Letters

Radiation Hazards

It is reported in "Science in the News" (*1*) that fallout amounts to about 1 percent of the man-made radiation. Although this evaluation is given in somewhat ambiguous terms, fallout radioactivity is placed in the same category as the radiation hazards from wrist watches and TV sets.

The most recent data derivable from reports (*2*) issued by the Atomic Energy Commission and its laboratories allow an accurate evaluation of the fallout radioactivity for the specific time period of March 1959 through February 1960. The total contribution of Zr^{95}, Ru^{103}, Ru^{106}, Cs^{137}, Ce^{141}, and Ce^{144} amounts to 68 millirad, if a uniformly contaminated, infinite, smooth plane is assumed. These data were obtained for land in the Chicago area where the natural background radiation, including cosmic rays, is 97 mrad/yr. (*3*).

Thus, for the most recent period for which data are available the "open field" radiation level averaged 67 percent of natural background radiation. It is to be expected that the fallout activity will decrease markedly during 1960, provided nuclear tests are not resumed. For example, the fallout level for January of this year averaged about 25 percent of the background radiation.

The highest value measured for fallout in the United States, exclusive of local "hot spots," was recorded during April 1959 as 8.41 μrad/hr, or a full 75 percent of that from natural sources (*4*). The principal contributor to the fallout dosage at that time was 65-35 day Zr^{95}-Nb^{95}, which accounted for 78 percent of the total. This relatively short-lived activity gained prominence in fallout due to the unexpectedly fast global deposition of fission products from the Soviet series of tests in October 1958. Charles Dunham, director of the Division of Biology and Medicine of the Atomic Energy Commission, has stated (*5*) that a report on "hot spots" and short-lived activities in fallout will be issued soon.

A comparison has been made at Argonne National Laboratory between the calculated radiation dose from fallout and radiation as measured by a sensitive ionization chamber (*6*). For the April 1959 period, a measured value of 18.5 μrad/hr compares with a calculated value of 19.5 μrad/hr for natural background radiation plus fallout.

The "open field" radiation levels may be criticized on the basis that they do not apply to real radiation doses absorbed by human beings, since people spend much of their time inside buildings where physical factors such as geometry and absorption serve to reduce the radiation dose. This shielding effect is difficult to estimate, being different for rural and metropolitan structures. One would expect, however, that an average shielding factor of 4 might apply.

Spokesmen for the Atomic Energy Commission, the Public Health Service, and the Federal Radiation Council (*7*) have been somewhat ambiguous in statements made about fallout. In giving values for fallout radiation levels they sometimes fail to specify what fallout nuclides are assumed to be involved, what time period is covered, and how the radiation dose is meant to apply.

The situation is even more complex with regard to the reporting of the internal hazard associated with the uptake of fission debris in human beings. The Fallout Prediction Panel convened by the Joint Committee on Atomic Energy predicted, in the course of an investigation by the Committee in May 1959 (*8*, p. 1793) that, in the latitude zone 20° to 60°N, there would be an 8 strontium unit "average Sr^{90} equilibrium bone level corresponding to average maximum deposition from weapons tests to date." The time of maximum retention of Sr^{90} is still a number of years in the future, and one must be careful to take this into account in reporting on present levels of Sr^{90} in human beings. Additionally, one should be careful to present the data for pertinent age groups and not average in adults, for whom Sr^{90} uptake is small. There is also the problem of estimating how many individuals will exhibit a higher uptake of Sr^{90} than the average of 8 strontium units predicted for the North Temperate Zone. Jack Schubert has estimated (*8*, p. 1638) that Sr^{90} displays a log-normal distribution in human beings and that 28 percent of a sampled group will retain three or more times the average (geometric mean) bone burden of Sr^{90}. I have stated (*9*) that a significant number of the young population will accumulate a Sr^{90} burden delivering a lifetime radiation dose to the bone comparable to that from all natural sources of penetrating radiation.

If these data are accepted, then both the external and internal hazards associated with radioactive fallout cannot be placed in the 1 percent category.

