would be acceptable to the electorate, they are unlikely to commit blasphemy against the goddess of everlasting growth." Thus the only answer may be a new party.

NATURE, in a long editorial against not only "Blueprint" but also against a group of distinguished British physicians who published a statement saying crowding in Britain is "a direct threat to the mental and physical well-being of our patients," uses many of the anti-environmentalist arguments which have become as predictable as the environmentalist ones. NATURE suggests that technology and the market system are basically benevolent and that they will evolve in such ways as to correct their own excesses. With regard to the growing shortage of petroleum, NATURE asks, for instance, "Is it not . . . likely . . . that prices for petroleum will be found to be so high [when shortages become more severe] that even the least successful nuclear power companies will find themselves able to sell reactors more easily?" The same substitution argument applies, says NATURE, to copper shortages: Use aluminum for conductors instead of copper. These kinds of arguments are often hard to evaluate. "Blueprint" maintains that substitutions and adjustments are ultimately self-defeating when resource consumption is growing at an exponential rate. The day will come when another 10-year doubling of energy consumption, for instance, will be disastrous; even with cleaner nuclear power, the problems of radioactive waste disposal or of thermal pollution will become insuperable. On the other hand, in the case of copper, feasible new sources may indeed be found: high-copper-content manganese nodules on the ocean floor, for instance (energy-intensive aluminum being a bad example).

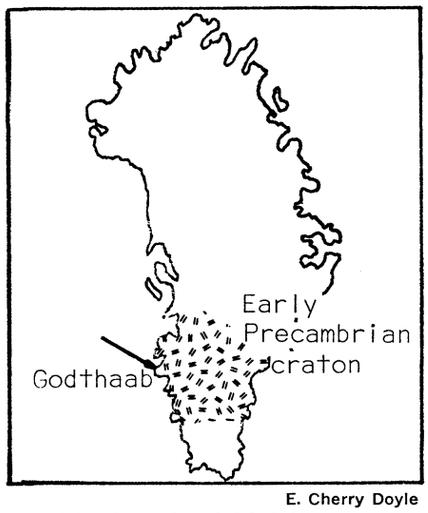
NATURE's philosophical and sociological arguments, presented in a second commentary, in the Jan. 28 issue, are particularly critical of "Blueprint's" recommendation for a return to a more pastoral existence where small communities of people would pursue organic farming and the cultivation of human relations in a framework of material frugality.

"Are these not potentially illiberal arrangements?" asks NATURE. "Is there not a serious danger that to strive for them will weaken the will of civilized communities, developed and developing, to work towards humane goals—the removal of poverty and the liberty of the subject?" But "Blueprint" suggests that the very problems that NATURE associates with rural community living are, in reality, products of a highly technologized and centralized society. Illiberal arrangements and a narrowing of opportunities *do* prevail in *today's* rural areas; but this is only because these areas are at the bottom of a technocratic hierarchy that is essentially urban. And the choices that appear to be offered to affluent urban dwellers are unreal; the sleekest automobile in the midst of a traffic jam is not necessarily an instrument of freedom. But, NATURE might reply, what of the immense cultural advantages of the city? And so the arguments will go on about nearly every aspect of modern life. "Blueprint" for instance, decries the sterility of suburbia, the absence of any truly variegated learning environments there for children. Establishmentarians will surely reply that the space, central heating and electric dishwashers in suburban housing developments represent an immense gain in quality of life for many people.

The arguments in the United States over environmental problems have not yet reached these basic levels, even though environmentalism got its first major impetus here. For instance, the question has always been, can auto companies produce effective emission controls? Only rarely has it been asked whether autos should be done away with in cities altogether. But "Blueprint" and its argument are beginning to receive attention here, too. Loudon Wainwright editorializes in LIFE that "happiness is not a major credit card or more garbage than the neighbors." TIME quotes an MIT systems analyst, Dennis Meadows, who has done careful analyses of resource consumption trends: "All growth projections end in collapse." The New York Times has stirred up a major spate of letters to the editor with its report on "Blueprint" and another report on a letter from 187 scientists to The Times of London generally supporting "Blueprint." A subject with which "Blueprint" concerns itself, the meaninglessness of much of the work in modern society, has been deeply examined in ATLANTIC and in The Washington Post.

