Letters

Pay of Government Scientists

While the academic scientist and the industrial scientist "unite in looking down upon their image of the government scientist" ("Scientists and their images," *Science*, 24 Jan., p. 311), has the academic or the industrial scientist ever stopped to consider that without the government's subsidy they could well be without jobs or at any rate not enjoying the personal and scientific gains they do today?

The image of the government scientist has in fact been created by the government itself. Until the government respects its own scientists, the image will remain regardless of the fact that government scientists are as dedicated and contribute as much to science as do industrial and academic scientists. The United States Public Health Service employs 3744 physicians and dentists and 228 scientists in its Commissioned Corps. All 288 of the scientists hold a Ph.D. In determining years of service creditable for pay purposes, physicians and dentists in the Corps are given 4 years' credit for their professional education, and physicians are given an additional year's credit for their medical internship. A scientist with a Ph.D. receives no such credits for his professional education. To illustrate, a medical or dental intern upon entering the service at the same rank (Senior Assistant Grade) as a scientist would receive $193.96 a month more than the scientist as a result of professional-education credit. In addition, the physician and the dentist upon completion of their internships receive what is called incentive pay, which amounts to from $100 to $350 a month (depending on length of service) which the scientist does not receive. Veterinarians are also entitled to incentive pay.

With the government encouraging the advancement of science, it is difficult to understand how it rationalizes the discrimination against the Ph.D. scientist, particularly within the USPHS. It is no wonder that recruitment and retention of scientists by the government has become an ever-increasing problem. In spite of the protests of the 228 scientists in the USPHS Commissioned Corps and in spite of the various committee reports recommending more fitting compensation to the scientists, remedial action has been forestalled or refused year after year.

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X-ray Hazard from Electron Microscopes

Although new electron microscopes are carefully checked for x-ray emission at the time of installation, it is uncommon to continue checking them on a daily basis after a period of years has elapsed during which no hazard has developed. We therefore wish to alert electron microscopists, particularly those engaged in high voltage operation, to a hazard which may develop. First, a word about normal behavior. On switching on our instrument on the 100-kilovolt range after it has been shut down overnight, a semicontinuous discharge occurs in the gun, and a high level of x-rays is emitted, accompanied by a gun-current reading which may exceed 60 microamperes although the filament is unheated. The x-ray emission and current fall with time and become negligible within 4 minutes or less. This "transient emission of x-rays" is believed to be normal behavior and results in only a small cumulative dose to the operator, since the high level (which may exceed 200 milliroentgens per hour close to the gun) is encountered for only a short time on switching on and gradually decays. On two occasions during the last 6 years, however, x-ray emission was observed which persisted for long periods.

The first incident occurred when oil vapor was drawn from the diffusion pump into the column because of failure of a sealing ring in the column. For a week or two after this occurrence, continuous x-ray emission was observed in an upward direction from the base of the gun whenever 100 kv was applied, accompanied by a gun-current reading due to the ion current. The level of x-ray emission and the gun current gradually decreased with continuous pumping as the column "cleaned up," and became negligible after 2 or 3 weeks. A film radiation badge was placed against the gun after this occurrence and gave no appreciable reading until the following incident occurred.

On routine checking about 2 years later, continuous emission of x-rays was again detected at 100 kv. A cone of x-rays was emitted, inclined about 20 degrees downward from the horizontal and slightly to the right of the operator in this vertical-column instrument. A radiation level of 250 mr/hr was measured at a distance of 0.3 meter from the gun on switching on and did not decay below about 100 mr/hr, corresponding to a gun-current reading of about 10 microamperes. No x-rays were emitted at 80 kv, presumably because they could not penetrate the gun casing. A further observation was that the continuous x-ray emission could be stopped by reducing the operating pressure in the column to between 10^{-3} and 10^{-4} torr, either by putting a controlled leak in the column or by closing off the column from the pumps with poorly outgassed plates loaded. X-ray emission recommenced when the vacuum reached 10^{-4} to 10^{-5} torr. The x-ray level was substantially reduced by cleaning the vacuum system and changing the pump oil. However, it was not until the manufacturers replaced the insulator, to remove a suspected oil leak from the high-voltage cable, that x-ray emission returned to normal transient behavior.

We suggest that x-ray generation results from decomposition of oil vapor in the potential field of the gun, probably at rough spots on the cathode assembly, giving rise to positive ions which impinge on the cathode (−100 kv), exciting secondary electrons which then impinge on the grounded 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.

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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.

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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.

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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-