tion) we evaluate the coefficients of the struggle for existence (alcohol production per unit of yeast volume), and if we then correlate these parameters in the form of an equation of the struggle for existence given for the first time by Vito Volterra (1926) and slightly modified by Gause (1932), we shall obtain an agreement in general features with the observed growth of a mixed population.[1] Further experiments confirmed this conclusion and showed also that under slightly different conditions (a greater content of oxygen in the nutritive medium) the complicating effect of the by-products of fermentation decreases, and the forecasts of the theory coincide entirely with the values observed. In all these experiments we had to deal with the distribution of a certain fixed and limited amount of energy between two populations.

In order to investigate the competition between species for a source of energy kept at a certain level experiments were made with various protozoa, and very clear and convincing results were obtained for *Paramecium caudatum* and *Paramecium aurelia.* These infusoria were cultivated in a buffered balanced Osterhout's salt solution (pH = 8.0), in which a suspension was made of *Bacillus pyocyaneus* (of fixed density). It has been found that bacteria do not multiply under these conditions.[2] Every day infusoria were centrifuged, the nutritive medium changed, and every other day the microcosms underwent a cleansing process with a salt solution. Specially arranged experiments showed that the deficiency of food was the only limiting factor in these cases. We had under such conditions (a) a competition of *P. caudatum* with *P. aurelia* for the still unutilized food resources, but after the source of energy had been altogether taken hold of, we had (b) a redistribution of energy between two components which always resulted in a complete driving out of *P. caudatum* by *P. aurelia* (Fig. 1). All this agrees with the mathematical theory. The corresponding equations are somewhat complicated, because the coefficients of the struggle for existence vary with time: one species may be favorable for the growth of another at the beginning of the experiment, and the depression of one species by another will only begin later on.

The destruction of one species by another has been studied with *Paramecium caudatum* being devoured by another infusoria, *Didinium nasutum.* Experiments showed that this biological system presents no oscillations in the numbers of individuals peculiar to itself, and that in spite of abundant food for *Paramecium* the latter are completely destroyed by predators which perish in their turn later on. However, oscillations appear if we admit a controlled and simultaneous immigration of predators and prey into the microcosm. Therefore, it is not the interaction itself, as would be expected from the mathematical theory developed by Lotka (1920) and by Volterra (1926), but the constant interference from without that leads to the oscillation in numbers. The corresponding equation of the struggle for existence has no periodic solution. This is owing to the particular biological adaptations of our predators, which have not been foreseen in the theoretical equations. In our experiments an analysis was made of the rôle of cover or refuge for the prey in the processes of the struggle for existence. This showed that when the number of individuals becomes reduced, and the conditions in the microcosm complicated, instead of the "deterministic" processes subject to differential equations we are confronted with "probabilities of change" in one direction or another. The corresponding material will be found in the above-mentioned book.

[1] Gause, *Jour. Exp. Biol.*, 9, p. 389.

[2] Johnson, *Physiol. Zool.*, 6, p. 22.

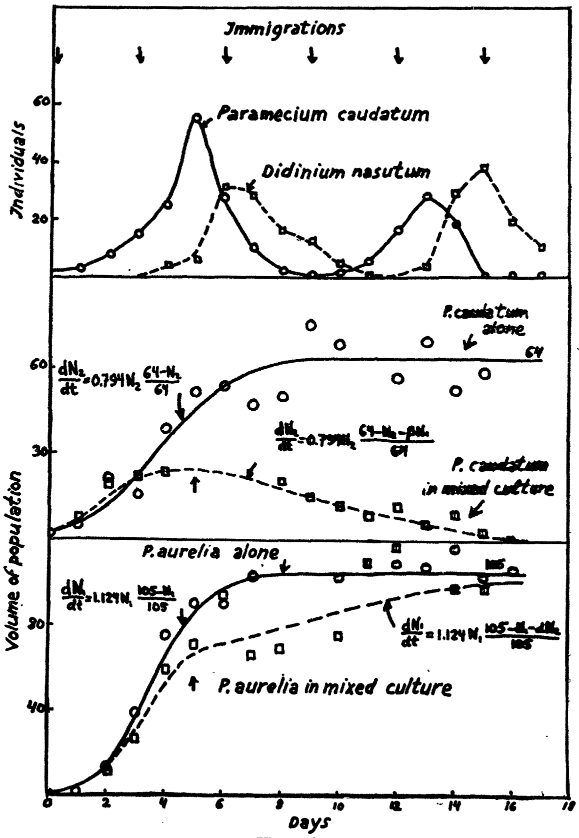

FIG. 1

G. F. GAUSE

ZOOLOGICAL INSTITUTE
UNIVERSITY OF MOSCOW

THE AMYLASE SYSTEM OF THE LIVER

COMPARISON of rat liver preparations, using the method for observing starch digestion introduced by Waldschmidt-Leitz and Samec,[1] showed that the

[1] *Zeitschr. für physiol. Chem.*, 203: 16, 1931.

amount of maltose formed at the blue-violet iodine endpoint in different preparations varies greatly. In a few cases, the iodine color endpoint was reached without any measurable maltose formation. This observation demonstrates, for the first time, that an amylase preparation can be made which in the early stages of starch digestion yields no reducing groups. This phenomenon is significant to the study of the constitution of starch.