According to Paul Ehrlich, a major problem has been that there has been far too little public debate over these kinds of issues. He may be right; the private and sometimes biased deliberations of National Academy of Sciences committees, for instance, have created almost no public involvement and thus politicians have been little interested. Ehrlich proposes "adversary science," a public courtroom kind of procedure where scientists would debate the issues and let the public serve as the jury. If "Blueprint" is correct in its prediction that the world has only a few more years before disaster overtakes it, it may be time to get moving on Ehrlich's proposal or a similar one. □

Western Greenland yields oldest rocks on earth



E. Cherry Doyle

Godthaab rocks: 3.98 billion years.

Some of the oldest rocks in the world have been found on Greenland. Many date back to the earliest geological era, the Precambrian, which began when the earth began and ended some 600 million years ago. A large portion of Greenland was affected by volcanic activity in the mid-Precambrian, however, so that its rocks date from that event, and earlier ages are obscured. Part of Greenland, the early Precambrian craton, escaped the effects of this activity, and it is here that the oldest rocks yet have been found.

South and southeast of the city of Godthaab, a team of five researchers, L. P. Black, N. H. Gale, Stephen Moorbath and R. J. Pankhurst of the University of Oxford, England, and V. R. McGregor of the Geological Survey of Greenland, have found gneisses (coarse-grained granite-like rocks) 3.98 billion years old.

The researchers dated the rocks by analyzing both the rubidium-strontium ratios and the ratios of isotopes of lead. It was the first method that yielded the 3.98 billion figure. This is the oldest Rb-Sr age yet discovered. "There is little clear-cut evidence in the literature for rocks older than about 3.4 billion to 3.5 billion years on the earth's surface," the researchers comment in their report in EARTH and PLANETARY SCIENCE LETTERS (12/71, pp. 245–259). A gneiss recently found in Minnesota was about 3.55 billion years old. The five scientists believe the 3.98-billion-year date represents the time when the granitic igneous rocks that were subsequently deformed and recrystallized to form the gneisses first crystallized from mantle-derived magmas.

In dating the rocks, the five encountered some of the same problems as U.S. scientists attempting to date

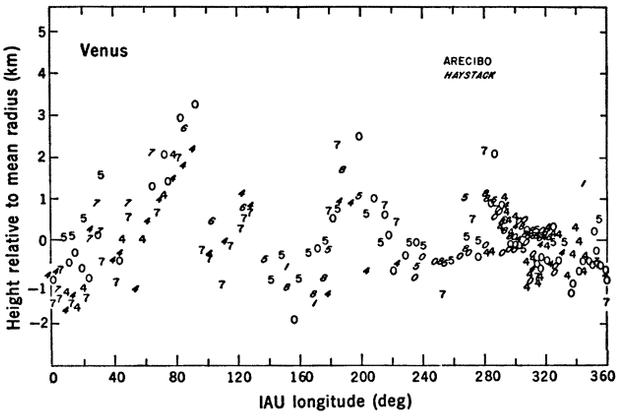
Probing Venus' equatorial mountains

While the dust on Mars has cleared to allow detailed photos of the Martian surface (see p. 106), Venus' perpetually cloud-shrouded surface remains penetrable only by radio waves. A planetary radar group now reports results of an extended series of radar measurements of the topography of Venus that for the first time provides a view of surface height variations around the entire circumference of the planet. All the measurements are within 10 degrees of the Venusian equator.

The most striking feature is a 3-kilometer-high peak at about 100 degrees longitude. This feature seems to rise gently from the west with a slope of about 0.04 degrees longitude, but then it drops to the east with a slope perhaps as large as 0.5 degree. This is regarded as unusually steep for a large-scale (continent-sized) slope on Venus. Earlier radar probes have shown the planet to have a fairly smooth surface in comparison with Mars and earth. The mountainous region extends at least 500 kilometers in latitude and about 6,000 kilometers in longitude.

Other, shallower peaks and valleys are evident. Higher, sharper peaks may also be present but would not be visible because the data generally represent average heights over regions about 200 by 400 kilometers in size.

