iron gun casing, generating x-rays. For the minimum wavelength generated at 100 kv of 0.12 angstrom, about 6 percent of the radiation would penetrate the 1-centimeter-thick casing.

Continuous emission of x-rays apparently requires at least three things: (i) a higher than usual amount of oil vapor in the column, (ii) a vacuum better than about 10^{-5} torr, (iii) a gun casing not thick enough in relation to the kilovoltage employed. If these conditions exist, gun-current readings exceeding 1 or 2 microamperes indicate a need for caution and for monitoring of x-ray levels, although they can be due to leakage along the high-voltage insulator rather than to ion current. The safest procedure is to place additional shielding around the gun if its thickness and material are such that appreciable penetration of x-rays could occur. Although observed on a particular instrument, the hazard is possibly existent in other instruments and should bear watching where continued high-voltage operation is a practice. We take the opportunity of noting that additional lead glass protection has been found desirable over the viewing window on our instrument when lining up the column with 100 kv applied and the condenser aperture removed, because of x-ray emission from the screen.

V. A. PHILLIPS
J. A. HUGO
General Electric Research Laboratory, Schenectady, New York

The Project System in Grant Allocation

H. R. Albrecht's statesmanlike assessment of the problem of support for research in the smaller educational institutions (*Science*, 24 Jan., p. 306) deserves thoughtful legislative response. Even for large and successful grant-getting institutions, the project method of research funding has generated undue administrative complexities. It needs to be more broadly supplemented or supplanted by institutional grants that will shore up higher education and research on a nationwide scale and in all legitimate fields of learning, without generating so much pressure for individual investigators to become "big astronomers." If a large fraction of the available funds were dispensed in a pattern adopting the better features of the British University Grants System, quality would not suffer, and productive scholars might flourish with better effect in a more generally enlightened setting and without pressure to produce new "breakthroughs" every time their grants come up for renewal.

It is easier to endorse what someone else has said than to phrase it oneself. As Albrecht has said the things I should like to have said on behalf of the smaller public institutions, so Barry Commoner, in an article in *The Science Teacher* for October 1963, has said superbly well the things it is important to say about the effect of the project system on freedom to choose our own problems, and on the need for equally strong support for all the forms that truth can take.

PRESTON E. CLOUD, JR.
Department of Geology and Geophysics, University of Minnesota, Minneapolis

Science, Culture, and Determinism

It was a pleasure to read Hoagland's article, "Science and the new humanism" (*Science*, 10 Jan., p. 111). Perhaps it will further encourage biologists to express their views on cultural evolution and other aspects of the science of culture.

Several of Hoagland's points are puzzling to me. For instance, he writes, "[Cultural evolution] accelerated markedly in the last 100,000 years with the emergence of *Homo sapiens*." The prevailing view of students of human evolution appears to be that the emergence of *Homo sapiens* is largely the result, rather than the cause, of cultural evolution, though it may be that a reciprocal relationship has existed between the human biological and cultural developments. Also, Hoagland refers to agriculture and the nation-state as inventions. I wonder how the biologist would react to a reference to photosynthesis or mammals as inventions.

The analogy between ideas and mutations is one of many such analogies which can be drawn between cultural and biological evolution; but it should be recognized that a particular idea may or may not be adaptive, depending upon the cultural context in which it arises, just as a mutation may or may not be adaptive, depending upon the biological context. And it is my impression that mutant genes are lethal for individuals rather than for species, which become extinct as a result of failing to adapt to changing environmental conditions. The same would seem to be true for individuals and cultures (and thus for societies) where mutations (ideas) and adaptation are concerned. It might be added that man has no more control over the nature of the new ideas than he has over the nature of new mutations. What they are to be depends upon what is already in existence and, to a large extent, upon cause-and-effect relationships which are not directed by man but operate according to their own nature.

It is possible that we are entering an era in which we will acquire knowledge requisite to influencing many of the cause-and-effect relationships of our own cultural evolution in significant respects, but the vision of man in *control* of his own destiny is a dim one and one which has the effect of obscuring, rather than enlightening, our view of ourselves.

RICHARD A. YARNELL
Department of Sociology and Anthropology, Emory University, Atlanta 22, Georgia

Hoagland is to be commended for his excellent article, which calls attention to the fact that, because man has not used science to any significant extent to test and thereby direct his value systems, we now have value systems which are all too often based on archaic notions completely at odds with scientific findings. Further, he correctly attributes much of this result to a rigid compartmentalization of thinking whereby religion, science, and personal behavior are walled off from each other. Scientific method and the results of science are regarded as being applicable only to the concrete conditions under which men conduct their daily lives, and not to matters involving values, ethics, morals . . . In practice this means that the most important of man's affairs are decided by custom, prejudice, class interest, and religious dogma or other institutional traditions. . . .

Without meaning to detract from the general excellence of Hoagland's article, I find myself puzzled by the line of reasoning he has used on the issue of free will. Difficulties in knowing and assessing the weight that past experiences will have on future be-