Letters to the Editor

Degradation of Streptomycin and the Structure of Streptidine and Streptamine

Recently the degradation of streptomycin to a diguanido base (streptidine) and the corresponding diamino compound (streptamine) was described, and evidence was presented that streptamine is either a 1,3- or 1,4-diaminotetrahydroxycyclohexane (*Science*, 1946, **103**, 53–54). Convincing data have now been obtained supporting the former structure. Oxidation of N,N-dibenzoylstreptamine with periodate yields a substituted five-carbon dialdehyde (I) (m.p. 130–131° C.) which appears to exist in a hydrated cyclic form (1,3,5-trihydroxy-2,4-dibenzoylaminotetrahydropyran). The triacetyl derivative of I is a beautifully crystalline substance (m.p. 217° C.). Oxidation of I with bromine water yields a dibenzoylaminohydroxyblutaric acid (m.p. 197–198° C.). These products are to be expected from 1,3-diaminotetrahydroxycyclohexane but not from the 1,4-diamino isomer. Hence, these data, in conjunction with the previously presented evidence, establish the structure of streptamine as 1,3-diamino-2,4,5,6-tetrahydroxycyclohexane. Streptidine is the corresponding 1,3-diguanido compound.

Streptamine is optically inactive and probably represents one of the eight possible *meso* forms. Correlation of the configuration of streptamine with that of *meso* inositol is an interesting problem with which we are now engaged.

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Scientific Research and National Welfare

H. S. Reed (*Science*, 1945, **102**, 524) apparently writes in behalf of the Executive Committee of the Pacific Division of the AAAS and makes certain statements to which one might take serious objection. The conclusion of his letter reads as follows: "For the first five years the Board of Research and Development could utilize existing laboratories. No greater mistake could be made than to spend large sums at present in the construction of Federal laboratories. It would be much better to make grants of funds to private industrial laboratories or educational institutions under the supervision of the Board of Directors. It will take nearly five years for the board to prepare an adequate program for research. In its essence, men and their intellects are the important things in research rather than lofty buildings. I am not in favor of having the research funds spent in the existing laboratories of the Federal Government because I do not believe that there are now men in those laboratories who are capable of directing basic scientific researches, except in a few cases."

The undersigned, in the belief that the somewhat unfortunate wording of the above statement was not intended to be taken literally, is writing this letter for the purpose of clarification of the terminology used, in the hope that this clarification will have sufficient circulation through the medium of *Science* to rectify the unfortunate impression which a misunderstanding of terminology implies.

As a pure academic scientist, the undersigned (in his capacity as reserve officer in the U. S. Navy) has been closely associated with aspects of the problem of national scientific welfare in connection with national defense. In an attempt to clarify this problem the undersigned published an article entitled "Naval research in peace and war" (*Proc. nav. Inst.*, 1945, 71, 1169). In this article some clarification of the terminology and the necessity for adequate support of Federal research laboratories for national defense were set forth in detail. In what follows the essence of this analysis, pertinent to Prof. Reed's letter, is presented with the hope that it will serve to clarify the situation:

What Dr. Reed and many others do not appreciate is that there is much more to the question of industrial and national defense research than is implied in the pure scientists' view of research. The undersigned has chosen to classify three aspects of the scientific research as it affects national welfare. These are: (1) the pure or *fundamental research* which leads to an understanding of the laws of nature, the discovery of new facts and laws, and the theoretical development of that knowledge; (2) the *basic research* as it applies to industrial or military development involving basic studies of the fruits of fundamental work to determine their potentialities antecedent to application; (3) the *applied research* and development.

Each of these phases is essential to national welfare, and each has its own specific requirements and qualifications. Thus, *fundamental research* must be unrestricted as to problems, mode of attack, scope, freedom of publication, etc. It is vital to the country's welfare, for whatever nation is paramount in *fundamental research* will also excel in the other phases. The logical place for this work is primarily in the academic environment and perhaps in a few specially equipped industrial and government laboratories. Primarily, government laboratories are intended to furnish research of types *more immediately* profitable to the Nation's needs and welfare, which must in some degree limit the amount of the often wasteful effort which goes into pure or *fundamental research.*

Basic research is usually somewhat more expensive. It requires larger fields for application and test and is definitely the concern of academic engineering schools, industrial laboratories, and the Federal Government laboratories. It perhaps should not have too many restrictions on freedom of effort, method of attack, and freedom of publication. However, in many questions vital to the Nation's welfare there may be urgent need for secrecy or classification. This point is often over-

looked. Such classified research is inimical to the spirit of academic institutions. Because of this influence as well as the difficulty in maintenance of security, except in the academic engineering field where free publication should be required, this work should not be done in such institutions.

