Comments and Communications

Distribution of Funds for Medical Research

In a recent leading article (*Science*, February 6, pp. 127–130) Clarence A. Mills, of the University of Cincinnati, severely criticizes the present manner of distribution of funds for medical research, thus bringing into the open a matter which has been the subject of a vigorous whispering campaign for a year or more.

The basis of Dr. Mills' criticism is that although the northeastern group of states, including Maryland and the District of Columbia, contain slightly less than 30% of the population of the United States, universities and other institutions in that area receive approximately 40% of Federal funds allocated for medical research and considerably more than 40% of funds allocated by privately endowed foundations and those supported by voluntary contributions from the public.

Moreover, a relatively few large privately endowed universities, notably Harvard, Yale, Columbia, and Johns Hopkins, now receive, in the opinion of Dr. Mills and those who share his point of view, a disproportionately large share of these funds; the serious charge is made that large funds are received because the memberships of consulting committees which recommend the grants are heavily weighted with faculty members of these same universities.

Phrases in Dr. Mills' article, such as ''long-term dominance exerted over medical research by the older institutions of the eastern seaboard,'' ''disturbing inequalities in the granting of such funds,'' ''pernicious in end-results,'' tend to obscure two basic considerations: (1) that disbursing bodies would seem to be under obligation to place medical research funds where they believe the most productive research will ensue; (2) that the results of research benefit not primarily the institution or the locality in which it is carried on, but the country as a whole.

Men make discoveries, not institutions; in general, the more gifted the individual, the more will be his contribution to society. It has been my privilege to serve at various times on committees responsible for recommending research grants. These committees work hard, for it is not easy to spend research funds wisely. Invariably, discussion centers around the qualifications of the individual who is to be the responsible investigator, with little or no consideration being given to the university in which that person happens to be working.

Important among secondary factors favorable to productive research are believed to be the amount of time free of teaching or private practice available to the responsible investigator and his principal assistants, adequate laboratory space, basic equipment, and various ancillary services. It so happens that these favorable factors are found more abundantly in some medical schools than in others. Moreover, several universities include not one large group devoted to teaching and research, but two—a school of medicine and a school of public health, each with largely a full-time faculty, independent study body, and separate physical facilities. On the other hand, in many medical schools faculty members are heavily loaded with teaching and private practice, leaving little time for research.

In Volume 5 of *Science and public policy*, the report of the President's Scientific Research Board, the desirability of encouraging the development of medical research in the smaller and less well-known institutions is recognized. The National Advisory Health Council and the consulting committees of the National Institute of Health responsible for the allocation annually of approximately \$7,000,000 of Federal funds for research in medicine and related sciences are keenly aware of this problem and are consciously making grants designed to support new groups in this field. But it is asking too much for research funds to bolster the whole structure of medical education throughout the country. Until medical schools are in a position to support a substantial portion of their faculty on a full-time basis, with sufficient free time for research, merely making grants to those institutions for specific research projects will not solve this important problem. The responsibility of the Federal Government with respect to medical education is another matter, which is beyond the scope of this letter.

At the present time therefore, allocation of Federal research funds on a strictly population basis, even within states, as Dr. Mills recommends, would lead to waste of public money and to shortchanging the people as a whole, who stand to benefit from medical research.

Research should be widely encouraged and supported wherever the opportunities seem promising. But to grant funds far beyond the capacity of an institution to use them to advantage is of questionable value, while to withhold funds from institutions where men and facilities are available appears to be contrary to the best interests of the country.

THOMAS B. TURNER

The Johns Hopkins University

Growth of Stumps

A view is presented here on the problem of stump growth. It is suggested that fluctuating temperatures during the winter and early spring initiate the cambial stimulus in the buds and everywhere in the bole, and that the downward course of its passage is governed by increasing diameter of the axis. This suggestion holds for stumps as well as standing trees. From the aspect of this thesis, the cambial stimulus is considered as enzyme activation and the change of stored foods to soluble products.

Stumps differ in behavior. Those of hemlock (W. J. O'Neil. *J. Forestry*, 1928, 26, 244–245), larch, and white fir increase in diameter, but those of spruce and most pines do not (J. H. Priestley. *New Phytol.*, 1930, 29, 316–

351). A few stumps of eastern white pine have been observed to callus over and increase in diameter (George S. Perry. Personal correspondence, 1939). Hemlock stumps will increase in diameter due to root graft unions with standing trees (O'Neil, *op. cit.*). A report cited by Priestley (*op. cit.*) states that a larch stump in a beech forest grew in diameter though no other larches were present. Stumps of many dicotyledons but few conifers produce shoots, and these appear at different levels on the stump. Most of the shoots from a stump are considered to have traces that extend to the pith. This view seems untenable to me, however, since (*Science*, October 4, 1946, p. 329) many shoots arise below the root collar, and error is possible with regard to the first few annual rings. Many factors of the environment are able to induce the formation of adventitious buds.