Incubation of an aqueous liver suspension causes a considerable increase in its capacity to form maltose, while the iodine endpoint activity increases only slightly. In the centrifugate of such a preparation the comparative ratio of sugar formation to iodine end-point value is found to have shifted still further in favor of the sugar-forming component. Adding the resuspended residue to the centrifugate causes the latter to lose the increase in sugar formation observed in centrifuging, the iodine endpoint activity being practically unaltered throughout. The hypothesis, that there are two amylases with different characteristic maltose levels at the same iodine color endpoint, and an unstable inhibiting substance specific for the component showing more maltose formation, explains the observations here reported.

The inhibitor, soluble in fresh liver centrifugate, can be precipitated by treatment with acetic acid, pH 5.2, for 30 to 120 minutes. Resuspended in water, the precipitate can be redissolved by neutralizing, and in either state has a quantitative inhibiting effect on the formation of maltose from starch by liver preparations.

By treating fresh aqueous liver extracts with various concentrations of acetone, very stable amylase preparations have been made which show reproducible maltose formation at the iodine color endpoint at different levels, ranging from 3 to 15 mg per 100 mg starch. The conditions for producing fractions with a low sugar-forming level are very delicate, and have yet to be completely defined.

It is apparent that the digestion of starch by liver amylase, like that by plant amylase, is performed by two different components. Each component splits starch molecules in its own fashion, forming the fractions which make up the total course of carbohydrate breakdown.

The complete procedure and results of this study will be published in a later paper.

The author acknowledges indebtedness to Dr. Ellice McDonald for his valuable counsel and encouragement throughout this work.

LEONORE HOLLANDER

CANCER RESEARCH LABORATORIES,
GRADUATE SCHOOL OF MEDICINE,
UNIVERSITY OF PENNSYLVANIA

A CANKER AND GALL DISEASE OF GARDENIA[1]

A CANKER and gall disease has been observed to occur on the branches, stems and particularly the crowns of several varieties of Gardenia grown in greenhouses in the San Francisco Bay region in California. Infection apparently takes place only through wounds and most readily where the wounded part is near or in contact with the soil. On branches and stems not in contact with the soil the disease manifests itself as oblong cankers, frequently with the woody cylinder exposed at the point of infection and with the bark surface rough and corrugated. On infected crowns the cankers remain typical for a comparatively short time, after which they become overgrown with hypertrophied cortical tissue. This hypertrophy involves the entire circumference of the stem, increasing its diameter to twice normal or more and extending longitudinally one to two inches in both directions from the point of infection, giving the effect of an oblong gall. This abnormal swelling seems to be correlated with moisture, as it is apparent only where infected parts are in contact with the soil. In both cankers and galls the cortex is colored bright yellow a considerable distance in advance of the invading fungus. Pycnidia of the causal organism are found partially submerged in the cortical tissues surrounding the point of infection. Two types of spores exude in a short tendril from the same pycnidium. One, the A type, is hyaline, unicellular, elliptic-fusiform; mean size 3.4×9.7. The other, B type, is hyaline, unicellular, filiform, curved or flexuous; mean size 1.4×22.2.

The two spore types would indicate that the causal organism belongs in the genus *Phomopsis*. The fungus is readily isolated in pure culture both from spore tendrils and from tissue plantings of diseased parts. Inoculation of twigs and crown of Gardenia with this organism gave rise to typical cankers and galls from which the fungus was re-isolated and again successfully caused to infect Gardenia plants.

H. N. HANSEN
C. EMLEN SCOTT

UNIVERSITY OF CALIFORNIA, BERKELEY

[1] Contribution from the Division of Plant Pathology, University of California, Berkeley, California.

BOOKS RECEIVED

Annual Report of the Secretary of the Interior for the Fiscal Year Ended June 30, 1933. Pp. 329. U. S. Government Printing Office.

MARTIN, THOMAS. *Faraday's Diary.* Vol. III, May 26, 1836 to November 9, 1839. Pp. xii + 466. Vol. IV, November 12, 1839 to June 26, 1847. Pp. xii + 448. Illustrated. G. Bell & Sons, London. £12 12s, for set of seven volumes.

TYSON, LEVERING. *Radio and Education.* Pp. vii + 203. University of Chicago Press. $2.50.