

cated goats or rabbits released in these same environments probably would survive better and do as much damage as, or more than, their feral cousins. The same argument applies to the analogy of domestic predatory cats.

Sharples' comments about the size of a pathogen pool affecting progress of a disease deflect from the issue. The focus should be on the chance of an unpredicted problem occurring, not on how many bacteria are necessary for a problem if the bacterium is a pathogen. Scientists do not test in the field microorganisms with the potential to cause epidemic disasters. Microbiologists have an excellent record of safety with field tests of thousands of different microorganisms in many countries over many decades.

The calculations Sharples presents to counter the argument that "all possible gene combinations have already been tested in nature" are irrelevant to the issue of laboratory-altered recombinant organisms. Genetic engineers are not trying, and will be unlikely to achieve, complex gene combinations (for example, 3000 specific human genes plus 1000 *Bacillus* genes plus 6000 *Drosophila* genes, and so forth, to make a desirable organism for use in agriculture). The best a genetic engineer can do will be to add a few specific genes to an organism. Calculations should therefore be based on an example such as estimating the chance that an *Escherichia coli* in an individual's intestine will pick up the human insulin gene from dying human cells. Many of us would predict, but cannot prove, that this could happen daily on this planet; however, the insulin gene does not appear to give *E. coli* any specific selectivity advantage; thus, random native *E. coli* strains do not contain the human insulin gene.

While Sharples does not support the analogy of our safe experience demonstrated over decades with release of wild-type and mutant bacteria, she makes unsupported statements, such as, "relocation to a new environmental setting could produce unintended negative results. . . ." Sharples states that "only two or three taxa [*E. coli* and *Rhizobium*] . . . have been studied well enough to qualify for the 'domesticated' label." Such "domesticated" organisms presumably are the only ones she believes to be safe to disseminate in the environment. In the dairy industry, for example, mutant strains are continually being used. All of those strains reach our environment, including our intestines and our woodlands (after a picnic). Are the following bacteria, used in the food, chemical, agriculture, and mining industries, not "domesticated"? *Streptococcus cremoris*, *Lactobacillus plantarum*, *Bacillus stercorophilus*, *Pediococcus cerevisiae*, *Aceto-*

bacter aceti, *Clostridium acetobutylicum*, *Nitrosomonas europea*, *Azospirillum brasilense*, *Azotobacter vinelandii*, *Thiobacillus ferrooxidans*, and *Propionibacterium shermanii*. It would be fruitless to require a major ecological study for each new mutant strain of these organisms.

No one argues that all products or experiments from biotechnology will be absolutely trouble free. Analogies related to the frequency and seriousness of problems from genetically engineered plants should be with what we have experienced from plants genetically altered by traditional means (not introduced "new" plants). Likewise, problems that will occur from field use of recombinant microorganisms will be similar to those we have experienced from a century's worth of testing microorganisms and their mutants in the field. Another relevant analogy for predicting the frequency and types of problems is the well-known alteration of microbial populations from the use of chemical herbicides and pesticides, which are routinely added to farms, gardens, and golf courses. Microbial mutants arise with increased ability to degrade such chemicals. There are many cases of new, bacterial plasmid-coded degradative enzymes appearing in sites where chemicals have been introduced. These altered microorganisms spread, transfer genes, and grow; however, the only problem known to occur is decreased efficacy of the chemical. These microorganisms usually are unclassified with regard to genus or genetic alteration, and no one seems to be worried about health or environmental problems where they are found in high concentrations over millions of acres. Released recombinant microorganisms are well defined with respect to classification and genetic alteration. Sharples' examples of feral goats and the AIDS virus do not help to focus scientific debate on the issue of potential harm by adding one or several foreign genes to an organism that, in its nonrecombinant state, has been of no serious concern when tested in the field.

