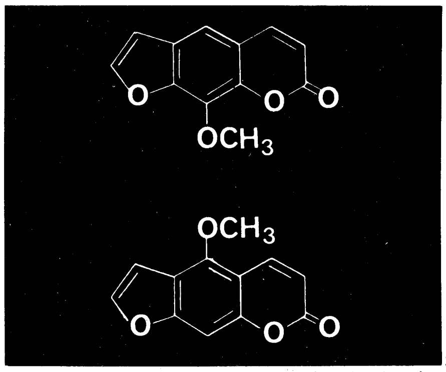
5-MOP: Nothing new under the sun?

From the rind of an orange-like Mediterranean fruit comes 5-MOP, the substance which, much to the delight of certain suntan-lotion manufacturers, can stimulate the human tanning process when combined with sunlight. But 5-MOP is hardly a chemical novelty — many plants contain structurally similar photosensitizing agents, substances that stimulate melanin deposition. Unfortunately, evidence accumulated since 1959 indicates that at least one of these chemical cousins of 5-MOP is a carcinogen when combined with near UV light (the tanning rays of the sun), and researchers suspect suntan-lotion ingredient 5-MOP may be similarly photo-carcinogenic.

The first confirmation of this suspicion is reported in the June 5 NATURE by Michael Ashwood-Smith and colleagues of the University of Victoria in British Columbia. The Canadian researchers report that, like its chemical relatives, 5-MOP damages the genetic material of mammalian cells in the presence of light. This damage is measured in Chinese hamster cells by the number of sister chromatid exchanges (SCE's). SCE's can best be understood by imagining that a replicated chromosome (carrier of genetic material) is a letter "X" and that each cross bar of the letter is a sister chromatid. Now imagine one cross bar (chromatid) is green and one red. SCE's occur when two sister chromatids break and swap pieces during cell division just before they pull apart. In the colored "X" analogy, this event would result in two part red and part green, rather than the expected red or green, bars.

In addition to being a light-dependent inducer of SCE's in mammalian cells, 5-MOP is a weak frameshift mutagen in bacteria, Ashwood-Smith and colleagues report. A frameshift mutagen changes DNA function by removing or inserting one or two of the paired nucleotides that constitute the double helix. Because DNA is read in sets of three nucleotides, such an insertion or deletion can cause a major misfunction. The ability of 5-MOP to induce SCE's or frameshift mutations is not evidence of carcinogenicity. These confirmed abilities do indicate, however, that 5-MOP possesses properties similar to those of its chemical relative 8-MOP — a mutagen, SCE inducer and confirmed carcinogen. On the basis of this information, Ashwood-Smith and colleagues conclude that "the use of 5-MOP in suntan preparations constitutes ... a definite and unnecessary hazard."

Finally, the Canadian researchers include "added proof" in an addendum to their paper: "Studies begun in August 1978 at the Institut du Radium, Orsay, France, [under the direction of F. Zajdela] have shown that 5-MOP in combination with near UV is almost as potent a skin carcinogen in mice as 8-MOP."



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Structures of 8-MOP and 5-MOP (below).

Interestingly, the French study may rekindle the Food and Drug Administration's long-smoldering interest in 5-MOP. If a 5-MOP-containing product is to be classified as a cosmetic rather than as a drug — and this is still a matter of debate — the burden of proof will be on FDA to show that it "is harmful under normal conditions of use," rather than on companies that use 5-MOP to show its safety, says John A. Wenninger of the FDA cosmetics division. Although FDA officials know of at least one suntan lotion available in the United States — "SunSystem" — that contains 5-MOP (in the product ingredient "oil of bergamot"), test priorities and a small staff have precluded FDA carcinogenicity tests of 5-MOP. But the French study "places the issue squarely before us," says Wenninger. "If 5-MOP is a photo-carcinogen, that certainly would be grounds for review."

Still, even if FDA finds 5-MOP to be a carcinogen, suntan agents containing the chemical will be available in the United States, says Ashwood-Smith: U.S. wayfarers unknowingly bring the products home from Europe. Ashwood-Smith says the 5-MOP-containing "Bergasol" products are the major tanning agents in parts of Europe. "And that, in my judgment," says the researcher, "is a hazard." □

Viking: Staving off the end

The first to expire of the four Viking spacecraft that reached Mars in the summer of the U.S. bicentennial year ran out of gas in July of 1978, leaving it to drift mutely in its orbit around the planet. Early this year, one of the two landing craft on the surface succumbed to over-drained batteries. Surviving are one orbiter and one lander, each still at work after some four years on the job. But for at least one of the craft, the end is nigh, and the longevity of the other depends on the success of an operation to be radioed up next month by engineers nearly a quarter of a billion kilometers away on earth.

The orbiter entered its circum-Martian path on June 19, 1976. Outlasting its later-arriving twin (which took up station that Aug. 7), it has been busily mapping large portions of the planet with photos that can show features as small as 10 meters across. Now it too is about to run out of the steering gas that enables it to aim its instruments and, just as important, its communications antennas. The gas supply is so low that engineers at Jet Propulsion Laboratory in California cannot tell just how much remains, but they are not just going to let it squirt away to the end. One more experiment is planned, a test that will have the side effect of putting an end to the orbiter's lengthy scientific observations: July 14.

The test is a final series of firings of the spacecraft's main engine, planned to show engineers exactly how much of the propellant (different from the steering gas) carried from earth was actually available for use, rather than left clinging to the inside of the propellant tanks. Virtually impossible to measure directly, this information could aid developers of future spacecraft such as the Galileo Jupiter orbiter in keeping the amount of provided propellant to a minimum, saving precious kilograms of weight. Stabilizing the spacecraft during the firings, however, requires steering gas, and its amount too is uncertain. Since the steering gas is essential for the orbiter's photographic tasks, officials have tried to schedule the engine firings to begin as late as possible — July 15 — to allow for a maximum amount of photography beforehand.

Even without the extra engine "burns," the orbiter's demise would come soon. The surviving lander, however, has been programmed to take pictures and conduct other studies automatically at a reduced level for a decade or more — but it has a problem. Its batteries are running hot, and putting out less than their intended voltage. Engineers believe that the lander's restricted operations have been discharging its batteries too slowly, causing the battery plates to accumulate an oxide layer that increases their electrical resistance. This would mean that the automatic recharging of the batteries (from the lander's nuclear power supplies) creates more heat, which further lowers the output voltage, and so the vicious cycle continues. Early next month, JPL engineers will begin commanding the lander's computer to periodically discharge and recharge each of the four batteries, in rotation, in hopes that these "conditioning" cycles will remove oxide accumulations. It may have been the lack of such conditioning that killed off the other lander, whose warm, weak batteries could not be detected until too late. Unlike the surviving lander, the now-silenced one could not report such information to earth until an orbiter was overhead to relay the message. The still-operating craft has no such limitation, and project officials are determined not to let the long-lived Viking mission end without a struggle. □