Was the universe born in a cold big bang?

Most cosmologists tend to believe that the universe began with the explosion of a very hot primeval fireball. This is the more or less orthodox big-bang theory. There are a few dissenters from this orthodoxy. One of them is David Layzer of Harvard, who, with some of his students, has been working out a theory in which the universe begins very cold instead of very hot, at absolute zero in fact. Now Layzer and Ray Hively (now of Earlham College in Richmond, Ind.) have published a paper in the Astrophysical Journal (Vol. 179, p. 361) that shows how the universal background of microwave radio waves, one of the chief pieces of evidence cited in favor of the hot big bang, can be explained in terms of a cold-universe theory.

There are two main reasons, according to Layzer, for going to a cold-universe theory when nearly everyone else is for a hot theory. One of these is the microwave background itself. The hot theory postulates that the germ of this background radiation was present in the original fireball in the form of a lot of photons or light particles, which gradually cool down as the universe expands until they reach the present observed temperature of 2.7 degrees K.

"It is advantageous to try to explain the properties and existence of the microwave background as a consequence of other things," says Layzer. He is concerned to make the theory as simple as possible and to avoid putting ad hoc postulates at the very beginning as the hot theory has to do.

Layzer and Hively make the microwave background arise from radiation given off by primeval supernova explosions. This radiation is then "thermalized," turned into a blackbody type of spectrum by reflection from cosmic dust. This process leaves a lot of burned-out supernova cores around, which can help solve another outstanding problem: how to find enough mass in the universe to bind it together gravitationally and close its curvature.

But what really started Layzer off on the track of a cold theory is the structure of the universe, the existence of galaxies. A fireball of the hot-theory type would tend to be homogeneous and smooth. To get galaxies out of it one has to postulate that for some unstated reason the fireball at the moment of origin contains fluctuations in density that later grow into galaxies. Layzer objects to this for two reasons. First it requires one more ad hoc postulate at the beginning. Second, "the real sticking point," says Layzer, is to see how such microscopic fluctuations can grow into galaxies. Some cosmologists even think that such fluctuations should smooth themselves out as the universe expands instead of developing further into galaxies.

Layzer's cold theory avoids these problems. It begins with a cold aggregation of hydrogen. The hydrogen solidifies in the metallic state and as it expands as a result of gravitational energy aggregations of calculable size naturally break off. These are of planetary size. By galactic standards they are small, but Layzer points out, they are of astronomical size at least, a far distance from microscopic fluctuations.

These planet-sized masses continue to accrete together into larger and larger units. At the time when the accretion stops it happens that the largest masses that can form are about the size of galaxies. This comes about because at that epoch the size of the universe is such that its event horizon, the distance between parts that are receding from each other at the speed of light and therefore cannot communicate with each other, is about the size of a galaxy. Aggregations larger than the event horizon cannot form because their parts could not communicate with each other.

Thus Layzer gets the galaxies very naturally, and the theory can also now predict the microwave background. But more work is needed. The theory does not yet predict the exact temperature of the background although 2.7 degrees lies within the range that would be possible.

beginning and should be completed in a few months. Seven similar studies (including one in Canada and another in Holland) are also nearing completion. When all nine studies are completed (possibly in April or May) the results will be turned over to Julius M. Coon of Thomas Jefferson University in Philadelphia. As chairman of the NAS subcommittee on nonnutritious sweeteners, he will be responsible for a final determination and a report back to the FDA. If the suspect tumors can indeed be linked to saccharin (rather than to impurities in the drug or to other factors), the FDA will once again invoke the Delaney amendment.

Saccharin, discovered in 1879, has been used in liquid and crystal form as a sweetener, and as an additive in dietetic foods, mouthwashes, cosmetics and even tobacco. If cancer in animals is indicated, the FDA would outlaw these uses. The Delaney amendment, however, applies only to food additives, not to drugs. Saccharin would still be available (by prescription) for use as part of the diets of diabetics. □

Soviet craft detect magnetic field on Mars

Magnetic measurements from the Soviet Mars 2 and 3 spacecraft suggest that Mars has a dipole field with a strength at the magnetic equator of about 60 gamma. Earth's is 1,000 times stronger. S. S. Dolginov, E. G. Eroshenko and L. N. Zhuzgov of the Academy of Sciences of the U.S.S.R. believe this is a paleomagnetic field not induced by the interplanetary field carried in the solar wind.

The fact the field is so weak may be one reason why NASA's Mariner 4 flyby failed to detect it. (Mariner 9 did not carry a magnetometer.) When the Mars 2 and 3 orbiters were at their closest approach to the planet they detected the strength of the field to be seven to ten times greater than the interplanetary field at the distance of Mars.

In another Mars 2 and 3 report, Soviet scientists say that temperature measurements of Mars suggest the thermal emissions from the surface depend not only on the albedo (the degree to which an object reflects the sun's energy) but also on the effects of thermal inertia (the degree to which the surface retains and conducts heat). Over one area of Mars, the orbiters' data indicated the thermal inertia to be 50 percent greater than that estimated from earth-based measurements. The measurements were taken after sunset over a dark area of Cerberus. The orbiters saw a temperature rise of about ten degrees K. The Soviet scientists speculate the surface material there is unusually coarse. □

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—The Editor
