physical sciences

PARTICLES

More on quarks and cosmic rays

The most common theory of subatomic particles holds that they are all built out of three fundamental entities called quarks. Last September an Australian, Dr. Brian T. McCusker, reported finding free quarks among the debris from cosmic-ray showers (SN: 9/13, p. 198).

Some physicists are skeptical because his results call for a much higher probability of quark production in particle collisions than current theory allows.

But current theory is based on the behavior of fairly low-energy particles. At the high energies found in cosmic rays, says Dr. John Dooher of Adelphi University in the Dec. 22 PHYSICAL REVIEW LETTERS, a pi meson striking a proton may be split into quarks instead of bouncing as it does at low energies.

Counting occurrences of this kind, says Dr. Dooher, could raise the probability of quark production to the level observed by Dr. McCusker.

CHEMISTRY

Support for polywater structure

Anomalous water, or polywater, is a strange form of water that condenses under certain conditions in tiny glass or quartz capillary tubes. The substance appears to have about 4 times the molecular weight of water and 15 times the viscosity.

Studies of infrared and nuclear-magnetic-resonance spectra of anomalous water have led to reports that it is a polymer formed by joining water molecules in hexagonal rings that string together in long chains (SN: 1/3, p. 17). In the Jan. 9 NATURE Dr. Gregory A. Petsko of Princeton University writes that a third method of investigation, proton magnetic resonance, also gives results "in agreement with the hexagonal ring structure."

PLANETARY ASTRONOMY

Origins of terrestrial planets

One of the many suggestions about how the inner or terrestrial planets originated traces them back to two primeval bodies. One of these so-called protoplanets would have broken up to form the earth, the moon and Mars; the other would have split into Venus and Mercury (SN: 10/18, p. 351).

In the Jan. 3 NATURE Dr. J. M. Bailey of George Washington University presents a dynamical objection to this idea. If the earth and Mars were once a single object, he says, their orbits ought to touch. Assuming that the earth's orbit is now much as it was in the beginning, if Mars had been ejected from the earth it ought to have a very elliptic orbit that returns it once each revolution to a point on the earth's orbit.

In fact, the orbit of Mars is nearly circular, and Mars never comes nearer to the earth than 60 million kilometers. Dr. Bailey concludes that the two planets were never one.

On the same page of NATURE, however, Dr. W. H. McCrea of the University of Sussex in England replies that if the breakup of the protoplanets took place at a very early stage in the history of the solar system, there would have been much debris in interplanetary space: matter that has since been picked up by other planets. This debris would have slowed Mars down and brought it to its present orbit even if it had started from the earth, he says.

COSMIC RAYS

X-rays, gamma rays and infrared background

Much of the cosmic-ray flux arriving at the earth consists of gamma rays and X-rays. Some of these apparently come from distant parts of the universe; others may be produced in our own galaxy by interaction of other cosmic rays with matter in the galaxy.

Last year, Drs. G. W. Clark, G. P. Garmire and W. L. Kraushaar reported (SN: 12/7/68, p. 568) that the flux of gamma rays from the region of the galactic center was too high to be accounted for by the then known methods of production unless the intensity of cosmic rays in that direction was for some reason higher than in others.

About the same time Drs. Kandiah Shivanandan, James R. Houck and Martin O. Harwit found a strong background flux of infrared radiation near the earth and suggested it might pervade the galaxy (SN: 11/30/68, p. 543).

In the Dec. 22 PHYSICAL REVIEW LETTERS, Drs. R. Cowsik and Yash Pal of the Tata Institute in Bombay point out that if the infrared does permeate the galaxy, collisions between it and the incoming cosmic rays could supply the observed excess rays.

SOLID STATE

Superconductivity linked to magnetism

Superconductivity, the ability of a substance to pass an electric current without resistance, is usually attributed to pairing of the current-conducting electrons at temperatures near absolute zero. Since electrons normally repel each other, an intermediary is needed to bring about the pairing.

For uranium and certain related elements, suggests Dr. B. T. Matthias of Bell Telephone Laboratories, the intermediary is an electron that spends part of its time in the so-called f shell of the atom. Electrons of the f shell are susceptible to magnetic forces, and this suggests a link between superconductivity and magnetism.

In fact the only known superconducting uranium compounds were with magnetic elements until Dr. Matthias and Drs. C. W. Chu, Ernest Corenzwit and D. Wohlleben found superconductivity in uranium-platinum-carbon, which includes nonmagnetic elements.

At first they were afraid the superconductivity-magnetism link had been broken, but, they report in the October PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, the compound can be separated into uranium carbide and uranium-platinum, and the uranium-platinum is magnetic. Nevertheless, they say, this is the first evidence that nonmagnetic elements can mix into the superconducting compounds of uranium.