a dearth of good mathematical libraries. It would seem that this book which he has written is especially well adapted to the needs of students where a good mathematical library is not readily accessible. To master this volume would imply an algebraic and geometric education of no mean order. However, if the author had been writing in the United States, where students acquire in courses in higher algebra a reasonably good mastery of this subject, he might have been disposed to devote less space to certain algebraic subjects, for example, "The General Theory of Matrices," to which Chapter XIII is devoted.

In writing this book the author has served the cause of geometry well. Students of geometry wherever English is spoken will find this a practicable reference for the topics discussed and the method employed. The author has succeeded in his purpose "to show the algebra at work, to illustrate its power and its range."

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SOCIETIES AND MEETINGS

THE SECTION OF PSYCHOLOGY OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION I (Psychology) of the American Association for the Advancement of Science will meet in Dallas, Texas, on Monday, December 29, and Tuesday, December 30, as part of the general meeting of the American Association for the Advancement of Science which extends from December 29 through January 3.

In addition to the usual program of contributed papers there will be, on Monday, December 29, a symposium on "Recent Advances in the Appraisal of Personality" under the chairmanship of Professor Ernest R. Hilgard, of Stanford University, and on Tuesday, December 30, a joint symposium with Section Q (Education) on "The Psychology of Learning and the Educative Process."

It is hoped that a large number of psychologists will attend and participate in the Dallas meetings. The character of the general program must depend on the submitted papers, and all psychologists are urged to send in abstracts. Both theoretical and experimental papers are acceptable.

Psychologists who wish to read papers should submit abstracts in duplicate (not more than 300 words in length). Please note on the abstract the time required for presentation up to a limit of 15 minutes, and also whether a slide projector or moving picture projector will be required. Abstracts should be sent to the Chairman of the Program Committee, Professor John A. McGeoch, Department of Psychology, State University of Iowa, Iowa City, Iowa, so that they will be received not later than November 15, 1941.

The meetings of Section I of the American Association for the Advancement of Science offer to psychologists not only an opportunity to participate in meetings of their own, but also to become acquainted with current investigations and investigators in other sciences. The activities of Section I can do a great deal toward establishing the place of psychology among the sciences, toward cementing friendly relations with related sciences, and toward increasing the influence and usefulness of psychology. It is hoped that many among the members and associates of the American Psychological Association who are not now members of the American Association for the Advancement of Science, and through it of Section I, will join the American Association for the Advancement of Science and participate in its meetings. By so doing they will be supporting the advancement of science in general and of psychology in particular. The secretary of Section I will be happy to receive and endorse applications of members and associates of the American Psychological Association, and to answer questions concerning the work of Section I.

ARTHUR W. MELTON, *Secretary*

UNIVERSITY OF MISSOURI

SPECIAL ARTICLES

PURIFICATION OF THE VIRUS OF MOUSE ENCEPHALOMYELITIS (THEILER'S VIRUS)[1]

BEARD and his collaborators[2] were able to purify the virus of equine encephalomyelitis and that of rabbit papilloma by differential centrifugation of infected tissue extracts. Working with encephalomyelitis virus in chick embryos, they observed, however, serious disturbances of the purification process, unless the brain and chord were removed from the embryos before preparation of the extracts.

The study on the virus of mouse encephalomyelitis to be reported here was made with the highly virulent FA strain of the virus.[3] Infected mouse brains served

[1] This study was made with the aid of a grant from the King of Sweden's Birthday Fund for Prevention of Disabling Diseases.

[2] H. Findelstein, W. Marx, D. Beard and J. W. Beard, *Jour. Inf. Dis.*, 66: 117, 1940; and J. W. Beard, W. R. Bryan and W. G. Wyckoff, *Jour. Inf. Dis.*, 65: 43, 1939.

[3] M. Theiler and S. Gard, *Jour. Exp. Med.*, 72: 49, 1940.

as starting material, and the difficulties mentioned by Beard were very obvious. The large quantities of slowly sedimenting, coarse material (cellular structural elements rich in lipoids and lipoproteins) present in the extracts rendered purification by means of differential centrifugation impossible. Attempts to obtain more suitable solutions through digestion with pancreatic juice were not successful. The purification procedure, finally adopted, was as follows.

