the paper by Sturgis and Albright was the first paper to demonstrate that estrogen given at the appropriate time does prevent ovulation in women. I would also point out that their primary goal of discovering a method for control of dysmenorrhea, while explained in terms of the absence of ovulation, is still unexplained in terms of what we know of the physiology of the uterus.

S. R. M. REYNOLDS
Department of Anatomy,
University of Illinois Medical Center,
P.O. Box 6998, Chicago 60680

Microorganisms on Mars

Horowitz and his associates in the article "Planetary contamination I: The problem and the agreements" (24 Mar., p. 1501) present a series of arguments for the relaxation of the COSPAR (Committee on Space Research) recommendation on spacecraft sterilization. There are several points, in addition to the question of Martian environmental hostility, which may be debatable. Some are moot and others are a reflection of the authors' seeming unawareness of current interplanetary quarantine policy. Examination of these points in detail is not warranted here.

The American Institute of Biological Sciences' Spacecraft Sterilization Advisory Committee of the National Aeronautics and Space Administration has been considering for the past year and a half many of the questions raised by Horowitz. It has developed a dry heat sterilization cycle which can satisfy the COSPAR requirements and is believed to be compatible with present spacecraft engineering and design.

Horowitz' call to lower the standards is not based on any more specific data than was used for the COSPAR premise. The prime difference is that the COSPAR recommendations have taken a quantitative form in a simple model while Horowitz' suppositions are less clearly formulated.

The 1966 USA recommendation to COSPAR, that the probability of contaminating a planet be no more than 1×10^{-3} during the period of biological exploration, sets up a sterilization requirement that is considered to be a workable and acceptable probability. The existence of such a quantitative definition has permitted engineering development of interplanetary exploration vehicles by setting the limits which the craft must meet. Such a definition is a continuing requirement.

Reducing COSPAR probability restraints is of lesser importance than a better understanding of sterilizing procedures. More precise sterilization requirements of time and temperature should be set in order to keep to a minimum the degradation of the reliability of the spacecraft and yet attain the desired probability of sterility. The committee has developed more precise dry heat sterilization data that have already significantly reduced these requirements without sacrificing or reducing the probability of attaining the desired sterility.

Horowitz does not specify a standard to be met. Can he suggest a more workable probability? He should specify the microbial burden to be allowed, the cleanliness requirements for his experiments, and the thermal tolerance of his equipment. These are practical problems urgently requiring resolution if the program is to be continued unimpeded. If this information is available, he can make valuable contributions. It is urged that he discuss these aspects with the AIBS committee. The problem can thereby be further removed from the area of rumination and supposition and lead to a rewarding scientific solution.

RICHARD G. BOND, JOHN H. BREWER
RICHARD CORNELL, MARK A. CHATIGNY
GILBERT V. LEVIN, IRVING J. PFLUG
GERALD SILVERMAN, JOHN A. ULRICH
FRANK B. ENGLEY, JR.
AIBS Spacecraft Sterilization Advisory Committee, 3900 Wisconsin Avenue, NW, Washington, D.C. 20016

The article which Bond's committee objects to is an examination of the basic assumptions of the current spacecraft sterilization policy in the light of new knowledge of the planet Mars. It shows that the validity of these assumptions is, at the very least, questionable. Our conclusions are based on a large amount of evidence which was not available in 1964 when the basic COSPAR resolution was adopted, including the data from Mariner IV and from recent earth-based observations. In view of this fact, the committee's assertion that our conclusions were "not based on any more specific data than was used for the COSPAR premise" is incomprehensible. Equally curious is the committee's declaration that "reduction of COSPAR probability restraints is of lesser importance than a better understanding of sterilizing procedures." Surely the establishment of a sound policy is as important as the pursuit of technology for implementing that policy.

Contrary to what the Bond committee implies, we do not reject the recommendation that the probability of contaminating Mars not exceed 10^{-3} during the period of unmanned exploration. We accept this objective, but contend that, for the reasons detailed in our article, it can be attained without the adoption of extreme sterilization procedures.

If the Bond committee can substantiate its claim to have solved all spacecraft sterilization problems by a dry heat cycle, it will deserve the thanks of everyone who is interested in planetary exploration—providing, of course, that the process is reasonable in cost. If such a process exists, it has been a well-kept secret. Current estimates of the cost of sterilizing the Voyager series run into the hundreds of millions of dollars.

N. H. HOROWITZ
Division of Biology, California Institute of Technology, Pasadena

Louis XV in a Dark Corner

My hat is off to the sharp historians of Harvard University and Norfolk State Prison who have finally fixed responsibility for the utterance "Après moi le déluge" on Louis V (The Sluggard) of France (News and Comment, 31 Mar., p. 1653).

Despite the distress this will cause those of us who for years have attributed this remark to Igwald (The Witless) of Finnmark, we may be comforted by the fact that still another lamp is lighted in a hitherto dark corner of history.

PAUL KOEPKE
Route 1, Box 64,
West Cornwallis Road,
Durham, North Carolina

Pressures and Student Disorders

Abelson placed a finger on a sensitive spot in American secondary education in his editorial "Excessive educational pressures" (12 May, p. 741). As he states, responsibility for excessive

pressure on secondary students must be shared by many agencies. . . . In my research on "student class loads" 17 years ago ("Incompatibility between class load and study time in the typical American minor seminary," Fordham University, 1950), I detected the beginnings of this academic pressure in widely divergent areas of study. It would be useful to learn to what extent the pressures of education are contributing factors in the mounting disorders on the college and university campus. Is the student actually rebelling against a mechanistic structuring of American education rather than the American philosophy of life?

EVERETT F. BRIGGS
Post Office Box 86,
Monongah, West Virginia

Crafts: Forerunners of Science

There is an analogy between the model for the geographical expansion of science into "colonial" areas which Basalla has described ("The spread of Western science," 5 May, p. 611) and the intellectual expansion of science into traditional areas of technology. Just as geographically outlying areas provided new facts and observations about nature that stimulated the growing biological and geological sciences, so did the established crafts provide a veritable museum of mechanical effects and chemical reactions to test theoretical notions and suggest new areas for research in the physical sciences. The works of Hooke and Boyle are full of references to artisans' "secrets." The intimate concern with crafts in 18th-century France exemplified by the *Encyclopédie*; the reexamination of the smelters' and assayers' quantitative separatory operations by chemists in Sweden and Germany; and the extension of analysis from metallic minerals to rocks in general impelled by the desire to duplicate imported Chinese porcelain—all these were essential preliminaries to the "Chemical Revolution." A century and a half later, practical knowledge of the alloying, crystallization, and deformation of metals assisted the birth of a physics of solids. Like the colonial, the craftsman was close to a rich and varied nature and, at first, did not philosophize too much.

Basalla's second phase too was matched (at least in the field with which I am most familiar—metallurgy), by a period in which the colonial tech-