

# ASTRONOMY

*From our reporter at the meeting of the American Astronomical Society in Haverford, Pa.*

## Cosmological origin for deuterium

One of the outstanding riddles in cosmology has been to ascertain the origins of the various observed elements, especially the most basic of them, hydrogen and deuterium. A group of researchers now report evidence that deuterium is primarily of pregalactic origin. A.A. Penzias, P.G. Wannier, R.W. Wilson and R.A. Linke of Bell Labs measured deuterated and carbon 13 isotopes of interstellar hydrocyanic acid (DCN and  $\text{H}^{13}\text{CN}$ ) to obtain their results. After scanning a large portion of the galaxy, they found that the ratio of DCN to  $\text{H}^{13}\text{CN}$  was significantly lower in the direction of the galactic center (Sagittarius B) than in others. They attribute the suppressed value to the particular concentration of stellar activity in that region. They reason that the smallness of this particular ratio is a reflection of yet a smaller value of the actual ratio of interest, deuterium to hydrogen. Although they recognize that some of the deuterium may be of stellar origin, they conclude from their observations that the net effect of stars seems to destroy it. This being the case, the observed deuterium must have been systematically depleted from a greater concentration established by pregalactic sources. The experimental survey was accomplished by detecting spectral line-radiation from DCN and  $\text{H}^{13}\text{CN}$  in the millimeter wavelength region.

## Microwave background anisotropy

A recent high-frequency (19 Ghz) experiment has measured a large-scale anisotropy in the cosmic microwave background of about one part in a thousand. Brian E. Corey and David T. Wilkinson of Princeton, using a balloon-borne radiometer fitted with two antennas  $180^\circ$  apart, detected the anisotropy. Since the microwave background is omnipresent, it represents something of a cosmic reference frame with respect to which the earth's motion can be measured. On the basis of this picture, the newly measured anisotropy is a result of the earth moving through the microwave "soup" at about 330 kilometers per second, the scientists report. The experimenters chose to detect at high frequencies in order to minimize and distill out the local effect of our galaxy (which predominates at the lower frequencies) on their data.

## Spherical proof about stars

Although any freshman astronomer would tell you that stars are basically spherical, the simple fact has been without proof within the framework of general relativity. Dennis W. Marks of Valdosta State College has changed that by reporting a proof applicable to stars composed of nonmagnetic, thermally conducting, "static" (without movement) matter. The proof's validity ultimately rests on the singularly uncontroversial statement that a star's energy content must after all be finite. The proof is obtained by a sequence of arguments which first demonstrates that general relativity implies the absence of heat-flow within the star. Marks then calculates that surfaces of constant stellar pressure and temperature are coincident with those of constant gravitational potential. He then invokes the second law of thermodynamics (description of a system's entropy) and establishes a relation between the star's energy and the constant-potential surfaces. He achieves the final "assault" by observing that from the three stellar surfaces possible—flat, hyperbolic, and spherical—only the latter shape produces a star with finite energy content.

# ZOOLOGY

## Salmon home by smell

Of all the world's celebrated noses, the salmon's has garnered relatively little attention. It has been generally known that the salmon's olfactory sense somehow plays a crucial part in its up-river ascent, which, in turn, plays a part in its accessibility to many a grateful palate.

University of Wisconsin scientists have identified the Coho salmon's process of homing by smell with data derived from two separate field studies that provide direct evidence that the juvenile Coho salmon learns, retains and utilizes the chemical cues of its natal stream in order to relocate it 18 months later during spawning migration (June 18 SCIENCE).

The fish, 5,000 in 1973 and 10,000 in 1974, were hatched under identical conditions and were at one-and-a-half years of age divided into three separate tanks. The tanks contained artesian well water, considered neutral since it could not provide the adult salmon with cues about the location of any tributary stream. One group of smolts (16-month-old-fish) was subjected to morpholine, another was exposed to p-alcohol and the third was left untreated to act as a control. The particular chemicals were chosen because salmon respond to them in small concentrations and they do not occur in natural waters.

After about six weeks of exposure to the imprinting chemicals, the salmon were released into two tributary streams off Lake Michigan, each of which would be scented with one of the chemical cues 18 months later at spawning time. At that time, both streams and 17 other locations were monitored for returning fish. Both experiments showed that about 95 percent of the morpholine-treated fish returned to the morpholine-treated waters and about 91 percent of the fish treated with p-alcohol returned to the waters treated with that chemical cue. A large number of the control fish were recovered from a variety of other locations. Monitoring was done by creel census surveys, electrofishing and gillnetting.

## Ring doves avoid cuckoldry

In contrast to most vertebrates who find the female most alluring at the time of ovulation, the male ring dove exhibits negative, aggressive behavior toward the sexually active female. His advances tend instead to be focused on the sexually unstimulated female.

This avoidance of potential cuckoldry, suggest Duke University researchers Carl J. Erickson and Patricia G. Zenone in the June 25 SCIENCE, seems to be associated with the amount of investment that the male of the species contributes to parental support. When the investment is great, certain behavioral mechanisms emerge to ensure genetic paternity—it is vital to the male that his mate's egg be fertilized by his own sperm. In a more promiscuous species, the probability of cuckoldry decreases in importance even though it may increase in incidence.

The male dove's efforts are large: He helps construct the nest, incubate the eggs and feed the young. To ensure that these efforts are not in vain, he sequesters the female for a time long enough to determine whether early egg-laying or nest soliciting occurs, both indications that she has had prior exposure to another male. Nest soliciting behavior is induced through ovarian stimulation, which in turn, is induced by male courtship—indications to the wary male that his potential mate has already mated. The female is then driven away or avoided by a series of chases and aggressive pecking, until it becomes clear that he is not interested.

Given direct choice, the male will try to find a female that has not had previous exposure to another male, thereby ensuring his paternity.