and to some important omissions in bibliographies may well be corrected in a later edition.

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SPECIAL ARTICLES

THE SIMPLEST CONSTITUENTS REQUIRED FOR GROWTH AND THE COMPLETION OF THE LIFE CYCLE IN AN INSECT (DROSOPHILA)

THE green plants are able to build up all the complicated proteins, polysaccharides and fats of their tissues from nitrates, phosphates and sulphates, on the one hand, and from CO_2, on the other. Those microorganisms which can not form sugar or starch from CO_2 must be offered a more complicated compound than CO_2 for the synthesis of their carbohydrates. They may be able, however, to form all their proteins from an ammonium salt or a single amino-acid. This astonishing synthetic power is in sharp contrast to the behavior of mammals which, according to Osborne and Mendel, can not grow unless one or more proteins are offered to them, for the reason that they lack the power of manufacturing the majority of amino-acids required for the building up of the proteins of their body.

Recent experimenters have pointed out that in addition to the chemically well-defined constituents of food, other more or less mysterious constituents, which only the living body can produce, are required for the growth of mammals. Thus Hopkins, and Osborne and Mendel have found that certain unknown constituents of milk or butter have a specific effect upon the growth of rats, and Allen has found that even a Diatom (*Thalassiosira*) grows incomparably better if one to four per cent. natural sea water is added to the culture medium.

It seemed of interest to find out which substances are required for the growth and the completion of the life cycle of such highly specialized animals as insects. The banana fly (*Drosophila*), on account of the ease with which it can be raised, served as an object for our investigations.

We wish to report only on one group of the experiments we have made, namely, those referring to the source of nitrogenous compounds required for the growth and the complete life cycle of these insects. Our culture medium consisted of a solution of the purest cane sugar or grape sugar obtainable, or of both, to which certain inorganic salts (Kahlbaum's purest) were added. To this medium was added a very small quantity (about 0.25 gram) of mechanically macerated Schleicher and Schüll filter paper (No. 589, "Blue Ribbon"), chiefly to keep the flies from drowning and to facilitate the raising of the larvæ. Dr. Levene was kind enough to have a nitrogen determination of the filter paper made, which showed that its nitrogen content is 0.008 per cent. In such a solution the flies laid their eggs. The larvæ hatched and increased slightly in size during the first days, but then their growth stopped, although they lived for a considerable time. If, however, a small quantity of one or two amino-acids, *e. g.*, alanine or glutaminic acid or others, or certain ammonium salts, *e. g.*, ammonium tartrate or succinate or a combination of one ammonium salt and one amino-acid, was added, the larvæ grew to full size and metamorphosed into pupæ and normal flies.

In these experiments everything used was sterilized, and in addition the culture media were heated for fifty minutes to about 100° C.; but since the flies were not sterile, the development of bacteria was not excluded. The flies were removed as soon as a sufficient number of eggs had been laid. In the majority of experiments no visible fungus formation occurred. When visible fungus growth took place the larvæ, as a rule, soon died or failed to develop.

If in these experiments the larvæ were actually able to manufacture all the complicated nitrogenous compounds of their body from one or two amino-acids or from one ammonium salt, without the aid of bacteria, it would indicate a power of synthesis equal to that of bacteria. In this connection it is of importance that the larvæ of the banana fly can be raised on their natural vegetable food without bacteria. Thus Guyénot has succeeded in raising aseptically forty successive generations of *Drosophila*, thereby proving that for

the normal nutrition of *Drosophila* no bacterial action is required.

It will be our next task to attempt to raise the flies aseptically on our artificial culture media, to decide whether or not in our experiments bacteria performed the work of synthesis for the larvæ.

It was natural to raise the question to what extent the nitrogen content of the filter paper contributed to the result. The fact that no larva was able to grow on filter paper, water, sugar and salts alone indicates that the nitrogen content of the filter paper played practically no rôle in the nutrition. Moreover, the amount of N contained in the filter paper was negligible compared with the amount of N added in the form of amino-acid or ammonium salts. One culture contained, as a rule, 200 mg. glycocoll or other amino acid, *i. e.*, roughly between 30 and 40 mg. of nitrogen. The 250 mg. of filter paper added to the culture contained only 0.02 mg. of nitrogen. The nitrogen in the filter paper was therefore about between 1/2,000 and 1/1,500 of the total nitrogen in the culture medium. Nevertheless, it is a fact that in liquid cultures without filter paper—in this case glass beads were used to prevent the drowning of the flies—the yield of larvæ was very much smaller than with filter paper. It should also be stated that the larvæ ate little if any of the filter paper. It will be one of the tasks of our further experiments to find out what caused the difference in the two cases.

