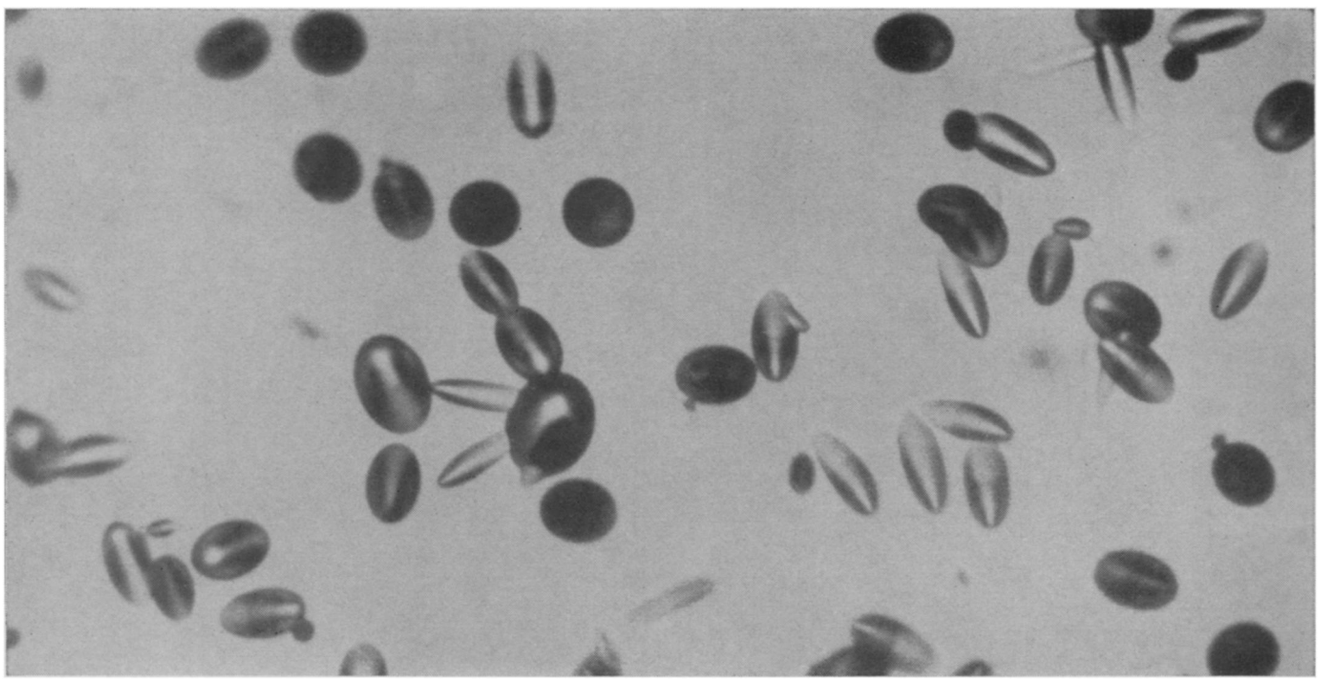


General Electric

Dating method developed to detect cosmic ray tracks in material returned from moon now has many applications.

And All From Fission-Track Dating

Minute footprints left in almost all insulating solids by charged nuclear particles can be used to study many diverse problems.

by Ann Ewing

Sometime this summer, hopefully by June, a balloon will be lofted from Fort Churchill, Canada, with an unusually simple payload—a stack of thin plastic film layers one foot square and two inches high.

The stack will be used to record the tracks of cosmic ray particles bombarding earth's atmosphere some 150,000 feet above the Arctic tundra. These are primary particles—nuclei of atoms—that never reach the surface because they react with the intervening air.

The plastic film is the newest application of the technique known as fission-track dating. The name was originally applied because the method was used to date terrestrial rocks and then meteorites from tracks left by atoms disintegrating by spontaneous fission.

It is now known that almost all insulating solids, including natural minerals, glasses and plastics, record tracks of charged nuclear particles.

The tracks can be used to study such diverse problems as the age of geological and archaeological specimens, the early history of the solar system as recorded in meteorites, nuclear interactions and neutron fluxes.

The basic method and the new application as well were developed by a team of scientists at General Electric Company's Research Laboratories in Schenectady, N.Y. The scientists, sparked by Dr. P. Buford Price, first started doing research on the idea because they hoped to find cosmic ray tracks in material returned from the moon after manned landings there.

That was some five years ago and since then the technique of fission-track dating has been so improved that scientists can tell not only the age but the relative abundance of elements in meteorites, as well as in cosmic radiation.

The original goal has not been forgotten, however. Dr. Price says the GE group would "get some of the first lunar material returned to earth, provided it comes in a spaceship marked U.S.A."

Drs. Price and Robert M. Walker, also of GE, reported details on the new dating technique in the August 1963 Journal of Geophysical Research. They had found then that charged particles leave fossil tracks in mica, and probably other materials as well, and, further, that these tracks could be brought out chemically.

If a piece of ordinary mica is dipped into concentrated hydrofluoric acid for a few minutes and then rinsed in water, it will show fossil fission tracks when viewed under a microscope at a magnification of a few hundred diameters. The tiny, etched-out tubes are only about one-thousandth of a centimeter long.

