SCIENCE

VOL. 97 FRIDAY, APRIL 9, 1943 NO. 2519

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

Lancaster, Pennsylvania

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

FORTY YEARS OF PLANT PHYSIOLOGY

SOME GENERAL IMPRESSIONS[1]

By Professor EDWIN C. MILLER

KANSAS STATE COLLEGE

FORTY years ago the work in plant physiology was changing from the old to the new. Those who were interested in the subject were concerned chiefly with the nature of the response of *Mimosa* or similar plants to stimuli of various sorts. In the main, they were not interested at all in any practical or applicable results that might accrue from their investigations. At about the time of my entrance into the field, the conflict between the purist and the practical man was at its height and was being waged bitterly. It is said that some purist when asked of what practical value his findings were in the field of science, replied, "None whatsoever and if I had thought before undertaking the work that they would be of any practical value, I would never have undertaken the investigation." Such a happening may be somewhat exaggerated, but it, nevertheless, illustrates the state of mind of some of the individuals who waged this bitter conflict. This condition illustrates the same spirit that was expressed by the so-called "malefactors of great wealth" who are reputed to have said that "the public could be damned" as far as they were concerned.

The public, rightly or wrongly, may eventually reach the stage where the workers not only in plant physiology, but also in most other lines of scientific work, must show that the results of their labors will contribute to the happiness or advancement of man-

[1] Address of the retiring president of the American Society of Plant Physiologists, December, 1942.

Contribution No. 443, Department of Botany, Kansas Agricultural Experiment Station.

it, and finally centrifuging it at 5,000 r.p.m. in an angle-head centrifuge and discarding the sediment. These preparations were then rendered non-virulent by exposure to the rays of a mercury arc lamp for a determined period of time.[2]

Freezing and drying of these antigens are accomplished in the following manner. The irradiated antigen is freed of sediment by centrifugation in a horizontal centrifuge for 10 minutes at 2,500 r.p.m. To the clear supernatant, merthiolate in a dilution of 1:10,000 is added. The antigen is then pipetted in 2 or 5 cc quantities into glass ampoules, frozen quickly by immersion into a dry ice-alcohol mixture, and dried over a period of 20 hours in a Flosdorf-Mudd apparatus,[3] after which the ampoules are sealed. The ampoules containing the desiccated antigen in an air-free space are stored at 2° C. When needed for use in tests the ampoules are opened and 2 or 5 cc of distilled water added to the desiccated material. A similar method was employed by Smadel and Wall for preserving spleen lymphocytic choriomeningitis antigen.[4]

In the following table the results of one test with an ampoule of irradiated frozen and dried Western equine encephalomyelitis antigen are shown. The figures in the first column indicate that the titer of the complement was the same with frozen and dried as with standard virulent antigen or saline control (0.13 cc), showing that the dried material was not anti-complementary. Column 2 indicates that the titer of dried and virulent antigens was the same, 1:8, showing that there was no loss of antigenicity from irradiation or freezing and drying. Finally, column 3 indicates that the fixation titer was the same in hyperimmune serum, whether virulent or frozen and dried antigen was employed.

Similar antigens with St. Louis and West Nile viruses have been prepared and tested. They have proved practically identical to the virulent antigens in antigenicity and specificity. Our observation of their keeping qualities is limited thus far to 6 weeks, but we believe that in view of universal experience with lyophilized materials, these antigens will maintain their specific properties for long periods of time.

TABLE 1

EFFECT OF IRRADIATION AND FREEZING AND DRYING ON THE COMPLEMENT-FIXING ANTIGEN OF WESTERN EQUINE ENCEPHALOMYELITIS VIRUS

(Antigen irradiated for 100 minutes; tested for virulence by intracerebral inoculation into Swiss mice. Out of 12 mice inoculated none died).

Antigen	Anti-complementary power*	Antigenicity†							Specificity and titer of serum‡							
		1:1	1:2	1:4	1:8	1:16	1:32	1:64	1:1	1:2	1:4	1:8	1:16	1:32	1:64	1:128
No antigen; saline control	0.13 cc								0	0	0					
Western equine encephalomyelitis, non-irradiated .	0.13 cc	4¶	4	4	4	0	0	0	4	4	4	4	4	4	1	0
Western equine encephalomyelitis, irradiated and lyophilized	0.13 cc	4	4	4	4	0	0	0	4	4	4	4	4	4	2	0
West Nile, irradiated and lyophilized	0.13 cc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* Amount of guinea pig serum in dilution of 1:30 equivalent to one unit.
† Dilution of antigen reacting with a constant amount of Western equine encephalomyelitis mouse immune serum.
‡ Dilution of Western equine encephalomyelitis mouse immune serum reacting with a constant amount of antigen.
¶ 4 = Complete fixation; 0 = complete hemolysis; 1, 2 = intermediate degree of hemolysis.

J. CASALS

THE LABORATORIES OF THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, NEW YORK, N. Y.

BOOKS RECEIVED

Carnegie Institution of Washington Publication 524. Papers from Tortugas Laboratory. Vol. xxxiii. Illustrated. Pp. 195. $1.50, paper cover; $2.00, cloth binding.

CHERONIS, NICHOLAS D., JAMES B. PARSONS and CONRAD E. RONNEBERG. *The Study of the Physical World.* Illustrated. Pp. x + 884. Houghton Mifflin Company. $3.85.

