with the newly developed Hydraulic Piston Corer (HPC) (SN: 2/10/79, p. 86), Leg 70 was easily able to locate and take undisturbed core samples from the soft mounds 9,000 feet below.

According to Von Herzen, the core samples show layers of hydrothermally altered materials, such as manganese oxide and an iron-rich green clay, alternating with normal ocean sediments. The total thickness of the alternating layers is about the same — 30 meters — as that of the purely ocean sediments on the sea floor adjacent to the mounds. This suggests, Von Herzen says, that the ocean sediments falling on the mounds may be dissolved by the hydrothermal material. Temperatures within the mounds ranged from 59° to 68° F, compared with the ambient sea water temperature of 36° F. Along with evidence from pore water samples, the measurements suggest that water circulating through the mounds moves very slowly — "about tens of centimeters per year."

Together, the data seem to paint a picture of the mounds as breaks or leaks in the otherwise impermeable pipes of a beneath-the-crust plumbing system. The 5-meter to 20-meter-high mounds form in depressions in the sea floor, says Von Herzen, where faults may allow circulating water to surface. The very slow movement of the water keeps the minerals within the mounds instead of spewing them onto the sea floor. David Williams, Von Herzen and co-workers suggest in the Dec. 10 JOURNAL OF GEOPHYSICAL RESEARCH that such mounds build from the inside out. The alternating layers suggest that the mounds are not "on" continuously but that they last for thousands of years, unlike the short-lived, violent activity of the hot vents at the spreading center. Further analysis of the distinct layers preserved in the HPC samples may pin down the timing of the active episodes, Von Herzen says.

Leg 70 also tended to leftovers from Leg 69. Guided by a sonic beacon on the sea floor, Leg 70 re-entered and deepened a hole in what researchers aboard Leg 69 described as a rock formation perfectly sealed from penetration by water (SN: 12/15/79, p. 413). Based on temperature measurements, the earlier researchers had found that the drill hole was sucking water at a rate of 40 gallons per minute, which indicated a low pressure area. According to Von Herzen, water is still being pulled into the formation and temperatures at the bottom of the now 561-meter hole — one of the deepest in the ocean floor — measure about 232°F. The significance of the formation is, however, unclear. Roger N. Anderson of Lamont Doherty Geological Observatory, who was aboard Leg 69, believes the formation to be a fossilized low pressure area formed by an unusual combination of heat and geology. Von Herzen suggests that the drill hole has tapped into an active circulation pattern where low pressure is created by water moving through the crust. □

CESR in the province of bottomonium

Quantum chromodynamics is the theory of what holds everything together. There are physicists who don't think much of QCD as it is called, but there is no really thoroughly worked out alternative theory, so either the center holds on this basis or there will have to be lots of new work done. To see if it holds, experiments look for predicted phenomena.

One reported at the recent meeting of the American Physical Society in Chicago is a confirmation of the existence of the particle with the unwieldy name upsilon-double-prime. This was done by experimenters at the Cornell Electron Storage Rings (CESR) in what appears to be a winning cast of dice in what could be called the "onium" sweepstakes. According to QCD the subatomic particles of physics are built out of six different varieties or "flavors" of quarks. When the fourth of these postulated flavors (designated charm) was discovered five years ago, it exhibited the ability to form what is called charmonium, a particle made of a charm quark and a charm antiquark. Charmonium comes in a spectrum of states (called psi, psi-prime, psi-double-prime, etc.) that differ from one another in mass. How the charmonium states change into one another, resemble one another and differ from one another is extremely important for an understanding of the characteristic called charm and of the chromodynamic force that holds these structures together.

In 1977 the fifth quark, called bottom, was discovered, and in being discovered it manifested itself as bottomonium, otherwise known as the upsilon particles. The discoverers, who worked at the Fermi National Accelerator Laboratory, found clear evidence of the upsilon and the upsilon-prime at 9.4 and 10.0 billion electron-volts (9.4 and 10.0 GeV) respectively and an indication of a third at 10.3 GeV. The DORIS colliding beam facility at Hamburg confirmed the first two. Now CESR has found "a beautifully clear indication of the third state, upsilon-double-prime," says Karl Berkelman of Cornell, thus confirming its existence.

It was a fortunate thing in that CESR was designed to operate optimally in just the energy range where bottomonium can be made before anyone knew what the mass of bottomonium would be. One of the big weaknesses of the theory is that it does not specify the masses of the particles it predicts, so nobody is sure what the masses will be until the particles are found.

The optimal operating range around 10 GeV was chosen for CESR, because it is halfway between those of the first generation of electron-positron colliding beams (SPEAR, DORIS, etc.) and those of the second generation (PETRA, PEP). CESR was built rather quickly because tunnels did not need to be excavated to hold the rings that store the electrons and positrons before they collide to make all these new particles. The rings were put into the existing tunnel of the Cornell Electron Synchrotron.

CESR began experimental operations in the fall of 1979. By then, of course, physicists were well aware of the mass range where bottomonium was to be found, and that became the opening campaign. The detector is called CLEO. That is not an acronym for anything, Berkelman says. "It's just a name we thought went well with CESR."

Berkelman stresses the precision and clarity of the CESR results. With an exact picture of the bottomonium spectrum, study can proceed to the ways in which the flavor called bottom behaves and how it responds to the chromodynamic force. Comparisons with charmonium will be drawn. One of the important things to be sure of is that the chromodynamic force relates to different flavors of quark in the same way. If it doesn't there will be a tremendous scramble to redo the theory. With three well-defined levels of the bottomonium spectrum the CESR physicists feel the omens for being able to do such studies are good.

And there may be more. There are indications that bottomonium may be divided into more than three parts. Berkelman speaks of a hint of a fourth bottomonium state. Beyond bottomonium Berkelman suggests that CESR may be working in a good range to find bottom mesons, structures in which a bottom quark is united to an antiquark of another flavor. Here bottom would manifest itself unmasked by antibottom. This is an aspect of that famous search for bare bottom that has caused so much witticism. Witticism aside, the discovery of bare bottom is one of the things that are fundamental to QCD as the theorists perceive it. □

DNA rules take effect

Revised guidelines for research involving recombinant DNA were published in the Jan. 29 Federal Register. The guidelines lower the physical safety requirements for conducting most experiments using the common laboratory bacteria *Escherichia coli* K-12 and eliminate the requirement that such experiments be registered with the National Institutes of Health. Those experiments, however, are not exempt from the guidelines, as the Recombinant DNA Advisory Committee recommended (SN: 9/29/79, p. 214). Director of NIH Donald S. Fredrickson proposed the revised guidelines Nov. 30 (SN: 12/8/79, p. 389). Bernard Talbot of NIH says that the public comments received overwhelmingly endorsed the proposed guidelines. □