ment about the relationship between violent volcano activity and long-term climatic changes.

When a volcano erupts, quantities of ash and volcanic gases rich in sulfur dioxide are hurled into the stratosphere where they remain for several years, reflecting sunlight back into space, thus cooling the earth's surface. Studies by British climatologist H. H. Lamb show that the period of major volcanic activity between 1500 and 1912 resulted in average temperatures almost 1 Fahrenheit degree cooler than during the post-1912 nonvolcanic period. Likewise, Toon and Pollack note, a worldwide study of volcanic ash layers in ocean sediments has found that there were many more violent volcanic eruptions during the 2 million years of the ice ages than during the preceding tens of millions of years. This does not prove that volcanic activity could initiate another ice age, but the evidence suggests that volcanoes have produced unusual weather in the past and may have been involved in important climatic changes.

'Gene-Splicing': A Public Debate

"Gene-Splicing: At Grass-Roots Level a Hundred Flowers Bloom" by Nicholas Wade, in *Science* (Feb. 11, 1977), 1515 Massachusetts Ave., N.W., Washington, D.C. 20005; "Recombinant DNA: Fact and Fiction" by Stanley N. Cohen, in *Science* (Feb. 18, 1977); "An Evolution-Perspective for Genetic Engineering" by Robert Sinsheimer, in *New Scientist* (Jan. 20, 1977), King's Reach Tower, Stamford St., London, SE19LS, England.

"For a research technique too new to have produced a single practical application," writes Wade, a *Science* reporter, the recombinant DNA method of "gene-splicing" has produced an unusually lively dispute revolving around safety issues. The debates have spread from university campuses to city councils or state legislatures in Sacramento, San Diego, Ann Arbor, Madison, Albany, and Cambridge. The Sierra Club and its allies seek tighter curbs on the technique; scientists who first pointed out the risks call much of the opposition "irrational." In the end, most public bodies endorsed the safety guidelines set by the National Institutes of Health last June.

Essentially, says Cohen, a Stanford geneticist, the three-year-old laboratory technique "involves the propagation of genes from diverse sources in bacteria." On a practical level, the process has potential for the construction of bacterial strains that can produce antibodies and hormones; it could vastly simplify the production of antibiotics, vaccines, vitamins, and medically and industrially useful chemicals. Other potential uses are less certain. In agriculture, the technique may someday be used to reduce plants' need for fertilizer. In the energy field, it may lead to the exploitation by man of the process

whereby certain algae produce hydrogen from water, using sunlight as energy.

Defending the NIH guidelines, Cohen says that no such thing exists as "zero risk"; the public should weigh the "reasonable expectation" of major benefits from recombinant DNA research against "the vague fear of the unknown."

In *New Scientist,* Sinsheimer, a California Institute of Technology biologist, contends that the NIH guidelines neglect the long-range "potential evolutionary consequences" of gene-splicing because they were written to cope with "immediate medical hazards." (The complex NIH rules prohibit some experiments, notably those involving known high-risk pathogens such as the Lassa fever virus and Newcastle disease virus, which affects chickens, but some "moderate-risk" organisms, such as *Salmonella typhi,* are eligible for recombination. Release into the air of *any* recombinant DNA molecule is prohibited.)

Sinsheimer urges that all such research, by industry or universities, be done under maximum security conditions, using organisms which, in contrast to the commonly used *Escherichia coli,* are not apt to survive if they escape the laboratory.

Are We a Nation of Hypochondriacs?

"On the Science and Technology of Medicine" by Lewis Thomas, in *Daedalus* (Winter 1977), 165 Allandale St., Jamaica Plain Station, Boston, Mass. 02130.

Notwithstanding congressional complaints of its "insufficiency," writes Thomas, the American health care system—doctors, clinics, hospitals, nurses—has been expanding rapidly. Estimated annual expenditures for health care have gone from $10 billion in 1950 to $130 billion in 1976, and the costs will rise further if a national health insurance program is enacted.

Thomas, executive director of Memorial Sloan-Kettering Cancer Center in New York, sees little justification for this spending "boom" in terms of real U.S. health needs. Average life expectancy is now 72 years; far less hospital care is required for common infectious diseases (e.g., lobar pneumonia and meningitis) since the development of antibiotics in the 1940s. Nor is the boom explicable in terms of major medical breakthroughs requiring expensive new technology. Indeed, the major killer diseases of 1950 (heart disease, cancer, kidney disease) are the same in 1977; here, U.S. medicine has employed extremely costly "halfway" techniques of diagnoses and treatment, far short of "cures" or "prevention."

Most important, the lion's share of health outlays by Americans is spent on nonfatal, as yet technologically incurable, illnesses—influenza, gastrointestinal ills, arthritis, neurosis, psychosis. Thomas argues