surements would suggest, Tera proposes that the uranium may be concentrated more closely to the surface than has been supposed. This fits nicely with what seemed to be one of the general conclusions of many Rockfest VII participants: that the lunar lithosphere is thick indeed, encasing whatever lunar core may exist in a rigid shell perhaps 1,000 kilometers deep. More important, perhaps, is that the more nearly terrestrial element ratios allowed by the reduced heat-flow data do not require the moon to have formed at a great distance from the earth.

Comparisons between the moon and the earth and other terrestrial planets, in fact, were a significant part of this year's conference. Mark J. Cintala, James W. Head and Thomas A. Mutch of Brown University, for example, calculated the differences in crater shapes for the moon, Mars and Mercury. On Mercury, Cintala pointed out, craters of a given size are shallower than they are on the moon, in part because the surface gravity of Mercury is more than twice that on the moon. But Martian craters tend to be shallower still, and the gravity of Mars and Mercury differ by barely 3 percent, so there must be other factors that affect the hole produced by an impacting meteorite. Because Mars and Mercury are at different radial distances from the sun, he suggested, their impact velocities, even with similar gravity, could vary by as much as 30 percent. Atmospheric differences would make a difference, as might variations between the two planets' subsurface layering (providing a harder or softer floor to absorb impact energy).

Charles A. Wood, also of Brown, adds that basins—large craters with concentric ring structure—follow a regular progression from Mars inward to Mercury, both in the total number per planet (19 on Mars, 33 on the moon, an estimated 100 on Mercury) and in the number for a given surface area. That they are so different in number for Mars and Mercury is further evidence that other, nongravitational influences were at work.

Survivor and Genesis rocks notwithstanding, a major goal for planetologists is to identify "pristine surfaces"—areas where portions of a planet's original outer layer have not been radically altered by impacts and volcanism. Earth presumably has none; tectonics and erosion have seen to that. The same may be true for Mars, but there are promising signs in Mariner 10's photos of Mercury. Vernon R. Oberbeck of NASA's Ames Research Center and R. H. Morrison of LFE Corp. in California have carried out laboratory studies showing where the fall of material tossed out by an impact would be at a minimum, and Oberbeck told the Rockfesters that a few such areas—with a minimum of small craters between the big ones—may exist on the moon. One appears to be a region in the south-central lunar highlands near Hipparchus. □

O+ in eggs: Getting past the hollow ball

The "gee-whiz" approach to biology went out with Buck Rogers and his magic flying machine. The "wonders of this" and the "mysteries of that" began to melt away when biologists turned high-powered microscopes and biochemical techniques on the living cell. There is still at least one life process, though, that deserves the term "amazing": It is the series of events that begins with one egg cell and ends with a young organism composed of several trillion. Embryologists are still baffled by the early events in this series, specifically how the egg cell is "activated" and its genes suddenly turned on and directed toward the production of differentiated cell types. One embryologist, a doctoral candidate at Indiana University, has now unraveled a bit of this "amazing mystery."

Ann Janice Brothers reports a detailed study on the "*o*+ substance" from the Mexican axolotl in the March 11 NATURE. The axolotl is a strange looking, neotenous salamander that never loses its feathery gills or tail fin during maturation. The "*o*+ substance" is one or more proteins that seem to be necessary for egg cell activation past the early stages of development. These proteins are laid down in the cytoplasm of egg cells during oogenesis (egg production) in the normal adult female axolotl. Abnormal females with a mutation in the gene pair that codes for synthesis of these *o*+ proteins cannot produce the proteins or stock them in the egg cells, and thus make defective eggs. These defective eggs stop dividing a day or so after fertilization and never form normal axolotl young. Normal eggs, with the *o*+ proteins, continue to divide.

Two Indiana University embryologists made the initial discoveries that led to Brothers's experiments. R. R. Humphrey found the mutation in the female axolotl, and Robert Briggs discovered that the *o*+ proteins are laid down in the egg cytoplasm before fertilization. But Brothers, for her doctoral dissertation, did an extensive series of nuclear transplantation experiments to pinpoint the role of the *o*+ proteins in egg cell activation.

Brothers took nuclei from normal axolotl eggs and transplanted them into mutant eggs (without *o*+ protein). Nuclei removed from normal cells during the early blastula (hollow ball) stage did not induce full development of the mutant eggs. But nuclei removed during the mid-to-late blastula stage did induce full development of the mutant eggs to adult axolotls. This shows, Brothers says, that the *o*+ proteins in the cytoplasm begin to work only during the middle or late hollow ball stage, just in time for the gene activation that directs the next and subsequent stages (gastrulation and organ formation) in the growing embryo.