I agree with Sharples that regulation of biotechnology products is, at this time, justified; however, regulations not based on relevant scientific principles but, rather, on alarmist views, will only hinder research and development and U.S. competitiveness in projects that are expected to help agriculture and the environment. The Environmental Protection Agency's regulations are already inhibiting research progress, and Sharples' arguments will be used to make the regulations even more severe.

WINSTON J. BRILL

Agracetus,
8520 University Green,
Middleton, WI 53562

The arguments advanced by Sharples that "new" microorganisms might have devastating effects on the terrestrial biosphere are reminiscent of the fears voiced 10 to 15 years ago of dangers that could be caused by samples returned from Mars (1). Alexander (2), who is quoted by Davis as proposing a complex series of tests for estimating "the probability of environmental harm" from new strains, entertained us in 1972 by proposing that fungal plant pathogens could be a danger in samples returned from outer space (3). The U.S. Department of Agriculture subsequently undertook examination of lunar materials for wheat rust spores.

I contended (1) that, if it is hazardous to return a surface sample from Mars, then a sample of soil from Antarctica should be more dangerous than one from Ohio. Davis argues along similar lines.

Fear of "new" DNA sequences expressed by Sharples was anticipated by apprehensions I cited (1) that if Martian species were brought to the earth there would be risks of catastrophic pathologies by the spread of nonterrestrial genes. But evolution shows that genes have not tended to "jump" during the past 200 million years to vertebrates from bacteria, including the much maligned pseudomonads. Instead, a slow process of divergence and modification of genes from a common ancestor has taken place.

THOMAS H. JUKES
*Department of Biophysics
and Medical Physics,
University of California,
Berkeley, CA 94720*

REFERENCES

1. T. H. Jukes, *Life Sci. Space Res.* 15, 9 (1977).
2. M. Alexander, *Issues Sci. Technol.* 1, 57 (1985).
3. ———, *Theory and Experiment in Exobiology* (Wolters-Noordhoff, Groningen, 1972), vol. 2, p. 121.

Tanker "Dumping" Regulations

P. Dee Boersma (Letters, 10 Apr., p. 135) cites a study of oiled penguins in Argentina and asserts that "Because it is cheaper to dump oil-contaminated ballast water into the ocean, most tankers still dump untreated waste water." She goes on to suggest that "policies to prohibit [this] dumping should be instituted."

Such policies already exist. The International Convention for the Prevention of Pollution from Ships, 1973, as amended in 1978, 1984, and 1987, is a treaty adopted by the International Maritime Organization, which is the maritime agency of the United Nations. The Convention has been ratified

by 46 countries (Argentina and Chile not among them), including all of the major maritime nations. It imposes strict rules on tanker operators to prevent oil pollution. These rules not only prohibit the type of dumping that Boersma highlights but also incorporate vessel design and equipment requirements. These include segregated ballast tanks, crude oil washing, and other features that minimize the amount of oily waste that is generated aboard a tanker. The rules also require the installation of oil-in-water monitors that measure and record the oil content of ballast that is discharged by a tanker. In fact, these monitors are designed to stop the discharge of ballast automatically should oil concentration in the water exceed strict limits.

Thus, there are international regulations that prohibit tankers from "dumping" oil into the sea, and, contrary to Boersma's assertion, most tankers follow these rules.

In dealing with the "oily penguin problem," it appears first necessary to consider possible sources of contamination, for example, spills occurring during drilling and producing operations in the Tierra del Fuego area, indiscriminate discharges of oily engine room bilge wastes from any type of vessel operating in the area, and discharge of oily ballast water from tankers that may operate in the area and not conform to international operating standards.

Second, it will be necessary to heighten the level of awareness of government, industry, and the public with respect to the nature of the problem. Oil-producing and transportation operations are routinely conducted in other environmentally sensitive areas without adverse effects on those areas. Such environmentally acceptable operations should be sought and are achievable in Tierra del Fuego.

