Letters

Geophysical Research Shaft

A far-reaching modern social development is the massive financial backing which can, with increasing ease, be obtained for organized group attacks on new areas of basic knowledge. One thinks immediately of the large accelerators of the AEC, of the upper-air exploration programs, of the IGY, and of the artificial satellite. In general, none of these programs has immediate economic or national defense purposes; rather, their support by various governmental and private agencies reflects a general understanding of the ultimate utility of all physical knowledge. Although massive public support of science undoubtedly entails some undesirable consequences, the very technologic resources thus made available for scientific purposes mean the opening up of research areas otherwise inaccessible. Scientists in all fields should be aware of this opportunity.

The purpose of this note is to suggest one such possibility: a geophysical penetration of the earth's crust. I am not a geophysicist, nor am I qualified expertly to discuss the novel engineering problems involved. Nevertheless, a comparison of such an exploration with, say, the artificial satellite project (with regard to basic scientific worth, to possible practical uses, and to the expense of developing the technology involved) would seem immediately to confirm the suggestion that crustal penetration should be thought about, discussed, and evaluated by the scientific community. If the consensus is then that such a project would be valuable and feasible, we might expect on the afore-mentioned general grounds to find support forthcoming.

There appear to be many geophysical problems that could be profitably investigated by a physical penetration of the earth's crust and by an examination of the composition, properties, and physical condition of the mantle below the Mohorovičić Discontinuity. Among these are the following. (i) Knowledge of the variation of the earth's magnetic field below the surface could show whether its origin is in the crust or, alternatively, is the result of magnetohydrodynamic mechanisms in the core. (ii) Knowledge of the temperature variation below the surface is important for discussions of the earth's heat balance, radioactivity, and evolution. (iii) Knowledge of pressure, temperature, and density conditions at the outer boundary of the mantle are required for the numerical integrations in geophysical theories of Earth, Venus, and Mars. (iv) Geophysical theories of continent building require knowledge of the ultrabasic mantle material and of its relation to the basalt layer and to the granitic continental basement. (v) Penetration of the crust could shed light on the validity of the isostasy concept; this in turn has important and practical geodetic consequences. (vi) The earth's crust apparently has an unusually high radioactive content; it is important to determine whether this is actually so, and whether the radioactive elements have been fractionated out of the mantle. (vii) Knowledge of the composition of the mantle and, hence, of by far the largest part of the earth's mass is of great interest for astrophysical discussions of cosmic abundances. Furthermore, as in any scientific exploration, one cannot estimate in advance the importance of the new and unexpected phenomena and conditions that would be encountered; for example, it was suggested to me, not necessarily in jest, that the mantle might prove diamondiferous.

The site of the research shaft would be chosen so that the depth of the Mohorovičić Discontinuity was there a minimum. While this indicates drilling from an oceanic island, the logistic convenience of a continental location would also be a factor. Presumably seismic and volcanic complications should be voided. Sedimentary overlay per se is uninteresting, and ground water and other seepages could be avoided by seeking exposed Archean rock. I cannot adequately judge the relative importance of these factors.

It is, however, clear that present well-drilling technology would be inadequate to achieve the vertical depth required—perhaps 10 miles. One might, instead, imagine a small-bore (perhaps 12 inches in diameter, 30° down-slant) shaft, drilled into the granitic and basaltic rock by remote-controlled equipment. The power transmission from surface to drill could be by electric cable; rock removal, by belt or hydraulic means. The temperatures encountered should not be excessive (perhaps a few hundred degrees centigrade); the extreme pressures would probably require the use of heavy drilling muds for hydrostatic compensation.

Although estimation of costs for such a project is extremely difficult until preliminary site surveys and a technologic feasibility study have been made, I might point out that the large-scale rock tunneling on the surface costs perhaps $1 million per mile. We might expect that the proposed small bore, the use of modern remote-controlled instrumentation, and especially the absence of complicating seepage and ventilation problems would greatly reduce the cost from that of conventional tunneling. So this cost might well be commensurate with that of many modern group attacks on other basic areas of science, as is indicated in the first paragraph. I should like to thank James Garvey for many discussions, and for encouragement in this matter.

FRANK B. ESTABROOK
Basic Research Branch, Los Angeles Ordnance District, Pasadena, California

Teachers, Second Class?

In the letter by J. W. Still [*Science* **124**, 408 (31 Aug. 1956)] there is an implication that is frequently made by members of university staffs. The concept here implied is that one cannot be an effective teacher unless one worships the deity of research. This is too rarely challenged by those who teach in colleges and secondary schools where research is limited or does not exist. Perhaps the idea has developed because the top positions in the universities are open only to research personnel.

Why is research (of the classical type) essential for effective teaching? Does an expert on mice give a better course in general zoology or even in mammalogy? Does a protozoologist have greater insight into the evolutionary picture? I doubt it. In fact, this may often be a detriment by distorting the balance of the presentation.

There are individuals in any university who are strictly research persons, not because there is no need for them as teachers, but because they cannot teach. We do not call them second-class researchers for this reason. But one who teaches and does not do research is considered second rate.

Actually, a good college teacher keeps up with a far greater variety of scientific literature than the professional research

worker can afford to follow. His picture of science is usually broader and better balanced—even his training has usually been along broader lines. That there are those who can do both teaching and research well is a marvelous and rather rare thing. But please credit the teacher for his art and stop insisting that he is only second rate because his only research lies in the challenge of a vast literature.

