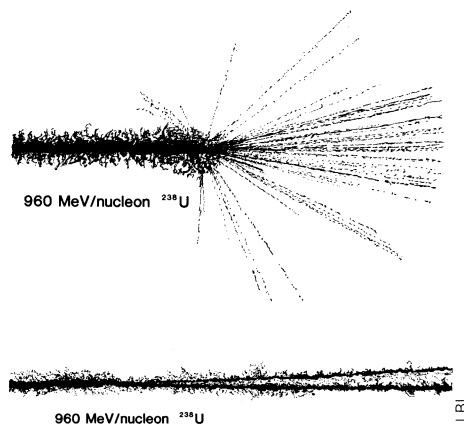


Uranium at a Quarter-Trillion Volts



Multiple fragmentation (top) and binary fission of high-energy uranium nuclei.

For decades physicists have studied atomic nuclei with very low energy. Now with the development of techniques for accelerating ions, nuclear physics is entering the domain of what physicists consider high energies. There they expect to find both exotic behavior and strange new states of matter.

At the moment the leading apparatus for accelerating ions of the heaviest elements to the highest energies is the Bevalac at the Lawrence Berkeley Laboratory in Berkeley, Calif. (SN: 8/14/82, p. 106). On the night of Sept. 25 the Bevalac beat its own record, by making what its managers call a full-energy run and accelerating uranium ions to almost a billion (10^9) electron-volts per nucleon (that is, per neutron or

proton). Since there are 238 neutrons and protons in this particular isotope of uranium, the total energy of each nucleus was just about a quarter of a trillion electron-volts. The achievement and the first observations of what nuclei of this energy can do were described three nights later by Howel Pugh, scientific director for the Bevalac, in a special session of the International Conference on Nucleus-Nucleus Collisions, at Michigan State University in East Lansing.

The Bevalac is a coupling of two accelerators, the SuperHILAC (HILAC stands for Heavy Ion Linear Accelerator) and the Bevatron. The Bevatron was built about 30 years ago and was one of the first accelerators to bring protons to energies of a billion electron-volts. Now it does the same for heavy ions. Its vacuum system had to be rebuilt and a technique for using lighter ions as pilots to tune the guiding and focusing system for the heavy ions had to be developed (SN: 8/14/82, p. 106). Uranium is the heaviest natural element, so achieving the maximum Bevatron energy for it means the same feat is possible for any other element.

The process starts with uranium ions that are passed through metal foils to strip away their electrons. It is not practical to strip them completely at this point, so they enter the accelerator with a positive charge of 68, having lost 24 of their 92 electrons. After acceleration they are put through more stripping foils, and it is believed, though not known for certain, that the ions in this first run may have been

fully stripped (positive charge 91 or 92) when they entered the detectors. Because of the final stripping the ions enter the detector with slightly less than the billion volt maximum energy of the accelerator. In the actual case it was 960 million electron-volts per nucleon.

The tracks the ions made in the detectors were analyzed by Harry H. Heckman, E. M. Friedlander and Y. J. Karant, all of LBL. The tracks of interest are cases where the incoming uranium nucleus strikes some nucleus in the detector material and thereby undergoes a change. One hundred and fifty-two such interactions had been analyzed at the time of the presentation. Half of them show fission into two more or less equal parts; half show fragmentation into several or many pieces. Most interesting of these are the 18 percent that represent a complete blow-up of the projectile nucleus into a large number of very light fragments. These events seem to represent a new kind of nuclear behavior that has physicists very interested. There are indications that these complete blow-ups are more likely to happen the higher the energy of the projectile. Thus, there is already an indication of exotic behavior at high energy.

LBL physicists are already making plans to use the Bevalac as a feeder for a large apparatus called Venus, the first phase of which is planned to bring heavy ions to 10 times the Bevalac maximum energy and strike them against fixed targets. The second phase of Venus would provide colliding beams of ions. —D. E. Thomsen

Earliest 'humans' may have inhabited ancient Israel

A California paleontologist has reported evidence that the species *Homo erectus* — immediate ancestor to *Homo sapiens* — was living in what is now Israel approximately 2 million years ago, raising the possibility that man evolved into a tool-maker in the Middle East or Asia rather than in the African savannas. Coupled with the fossil evidence of *H. erectus* from sites in Tanzania and Kenya, the new research suggests that ancient humans left the Middle East (perhaps driven south by a cold spell) to "invade" and colonize eastern Africa.

