physical sciences

ACOUSTICS

Breaking a virus with sound

Information concerning biological damage, thresholds and structural stability can be obtained by studying the response of these systems to mechanical stresses. But problems include the complex structure of most organisms and the lack of equipment for exposing them to stresses of known amplitude and waveform.

Drs. Philip E. Hambrick and Stephen F. Cleary of the Medical College of Virginia in Richmond have found a way to beat the latter difficulty by applying a stress in the form of a single pulse of pressure that lasts only a 10-millionth of a second. The sound pulse is produced by rapid thermal expansion following the absorption of an intense pulse of light from a ruby laser in an optically dense substance.

The organism chosen for study was tobacco mosaic virus, whose structure has been extensively investigated by X-ray crystallographic, hydrodynamical and biochemical methods. They find that the laser-induced acoustic stresses were less than those calculated theoretically to cause breakage of the TMV particle into halves. This suggests, they report in the January JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA, that the breakage is something other than strictly a mechanical interaction.

THEORETICAL PHYSICS

An exclusion-principle force

The particles of physics can be divided into two classes according to whether or not they obey the Pauli exclusion principle.

The exclusion principle applies to particles with half-integral amounts of spin (½, 3/2, 5/2, etc.). It states that more than one such particle cannot exist in the same place with the same velocity and the same set of quantum numbers. Particles with whole number amounts of spin are not subject to this restriction.

The Pauli principle explains the structure of atoms, since electrons have one-half unit of spin, and the principle governs the maximum number that can coexist in a given shell of an atom.

Physicists have wondered why the Pauli principle should work. Now Dr. William A. Barker of the University of Santa Clara in California suggests that there may be a force involved. Speaking before the American Physical Society meeting in St. Louis, he proposed a short-range repulsive force dependent on the spin of the particles to explain why the exclusion principle selects certain ones to stay and others to go in any situation.

But a mathematical description of such a force is difficult to derive, he says.

SELENOLOGY

Nature of the mascons

Some months ago studies of the motion of lunar orbiter satellites showed that there were concentrations of mass (mascons) under several of the moon's smooth maria (SN: 8/31, p. 205).

Early astronomers called the maria by the Latin word for sea, and the name has been retained long after it became known that they are dry. Dr. J. J. Gilvarry of the Space Science Laboratory of General Dynamics/Astronautics in San Diego, Calif., believes, however, that the maria were in fact seas at one time.

In Dr. Gilvarry's theory, the moon, early in its history, possessed an atmosphere and had rain and rivers. The maria represent ancient ocean beds that have dried up.

But before the moon's rivers and maria dried, Dr. Gilvarry says in the Feb. 22 NATURE, the rivers brought down sediment from the lunar mountains and deposited it on the bottoms of the maria. It is this sediment, he says, that now shows up as the mascons.

QUASARS

Optical variations

Although during the past year pulsars have been stealing the headlines and scientists' attention, astrophysicists have not been neglecting their observations of quasars.

During a two-year period, Dr. Philip K. Lü and James H. Hunter Jr. of Yale University Observatory, New Haven, Conn., have observed the quasar known as 3C-454.3 on 17 photographs taken with their 40-inch reflector. They also examined three plates taken at the U.S. Naval Observatory.

These observations, the astronomers report in the Feb. 22 NATURE, suggest that this quasar varies by about one magnitude every 340 days. Optical variations of this object were first reported by Dr. Allan R. Sandage of Mt. Wilson and Palomar Observatories.

GALACTIC ASTRONOMY

Pulsars and the magnetic field

Since the discovery that pulsar emanations are polarized, astronomers have hoped to use them to measure the galactic magnetic field by the rotation it imposes on the polarization (SN: 8/17, p. 162).

Some tentative results have even been published. Now, in SCIENCE for Feb. 21, Drs. S. J. Goldstein Jr. and D. D. Meisel of the University of Virginia warn that a study of CP-3028 shows rotation of polarization going on in the pulsar itself and that this must be evaluated before reliable estimates of the galactic field can be made.

PLANETARY ASTRONOMY

Escape rate of hydrogen

The classic formula for escape of gases from a planetary atmosphere stems from an assumed Maxwellian distribution for upward-moving atoms in the outer fringes. However, the absence of downward-moving atoms exceeding the escape velocity alters the upward moving distribution.

Dr. Joseph W. Chamberlain of Kitt Peak National Observatory in Tucson, Ariz., has therefore calculated the departure from the classical rate of escape of atomic hydrogen from an atmosphere composed mainly of carbon dioxide. The correction factor, reported in the February ASTROPHYSICAL JOURNAL, although not major, has application to the atmospheres of Venus and Mars.