The *applied research* and development of devices is obviously the sole concern of industry and the Federal Government. It is far too costly to be carried out in academic centers and is definitely of utilitarian import. Some of this material can and must be published, at propitious stages of development. Other aspects of this work, both in industry and the Government, must be kept restricted for security purposes. The writer, being familiar with the defense aspects of the problem as it affects the Navy, is convinced that while part of the *basic research* on such measures can be farmed out to industry, it is essential for security reasons as well as for the proper development of the devices that such work be carried out in laboratories directly under the agencies involved.

This statement follows, since the industries are not operated directly for the public and have their own interests and problems, and is based on experience. The need of Federally controlled laboratories applies equally to *basic studies* such as those carried out by the National Bureau of Standards and the U. S. Department of Agriculture, irrespective of whether the material is classified or not. Experience has shown that under these conditions the only solution is to endow the national defense agencies and other Federal agencies charged with specific problems sufficiently to insure the national welfare. Such endowment and support is vital to the national welfare and must receive its share of support with other research activities.

The undersigned cannot agree with the statement of Dr. Reed in saying: "I do not believe that there are now men in those laboratories who are capable of directing basic scientific researches, except in a few cases." This is quite contrary to the experience of the writer, which has been far from limited, even if the writer's term "fundamental" replace the word "basic." There are many highly able and brilliant research men capable of fundamental research work in these laboratories. That they have not done much work of this character results from the fact that they are employed for other purposes and do these well.

It is admittedly true that Federal scientific agencies have suffered under severe handicaps in the past, such as low salaries for the more highly placed technical personnel, difficulties in employment conditions by Civil Service restrictions, and budgetary restrictions. These are conditions that should, and will, be improved. However, it does not assist in improving the situation or in encouraging good men to assist in the necessary Federal Government conduct of research to have such statements as those of the Executive Committee of the AAAS broadcast.

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Temperatures in Deep Wells and the Ice Age

In *Science* (1945, 102, 334–335), the writer published an article entitled "Temperatures in some deep wells in Pennsylvania and West Virginia." A study of the data indicates that, in general, the rate of increase in degrees Fahrenheit, per unit increase in depth, becomes greater.

It has been suggested that the lower temperatures of the recent ice age might be responsible for this phenomenon. The tundra regions of the high latitudes in Asia and North America are frozen, at present, to depths of hundreds of feet and in northern Siberia to a thousand feet or more. The wave of low temperatures of the ice age may be working its way to still lower levels. It is reasonable to suppose that a large area in the United States, during the ice age, was frozen to considerable depth. This might explain the lower rate of increase in temperature per unit of depth nearer the surface than at greater depths.

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Consultant Articles

The purpose of this letter is to suggest a method by which scientific evidence may be tested to determine its validity. It is a common observation that some long-established misconceptions may prevent the acceptance of new observations and thus impede the progress of science. Granting this to be true, science needs fact-finding boards to determine whether or not the evidence presented is sufficient to support a new hypothesis.

The discussion of scientific reports at meetings may air a subject to a certain extent, but generally this is inadequate to test the correctness of new evidence. Those workers who might be able to judge the results rarely express a definite opinion because they wish to have more time for thought and possibly for experimentation. After leaving the meeting, their own problems again occupy all their attention, and so acceptance of a new concept may be delayed year after year.

The "consultant article" appears to offer a solution. By this means an investigator who decides to submit his observations to a searching analysis can determine whether or not evidence supporting his hypothesis meets the approval of authorities in his particular field.

The method of setting up consultant articles has been used in various forms in the *Journal of Dental Education,* in which more than 30 such articles have appeared since 1939. Even textbooks lend themselves to this method of authoritative presentation. B. Orban, together with 18 other authors, prepared a work (*Oral histology and embryology.* St. Louis: C. V. Mosby, 1944) in which each chapter was written by an authority, the entire text then being submitted to all authors a number of times for revisions, additions, and deletions.

Experience has shown that the author of a consultant article must present his evidence clearly and briefly. The principal issue must be focused definitely to limit discussion to major data. This can be done by referring a number of questions to the consultants which