T. S. WYMAN
Government and Public Affairs Division,
Chevron Shipping Company,
555 Market Street,
San Francisco,
CA 94105-2870

Man's Role in Space

Peter M. Banks and David C. Black (Perspective, 17 Apr., p. 244) write optimistically and philosophically about what might be gained through manned research facilities in space. James A. Van Allen has already written factually (1) about what has been gained through unmanned spacecraft and what further surely could be gained. One might add that that work (in which I participated some three decades ago) (2) led to new and largely

unforeseen technological applications of unmanned spacecraft as communication satellites. Since then earth observation satellites of various sorts and navigation satellites have assumed great importance.

Our present humiliating position is that exaggerated emphasis on man-in-space has left us, temporarily, we hope, without any domestic means for launching either scientific or technological spacecraft.

Man-in-space is an old dream which I exploited in science fiction (3) at a time when no one had thought of the new capabilities we have seen in unmanned spacecraft. The old dream of man-in-space, magnificently realized in Apollo, has been extended in the Shuttle, with an emphasis that has had disastrous consequences for our exploration and exploitation of space.

Surely, the exploration of man's role in space is worthy of continued and intense investigation. The survivability of man-in-space, to which Banks and Black give no emphasis, calls for continued and intense investigation, but not at the cost of scientific and technological benefits which we know we could attain through unmanned spacecraft—if we had the resources to construct and launch them.

JOHN R. PIERCE
Center for Computer Research
in Music and Acoustics and
Department of Music,
Stanford University,
Stanford, CA 94305

REFERENCES

1. J. A. Van Allen, *Science* 232, 1075 (1986).
2. J. R. Pierce, *The Beginnings of Satellite Communications* (San Francisco Press, San Francisco, CA, 1968).
3. ———, "Relics of the earth," *Sci. Wonderstories*, March 1930, p. 894.

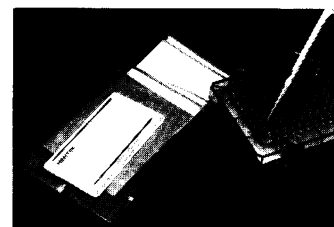
Neutrino Shield?

M. Mitchell Waldrop (Research News, 1 May, p. 523) quotes a theorist as saying that the neutrino flux alone from supernova 1987A would have killed an "unprotected human" out to nearly a billion kilometers. I am curious about what sort of protection the theorist had in mind. Is this one of the theorists behind the Strategic Defense Initiative?

BILL MIXON
Route 6, Box 62C,
Austin, TX 78737

Erratum: In Constance Holden's article "Adjusting to an aging population" (News & Comment, 15 May, p. 772), Secretary of Labor William E. Brock III is incorrectly described as "Commerce Secretary."

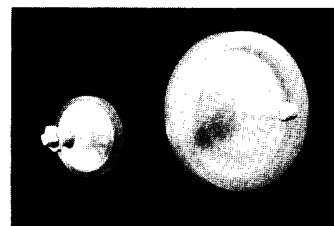
Dot Binding Membranes



New MEMTEST™

- ▲ Ideal for ELISA and other sensitive protein dot binding assays
- ▲ NO quenching—NO background—NO time consuming blocking steps
- ▲ Hydrophilic, biochemically reactive membrane binds to amino group of proteins
- ▲ Reinforced membrane matrix insures no loss of data through breakage

Fast Affinity Chromatography Separations



New MAC-25™ & MAC-50™ Capsules

- ▲ Lab scale, biochemically reactive affinity membrane capsules offer fast reproducible separations
- ▲ Combines the covalent binding found in gel affinity chromatography with the superior flow rate qualities of microporous membranes
- ▲ Bind ligands ranging in size from amino acids and haptens, to immunoglobulins and other macromolecules
- ▲ MAC capsules can be stacked for affinity scale-up

For more information call:
1-800-527-0433

MEMTEK

Memtek Corporation
28 Cook Street, Billerica, MA 01821
(617) 667-2828

Membrane Affinity Chromatography