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References and Notes

1. *Science* **131**, 1656 (3 June 1960).
2. "Quarterly Statement on Fallout," *U.S. Atomic Energy Comm. Rept. No. 4* (Apr. 1960); P. F. Gustafson, "Calculation of Background Gamma-ray Dose Based on Measurement of Radioactivity in Soil" (undated memorandum).
3. See P. F. Gustafson, L. D. Marinelli, S. S. Brar, *Science* **127**, 1240 (1958).
4. P. F. Gustafson and L. D. Marinelli, "Fallout Radioactivity and the Dose Arising Therefrom at Argonne National Laboratory, Lemont, Ill.," appendix to the statement of A. M. Brues in "Fallout from Nuclear Weapons Tests," *Proc. Joint Committee on Atomic Energy* (1959), vol. 2, p. 1400.
5. C. Dunham, verbal comment made during the Joint Committee on Atomic Energy hearings on radiation protection criteria and standards (31 May 1960).
6. P. F. Gustafson, "Assessment of the Radiation Dose Due to Fallout," *Argonne Natl. Lab. Mem.* (1 Oct. 1959).
7. "Radiological Health Data," *U.S. Public Serv. Rept. No. PB 161371-1* (Apr. 1960); "Radiation Protection Standards," Federal Radiation Council staff report (13 May 1960).
8. "Fallout from Nuclear Weapons Tests," *Proc. Joint Committee on Atomic Energy* (1959), vol. 2.
9. R. E. Lapp, *Bull. Atomic Scientists* **15**, 311 (1959).

Our news article was only a summary of what appeared to be the commonly accepted view among the scientists testifying at the radiation hazard hearings. Our wording, as Ralph Lapp points out, was ambiguous. In particular, we should have made it clear that the reported figures referred to the accumulated dose over a period of years. At this time, while fallout is at its peak, it is, as Lapp points out, substantially more than 1 percent of background radiation, although this does not necessarily conflict with the view that the accumulated dose over, say, a 30-year period will be roughly equal to that from television sets or luminous watch dials.—ED.

Education and Research

As an interested outsider to the academic field, I have been keenly following the minor debate on teaching and research. May such an outsider offer an opinion?

The question put in the editorial [*Science* **131**, 71 (8 Jan. 1960)], "why . . . should some instructors oppose the recognition of good research as a consideration second to good teaching?" is, it seems to me, answered by the spirit displayed in Paul Bohannan's letter [*Science* **131**, 1282 (29 Apr. 1960)]. Bohannan's apparent position, that any scholar not doing research simply cannot be a fully effective teacher, represents the camel whose nose the instructors are trying to keep out of the academic tent by refusing to recognize research at all. Bohannan may be describing a worthy ideal, but F. J. Allen's letter [*Science* **131**, 944 (25 Mar. 1960)] has the honest ring of reality.

Surely, a well-balanced view of the situation would run something like this:

1) The primary mission of a college is to educate its students, not to conduct research.

2) Research at such an institution is desirable for two reasons: (i) for the educative value of exposing the student to an environment in which research is

conducted; (ii) to attract instructors who, by reason of inclination and ability, wish to divide their time between research and teaching.

3) It is not necessary under these circumstances that all instructors be researchers.

4) Due recognition being given to the contribution that research makes to education, all faculty members should be evaluated on the basis of their contributions, made in various ways, to the primary mission: education.

My own undergraduate experience of a decade ago tends to bear out Allen's contention; the better teachers on that level were not deeply involved in research. At any rate, an attempt to find the proper place for research in a college is not at all helped by broad claims for the essentiality of research.

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Differentiation of Basaltic Rock

In his excellent article on granite, Walton [*Science* **131**, 635 (1960)] discussed the problem of deriving granitic rock from a parent basaltic magma. He summarized the classic ideas on processes of magmatic differentiation, and he elaborated on mechanisms for selective mobilization of certain rock-forming components under high temperatures and pressures. As he noted, the components at the apex of Bowen's reaction series will be selectively mobilized in the presence of high pressure of water vapor and temperature of about 700°C. This is the means by which granitic rock tends to be formed at the expense of other rocks. His statement, however, neglected a consideration of differentiation at the surface of the earth; and yet this is a fundamental part of the geologic cycle.

