An unexplained flurry of neutrinos from space

When asked recently "How does the sun work?" Richard Tousey of the Naval Research Laboratory quipped, "The sun works fine." But the real truth of the matter is that while the sun is apparently working, solar scientists really don't know *how* it works—exactly. There are many theories, some of which will have to be revised as a result of the voluminous data now being returned from the six Skylab solar telescopes (see p. 120).

One fundamental question about the sun concerns neutrinos. Neutrinos are believed to be by-products of nuclear fusion in the sun's interior. Raymond Davis Jr. of the Brookhaven National Laboratory has been trying to catch neutrinos since 1967 in an underground tank in South Dakota. He and John C. Evans presented the results so far of the five-year search this week at an international conference on cosmic rays in Denver.

The process for catching this illusive matter is complex. Neutrinos have no rest mass, and they travel at the speed of light. They can pass through the entire earth with no interaction. The Brookhaven group is the only team trying the experiment, which makes the results even more difficult to interpret. So Davis understandably is very cautious about what he claims.

The hitch is that for the last five years, Davis has not been catching as many solar neutrinos as had been predicted. This has led to a flurry of new theories about the sun to explain the "missing" neutrinos (SN: 3/10/73, p. 155).

But now there is another mystifying result. During an experiment last year, Davis caught three times more neutrinos than he has ever snared before or since. The experiment in question began July 7, 1972, and lasted until Nov. 5, 1972.

During the three-month period the group collected 57 ± 23 atoms of argon 37, presumably produced by that many neutrinos in the chlorine tank. During the previous three-month run, the count had been 10 ± 9 atoms. During the succeeding three-month run the count was 16 ± 15 atoms.

During that period in 1972 two events occurred in the neighborhood of earth: a large solar flare on Aug. 4 (SN: 8/19/72, p. 119) and a large radio outburst in Cygnus X-3 from Sept. 2 to 11 (SN: 9/9/72, p. 165). The Air Force's Vela satellites were also detecting high gamma-ray pulses from outside the galaxy.

Davis has found no direct correlation between the gamma-ray pulses and his high neutrino count.

Some solar scientists think the count might have something to do with the solar flare. Perhaps the neutrinos indicate that something drastic happened inside the sun's interior, and the only event observed by man was a ripple (the flare) on the surface. But Davis believes the sun is an unlikely source for his neutrinos. "I belong to the old school of solar thought," he says, "which believes the sun just doesn't change all of a sudden. Something happening on a month by month time-scale is improbable." He also considers the Cygnus X-3 outburst an unlikely source.

What about a supernova (stellar explosion)? "This is not unreasonable," Davis says. Astronomers think a supernova occurs when a star gets so hot that photons escape as neutrinos prior to the star's collapse.

If the missing neutrinos were an enigma, the high count may develop into an even bigger one. Davis' tank may prove to be a scientific gold mine—an indicator of extragalactic events. The problem is to find the event that matches the results.

"There may never be an explanation," says Davis.

In the spectrum of 3C 286 taken with the 300-foot NRAO radio telescope at Green Bank, W. Va., they found an absorption line at a wavelength of 37.5 centimeters. They believe this represents absorption of waves emitted by the quasar by neutral hydrogen in some galaxy lying between us and the quasar.

Neutral hydrogen at rest absorbs at a wavelength of 21.1 centimeters. Thus the new position at 37.5 centimeters represents a sizeable redshift, one indicative in fact of a velocity of more than 100,000 miles per second, nearly seven-tenths the velocity of light. It is the largest redshift yet discovered in a radio spectral line.

Since gas pervading some galaxy between us and the quasar should not be subject to any strange processes going on in the quasar, such as might produce a nonvelocity redshift, the galaxy's redshift must be due entirely to velocity and thus should represent its distance. The galaxy's redshift turns out to be 80 percent of that measured for the quasar.

Since the quasar is at least as far away as the galaxy, the conclusion is that at least 80 percent of the quasar's redshift represents distance, and that quasars are indeed among the most distant objects in the universe. □

Molecule building in the prebiotic soup

How did molecules destined to become the building blocks of life form on the primitive earth? Scientists have attempted to get these answers by conducting chemical experiments under simulated prebiological conditions. So far, nucleotides, which make up cells' genetic material, have been synthesized under such conditions. So have many of the 20 amino acids that make up peptide chains, and in turn proteins. But how did nucleotides evolve into chains of nucleotides and amino acids into peptide chains? A unified scheme for such activation is presented in the Aug. 17 NATURE by Rolfe Lohrmann and L. E. Orgel of the Salk Institute of Biological Studies.

The chemists' scheme is based on a series of reactions that they carried out under simulated early earth conditions. Unlike any suggested before, these reactions parallel contemporary biological mechanisms.

First they determined that polyphosphates, such as ATP, were probably the primary energy reserve for primitive chemical reactions. (ATP is the major source of energy in modern living organisms.) Polyphosphates' importance on the primitive scene had been suspected before. But it had not been documented chemically.

They next placed imidazole, an amine, in the presence of ATP and magnesium. ATP provided the source of polyphosphate energy. The resulting products were phosphoramidates. Phosphoramidates are nucleotides that under acidic conditions have a tendency to condense on a complementary nucleotide template. Lohrmann and Orgel found that one of the phosphoramidates, which contained adenylic acid, condensed on a complementary template containing uridylic acid. The result was short nucleotides.

Then they found that amino acids, which are also amines, formed phosphoramidates. Although the phosphoramidates were energy-rich compounds, they could not react directly to form peptides. But if the phosphoramidates were put in the presence of imidazole, they formed short peptide chains.

Polyphosphates, magnesium, imidazole and amino acids, then, were some of the ingredients that they used to make chains of nucleotides and chains of amino acids. "But it is probable," Lohrmann and Orgel say, "that other organic molecules can replace them." □