mass estimates are always the weakest links in theoretical predictions of new particles.

The mass is, in fact, somewhat fantastic for a single particle. Only the heaviest atomic nuclei surpass it, and they contain hundreds of particles. The heaviest particles that accelerator experiments have so far found are around four billion electron-volts.

The mass, of course, explains why accelerator experiments have never found monopoles. No existing accelerator can apply that much energy to the creation of new objects. However, if the mass is not much over 200 billion electron-volts, then, when and if colliding-beam facilities are built to take the fully accelerated protons of the world's two biggest accelerators (400 or maybe 500 billion electron-volts), there may be a capability of producing monopoles in them. Provided other factors don't supervene.

And other factors may. One of the questions Price raises is why other searchers with greater collecting power but different techniques failed to find monoples. Is there something about them that prevents them from being trapped in ferromagnetic solids? Do they interact with matter in such a way as to create other, more elusive particles? There may be more to their nature that makes them hard to produce and keep than the energy requirement.

Another big question is theoretical. Quantum electrodynamics is the theory that describes electromagnetic phenomena in the subatomic microcosm. But its technique works for objects that have a fairly weak interaction to other matter. Monopoles would interact very strongly with other matter, so new theoretical developments would be necessary to deal with their interactions.

Assuming that theory can be patched up and monopoles made and kept in copious numbers—very big ifs—a number of practical results might follow. There might be a whole family of magnetically charged particles for particle physicists to become interested in and from which they could learn very fundamental things about nature. Monopole accelerators could be made using magnetic fields to energize them at much smaller size and cost for the same energy than electric-particle accelerators, and monopoles could then be used as probes in particle physics.

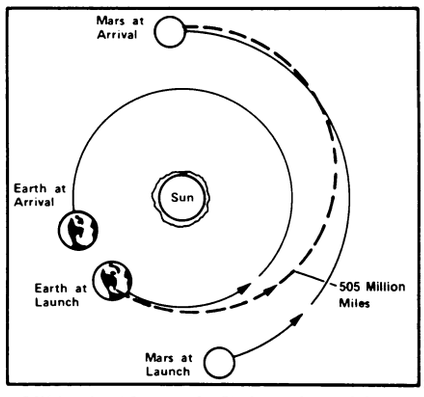
Monopole currents could be used in practical devices, especially motors and propulsive devices, and monopoles guided by magnetic fields might deliver energy for the destruction of tumors more efficiently and with less damage to healthy tissue than other options. All this is beginning to sound like science fiction come true, and someday it may. But if it is in the future, it's a long way down the pipe. Readers would be ill advised to rush out and buy stock in magnetic monopole manufacturing and mining companies. □

Viking off to Mars for historic landing

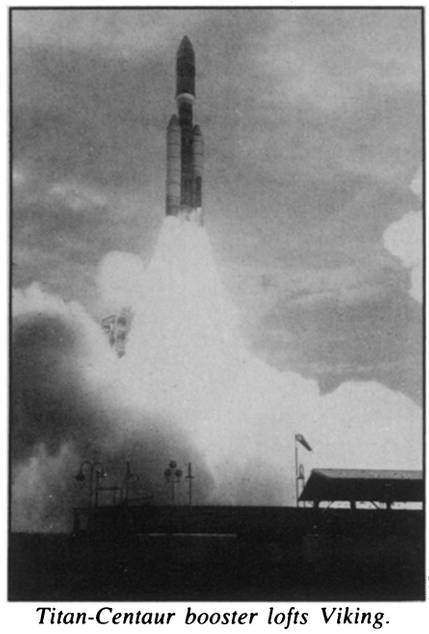
Mars ho! Viking is on its way. The dual-purpose spacecraft—one section will orbit the planet while the other lands on the surface—was launched from Florida's Kennedy Space Center on Aug. 20, nine days past its original Aug. 11 departure date. The National Aeronautics and Space Administration described the launch as "very clean," auguring well for a mission that will really begin when the spacecraft goes into orbit around Mars next June 19, one to three days later than its first-planned arrival. The remaining Viking, similarly delayed because it must use the same launch pad, was reset to take off on Sept. 1 (instead of Aug. 21), but it should still arrive on the originally scheduled Aug. 7, 1976.

The first of the problems that caused the delay, discovered barely three hours before the scheduled launch time, could have been disposed of in 24 to 48 hours. With that work underway, however, one of the batteries on the orbiter was found to be undercharged due to a faulty switch, leading NASA to decide to take the whole spacecraft down from its rocket and replace it with the Viking that would have been launched second. To save time, because a few more days' delay in launching would have meant an even longer delay in reaching Mars, the space agency bent one of its fundamental rules by allowing the spacecraft to be interchanged without first removing the half million pounds of fuel from the rocket on the pad. Time was doubly critical because early in November 1976, the movements of earth and Mars in their orbits will put the sun between them, cutting off communications for about a month, and Viking officials want the main part of the mission out of the way before then.

A minor question was whether the first launched lander would still be able to touch down on the Martian surface on July 4, 1976, as a bit of bicentennial bravado. Mission scientists have estimated that it will take 18 days for the orbiter to reveal whether the landing site, at the region



Viking's 10-month flightpath to Mars.


NASA

Titan-Centaur booster lofts Viking.

called Chryse, is both safe enough and scientifically acceptable, but a shorter period may turn out to suffice. "I don't consider the Fourth of July all that sacred," says project manager James Martin. "We're going to land when we're ready to land." But, he adds, "I personally would not like to wait in orbit if we are ready."

Unlike several other NASA interplanetary missions, Viking does not have a list of extra scientific tasks such as astronomical observations to perform en route, so most of the direct concerns during the 10-month, half-billion-mile journey will be matters of engineering and navigation. The huge Viking scientific team, however, has been building up steam for years, and many of the specially built offices and laboratories at Jet Propulsion Laboratory in California, from which the flight is being controlled, will be occupied well before the two spacecraft reach their destination.

One of their major concerns, of course, is Viking's upcoming search for life—the first such on any planetary probe to date. But even without the quest for Martians, the mission still represents an unprecedentedly wide-ranging study of another world. At Kennedy Space Center a few days before the launch, about 150 scientists gathered for the third in a series of annual Mars symposia, and the overall topic was not biology, but the Martian atmosphere. (Biology was the star of the first meeting in the series, followed last year by discussions of Martian geology.)

But even at an atmosphere-oriented symposium, the intriguing possibility of life crept in. There are enough favorable and unfavorable data to keep even blasé scientists eager with anticipation. "It's not as though I don't have plenty to do," says a member of Viking's army of biologists, "but 10 months is a long time in some ways." □