The oldest known *H. erectus* fossils — characterized by a thick cranium and robust skull features — are from the Olduvai Gorge in Tanzania and the Koobi Fora in Kenya, sites that have been worked by Mary Leakey and Richard Leakey, respectively. Both have been dated at about 1.5 million years. But according to Charles A. Repenning of the U.S. Geological Survey in Menlo Park, recent research indicates that

the Ubeidiya site near the Sea of Galilee, which has yielded sophisticated stone tools, should be redated from 700,000 years old to anywhere from 1.9 million to 2.6 million years old. The presence of the tools in Ubeidiya indicates that the Jordan River valley was inhabited by *H. erectus*, Repenning told SCIENCE NEWS, and as a result the redating of the site provides the earliest known evidence of the species' existence.

Repenning, working with Oldrich Fejfar of the Geological Survey of Czechoslovakia and writing in the Sept. 23 NATURE, says that Ubeidiya cannot be reliably dated with traditional geological methods; the 700,000 year date has been assigned to the site because it has been assumed that humans dispersed from Africa, migrating north through the Middle East into Europe and Asia. What Repenning and Fejfar have done is examine the record of mammal fossils in Ubeidiya, and they have found that several animals thought to be extinct

by 2 million years ago — including a sabre-toothed tiger — co-existed with the tool-bearing humans. Either the well-established evolutionary records of these mammals must be reconsidered, they say, or it must be granted that the human species immigrated from the Middle East to Africa between 1.5 and 2 million years ago.

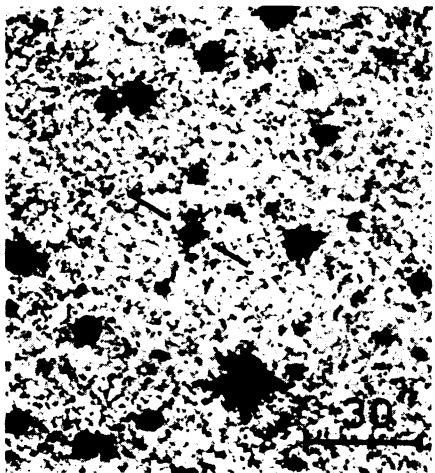
Anthropologist F. Clark Howell of the University of California at Berkeley agrees with Repenning's findings although not necessarily with his speculations. "He's right, in essence, though I don't think it [Ubeidiya] is quite as old as 2 million. But it doesn't matter; it's twice as old as anybody thought before." And although Howell says that the data provide the earliest record of humanity outside Africa, he says that many different evolutionary scenarios could still be constructed.

Anthropologist Adrienne L. Zihlman of the University of California at Santa Cruz is more skeptical. It is reasonable to ex-

pect hominids in Ubeidiya at 2 million years because they are known to have existed in Africa at 3 million to 4 million years, she says; but it is "naive," based simply on the presence of tools, to assume the presence of *H. erectus*. She offers her own scenario: "Around 2 million years ago is when hominids had evolved the savanna-mosaic adaptation. They're independent and more mobile, able to carry their own water and adapt to very hot temperature, giving them the flexibility to venture into other areas." The evidence for African evolution is overwhelming, she says, and the documentation of 2 million-year-old hominids in Israel does not refute the view that man migrated north, through the Middle East, to Asia.

But according to Repenning, the so-called Acheulian tools (including two-sided axes made from a variety of raw materials) indicate *Homo*. Although the species probably originated in Asia, he says, it clearly passed through Ubeidiya and was probably driven south by the same cold period — at about 2 million years — that is known to have driven other mammal species into Africa. —*W. Herbert*

The farthest and brightest



Astrophysical Journal Letters

The object shown between dashes in the photo is a quasar and is the optical counterpart of the radio source catalogued as PKS 2000—330. It is put forth as the farthest visible object in the universe and also intrinsically the brightest by a group of astronomers working in Australia: Bruce A. Peterson of the Mount Stromlo and Siding Spring Observatories, Ann Savage of the United Kingdom Schmidt Telescope in Coonabarabran and David L. Jauncey and Alan E. Wright of the Commonwealth Scientific and Industrial Research Organization, Division of Radiophysics, in Sydney. They present their analysis of the emission spectrum of PKS 2000—330 in the Sept. 15 *ASTROPHYSICAL JOURNAL LETTERS*. From the analysis they deduce a redshift of 3.78 for this object. The greater the redshift, the greater the distance. The previous record holder (so far as records show) was the quasar OQ 172 at redshift 3.53.

