Meteorites reveal alien conditions

One of the best records of extraterrestrial conditions are contained by meteorites.

The study and recovery of meteorites provides a natural record of cosmic rays, solar activity and other conditions of the environment from which it came. Meteorites are one of the few rocks not extensively worked upon by the earth's environment and as such provide data on questions ranging from original planet formation to the composition of the earth's core.

Meteorite research in Alberta received its impetus from the fall of the Bruderheim meteorite near Edmonton in 1960. (Meteorites are named after the town nearest the fall.) Fragments of the rock together weighed over 300 kg, making it the largest fall in Canada.

As a result of the fall, the National Research Council (NRC) formed an associate committee on meteorites which in turn spurred the development of the Meteorite Observational and Recovery Project (MORP).

MORP established a prairie-wide camera network which allows for the recovery of meteorites before they are substantially eroded. The network recorded the fall of the Innisfree meteorite in February 1977, only the third such time such an event has ever been recorded in the world.

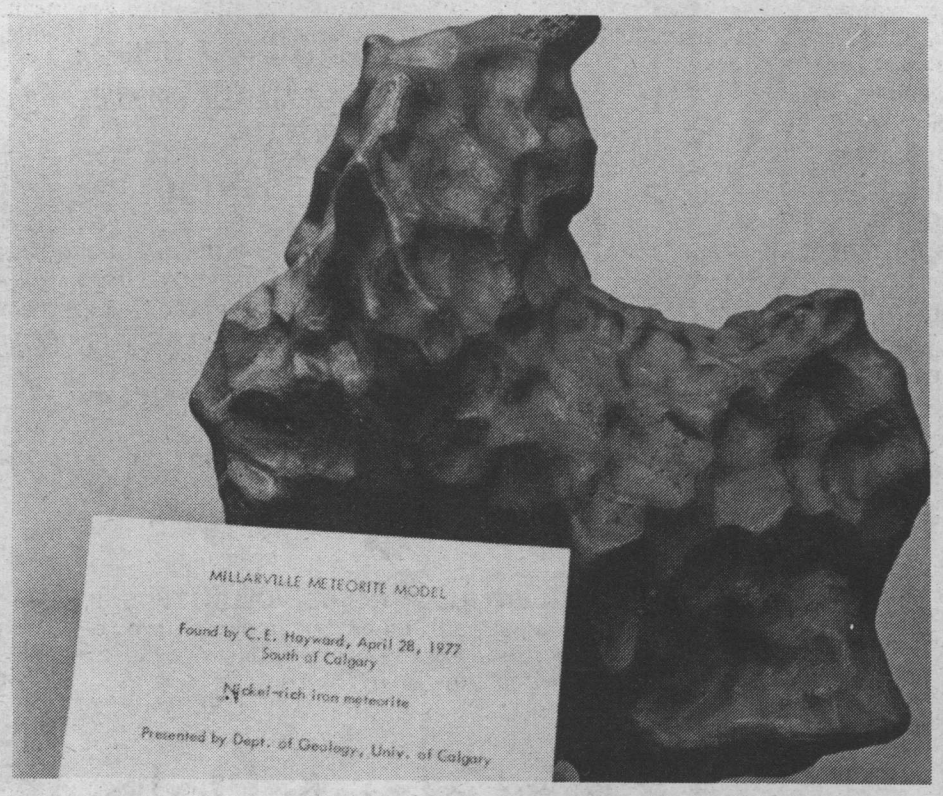

Photo Russ Sampson

This meteorite is part of the U of A collection housed in the Agriculture bldg.

MORP also investigates meteorite "finds," for which there is no information regarding its descent. In fact much of a geologist's time is spent investigating "false alarms," rocks reported for unusual characteristics to the department. Often however, in the case of the Skiff meteorite, careful investigation is rewarded with the recovery of a prime specimen. Meteorites are actually a rare phenomenon, as most meteors burn on entry to the earth's atmosphere — at night they are observed as shooting stars.

Dr. Johann Steiner, a professor of geology and a member of MORP, is concerned about the possibility of meteorites on the ice fields of Northern Canada. The recent discovery by the Japanese and American expeditions of nearly 1000 fragments on Arctic icefield could be well worth searching, said Steiner. Steiner said he was also concerned that the Americans could well afford to outfit an expedition into the area and thus capitalize on what must be considered an important part of Canada's scientific heritage.

Steiner said he hopes that a program will be established for scientists in other disciplines and persons on Ellesmere Island for industrial reasons, to educate them on the basic techniques of meteorite identification and recovery.

Steiner is also curator of the university's meteorite collection, housed in the Agriculture Building. The collection is one of the most expansive in Canada.

relative perspectives

by W. Reid Glenn

CANDU reactors operate as good converters and have the possibility of becoming excellent breeders (with the use of thorium additions in the fuel). Thorium is a fertile material; can be transmuted into U-233 and is found in much larger quantities than uranium in Canada. U-233 is the best possible fissile material for a thermal reactor's appetite and can be easily created with a CANDU reactor without significant modifications. Thus as the price of natural uranium fuel increases, thorium can be combined with the uranium fuel to vastly extend the lifetime of nuclear power in Canada. The neutron efficiency of the CANDU reactor again allows the natural resources of Canada to be efficiently exploited.