The implication is strong that this *o*+

Adult Mexican axolotls, grown from egg cells with transplanted nuclei, to show that o+ proteins must be present for normal development.

Indiana University/Lawrence M. Lawrence

substance somehow interacts with the embryonic genes during the blastula stage, perhaps to "turn on" the genes needed for continued development. "But," Brothers says, "we don't have direct evidence of this interaction yet." The next step, she says, will be to isolate and characterize the *o*+ proteins, then to trace their movements within the cell with fluorescent antibodies. These will adhere to the *o*+ proteins and should make it possible to detect whether or not they enter the nucleus during mid-to-late blastula stage and form a complex with some of the chromosomes—an indication of gene activation. It is also not clear yet whether this *o*+ system works only in axolotls. Briggs's earlier work, however, shows that a wide variety of amphibians have an egg activating substance. □

Laser enrichment: Companies vying

In spite of Marx, Engels and Lenin, the wave of the future with regard to the one socialized industry built in the United States, uranium enrichment for reactor fuel, seems to lie with the corporations of bourgeois capitalism rather than the proletarians of the federal bureaucracy. As long ago as 1972 the Reynolds Metals Co. filed an application with what was then the Atomic Energy Commission for a license to build a uranium enrichment plant in Wyoming. Reynolds has since dropped the idea, but at least three other private enterprises are now asking for a piece of the enrichment action: Exxon, Garrett Corp., and Centar Associates, the latter described as "a joint project of ENI Nuclear Co., owned by ElectroNucleonics, Inc., and Arco Nuclear Co., owned by Atlantic Richfield Co."

For use as reactor fuel (or as bomb charges) natural uranium must be processed so that the concentration of the fissile isotope U-235 is increased compared with that of the inert U-238, The original enrichment technology was developed by the government during World War II as part of the atomic bomb project. Reactors are now commonly licensed to private concerns, but enrichment remains in government hands.

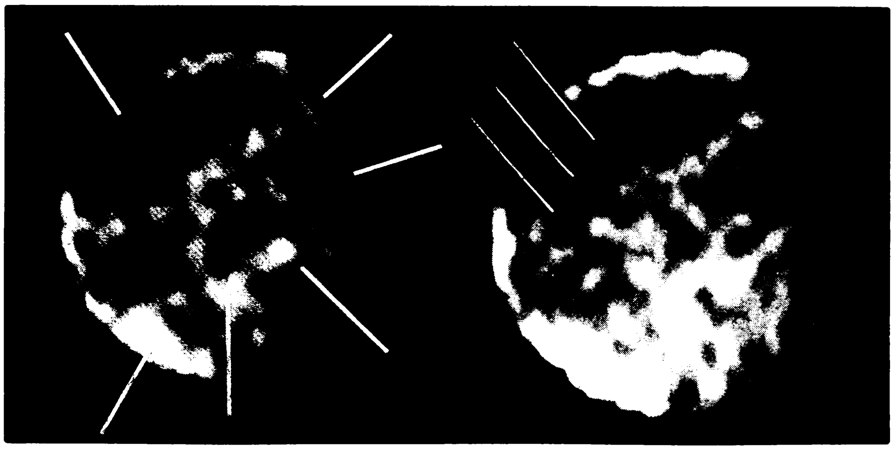
The sudden increase in private interest appears to be due to the development or potential development of new methods of enrichment that promise greater profit and efficiency than the original one. It is momentarily opportune because the congressional Joint Committee on Atomic Energy is considering the Nuclear Fuel Assurance Act, which would facilitate entry of private organizations into the business.

Enrichment depends on separating the two isotopes so that more U-235 can be introduced into or retained within the batch under process. The oldest method, gaseous diffusion, is based on the tendency of light atoms in a gas to rise higher than heavy ones. It is, as economists would say, capital intensive, and slow, requiring repeated processing of each batch. In recent years the gaseous centrifuge, a less expensive and quicker method, based on the idea that the heavier isotope will fly farther than the light one, has developed.

