Mare Imbrium, 1,000 kilometers across and visible from the earth even to the naked eye, just east of the Ocean of Storms.

On earth, such rubble would be a terrible conductor of tremors; on the geologist's "Q" scale, a measure of how long vibrations in the earth take to die down, it would rate about 10. By contrast, the moon rubble scores at least 2,000. The difference is that the earth rubble would be filled with gases and liquids that would let the vibrations travel at high speeds, enabling them to penetrate far down into the planet. On the moon, these have long since boiled away, leaving a very low-velocity material that can slow down seismic waves enough to trap them between the hard layers above and below.

The Apollo 11 seismometer, left on the moon in July, picked up about 100 similar, though smaller, seismic events which resonated for up to 20 minutes. "No one was prepared to accept the fact that they might be due to impacts," Dr. Latham says, "but now we think differently." Re-studying the Apollo 11 data—its seismometer finally froze to death in the lunar night—may thus provide the first accurate measurements of the rate at which meteorites bombard the moon.

Apollo 13 should add a great deal to Apollo 12's exciting discovery. Its site is a bed of ejected material from Imbrium not covered by any hard layer. Samples of this rock should tell scientists how long ago Mare Imbrium—and thus the middle of the Ocean of Storms sandwich—was formed. In addition, the third-stage booster that sends Apollo 13 off toward the moon will later be sent to crash into the lunar surface, within 220 miles of the Apollo 12 seismometer. It will hit before the astronauts land, so safety should not be a concern, and it should provide a blow with almost six times the momentum of the Intrepid.

It is also likely, Dr. Latham believes, that the Apollo 13 astronauts will be able to find rocks on the surface that were part of the same layer that forms the bottom of the sandwich. Such rocks, even older than Imbrium, would be the oldest ever found on the moon, and could well confound more theorists by being even older than present estimates of the age of the solar system.

The seismometer was not the only ALSEP instrument to start out with a surprise. Also monitoring the state of the moon is an ultrasensitive magnetometer.

Past measurements of the lunar field have been limited at best, and all seemed to point to a field approaching zero. The first close-up data came from Russia's Lunik 2, the first man-made object to touch the lunar surface, which crashed there in 1959. Before the collision, the spacecraft radioed back that it could detect no field at all, meaning that if there was one, it was weaker than the instrument's sensitivity of 50 gammas. Earth's magnetic field is some 35,000 gammas.

Next came Lunik 10, also an unmanned Soviet craft, which orbited the moon in 1966 and reported a field of from 23 to 40 gammas. The following year, however, the U.S. launched Explorer 35, fifth satellite in the Interplanetary Monitoring Platform series, which determined from its moon-circling orbit that the field was less than 16 gammas. The implication definitely seemed to be downward, leading to the conclusion that the chances of the moon's having a molten core (now or at some time in history) were slim. A molten moon, if still fluid, would produce a magnetic field by electric currents from its turbulence; if long since cooled, it might have aligned the then-plastic lunar rock along the field lines into a huge dipole magnet.

Now the ALSEP magnetometer has found what may be evidence of a core after all. Within days of being turned on by the astronauts, it has detected an ambient magnetic field of some 30 gammas, twice that of previous estimates.

In coming days and weeks, the data will be compared with other information derived from studies of the orbits of the Lunar Orbiter spacecraft to help pin down the number. In addition, comparisons will be made with data from Explorer 35; the magnetic field is sure to be deflecting electrons and protons coming from the sun, with the result that fewer particles should be reaching the surface than hit the spacecraft.

