Eating food additives and having them too

What you don't absorb can't hurt you. This is the strategy that has now produced three food dyes and one preservative that the developers believe will be much safer than present additives. At the American Chemical Society national meeting in New Orleans this week, Ned M. Weinshenker and Nicolo Bellanca described the new compounds, their method of synthesis and the safety tests performed so far.

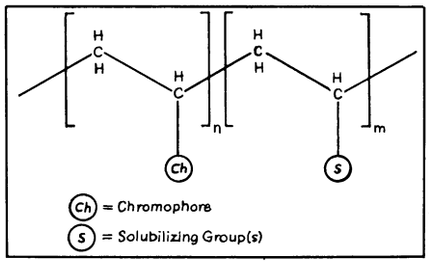
Most food additives, according to Weinshenker, perform their intended function in the food system to which they are added and serve no further function once they are ingested. "If they are not used past the throat, why should they be allowed to get into the rest of the body?" he questions.

The researchers at Dynapol, a small company in Palo Alto, Calif., formed specifically to develop the new type of additive, are working on food colorings, antioxidants and even sweeteners. They synthesize long polymers (molecules with repeating subunits) that are too large to filter across the lining of the intestinal tract into the body. The challenge is in finding molecules that perform the desired function but that will not break into smaller pieces either during cooking, food storage or passage through the body. The polymers must be able to withstand the acidity of soft drinks, the high temperatures of baking and candy making and the attacks of intestinal enzymes and microbes.

The researchers expect to have food colors and a preservative on the market in three to four years, if all goes well in the safety testing. Sweeteners have turned out to be a more difficult problem. Molecules of those additives must interact successfully with receptors on the tongue. Dynapol chemists have produced sweetener polymers large enough to prevent absorption but none that give the full range of sweet tastes. "The subtleties between good sweeteners and poor sweeteners are difficult to engineer," Weinshenker says.

Yellow, red and red-violet are the colors of the dyes Bellanca and colleague W. J. Leonard Jr. have most successfully produced. A blue dye is also being developed and an orange may follow. With blends of four or five colors, the researchers expect to be able to duplicate all the colors currently available to food companies and the shade of recently banned Red Dye No. 2.

The dye molecules have a structural backbone of carbon molecules (see diagram). The chromophore is the part of the molecule that absorbs light and confers color. Solubilizing groups were incorporated because the product, to be practical, had to be soluble in water. The two major portions of the molecule (in brackets) are repeated many times so that the final dye molecules have backbones about 600 carbons long. The polymer *is* the dye, Bellanca says; it isn't that a dye is attached to a polymer.



Molecular structure of the polymeric dye.

The antioxidant that Weinshenker described is actually a composite of three preservatives now on the market. The polymer contains groups resembling BHT, BHA and TBHQ. Tests feeding the additives to rats showed that although BHA, BHT and TBHQ all caused enlargement of the animal's livers, the polymer had no effect.

The scientists are doing very extensive safety tests on the polymers. They have been using the Ames screening test for mutagenicity not only on the final product, but also on raw materials, concentrated impurities and the products of stress with light, heat, acid conditions and components in the urine of animals fed the polymers. "Only if all results are negative, do we proceed with that candidate," Weinshenker says.

If the additives are not absorbed, the only possibility for harm would be local irritation of the digestive tract. So far in their animal studies, there has been no indication of the problems there.

Also there is probably no need to worry about technicolor feces and pursuant psychological trauma. "With normal consumption patterns there should be no problem," Weinshenker explains. If people eat very high levels of a certain food, however, it is possible there will be coloration. "If you abuse beets, you'll have the same effect," Weinshenker points out.

These compounds will not be the first additives that are long polymers, although they will be the first deliberately developed as such. Cellulose and cellulose derivatives, which are used as thickening agents, are considered the safest of food additives. They are also not absorbed by the body.

"Historically, food additives were picked from a myriad of industrial chemicals that had originally been created to solve nonfood problems," Weinshenker says. Now that safety is becoming to consumers the most important property of additives, new approaches are needed. □

Ararat 'ark' wood dated at A.D. 700

Perhaps the last hope that the battered remains of Noah's Ark exist on Mount Ararat near the Turkish-Soviet border has been washed away by a new wave of scientific evidence. Recent tests at the University of California at Los Angeles, La Jolla and Riverside all conclude that a piece of timber found at the Ararat site is only about 1,200 years old—some 2,700 years younger than the first known account of the Ark.