JAMES P. HEATH
San Jose State College,
San Jose, California

Science and the Department of State

J. J. Nassau has illustrated well, with the specific case-history of Daniel Chalonge [*Science* **124**, 127 (20 July 1956)] the workings of the State Department's "exclusion principle." Were it not, in the long run, harmful to the general interests of science and to the good repute of our country, this policy would be ludicrous. The situation is further worsened by the invention of a "seclusion principle," which I should like to illustrate also in a specific case, my own.

Recent work in my laboratory has, we believe, important implications for the nature of bioelectrogenesis and of synaptic transmission. A paper before the 20th international Physiological Congress at Brussels was to deal with some of these. I had also made plans to meet with French and British colleagues to discuss these matters but was forced to default on all these commitments because the State Department refused me a passport.

I have also had to turn down invitations for visits to several Latin-American universities and that in Jerusalem which were planned to help enlarge the scope of their neurophysiological research. Once before, in 1952, I was prevented from visiting Israel, chiefly in my capacity as the chairman of the Medical Advisory Board to the Hebrew University and Hadassah. That visit was intended to expedite planning of the magnificent new medical center which is now beginning to rise near Jerusalem.

I happen to hold political views somewhat at variance with those which John Foster Dulles trumpets with confidence and moral unction. This is my privilege as an exercise of conscience. I am also a member of two organizations that the Attorney General in his alleged authority has placed on an *index expurgatorius*. The National Council of American-Soviet Friendship, organized during Hitler's threat to civilization, received considerable encouragement from President Roosevelt's administrations. In the face of the present, even greater threat from the hydrogen bomb, President Eisenhower and some of his colleagues are aware of the need again for American-Soviet friendship—but not, it seems, the Attorney General or the Secretary of State. The Committee for the Protection of the Foreign Born is also proscribed. Whatever the curious reasoning for this, A. J. Carlson has testified eloquently and cogently against its "subversive" label. Foreign-born also, I share Carlson's views and do not concede the Attorney General's legal or intellectual right to make proscriptive lists. Therefore, although I do not have the time to be active in these two bodies, I do not propose to resign in order to grovel for a passport.

Multiplied even a few times, the operation of the State Department's two "principles" affects unpleasantly foreign opinion of our country. Within, the effects may be more disastrous. Our country is fortunate in its wealth and high general level of education. The present high state of our science reflects these factors, but can we afford even a "little" Chinese Wall, which hinders scientific communication? Another effect is the tendency to breed conformity and intolerance, modes of thinking that become deadly when carried over into science. Many thoughtful people suspect that such a spilling over has already begun. Certainly, there is not today a concerted expression of outrage at a beaurocracy which, although irrational and silly, is also actually or potentially harmful to science. Do not our scientific societies, dedicated to the promotion of science, have an obligation to react vigorously; to alert public opinion against the stupidities and their dangers? Can they afford to be silent and still remain true to their trust?

HARRY GRUNDFEST
Marine Biological Laboratory,
Woods Hole, Massachusetts

Smugness and "Success"

It seems a pity that the delightfully uninhibited Agnes Brues [*Science* **124**, 409 (31 Aug. 1956)] begrudges us scientists the right to be oracular, useful, and smug in the one easy, simple way we might help to counteract the pitfalls of the present technologic society. She does not, I suppose, approve of any legislation to "protect" the ignorant or the lone widow, and she has revealed to me how dodderingly paternalistic my social concepts have remained, in this clean, competitive world.

John Tyndall, one of my scientific heroes, was a trifle smug; so is the—apparently competent—surgeon who cut me up. Something of classics in the matter of smugness are literary and art critics, Hollywood stars, and the staff of a prominent news magazine. A really top-flight performer in this line is a popular politician from the lady's part of the country, who carries on despite a recent alleged come-uppance.

The lady undoubtedly agrees that all these are examples of smugness and bossiness. A freedom to indulge these vices, more or less disguised, seems to be an incentive to "success." Is the purer form of egghead a poor disguiser, or just too small an operator? Or does he needle us to face, today, unpleasantnesses we should rather maybe glance at, tomorrow?

Despite seeming dissent, let me say: if all citizens were as hard to sell as Agnes Brues, most occasion for social correctives would vanish.

HERBERT O. ALBRECHT
Bartol Research Foundation,
Swarthmore, Pennsylvania

Second BS Degree for Teachers

In relation to the master's degree for teachers [*Science* **124**, 322 (17 Aug. 1956)] I wish to make three suggestions to the AAAS Council for action during this year.

I propose that (i) the Council go on record as opposing any actions which tend to reduce the traditional high standards of the MS degree, (ii) the Council consider recommending to the nation that a second bachelor's degree be recognized as a more suitable training for school teachers than a diluted MS degree, (iii) if for any reason the preceding recommendation could not be made (slight modifications of existing rules concerning second BS degrees should remove the sound reasons against them), the Council should recommend to the nation that if the MS degree for teachers is allowed, it should be so designated —MST.

In reply to John Mayor's statements about the problem of teachers in classes with freshmen and sophomores, my experience of two decades says that there is no problem, once they are actually in the classroom. Teachers in the college classes are almost always good students, and it is a pleasure for the college teacher to have them in class.

I join with Jerry Kollros in urging that the AAAS do some "promoting among school boards and any other controlling agencies." Other avenues for influencing education are likely to be plugged by men of good will acting on concepts of extremely limited applicability which they mistake for general truths.

RALPH W. LEWIS
Department of Natural Science,
Michigan State University,
East Lansing