomas Gold of Cornell University (SN: 5/31, p. 522) predicts the spectral range of pulsars according to the speed of pulsation. On this basis optical pulses are predicted for NP-0532 and are just barely possible for the one in Vela.

Drs. K. C. Freeman, A. W. Rodgers and P. T. Rudge of Mount Stromlo and Sindings Spring Observatories and Dr. G. Lynga of the Uppsala Southern Station at Mount Stromlo report in NATURE for May 3 that they have observed a very faint pulsed signal from the direction of the Vela pulsar that is "possibly significant." If it is real, its magnitude is something between 20 and 21. Further observations are planned.

PLASMA PHYSICS

Density measurements

Physicists have a number of means by which they can measure the density of plasmas. Each method has certain drawbacks, and the general situation has been, say Drs. F. C. Jobes, J. F. Marshall and R. L. Hickok of Mobil Research and Development Corporation in Princeton, N.J., that the physicist can choose either a method that does not disturb the plasma but gives him an indistinct picture or one that gives a well-resolved picture but disturbs the plasma by an unknown amount.

Now, they report in PHYSICAL REVIEW LETTERS for May 19, they have developed a method that solves this dilemma by giving a well-resolved picture without disturbing the plasma. The method uses a stream of singly ionized hydrogen molecules that is shot across the plasma. When the ions strike plasma particles, they break up into a proton and a hydrogen atom. The number of such protons produced at any point in the plasma serves as a measure of the density of the plasma at that point.

Since the stream of probe particles is very thin to start with, and only one percent of them collide with plasma particles, there is not much disturbance of the plasma. Furthermore the probing beam can be scanned electronically, a faster method than mechanical scanning.

The method can be used with heavier ions as the probe, they say, and the heavier the ions, the smaller is the energy they need to carry.