Letters

Law of Aging

In their article "General theory of mortality and aging" [*Science* **132**, 14 (1960)], Strehler and Mildvan have determined the parameters R_0 and α in Gompertz's law of aging

$$R(t) = R_0 e^{\alpha t}$$

for a large number of relatively homogeneous human populations. $R(t)$ is the death rate in the population at age t. They find that most of the available demographic data are well fitted by Gompertz's law for ages 35 to 80 years. The authors then plot log R_0 versus α for the populations analyzed and find that the points lie in the vicinity of a straight line over the whole range, $0.7 < \alpha < 0.12$. This quite unexpected circumstance means that Gompertz's law is actually a one-parameter law, and that the various populations studied can be ordered and discussed in terms of this single quantity. For males, the relation between R_0 and α is

$$R_0 = 0.054\, e^{-70\alpha}$$

so that Gompertz's law becomes

$$R(t) = 0.054\, e^{\alpha(t-70)}$$

Comparing any two populations, we see that if one has a higher death rate than the other before 70 years, then after 70 its death rate is lower, and that every man alive at 70 has one chance in 18 of dying in that year, regardless of race and nationality. This is a curious aspect of the Biblical term of years.

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Needs in Engineering

The report of the Panel on Basic Research and Graduate Education [*Science* **132**, 1802 (1960)] is by far the soundest and, at the same time, most literate statement about the task facing American graduate education in science that I have seen. Emphatic recognition that the university should bear the principal responsibility for basic scientific discovery and that this same effort must also spawn our scientific talent in long overdue. The detailed discussion by the report of problems facing our universities is complete and farsighted within the field of basic science as such. Especially gratifying is the recognition that there should rightly be a number of great scientific universities throughout the nation, rather than a mere handful of elite ones. While better scientific education is desirable at all levels, and nonuniversity basic research is certainly important, we cannot escape the fact that the real long-range key to greater achievement in science is the long-neglected graduate school. My personal fear is that the panel may have been too conservative in emphasizing the importance and magnitude of the things that need to be done.

While I recognize that the problem of graduate education in engineering may not have been directly within the assigned task of the panel, I am somewhat alarmed by the implication that engineering research may not be "directly included in our central analysis," and by the statement, "the question arises whether in this sector there is anything that can be done to advance the fruitful connection between basic research and graduate education." If this particular conclusion of the committee applies to graduate work in engineering, as it seems to, then I must sharply dissent. The position of scientific discovery in our social-economic system is a relatively simple one. The process of engineering synthesis occupies a much broader spectrum of human endeavor, and technology's relationship to science, not only as beneficiary but often as progenitor, is not well understood—not only by scientists but by engineers, university administrators, economists, and politicians as well. A similar lack of understanding of engineering in relation to economic and social progress widely exists. It is true that the engineering arts must be forged in the market place, but this complicates the task of the engineering graduate school, it does not eliminate it. It is a long step from scientific discovery to the invention and production of useful economic goods or applications.

Perhaps now that the task and needs of basic science have been so clearly stated, some attention should be given to the real nature and the needs of engineering. In this, engineers (many of them scientists) solicit the help and understanding of scientists (many of them also engineers), for we are now in even greater danger of falling behind here than in basic science.

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Loyalty Oath

I am amazed to find that the National Science Foundation requires an applicant for its graduate fellowship to sign a loyalty oath. I recently requested and received an application for the fellowship to be awarded for academic year 1961–62, but since I feel that I cannot support any educational program which is contingent upon oaths, my application will not be submitted. The country's top educators have objected to such stipulations, but it is time for prospective graduate students also to speak out. I realize that much has already been said concerning the oaths in education, and I do not pretend to be familiar with all the issues involved; I can only state my own reasons for refusing to sign the National Science Foundation oath.

My first thought upon reading the oath form supplied by the foundation was, "how unnecessary!" It seems to me that if one is loyal to his country, such a written statement neither expresses fully his feelings of loyalty nor enhances them in any way; the superficial statement is, in fact, an insult to his deep convictions of loyalty. More importantly, the person who is not loyal would be most happy to sign, thus throwing off suspicion. If such a person commits treason, certainly signing a false oath is an insignificant offense as compared to his treasonous act. A disloyal person has everything to gain and very little to lose by signing. Therefore, I look upon oaths not just as unnecessary but as really dangerous, since they may lead us to false feelings of security.

But more importantly, why are *students* singled out as particular subjects of distrust? In these times, I read repeatedly in our news sources that scientists are needed and that the government is using many means to encourage scientific and engineering careers for individuals of my generation. And yet, paradoxically, in one of the very programs conceived to encourage these ends, open suspicion is directed at the prospective scientist through the loyalty oath. It would be less objectionable if *every* person in the country, before benefiting from a federally financed program of any kind, were required to sign such an oath; however, this is not the case. Financial support of a graduate student in the sciences is far from being a donation; it is an investment by the nation in a potential scientist. It is held by many persons to be axiomatic that academic freedom and alleviation of heavy financial burdens are two prime conditions necessary for the development of a creative scientist. Therefore, to be fully effective in achieving the goals of the National Science Foundation, fellowship programs must not continue to violate academic freedom with the requirement for loyalty oaths.

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