Johanson examines a day's fossil finds.

million years by associated fossils.

"Finding a group of individuals of this antiquity in one small site is exceptional," says Johanson. He suggests that they may have been caught by a sudden disaster, possibly a flash flood that trapped them in the small defile or gorge. The site, about 40 feet wide and 60 feet from top to bottom, was apparently filled in a single day.

Previous human fossil finds in this age range have consisted mainly of skulls, jawbones and teeth. The Hadar fossils are somewhat more complete. Johanson not only concludes that the bones are those of *Homo* but also has enough evidence to begin a physical description of what these humans may have been like.

"One nearly complete hand is almost modern in size and obviously was capable of a long grasp and probably of fine, precise movements," says Johanson. Measurements of leg bones from the site have helped him determine that at least one of the individuals was a large person, approaching the height of modern humans, more than five feet tall.

Mary Leakey's recent finds at Laetolil, Richard Leakey's almost 150 hominid bones from digs on the eastern side of Lake Turkana (formerly Lake Rudolf) and the latest Hadar finds are all adding up to what will eventually be a complete morphological description of our early ancestors. And with the growing number of human fossils it is now possible to begin asking other questions. Richard Leakey (in a recent interview with Unesco Features) discussed the apparent fossil richness of East Africa and some of the questions that can now be asked about *Homo*: "Previously a book would be written about a single skull or jaw; nowadays, studies are based on whole collections of data. We have enough material in some instances to begin to talk about population dynamics and population variation in the Pleistocene era." □

Crab nebula pulsar: Superslippery

Now that neutron stars are actual objects of observation rather than theoretical speculation—most astrophysicists would now agree that pulsars are neutron stars—much observational and theoretical effort is going into attempts to determine the details of conditions and activities in them.

A group from Columbia University (Robert Novick, professor of physics, Richard S. Wolff, assistant professor of physics, Howard I. Kestenbaum, research associate in the Columbia Astrophysics Laboratory and graduate student William Ku) now report the first measurement of the surface temperature of a pulsar, a datum that has an important bearing on the state of the matter in the neutron star. In fact they conclude that this neutron star, NP 0532 in the Crab nebula, at least, is a ball of superfluid.

To get the surface temperature, it was necessary to distinguish between the pulsed X-ray emission that makes the object a pulsar and is believed to come from the neutron star's magnetosphere, and continuous X-ray emission which would be the result of thermal activities at the surface of the neutron star, and from which its surface temperature could be determined.

The way to make this distinction was to use a lunar occultation of NP 0532. Every 11 years the moon makes a series of passes in front of the Crab nebula. The occultations of 1974 were the first to occur since the discovery of pulsars and are thus the first opportunity for this kind of measurement. As the moon's edge passes across the nebula it cuts off radiation from one location after another.

The observations were made with a rocket that went a hundred miles up. As the moon eclipsed the pulsar, the observers could record the X-ray emission of the surrounding nebula. Then, as the pulsar came out from eclipse, its own contribution could be distinguished from the nebular background. The observers then searched between the 30-hertz pulses of NP 0532's contribution for a steady flux that would be expected from the surface. They found none.

They conclude, therefore, that the pulsar's surface temperature is no more than 4.7 million degrees K. Since neutron-star models that exclude superfluidity require much higher temperatures (9 million degrees K. or more), the Columbia group conclude that superfluidity must be part of the picture. Their findings are being published in the ASTROPHYSICAL JOURNAL (the first appears on p. L77 of vol. 202).

Superfluidity is a state in which a fluid loses all viscosity and flows without friction. The fluid can perform many amazing tricks such as climbing the walls of its container or passing through orifices normally too small for it. On earth superfluidity appears only in liquid helium at temperatures near absolute zero, but the pressures and forces between the neutrons (and some protons and electrons) that make up a neutron star are so different from those between liquid molecules on earth that a much higher temperature limit is possible. □

Breeder reactor: Full speed ahead

When the Energy Research and Development Administration earlier this year announced a sweeping "National Plan" for energy development, a key feature was to be reassessment of the breeder reactor program and a shift of emphasis in favor of non-nuclear alternatives (SN: 7/5/75, p. 4). Specifically, ERDA Administrator Robert C. Seamans Jr. ruled that the previous environmental impact statement for the breeder was inadequate, and called for a complete review of the seven-volume document.

The reassessment has now apparently been completed and the breeder reactor program is being pursued with renewed vigor. Seamans's review added three more volumes to the environmental impact statement but created little change in the program direction. Simultaneously, ERDA has created a new Division of Reactor Development and Demonstration devoted exclusively to the breeder. Elevation of the program to full division status reflects both "the importance assigned to the program by ERDA, and the Government's determination to carry the program forward with proper safeguards and sound environmental considerations," according to the official announcement.

Seamans admits "major areas of uncertainty" remain, including plant operation, fuel cycle performance, reactor safety, safeguards, health effects, waste management and uranium resource availability, but says these should be cleared up by 1986. At that time a decision would presumably be made as to whether the breeder reactor could be safely licensed for commercial application and whether the economics of doing so are attractive.

A three-stage program for the breeder is now contemplated: a demonstration reactor at Clinch River, Tenn. (CRBR); a Prototype Large Breeder Reactor (PLBR); and the first Commercial Breeder Reactor (CBR-1). By the 1986 deadline for a decision on whether the breeder is feasible for commercial use, CRBR should have been in operation three years, construction of the PLBR should have been largely completed, and the CBR would be in the design stage. The goal, in the words of Assistant Administrator Richard W. Roberts, is to have the breeder as an "alternative for the 1990's." □