# Cruising close to comet Kopff

On Sept. 11, 1985, a U.S. space probe will flash through the tail of comet Giacobini-Zinner (SN: 1/7/84, p. 6), and six months later, craft from the Soviet Union, Europe and Japan will hurtle past comet Halley. But all of these visits—the first cometary encounters by spacecraft ever conducted—will be brief, providing close-up data for only a few hours or days. Now a science planning group has recommended that a comet named Kopff be the goal of a probe that would cruise near its objective for as long as six years.

Such a "rendezvous" was initially proposed in the mid-1970s as a possible U.S. mission to take an extended look at Halley. When that plan fell by the wayside, many of its advocates turned to an alternative that would merely fly past Halley but then go on to rendezvous with a comet called Tempel 2. That idea, too, died (no U.S. spacecraft will go to Halley at all), but scientists would still like a chance to study some comet from close up while it is far from the sun, with its nucleus a bare, hard chunk. They would then watch as its coma and tail develop during its solar approach, and finally observe its new form as it heads off to the far reaches of its orbit. No job for a quickie flyby.

A comet rendezvous has thus been among the highest priorities of the Solar System Exploration Committee (SSEC), a panel established in 1980 by the National Aeronautics and Space Administration to develop an affordable plan of scientifically desirable planetary and related missions through the end of the century. The SSEC's first item, a high-resolution Venus Radar Mapper, is already under development for a 1988 launching, and number two, a Mars Geoscience/Climatology Observer to take off in 1990, is sought in the administration's latest budget proposal. Next (for a start two budget cycles from now, NASA hopes) is the comet rendezvous.

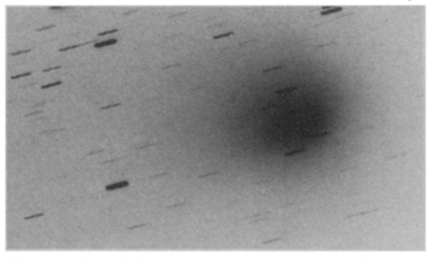
Last week, NASA announced that the working group studying the mission has recommended that the target comet be Kopff, discovered in 1906 by German astronomer August Kopff. Selected from a list of about 10 candidate comets, Kopff is relatively active as short-period comets go (it circles the sun about every 6.5 years), and its orbit is such that a space probe launched in July 1990 could match speeds with it four years later, leaving about two years to study the comet before its closest approach to the sun. In addition, while some comets change their orbits, split into fragments or even disappear completely from one orbit to the next, Kopff has been refound on all but one of its orbits since its discovery, suggesting that its presence can be counted on when the spacecraft arrives.

The working group's favorite version of the mission, which would be sent off from the space shuttle on or about July 5, 1990, also offers a double bonus: the chance to fly past two asteroids on the way to the comet. About seven months after departing from earth-orbit, the craft would zip by a little asteroid known as 1327 Namaqua, estimated to be about 14 kilometers across, and five months later it would encounter 222 Lucia, perhaps 84 km in diameter. Both will be hasty visits, providing only a day or so of useful data, but they could also be the first of their kind. And even if they are not, they would represent a chance to study the diversity of asteroid types, understood only poorly from earth-based techniques.

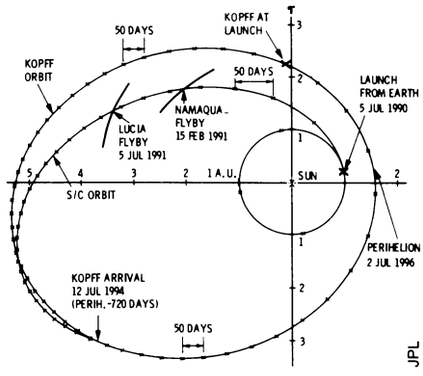
The mission could also be launched a year later, and there is even an alternative though scientifically less-interesting comet candidate named Wild 2, but those options are still being studied for possible asteroid flybys en route.

The feature attraction, however, is the possibility of the probe's spending literally years in close proximity to the comet, watching the changes as the comet approaches and then recedes from the sun's warmth. Plans call for the vehicle to go into orbit around the comet's nucleus, perhaps less than 10 km away, backing off only when the dust of the coma and tail begin to develop and reapproaching after the sun has been left behind. If all goes well, the probe could be hanging around until the year 2000.

It is also planned as the first of a new generation of planetary spacecraft, called Mariner Mark II, now being studied at Jet Propulsion Laboratory in Pasadena, Calif. The craft is envisioned in various configurations for different missions, ranging from dropping off an atmosphere probe at Titan to a multi-asteroid rendezvous. To minimize development costs, some Mariner Mark II components would be adapted from existing spacecraft such as Voyager, while various systems could be standardized throughout the diverse missions. The working group is also studying possible West German participation in the comet flight. —*J. Eberhart*



*Comet Kopff (above; negative print from Kitt Peak National Observatory, Aug. 1983) is proposed target for 1990s space probe that would cruise near it for years after first flying past two asteroids.*




# Lower estimates for ozone decrease

Ozone concentrations in the upper atmosphere are less vulnerable to changes caused by human activities than previously believed, a committee of the National Research Council (NRC) reports. The committee's conclusion is based on new data and on results from two improved mathematical models. One model considers only the effects of chlorofluorocarbons (CFCs) in reducing stratospheric ozone, which screens the earth from harmful ultraviolet radiation. The other considers effects of changes in other trace gases, such as carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$).

Both models indicate a reduced potential for decrease in stratospheric ozone. When the CFC model is used, calculating the release of CFCs at current rates, the reduction of the total amount of ozone in the stratosphere is 2 to 4 percent by the end of the century. Previous estimates by NRC committees in 1979 and 1982 were 16.5 percent and about 7 percent, respectively (SN: 11/17/79, p. 340; 4/10/82, p. 244).

The trace gas model indicates that in the next few decades the net ozone in the atmosphere may *increase* about 1 percent. However, the committee cautions that this is a very small increase and that environmental concerns should not be abandoned. Uncertain factors such as changes in $CH_4$, $CO_2$ or $N_2O$ emissions by commercial subsonic aircraft could affect the amount of potential ozone change, up to a decrease of 10 percent.

The new estimates too will be revised as researchers learn more about the combined effects of ozone changes and "climatic alterations" caused by carbon dioxide and other trace gases. The committee notes that the trace gases may cause direct radiative effects that may enhance surface warming and a corresponding cooling of the stratosphere, which would slow the rate of ozone destruction.

From 1970 to 1980, the committee says, no decrease was discerned in the total amount of atmospheric ozone. Concentrations may have decreased at an altitude of about 40 kilometers, where all models indicate that ozone is especially vulnerable to destruction by chlorine atoms. So far, though, this decrease apparently has been offset by ozone increases at lower altitudes. —*C. Simon*