Five hundred mouse brains are ground with sand and 0.05 M sodium chloride solution is added to make a total volume of 3,500 ml. The coarse material is allowed to settle overnight in the cold room. The supernatant extract is then siphoned off and vigorously shaken with two thirds by volume of ether. The mixture forms an emulsion, which, however, soon separates into two distinct layers, an aqueous one containing practically all the original activity and an ethereal top layer, in which most of the lipoids are to be found. The bottom layer is collected and one half by volume of saturated ammonium sulfate is added. A voluminous precipitate, containing more than 99 per cent. of the activity, is formed, rapidly rising to the surface. This precipitate is collected, washed in a separatory funnel with one third saturated ammonium sulfate solution, and finally extracted with distilled water. It is important that the ether should not be removed until the extraction is completed, otherwise the lipoids, still present in the precipitate, will be emulsified and the extract thus be unsuitable for further purification. The aqueous extract, faintly yellow in color and almost clear, is concentrated by means of ultrafiltration as described by Seibert,[4] washed on the filter with distilled water until free from salt and ether, and finally fractionated in an air-driven high-speed quantity centrifuge at 11,000 and 22,000 r.p.m. After 3 to 4 fractionations the solution is usually free from fast sedimenting material, and gives by centrifugation for 2 hours at 22,000 r.p.m. a small pellet, homogeneous, yellowish brown and readily soluble in distilled water. If optical methods are to be applied in the further analysis, the final volume of the preparation should not exceed 1 ml. All operations indicated above should be performed at a temperature below 8° C.

The preparations, purified according to this method, retained 30 to 50 per cent. of the original activity, corresponding to an increase in activity per unit of volume of about 1,000 times. The sedimentation constant of the virus was determined in two ways.[5] By optical analysis of purified material in the ultracentrifuge three components could be distinguished with sedimentation constants s_{20} of about 40, 160 and 210×10^{-13}. In similarly treated normal mouse brain only two of these were present and no traces of the middle component with the sedimentation constant $s_{20} = 160$ could be detected. In the active preparations the concentrations of the three components were nearly equal, corresponding to about 0.5 mg per 100 g of mouse brain.

Furthermore, crude extracts as well as partially purified material were spun in the separation cell[6] and activity determinations performed on the contents of the outer and inner compartment. The sedimentation constant was calculated to be 160 to 170×10^{-13}. It seems, therefore, highly probable that the medium component, present in active material only, really represents the virus protein.

On one preparation, consisting of the virus component in practically pure state, a determination of the diffusion constant was attempted. The accuracy of the value observed, $D_{20} = 0.27 - 0.33 \times 10^{-7}$, must be regarded as somewhat questionable on account of the small quantity of material available. On the assumption of a specific gravity of 1.33 the diffusion constant 0.30 corresponds to a molecular weight of 52×10^6. If one further assumes ellipsoidal and unhydrated molecules, the axial ratio can be calculated to be 46 : 1 and the actual size 640×14 mμ. Beard and his collaborators[7] found, however, in another neurotropic virus, that of equine encephalomyelitis, a large proportion of lipoids and a correspondingly low specific gravity of 1.19. On the basis of this latter value the figures in the case of mouse encephalomyelitis virus would be $M = 81 \times 10^6$, the axial ratio 31 : 1 and the size 590×19 mμ. In all figures given above the error might amount to ± 20 per cent. For comparison it might be mentioned, that Theiler and Gard by means of ultrafiltration determined the particle diameter to be 9 to 13 mμ.

The observation by Armstrong[8] of murine strains of the virus of human poliomyelitis has augmented the importance of the study of that of mouse encephalomyelitis and its possible relationships to the human virus. The results reported here, seem to indicate new ways for approaching this problem. A study along these lines has been started, the results of which will be published elsewhere.

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[4] F. B. Seibert, *Jour. Biol. Chem.*, 78: 345, 1928.

[5] Sedimentation and diffusion experiments were always carried out at 0° C. and the constants corrected as usual.

[6] A. Tiselius, K. O. Pedersen and T. Svedberg, *Nature*, 140: 848, 1937.

[7] D. G. Sharp, A. R. Taylor, D. Beard, H. Finkelstein and J. W. Beard, SCIENCE, 92: 359, 1940.

[8] C. Armstrong, *Pub. Health Rep.*, 54: 1719, 1939; C. W. Jungeblut and M. Sanders, *Jour. Exp. Med.*, 72: 407, 1940.