the moon." The alpha particle spectrometer looked for radon in the lunar surface. According to Paul Gorenstein of American Science and Engineering Inc., at Cambridge, Mass., radon might be generated in concentrations of radioactive material or brought to the surface by volcanic or seismic activity. The instrument can see two types of radon activity. One type exists in its present form on the moon and one is a record of past emanations in the form of polonium 210, the decay product of radon. "We do indeed find evidence that radon emanation is present on the moon and is highly variable in time," says Gorenstein. From the Apollo 15 data Gorenstein found radon over the crater Aristarchus. The Apollo 16 instrument located an increase in polonium 210 at 40 degrees east longitude in the vicinity of Mare Fecunditatis. One lunar scientist characterized the orbital data so far examined as a dream fulfilled. "We got almost all of the activities that we had planned," says Richard A. Moke of MSC, "in spite of the command module problems that caused the mission to be cut short a day." □

Gravity-wave search: No support for Sadeh

One of the theoretically possible antennas for gravitational radiation is the earth itself. The passage of a gravitational wave through the earth should cause minute vibrations that, in principle, could be picked up by a sufficiently sensitive seismograph placed so as to record vertical fluctuations.

A few weeks ago Dror Sadeh of the University of Tel Aviv in Israel and the U.S. Naval Research Laboratory announced that he had detected gravity waves in this fashion (SN: 4/1/72, p. 213). At last week's meeting of the American Physical Society in Washington Sadeh was faced with opposition from a group at the University of California at Berkeley (R. A. Muller, Bruce Bolt, Terry Mast, Jerry Nelson and John Searloos) who tried to repeat his experiment and failed to find data they consider significant.

Sadeh's experiment was set up in a cave near Eilat, Israel. It was designed to record vertical seismographic data for "months or years" and integrate them—add them up—in such a way as to enhance and bring out clearly any signal that had periodic qualities.

A periodic signal due to gravity waves would be easier to distinguish convincingly from the random continuous background of seismic activity. Of the several theoretically possible sources of periodic signals, Sadeh concentrated on pulsars.

Sadeh was looking for gravity waves from pulsars because they should be strong enough to record and because theory gives ways to identify the particular source. The period of gravitational waves from a pulsar should equal twice the period of the pulsar's radio pulses. Furthermore the way in which the signal interacts with earth (producing motions on the order of a fraction of an angstrom) should yield a maximum record at times when the particular pulsar was rising or setting at the location of the seismograph.

It took four months of integration to find what Sadeh calls a significant signal. In a channel corresponding to a period interval between 0.56 and 0.6 seconds, maximum signals were found to repeat at nearly 24-hour intervals (23.87 hours). Looking at the record for days in October when the peak was at least twice as high as the record in other channels at times between 2 and 6 a.m., says Sadeh, "you can see which pulsar was rising." It was CP 1133. It turns out that twice the period of CP 1133's radio pulses lies within the period range in which the signal was found. Sadeh believes that he is recording gravity waves from CP 1133. In support of that contention he has charted the succession of maximum signal over several months and insists that it correlates with the rising and setting of CP 1133. Another signal was found in the channel recording periods between 0.33 and 0.34 seconds with a repetition of maximum intensity every 12 hours, but there is no known pulsar with a radio pulse period one-half of that.

The California group set up their seismograph in a shaft at Jamestown, Calif. Data were telegraphed to Berkeley for analysis. All that they find in their signals, they say, can be attributed to random seismological noise. They even find things that at first blush look like periodicities, but which can be explained as noise.

The Californians contend therefore that Sadeh's method of integrating the data could have given him spurious periodicities manufactured out of the random noise that is always present. In summing up their argument, Muller said: "It is impossible to tell whether the Sadeh data are due to noise or not."

Sadeh insists that it is possible to tell, and that his signals are real. He also mentions a periodic seismicity on the moon that could be "a sidereal periodicity" caused by CP 1133.

There are other solutions to the disagreement besides saying one or the other is in error. As the Californians continue to record, they may find a pulsar signal. Or there may be something special about the Eilat site: A questioner at the meeting asked whether the location might have some particular resonant quality so that it would record the waves from the pulsars while the Jamestown one would not. Sadeh replied that he does not like to think of the theoretical and practical consequences of such a peculiarity. "I would like to see other people do it and find it," he said.

Sadeh is going back to do more recording; the California group is doing likewise; and elsewhere in the world others are getting into it. Further results are eagerly awaited. □

Cometary evidence of a planet beyond Pluto

From time to time there have been suggestions that our solar system might have a tenth planet, either within the orbit of Mercury or outside the orbit of Pluto. In the April PUBLICATIONS OF THE ASTRONOMICAL SOCIETY OF THE PACIFIC, a mathematician at the Lawrence Livermore Laboratory, Joseph L. Brady, presents what he says is, "some very interesting evidence of a planet beyond Pluto."

The evidence comes from calculations of the orbit of Halley's comet that Brady did with Edna M. Carpenter and Francis H. McMahon. Halley's comet is one of the best known and longest observed of the periodic comets. Its orbit passes from near the sun to the outermost reaches of the solar system, and its motion is thus a good way to test for the existence of large masses at great distances from the sun.

The computation of the cometary orbit by Brady, Carpenter and McMahon shows deviations that can be interpreted as evidence that Halley's comet is affected by a mass about three times that of Saturn located in an orbit about 65 times as far from the sun as the earth. The hypothetical planet would take about 512 years to go once around the sun. It would move in a retrograde sense—opposite to the orbital motion of the other nine planets—and its orbit would be inclined 60 degrees to the ecliptic, the plane of the earth's orbit. These last two facts would make the hypothetical body a very unusual member of the solar system. All the other planets go around the sun in the same direction, and all their orbital planes lie within a few degrees of the ecliptic.

Brady is a little dismayed at press reports last weekend that said he has discovered a new planet. He has not, but he believes the evidence for the existence of one to be stong enough to warrant a search. He also expects that the suggestion of a tenth planet will generate a sharp debate among astronomers. Nevertheless some observers are beginning to indicate a willingness to look. If the hypothetical planet exists, its position as seen from earth would be in the direction of the constellation Cassiopeia. □