All other breeder reactor designs suffer in comparison, as one shall see.

A breeder reactor is one in which more fuel is created by the nuclear fires than is consumed. A convertor does not quite produce as much as it burns while a burner reactor creates little or no extra fuel. It is inevitable if future power is to be derived from the atom that breeder reactors are necessary in order to extend to infinity the finite fissile reserves of our planet. The CANDU reactor is a slow breeder primarily designed for low grade heat production and is quantitatively safer than the horrendous Liquid Metal Fast Breeder Reactor (LMFBR) pawned off as progress by the rest of the nuclear club (Britain, France, West Germany, U.S.A.).

LMFBR are solely designed for breeding and do not employ a moderator to slow down fast neutrons. Since the neutrons are only slowed by converting other materials, this means that the energy of a neutron in the core of a LMFBR will be, on average, a million times that of an average neutron in a CANDU core. This situation is very conducive to transmuting materials but also very difficult to control, cool and maintain.

Maintenance problems occur from the deleterious effects that these atomic missiles have on the material which makes up the core. Very exotic alloy steels are blended to be able to withstand the constant neutron bombardment. However, when the materials are stressed, they exhibit a phenomenon known as creep; a gradual, permanent deformation caused by their strains.

In the highly successful Pickering reactors, for example, it has become necessary to retube the fuel bundle channels because of creep caused in the metal tubes. LMFBR of the past have suffered this problem also. The Enrico Fermi reactor almost melted down (*The China Syndrome*) because a cooling channel was blocked by a piece of the core structure which became loose inside the core. The fact that Detroit was not lost because of this incident was very fortunate for all concerned.

Since the neutrons are so energetic within the LMFBR core the heat generated per unit area is correspondingly greater than in a conventional thermal nuclear reactor. The heat flux is so great that water cannot be employed and liquids with high thermal conductivities are required (liquid metals such as lithium, sodium and potassium). Their disadvantages are legion; corrosiveness, the ability to become highly radioactive and their unstable nature at flowing conditions.

In any reactor it is necessary to transfer heat from the core to an open steam cycle. The heat is transferred by heat exchangers containing liquid metals on one side and water on the other in a LMFBR. Any leaks in these large, highly stressed vessels will cause radioactive chemical reactions that release great amounts of heat. In these situations, small tube break can cause extensive, possibly catastrophic damage.

The CANDU reactor employs heavy water which, if maintained pure and without gases, is non-corrosive and does not become radioactive. The contaminants which are radioactive within the fluid are easily removed by water treatment techniques (similar to water softeners). Leaks in CANDU style heat exchangers do occur but only involve the loss of heavy water into the environment, a costly but not very dangerous occurance as compared with a similar LMFBR incident.

The control problem is a function of the reactor design. The CANDU system has considerable inertia in the moderator and the period of the reactor (the time it takes a neutron given off in a fission reaction to start another) is long. This allows easy control since the plant responds slowly to levels of criticality (i.e. the rate at which fission reactions take place). The fast breeder's period is much shorter and so must be much more quickly controlled and monitered to prevent accidents.

The next article will describe the differences in core cooling between the CANDU and other thermal reactors and why again the CANDU system is safe.

Scientist wins prize

Dr. Gordon Rostoker, one of the world's foremost authorities on the physical phenomenon responsible for the Northern Lights, is the 1979 recipient of the Steacie Prize.

The award, which includes a cash prize of $3,000, is presented annually by a committee of distinguished Canadian scientists for outstanding scientific research in Canada.

While a graduate student, Rostoker conceived that the key to unravelling the mysteries of the aurora lay in the design of an array of recording instruments capable of measuring the varying magnetic field of the earth simultaneously at several different points along the same meridian. He established these instruments at the U of A shortly after he joined staff as a physics professor in 1968.

Information gathered has been used to develop a number of successful theories on the rapidly changing aurora displays. The changes apparently are closely related to changes in the interplanetary magnetic field and are ultimately caused by the sun.

Zooooo-ology exhibition

Over 90 specimens of birds and mammals are featured in Zoogeography, an exhibit that depicts the global distribution patterns of birds and mammals.

The exhibit will be on display at the Provincial Museum, from December 15 to March 18.

Zoogeography looks at the composition and distribution of exisiting wildlife from a historical perspective. The exhibit looks back over the past 200 million years and examines the effect of movement of the continents through continential drift, and major geographic barriers such as the Isthmus of Panama, pointing out how the degree of isolation can effect the uniqueness of a region's wildlife.

The exhibit is sponsored by Alberta Culture.