SCIENCE

VOL. 101 FRIDAY, MARCH 30, 1945 No. 2622

SCIENCE: A Weekly Journal, since 1900 the official organ of the American Association for the Advancement of Science. Published by the American Association for the Advancement of Science every Friday at Lancaster, Pennsylvania.

Editors: JOSEPHINE OWEN CATTELL and JAQUES CATTELL.

Policy Committee: MALCOLM H. SOULE, ROGER ADAMS and WALTER R. MILES.

Advertising Manager: THEO. J. CHRISTENSEN.

Communications relative to articles offered for publication should be addressed to Editors of Science, 34 Gramercy Park, New York 3, N. Y.

Communications relative to advertising should be addressed to THEO. CHRISTENSEN, Advertising Manager, Smithsonian Institution Building, Washington 25, D. C.

Communications relative to membership in the Association and to all matters of business of the Association should be addressed to the Permanent Secretary, A.A.A.S., Smithsonian Institution Building, Washington 25, D. C.

Annual subscription, $6.00 Single copies, 15 cents

NEW FRONTIERS[1]

By Professor RICHARD STEVENS BURINGTON

DEPARTMENT OF MATHEMATICS, THE CASE SCHOOL OF APPLIED SCIENCE (ON LEAVE)
HEAD MATHEMATICIAN, BUREAU OF ORDNANCE, NAVY DEPARTMENT[2]

(1) FOR the past several years it has been my privilege to have intimate contact with a large amount of work concerned with an array of investigations in engineering, physical research and related activities, and with work in which all sorts of mathematical and physical fields appear as fundamental items in the larger problems under study. The nature of this work has been such that much of it, as met, would not be suitable for discussion here. Nevertheless, there are certain important facts and observations which I have noted from time to time that I hope will be of interest to many persons—to engineers, physicists, chemists, investigators, businessmen, industrialists, as well as to pure and applied mathematicians, and university people. Some of these items may well be made the subject of serious study, and such action as may be indicated should then be pushed vigorously by responsible individuals and organizations.

In discussing this topic, "New Frontiers"—some new, some old, some always new—I have in mind the vast store of potentially powerful and valuable mathematical knowledge and talent which has scarcely been tapped by industry and business. I should like to

[1] Address delivered to Section A—Mathematics, American Association for the Advancement of Science, Cleveland, Ohio, September 12, 1944. The author wishes to express his appreciation for the many constructive suggestions and critical comments made in connection with the preparation of this paper by Dr. Arthur Bennett, astronomer and engineer, and by Dr. C. C. Torrance, mathematician.

[2] The opinions expressed in this paper are those of the author and are not necessarily those of the Navy Department.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF IONIC EXCHANGE RESINS FOR THE PURIFICATION OF PENICILLIN AND HYPERTENSIN

THE selective absorption of inorganic ions by ionic exchange resins suggests the possibility of an interesting method for analysis and purification of mixtures of organic substances obtained from biological materials. We have, therefore, studied the behavior of amines, amino acids and polypeptides filtered through these resins, using to this effect the anionic and cationic exchange resins, Ionac A and C, under the following conditions.

Small funnels with a stem seven centimeters in length and eight millimeters wide are filled with four grams of resin previously subjected to a thorough washing with distilled water. This preliminary washing is essential because the resin releases at first up to 0.2 milligram nitrogen per cc. The removal of this nitrogen does not in any way alter the absorptive activity of the resin.

The anionic resin thus prepared absorbs proteins, long chain polypeptides, a variety of chromogenic substances and a few amino acids; the cationic resin retains in addition most amino acids and in particular basic amino acids and amines. Detailed results of these experiments will be presented elsewhere.

It has seemed to us that these exchange resins could be used for the purification of biological products by removing from the latter certain inactive or toxic impurities. The purification of hypertensin and penicillin will serve to illustrate the potentialities of the method.

PURIFICATION OF HYPERTENSIN

When hypertensin is prepared according to the method of Braun Menendez *et al.*, one obtains a product still somewhat impure and which loses much of its activity when attempts are made to purify it further by means of the usual absorbents. We have found, however, that by treating the crude product with the anionic resin, Ionac A, one can remove several inactive substances; chromogens, polypeptides, etc., without affecting significantly the hypertensive activity. One thus obtains readily a product containing only 0.08 milligrams of nitrogen per unit of hypertensin.

In contrast to Ionac A, the cationic resin, Ionac C, absorbs the active principle of hypertensin. Unfortunately, we have not yet been able to release an active eluate with any of the thirty eluents which we have used, such as salts, bases, acids, detergents, alcohol and other organic solvents, etc.

PURIFICATION OF PENICILLIN

As is well known, cultures of *Penicillium notatum* release, in addition to the antibacterial agent penicillin, a variety of impurities, many of which are toxic, which prevent the use of the untreated filtrate for therapeutic purposes. The classical method employed for the isolation of penicillin is not only time-consuming and expensive, but also causes important loss of the active material.

We have observed that by filtering the crude culture filtrate containing penicillin, first through the cationic resin, Ionac C, at pH 6 to 7, then through the anionic resin, Ionac A, at the same pH, one obtains a product which retains all the penicillin activity of the original material, but which is now free of any toxicity for experimental animals and for man. In fact, the filtrate can be injected by the intraperitoneal route into mice and by the intravenous route into cats, dogs and man without any toxic manifestations. The penicillin preparation thus obtained can be concentrated *in vacuo* at low temperature. It seems likely that this simple procedure will be found useful for the purification of other active substances produced by molds and various biological agents.

E. CRUZ-COKE
F. GONZALEZ
W. HULSEN

DEPARTMENT OF PHYSIOLOGY AND PATHOLOGICAL CHEMISTRY, UNIVERSITY OF SANTIAGO, CHILE

BOOKS RECEIVED

BENNETT, JOHN W. *Archaeological Explorations in Jo Daviess County, Illinois.* Illustrated. Pp. xiii + 168. University of Chicago Press. $1.75. 1945.

GRAHAM, HERBERT W. and NATALIA BRONIKOVSKY. *The Genus Ceratium in the Pacific and North Atlantic Oceans.* Illustrated. Pp. 209. Publication No. 565 of the Carnegie Institution of Washington. $2.00. 1944.

PIGGOTT, CHARLES S. and ROGER R. REVELLE. *I, Marine Bottom Samples Collected in the Pacific Ocean by the Carnegie on Its Seventh Cruise. II, Radium Content of Ocean-Bottom Sediments.* Illustrated. Pp. 196. Publication No. 556 of the Carnegie Institution of Washington. $2.00. 1944.

SEMAT, HENRY. *Fundamentals of Physics.* Illustrated. Pp. 593. Farrar & Rinehart. $4.00. 1945.

SINGER, T. E. R. *German-English Dictionary of Metallurgy.* Pp. 298. McGraw-Hill. $4.00. 1945.

WEEKS, MARY E. *Discovery of the Elements.* Fifth edition, revised. Illustrated. Pp. 578. Journal of Chemical Education, Easton, Pa. 1945.