physical sciences

GEOPHYSICS

New heating process for solar system

A dynamic electric effect that could have heated solid bodies in the solar system eons ago is proposed by three scientists in the Aug. 31 NATURE.

The process would not necessarily affect the primordial earth—gravitational attraction and radioactive heating are sufficient to provide its warming—but could be a way for heating asteroids. Because meteorites retain some of their birth characteristics, including convincing evidence of having once been melted, they provide a clue to the way planets or asteroids are formed.

These solid bodies could have been heated electrically by dynamo induction, suggests Drs. C. P. Sonnett and D. S. Colburn of the National Aeronautics and Space Administration's Ames Research Center at Moffett Field, Calif.

Their calculations of heat flow in the early solar system were made using computer equations worked out in cooperation with Dr. Kenneth Schwartz of American Nucleonics Corporation in Glendale, Calif.

They propose that when the sun was very young, still in the birth process and surrounded by proto-planets, the solar wind was very steady and much stronger than now. The magnetic field trapped in this solar wind could give rise to electric currents in any body encountered, provided its surface layer was highly conductive. This would result in high temperatures inside asteroids.

GEOPHYSICS

Cosmic dust density

The density of cosmic dust is a thousand times smaller than has been believed. So conclude Drs. H. Fechtig, U. Gerloff and J. H. Weihrauch of the Max-Planck-Institut für Kernphysik in Heidelberg, West Germany, after extensive study of a collector surface sent up in 1965.

The collector, a 100-square-centimeter metal film, was carried by a Luster rocket and exposed at altitudes between 65 kilometers and 145 kilometers. Afterwards it was subjected to examination by optical and electron microscopes and by X-ray. A two-megavolt Van de Graaff dust accelerator bombarded control plates.

No statistically strong evidence of dust was found, the group reports in the Aug. 15 JOURNAL OF GEOPHYSICAL RESEARCH, but from a few possible particles, they deduce an upper limit of 0.1 particles per square meter per second at those altitudes.

ASTROPHYSICS

Distance to the quasars

Dr. James Terrell of the Los Alamos Scientific Laboratory argues, in the Aug. 26 PHYSICAL REVIEW LETTERS, that some quasars are not as far away as the tens of millions of miles that other observers have suggested.

The argument depends on the proper motion of the quasars—the change in their apparent position in the sky over the years. Such proper motion shows up for bodies whose intrinsic motion carries them in paths that are oblique to the line of sight from the earth.

If one assumes that the quasars started out millions of years ago from the center of our galaxy, then, since the earth is some distance from the center, the quasars' motion will be oblique to the line of sight. The farther from the center they get, however, the narrower the angle becomes between their motion and the line of sight, and the smaller the change becomes in their position so long as their speeds remain constant.

Figuring the quasars' speed from the shifts in their spectral lines, one can estimate the amount of proper motion that would appear at different distances and then pick the distance whose proper motion corresponds to what is observed. Dr. Terrell says these estimates have been too high. His figures give minimum distances between 200,000 and 400,000 light years and maxima no greater than two million.

SOLID STATE

Squeezing crystals

High temperatures and high pressures can iron certain imperfections out of crystals, reports Dr. Abraham Taylor of the Westinghouse Research Labs in Pittsburgh.

Natural crystals of many materials have holes—places where atoms should be but are not. In titanium monoxide, for example, as many as 25 percent of the atoms of each element may be out of place.

Dr. Taylor finds that pressures between half a million and a million and a half pounds per square inch and temperatures between 1,500 and 3,000 degrees Fahrenheit will squeeze out the holes. The technique may be adjusted to get rid of all or only some of the holes.

Squeezing the holes out of titanium oxide more than tripled the temperature at which it became superconducting. "These holes," says Dr. Taylor, "can exert a tremendous influence on other physical properties, such as elasticity, aging, working characteristics and magnetic qualities. Elimination or reduction of the holes might result in a new class of materials."

SOLID STATE

Magnetic electron diffraction

When a beam of low-energy electrons strikes a crystal, the electrons are reflected by the atoms in the crystal. If the reflected electrons then strike a fluorescent screen, they will form a pattern that reveals the location of atoms in the crystal.

This kind of scattering or diffraction is caused by electrostatic forces between the impinging electrons and those of the crystal atoms. In addition, theory predicts another kind of scattering—by magnetic forces.

This magnetic or coherent exchange scattering has now been found in an experiment using niobium oxide crystals by P. W. Palmberg, R. E. DeWames and L. A. Vredevoe of North American Rockwell Corp. in Thousand Oaks, Calif. They report in the Sept. 2 PHYSICAL REVIEW LETTERS.

The magnetic scattering occurs because each electron is a small magnet and so is each atom. Therefore, an interaction between the magnetic fields of the two can cause the electron to bounce. The experiment shows that this actually happens between one and three percent as often as the electrostatic scattering.

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