Tracing the origins of life

In the search for clues to the origin of life, says University of Maryland's Cyril Ponnamperuma, you can look up or you can look down. Ponnamperuma and co-workers from the university's Laboratory of Chemical Evolution have looked both places—in 4.6-billion-year-old meteorites and in 3.8-billion-year-old sediments from Greenland. And in both places, the researchers reported last week at a meeting of the American Chemical Society in Washington, D.C., they found evidence for the fits and starts that probably led to life.

In two meteorites recovered from Antarctica, the scientists found nonbiological amino acids of extraterrestrial origin, which indicate, Ponnamperuma told a press conference, that "the processes of chemical evolution appear common in the solar system." The meteorites — one called Yamato 74662, which was found in the southern Yamato Mountains of East Antarctica, and one called Allan Hills, found near Victoria Land—are of the type called carbonaceous chondrites, the only type of meteorites known to contain hydrocarbons. Examination of a previously recovered carbonaceous chondrite by the same group indicated the presence of similar amino acids (SN: 2/2/74, p. 71). That these new meteorites — which are much less contaminated — also contain organic compounds reaffirms the earlier evidence and indicates that pre-biotic reactions, which produce the organic compounds necessary for life to begin, occur throughout the solar system.

Analysis of the meteorites by R. K. Kotra, Akira Shimoyama, Ponnamperuma and others revealed the presence of both non-protein and protein amino acids, which were of equal amounts in both the interior and exterior of the meteorites and were evenly distributed between righthanded and lefthanded forms. Nonprotein amino acids are clear evidence of extra-terrestrial origin; equal amounts of amino acids inside and out indicate little terrestrial contamination. Their nonbiological origin is confirmed by the even distribution of left and righthanded forms; biological systems contain only lefthanded molecules (those that bend polarized light to the left). Though these are not molecular fossils and do not indicate that there is extraterrestrial life, said Ponnamperuma, they "increase the chances."

But the scientists believe they may have found the oldest evidence of life on *earth* —in the form of molecular fossils. Clifford Walters, Akira Shimoyama, Ponnamperuma and others reported analysis of 3.83-billion-year-old graphite found in sediments from Isua (which means, rather appropriately, the farthest you can go) in southwest Greenland. The graphite, determined by isotope ratios to be the oldest known rocks on earth (3.4-billion-year-old rocks — and possibly algae — have been recovered, see SN: 10/15/77, p. 245), was purified and dissolved. It released several hydrocarbon molecules, including benzene-like and napthalene-like compounds, Walters reported. Satisfied by the rigors of their technique and by the difficulty of removing the molecules, the scientists conclude "there is no question that these organic compounds are syngenetic with the time of deposition [of the graphite]. These are the oldest terrestrial organics known."

That they are also from biological sources is less certain. The abundance of carbon 12 compared with carbon 13 in the graphite indicates that the rock may have a biological origin, according to co-worker Manfred Schidlowski of the Max Planck Institute (carbon 12 is incorporated into compounds by biological processes, especially photosynthesis), but the individual molecules have not been similarly analyzed. Further isotope work remains to be done, Walters told Science News, and the presence of actual microfossils would absolutely confirm their results. Even so, the researchers believe their results, "increasingly suggest that life may have indeed originated and can be detected in the oldest record we have today." □

PCB's linked to male sterility

Over the course of the twentieth century, sperm counts seem to have declined precipitously. In 1929, for example, the median sperm count of American males was reported to be 90 million sperm per milliliter of seminal plasma. In 1974, it appeared to have dropped to 65 million. Similar results have also been obtained for men in Europe and Japan.

A number of studies have attempted to pinpoint the reason for the declines. One Hungarian study linked low sperm counts with cigarette smoking. An American investigation pointed a finger at stress. And now industrial chemicals have been indicted as a cause by Ralph C. Dougherty, professor of chemistry at Florida State University, in a paper presented at the fall meeting of the American Chemical Society in Washington. Dougherty and colleagues have linked declining sperm levels to polychlorinated biphenyls (PCB's) — chemicals that, because they do not degrade in the environment and are concentrated in the food chain, are still prevalent in spite of the 1976 ban of their manufacture by the Toxic Substances Control Act (SN: 7/25/70, p. 69; 10/24/70, p. 332; 10/16/76, p. 244; 7/8/78, p. 21).

The Tallahassee, Fla. chemists first attempted to confirm previous findings of declining sperm counts by collecting samples from 132 Florida State University students. The median amount found was only 60 million sperm per milliliter of seminal plasma, and 23 percent of all students had only 20 million sperm per milliliter—an amount that is considered by many fertility authorities to indicate functional sterility.

Dougherty and colleagues then analyzed the sperm samples using a relatively new mass spectometry-computer method that compares the quantity of foreign chemicals present in sperm samples with their quantity in the general environment. The results showed excessively high levels of PCB's in the sperm samples compared with the level of environmentally occurring PCB's. (In addition to the PCB's, the researchers detected traces of pentachlorophenal, hexachlorobenzene and compounds resulting from metabolism of DDT.)

Dougherty and his co-workers suspect that the mechanism by which PCB's (suspected carcinogens) influence sperm density is an inhibitory one generally found in carcinogens. With each sperm occurring from at least eight cell divisions, a substance inhibiting division would affect sperm maturation and overall density.

To further check the relation between PCB's and low sperm counts, Dougherty plans to examine sperm counts and PCB levels in the seminal plasma of factory workers suffering a great deal of occupational exposure to the chemicals. □

Workers at risk of cancer

Scientists know that workers in some industries have a greater-than-average risk of developing cancer because of their exposure to chemical carcinogens. But what can be done to lower their risk? For one, industry can remove chemical carcinogens from the workplace or better shield workers from them. For another, genetic monitoring of workers could pinpoint which workers are particularly susceptible to chemically caused cancer. These recommendations were made at the fall meeting of the American Chemical Society in Washington last week by Jack Kilian of the University of Texas Health Sciences Center in Houston.

Genetic monitoring, Kilian explains, is used regularly in Europe, but not yet in the United States, to pinpoint workers who are particularly susceptible to chemical carcinogens. It involves taking a blood sample from a worker and examining the sample for chromosome breakage. American, British and Japanese studies have shown that workers with increased risk of chemically caused cancer, for example, uranium workers, show corresponding increases in chromosome breakage. "When an individual shows increased chromosome breakage," Kilian admits, "we can't say that that person is going to get cancer. But we can say he's at increased risk and should be watched closely." □