The data were obtained from a long series of radar



echo-delay measurements at the National Astronomy and Ionosphere Center in Arecibo, Puerto Rico, and at the Haystack Observatory in Westford, Mass. They are reported in the Feb. 4 SCIENCE by D. B. Campbell and R. B. Dyce of Arecibo, R. P. Ingalls of Haystack and G. H. Pettengill and I. I. Shapiro of the Massachusetts Institute of Technology.

"The present results, although limited, show that Venus has a rich, varied and durable topography, its high surface temperature of 800 degrees K. notwithstanding," they conclude.

moon rocks (SN: 1/1/72, p. 12). The lead isotope method yielded a younger age than the Rb-Sr method—3.62 billion years. One possible explanation, the Greenland researchers write, is that the half-life of rubidium may be in error, or the process by which lead was extracted in the laboratory may have failed to get all the lead out. Another possibility is that some uranium (the parent of lead) had diffused out of the rocks, throwing off age estimates based on lead ratios. Finally, the Rb-Sr date and the lead date may represent two different thermodynamic events. The answer, say the researchers, must await further study.

Whatever the case, the age of the Godthaab rocks "has important consequences for the genesis and early chronology of the earth. After accretion of the planet from a dust cloud, the most important event would be the formation of a core. This has been recognized by many authors to lead to the liberation of an enormous amount of energy within a very short time." Such an energy release, it has been calculated, would have melted the outer 1,000 kilometers of the mantle—an event that must have preceded formation of a crust. The gneisses from Godthaab are the first direct evidence of a granitic crust nearly 4 billion years old, so that core formation must have occurred before that time. (The age of the earth is placed at about 4.5 billion years.) "The terrestrial time-scale is now taken back *at least* to the supposed lunar melting event at about 3.6 billion to 3.7 billion years ago shown by the Apollo 11 rocks and the Apollo 14 rocks." □

Viroid identified: Smallest known virus

The Gustav Stern Symposium on Perspectives in Virology draws some of the top virologists from throughout the United States. One of the highlights of this year's symposium, held this week in New York City, was the announcement of the smallest virus yet identified—one of 50,000 molecular weight, or about 80 times smaller than other known viruses. What is more, the minuscule particle consists of pure nucleic acid, or genetic material. Other known viruses wear a protein coat. Theodor O. Diener of the U.S. Department of Agriculture has dubbed the particle he has tracked down a "viroid."

The Beltsville, Md., virologist identified the viroid in potato plant cells afflicted with potato plant disease. In 1963 Diener centrifuged out a particle from diseased potato plant cells. The particle had an exceptionally low molecular weight. "I knew we had something unusual," he recalls.

He speculated that the particle might be a lipid-containing virus, because such viruses have rather low density. But he eventually concluded that the particle must be nucleic acid without the usual heavy protein coat. After many abortive attempts, he finally determined, with a technique called electrophoresis, that the virus had a molecular weight of about 50,000 and consisted of a single strand of RNA, mixed with some double-stranded RNA —also unusual. All together, the nucleic acid might possibly appear in a clover leaf configuration, somewhat like the appearance of ribosomal RNA.

The USDA virologist is not sure how the viroid can get along without a protein coat. The only other viruses known not to have protein coats have been created as mutants in an artificially contrived laboratory situation. It would seem that the nucleic acids of the virus would be susceptible to destruction by certain enzymes within the potato plant host itself, as the virus moves from one plant to another. The enzyme ribonuclease, for example, likes to chop sections out of RNA. The enzyme exonuclease will attack RNA at each end of its molecular strand. Diener speculates that perhaps the viroid is protected from these enzymes by its close association with the potato host cell nuclei.

"We have purified the viroid as far as we can now," Diener says, "and can barely see it under an electron microscope. Obviously we are not satisfied with these results." Diener believes that it may eventually be possible to identify cousins of the potato plant viroid and that they may be implicated in the animal disease scrapie. The viral agent behind this neurological affliction in sheep has eluded discovery for years. Its molecular weight is not all that far off from the weight of the potato plant viroid—an estimated 150,000 compared with 50,000.

Diener believed at first that the viroid was a primitive agent. "But now," he says, "I believe it is neither a precursor nor a descendant of other viruses. So its method of producing disease in the plant is probably different." □