CHEMISTRY

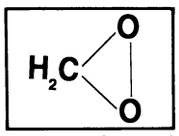
Chemical synthesis of a gene switch

The on-off switch for a bacterial gene has been chemically synthesized, slipped into bacteria and observed to subvert normal gene control. Saran A. Narang and Jacek Stawinsky of the National Research Council of Canada, working with Chander P. Bahl and Ray Wu of Cornell University, constructed a DNA segment that controls the group of genes involved in *Escherichia coli's* use of the sugar lactose. The synthetic segments were linked into DNA plasmids and, thus, carried into bacterial cells, Narang told the meeting of the Chemical Institute of Canada and American Chemical Society in Montreal.

Both the natural segment of bacterial DNA and the synthetic segment bind a special protein called repressor. The natural segment turns on expression of adjacent genes when it is vacant and turns off those genes when repressor protein binds (SN: 11/27/76, p. 348). When many copies of the synthetic segment are added to a bacterial cell, they capture most of the repressor, leaving the natural sequence free and the lactose genes functioning unrestrained.

Several laboratories are attempting to attach such control segments to mammalian genes to coax bacteria into making desired proteins, such as insulin (SN: 5/28/77, p. 340). Synthesizing the gene control regions is safer than isolating the fragments from bacteria by recombinant DNA techniques, the scientists explain in the June 6 CHEMICAL AND ENGINEERING NEWS. Previously, chemical synthesis had been a slow process, but Narang has developed new methods that make it faster and more efficient.

Ringed molecule: New path to smog



Identification of a ring-shaped form of the compound methylene peroxide has opened new potential routes for a complex reaction important in smog formation. Richard D. Suenram and Frank J. Lovas of the National Bureau of Standards discovered the novel molecule when examining known products of the reaction between ozone and ethylene ($H_2C{:}CH_2$), a component of auto exhaust fumes. Ozone and ethylene were first condensed on the walls of a special cell cooled by liquid nitrogen and then gradually warmed. Cyclic methylene peroxide, identified by its absorption of microwaves, was one of the first reaction products to appear. "The established existence of the smallest member of this new class of compounds suggests numerous new experiments to determine their role in photochemical smog formation," the researchers explain. Other scientists are currently adding the reaction pathway to computer models of atmospheric chemistry to see how it affects the overall picture.

River water induces bacterial mutation

Unconcentrated water samples from the lower Mississippi River cause genetic changes in bacteria, and are thus likely to contain cancer-causing chemicals. These results indicate "a potential threat to consumers of finished waters of river origin during the late summer and autumn months," report William Pelon, Beth F. Whitman and Thomas W. Beasly in the June issue of ENVIRONMENTAL SCIENCE AND TECHNOLOGY.

Twenty-seven of 53 water samples collected by the researchers produced a significant number of mutations in one or more of four bacterial strains in the test devised by Bruce Ames (SN: 3/29/75, p. 207). Although the sources of the active chemicals could not be identified, the Louisiana State University scientists noted that the samples containing the most "suspect compounds" were collected in heavily industrialized areas.

EARTH SCIENCES

From the spring meeting of the American Geophysical Union in Washington

Tapping the underground for energy

While the United States worries about its energy crisis, nature apparently stands prepared to offer an effectively limitless supply of energy in various forms: wind, solar, geothermal, and ocean to name just a few. Researchers at the Los Alamos Scientific Laboratory have now recently estimated that the United States alone contains a largely untapped resource of volcanic energy that may amount to 1,000 times the country's annual energy consumption.

Thomas R. McGetchin and Uzi Nitsan are currently involved in studies that may eventually lead to the efficient utilization of this underground energy source. They have used a computer to simulate the temperature history of buried bodies of molten rock that are commonly found under volcanoes. They have thus been able to estimate the rocks' energy content and assess the extent of this energy reservoir. The computer modeling is quite detailed and includes such considerations as size, shape, depth of burial, thermal conductivity of the surrounding rock and hydrologic effects.

These, unlike conventional geothermal sources often spoken of, do not contain their own natural circulating water system. Consequently, techniques like those being developed at Los Alamos are required to pump water down to the hot rocks. The heated water and steam are then retrieved, run through a conventional turbine to generate electricity, and then recycled.

The researchers estimate 10 such artificial circulating systems could produce about 1,000 megawatts of power—sufficient for a city the size of San Francisco. In fact, they have located about 20 sites in the western United States that may have significant amounts of igneous-related heat. In these areas, the magma is constantly replenished during the lifetimes of the associated volcanoes, enhancing their usefulness as future energy sources.

African plate an island of stability?

Most of the earth's crustal plates are in motion with respect to the mantle underlying them, but Africa has been suggested to have been at rest with respect to the underlying mantle for the past 25 million years. Among the several lines of evidence leading to that view are the concentration of active hotspots on the African plate; upsurge of volcanism over much of the plate 25 million years ago and its persistence in the same place in some areas throughout this period; and paleomagnetic evidence of no relative motion between Africa and the earth's spin axis. The absence of relative motion between Africa and the mantle in the last 25 million years would help explain the development of the East African Rift System and the Red Sea and also the anomalous general elevation of the continent.

Three scientists at the State University of New York at Albany, Richard Thiessen, Kevin Burke and W.S.F. Kidd, have now produced still more evidence of Africa's stability. They analyzed the distribution of volcanic areas within the African plate and found a pattern similar to that produced in laboratory experiments modeling mantle convection under a stationary upper layer. They scaled the dimensions of the laboratory model to the earth and found that the resulting separation distances between rising currents in the model are similar to those between African plate hotspots. This would all seem to indicate, they say, that the African hotspots lie above rising mantle plumes. These plumes produce a convective pattern that implies little horizontal movement of the overlying crustal plate.