NAS report: In defense of open science

"When you marry someone, you don't look for the warts and blemishes, you take a look at the whole person and at what the essence is." Francis B. Kapper, director of military technology at the Department of Defense, was not referring to anyone's prospective spouse. But he was evaluating a newly released report on scientific communication and national security that the Pentagon may have to live with for a long time. "I would like to have seen some things strengthened and others toned down," Kapper said. "But considering the prominence of the scientists and others who were on that panel... whatever they came up with I was more than willing to abide by as a considered judgment of honorable and highly expert people."

The report, prepared by a panel of the National Academy of Sciences, says that open scientific communication at meetings and among academic institutions "has been of little consequence to U.S. security.... To attempt to restrict access to basic research would require casting a net of controls over wide areas of science that could be extremely damaging to overall scientific and economic advancement as well as to military progress." At the same time, the panel found technology leakage through equipment sales — both legal and illegal — and via third countries is "substantial and serious" and includes "a significant portion" that is damaging to national security.

The predictably mixed reaction of Defense officials to the report comes on the heels of DOD's last-minute censorship of more than 100 scientific papers at a recent meeting of the Society of Photo-Optical Instrumentation Engineers (SPIE) in San Diego (SN: 9/4/82, p. 148). And while the NAS report did not directly address that incident, panel chairman Dale R. Corson said the "process" by which the Pentagon evaluates scientific papers for clearance "is wrong. There is a great deal of vagueness now, and it must be corrected." Corson, president emeritus of Cornell University, said the panel "found inadequacies in the way data [from scientific papers to be presented in public meetings or in journals] are assessed" by the government.

NAS panel members, a number of whom had been briefed in secret and top secret sessions at the Pentagon during their research, said they had seen "no documented examples" of national security damage from open scientific communication. The report concludes that the "limited and uncertain benefits" of governmental controls are "outweighed by the importance of scientific progress, which open communication accelerates, to the overall welfare of the nation."

As a result, Corson said at a press conference last week, "the panel recommends that no restrictions of any kind limiting access or communication should be

applied to any area of university research, basic or applied, unless it involves technology meeting all of the following four criteria":

- The technology is developing rapidly and the time from basic science to application is short.
- The technology has "identifiable, direct military applications," or involves processes or production techniques related to military technology.
- The technology would give the Soviet Union a "significant, near-term military advantage."
- Either the United States is the only source of such information or other friendly nations that could be sources have control systems at least as secure as the United States'.

The panel did not address in detail industry-based technology research, where, the report said, there is much greater risk of information transfer damaging to national security — through espionage and legal means alike.

Panel members acknowledged, however, that "universities and other research institutions" are becoming more important targets for Soviet intelligence efforts, "as the [U.S.] government tightens its controls on other domestic sources of information." They also conceded that an imbalance exists in scientific exchange between the two countries. "We're giving more to the Soviets than they're giving us," Corson said. "They send top-level scientists here [to U.S. meetings] and we send *social scientists* there."

Nevertheless, the panelists said, the risk of conveying scientific findings "to our adversaries" is more than balanced by the enhanced knowledge that comes with scientific communication. "Over time," said Elmer B. Staats, a member of the panel and former comptroller general of the United States, "the Soviets will find some way to get it [technology]. The key is to keep ahead of them."

While the NAS report predicts that the current U.S. technological advantage over the Soviets can be maintained through a policy of open scientific communication, the Defense Department appears non-committal on the matter. Defense Secretary Caspar W. Weinberger is "torn by two things," Corson told *SCIENCE NEWS*, "the need for scientific communication and [reports of] large amounts of information leakage from universities [to the USSR]." In an official Pentagon reaction to the academy's findings, Defense Department spokesman James Freeman said "the panel's report will provide an excellent opportunity for future dialogue."

A possible forum for such dialogue is a proposed government task force, including a number of scientists, that would develop guidelines to implement the report's recommendations. —*J. Greenberg*