Meanwhile, the astronauts and the lunar samples are again in quarantine, while an enlarged group of outside investigators waits to get its hands on the priceless pieces of the moon. □

A SINGLE GENE

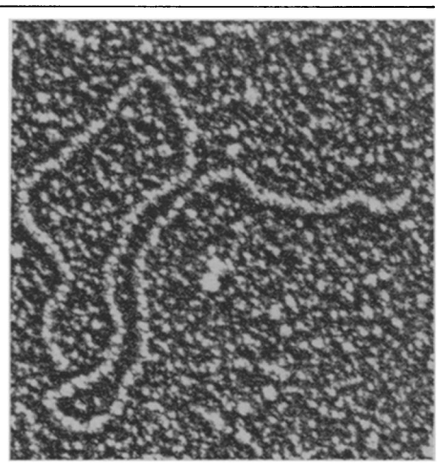
Molecular tour de force

According to a now classic hypothesis in genetics, there are two classes of genes. The first consists of structural genes that, through RNA, determine the sequence of the amino acids and thus the structure of protein. The second class of genes, called operators, control the first, turning them on and off to regulate gene expression. Working as a unit, a package of structural and operator genes is called an operon.

While there is already considerable circumstantial evidence to support this view, its final confirmation and new insights into the detailed mechanisms by which gene classes interact may now be possible because scientists have isolated a single gene from the common intestinal bacterium called *Escherichia coli*, or *E. coli*. With the assistance of viruses, a team led by Dr. Jonathan Beckwith at the Harvard Medical School has achieved a skillful molecular tour de force that at once gives scientists pure genes for study and a method of obtaining more.

The gene they isolated, the lac operon, regulates the production of an enzyme called beta-galacto-sidase, which degrades or breaks down lactose. "What we have," says Dr. Beckwith, "is a piece of DNA that contains the gene that controls the structure of lactose, and the regulator or controlling sites of that gene."

With Dr. James Shapiro and Lawrence Eron, Dr. Beckwith began by selecting two bacteriophages (viruses that infect bacteria) that get into an *E. coli* cell and incorporate into their own genetic material the bacterial lactose gene. "The two phages we isolated, lambda-plac5 and phi-80plac1, are very similar in all regards, including their ability to pick up lactose genes," Dr. Beckwith says, "but their strandedness is different." That is, the sequence of bases that make up the lactose gene face in opposite directions.



Harvard Medical School

A single lac gene, 1.4 microns long.

In the laboratory, the Harvard team isolated the DNA from each phage, treated it with chemicals to force the helix to uncoil and then put together a single DNA strand from each. Because only the portions of those single strands that held the lactose gene matched, they joined to form a whole, coiled lactose gene; the remaining DNA remained separate. When that extraneous DNA was

destroyed by enzymes that act only on single strands, a pure lactose gene with its controlling sites was left behind.

Now the researchers will turn their attention to the mechanisms by which that gene makes ribonucleic acid. "The first step," notes Dr. Beckwith, "will be to provide a chemical environment in which the isolated gene can function. Then we can look at the steps involved in RNA synthesis." By manipulating their virus extraction method and employing phages that selectively incorporate other bacterial genes, it will also be possible to isolate and examine other types of genes as well.

NIXON ORDER

Out with CBW

The United States has repeatedly refused over the last 44 years to join the Geneva protocol designed to prohibit the "use in war of asphyxiating, poisonous or other gases and the bacteriological methods of warfare." The subject has been under intensive review by the National Security Council for some months (SN: 10/25, p. 373).

This week, along with an order to remove chemical and bacteriological weapons from the U.S. military arsenal, President Nixon brought the issue before the Senate.

The order, unequivocal in banning biological weapons, confined military biological research to "defensive measures such as immunization and safety measures." It also reaffirmed the renunciation of the first use of lethal chemical weapons and extended this disavowal to the "first use of incapacitating chemicals."

But the Nixon order did not go into detail on a question that is bound to confuse the future course of the protocol: the use of tear gas and other riot-control agents.

Most nations supporting the protocol meant the ban to include the use of tear gas. But the Senate is unlikely to ratify the protocol without stating the right to the U.S. to use crowd-control agents, or at least interpreting the document as not including them in the banned list. Such a reservation would mean that other signatories would have to re-evaluate their own position regarding the use of tear gas.

The President's order asked the Pentagon to make recommendations on disposing of existing stocks of bacteriological weapons. This could also include means for the production and delivery of such weapons, said Deputy Assistant Secretary of Defense Jerry W. Friedheim. It might also mean the closing down of some facilities and the disposal of some production equipment and materials, he said.

