constraints such as limited resources, disease, and predation serve to limit the growth of populations. Mitigation of constraints, as in the case of man, results in a population explosion, which, if unchecked, is certain to visit global catastrophe on the species.

I agree with Dare that an anthropocentric bias can be explained in scientific terms. However, my claim that man occupies a special place in the biosphere because of his ability to influence his own evolution toward the enhancement of value in the world and that an anthropocentric belief in the value, meaningfulness, and creative potential of the human phenomenon may be a necessary motivation for action to solve our crises is no more verifiable by the present data of science than the claim of others who deny man unique importance and advocate the abnegation of anthropocentrism in order to preserve and enhance "nature's values." I regard both positions presently as items of faith.

Rowe in his letter asserts: "the purpose of a species is to keep its ecosystem running smoothly." I maintain that in order to survive as a biological species we must preserve our life support system, but in addition, in order to survive as an evolving cultural entity, we must seek to preserve and to enhance values unique to the human species.

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Radioactive Waste Disposal

Recently we have become aware of the difficulties of storing or disposing of radioactive wastes from the world's nuclear power stations. Possible methods of disposal include elimination by nuclear transformation or disposal in space, salt and other geologic formations, the ocean bed, and the major ice sheets, particularly that of East Antarctica (*1*).

This last suggestion was considered in May 1973, by the Glaciology Panel of the Committee on Polar Research of the National Academy of Sciences, and later by the committee itself, which then conveyed to the Scientific Committee on Antarctic Research (SCAR) of the International Council of Scientific Unions, and to the International Commission on Snow and Ice (ICSI), "the urgent need to investigate thoroughly the geophysical basis for, the implications of, and any scientific basis for such an ice sheet disposal scheme, so that its feasibility can be evaluated. . . ." In September 1974, SCAR agreed on the urgency of investigating the environmental implications of such schemes, pointing out that, although past research has already generated much valuable scientific information for these investigations, national committees should encourage governments to support further studies.

Concurrently, Battelle Northwest Laboratories has examined many possible disposal schemes (*2*). For disposal in the ice sheet, three main concepts were developed: (i) surface storage; (ii) anchored emplacement at a depth of 200 to 500 meters; and (iii) "melt-down," in which canisters containing radioactive material would melt through the ice sheet. These concepts, and the earlier one (*1*), were based on analyses by Budd, Jensen, and Radok (*3*). With extreme values for some parameters, their models predicted that in part of East Antarctica the ice sheet base was well below melting point and that the "residence time" for snow falling there was greater than 250,000 years—the time the waste must be isolated from the biosphere.

A meeting was held in Cambridge, England, on 25 September 1974, of representatives of ICSI, the SCAR Working Group on Glaciology, and the International Antarctic Glaciological Project, from eight countries (*4*). They determined that the primary requirement in any disposal concept is that the oceans and atmosphere must not be contaminated by the dissemination of radioactive wastes, including that initially contained in canisters if the canisters are not retrievable.

With present technology we cannot recover canisters that have sunk deep into the ice sheet, even if they remain intact; the recovery of "melted-down" material will always be more difficult than with the other concepts. The waste and canisters could be constructed with the same density as ice and, if aged to thermal inertness before emplacement, would follow flow lines, increasing their residence times. "Tethered-canisters" probably are retrievable unless the mooring system fails.

In the last 2 years, radio echo sounding has shown that many lakes underlie the East Antarctic ice sheet, and over extensive areas the base is melting. Water may flow from these areas to the oceans very quickly. The implications for ice sheet disposal are obvious.

The major question with all these concepts, however, is the ice sheet's durability. In the last 250,000 years northern ice sheets have come and gone, although the Antarctic ice sheet may have changed only 10 percent. Our knowledge of the mechanisms for initiation and disappearance of ice sheets and of future natural and man-made changes in climate and in geothermal flux is insufficient for long-range pre-

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other data may be treated. Up to 256 vital sign signals may be recorded with bedside apparatus and logged at precise intervals by the system. Hewlett-Packard Medical Electronics Group. Circle 870.

Blood Analysis Photometer

Model 370 (Fig 2). is a filter photometer that includes a 37° and a 100°C incubator. Seventeen blood chemistry tests are available for use with the device. Each test requires a single pipetting. Sample is placed in a cuvette and a reagent module is added to the cuvette. After color develops the cuvette is read in the serometer and the readout is compared to a reference chart. Mallinckrodt. Circle 872.

Urinary Sediment Stain

Cyto-Diachrome is a supravital diagnostic stain for urinary sediments. It consists of copper-phthalocyanine, a blue dye, and pyronin-B, a red dye. Benign and malignant cells, casts, and inclusions are stained differentially. Cyto-Diachrome facilitates identification of leukocytes, erythrocytes, and epithelial cells. Staining is rapid enough for use in routine screening applications. Sufficient stain for 325 determinations is provided in each 12.5-milliliter bottle. Regis Chemical. Circle 871.

Urinalysis System

Uricult simplifies urinary tract infection screening procedures. Test paddles are integral with caps on sterile capsules. The user opens the capsule, dips the paddle in a sample, allows the excess to run off, and returns the paddle to the capsule. The capsule incubates for 24 hours and bacterial colony density is estimated from a reference chart. Each paddle has two media, one on each side, and six media combinations are available. Corning Diagnostics. Circle 866.

