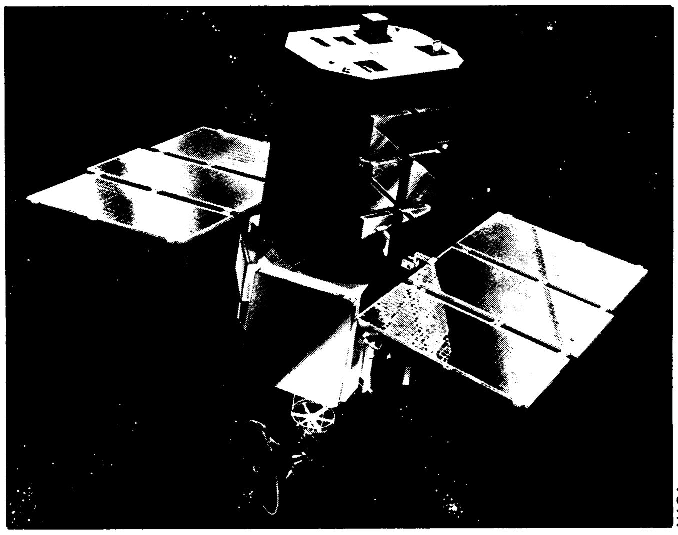
Ganging Up On The Sun

Many scientific investigations are hampered by an inability to get a complete picture of the phenomenon under study. This has been especially true of studies of solar surface activity: spots, flares, etc. These occurrences radiate at wavelengths that do not penetrate the earth's atmosphere as well as those that do.

Now there is a satellite in orbit that is getting the whole range of wavelengths from high-energy gamma rays (160 million electron-volts) to orange light at 6,583 angstroms. The vehicle of the Solar Maximum Mission, in orbit since Feb. 14, provides correlated observations by several instruments over all these wavelengths of any chosen solar phenomenon, a single flare, for example. Its performance so far has already yielded new insight into how flares are triggered. Two dozen or more of the scientists involved with Solar Max spoke at the meeting last week of the American Astronomical Society in College Park, Md.



NASA

Solar Max, here shown in simulated flight, has been in orbit a little over four months. It is already changing people's ideas about the sun's active regions.

The orbiting of Solar Max was timed to observe the peak years (1980 and 1981) of the current cycle of sunspot activity. Its operations are coordinated with activities of a worldwide network of solar observatories on the ground, a system that is intended as a kind of dress rehearsal for the way the Space Telescope will be managed. (The craft itself, its instruments and the functioning of the observing system will be the subject of a future article.)

Contrary to a rumor that seems to have been going around, this is a more active solar maximum than most, according to Kenneth J. Frost of the NASA Goddard Space Flight Center in Greenbelt, Md., who is Project Scientist for the Solar Max Mission. Of all the flares that go into better than average activity, one may go down in the books as having provided the first strong confirming evidence for a theory of how flares are triggered. It happened on April 30 on the southwest limb (that is, edge) of the sun.

A solar flare is an energetic outburst. Atomic particles are accelerated to very high energies. Some escape from the sun. The disturbance can propagate through interplanetary space and reach the earth, where it causes magnetic storms, auroral displays, radio blackouts, etc. The theory proposes that flares are triggered by interactions between local magnetic fields on the surface of the sun, fields associated with sunspot activity.

The April 30 flare, says Frost, gave a very clear picture of preflare conditions in an active region. In that picture Frost and his co-workers "observed a theoretical mechanism: The flare began as a loop [a loop extending outward from the sun in which ionized gas and magnetic field are bound together] interacted or collided with a higher lying loop." If that kind of interaction is necessary to trigger a flare, the finding could explain why a flare does not occur everywhere that there is magnetic activity on the sun.

More puzzling to theorists is the finding that flare mechanisms can produce fantastically high temperatures, higher than anyone had thought could be on the sun, readings in the hundreds of millions of degrees. As curious as the high temperatures in these regions is the density, says Loren W. Acton of the Lockheed Palo Alto Research Laboratory. The gas does not expand when heated as a free gas would. Its density also rises, indicating that something is pressuring or containing it. Acton remarks that this situation, containment of a high-temperature, high-pressure, magnetized, ionized gas, is what the thermonuclear fusion researchers on earth are trying to do. They may be interested in what the sun does. More to the point probably is that these high-energy phenomena on the sun give a model for understanding other stars with high-energy phenomena in their atmospheres. "We can serve as a Rosetta stone for many of the things that happen in the universe," Acton says. □

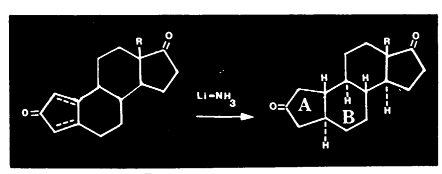
Dinordrin: A touch of stereochemistry

Chemist Pierre Crabbé had a pleasant surprise waiting for him at the end of his scheme for synthesizing the contraceptive Dinordrin.

The final step of Crabbé's synthetic plan — detailed in the June JOURNAL OF THE CHEMICAL SOCIETY, CHEMICAL COMMUNICATIONS—involves addition of a hydrogen atom at a position shared by two chemical rings (A and B rings in the diagram). Since, like most organic molecules, Dinordrin's biological activity (it inhibits egg implantation) depends on the stereochemical or three-dimensional arrangement of the molecule, each of its atoms must lie in a specific spatial orientation. For the hydrogen added in the final step (joined to rings A and B by a dotted line in the diagram), this orientation is below the plane of the molecule. The particular method Crabbé chose to add this hydrogen usually results in a mixed reaction product—part of the reaction mixture has the added hydrogen above the plane, part below—from which the desired structure must be purified. But Crabbé's synthesis was blessed with unexpected chemical cooperation: The reaction was completely stereoselective, with the result being the addition of hydrogen only in the desired below-the-plane orientation.

Although Crabbé, of the University of Missouri at Columbia, first derived Dinordrin from substances in the roots of certain wild plants from China, Central America and northern India, this route was lengthy and low-yielding. Crabbé's recently developed synthesis offers an economical way to produce the steroid drug that could be the basis for a twice-a-month birth control pill for women.

Interestingly, the Chinese—who recently replicated Crabbé's synthesis — could be the first to use Dinordrin. □



Final step in Dinordrin synthesis.