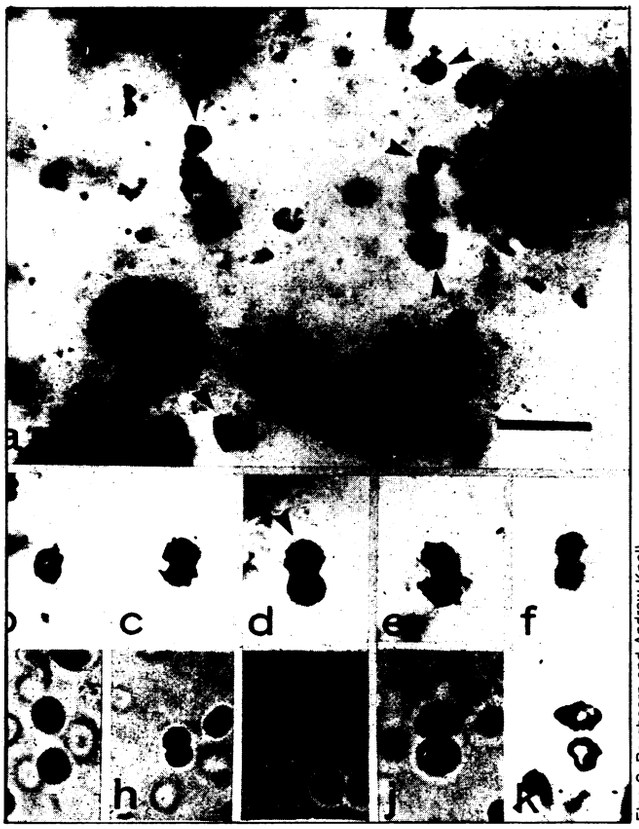
The Figtree fossils: Oldest algae yet



Preserved microfossils of 3.5-billion-year-old algae are seen contained in Figtree chert (a). Closer examination reveals the primitive cells in various stages of cell division (b-f, k) comparable to the "pinching off" observed in the modern, unicellular blue-green algae Aphanocapsa *(g-j).*

Elso S. Barghoorn and Andrew Knoll

In the rugged, green Barberton mountain land of southeast Swaziland, ancient history is strewn about the roadsides—in full view, there for the picking. But it was not until recently that scientists discovered the paleontological goldmine chunking off from the group of rocks known as Figtree—a 2,150-meter-wide band of stone running through the mountain range.

Trapped within loose slivers of Figtree chert are microscopic pools of water containing what are believed to be primitive forms of algae, some "frozen" in the act of cell division. The rocks are dated at 3.5 billion years, making the algae the oldest fossilized material found to date, according to Elso S. Barghoorn, Fisher professor of natural history at Harvard University.

Barghoorn and his colleagues gathered the rocks in August 1975, and have since worked at confirming the existence of the algal cells. The key rested in whether or not these ancient spheres had divided as do present-day blue-green algae. Miscrosopic scrutiny of the chert has convinced Barghoorn that these are indeed microfossilized algae, and he will report his findings in SCIENCE later this month.

Although it is "not completely understood how chert precipitates," Barghoorn believes that over the years the hard rocks evolved through silicate, gel and finally crystallization stages as they lost their water content. But tiny drops of water remained within the crystalline formations, preserving the floating plankton fossils for billions of years, the paleontologist says.

Several years ago, Barghoorn found what he believed were algal-like fossils in Figtree rocks not far from the site of his 1975 discovery. But that earlier find was questioned by other scientists, he said, because there was not conclusive evidence of cell division. In the latest rocks, however, there is no question in Barghoorn's mind that the algae underwent simple, binary fission, where two cells were "pinched off" from one.

The oldest previous microfossil was found in the early 1950s by Barghoorn and the late Stanley Tyler. The fossils, which were found in Gunflint chert in Schreiber, Canada, were dated at two billion years. □

Saccharin and cancer: Confounding data

Until recently, the controversy over whether saccharin causes bladder cancer or not was based exclusively on animal studies, especially on a Canadian animal study in which 100 rats were fed a diet containing seven percent saccharin. Three of the animals, as well as 14 of their offspring, developed bladder tumors (SN: 3/19/77, p. 182).

