

Background Radiation and the Birth of the Universe

The report that earth is bathed with background radiation in the microwave range equally from all directions was received with more than a bit of skepticism when it was made in 1965. Since then, evidence has continued to accumulate that this radiation could really be electromagnetic waves emitted by the remnants of the primordial blast in which the universe was born.

The temperature of this radiation, detected then at only 4080 megacycles, was found to be slightly above three degrees Kelvin. It was, and is still found to be, close to this temperature from all observed regions in space. This lack of variation in direction, or isotropy, supports the theory that the radiation resulted from the debris still pervading the universe from the primeval fireball, a superdense concentration of radiation and matter.

Study of this cosmic microwave background is growing and, it is predicted in an editorial in the Nov. 25 NATURE, will grow further. NATURE helps the boom along with five reports in that issue alone on various aspects of the radiation.

Regardless of their effect on the theories of the birth and evolution of the universe, the flurry of research efforts is certain to provide a new tool for learning about its structure today, and more and more attention is sure to be paid to this background radio noise.

Until very recently, the science of cosmology was based on only one observational fact—other galaxies are moving away from the Milky Way at speeds that grow increasingly greater as the distance increases.

This observation was interpreted as evidence for opposing theories—the primordial cataclysm and the steady state. The latter holds that matter is being continuously replenished as it is destroyed, so that the total universe is apparently unchanged throughout the past, present and future.

One problem many scientists had with accepting the first Princeton University report of cosmic microwave background as residual radiation, in 1965, was that it had been detected at only one frequency. It could, therefore, have other origins than cosmic debris.

Observations would have to be made over a large frequency range in order to substantiate the original Princeton measurements of three degrees Kelvin as the temperature of this universe-pervading radiation.

Now that criterion is being met. Scientists have found that the background radiation from all over the universe is within three-tenths of a degree of this

temperature and ranges from wavelengths of eight millimeters to ten centimeters. This range of frequencies substantiates the contention that the remains of the primordial mass radiate equally everywhere.

The hypothetical ideal object that absorbs all wavelengths of electromagnetic radiation and reflects none is termed a "black body." Such an ideal body also emits perfectly at all wavelengths, when it is heated; temperature determines wavelength of the emission.

As the range over which the background radiation intensity is being measured increases, it adds to the evidence that the electromagnetic spectrum corresponds to that of a black body.

Based on this, Drs. J. M. Stewart and D. W. Sciama of the University of Cambridge, England, believe measurements are now approaching sufficient accuracy over a large enough range that it should be possible to detect the velocity of the sun relative to this microwave background. They predict in NATURE that the radiation will seem to be the same everywhere in space only for an observer at rest.

Their theoretical calculations show that the motion of the solar system through the microwave background would result in an apparent change in temperature of the radiation from one direction to another. Drs. Stewart and Sciama state that future observations of the lack of isotropy of the cosmic microwave background are expected to reveal the solar system's velocity relative to distant matter.

Other related reports in the Nov. 25 NATURE:

- Drs. T. F. Howell and J. R. Shakeshaft of the Cavendish Laboratory, University of Cambridge, have found that at frequencies of 408 million cycles and 610 million cycles there is radiation "consistent with a black body spectrum of about three degrees Kelvin."

- Drs. R. C. Roeder and R. H. Chambers of the David Dunlap Observatory of the University of Toronto suggest that the black body radiation as so far observed could also describe a modified form of the universe that is alternately expanding and contracting. They call their model "cool," because the temperature of the radiation is always quite low.

- Dr. James E. Felton of the University of California, San Diego, finds that there is "no apparent contradiction between the observations of isotropic gamma rays and the assumption that the universe is filled with equilibrium black body radiation having a temperature about three degrees Kelvin at

the present time." He refutes previous charges that the distribution of gamma rays is such that it conflicts with a residue of three degrees radiation, holding instead that the distribution favors it.

- Drs. E. K. Conklin and R. N. Bracewell of Stanford University's Radio Astronomy Institute in California have looked for small scale variations in the cosmic background radiation that would now be present if there had been small differences in density at the explosive instant of creation. They found no detectable differences.

L-ASPARAGINASE

Enzyme Starves Cancer Cells

The arsenal of anticancer drugs includes several compounds that kill malignant cells. Originally, scientists administered them singly or in sequence. Success improves, they have recently learned, when four drugs are given simultaneously in an all out bombardment of rapidly replicating cancer cells. But, no matter how they're given, available drugs can only slow, not stop, the course of cancer.

Though known compounds attack cancer cells, they also damage healthy ones, making it unsafe for physicians to give a patient doses sufficient to eliminate the destructive cells completely. Leukemia patients, for example, may carry a trillion leukemic cells. Today's drugs only wipe out somewhere between 10 million and 10 billion. This is a considerable number, enough to cause a remission of disease, but not enough to cure the patient. Remaining cells simply multiply and attack again.

Now, preliminary clinical trials of an enzyme that has undergone 14 years of test tube and animal experimentation show it to be useful in man. Testing it in 12 leukemia patients, New York scientists report a favorable response in six.

The enzyme, called L-asparaginase, distinguishes itself from known drugs by its ability to discriminate between cancerous and healthy cells. Its effect is highly specific, killing the former and leaving the latter untouched. L-asparaginase removes a protein-building amino acid known as asparagine from body fluids. Normal cells manufacture their own supply of this amino acid but cancer cells depend on the fluid as an external source. When L-asparaginase eliminates this supply, cancer cells starve.

"This is the first biochemical distinction between healthy and malignant cells," according to Dr. Lloyd J. Old of New York's Memorial Sloan-Kettering Cancer Center. "It may lead to further important biochemical distinctions," he predicts. And even though

the distinction has been made, researchers have yet to learn why cancer cells need the external supply and how they use it.

