stitute higher education but the men to whose influence students are exposed.

There will always be scientists who prefer industrial research and the higher salaries that go with it, but if the university succeeds in remaining what it originally was, a Universitas Litterarum and an active center of independent research, it will continue to attract the best minds and need not be afraid of competition.

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SCIENCE TALENT IN AMERICAN YOUTH[1]

A RECENT note on the Science Talent Search states that "the methods which are being used, and the conclusions which are being derived, deserve the careful examination of every scientist and of every teacher of science," and that "the sponsors of the examination have an excellent opportunity to gain for science a quantity of data which may determine just what makes a scientist."[2] Such ideas have always been basic in the thinking, planning and operation of this annual competition for the Westinghouse Scholarships, conducted by Science Clubs of America and Science Service. The objectives are:

1. To discover and foster the education of boys and girls whose scientific skill, talent and ability indicate potential creative originality and warrant scholarships for their development.

2. To focus the attention of large numbers of scientifically gifted youth on the need for perfecting scientific and research skill and knowledge so that they can increase their capacity for contributing to the task of winning the war and the peace to follow.

3. To help make the American public aware of the role of science in war and in the post-war reconstruction.[3]

As has been pointed out on numerous occasions[4]—including one conference on the methods of the Science Talent Search attended by Mr. Brandwein—surveys are being made annually of the social, physical and professional development of all the entrants in the first and second contests. This includes detailed information on trip winners, honorable mentions and *non*-winners; similar surveys are being made of all winners in additional years. The resulting materials will be useful in tracing the growth of several thousand young people interested in science as a career, and will also supply significant data regarding selection procedures so that these can be improved if so indicated. As a hypothetical example, if it is found that a significant number of non-winners have made greater progress in science than winners and honorable mentions, it will mean that the factors or evidences on which selections are made in future years will be modified or weighted accordingly.

The 120 who placed highest in the first three contests have been above the average in their scientific studies and endeavors. We are confident that some of them will be great scientists in a creative sense; it is too much to expect that all will. The boy winner of the Westinghouse Grand Science Scholarship in the first year (1942), a recent Phi Beta Kappa, is now in medical school; and the top girl winner of the same year, also a Phi Beta Kappa, has been outstanding in her college career. It is too early yet to arrive at any general conclusions, especially considering the fact that at least 2,088 boys and 39 girls among the contestants in the first and second years are known to be in the military service. In fact, 44 of the 88 boy winners in the first three contests are now in the armed services.

The author of the critical note inquires whether non-winners might become successful scientists, "especially if they obtained the publicity and opportunities afforded the winner."[5] The only way to make a comparison of winners and non-winners and at the same time keep the variable of publicity approximately the same for both groups would be to give equal scholarships also to those who are *not* believed to be potential future scientists—of course keeping the basis of their selection unheralded and unsung—and then to compare the two groups over the years ahead. We wonder how acceptable such an idea would be to our leading colleges and technical schools; would they like to give financial scholarships for probable future scholarly attainment to students who it is thought will *not* be successful in their academic pursuits?

In the meantime we are obtaining a variety of information that may be useful in answering a question recently asked of Dr. Vannevar Bush by President Roosevelt: "Can an effective program be proposed for discovering and developing scientific talent in American youth so that the continuing future of scientific research in this country may be assured on a level comparable to what has been done during the war?"[6] Able young men traditionally have been selected for training at West Point and Annapolis in military

[1] The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

[2] Paul F. Brandwein, SCIENCE, 101: 117, February 2, 1945.

[3] "Science and the Future," Washington, D. C., Science Service, 1943, 126; "Scientists of Tomorrow," Washington, D. C., Science Service, 1944, 134. Copies of these books, containing the essays of all trip winners in the Second and Third Annual Science Talent Searches may be obtained free of charge from Science Service, 1719 "N" St., N.W., Washington 6, D. C.

[4] Harold A. Edgerton and Steuart Henderson Britt, *American Scientist*, 1943, 31, 55–68, p. 67; SCIENCE, 99: 319–320, April 21, 1944; "Science and the Future," *op. cit.*, 114–115. Also, "Scientists of Tomorrow," *op. cit.*, 130.

