# Letters

## Leukemia and Radiation

Brues article "Critique of the linear theory of carcinogenesis" [*Science* **128**, 693 (1958)] is an admirable and highly critical review which deals particularly with the relationship of human leukemogenesis to ionizing radiation. Many good points are made indicating that there may be a nonlinear relationship of radiation dose to leukemic end result. In the end, however, one is faced with the usual difficulty of trying to assess which of the different interpretations derived from the same sets of data is correct. Brues would be the first to admit, I am sure, that his interpretations, however well reasoned, may be as far from the mark as the next man's.

The statement is made (page 694) that "this steady increase [in incidence of leukemia in the United States] has been *loosely* attributed to an increase in human irradiation (*17*)" (italics mine). The reference is to an editorial of mine written in 1947 ["Is leukemia increasing?" *Blood* **2**, 101 (1947)] in which some comment is made upon an article by Sacks and Seeman appearing in the same issue. Various possibilities for the apparent increase in incidence of leukemia are discussed, including those of radiation and chemical exposure. Indeed, most emphasis is placed upon various forms of chemical exposure and their possible leukemogenic effects. There is no mention (in this editorial) of "an increase in human radiation" as Brues rather "loosely" states. However, the prophetic statement is made, shortly after the event and before any cases of leukemia were described, that "it will be of interest to observe the Japanese survivors of the atomic bomb for future indications of proliferative disease of the white cells."

Brues may have reference to another editorial published more recently [W. Dameshek and F. W. Gunz, *J. Am. Med. Assoc.* **163**, 838 (1957)] in which the suggestion was broached that the apparent increase in incidence of leukemia may be due, at least in some measure, to the increasing exposures of affluent populations to diagnostic and therapeutic x-radiation. Although some of the conclusions were admittedly speculative, it seemed fitting in this editorial to emphasize the potential dangers of radiation therapy for nonneoplastic disease and of unnecessary and frequently repeated diagnostic x-ray procedures.

In our recent book *Leukemia* [W. Dameshek and F. W. Gunz (Grune and Stratton, New York, 1958)] Gunz and I discuss the matter of leukemogenesis and ionizing radiation at length and conclude from all the available data that only about 15 percent of the cases of leukemia can reasonably be ascribed to radiation and that there are other etiologic agents such as chemical exposure and heredity which it is just as important to emphasize. It may well be that the various leukemogenic agents that have been discussed (ionizing radiation, carcinogenic chemicals, viruses, heredity) act by inducing a modification or "deletion" of certain cellular enzymes, thus leading to an altered type of growth pattern for a certain number of cells, depending upon (i) the dose and (ii) the tissue. The leucocytic tissues, already "generalized," will respond in a generalized—that is, leukemic—fashion. However, it is also possible that a very small clone of abnormal cells may develop which is insufficient to do much damage or may indeed be overwhelmed.

Brues article, which is a model for a critical review, is well worth reading and carefully digesting.

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My blunder in attributing this view to Dameshek is the sort of thing that is the nightmare of anyone who prepares an extensive bibliography. While others have loosely attributed to radiation many things which are changing or thought to be changing, he is not one of them. I apologize particularly because he has maintained and voiced a balanced and reasonable view of the whole problem.

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## Excessive Education Department Requirements

Recently I wrote a letter to *Science* [**128**, 1156 (1958)] mentioning, among other things, the excessive education department requirements for science teacher certification. It was implicit in the discussion that university science departments had produced thousands of fine science teachers who are barred from secondary-school teaching positions in most states because they would not spend a fifth to a quarter or more of their university time taking education department courses.

Subsequently, the 85th Congress passed Public Law 85-864, which by its own terms may be cited as the National Defense Education Act of 1958. Certain provisions of this act create concrete financial difficulties for student borrowers because of the excessive education department requirements.

Title II of the act provides for student loans of up to $5000, and in section 205 (b)(3) provides for cancellation of the obligation to repay up to 50 percent of the loan as a reward for specified time spent in teaching in public elementary or secondary schools. Thus, a student borrower who after graduation goes into teaching is entitled to what amounts to a bonus of up to $2500. Yet regardless of the fact that a science department believes the man well qualified to teach science, he must also satisfy the education course requirements, which have been lobbied into the regulations in most states. The student who won't give time to all the required education department courses is penalized up to $2500, and his services are lost to the public-school system. The student who must heed the $2500 bonus provision must spend time on education department courses which might be better spent on solid subject-matter courses. The Defense Education Act thus becomes in effect a force feeder for the already disproportionately large education departments.

It seems more important than ever that scientists and science departments rather than educationists should prescribe the qualifications for science teachers—that a science department teaching recommendation be admitted in lieu of an arbitrary number of education courses for teacher certification. The American Association for the Advancement of Science can properly advise state regulatory bodies that the quality of teaching will be improved, not lowered, by elimination of all education department courses not deemed necessary by the science department to fit each individual case.

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## Scientific Communication

A recent editorial [*Science* **127**, 1145 (1958)] and a letter by D. Lebo [*Science* **128**, 424 (1958)] have called attention to increasingly critical problems of scientific communication. Some attributes of an improved communication system are (i) capability of evolving from the existing system; (ii) reduction of delays in communicating results; (iii) coverage of a broad range of scientific interests (reversal of the trend toward overspecialized journals); (iv) guarantee of self-determination to the individual author (elimination of editor-referee censorial power and of pressure toward source-material abridgment); (v) guarantee of self-determination to the individual subscriber (elimination of unwanted material from his mail, unlimited availability of wanted material); (vi) incurrence of no added cost.

The following hypothetical system illustrates the possibility of reconciling these apparently divergent requirements. The contributor prepares a full account of his research, sparing no detail. He also prepares an abridgment of perhaps two pages and a conventional abstract. The full account receives an identification number and is permanently filed in a central repository. The abridgment is printed, with its number, in a bound journal resembling (except for its broader scope) the appropriate existing journal. Thus, the necessary evolutionary link with the present system is provided. The abstract is not, as now, adjoined to the article but is printed, with identification number, on a separate card.

The journal subscriber receives with each issue the corresponding stack of abstract cards (optionally he might wish to receive only the cards). These may advantageously be border-punched cards [G. Cohn, *J. Franklin Inst.* **266**, 133 (1958)], partially prepunched to provide rough classification assistance. Most of the border holes are left unpunched, to allow the subscriber to apply his own information-retrieval methods and adapt his punching system to his personal needs and mnemonic habits. (The required tools are simple: a punch and a sorting needle. To retrieve abstracts in a given category, form cards into a deck in any order, pass the needle through the appropriate hole, spread and lift the deck; the punched cards fall out.)

By postcard, included with the abstract cards, subscribers request photocopies (or other facsimile reproductions) of those full accounts that interest them. If the latter prove scientifically exceptionable, the volunteer "referees" have a professional obligation to communicate their suggestions to the authors. Profiting from such criticisms, authors may issue revisions to supersede their earlier accounts. The constructive aspects of the present refereeing system are thus retained and enhanced, since a maximum number of maximally interested referees are effectively consulted. The editor, too, plays a more constructive role. He can select for full publication articles worthy of general attention, or those for which the demand exceeds the resources of economical facsimile copying, but he suppresses nothing and delays nothing.

Subscribers might be entitled to annual allowances of facsimile material, extra requests being charged on a per-page basis. The reprint problem is solved automatically. Savings in type-setting costs resulting from the abridgment policy might offset the cost of abstract cards.

It is hoped that these suggestions may encourage scientists to experiment with evolutionary improvement of traditional publication procedures.

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