Dr. Old, with Dr. Herbert F. Oettgen and co-workers, reported results of clinical trials at the meeting of the American Association of Hematology in Toronto this week. Five patients, three of them children, with acute lymphoblastic leukemia, responded well, they said. The three children had complete bone marrow remissions. Another patient, with acute myeloblastic leukemia, showed temporary improvement. But, the researchers caution, six other patients showed no response at all and there is no evidence the remissions will be permanent. They stress that clinical use of L-asparaginase is so new that it is impossible even to speak of it as treatment, let alone a potential cure.

One serious problem facing physicians studying L-asparaginase is that there is not enough of the enzyme available to give to patients in meaningful doses. Experiments in mice show that the amount of L-asparaginase required to cure leukemia in these animals is 100 times greater than the dose used to bring about a temporary remission. Dr. Old says no human being has yet received enough of the enzyme to cure leukemia, if indeed a massive dose would do the job.

The short supply is the result of the time-consuming and complex proce-

dures required for the enzyme's production. Although scientists have known about L-asparaginase since 1961 when it was identified as the anticancer agent known to exist in guinea pig serum, useful quantities would require tens of thousands of animals, and no one considered trying to produce it in any quantity until 1963, when researchers learned it could also be extracted from the common intestinal bacteria *Escherichia coli*.

But even though a ready source of supply is now available—*E. coli* can be easily grown in tremendous quantities—production problems abound: Growing the bacteria in the first place takes three to five days. Then they have to be washed, which may take another two days. To extract pure L-asparaginase, scientists must precipitate it by column chromatography, an extremely complicated process that takes another four to five days. Dr. Old is confident that faster methods and new sources of L-asparaginase will be found, but in the meantime available procedures severely limit the possibilities of mass production.

So far, L-asparaginase activity has been studied only in terms of its effect on leukemias, but researchers suspect it may be active against other types of cancer as well. The National Cancer Institute, Bethesda, Md., has awarded grants to eight different research groups for L-asparaginase study. ♦

emotional bonds. But that also meant an attendant increase in frustration and aggression, says Dr. Holloway. Also in the service of survival came the enlarged brain and its capacity to symbolize. Then evolution played a strange trick: It infused the intellectual-symbolic structures with strong human emotions. Symbols like clan, tribe, race, state, nation and ideology became capable of inspiring the strongest emotional feelings—positive for one's own group, negative for those outside.

Man, in other words, can't look to lower, brute instincts for an explanation of his wars because they are rooted in his own much-valued intellect. "Man is up against himself—he is up against social structure—he is up against culture," says Dr. Holloway. "These are his costs as well as his gains."

For some of the anthropologists, the warfare to be concerned about is not that of primitive peoples, but of modern society, civilized society, American society in particular and especially in Vietnam.

"Wars in most authentic primitive societies are highly ritualized, self-limiting and qualitatively distinct from ours," says Dr. Stanley Diamond of the New School for Social Research.

"I think that there is an extremely deep psychopathology which is involved with the character of our social structure in almost every conceivable way," says Dr. Diamond. It is rooted, he says, in disassociated persons: "persons who have permitted themselves to be reduced to social functions, alienated, bureaucratized, persons who can kill for an abstract strategy but who are out of touch with their own capacity to express and transcend hostility."

Dr. Seymour Melman of Columbia University, the only non-anthropologist at the symposium and one of the country's foremost experts in conversion from a wartime to a peacetime economy, focuses on the U.S. Department of Defense—which he sees as a distorter of American society.

Military spending in this country amounts to \$87 billion a year—more than half the world's total annual military budget of \$150 billion, says Dr. Melman.

Who needs the war system . . . the military establishment, he says.

In an age when nuclear horror has made military defense an anachronism, those involved with the huge defense establishment have nevertheless been able to maintain the myth that they can defend American shores.

"They cannot do it," says Dr. Melman, but the mythology remains, and is instilled in the culture's children.

Dr. Mead has few words for this point of view. "Saying your society is

WAR

A Human Idiosyncrasy, Anthropologists Conclude

Man's curse, constant companion, and social invention—war—doesn't often come under close scrutiny. Men simply do it all the time; they don't know why, and seldom ask.

Anthropologists this year asked why and amassed a bulk of evidence that goes far toward opening up two troubling questions: What drives us to legalized killfests and what are the consequences to ourselves and nature?

The evidence was presented in an eight-hour symposium at the annual association meeting early this month and reflected wide-ranging views drawn from cultural, physical and medical anthropology.

From the start the anthropologists drew a sharp line between aggressive behavior in animals and human wars, a parallel often used to explain warfare.

"I think there is no continuity between animal aggression and what we call war," says Dr. Margaret Mead, curator of ethnology at the American Museum of Natural History. There is much continuity between animal behavior and the actions of a man who

gets his foot trod on in a subway and comes back with a punch in the ribs, or between fighting stags and human rivals, says Dr. Mead. But war is something else. "War depends on man's capacity to symbolize."

Legal killing, in other words, arose hand-in-hand with the developing human ability to break down natural perceptions into symbols—thoughts, ideas and words. Once a man could make symbolic distinctions he was able to identify his own men as "insiders"; other men as "outsiders" and therefore less than human. The human symbolic capacity allows men to deny others their species, says Dr. Mead. The others become "legitimate prey—and so non-human—or predators, whom it is noble to fight and kill—and so non-human." The symbols become a trap.

"Human evolution has been the evolution of a paradox," says Dr. Ralph L. Holloway Jr. of Columbia University. On one hand, human beings—requiring a high degree of cooperation to insure their evolutionary survival—developed a capacity for heightened