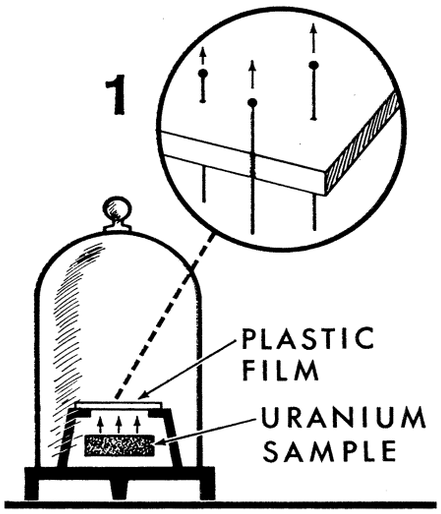
The tracks are the trail of damage, a few atoms in diameter, left when uranium atoms undergo spontaneous fission. The fission fragments move apart, leaving tracks that can then be etched by an appropriate chemical. The trails are developed in much the same way that a photographic developer brings out the image on an exposed film.

Shortly thereafter, the two scientists, with co-worker Dr. Robert L. Fleischer, found that the tracks in minerals can be created either when a uranium atom fissions spontaneously, or when a cosmic ray collides with the nucleus of a heavy atom, such as lead, inducing it to fission.

Even a high school chemistry class equipped only with a bottle of acid and a microscope can easily see the perma-

nent records traced in minerals.

The method for telling the age of a



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Plastic filter with uniform size holes.

rock sample or a meteorite from fossil tracks is also simple. After the sample has been etched, the trails are counted, and it is then irradiated in a nuclear reactor, which artificially splits some of the remaining uranium atoms.

The sample is etched for a second time, and a count made of the fresh tracks produced by artificial fission. The age of the sample can be calculated from the ratio of old tracks to fresh tracks, which is related to the amount of uranium originally present.

The technique gives scientists all over the world, even in very poor countries, a simple, inexpensive way of making basic contributions to science by dating not only meteorites but also geological formations, artifacts and archaeological samples. A nuclear reactor in which specimens could be irradiated to check on the number of induced fission tracks is available in virtually every nation.

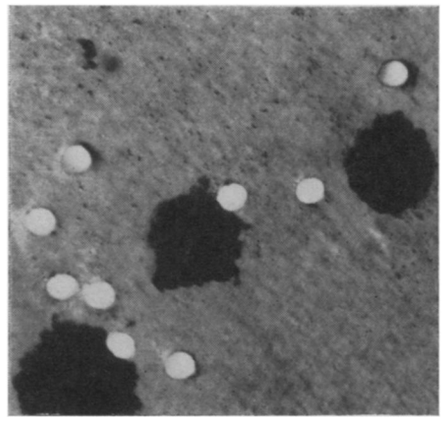
Studies of charged particle tracks led also to the development of a new filter proving useful for biological research. When a thin sheet of plastic is exposed to an aligned beam of fission fragments, a controlled number of tracks is produced. The track holes are then etched out, the size being adjusted by the etching time. Holes ranging from some 50 Angstroms and up to many microns—but still only a tiny fraction of the width of a human hair—are easily obtainable.

Using such a filter, free-floating cancer cells can be filtered out of serum, nondestructively by gravitational action, rather than by an applied pressure. Because the filter is transparent and chemically resistant, the larger, trapped cells can be stained and studied right on its surface, reducing the danger of accidental damage to them. Cancer cells appear as dark blobs when this technique is followed, while the uniform-sized holes show up as white circles in the accompanying photograph.

The plastic film detector to be flown at high altitudes above Fort Churchill works on the same principle as fission-track dating, but the tracks will be made by cosmic ray particles. These high energy nuclei of elements from hydrogen to carbon will penetrate the plastic film layer to a certain depth depending on their atomic weight.

To bring out the cosmic ray tracks, the plastic layers are etched with sodium hydroxide. A coating of an aluminum film is then applied to one side of the stack and the opposite side treated again with sodium hydroxide. The etched tracks make holes in the aluminum film, easily visible to the naked eye.

The various elements reacting in the plastic layers are identified by the length of the etched track; the longer the track, the heavier the element responsible.



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Cancer cells trapped and stained.

The discovery of a new type of fossil nuclear track in mica was reported by Dr. Walker and Dr. W. H. Huang, both now at Washington University, St. Louis, Mo., in the March 3 Science.

The track is produced by the recoil nucleus accompanying the alpha particle decay of uranium and thorium impurities. The very short tracks can be seen using phase contrast microscopy. Measurement of trail densities, coupled with determinations of the thorium and uranium contents, provides a new dating technique analogous to the fission-track method.

The primary advantage of the alpha recoil method is that it is several thousand times more sensitive than fission-track dating.

Fossil tracks in lunar material should give a wealth of information concerning such now puzzling questions as the age at which the moon solidified, the date of impacts or eruptions on the surface and the abundance of very heavy nuclei in primary cosmic radiation.

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