Now the first clinical study showing a positive association between saccharin and bladder cancer in humans is reported in the Sept. 17 LANCET by another group of Canadian researchers—G. R. Howe, J. D. Burch and A. B. Miller of the National Cancer Institute of Canada and of the University of Toronto, and their colleagues. An editorial in the same issue of LANCET explains that the research results were published because they have already been publicized in the lay press. The editorial reasons that the results can now be carefully assessed by a scientific as well as by a consumer audience. However, the editorial does point out some serious weaknesses in the study and concludes that "the case against saccharin [remains] unimpressive."

Howe and his colleagues conducted a case-control study of bladder cancer in the Canadian provinces of British Columbia, Nova Scotia and Newfoundland. All newly diagnosed cases of bladder cancer in the three provinces between April 1974 and June 1976 were identified through provincial cancer registries and cooperating pathologists and urologists. Bladder cancer was diagnosed in 821 patients, and 632 of them (480 men and 152 women) were interviewed in their homes, using an identical questionnaire. Most interviews were conducted within three months of diagnosis and all were conducted within six months. For each case, an individual control (matched for sex, age and neighborhood of residence) was also interviewed.

The subjects were questioned about demographic variables, residential history, occupational history, consumption of beverages and preservative-containing meats, medical history, use of analgesics and smoking. To test the hypothesis, based on animal data, that use of saccharin might increase the risk of bladder cancer, three questions were asked. The first question was: "Do you now or have you ever used sugar substitutes?" If the answer was "yes," the number of tablets or drops usually used and the frequency and duration of use of a particular brand were determined. The second and third questions asked for similar information on the use of diet drinks and for dietetic foods. All questions were sent to the Canadian NCI for coding and analysis.

As Howe and his co-workers report, they found a positive association between the use of artificial sweeteners, particularly saccharin, and the risk of bladder cancer in males, which did not appear to change when controlled for variables such as smoking and coffee consumption. "Our results suggest a causal relationship between saccharin use and bladder cancer in males, especially when they are considered in conjunction with results in animals," the researchers conclude. However, the scientists were not able to find a link between saccharin and bladder cancer in their female subjects, which they believe might be due to some difference in saccharin metabolism between men and women.

The LANCET editorial reaches somewhat different conclusions in assessing this data. For instance, it points out that

while significantly more males with bladder cancer are reported as having used saccharin than have controls, women with bladder cancer are reported using somewhat *less* saccharin. Thus, when results for both sexes are combined, no significant relationship can be found between saccharin use and bladder cancer, the editorial deduces.

Another criticism raised by the editorial is that no nonhormonal carcinogen in people is known to affect only one sex. So the case made by the investigators that "saccharin is the first such example is less than convincing."

Still another weakness in the study, the editorial stresses, is that it pays only superficial attention to subjects' use of cigarettes and coffee, yet there is ample evidence that cigarettes, and some evidence that coffee, can trigger bladder cancer. "Insufficient data are presented on these potentially important confounding factors to allow adequate analysis," the editorial charges. For instance, cigarette smoking was examined simply by dividing males into those with a lifetime consumption equal to or less than 10,000 packs, and those who had smoked in excess of 10,000 packs. Thus, lifelong nonsmokers, who would be of special interest in the study, were merged in the first category with smokers of, perhaps, 14 cigarettes per day for 40 years. Similarly, coffee consumption was studied only in relation to whether instant coffee was "ever consumed" or "never consumed," and other types of coffee were not considered.

Thus, "we judge that most readers will find the case against saccharin unimpressive," the editorial concludes and stresses that "there is need for further work on saccharin and bladder cancer in man." □

Soyuz 25 fails to dock with Salyut 6

Soviet cosmonauts Vladimir Kovalenok and Valery Ryumin were forced to return to earth only a day after the Oct. 9 launch of their Soyuz 25 spacecraft, when difficulties prevented their docking the capsule with the waiting Salyut 6 space station. Depending upon who is counting, this is somewhere from the third to the ninth Soviet docking failure in a string dating back to the late 1960s.

