physical sciences

ASTROPHYSICS

Atoms in pulsars

The study of pulsars has aroused a good deal of interest in the behavior of matter under extreme conditions of density, pressure and magnetic field strength, since theorists believe that such conditions occur in pulsars.

Estimates of magnetic fields in pulsars run as high as 1,000 billion gauss. (The earth's field is about half a gauss.) Under such a field the structure of atoms would be drastically altered, according to an argument presented in the Aug. 17 PHYSICAL REVIEW LETTERS by graduate students Richard Cohen and John Lodenquai and Dr. Malvin Ruderman of Columbia University.

The strong magnetic forces would stop atomic electrons from orbiting and force them to move back and forth along magnetic field lines. This would destroy the shell structure of the heavier atoms, and cause the electrons to spend more of their time close to the nucleus than they normally do. This closeness would raise the binding energy of the atoms so that only the lightest atoms would have a good chance of ever being ionized.

Some theorists have suggested that the cosmic rays are ions that have been pulled off the surfaces of pulsars by electric fields. If that is so, Dr. Ruderman, Cohen and Lodenquai warn, the abundances of elements in the cosmic rays should not be taken as representative of the abundances in pulsar surfaces, since the lighter elements would be drawn off in disproportionate amounts.

METEOROLOGY

Thunderstorms fall mainly on the land

Lightning flashes from thunderstorms at night are bright enough to be recorded by a satellite orbiting overhead. Therefore a global survey of nighttime thunderstorms was undertaken by the orbiting solar observatory satellite OSO-B. It recorded lightning flashes between 35 degrees north latitude and 35 degrees south latitude for a period of eight months.

The result, report Drs. J. A. Vorpahl of the University of California at Berkeley and J. G. Sparrow and E. P. Ney of the University of Minnesota in the Aug. 28 SCIENCE, is that 10 times as many lightning storms were seen over land areas as over the ocean.

One ocean area that did show a significant cluster of thunderstorms, however, was just east of South America. The location coincides with that of the geomagnetic anomaly, a kind of dent in the earth's magnetic field. According to Drs. Vorpahl, Sparrow and Ney, this suggests some connection between the storms and the geomagnetic anomaly.

OCEANOGRAPHY

Measuring mid-ocean tides

Tides in the middle of the ocean are difficult to measure because there is no solid ground on which to mark their rise and fall. But the job can be done by placing pressure gauges on the ocean bottom and measuring the change in pressure as the water above them rises and falls. The gauges must be sensitive enough to detect a change of half a centimeter in a depth of five kilometers.

In SCIENCE for Aug. 28 Dr. Jean Filloux of Gulf General Atomic Inc. in San Diego, Calif., describes the results of such a survey at a point 1,150 kilometers off the coast of Baja California, where the water was 4.4 kilometers deep.

One way of regarding tides is as a kind of vibration of the whole ocean, a slopping of the water from side to side. Tides in the Pacific were thought to be composed of two such motions, one with a period of a day, the other with a period of half a day.

Theory predicted that at the place where Dr. Filloux measured, the heights of both these components should be 0.7 what they were at La Jolla, Calif. Dr. Filloux found a height ratio of 0.81 for the diurnal component and 0.48 for the semidiurnal. This suggests, he says, that other modes of vibration of the ocean with different periods may be mixing in.

AERONOMY

Pollution and the stratosphere

If supersonic transport airplanes ever come into existence, they will deposit large quantities of water vapor and other pollutants into the stratosphere. Some scientists fear that this will permanently raise the temperature of the stratosphere with possible dire effects on the climate.

To see what happens when the stratosphere is polluted by natural effects, Dr. Reginald E. Newell of the Massachusetts Institute of Technology studied the aftermath of the eruption of Mt. Agung on the island of Bali in 1963. He reports in Aug. 15 NATURE that stations in Australia and New Zealand reported increases of about 5 degrees C. in the stratospheric temperature after the blast. The temperature remained above normal for several years. If this sort of thing occurred over more than a quarter of the globe it could produce serious geophysical changes, he says.

ATOMIC PHYSICS

A laser at 1,600 angstroms

Lasers started out in the infrared part of the spectrum at wavelengths of the order of 10,000 angstroms. Part of their history has been a continuing attempt by scientists to shorten their wavelengths into the visible and ultraviolet regions.

In the Aug. 24 PHYSICAL REVIEW LETTERS, Dr. Rodney T. Hodgson of the IBM Research Division at Yorktown, N.Y., reports development of a laser that reaches down to 1,600 angstroms. The lowest wavelength previously reported was 2,120 angstroms.

Dr. Hodgson's laser uses molecular hydrogen as the lasing substance. The hydrogen is excited by an electric discharge, and as it returns to its lower energy state, it emits nine different wavelengths close to 1,600 angstroms.

The energy of the photons or light particles emitted by such a laser is nearly 8 electron-volts. This should make it useful to chemists studying the dynamics of chemical reactions. They like to be able to deliver enough energy to break the chemical bonds they are studying. A photon energy of 7 electron-volts is enough to break many bonds that could not be broken by previous laser energies.