

Quarks not bagged; still in the bag

The hunting of the quark would interest Lewis Carroll — for more than one reason. For example, to say that a quark is “in the bag” can mean that it has been captured or that it has eluded capture depending on what the speaker wants the word to mean.

Quarks are supposed to be the constituents out of which most subatomic particles (protons, neutrons, etc., etc.) are built. Theory says they cannot escape from the particles they make and fly around free. In one view, attributed to physicists at Massachusetts Institute of Technology, the protons, neutrons, etc., are seen as “bags,” in which the quarks live but from which they cannot escape. If quarks are truly held captive in these MIT bags, they cannot be bagged by experimenters who hunt them, but physicists are always testing theory.

The latest such experiment, reported in the June 25 *PHYSICAL REVIEW LETTERS*, involved looking for free quarks among the particles produced as electrons collided with positrons and annihilated each other. The work was done at the PEP colliding beam facility at the Stanford Linear Accelerator Center in Menlo Park, Calif., by 81 physicists from the United States and Japan (H. Aihara et al.) using total energies up to 29 billion electron-volts. No evidence of free quarks was found. This was a search for “inclusive” production of quarks, that is, quarks produced along with other kinds of particles. A search for exclusive production, of quarks and antiquarks only, is also underway.

Does nature ♥ magnetic monopoles?

“Roses are red, Violets are blue./The time has come/For monopole two.” So reads a valentine greeting sent to Blas Cabrera of Stanford University by a group of physicists at Harvard University. On Valentine’s Day (Feb. 14), 1982, a detector set up by Cabrera recorded the passage of what might have been a magnetic monopole. The other shoe has not yet dropped.

Magnetic monopoles are supposed to be particles carrying a single magnetic pole, quite unlike ordinary magnets, which always have two or more. Monopoles are important in current physics theories, and Cabrera’s event caused a furor (SN: 11/27/82, p. 348; 12/4/82, p. 362). Cabrera has since set up a second detector, but after logging 120 times as much running time as it took to get that first valentine event—nothing. He is puzzled, but undaunted. He is now building an even bigger detector. This will be a dewar three feet in diameter and 20 feet long. It will contain eight superconducting electric coils designed to detect the magnetic field of any passing monopole. Arranged in an octagonal pattern, they will form a total surface of 1.5 square meters, 30 times that of the present detector, to be searched for any monopole that happens to pass through it.

Exotic things inside nuclei

Standard theory says atomic nuclei are made of neutrons and protons, and neutrons and protons are made of quarks. Moreover (see above), quarks cannot get out of the neutrons and protons in which they happen to be. Some recent experiments in which nuclei were probed by muons and electrons found evidence of differences in the structure of light and heavy nuclei that do not conform to this pattern. One school of thought attributes the differences to individual quarks coming somewhat loose inside the nucleus (SN: 5/5/84, p. 279).

In the June 25 *PHYSICAL REVIEW LETTERS*, Shin Daté of Waseda University in Tokyo and Koichi Saito, Hiroyuki Sumiyoshi and Hirokazu Tezuka of Tokyo University argue that the evidence better supports the presence of exotic components inside nuclei. These could be extra pions, odd delta particles, clusters of alpha particles, or particularly, multi-quark clusters. These are all variations on or unusual groupings of objects normally found in the nucleus.

JULY 7, 1984

Navahos signal uranium mining hazard

American Indians have a low incidence of lung cancer, something that has been attributed in large part to their minimal use of cigarettes. And this is what makes a new study of Navaho uranium miners so interesting. It “offers an assessment of the role of a single occupational risk factor, uranium mining, in a population at low risk for lung cancer,” according to the study’s authors, Jonathan Samet and colleagues from the University of New Mexico Medical Center in Albuquerque and from the National Institute of Occupational Safety and Health in Cincinnati. Their finding of a fourteenfold elevation in lung cancer risk attributable to uranium mining is reported in the June 7 *NEW ENGLAND JOURNAL OF MEDICINE*.

The researchers compared the 32 diagnosed cases of lung cancer among Navaho men between 1969 and 1981—23 of them uranium miners—with twice that many age-matched Navaho men who developed other cancers. They found not only an increased risk of lung cancer associated with mining, but also that mining-related cancers occurred early: Relative to other lung cancer victims who had not mined—either Navahos or white males—the median age at which the mining Navahos developed cancer was 20 years younger (age 44 instead of 63).

Uranium mining has long been linked with lung cancer. The precise role that inhaling radon and its radioactive decay products plays has been unclear, however, because most of those affected have also smoked cigarettes. In this study, eight of the Navaho miners did not smoke, and the median consumption of those who did was only three or less cigarettes daily.

The nonsmoker’s radon cancer risk

A study, characterizing the relative risks posed to smokers and nonsmokers breathing air contaminated with radon and its radioactive decay products has been reported in the June 7 *NEW ENGLAND JOURNAL OF MEDICINE*. The analysis examined lung cancer death rates among 1,415 Swedish iron miners over a 25-year-period. Radon-related lung cancer is the leading cancer associated with work in underground mines.

Based on incidence rates for the general population, though 12.8 cancers might have been expected, 50 occurred. Among nonsmokers, however, the risk was elevated tenfold—18 deaths occurred when 1.8 were expected. In fact, the data suggest that for nonsmokers, “the [radiation] dose required to double the risk of lung cancer is less than 10 WLM [working level months, a unit of alpha-radiation exposure to miners]” and a very low level, according to University of Pittsburgh radiation epidemiologist Edward Radford and K.G. St. Clair Renard from Luossavaara-Kiirunavaara Aktiebolaget in Malmberget, Sweden.

Moreover, the scientists say, controlling lung cancer risk may require limiting a miner’s underground time to only a few hours daily or a few years totaled over an entire career. More problematical is how to reduce risks posed to unwitting dwellers of homes that emit relatively large and potentially hazardous levels of radon to indoor air (SN: 11/7/81, p. 301).

Don’t heat with ‘treated’ wood

A rural family experienced seasonal arsenic poisoning after using wood treated with the preservative chromium-copper-arsenate to heat their home. According to a report of the four-year episode in a recent *JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION*, their symptoms included sinusitis, bronchitis, pneumonitis, muscle cramps, earaches, acute sensory sensitivity, skin rashes, “blacking out” for hours, disorientation, and epileptic-like seizures in the infants. Investigators from the University of Wisconsin and Agriculture Department believe that the infants were most affected (one almost died) because they crawled on floors contaminated with arsenic-laden ash.

9