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THE BOTANICAL SOCIETY OF AMERICA

The ninth annual meeting of the Botanical Society of America was held in the Medical School of the University of Pennsylvania, Philadelphia, Pa., December 29–31, 1914. The following officers were elected for the ensuing year:

President—John M. Coulter.

Vice-president—R. A. Harper.

Treasurer—Arthur Hollick.

Councilor—W. F. Ganong.

The resignation of George T. Moore as secretary was accepted and Mr. H. H. Bartlett, of the Department of Agriculture, elected to fill the unexpired term.

The council for 1915 will consist of above officers and George P. Atkinson and David Fairchild.

The following botanists were elected to membership: Adeline Ames, Department of Agriculture, Washington, D. C.; E. G. Arzberger, Bureau of Plant Industry, Washington, D. C.; Freda M. Bachmann, Milwaukee Downer College, Milwaukee, Wis.; Samuel M. Bain, University of Tennessee, Knoxville, Tenn.; A. L. Bakke, Ames, Iowa; Henry W. Barre, Clemson College, S. C.; H. P. Barss, Oregon Agric. Coll., Corvallis, Oregon; R. Kent Beattie, Bureau of Plant Industry, Washington, D. C.; Albert T. Bell, University of Louisiana, Baton Rouge, La.; H. M. Benedict, University of Cincinnati, Cincinnati, O.; R. C. Benedict, 2303 New Kirk Ave., Brooklyn, New York; Charles Brooks, Bureau of Plant Industry, Washington, D. C.; E. P. Bicknell, 30 Pine St., New York City; Guy R. Bisbey, Brooklyn Botanic Garden, Brooklyn, N. Y.; Harry P. Brown, 219 Linden Ave., Ithaca, N. Y.; Stewardson Brown, 20 East Penn St., Philadelphia, Penna.; Edward Sandford Burgess, Hunter College, New York City; Gertrude S. Burlingham, 556 Lafayette Ave., Brooklyn, N. Y.; George H. Chapman, Mass. Agric. College, Amherst, Mass.; C. Harvey Crabill, Va. Agr. Exp. Sta., Blacksburg, Va.; Richard O. Cromwell, North Carolina Agric. Exp. Sta., West Raleigh, N. C.; Gilbert Cameron Cunningham, Burlington, Vt.; Charles C. Deam, Bluffton, Indiana; W. W. Eggleston, Dept. of Agriculture, Washington, D. C.; John H. Ehlers, Univ. of Michigan, Ann Arbor, Mich.; Julia T. Emerson, 131 East 66th St., New York City; T. J. Fitzpatrick, Cotner University, Bethany, Nebraska; Eloise Gerry (U. S. Forest Service), 616 Lake St., Madison, Wis.; Melvin R. Gilmore, Neb. His. Soc. Museum, Lincoln, Nebraska; John P. Helyar, New Brunswick, New Jersey; Bascombe Britt Higgins, Georgia Exp. Sta., Experiment, Georgia; H. B. Humphrey, Dept. of Agric., Washington, D. C.; L. M. Hutchins, Bureau Plant Industry, Washington, D. C.; H. S. Jackson, Oregon Agric. College, Corvallis, Oregon; Cyrus A. King, Erasmus Hall High School, Brooklyn, N. Y.; B. F. Lutman, University of Vt., Burlington, Vt.; Fred McAllister, University of Texas, Austin, Texas; Walter B. McDougall, University of Illinois, Urbana, Ills.; S. M. McMurran, Bureau of Plant Industry, Washington, D. C.; K. K. Mackenzie, 139 North Walnut St., East Orange, New Jersey; W. E. Manewal, Univ. of Virginia, Charlottesville, Va.; H. F. Meier, Syracuse University, Syracuse, N.