SCIENCE

VOL. 99 FRIDAY, MAY 5, 1944 No. 2575

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SCIENCE: A Weekly Journal devoted to the Advancement of Science. Editorial communications should be sent to the editors of SCIENCE, Lancaster, Pa. 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 25, D. C.

BRAIN MECHANISM[1]

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I CAN think of no better way of beginning than by recalling another function due to the Pilgrim Trust at which I was present six months ago. I recall it in gratitude to a foundation which has preserved so much that is worth preserving in Great Britain, and because this particular occasion concerned a scientist who might be claimed from both sides of the Atlantic, since he belongs to the period of our common ancestry. The occasion was the presentation by the Trust to Trinity College, Cambridge, of some of the private library of Sir Isaac Newton, scholar and fellow of the college and afterwards president of the Royal Society. The presentation was made in the great library built by Christopher Wren at the request of Isaac Barrow, the master of Trinity who recognized the genius of Newton and did all he could to foster it, and the books are now in the shelves at the south end of the library near the Newtonian telescope and the statue of Lord Byron.

The war has prevented an international celebration of three famous men who were born or died 400, 300 and 200 years ago, Copernicus, Newton and Lavoisier, and the Royal Society has been forced to honor its greatest president without the ample banquet which would normally have shown our devotion to science. But the meetings in his honor have made us more aware of those aspects of Newton's work which are overshadowed by the "Principia" and the "Optics." As far as mathematical physics was concerned Newton had only to be and all was light. But there is also the less triumphant figure, Newton the student of the occult, the interpreter of the book of Daniel, the half-believer in Hermetic secrets, who could scarcely bear to be distracted from these things by the mathematical problems which he could not resist solving, who spent the best years of his life in chemical experiments which have had no result. His

[1] The second Pilgrim Trust Lecture to be given in the United States. This address was delivered at the United States National Museum, Washington, D. C., under the auspices of the National Academy of Sciences, on April 24, 1944.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A CHEMICALLY DEFINED MEDIUM FOR THE CULTIVATION OF THE GONOCOCCUS[1]

A FLUID medium comprising 9 organic acids, 5 inorganic salts and glucose has been developed for the growth of the gonococcus. It contains 7 organic acids in addition to those required by the meningococcus as reported by Frantz.[2] The composition is as follows:

	Grams per liter
d-Glutamic acid[3]	1.3
dl-Leucine[3]	0.40
l-Arginine monohydrochloride[3]	0.25
l-Histidine monohydrochloride[3]	0.15
dl-Methionine[3]	0.15
l-Proline[3]	0.10
Glycine[4]	0.05
l-Cystine[4]	0.01
Indole-3-acetic acid[4]	0.10
NaCl[5]	6.0
$NaH_2PO_4 \cdot H_2O$[5]	2.5
NH_4Cl[5]	1.25
$Mg(NO_3)_2 \cdot 6H_2O$[5]	0.05
$FeSO_4$[5]	0.012
Glucose[4]	5.0

With the exception of glucose, indole acetic acid, ferrous sulfate and magnesium nitrate, the constituents are added to 950 ml of distilled water. The pH of the mixture is adjusted with normal sodium hydroxide to from 6.8 to 7.0, and then autoclaved at 121° C for 10 minutes in a pyrex-glass container. After cooling to room temperature, 25 ml of a sterile 20-per cent. glucose solution are introduced into the medium. One per cent. solutions of ferrous sulfate, magnesium nitrate and indole acetic acid are added separately in the following volumes, respectively; 1.2 ml, 5.0 ml and 10.0 ml. The pH is finally readjusted to from 7.0 to 7.2.

Five ml of the medium were inoculated with one loopful of washed gonococcal cells obtained by centrifugation from a 24-hour Douglas's broth culture. Incubation was carried out at 37° C in an atmosphere containing approximately 10 per cent. of carbon dioxide. The method of introducing 10 per cent. tank carbon dioxide as described by Leahy and Carpenter[6] gave better results than the method of burning a candle to self-extinction. The gaseous mixture was replaced at daily intervals.

Sixty strains of *Neisseria gonorrhoeae* were employed for the development and testing of this medium. Both recently isolated strains and those subcultured for several years were included. Not all strains grew equally well and approximately 25 per cent. did not grow either in the synthetic medium or in Douglas's broth. Growth was maximal after 2- to 3-days' incubation. At this time, 5.0 ml of the medium contained, on the average, 0.25 mg of bacterial nitrogen, which is equivalent to 2.0 mg of gonococcal cells. The growth was more than double that obtained in Douglas's broth under the same conditions. The cells remained viable for at least 5 days. Cultures transferred every third day have been maintained readily for 3 months.

The final concentration of each substance in the medium was determined on the basis of maximal growth of the majority of the strains tested. The concentrations of glycine, cystine, ferrous sulfate and of both ions of magnesium nitrate were critical. The amount of the other substances employed in the medium permitted of some variation. Divalent lead and trivalent iron salts in concentrations of 10 micrograms per ml favored the growth of certain strains. The manganous ion, in a concentration of 5 micrograms per ml was toxic for the gonococcus. The cupric ion was also toxic but only at concentrations greater than 5 micrograms per ml.

Growth of the strains which otherwise failed to grow in the medium above described was obtained in almost every instance when glutamine[7] and choline were incorporated in the medium in concentrations of 0.2 mg and 0.1 mg per ml, respectively.

Studies to determine the more rigid requirements of certain primary cultures of *Neisseria gonorrhoeae* are in progress.

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[1] Supported in part by grants from the John and Mary R. Markle Foundation and the United States Public Health Service.

[2] I. D. Frantz, *Jour. Bact.*, 43: 757, 1942.

[3] We are indebted to Merck and Company, Incorporated, Rahway, N. J., for certain of the synthetic amino acids.

[4] Eastman Kodak Company, Rochester, N. Y.

[5] J. T. Baker Chemical Company, Phillipsburg, N. J.

[6] A. D. Leahy and C. M. Carpenter, *Am. Jour. Syph., Gonor. and Ven. Dis.*, 20: 353, 1936.

[7] C. E. Lankford and E. E. Snell, *Jour. Bact.*, 45: 410, 1943.

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