[5] *Cf.* Brandwein, *op. cit.*

[6] SCIENCE, 100: 542, December 15, 1944.

careers. An attempt is now being made for the first time in our history also to locate and select a small number of capable young men and women each year who can be assisted in their training for scientific careers at colleges and technical schools of their own choice. In a technological world they, too, are an important adjunct to the wartime and peacetime strength of the our nation.

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SCIENTIFIC BOOKS

THE PRODUCTION OF ANTIBODIES

The Production of Antibodies. By F. F. BURNET, with the collaboration of M. FREEMAN, A. V. JACKSON and DORA BUSH. Melbourne: Macmillan and Company, Ltd. 1941. $2.50.

THIS short monograph of 76 pages is a noteworthy attempt to integrate modern concepts of biology, immunochemistry and protein chemistry toward the formulation of a realistic hypothesis of the *in vivo* synthesis of antibodies. Although published nearly four years ago, a belated review of this work hardly requires justification, since the ideas expressed by the authors have maintained their value and importance in the face of more recent discussions of this lively problem. Indeed, it appears that this monograph has escaped the attention it deserves, for recent reviews and monographs dealing with immunochemistry have either omitted mention of it or given only passing reference.

Following an introductory discussion of the general character of antibodies more biological aspects of their general immunological functions are reviewed in chapters II to V. These include considerations of the rate and extent of antibody formation in the blood of actively and passively immunized animals; of the evidence for qualitative differences among antibody molecules produced against the same antigen in a single animal; and of the qualitative changes in antibodies during prolonged immunization. Original experimental data are incorporated in the review of these problems, as well as in a comprehensive, yet concise discussion of the site of antibody production (chapter VI). The latter leads the authors to conclude that antibody is produced by the very phacogytic cells of the reticulo-endothelial system (spleen, liver, bone marrow, lymph nodes) which ingest the antigen. Although difficult to prove experimentally, the view is advanced that antibody production may continue in the absence of antigen, an argument which is fundamental to the general thesis which the authors finally propose. Chapter IX draws further factual and presumptive evidence, from considerations of the tuberculin type of sensitization to bacterial products, for the belief that the very reticulo-endothelial cells which are involved in disintegration of the antigens likewise are effective in antibody production.

In chapter X a theory of antibody production is developed, based on seven principal conclusions derived from the preceding discussion, and viewed in the light of modern concepts of protein structure and protein synthesis. The authors emphatically criticize the claims for reality of the Haurowitz-Mudd "template" theory, according to which antibody globulin is synthesized in direct spatial contact with the antigen molecule, resulting in the development of complementary patches to the determinant groups of the antigen. They deny any real physico-chemical basis for believing that simple juxtaposition of the growing globulin molecule to the antigen would result in the development of complementary pattern, particularly since the very argument has been used by virus workers, "to show that protein synthesized in contact with a pattern (virus protein) will produce not a complementary pattern but a replica of the original pattern."

In the author's hypothesis the Bergmann-Niemann concept of the dual proteolytic and protein-synthetic activity of intracellular enzymes occupies a central portion. However, instead of invoking an organizer to control the regular addition of amino acid residues or protein fragments, they consider the intracellular proteins to be endowed with enzymatic activity in such a way as to provide a pattern and a "scaffold" on which the new protein is constructed. Unlike the proteins of the extracellular secretions, these intracellular proteins are self-synthesizing according to their own pattern. Applying these ideas to the intracellular proteins of the reticulo-endothelial system, the thesis is developed that, in the absence of antigenic stimulus, normal globulins are produced by these cells and liberated eventually into the blood and lymph. However, upon contact with any foreign antigen, such modifications of the intracellular proteinases take place, simultaneously with the destruction of the antigenic particle, as is required for an effective hydrolytic action on the foreign antigen. This modification in structure and activity of the enzymes is believed to result in the synthesis of modified globulins (antibody) and to persist, even in the absence of further contacts with the antigen. Gradually, however, the original impression will be eliminated, regressively, and ultimately, normal globulin will again be produced. It is emphasized that these processes should not be considered to result merely from spatial con-