Surficial processes of weathering, erosion, transportation, and deposition accomplish a differentiation of rock-forming components. Some of the products of weathering of, for example, basaltic rock, are carried in solution or colloidal suspension, and others are carried as detrital particles. The resulting sediments include cherts, iron oxides, carbonate rocks, evaporites, and detrital sediments, with hydrated clays and connate water. There may be a geographic concentration of some of these deposits in some places and others in other places.

Nonetheless, the total complex of materials that accumulate in a geosyncline should approximate the total complex of materials eroded from the source region. But, the rock-forming components are arranged differently in the sediments than in the source rocks; and with geosynclinal downwarping to zones of higher temperature and pressure, the now-unstable components in the sedimentary rocks will react more readily to selective mobilization than will the components in basaltic rock. Thus, in one or more geologic cycles, granitic rock can be derived from basaltic rock, through surficial processes followed by plutonic processes.

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I welcome Baldwin's commentary, which adds another perspective to my review of "Granite problems." He and I studied together under that staunch magmatist S. J. Shand, who was wont to remark that sediments bear the same relationship to rock as sawdust does to the living tree. Shand said it with an ironic twinkle in his eye, and yet there were overtones of the traditional "hard-rock" school, which tended to regard weathering and sedimentation as the terminus of the rock-forming process rather than a stage in a major geochemical cycle. If, in not dealing explicitly with this broader aspect of the problem, I betrayed relics of a "hard-rock" bias, I am glad it is an old Shand man and fellow student who puts the matter straight.

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Evaluating New Drugs

I would like to point out one error in the article on drug hearings [*Science* **131**, 1299 (29 Apr. 1960)]. It is stated that at the present time physicians have no convenient index for evaluating pharmaceutical products except for the printed information from the various drug manufacturers.

In 1959 the bi-weekly *Medical Letter* began publication. This is a publication of Drug and Therapeutic Information, Inc., 136 E. 57 St., New York 22. The *Medical Letter* is a nonprofit publication having as its aim the dissemination to the medical profession of information concerning manufactured drugs. It has an editorial board of university faculty members who advise, through the medium of this publication, what is a valuable addition to the therapeutic armamentarium and what is not. The board of editors also frequently points out differences in the costs of similar products, comparing the prices of drugs under generic and trade names. This publication is available on subscription.

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Meetings

Southwestern and Rocky Mountain Division

The Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science held its 36th annual meeting in Alpine, Tex., 1–5 May 1960.

Members of the division were special guests of Sul Ross State College at ceremonies for the dedication of the new Science Building on 2 May. Later that day Chauncey D. Leake, president of the AAAS, delivered the opening address of the meetings, speaking on "Communications among scientists in relation to the unity of science." Dael Wolfle reported on the general activities of the Association.

Programs of the sections of the division included 48 individual papers. Two symposia consisting of invited papers were conducted. One of these, extending through two sessions, was sponsored by the division's Committee on Desert and Arid Zones Research. It was presented by eight specialists in the fields of agriculture and forestry and dealt with problems of water yield in the Southwestern United States. In the other, the fifth in a series of symposia on the improvement of science teaching, curriculum studies in the fields of science were discussed. Members of each of the curriculum study groups were present to conduct these discussions.

The division's annual John Wesley Powell memorial lecture was presented by Knox Taylor Millsaps, chief scientist, Air Force Missile Development Center, Holloman Air Force Base, who spoke on fluid flow in circular pipes.

Retiring divisional president Lora M. Shields, professor of biology of the New Mexico Highlands University, delivered the presidential address, entitled "No life for a lady."

Members in attendance were special guests of the McDonald Observatory, on Mount Locke, on one evening during the meetings. The observatory staff very graciously set aside their regular observation program to demonstrate the 82-inch refractor telescope and to give the visitors a view of the heavens such as few of them had ever seen before.

The final day of the meeting was devoted to a field trip into the Big Bend National Park. Under the direction of park naturalist Harold Broderick, the group was able to observe many of the interesting geological features of the area, and with the desert flora in full show, the botanical observations were equally interesting.

Newly elected officers of the division include Alan T. Wager (Arizona State University), president; Anton Berk-