Despite similar findings at England's National Physics Laboratory in the early 1960s and at UCLA in 1970, speculation that the pile of oak timber might indeed be part of the Ark has increased in the last several years. The interest has been fueled by a recent movie that strongly suggests the wood is part of the Ark.

But the new UC experiments confirm that the timber came from a tree that was chopped down around A.D. 700, UCLA archaeologist Rainer Berger reported last week at a symposium on archaeometry and archaeological prospection at the University of Pennsylvania Museum in Philadelphia. Berger believes the wood—discovered more than 20 years ago packed in a snow- and ice-filled crevice 13,500 feet up the mountain—might be the remnants of a shrine that perhaps commemorated the landing of the Ark near that site.

Using carbon-14 dating, Berger recently repeated his 1970 study on a piece of Ararat wood and came up with the same results. In separate tests, R.E. Taylor of Riverside and Hans Seuss of La Jolla obtained similar findings. Taylor extracted the solid cell wall (lignin) portion from part of the wood and dated that sample at 1,210 ± 90 years.

Seuss disproved an argument that because the wood was located so high on the mountain, it was exposed to an unusual amount of cosmic rays that manufactured high levels of C-14 to make the wood appear younger when tested. Seuss obtained the remains of a tree in the Danube River region, near sea level, and a bristlecone pine from the 10,000-foot-high White Mountains of California. Through tree-ring studies in both areas, each of the specimens was known to be about 2,000 years old. Seuss found that the two pieces of wood had the same amount of C-14, and that altitude apparently had no effect.

French industrialist Fernand Navarra first found the Ararat remains in 1955, almost immediately triggering speculation among biblical scholars that the wood might be part of the Ark. Genesis says that the Ark landed in the Ararat vicinity, Berger notes, but he questions whether this is the same Ararat of ancient times.

The first English examination dated the wood at 1,190 ± 90 years. But critics said the British researchers had not deconta-

minated the sample. In 1970, a piece was sent to Berger who used solvents to remove the tar and other toxins from the timber. He then used the C-14 method to date the sample at 1,230 ± 60 years. "I determined the English had been correct," he says.

The wood, however, is curved and apparently shaped by man, Berger notes. He proposes that a scientific excavation team be dispatched to Ararat in an effort to reconstruct exactly what type of structure stood there. Because part of the mountain sits in the politically touchy region of the Russian border, Turkish officials have so far refused permission for such a full archaeological investigation. □

Rockfest 8: Still breaking new ground

"We're sort of in a retrenchment stage," says Sean C. Solomon of the Massachusetts Institute of Technology. "The amount of data coming in is not zero, but it's slowing down." At the NASA Johnson Space Center in Houston, hundreds of researchers met last week in their eighth annual Lunar Science Conference since the Apollo astronauts began bringing pieces of the moon back to earth, and the years-long peak of the investigative effort has understandably leveled off somewhat. Yet, plenty is still going on. Last week's "rockfest" revealed new discoveries about the samples, new research techniques, new information about the moon itself and even a new piece of the moon.

The new sample was a 2.3-gram portion of the 160-centimeter core gathered last August by the unmanned Soviet Luna 24 spacecraft in the northeastern portion of the moon's Mare Crisium. Officially presented at the meeting (it had actually been sent several days before by diplomatic pouch), it followed a 0.7-gram portion from the same core that was picked up in Moscow last December by U.S. officials at Soviet invitation (SN: 12/18-25/76, p. 390). The overall core, according to Soviet scientists at the rockfest, shows as many as 10 to 20 distinguishable layers, most of them in the bottom 90 centimeters, but a "fairly uniform" chemical composition. "In general," says Valery L. Barsukov, director of the Vernadsky Institute of Geochemistry and Analytical Chemistry, "fresh fragments of relatively abyssal rocks or fragments representing the interior parts of basaltic flows are predominant. . . ." There seem to be no fragments from surface basaltic eruptions, and only a few traces of igneous rocks from the highlands some 60 kilometers away.

