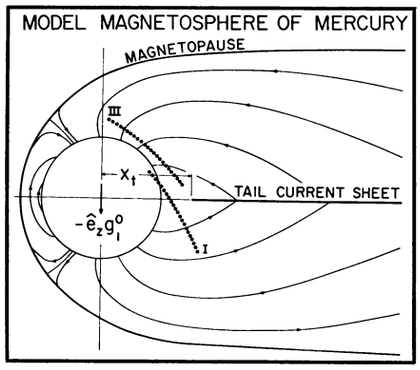
Mercury's Magnetism Is Its Own

"Unquestionably," says Norman Ness. "Unequivocally," says James Dunne. Surviving a knuckle-whitening last-minute cliff-hanger, the crippled Mariner 10 spacecraft this week revealed that the magnetic field of Mercury, a complete surprise when the probe first detected it a year ago, is definitely the planet's own, intrinsic to Mercury, rather than something generated from outside by some complex interaction with the solar wind.

Mariner barely lasted long enough to tell the tale. From the very day of its Nov. 3, 1973, launching, when balky heaters threatened to let its two TV cameras freeze solid, the probe was assaulted with a seemingly endless succession of woes. The most recent was a severe tracking problem that threatened to wipe out this week's third encounter with only two days to go. More than any other planetary mission on record, in fact, Mariner 10 has brought out the best in its human crews, who have staved off innumerable potential tragedies to convert ever-looming disasters into a two-planet, four-encounter triumph.

The third and final encounter with Mercury (which was so down-to-the-wire that Mariner will probably run out of control gas by the end of this week) was originally no more than a promising bonus, made possible by an accident of celestial mechanics. But the discovery of Mercury's magnetic field during the first encounter last March 29 gave new importance to the third visit (the second pass, on Sept. 24, was too far from the planet to help). In this third pass Mariner skimmed by only 323 kilometers from the newly intriguing world. The earth's much more powerful magnetic field, points out Ness, of the Goddard Space Flight Center, blocks the solar wind at a distance equal to about 15 times earth's radius. Mercury's little field, however, forms its solar wind shock wave less than half a Mercury radius out from the planet's surface; in other words, the planet itself occupies most of its magnetosphere, making a close flyby a necessity.

It would have paid off even if it had only answered the one big question. But besides showing that the field is intrinsic, says Ness, the data from the final pass may also have made it possible to shed some light on why it is there at all. One possibility is that Mercury is composed in part of permanently magnetized rock, but this, Ness



points out, "requires a very special sequence of events occurring during the formation and evolution of the planet." Even so, he says, a comparison with Apollo lunar samples suggests that a 300- to 600-kilometer-thick crustal shell with similar magnetization could account for the observed field strength. The more likely source, he implies, is an active "dynamo" of spinning electric currents within Mercury's iron-rich core. Detailed studies of the first and third encounters should help. But the dynamo idea "faces some difficulties because we are uncertain about the exact structure" of Mercury's interior.

The surface is better known, thanks not only to Mariner 10 but to ground-based work as well. T. B. McCord and F. Vilas of Massachusetts Institute of Technology reported as long ago as 1972 that the surface was moon-like, basaltic, rich in iron and titanium and partially smoothed by the effects of "shock weathering." Last month, Rob Landau of the University of California added the finding, from thermal polarization studies, that the surface may be loosely packed on a scale of centimeters or meters but that the loose particles seemed to be composed of smaller structures that are compact on the scale of microns.

One particularly important contribution of the close flyby, points out Clayne Yates of JPL is in the form of evidence showing that one characteristic of Mercury, notably its charged-particle populations, can be reasonably compared with the earth's. Electron fluxes, for example, show similar distributions around both worlds given the different scales of their magnetic fields, says Yates. Occasional bursts of charged particles originating in Mercury's magnetic tail, adds University of Chicago's John Simpson, also resemble their earthy counterparts. Such data could become important if it becomes necessary to rework ideas about the earth, such as the out-of-hand assumption that it is earth's rapid rotation that makes possible its magnetic field, in the light of new insights into slowly turning Mercury.

Mariner 10 data will keep researchers going for a long time; they'll have to, since the National Aeronautics and Space Administration has no present plans to return to Mercury before the late 1980's. But the team that made it all possible is already fast fading from view. Project scientist James Dunne and project manager Gene Gibberson, for example, are even now at work on the 1978 ocean-monitoring satellite called SEASAT. The 110-person complement of flight controllers was down to about 35 before the final encounter, and, says Dunne, "Viking [the upcoming Mars-landing mission] is swarming all over the control area now, kicking us out." □

Helios makes closest pass to sun

Last Sept. 21 during its second encounter with Mercury, Mariner 10 reached within 68,314,000 kilometers of the sun. Not even Venus probes had previously come as close to the sun as 100 million kilometers, but now all previous record keeping has become academic. Less than a month ago, on Feb. 25, the German-built solar probe called Helios (SN: 8/3/74, p. 74) smashed Mariner 10's record, and last Saturday it reached its own closest point, some 46,291,060 kilometers from earth's home star.

At such proximity, about 30 percent of the earth's mean distance from the sun, water would have long since boiled away. Lead would melt. At perihelion, Helios was bathed in 11 times as much solar energy as ever reaches earth's atmosphere, and the temperature hovered around 700 degrees F.

Yet the hardy spacecraft is surviving. In fact, says Gilbert Ousley who manages the U.S. side of the predominantly German project from NASA's Goddard Space Flight Center in Maryland, "it works better in space than it did on the ground." So exhaustive an effort went into developing the craft that officials at the German Space Operations Center near Munich referred to