earth sciences

A rocky balance of nature

The mystery of those precariously balanced rock formations that are one of nature's more puzzling phenomena has been confronted with a computer by two Kansas State University researchers.

One such formation, the improbably top-heavy Goblet of Venus that used to stand in southern Utah, has fascinated Wilson Tripp since he first saw it in 1947 (it was inadvertently toppled by would-be climbers in 1948). Inspired by the Goblet, and aided by colleague Frederic C. Appl, Tripp has theorized an explanation for the wobbly structures.

If a rocky pedestal erodes in such a way that its top begins to tip toward one side, says Tripp, the lower part of the pedestal on that side will become compressed. This slows down erosion on the stressed side and speeds it up on the other. "In time," he says, "the cap rock becomes delicately balanced on a stem that becomes smaller and smaller as erosion by wind-blown sand and dust continues."

Wind velocity increases with height above the ground, while the density of the abrasive, wind-blown sand is greater close to the surface, the scientists point out. The result is the classical hour-glass shape of features such as the Goblet of Venus. In fact, says Appl, the erosion pattern is such that the supporting column virtually works its way under the center of gravity of the large mass above.

Ship dumpings blamed for Atlantic tar

Pollution of the open ocean by such things as clumps of tar and bits of plastic has received considerable study since it was publicized by Thor Heyerdahl following his 1970 raft voyage aboard the Ra. Analysis of a 1973 survey covering more than 700,000 square miles of ocean along the U.S. East Coast has now indicated that most of the tar clumps suggest oil wastes dumped from ships and tankers.

By comparison, oil concentrations in the Gulf of Mexico, where oil producing activities are numerous, are "relatively free of oil pollution when compared with other areas in frequent use by maritime traffic," according to the National Oceanic and Atmospheric Administration.

The NOAA National Marine Fisheries Service has not yet determined, but is investigating, whether larval and young fish face potential danger from exposure to widespread oil contamination. However, "hundreds" of fish collected in waters contaminated by plastic bits revealed no cases where the bits had been ingested.

Closing in on the tornado's signature

Five years ago, a team of meteorologists at the Environmental Science Services Administration undertook to discover whether tornadoes have a characteristic electrical "signature" that would thus make it possible to detect them before they strike. The quest was transferred to the National Oceanic and Atmospheric Administration's Wave Propagation Laboratory in Boulder, Colo., and it's still going on. But the sleuths are finally learning where to look. A group of severe, tornado-producing storms that struck Oklahoma in late April of 1970 has been analyzed over a wide range of electromagnetic frequencies from 10 kilohertz to 3 megahertz. The result, reports the Laboratory's William L. Taylor in the Dec. 20 JOURNAL OF GEOPHYSICAL RESEARCH, is the discovery that the numbers of electrical bursts at the lower frequencies reach a limit as the storm strengthens. A useful "signature," therefore, is likely to be found at frequencies of 1 MHz or higher.

astronomy

Evidence of an open universe

The ratio of the deuterium to the hydrogen now present in the universe can be used to tell the present density of the universe. The density of the universe is important because it will tell whether the universe is closed—whether it will stop expanding at some future date and begin to contract—or whether it is open and therefore fated to endless expansion.

Lately a number of attempts to measure the deuterium-hydrogen ratio have been made, and all have led to densities that suggest an open universe. So does the latest, a direct comparison of the hydrogen and deuterium in the space between the earth and the star Beta Centauri by John B. Rogerson, Jr., and Donald G. York of the Princeton University Observatory. (Some of the other observations used indirect methods of determination.)

The work was done with a spectrometer aboard the Copernicus astronomy satellite. It consisted of comparing the absorptions of particular wavelengths from the light of the star by hydrogen and deuterium in the space between it and the earth. Rogerson and York report in the Dec. 15 ASTROPHYSICAL JOURNAL LETTERS that they derive a density for the universe of 1.5×10^{-31} grams per cubic centimeter, a factor of 27 too small for closure.

Unraveling the Coma cluster

Galaxies appear to associate in clusters. One of the questions cosmologists ask is whether these clusters are gravitationally bound and therefore long-term characteritics of the architecture of the universe or whether they are ephemeral, chance associations. One of the most studied examples is the cluster in the constellation Coma Berenices.

Visual observation shows that there is not enough matter in the galaxies to bind the cluster. It is therefore suggested that the necessary additional mass may take the form of invisible intergalactic gas, and there is some evidence (a diffuse X-ray source in the center of the cluster) that intergalactic gas may be present.

Is it enough? If one starts with the amount of gas that ought to be there and assumes it is ionized, it should manifest its presence by X-ray, ultraviolet and radio emanations of at least a certain brightness. Arthur Davidsen, Stuart Bowyer and William Welch of the University of California at Berkeley have done a new determination of the radio brightness of the Coma cluster at a frequency of 23 gigahertz. In the Dec. 15 ASTROPHYSICAL JOURNAL LETTERS they conclude that when this determination is combined with their previous data on far-ultraviolet emissions from the cluster and with data on its soft-X-ray emissions, the Coma cluster does not have enough gas to bind it.

A third nebula with a core

Many of the nebulas in our galaxy are believed to be remnants of supernova explosions. If so, they should have condensed cores associated with them, relics of the star that exploded. Such cores are of interest because they could be neutron stars or black holes. Up to now only two nebulas (the Crab and Vela X) were known to have cores. The third is now announced in the Dec. 15 ASTROPHYSICAL JOURNAL LETTERS by a group from the Massachusetts Institute of Technology and the University of Wisconsin (S. Rapaport et al.). It is the Cygnus Loop. Evidence for the core was found by X-ray observation, the first use of X-rays for such a finding.