The reasons for the differences in behavior between stumps are obscure. Such factors as water supply, temperature, food reserves, responses to wounding, and the activation of buds of standing trees have been studied. Similar work is necessary with respect to activities in stumps.

A number of facts are known. Some of the stumps that increase in diameter have root graft unions with standing trees. Buds remain viable in stumps for varying periods of time. Diameter growth of the stump and the emergence of shoots from it indicate that the conditions favorable for meristem maintenance (and probably initiation as well) are present. It is obvious, therefore, that enough food and moisture are available and that a stimulus to bud and cambial activity appears.

The cambial stimulus is a process, not yet understood, that results in the initiation of cambial activity. In a standing tree the impulse to renewed cambial activity begins in the swelling foliar initials and then proceeds in a downward course to and into the roots, where such activity is sluggish and perhaps continuous (J. H. Priestley and Lorna I. Scott. *An introduction to botany.* New York: Longmans, Green, 1938; J. H. Priestley. *New Phytol.*, 1930, *29*, 316–351). It probably does not enter the stumps across the root graft unions because the normal course in the tree is downward. Nutrient solutes available in the spring may be the cambial stimulus (Priestley and Scott's *An introduction to botany*; J. H. Priestley. *Forestry*, 1935, 9, 84–95). Contrary to the belief of many investigators that hormone action is the stimulus, it is suggested (*Forestry*, 1935, 9, 84–95) that solutes released in sieve tube differentiation during the spring are the cambial stimulus. There is also a suggestion (O. F. Curtis. *The translocation of solutes in plants.* New York: McGraw-Hill, 1935) that food solute movement and an electrical gradient are parts of the complex. It seems to me that there might be a condition that is something like after-ripening of seeds, with fluctuating temperatures, simulating seed stratification, entering into the situation.

Such fluctuation may lead to enzyme activity and make food reserves soluble in the swelling foliar initials, differentiating dividing tissue beneath quiescent growing points, and (in secondary tissue) in the phloem parenchyma and xylem ray parenchyma. This situation appears first in the buds because the diameter there is small. The process would follow a downward course through the shoots and the bole in the direction of increasing diameter. Such changes would lead to sieve tube differentiation in the phloem parenchyma, followed by cell division in the growing points and cambium, and the production and differentiation of primary tissue beneath the shoot apices. Solutes from the parenchyma elements, and finally from differentiating vascular elements, would lead to the nourishment of buds and an increasing expanse of cambium until all the elements in all the meristems are engaged in cell division. This basipetal progression of solute availability, begun by fluctuating temperature and governed by diameter, is the cambial stimulus.

Given a stimulus that begins and behaves in this manner, such an appearance should be equally possible in both standing trees and stumps. Only moisture, stored foods, and fluctuating temperature would be needed. A multiple of buds would not be necessary. The speed of the stimulus in ring-porous trees would seem to be too great for a downward movement of hormones. It is, more likely, a downward development of transverse availability of solutes, perhaps influenced by delaying action effects of bark of increasing thickness in a proximal direction. The effect of disbudding in delaying the downward spread of cambial activity would in consequence have to be within the realm of some other condition than hormone action—and what that is I do not know. Perhaps it may be interference with hydrostatic units that have to begin somewhere in a meristem terminal. The fact remains that stumps are known to increase in diameter. It is also certainly reasonable to believe that solute formation that is incidental to temperature would take place in regions of small diameter sooner, but would nourish cambium equally well anywhere.

ISADOR AARON

P. J. Oesterling & Son, Inc.

Courses on the Biochemistry of Cancer

In a recent announcement of a course on the Biochemistry of Cancer to be given this summer at the University of California (*Science*, February 6, p. 137) it was stated that it would be the first of its kind offered in a U. S. university. J. Murray Luck, professor of biochemistry at Stanford University, in a Letter to the Editor, comments that "... Stanford University already offers a course of lectures on the 'Biochemistry of Cancer.' Dr. Clark Griffin is the instructor, the present enrollment is 40, at has been in progress since January 7, and will be repeated annually." H. P. Rusch, director of the McArdle Memorial Laboratory for Cancer Research, University of Wisconsin, writes: "A course in Experimental Oncology emphasizing biochemical aspects is now a part of the official curriculum. . . . It is being given during the present semester by the faculty of the McArdle Memorial Laboratory for Cancer Research. Twenty-one graduate students are enrolled."