SEA-FLOOR TREATY

Narrow issues and large

Antarctica and outer space are the first two preserves set aside by international agreement to be forever free of bases for nuclear devastation. The floors of the deep oceans may be next, if problems with a draft treaty now being considered by the United Nations are eventually overcome.

The two superpowers, the United States and the Soviet Union, reached agreement on the draft on Oct. 8 at the Geneva conference on disarmament (SN: 10/18, p. 350). It would forbid the emplacement on the seabed and the ocean floor of any objects with nuclear weapons or of any other weapons of mass destruction. The ban would apply in all regions beyond the "maximum contiguous zone" of 12 miles from the coast as defined by the Geneva Convention of 1958.

The draft treaty has not pleased everybody.

Some members of the 25-nation conference criticized the draft for ignoring their interests on a variety of points. With the conference drawing near its close a slightly revised draft was submitted on Oct. 30, but other nations had time only to take note of it before recess.

Now the treaty is before the U.N. General Assembly. In a plea for approval, Charles W. Yost, the chief U.S. delegate, has sought to reverse a tendency he saw on the part of many nations to underestimate the importance of early approval. "Prevention before the fact is far easier than removal after the fact," he said. "Let me be clear. It is already within our capability to emplace nuclear weapons on the seabed, and such action would not be without some military advantages."

Objections to the present form of the treaty have come from Brazil, Canada, Sweden, Pakistan and Mexico. Much of the criticism has contended that only the superpowers have the technology to enforce the treaty. In fact the central substantive difficulty is over the matter of verification. The treaty gives any nation the right to verify the activities of any other nation. But the argument of the smaller countries is that they have no suitable means of verification.

Brazil has called for granting to each coastal state the right to participate in any verification activities carried out by other nations along its outer continental shelf. Canada has also urged that coastal states be given special rights. And it has sought changes in the draft to enable nations seeking to verify the absence of forbidden weapons to work through an international organization instead of having to rely on the facilities and cooperation of the superpowers.

The continuing dispute between the nuclear and nonnuclear nations may prevent action this year.

And even when a version of the treaty is finally accepted, it will remain fuzzy in many areas, because of the lack of agreed-upon rules and definitions where the seafloor is concerned. The draft treaty, for instance, fixes the width of the area exempt from the ban at 12 miles from the coast, but leaves unspecified whether a bay or estuary ought to be included.

Many of the difficulties with the seabed treaty, in fact, go far beyond weapons and are related to the more fundamental and still unresolved issues concerning the definition of continental shelf areas, jurisdiction over the seafloor and the rights to exploit its resources.

The existing legal agreement governing such questions is still the 1958 Geneva Convention, which gives exclusive exploitation rights of coastal nations out to a depth of 200 meters. That was about the limit of depth that could be exploited at the time. Since then drilling and mining technology have advanced dramatically; commercial offshore oil production has gone down 340 feet, and exporatory drilling has begun in water 1,300 feet deep. The scientific research ship Glomar Challenger drilled in more than 20,000 feet of water (SN: 11/1, p. 394), although such an effort is nowhere near being an economically feasible technique.

The 200-meter definition short-changes nations such as Chile and Peru, with steep and narrow continental shelves. And in the shallow North Sea, there is no area that does not belong to one of the countries. In many places there the shelf jurisdictions overlap.

In recent weeks a number of resolutions have been put before the United Nations, seeking further study, reconsideration of the 1958 agreement and a moratorium on claims to the ocean bed.

The United States does not plan to state an official position on the resolutions until they actually come up for a vote, possibly on Dec. 2. But the unofficial view on all such proposals, according to several Government officials, is that they should all be referred back to the U.N.'s Seabed Committee, a 42-nation group established last year to study and discuss the issues of sea-floor jurisdiction, exploitation and redefinition of the continental shelves.

The issues are too complex and the state of knowledge too preliminary in the U.S. view, for the entire U.N. General Assembly rationally to make any major decisions now. □