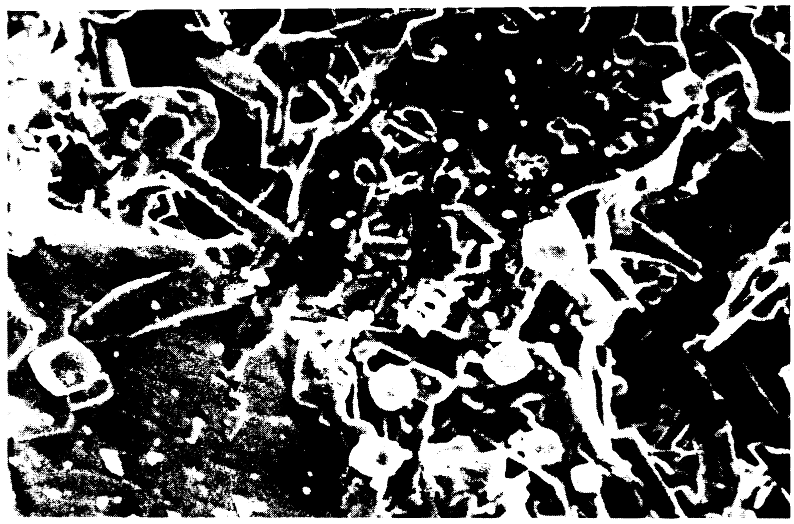
Orange glass: Tiny mounds grow on top of larger mound.



Iron crystals show new crystal habits in lunar material.

Another correlation is what appears to be an increase in volatile materials at sites within the ring of fire. These volatiles may point to volcanic fumarole activity. The orange glass of Apollo 17 is enriched in zinc, copper and gallium. Other odd-ball compositions appear at the Apollo 14, 16 and 17 sites.

New theories emerged to explain how the moon got magnetized (SN: 5/27/72, p. 346). Strangway has a "fence-riding proposal" that he offers if his favorite theory, an early lunar dynamo, proves unfeasible. It goes like this: While the moon was cold, it was exposed to a magnetic field of about 20 gauss and became magnetized throughout. The surface melting erased that magnetization, but the interior kept it and then remagnetized the surface lavas as they cooled. As the moon was bombarded, the more magnetized material from below was ejected all over the moon. This would explain why the magnetization appears random. Big magnetic anomalies appear in deep craters that may be filled with this ejecta. The highlands on the near side are more magnetic than the maria.

Dyal suggests the moon could have been magnetized by thermoelectric currents caused by the differences in material and temperature, perhaps when the surface was molten. To account for the observed field today, the magnetic people need only about 2 to 3 percent more iron than now appears in the moon, and the geochemical people indicate they would concede that. A figure for the moon's moment of inertia, presented by W. M. Kaula of the Jet Propulsion Laboratory, is 0.395, which allows for a somewhat denser interior (thus more iron) than was originally thought. □

A major surprise from CERN: Growth of proton cross section

Much of modern particle physics has been deduced from experiments in which beams of accelerated protons struck target protons. In the past year physicists have had a new energy range opened to them for proton-proton experiments—up to 400 billion electron-volts (400 GeV) at the National Accelerator Laboratory in Illinois and to the equivalent of thousands of GeV in the colliding proton beams of the Intersecting Storage Rings at the CERN Laboratory in Geneva.

The ISR has now served high-energy physicists with a sharp surprise. The surprise has to do with the total cross section for proton-proton collisions. The total cross section is the probability that anything at all will happen when projectile protons are fired at target protons. It is one of the most basic data in proton experiments. Up to now the total cross section had seemed to behave the way physicists believed it should: At low energies it is large. As the energy of the projectile proton increases, the total cross section decreases. Theorists believed that at sufficiently high energies this decrease would end, and the cross section would come asymptotically to a constant value.

The first experiments in the hundreds of GeV range seemed to bear out the prediction, and physicists rejoiced that they were entering a country where results were less dependent on energy and therefore simpler than at low energies. Two new experiments in the ISR, conducted by groups led by Giorgio Belletini of the University of Pisa and Giuseppe Cocconi of CERN, and reported last week, may end the rejoicing.

These measurements show that in the range of 1,000 GeV and up, the cross section increases, rising to the same range of values that it had at energies around 10 GeV and lower. This is contrary to expectation. The overall behavior of the cross section is thus that it decreases from zero to about 100 GeV, remains at a more or less constant minimum for several hundred GeV and then rises again.

The cross section is a geometric measure of probabality. It delimits more or less the space over which the proton's material influence is felt. Hit within that area and something will happen. The actual physical size of the proton is something different, but according to the CERN announcement a close idea of the actual size can be obtained by looking at how big a proton seems to another at just the grazing angle. Such measurements indicate that the diameter of the proton also rises slowly with energy.

One reaction has it that the ISR results will strengthen the hand of those theorists who believe in the parton model of the proton (SN: 10/28/72, p. 285). But the results seem bound to cause dismay elsewhere. According to the CERN announcement they cast doubt on one of the most strongly entrenched theories of particle physics, the so-called Pomeranchuk theorem.

The Pomeranchuk theorem is based on the symmetry of matter and antimatter. It says that although the proton-antiproton cross section can at low energies be a little larger than the proton-proton cross section, at high energies the two cross sections should tend to the same value. Unless the proton-antiproton cross section takes a sharp turn from its present direction somewhere between 70 and 300 GeV, it is likely to go below the proton-proton cross section. If it does, it will mean radical changes in physicists' beliefs about the relation of matter and antimatter.