ASTRONOMY

Moondusted by supernovas

NASA spent a great deal to fetch some buckets full of lunar material and deliver them to laboratories on earth, but that may not have been the first lunar material to arrive. Nearby supernova explosions may have dusted the earth with lunar evaporates from time to time throughout the history of the solar system. This is a suggestion put forth in the March 27 NATURE by Malvin Ruderman and J. W. Truran of the Institute of Astronomy at Cambridge University in England.

In theory the beginnings of certain kinds of supernovas should be punctuated by intense blasts of gamma rays. That no such gamma-ray burst has ever been observed in connection with a supernova does not deter theorists. It would take a large orbiting detector to identify a supernova gamma-ray burst, and such a burst would arrive sometime before the supernova was visibly noticeable so its detection would be a matter of chance anyhow.

There is some indirect evidence in unusual concentrations of negative nitrogen trioxide ions in Antarctic ice cores. Action of gamma rays in the upper atmosphere should increase nitric oxide production and the destruction of ozone, facilitating formation of nitrogen trioxide. In fact, the dates of concentrations of the ion in the ice cores correspond to those of known supernovas.

Earth's atmosphere protects the surface from such blasts but the moon gets the full scorch. The blast ought to evaporate matter from the surface layer. Some of this evaporate should be blown loose from the moon's gravity and sift down on the earth. Considering the differences in elemental abundances between the earth and the moon, the signature to look for is unusual concentrations of iridium in terrestrial sediments. Those found by Luis Alvarez and others at Gubbio seem at first too strong, but arguments involving the amount of mixing during evaporation and on the earth might make them fit.

Origin of the galaxies: MHD

Cosmologists have trouble explaining the origin of the galaxies. For a stationary universe, as James Jeans showed a long time ago, gravitational attraction is enough to cause the exponential growth of clumps until they are big enough to become galaxies. But in an expanding universe gravity will no longer provide the exponential growth. Cosmologists have tried many kinds of amendments and some have been driven to exotic theories of gravitation. Now comes A. J. Fennelly of Western Kentucky University in Bowling Green to suggest an appeal to the physics of electrically conducting fluid, magnetohydrodynamics. This can be done, he writes in the April 7 PHYSICAL REVIEW LETTERS, without sacrificing Einsteinian gravity.

In the earliest moments of the universe, before the primordial protons and electrons combined to form hydrogen atoms, the universe was a conducting fluid with a high conductivity, up to a million million mho per meter.

Fennelly contends that some of the very magnetohydrodynamic instabilities that have caused so much frustration in attempts at MHD power or controlled thermonuclear fusion — pinch effects, hose instabilities, sausage and kink instabilities — could have provided the growth of condensations that became galaxies. The instabilities would have created pressures and currents in the conducting fluid. The currents generate magnetic fields. The fields increase the pressure. That increases the field, which increases the pressure, and so on around again. Fennelly concedes that astrophysicists regard MHD instabilities as inhibitors of condensation in star formation, but in the case of galaxies, he aims to show that even in the Newtonian dynamic regime, and especially in the relativistic regime, instabilities enhance condensation.

ENVIRONMENT

Cleaning up with gamma rays

With clean drinking water getting harder and harder to find, methods to clean wastewater—particularly water contaminated with industrial organic chemicals — are of growing interest and commercial importance. Right now chlorine is the primary disinfectant for wastewater in the United States, says David Woodbridge of Hittman Associates in Columbia, Md. "However," he added in a paper at the recent American Chemical Society meeting in Houston, "[chlorine] is known to create carcinogenic agents." That's why he prefers the dual blitz of chlorination and gamma-ray irradiation to zap water contaminants.

"A definite synergistic, or multiple, effect has been found to exist" when oxygen, ozone, chlorine, iodine or heat are used in conjunction with radiation to clean up water, Woodbridge says.

Irradiation produces some "very reactive" molecules, such as hydrated electrons together with hydroxyl- and hydrogen-free radicals — each capable of strong disinfecting and detoxification action, he claims. Further magnifying these effects are the cleansing properties of hydrogen peroxide, free hydrogen and other molecules formed as secondary effects within the water itself. Finally, electrons stripped from water by irradiation move "faster than the speed of light in water," Woodbridge explains, creating ultraviolet radiation — another boon to cleanup.

The process reduces "to insignificant levels in less than five minutes" powerful toxic agents such as chloroform, other chlorinated organics and benzo(a)pyrene, Woodbridge says. And while eliminating cyanide and phenols, it degrades trinitrophenyl, benzoquinone and surfactants. What's more, the chlorine/gamma-ray duo completely eliminated 10^8 coliform bacteria (normally radiation-resistant) from 100 milliliter samples of water in less than four minutes; but the cesium-137 or cobalt-60 gamma dose needed was "about 50,000 rads."

And therein may lie the concept's limitation. Treatment plants handling a million gallons of water daily would probably require a million-curie cesium source, Woodbridge told SCIENCE NEWS. While Woodbridge suggests extracting cesium-137 — a good gamma source — from used nuclear-reactor fuel, that would require costly and complicated chemistry and the reprocessing of fission wastes, which President Carter has already prohibited. However, even should Carter policy not change, Woodbridge asserts there are already "hundreds of millions of curies" of cesium separated from reactor waste and immediately available at the Energy Department's laboratory in Hanford, Wash.

Breezy culprit in soil theft

Wind-induced soil erosion nearly trebled last year, according to Soil Conservation Service figures. In fact, the April 4 High Country News reports that more than 3,000,000 acres of crop and rangelands in 10 West and Central states fell victim during just the three-month period ending last February. Low levels of rain and snow cover are held at least partly responsible.

Synthetic oil's potent mutagens

Last year polycyclic aromatic hydrocarbons (PAH's) and alkaline tar fractions — or organic bases — were identified as the most mutagenic components of coal-gasification products (SN: 11/3/79, p. 313). Now Mike Guerin and colleagues at Oak Ridge National Laboratory in Tennessee report similar findings for coal-liquefaction and oil-shale-conversion products. That PAH's appear mutagenic comes as little surprise, Guerin says. His group's important find was that polycyclic aromatic primary amines — only 0.5 percent by weight of synthetic-petroleum products — contribute 50 percent of the mutagenicity of those products.