

ments of the earth's surface in response to differences in density. This resulted in some ironies: V. V. Belousov of the Soviet Academy of Sciences, an adamant disbeliever in continental drift, found himself chairing a session on the earth's interior that included several papers on plate tectonics.

In spite of the excitement over plate tectonics, the 24th International Geological Congress reflected the concern that has been growing in many scientific organizations over the uses to which science may be put. Geologists now seem to be trying to undo the damage some of their colleagues, however unwittingly, may have done to the environment. And as Harry V. Warren of the University of British Columbia pointed out, geologists "have the unique knowledge necessary to do something about it." □

Was the universe born in a clumpy big bang?

Among cosmologists who believe in the big-bang theory—and that probably includes a majority nowadays—one of the important questions is whether the cosmic fireball that came out of the bang was smooth and homogeneous or clumpy and turbulent. The universe of today is both clumpy and turbulent: Matter is grouped into galaxies and clusters of galaxies, and circular motions, small and large, are characteristic of objects and groups of objects.

Many cosmologists wonder how a smooth beginning could lead to the present state (SN: 2/26/72, p. 140). Evidence pointing toward an inhomogeneous beginning is now adduced by Peter George Gross of Yale Univer-

sity as a result of studies of the composition of old stars in the globular clusters of stars surrounding our galaxy. Gross' conclusions were presented at the recent meeting of the American Astronomical Society in East Lansing, Mich.

Helium is one of the most abundant elements in the universe, and it is the first nuclear species not an isotope of hydrogen that can be made when nucleosynthesis starts with free protons and neutrons. The usual big-bang picture is that the universe started as electromagnetic radiation which, as it expanded and cooled, produced elementary particles. After further cooling, synthesis of nuclei becomes possible, and eventually ionized nuclei and ultimately neutral atoms appear. According to theories that start from a smooth fireball, the amount of helium produced

Cyclic AMP: 15 years later

In 1957, medical researchers made a discovery that would have a profound bearing on subsequent research on hormones and cell physiology. It was cyclic AMP. Since then the naturally occurring cell chemical has been found to transmit the messages of virtually every hormone in the bodies of man and animals (SN: 12/12/70, p. 450). The compound has also been identified in plant cells and bacteria, where it appeared to interact with nutrients rather than with hormones.

Sessions on cyclic AMP at the meeting of the American Chemical Society in New York City this week reveal that the challenge now facing scientists is to find out what cyclic AMP does. "There are a cascade of events at the cell boundaries," declared Theodore W. Rall of Case Western University, and a co-discoverer of cyclic AMP.

During the past five years or so, for example, scientists have noted interactions between cyclic AMP and prostaglandins. Prostaglandins, like cyclic AMP, are a discovery of the past 15 years. They, too, have been found in virtually all mammalian tissues and been shown to exert a plethora of physiological effects (SN: 10/24/70, p. 306). But unlike cyclic AMP, prostaglandins are a family of closely related chemicals. They act as local chemical messengers between cells rather than limiting their activities to within cells as does cyclic AMP. Prostaglandins are also leaps ahead of cyclic AMP in potential therapeutic roles—labor inducer, post-coital contraceptive, nasal decongestive. Interactions between prostaglandins and cyclic AMP were first noted five years ago by R. W. Butcher of the University of Massachusetts School of Medicine. They have since been confirmed by other researchers.

As Butcher explained at the ACS meeting, the interactions he and others have observed so far consist of prostaglandins increasing or decreasing the levels of cyclic AMP in the cells. "Oxidation is far more common than inhibition," he says. The prostaglandins, he explains, may serve as intermediates between hormones and cyclic AMP in the hormones' target cells, or they may mimic the actions of these hormones.

During the past two years Ferid Murad at the University of Virginia and some other researchers have come up with the first diagnostic use of cyclic AMP. They have

found that high levels of cyclic AMP in urine generally indicate high levels of parathyroid hormones in the kidneys. "With some of our recent studies," Murad said at the ACS meeting, "we simply can categorize different kinds of parathyroid defects [e.g. kidney stones]." Rall indicated he is presently looking for interactions between cyclic AMP and neurohumors—nerve chemicals produced in certain nerve cells that bridge interactions between nerve cells. Rall said he is finding that interactions exist, as are some other nerve and endocrine researchers (SN: 8/5/72, p. 93). "Whether cyclic AMP will have a role in the diagnosis of neurological diseases, I do not know," he admitted.

I. H. Pastan of the National Cancer Institute is looking for the possible implications of cyclic AMP in cancer. He is using embryo cells as models for cancer cells because he says they share certain properties (for example, rapid growth). By raising the level of cyclic AMP in these cells, he is finding that they behave more like non-embryonic cells. They grow more slowly, move around less and are able to make certain proteins they are otherwise not able to make. He said he did not think anyone had yet looked at the levels of cyclic AMP in cancer cells themselves.

Murad pointed out, however, that he had done just that and had found cyclic AMP to be present in cancer cells in rather high amounts. Such a finding counters Pastan's. Pastan suggests that high amounts of cyclic AMP might turn off cancer cells. Consequently Pastan pointed out that no one really knows what normal levels of cyclic AMP in the body are. He suspects they vary from tissue to tissue and that "cyclic AMP may inhibit growth of one kind of tissue but not of another." So, he says, it would be difficult determining whether cyclic AMP levels in cancer tissues are normal or not.

Might cyclic AMP be used as a diagnostic marker for cancer any time in the near future? Pastan, Rall, Butcher and Murad all say "no." The problem, they agree, is that cyclic AMP, like the prostaglandins, is active in so many tissues and plays so many roles that it is incredibly difficult to link them with the disease state. Rall crisply put cyclic AMP in perspective: "Certainly not all hormone actions can be explained by cyclic AMP. As time goes by we will find other substances like cyclic AMP. We are looking at the tip of the iceberg, rather than at the whole story."