There is at least one surprise, however: signs of an unusual calcium-chromium silicate. "Apparently," says Barsukov, "this represents a new, previously unknown mineral," at least on the moon. There have also been hopes that the top of the core might contain the additional bonus of material ejected from the crater Giordano Bruno on the lunar far side, which would make it the first sample of the part of the moon that is never seen from earth. Some rockfest attendees, however, were left with the impression from the Soviet descriptions that the critical surface layer might have been disturbed or even pushed aside altogether in the sampling process.

The Apollo samples, meanwhile, have yielded a surprise of their own. David T. Vaniman and James J. Papike of the State University of New York at Stony Brook reported the discovery of a very-low-titanium mare basalt in the drill core taken by the Apollo 17 astronauts in the moon's Taurus-Littrow Valley. Titanium is a key element in studies of the moon's early heating and differentiation, and the newly found traces contain less than 1.5 percent by weight of titanium oxide. How the low-titanium basalt got to Taurus-Littrow is uncertain. Earth-based reflectance studies show similiar TiO_2 levels in basalts of the Imbrium, Frigoris and Crisium basins (the Luna 24 sample from Crisium yielded similar concentrations), but the abundance of "imported" material in the Apollo 17 core suggests that the source may have been much closer. In central Serenitatis, for example, there are signs of basalts with as little as 2 to 3 percent TiO_2 reaching to within 100 kilometers of the Apollo 17 site. The new discovery, says Anthony E. Bence, also of Stony Brook, "may bring about major reconstruction in lunar evolutionary models."

The conference also continued last year's efforts to bring the weight of lunar research to bear on other parts of the solar system (SN: 3/27/76, p. 196). Robert C. Reedy of Los Alamos Scientific Laboratory, for example, was able to use the short-lived isotopes sodium 22 and iron 55 (half-lives of 2.6 and 2.7 years respectively) in Apollo 11, 12 and 14 samples to further enforce the recent theory that the solar constant—the sun's output—is not so constant after all. The isotopes are produced by solar protons, and Reedy was able to use them, together with earlier work on much-longer-lived isotopes, to provide the first "direct" evidence that the average proton flux in the solar cycle from 1953 to 1963 was about five times the average flux over the preceding million years, as well as over the following cycle.

There were scores of other reports, and construction of an improved facility to house the moonrocks began at JSC on the first day of the meeting. Some attendees complained about plans to shut down the ALSEP instrument packages on the moon by Oct. 1, and there was plenty of lobbying for the proposed Lunar Polar Orbiter. "We're getting down to the hard work now," says John B. Adams of the University of Washington in Seattle. "We've really just begun." □

NAS: EPA effort needs some revising

An 11-volume report being issued by the National Academy of Sciences concludes that the Environmental Protection Agency has performed its function pretty well, considering restrictions placed on it, but that new legislation is needed to straighten out inefficiencies and inconsistencies in the federal environmental effort.

Comprehensive protection of the environment can no longer be provided by considering pollution of air, land and water separately, the report says. New legislation should take into account the interconnections between land-use planning and various kinds of pollution. Also, better lines of authority should be established among the different government agencies responsible for enforcing rules.

The report calls for consideration of economic incentives to replace outright regulation in many areas of environmental protection: "From one point of view, it makes no difference whether EPA is empowered to say, 'Thou shalt not emit more than so much SO_x,' or to say, 'For every bit of SO_x emitted, thou shalt pay so many cents.' In principle, the same goals can be achieved either way." Economic incentives, for example, are generally more flexible, involve less overall cost and tend to stimulate greater research effort to find nonpolluting alternatives.

The EPA should also have more power to conduct its own "anticipatory research," the report concludes. Such research would help forestall problems as they develop, rather than having the agency just respond to crises as it tries to enforce legislative standards based on sometimes outmoded data. By granting contracts to outside experts to perform this research, EPA would also involve more of the scientific community in the effort to find new ways of monitoring and protecting the environment. □

Indonesia's second satellite launched

Indonesia's second satellite, Palapa 2, was launched March 10 by the U.S. National Aeronautics and Space Administration. Like Palapa 1, launched last July 8, it is a communications satellite, designed to relay voice, picture and data traffic from a geosynchronous orbit that holds it fixed over one spot on the earth. Although two satellites may seem ambitious, they may, in fact, be the only way to effectively address some of the rapidly growing communications needs of the world's largest archipelago, in which the inhabitants are spread throughout as many as 13,000 individual islands. Indonesia will reimburse NASA for the launch costs. □