This mission, however, was to have had special significance in the Soviet Union, since the cosmonauts were expected to be aboard the Salyut at least through the Nov. 7 60th anniversary of the Bolshevik revolution, and perhaps long enough to eclipse the 84-day record set by a U.S. Skylab crew in 1974. Western observers have speculated that the failure may be due to a rocket too weak to carry a Soyuz with enough fuel for repeated docking attempts. Another launch may follow soon. □

Future fertilizer: Chemistry or biology?

On much of the world's agricultural land, availability of usable nitrogen limits crops. That is why nitrogen fertilizers, such as ammonia, have caused such a boost in productivity. Now the achievement of that high productivity may soon be limited by its cost in nonrenewable fuel.

Researchers with very different approaches are looking to plants' primary energy source, the sun, to provide them with nitrogen in a usable form. Gerhard N. Schrauzer and T. D. Guth of the University of California at San Diego announce they have produced ammonia in a prototype solar cell. The new method, described in the Oct. 3 CHEMICAL AND ENGINEERING NEWS, proceeds at low temperature and at atmospheric pressure, unlike the current process that requires conditions of 500°C and 350 atmospheres pressure. The catalyst for the new reaction is titanium dioxide doped with small amounts of powdered iron. To be commercially attractive, Schrauzer estimates that the catalyst's efficiency must be improved by a factor of 10 to 100.

Taking a more biological tack, speakers at a National Academy of Sciences public meeting last week reported some progress toward creating plants or plant partnerships that will themselves convert nitrogen from the air into a useful form. The energy for this process is stored in compounds made by the plants and, thus, initially also comes from the sun.

Legumes, such as soybeans and peanuts, when teamed with certain bacteria have no need for chemical fertilizer. In nodules on the legume roots, the bacteria continuously spew compounds containing nitrogen. Because the bacteria are particular about what plants they will inhabit, only a limited number of these natural partnerships exist. Marvin Lamborg of the Kettering Research Institute in Yellow Springs, Ohio, reported on a three-member potentially useful association. Lamborg described cavities in a photosynthetic water fern called Azolla, that contain filamentous membrane packets of blue-green algae. The algae supply nitrogen to the Azolla. In Vietnam these ferns are often grown in flooded rice paddies. Lamborg suggests that the degrading ferns fertilize the rice. Research on different varieties of Azolla should offer a means to take the best advantage of this potential alternative to manufactured fertilizer.

For several years researchers have been able to transfer genes for nitrogen fixation among different bacteria by using viruses and natural plasmids (SN: 11/15/75, p. 315). But the nitrogen-fixation process requires several steps, Raymond C. Valentine of the University of California at Davis points out. Transferring the potential for nitrogen fixation in bacteria such as *Escherichia coli* is relatively easy because that bacteria is only missing one necessary enzyme, Valentine says. In contrast, higher plants are missing two additional factors. "No plant has ever achieved nitrogen fixation in nature," Valentine says. "This may be telling us it is a difficult task."

Two new techniques promise to be useful in nitrogen-fixation research. Fusion of plant cells grown in a liquid medium in the laboratory bypasses the limitation that only closely related plants can be crossed naturally. Olaf Gamborg of the Canadian Research Council reports that cells of different species, such as barley and soybean, have been combined, but no whole plant has yet been regenerated.

The other recent technique uses recombinant DNA. This method might allow transfer of nitrogen-fixing genes into crop plants or alter the specificity of nitrogen fixing bacteria. Compared to the fierce arguments at the NAS meeting on recombinant DNA last March (SN: 3/12/77, p. 165), discussion of potential hazards at this recent meeting was calm. A statement drafted by eight scientists said the risk was minimal that genetically modifying the bacterium that infects soybeans would have adverse health or environmental consequences. They also point out that fixing nitrogen requires a large amount of energy, so there would be little chance of the nitrogen production getting out of hand.

The high energy requirement leads Ralph Hardy of E. I. du Pont de Nemours and Company to suggest that there are inherent problems in harnessing this biological process. For example, the price of fixing nitrogen may come out of plant growth and, therefore, crop yield, Hardy says.

So although solar energy in one way or another will probably be called to the aid of agriculture, it is still uncertain whether future fertilization will involve chemical or biological nitrogen compound production. □

Slicing open a soybean root nodule exposes a dense mass of nitrogen-fixing bacteria.

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