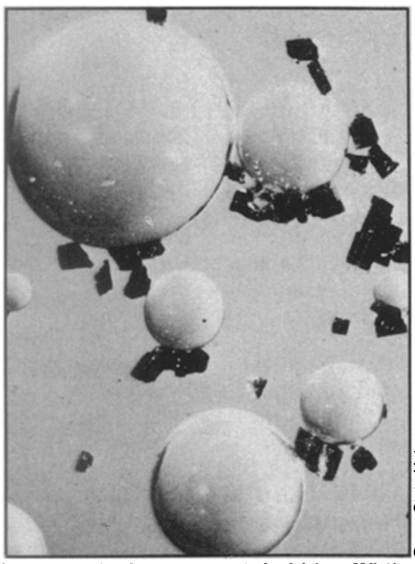
CHEMISTRY

Flotation: Tiny bubbles clean the coal


Penn. State Univ.

Coal engineers always are on the lookout for improved flotation techniques — methods that separate coal from pyrite, a sulfur-containing compound that cuts the heating efficiency of coal. Now, Frank F. Aplan and colleagues of Pennsylvania State University in University Park have designed a special cleaning procedure that allows "free" coal to float on the air with the greatest of ease.

Aplan credits the procedure's success to the use of a particular molecule that attaches to pyrite but not to air bubbles. While the pyrite is held down by this molecule, the coal latches onto air bubbles and floats to the surface of the coal-cleaning chamber, as shown in the photograph. "The flotation chamber is a common coal-cleaning device not too different from a giant 'mixmaster,'" Aplan says. He hopes to have the process available commercially in about two years.

Aluminum foiled by water

While experimenting with various metals to use in their routine metal-coating operations, researchers at TAFA Metallisation Inc. in Bow, N.H., recently chanced upon a unique aluminum alloy: The substance has "all the classic characteristics of metal." but it rapidly dissolves in water. "If I had a piece of the metal and put it in a glass of water," says TAFA president Merle Thorpe, "within minutes it would just bubble away."

Thorpe immediately thought the new metal "would be a nifty material to make handcuffs for any modern Houdini who likes to leap into rivers manacled." Now, however, he is considering other applications, including encapsulating algicides and water sensors for flood control.

Citrus sappers — heat and oxygen

Florida researchers recently stocked their shelves with canned single-strength (as opposed to concentrate) grapefruit juice to measure the effect of storage temperature on vitamin C potency. John M. Smoot and colleague of the U.S. Citrus and Subtropical Products Laboratory in Winter Haven, Fla., stored citrus juices at 50°F, 68°F, 104°F and 122°F for 12 weeks. Then the researchers analyzed the juice for ascorbic acid, the reduced form of vitamin C, and dehydroascorbic acid, the oxidized form of vitamin C, to measure the total active vitamin C (TAVC) in the product.

The results of the TAVC analysis, published in the March/April JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY, indicate that while refrigerated juice loses only 2 percent of its vitamin C potency, juice stored in hot warehouses can lose up to 70 percent of its potency. Furthermore, juice stored in plastic bottles or waxed cardboard is at a greater disadvantage: Oxygen diffuses through the walls of these containers to help hasten vitamin C breakdown.

PHYSICAL SCIENCES

A second binary star

Most of the stars in the galaxy are binary or multiple systems, two or more stars bound together and revolving around a common center of gravity. Pulsars overwhelmingly do not live in binary systems. This is strange because pulsars are generally believed to be neutron stars, one of the possible kinds of remnant from the supernova explosion of an ordinary star.

A supernova explosion might be expected to break up some kinds of binary systems, but as the four astronomers who now announce the finding of the second reported binary pulsar point out, theoretical calculation shows, perhaps surprisingly in its turn, that binary systems with a wide variety of initial dynamic characteristics should survive supernova explosions. Yet up to now only one pulsar was known to be in a binary system, PSR 1913 + 16. Writing in the ASTROPHYSICAL JOURNAL (Vol. 236, p. L25), R. N. Manchester, Lynette M. Newton and D. J. Cooke of the Division of Radiophysics of the Commonwealth Scientific and Industrial Research Organization in Sydney, Australia, and A. G. Lyne of the Nuffield Radio Astronomy Laboratories at Jodrell Bank, England, add PSR 0820 + 02.

The binary character of PSR 0820 + 02 was discovered from two years' record of the timing of its pulses. This was part of a survey of 125 mostly newly discovered pulsars done with the 64-meter antenna at Parkes, Australia. PSR 0820 + 02's pulse times showed a variation consistent with being a member of a binary system.

The data indicate an orbital period of 1,700 days or 4.5 years for PSR 0820 + 02. This puts it way over at the other end of the dynamic scale from the other known binary pulsar, PSR 1913 + 16, which has a period of 7.7 hours. PSR 1913 + 16's orbit is highly elliptical (eccentricity 0.62); PSR 0820 + 02's is nearly circular. The pulse repetition period of PSR 1913 + 16 is the second shortest known, 59 milliseconds; PSR 0820 + 02's is longer than the median for known pulsars (0.66 seconds). It is not known whether these two pulsars have similar origins or histories, but study of their divergences could throw some light on why there are so few binary pulsars when there ought to be many.

Cosmological communication

"There is something puzzling about the standard, homogeneous, isotropic cosmology." So begins a paper by A. Zee of the University of Pennsylvania in the March 17 PHYSICAL REVIEW LETTERS. What Zee is getting at is the question that has agitated many cosmologists: We observe a universe that is now homogeneous and isotropic. How did those qualities get put in?

To say they were there at the beginning poses physical, philosophical and theological questions. These are not random qualities. They would not be expected at the beginning of just any old universe that started from a big bang.

One can postulate that the homogeneity and isotropy came in by some smoothing process after the moment that started time. But Zee points out that traditional cosmology renders that impossible because early on the universe expands too fast for all the objects in it to communicate with each other quickly enough to accomplish the smoothing.

To make the universe expand slower one must weaken gravity in the early moments. But famous theories in which gravity varies with time have it stronger in the past. Zee finds a way in attempts to assimilate gravity to the grand unified field theories of particle physics. This procedure allows him to add in a term (not the usual one but a permitted one) that will allow gravity some moments of weakness in the past. Then for one brief fiery moment right after the start, everything communicates with everything else, and homogenization can happen. Afterwards cosmology proceeds according to tradition.