physical sciences

Light pressure on liquids

One of the results of light being a stream of particles (photons) as well as a wave is that it exerts a pressure on bodies it encounters. If a light beam strikes the surface of a liquid, such as water, this radiation pressure should deform the surface.

Over the years theorists have held divergent opinions on what the deformation should be. In 1905 J. J.Thompson and J. H. Poynting concluded that light on entering the liquid exerted a net outward force at the surface. An as yet unpublished result of M. G. Burt and R. Peierls concludes that the net force should be inward.

These disagreements prompted Arthur Ashkin and J. M. Dziedzic of the Bell Telephone Laboratories to set up an experiment in which focused pulsed laser light impinging on water was used to determine the direction of the force. They report in the Jan. 22 PHYSICAL REVIEW LETTERS that on entering or leaving water the light exerted an outward force. This caused strong surface lens effects since it deformed the surface. It also produced surface scattering and nonlinear absorption. The results will be useful in understanding the momentum of light in dielectrics.

Free positronium

Positronium is one of the curiosities of modern physics. It is a quasi-atom in which an electron and a positron are involved. A positron, acting as if it were an atomic nucleus, captures an electron, which revolves around the positron for a short while until the two meet and annihilate each other. The study of positronium is important for the information it gives about the positron and the electron.

One way of making positronium is to stop a beam of positrons in a powdered metal oxide. The positrons pick up electrons from the molecules of the oxide. If the positronium can free itself from this oxide, it will be easier to study. There has been evidence that it does so, that it diffuses through the surface of the powder grains. In the Feb. 5 PHYSICAL REVIEW LETTERS a group from Johns Hopkins University and Yale University (D. J. Judd et al) report "strong" evidence for free positronium. They have observed radiation due to a certain transition characteristic of free positronium.

Magnetic fields and cosmology

Cosmologists argue whether the universe was turbulent or smooth at its beginning. One of the advantages of believing in a turbulent beginning, E. R. Harrison of the University of Massachusetts points out, is that it permits the formation of large-scale magnetic fields. Magnetic fields of at least galactic size have been observed and there is a suspicion that intergalactic fields may exist.

As Harrison calculates it in the Jan. 29 PHYSICAL REVIEW LETTERS, turbulence in the era of radiation domination, when there was more radiation than matter in the universe (between 10 seconds and 100,000 years of age), generated small magnetic fields, which were then amplified. Generation of the fields would have ceased at the time when matter became dominant in the universe. This would lead to a present intergalactic magnetic field of 10^{-8} gauss. This is compatible with present observations.

space sciences

An astronomical eye in space closes

On the birthday of its namesake, Copernicus, the last in a series of orbiting astronomical observatories (OAO's), took over full time. At 10:40 EST Feb. 13, Copernicus' predecessor, OAO II, was shut down.

OAO II was the first successful observatory in space (SN: 9/2/72, p. 156). "It was the hard one," says James E. Kupperian Jr. of Goddard Space Flight Center. "We pioneered a great deal of technology with it. It was a milestone in astronomical history, and demonstrated that space—if you can afford it—is certainly the place to do astronomy."

The satellite, launched Dec. 7, 1968, was built to operate for a year. The Wisconsin telescope aboard operated for 50 months—over four years. On Feb. 1, a high-voltage subsystem in the telescope failed and attempts to revive it did not succeed.

Solar wind interaction model

Pioneer 10, on its way to Jupiter, detected an increase in the temperatures of the solar wind from the usual 100,000 degrees K. to 2 million degrees K. (SN: 9/16/72, p. 181). Now Thomas E. Holzer of NOAA's Environmental Research Laboratories in Boulder has suggested a model to explain this rise.

The solar wind is a stream of protons and electrons accompanied by a magnetic field flowing continuously out from the sun at speeds of about 400 kilometers per second. According to Holzer's model, at a distance of about three times farther out than the earth, the solar wind collides with interstellar neutral hydrogen that has been pulled into the solar system by the sun's gravity. The result of the collision is that some of the kinetic energy is changed to thermal energy and temperatures rise. The wind is slowed down a bit, but it remains at supersonic speeds.

Pioneer 10 may have a chance to observe another interaction in Holzer's model—that of the solar wind with interstellar thermal plasma which Holzer thinks may occur at the fringes of the solar system. At that time the meeting between the wind and the interstellar plasma would cause a shock event and the wind would be slowed down by a factor of four to subsonic speeds.

Mascons and moonquakes

Scientists think that the mass concentrations (mascons) beneath the surface in the large circular basins on the moon are concentrations of lava. After the impact that dug out the basins, material from below filled in the hole. More material probably filled in on top after thermal shrinking occurred. All this causes a gravity high in the basins. The mascon edges in Serenitatis basin correlate well with the wrinkle ridges on the surface. It appears the material filled in the inner rings of the basin and thinned out toward the edges of the mare.

Now S. K. Runcorn of the University of Newcastle upon Tyne has suggested there may be a relationship between moonquakes, some of which occur about 600 kilometers below the rims of the mascons, and the mascons. The mass may be sinking, he says. The mascon basins are lower than other maria. The settling process would be a slow one that has been going on for 3 billion years, but the energy release would be enough to cause some of the quakes.