The latest method, still under experiment and not production ready, uses laser light and the fact that the wavelengths preferentially absorbed by one isotope differ slightly from those absorbed by the other. With the proper laser, one isotope can be energetically excited while the other is left alone. If the excited isotope is ionized, it can be collected electrically; if not ionized, it can be swept up by a chemical reaction. A study done at Los Alamos Scientific Laboratory, where experimentation on the laser methods is in progress, compares costs of plants of similar capacity. A gaseous diffusion plant would require $4.5 billion; a centrifuge plant $2.8 billion, and a laser one, if it works (and its proponents are optimistic), would come to only $140 million. Others see substantial savings in laser methods, but not as much as this.

Centar proposes a centrifuge plant. Their announcement says they have done feasibility studies with the Tennessee Valley Authority and have already interested utilities in buying fuel. Exxon proposes a kind of pilot laboratory, an Experimental Test Facility to work on laser methods. They would build it in Richland, Wash., spending about $15 million. If they can break ground in early 1977, they expect operations to start in 1978 or 1979. Garrett is also considering a laser technique. At the same time both Exxon and Garrett have proposed centrifuge plants.

Surface features seen on Ganymede



B. Roy Frieden

Computer-restored images of Ganymede, Jupiter's largest satellite, reveal for the first time some interesting surface details. Both were taken by the Pioneer 10 spacecraft, left with red filter, right with blue. According to the scientists who digitally restored the images, B. Roy Frieden and William Swindell, professors of optical sciences at the University of Arizona, the dark caplike region at the upper righthand edge is consistent with the way a crater, or other large hole, would appear on the dark limb side. Beneath it is a darkened elliptical region that resembles a large, shallow crater. Nearby are other features with a craterlike appearance. The small bright feature in the lower right quadrant appears as the center of a large, scallop-shaped bright arc. The righthand image shows three round details (see pointers) that Frieden and Swindell say very much resemble maria. If so, they add, the maria are very large. Some structure appears evident within the topmost round feature, "which makes it reminiscent of certain lunar maria." The images show a few rather large, bright rings, but whether they are ice or reflections from smooth surface features is unknown. Earlier radar evidence has led to the belief that Ganymede's surface is very rough, largely composed of rocky or metallic material embedded in ice. Ganymede's diameter is about 5,200 kilometers, half again as great as earth's moon. Images and details of restoration techniques appear in the March 26 SCIENCE. □

Comet West's scientific show

As Comet West (1975n) swung around the sun to rise in the east (SN: 2/14/76, p. 104), it provoked a flurry of observations around the world. Comets are not particularly rare phenomena. They run to a dozen or more a year—in the midst of the Comet West activity the first of 1976, Comet Bradfield (1976a) was discovered on Feb. 19 by William A. Bradfield of Dernancourt, near Adelaide, Australia. But comets are fleeting phenomena, so that every piece of data gathered during quick looks helps to build the total picture of what they are. One of the firsts with Comet West was an ultraviolet spectrum.

The comet got progressively brighter as it approached the sun (perihelion came on Feb. 25) reaching a top visual magnitude of −3.65 on Feb. 26 as measured by daylight observations by D. Elmore and S. Koutchmy of the Sacramento Peak Observatory in New Mexico. By Feb. 23, when at the same distance from the sun as Comet Kohoutek, the belle of 1973, it was already intrinsically 1.4 magnitude brighter, according to astronomers E. P. Ney and J. Stoddart of the University of Minnesota.

While it was passing the sun, the comet's nucleus broke into four parts. The exact sequence of events is a bit hard to put together from piecemeal reports, but the recension given by Zdenek Sekanina of the Center for Astrophysics in Cambridge, Mass., goes as follows: On Feb. 22 nucleus B separated from the original nucleus (A) because of the attraction of the sun. Nucleus D probably separated from B on Feb. 25, and nucleus C, which may be short lived, separated from A on March 5.

After perihelion the comet's tail showed a typical growth. According to J. Young of the Table Mountain Observatory in South Africa, the tail was less than 10° long on March 2 and increased by stages to 30° by March 8. Superimposed on the tail of plasma particles was a dust tail composed of so-called synchronic bands (up to 20 in number), which moved laterally and rotated with respect to the fainter plasma tail.

Spectroscopic observations to determine chemical composition were taken in visible light, infrared, radio and (for the first time) ultraviolet. The ultraviolet work was done by Charles A. Barth and C. Lawrence of the University of Colorado using an Aerobee rocket launched March 5. They report evidence for oxygen, carbon and carbon monoxide.

Radio detection of hydroxyl radical emission is reported by J. C. Webber, L. E. Snyder, R. M. Crutcher and G. W. Swenson of the University of Illinois. Visible spectra were taken by various observatories from the University of Minne-