GENTRY, HOWARD SCOTT. *Rio Mayo Plants, A Study of the Flora and Vegetation of the Valley of the Rio Mayo, Sonora.* Illustrated. Pp. vii + 328. Carnegie Institution of Washington. $2.25, paper cover; $2.75, cloth binding.

GOLDBERG, LEO and LAWRENCE H. ALLER. *Atoms, Stars and Nebulae.* Illustrated. Pp. v + 323. The Blakiston Company. $2.50.

HAILE, FATHER BERARD. *Origin Legend of the Navaho Flintway.* Pp. 319. University of Chicago Press. $3.00.

HUDDLESON, I. FORREST and OTHERS. *Brucellosis in Man and Animals.* Illustrated. Pp. xix + 377. The Commonwealth Fund. $3.50.

PENNEY, A. C. *Everyday Electricity and Magnetism.* Illustrated. Pp. vii + 248. Longmans, Green and Co. $1.75.

SUTTON, RICHARD L. and RICHARD L. SUTTON, JR. *Synopsis of Diseases of the Skin.* Illustrated. Pp. 481. C. V. Mosby Company.

ZOETHOUT, W. D. *Laboratory Experiments in Physiology.* Illustrated. Pp. 256. C. V. Mosby Company.

[3] Earl W. Flosdorf and Stuart Mudd, *Jour. Immunol.*, 29: 389–425, 1935.

[4] J. E. Smadel and M. J. Wall, *Jour. Bact.*, 41: 421–30, 1941.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

FLIGHT PREPARATION TRAINING SERIES

Published under the Supervision of the Training Division,
Bureau of Aeronautics, U. S. Navy

Mathematics for Pilots

157 pages, 4½ x 7⅞, illustrated. 75¢

Covers the algebra, geometry, and trigonometry that every pilot must know. A feature of the book is the large number of problems taken from navigation and principles of flying. A review of arithmetic is included to insure quick and automatic use of fundamental operations. The need for speed and accuracy is stressed throughout.

Physics Manual for Pilots

229 pages, 4½ x 7⅞, illustrated. 90¢

Gives a condensed treatment of most of the topics included in a standard high school physics text. All fundamental principles needed by the pilot are discussed. Units requiring the smallest amount of mathematics are given first so that a student taking a mathematics refresher course at the same time can use the mathematics review in his physics class.

Principles of Flying

338 pages, 4½ x 7⅞, illustrated. $1.50

Aims to acquaint the student with the basic principles involved in flying, including the rudiments of airplane construction. The book presupposes knowledge of only the most elementary mathematics and physics, and is written, as far as possible, in nontechnical language.

The Effects of Flight.
Mental and Physical Aspects

120 pages, 4½ x 7⅞, illustrated. 60¢

Explains the causes of the many physical sensations which the aviation cadet encounters for the first time in his flight training. Psychological reactions, which have been responsible for many "washouts," are dealt with, and the fear of the check pilot and the cure for this are discussed in some detail.

Operation of Aircraft Engines

206 pages, 4½ x 7⅞, illustrated. 90¢

Explains the operation of the internal-combustion engine, pointing out the refinements which make it possible to adapt it for use in airplanes, where decreased weight and increased horsepower are essential. The book teaches the student how to recognize the first signs of engine trouble and tells him what to do about it.

Aerology for Pilots

107 pages, 8¼ x 11, illustrated. $1.25

What the pilot should know about aerology. Emphasis is placed upon understanding of weather reports (forecasts, weather maps, and sequence reports) and the personal weather observations necessary to find favorable flying conditions and avoid or conquer weather hazards.

AIR NAVIGATION

Part I. Introduction to Earth

79 pages, 8¼ x 11, illustrated. $1.00

Designed to orient naval aviation cadets to navigation that may encircle the earth. The book gives an over-all view of the earth as a sphere, of place relationships of war zones, of general and climatic considerations underlying strategy, and something of the strategic significance of military objectives.

Part II. Introduction to Navigation

81 pages, 8¼ x 11, illustrated. $1.00

Covers the basic fundamentals of navigation technique. There is a detailed explanation of the various types of map projections, an understanding of which is essential for plotting courses. Emphasis has been placed upon the importance of thorough knowledge and accuracy.

Part III. Dead Reckoning and Lines of Position

60 pages, 8¼ x 11, illustrated. $1.00

Introduces some basic applications of the fundamentals covered in the first two volumes. It explains how the aerial navigator records the progress of his plane over the surface of the earth, and describes certain methods used to check the estimated position of the plane during flight, and the manner by which the effects of air currents on the movement of a plane can be determined.

In Preparation

Part IV. Navigation Instruments
Part V. Relative Movement
Part VI. Contact Flying
Part VII. Nautical Astronomy and Celestial Navigation

Send for copies on approval

McGRAW-HILL BOOK COMPANY, INC.

330 West 42nd Street, New York, N. Y. **Aldwych House, London, W.C.2**

VITAMINS
FOR RESEARCH

Because they satisfy the most exacting requirements, 'Roche' vitamins are the choice of many scientists engaged in research.

The dependable purity and unexcelled standard of quality of 'Roche' vitamins are backed by years of experience in vitamin research and manufacture.

THIAMINE HYDROCHLORIDE
RIBOFLAVIN
NICOTINIC ACID
NICOTINIC ACID AMIDE
PYRIDOXINE HYDROCHLORIDE
CALCIUM PANTOTHENATE
ASCORBIC ACID
α-TOCOPHEROL ACETATE

'ROCHE'

HOFFMANN-LA ROCHE, INC.
Vitamin Division
ROCHE PARK, NUTLEY, N. J.