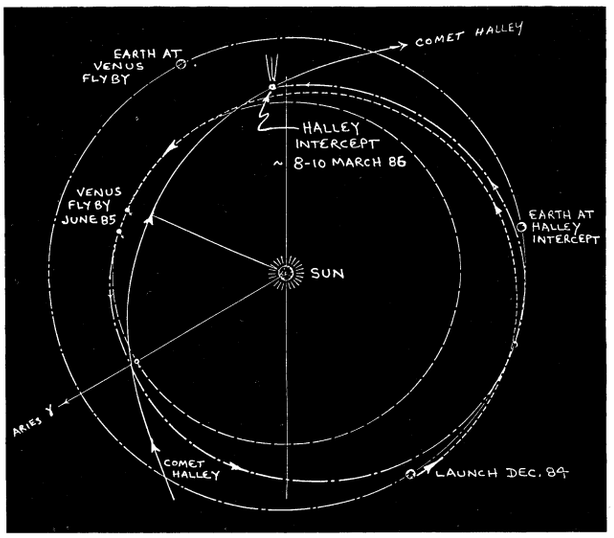
SCIENCE NEWS OF THE WEEK

Chasing Halley



Possible orbit of Soviet mission to Venus and comet Halley, based on U.S. analysis.

Almost buried beneath the swarm of activities surrounding this week's preparations for the first flight of the space shuttle was a much smaller-scale space matter: the announcement of a privately organized "Halley Fund" to gather contributions and support for a U.S. mission to the sky's best-known comet. No such mission is even in the fiscal 1982 budget now being considered by Congress, and its proponents face a steep uphill fight at best to get one included. Meanwhile the Soviet Union, the European Space Agency and Japan are making Halley plans of their own, representing a total of five spacecraft that will be sent in the mid 1980s to study the comet's first apparition since 1910.

Some American scientists have held that a proposed U.S. project known as the Halley Intercept Mission (being pursued at the Jet Propulsion Laboratory in California) is necessary to take proper scientific advantage of the once-in-most-lifetimes event. The European mission is limited by its batteries to four *hours* of observation; the aiming accuracy of the principal Japanese craft is reported in a JPL analysis to be as uncertain as plus or minus 100,000 kilometers; and past Soviet interplanetary missions have been rated by many U.S. space researchers as scientifically weak (notwithstanding the notable engineering triumph of several successful landings on Venus, a feat not even attempted by the National Aeronautics and Space Administration).

The coming of Halley's comet, however, may mark a significant upgrading of Soviet capabilities — or at least ambitions — in space science. A group of U.S. space officials and researchers has analyzed what is known about Soviet Halley plans and concluded that they represent a marked advance over past deep-space endeavors from the USSR. The group's sources of information range from direct contacts with mission participants to deductions and published accounts. "We believe," says one group member, "that they're developing a substantially more sophisticated spacecraft." And according to a JPL planner working on the proposed U.S. Halley Intercept, the list of scientific instruments apparently planned for the Soviet effort is "formidable."

Soviet space officials have publicly announced that the mission will involve two launchings, each directing its payload first to Venus. Originally, however, Venus was to have been the primary goal, with one or two orbiters deploying landing craft to the surface and balloons to study the atmosphere; later, they would turn to "look over their shoulders" at the comet, and there was talk of possibly adding probes to be sent from the orbiters for a closer look (SN: 3/15/80, p. 167). Now Halley seems to have achieved co-star status. The Venus landers have been retained, but the balloons have been dropped, and the orbiters have become "flybys" that will use the planet's gravity to redirect them toward the comet. This will require passing Venus on its night side (possibly a further indication of the comet's importance to the mission, if it required sacrificing plans for photographing the top of the Venusian clouds), and will mark the first Soviet use of such a "gravity slingshot." (The U.S. Mariner 10 spacecraft was routed past Venus to get to Mercury, and Pioneer 11 and Voyagers 1 and 2 all swung past Jupiter for a gravity assist to Saturn.)

The careful timing involved in the slingshot, plus the need to have Soviet tracking stations facing the comet-bound craft at the right time, have enabled the U.S. analysts to calculate that the two probes will make their closest approaches to the comet on March 8 and 10, 1986. Both will have been launched in December of 1984, dropping off their Venus-landers the following June. The first of the comet encounters is believed to be targeted at a distance of 10,000 kilometers from the nucleus, which is hoped to be far enough away that it will be safe from damage by the comet's abundant dust. Depending upon the outcome, the second craft will be retargeted either out to a safer distance or in for a closer look.

That ability and the Venus slingshot are not the only signs of the mission's sophistication. Halley's path through space is not at all well known — it could differ from predictions by thousands of kilometers — so a spacecraft whose instruments are all looking in pre-programed directions (like those aboard the Voyager craft) may find itself facing empty space. The U.S. group believes that Soviet designers are equipping each probe with a three-stage pointing-control system that first detects the comet's brightness with photodiodes, then with a wide-angle camera and finally with a narrow-angle camera (a somewhat similar system is part of the proposed U.S. Halley Intercept spacecraft). The use of such a system could also mean that the spacecraft will be equipped to keep themselves pointed at the comet without help from earth, by means of an "autonomous" attitude-control system.

The cameras aiding this process — and photographing the comet — are also believed to represent major advances in Soviet technology, including Russian-built charge-coupled-device (CCD) detectors and multiple filters. Beam-splitters would divide the cameras' output, using one part for orientation of the spacecraft and returning the other to earth as data. Also, the cameras and some of the other instruments are expected to be mounted on movable "scan platforms" (like Viking and Voyager) rather than fixed to the spacecraft structure — another first for Soviet planetary probes. The U.S. analysts believe that data will be sent to earth at 50,000 bits per second, an increase over past missions; transmitters no stronger than those on past Soviet Venera missions would require improvements in Soviet tracking stations, some of the analysts think, but references to a 70-meter tracking antenna have been noted in print.

Besides the cameras, scientific instruments aboard each craft are believed to include visible and ultraviolet spectrophotometers, an infrared spectrometer, a dust mass spectrometer, a dust counter, ion and plasma-wave analyzers (for solar-wind studies) and a magnetometer, with more under consideration.

The Japanese mission will also involve two spacecraft, but one of them will merely study the solar wind upstream from the comet while the other carries only two instruments. The sole ESA spacecraft is expected to be instrumented for detailed compositional studies, but only for those four hours. It would be the sophistication of the Soviet mission, if anything, that makes advocates of a U.S. Halley mission wonder if they still have a niche to fill. □