Electrophoresis Cell

The 82-100 is suitable for gel electrophoresis with polyacrylamide, agarose, Sephadex, starch gel, and others. It features simultaneous rapid scanning of separations in six gels of different composition. The cell accommodates slabs 120 by 200 millimeters with thicknesses from 1.5 to 5 millimeters. It is suitable for preparative applications. The cell is tap-water cooled and is constructed mainly of acrylic plastics. Camag. Circle 863.

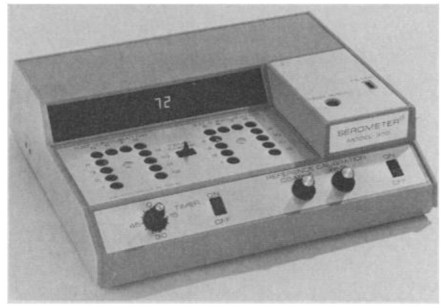

Fig. 2. Mallinckrodt's serometer model 370 features two integral incubators and provides temperature data along with blood chemistry results.

Hand-Held Programmable Calculator

The FX-20 is an eight-digit device that will operate up to 20 hours on two penlight batteries; it will also operate on line current. It features an independent memory (MR, MC, and M+). It performs trigonometric functions, inverse trig functions, common and neutral logarithms, raising to powers, square roots, exponentiation, and sign change. It also has a sexagesimal-decimal conversion key, a full floating point decimal system, and zero suppression. Casio. Circle 862.

Literature

Subsurface Monitors are sensitive listening devices with a variety of applications in fields as diverse as marine biology and earth science. Geophysical Instrument and Supply. Circle 857.

Petri-Scan is a bacterial counter featured in a four-page brochure. American Instrument. Circle 873.

Thin-layer Plates and Supplies are treated in a catalog. Kontes. Circle 874.

Newscan is a periodic newsletter about scientific instrumentation. DuPont Instrument Products. Circle 875.

New-Tron is a nuclear products application bulletin. Reactor Experiments. Circle 876.

Biochemical Catalog Summer '75 lists products for research and chemical uses. Calbiochem. Circle 877.

Liquid Chromatography includes packing materials and packed columns. Waters Associates. Circle 878.

Insight describes techniques and instrumentation for electron microscopy and microanalysis. McCrone. Circle 879.

Biochemicals Reference Guide catalogs more than 1300 compounds including chromatography media and many others. P-L Biochemicals. Circle 880.

Optical Products includes devices for activities involving light from ultraviolet to infrared. Oriel of America. Circle 881.

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dictions. For East Antarctica, the most stable ice sheet, it may be feasible to predict for 10^4 years, but not for 10^5 years, which is comparable to the longest residence times. For the Greenland and West Antarctic ice sheets, with shorter residence times, our ability to predict is correspondingly reduced. Furthermore, these statements relate to steady-state conditions and neglect the possibilities that the ice sheets could surge.

The Cambridge meeting thus reached three conclusions:

1) The Antarctic ice sheet is not a suitable site for the disposal of radioactive wastes that need to be isolated from the biosphere for periods of several hundred thousand years.

2) Over the last 20 years or so, theoretical and observational studies of the Antarctic and Greenland ice sheets have allowed us to build up an understanding of the basic physics of ice sheets sufficient to go some way toward answering the glaciological questions posed by the proposal to use the ice sheets as disposal sites.

At this stage, the efforts of the glaciological community should continue to be directed toward a better understanding of the basic physics and thermodynamics of ice sheets. Such an understanding is essential before any profitable consideration can be made of applied problems such as those that would be associated with nuclear waste disposal.

3) Even a complete understanding of the behavior of the ice sheet with respect to the present boundary conditions, including climate, geothermal flux, and sea level, is insufficient to allow the precise determination of the ice sheet's future. For that we need a corresponding knowledge of the future changes in boundary conditions.

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References and Notes

1. E. J. Zeller, D. F. Saunders, E. E. Angino, *Bull. At. Sci.* 29, 4 (1973).
2. *High-level Radioactive Waste Management Alternatives* (Report No. WASH-1297, National Technical Information Service, Springfield, Va., 1974); *Ice Sheet Disposal* (Report No. BNWL-1900, National Technical Information Service, Springfield, Va., 1974), sect. 5.
3. W. F. Budd, D. Jenssen, U. Radok, *Derived Physical Characteristics of the Antarctic Ice Sheet* (Publ. No. 18, Meteorology Department, University of Melbourne, Melbourne, Australia, 1971).
4. The participants in the meeting were Charles R. Bentley, United States; William Budd, Australia; Colin Bull, United States (secretary); Rene E. Dalinger and advisers, Argentina; Vladimir Kotlyakov, U.S.S.R.; Kou Kusunoki, Japan; Claude Lorius, France; John Nye, United Kingdom; Olav Orheim, Norway; Gordon de Q. Robin, United Kingdom (chairman); Charles Swithinbank, United Kingdom; Jean Vaugelade, France; and Edward J. Zeller, United States (invited guest).