Letters

Crimes and Science Fellowships

A bill now pending in Congress (HR 8556) proposes certain new requirements for applicants for fellowship or scholarship grants from the National Science Foundation. One section in particular requires that the applicant must have "provided the Foundation (in the case of applications made on or after October 1, 1961) with a full statement regarding any crimes of which he has ever been convicted (other than crimes committed before attaining sixteen years of age and minor traffic violations for which a fine of $25 or less was imposed) and regarding any criminal charges punishable by confinement of thirty days or more which may be pending against him at the time of his application for such scholarship or fellowship."

The National Science Foundation, anticipating passage of the act, has prepared and sent to all current applicants a form which requires them to state whether they have ever been convicted of any crime, according to the terms indicated in the bill. We regret this action by the foundation, and we question the wisdom of this new requirement.

We grant that this requirement violates no constitutional rights of the individual. Conviction for a crime is a matter of public record, and it may seem reasonable to take this record into account in awarding public funds. Furthermore, according to the proposed legislation the foundation would decide whether or not the matters disclosed are serious enough to disqualify the applicant. It might therefore be argued that the disclosure would simply improve the basis for making the kind of judgment of character in which every university would be interested. Nevertheless, we believe that the purposes of the fellowship program would not be well served by assigning this responsibility to a government agency.

We must recognize a fundamental difference between a government agency and a university. Universities have long recognized the importance, in fulfilling their roles, of protecting the right of individuals to espouse unpopular causes, provided they do so with integrity. Crimes involving intellectual dishonesty would be of grave concern to a university. On the other hand, certain actions that are crimes in the eyes of the law have little relation to the fitness of a person to contribute to scientific knowledge, and thereby to serve his country and the world. For instance, an applicant might have been imprisoned for taking part in a demonstration against segregation in a Southern state, or for being a conscientious objector. Or he might have refused, on the basis of the First Amendment, to give certain testimony before a congressional committee. Such crimes may be evidence not of a defect of character but of exceptionally uncompromising independence and integrity. While these traits may be expressions of a "difficult" personality, the history of science has amply demonstrated that the same traits are frequently associated with the most original and creative scientific work.

Although in principle the bill would permit the foundation to discriminate between crimes that are relevant to the purposes of the fellowship and those that are not, we can hardly assume that a government agency, under the watchful eye of Congress, would feel free to support a politically cantankerous but brilliant applicant. Indeed, one cannot escape the suspicion that the bill is aimed precisely at such persons, under the innocent guise of helping to reveal evidence of the defects of character that one ordinarily associates with conviction for a serious crime. The bill thus appears to represent, in veiled form, a return toward an earlier McCarthyite obsession with internal security. In this connection we note that National Science Foundation fellowships are for open, unclassified research; no questions of national security are involved in granting them.

The most important consequence of this bill would not be the very rare disqualification of an applicant with a history of crime. Rather, it would be the intensified pressure on students for political conformity. By that token, the measure would undoubtedly discourage some exceptionally independent individuals from undertaking careers in science. If universities, in their increasing dependence on government for financial support, are to maintain their traditional role as centers of free inquiry and are to encourage intellectual adventure, they must resist influences from the government that restrict their freedom and discourage boldness in their students. The danger from a rare fellowship award to a person of questionable character is small; the long-term danger from creating an atmosphere of intellectual intimidation is large.

On these grounds we conclude that passage of this section of HR 8556 would do harm, not good, and we record our opposition to it.

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On Ice

In his recent discussion of ice alloys [*Science* **134**, 164 (1961)], Kingery presented some views on the state of knowledge on the strength of crystals which I question. For example, he seems to believe that dislocation theory has provided a basis for rationalizing observed strengths of metals and alloys and for developing improvements logically. In contrast to his point of view, I believe that even though this is one of the few areas of theoretical thinking in which workers have been active for a generation, the hypotheses produced are, at best, of marginal usefulness to thinking about the mechanical behavior of metals.

(Continued on page 2054)

Letters

(Continued from page 2007)

The implication is ridiculous that the principle of adding extra phases to a material to strengthen it is a logical development of any kind of recent theoretical thinking, let alone a fruit of the state of confusion that has developed from the highly specific models which have been described in metallurgical literature. It seems quite apparent that the work reported by Kingery could have been accomplished by a clear-thinking scientist (which Kingery is, in my opinion) with a classical point of view on strengthening of materials, as opposed to a view of the kind that is arrived at by overdevelopment of oversimplified mechanistic hypotheses. For instance, must we consider dislocation theory the basis for the following statement by Kingery: "As found from long experience with metals, plastics, and ceramics, the kinds of alloys which are most useful under these conditions are those made with stable second-phase additives having useful properties"? The most useful two-phase material discussed by Kingery can be derived and explained on a purely classical basis, with no regard whatsoever for dislocations, whether edge or screw.

It is interesting to attempt to follow Kingery's conclusions about the virtues of adding glass fibers. First of all, it is not clear how fibers will limit the stress induced in ice to a *minimum* value. Second, I fail to see in Kingery's Table 1 the more than tenfold increase in strength from Fiberglas additions that he finds.

In his enumeration of requirements for fibers to be effective in reinforcing materials, Kingery has omitted the third essential feature of the system: good adhesion must be achieved at the fiber-matrix interface. Again, no knowledge of dislocations is required to derive this.

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McNutt's opinion that dislocation theory has been of marginal "usefulness" for developing improved alloys is a minority, but not uncommon, opinion among metallurgists. It is probably true that the scientists who have contributed most to dislocation theory have contributed least to alloy development. The argument that technological improvements would have been made with equal facility without a background of understanding based on dislocation

theory is difficult to refute when, in fact, there are few, if any, competent alloy developers unaware of dislocations. At the present time, dislocations *are* a significant part of the "classical point of view on strengthening of materials."

I think there can be no dispute about the utility of dislocation theory for "rationalizing observed strengths." A glance through any contemporary symposium volume on fracture, deformation, or mechanical properties makes it clear that dislocation theory forms the foundation for any science (as opposed to technology) of mechanical behavior of materials.

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Medical Instrumentation

Duncan A. Holaday is to be commended for his excellent survey "Where does instrumentation enter into medicine?" [*Science* **134**, 1172 (1961)]. He perhaps was more harsh in some of his criticism than someone outside the medical profession could be. However, his solutions to the dilemma—to train physicians in engineering and to bring engineers into hospitals—pose further dilemmas.

Let us consider the first problem: Where does a physician get such training? Only one or two institutions offer a training program honestly aimed at instrumentation. The several biomedical engineering programs offered elsewhere are directed toward developing an engineer with cross-disciplinary training for research—not a man who is a specialist at measurement.

Measurement systems are largely electrical or electronic, so one would expect to find electrical engineers with the necessary training. However, instrumentation is an unwanted by-product in most university electrical-engineering departments. The trend is toward training physicists for applied research, and instrumentation is no longer "respectable."

In any attempt to bring the engineer into the hospital there are two distinct obstacles. First, nonengineering administrators generally have little understanding of what an engineer is, beyond "someone who knows about electronics, radios, and so on." Consequently, in all but a few hospitals the