away from mid-ocean ridges, the warmer and lighter typical ocean crust will be, and the higher the crust will ride on the underlying mantle. The more young, shallow sea floor there is, the less room there will be for the ocean's water and sea level will rise. An increase in crustal generation through a lengthening of mid-ocean ridges can also shrink the volume of ocean basins and raise sea level.

In 1978 Walter Pitman of Lamont suggested on the basis of a reconstruction of the ancient ocean floor that a combination of higher spreading rates and longer ridges had pushed the sea 350 meters above the present level 80 million years ago. Peter Vail and his colleagues at Exxon Production and Research Company, Houston, used Pitman's 350 meters of sea level change to calibrate their now famous Vail sea level curve (*Science*, 25 July 1980, p. 483).

It now appears that the depth of the sea floor has not changed enough to lower sea level by 350 meters. Michelle Kominz of Lamont has recently repeated Pitman's calculations and found the most probable drop to be 230 meters, but large uncertainties allow a possible range of 45 to 365 meters. Like Pitman, she found a pulse of higher spreading rates about 80 million years ago. But in her reconstruction of the ancient Pacific, some of which has sunk back into the mantle at deep-sea trenches without a trace, Kominz has a smaller total ridge length. That accounts for their difference in sea level change. Other measures of sea level change made over the past few years, based on the extent of continental flooding or ocean depth at continental margins, generally fall between 100 and 150 meters, that is, the lower part of Kominz's broad range.

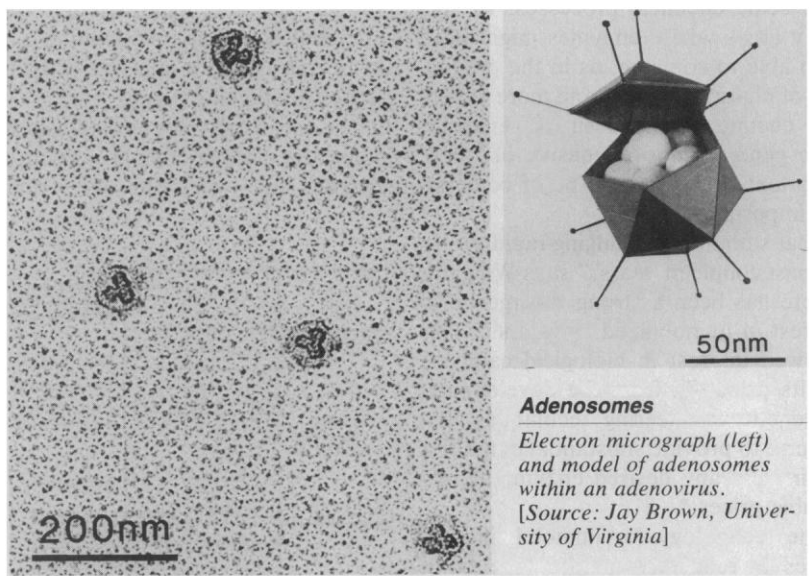
Barry Parsons of MIT has pointed out that these more modest sea level drops are also consistent with the age variations of the present sea floor. He found that the area of the present sea floor of a given age can be predicted with considerable accuracy if it is assumed that the rate of sea-floor spreading has been constant and that old crust is as likely as young crust to be subducted into the mantle. These two processes, each of which can change sea level, seem to have been in rough balance during the past 160 million years. This should not be so surprising, Parsons says, because changes in one process would tend to elicit compensating changes in the other. Deviations of only 12 percent in each process, which the record of foram lithium would allow, could account for the observed 150 meters of sea level change.—**Richard A. Kerr**

First Look Inside Adenoviruses

A team of investigators at the University of Virginia has revived a dormant technique to provide the first clear pictures of the internal structure of human adenovirus type 2, one of the many viruses which cause colds. Jay Brown, William Newcomb, and John Boring used a technique called "ion etching" to remove part of the capsid, the external protein coat of the virus, laying bare the internal structure for examination under an electron microscope.

To accomplish this trick, they used a beam of argon ions. Accelerated by an appropriate potential, the ions break chemical bonds in the capsid, penetrating to a depth of 50 to 150 angstroms. When enough bonds are broken, incoming argon ions are able to dislodge small peptides from the virus surface. In this fashion, the interior can be slowly exposed. They report in a paper submitted to the *Journal of Virology* that the interior contains 12 large spheres, one directly beneath each of the 12 vertices of the icosahedron that forms the capsid. They call these large spheres "adenosomes."

There had been some debate about the internal structure of the adenoviruses. Many investigators suspected that the viral DNA was condensed into structures resembling cellular nucleosomes—DNA coiled around a core of histones—as in the case of the SV40 virus. Dennis Brown of the University of Texas, however, previously used a detergent to remove the capsid. He isolated spherical structures that contained DNA and viral proteins previously numbered five and seven. This type of work is somewhat suspect, however, because of the possibility that the detergent has altered the internal structures. Dennis Brown says that he is "delighted" that the work from the University of Virginia group "resolves a controversy in my favor," and calls the forthcoming paper "one of the finest ultrastructural studies I've ever seen."



Adenosomes

Electron micrograph (left) and model of adenosomes within an adenovirus. [Source: Jay Brown, University of Virginia]

After they had completed their work, the Virginia group surveyed the chemical literature looking for similar techniques; they found only one. In 1976, Irwin Bendet of the University of Pittsburgh had used ions to study the internal structures of the tobacco mosaic virus and of bacteriophage T4. Newcomb speculates that subsequent investigators have been discouraged from using the technique because Bendet was unable to get clear pictures of the interiors. He hopes that his own results will stimulate wider use of ion etching. Meanwhile, the Virginia group is beginning to study the internal structure of herpesviruses. "It's believed that strands of DNA are wound in fishing reel fashion inside the herpesvirus," says Jay Brown. "Using ion etching methods, we should be able to find out if that's true."

—**Thomas H. Maugh II**