with alcoholic oleic acid, such de-fatted starch can be reimpregnated with fatty acid, and this added fat cannot be extracted by hydrocarbon type solvents.

Hence, it appears that free fatty acid is distributed throughout the starch granule as an extraneous impurity. To explain selective extraction, it is suggested that only those fat solvents bearing hydrophilic groups can penetrate into the granule, hydrocarbon types merely washing the surface. This investigation is being continued, and final results will be reported in detail at an early date.

CORN PRODUCTS REFINING COMPANY
EDGEWATER, N. J. THOMAS JOHN SCHOCH

RECEIVED SEPTEMBER 23, 1938

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## PANTOTHENIC AND NICOTINIC ACIDS AS GROWTH FACTORS FOR LACTIC ACID BACTERIA

*Sir:*

In a previous publication the preparation of highly active concentrates (1 unit in 0.5 $\gamma$) of an essential growth factor for lactic acid bacteria has been described [Snell, Strong and Peterson, *Biochem. J.*, **31,** 1789 (1937)]. Considerable difficulty has been encountered in attempts to further purify this factor, and a long series of fractionation procedures resulted in only about a two-fold increase in activity (1 unit in 0.20 $\gamma$).

Recently, information became available [R. J. Williams, papers presented before the American Chemical Society at Milwaukee, Wisconsin, Sept. 5–9, 1938, and private communications] which revealed a striking similarity between the properties of the above growth factor and pantothenic acid [Williams, *et al.*, THIS JOURNAL, **55,** 2912 (1933)]. Both are water-soluble, nitrogenous, organic, hydroxy acids, easily destroyed by aqueous acids or alkalies, but relatively resistant to the action of light, nitrous acid, bromine, and mild oxidizing agents. Through the kindness of Dr. R. J. Williams it has now been possible to subject two samples of pantothenic acid to our bacterial test. One preparation, A, contained approximately 40%, and the other, B, 83% calcium pantothenate. The following results were obtained on *Lactobacillus casei* as the test organism:

| Supplement | $\gamma$ Added per 10 cc. medium a | b | c | d | Cc. 0.1 *N* acid produced per 10 cc. medium a | b | c | d |
|---|---|---|---|---|---|---|---|---|
| Sample A | 0.0 | 0.05 | 0.1 | 0.5 | 0.5 | 1.4 | 3.5 | 7.0 |
| Sample B | .0 | .02 | .05 | .3 | .5 | 1.3 | 3.3 | 7.8 |

These and other tests indicated that sample A contained one unit in approximately 0.13 $\gamma$, and that B possessed about twice this activity.

Sample B was further tested on *Bacillus lactis acidi*, *Lactobacillus arabinosus*, *Lactobacillus pentosus*, *Lactobacillus delbrückii*, *Bacillus brassicae*, *Streptococcus lactis*, *Leuconostoc mesenteroides*, and *Propionibacterium pentosaceum*, and proved to be highly active for each organism. All of these organisms had previously been shown to require the growth factor. It appears certain that the active substance in our concentrates is identical with pantothenic acid, and that our best preparation contained approximately 26% pantothenic acid.

In addition to pantothenic acid some lactic acid bacteria seem to require nicotinic acid as well. Six species tested were found to grow very poorly or not at all in an acid-hydrolyzed casein medium containing both riboflavin and pantothenic acid. When small amounts of nicotinic acid were added to this medium, a marked improvement in growth and acid production occurred in some cases.

| Organism | $\gamma$ Nicotinic acid added per 10 cc. medium a | b | c | d | Cc. 0.1 *N* acid produced per 10 cc. medium a | b | c | d |
|---|---|---|---|---|---|---|---|---|
| *L. casei* | 0.0 | 0.1 | 0.3 | 0.5 | 2.2 | 4.1 | 5.4 | 6.6 |
| *L. arabinosus* | .0 | .1 | .3 | .5 | 1.7 | 4.7 | ... | 5.2 |

From the above data it appears that nicotinic acid is also an essential growth factor for at least two species of lactic acid bacteria.

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MADISON, WISCONSIN

RECEIVED SEPTEMBER 24, 1938

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## ORIENTATION OF HIGH MOLECULAR WEIGHT LINEAR POLYMERS IN UNSTRETCHED FILMS

*Sir:*

Recent electron diffraction studies by Storks[1] furnish definite evidence that unstretched films of polyethylene sebacate consist of relatively small crystallites which are oriented with their long axes approximately in the plane of the film, and with limited rotation around this axis, "probably due in part to the presence of carbonyl groups along the chain." Further, Storks points out that such films will probably show a preferred orientation until the film thickness exceeds the average chain length; only beyond this point do high molecular weight linear polymers exhibit truly amorphous Debye–Scherrer ring patterns.

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[1] Storks, THIS JOURNAL, **60,** 1753 (1938).

This work is in complete accord with a theory of partially oriented film structure proposed by us, which was advanced to explain qualitatively the results of film continuity studies.[2]

We have shown previously that the minimum coating weight of certain linear polymers on several metals varies essentially inversely as the average chain length.[2] If the chains made a 90° angle with the surface, a direct ratio of minimum coating weight to chain length would obviously be approximated. A system of oriented chains *parallel* to the surface would give a minimum coating weight independent of chain length. At any angle between zero and 90° which the chains make with the surface, a fixed chain length would give a coating weight directly related to the sine of the angle with the surface. Now, it is obvious from the work of Langmuir and others that a chain having only a single terminal polar anchoring group would tend to stand on end; with additional polar groups along the chain, the effective polarity gradient along the polymer would vary with the type and distribution of such groups. Assuming a relatively uniform distribution along the chain,[3,4] then the chain would incline at an angle with the surface which was directly related to the polarity gradient. Finally, with uniform distribution of polar groups along the chain, the longer the chain the smaller would be this polarity gradient. Accordingly, the longer the chain the smaller would be the angle it makes with the surface and as a result, an increase in chain length would reduce the minimum coating weight. This was actually found by experiment.[2]

This line of reasoning had already led us to make electron diffraction studies, with inconclusive results. Storks' results obviously reopen this method of attack. They furnish independent confirmation of our theory of partial orientation in what are usually considered to be wholly amorphous films.

Unfortunately, our film continuity studies depend upon a specific method, namely, that of conductivity through discontinuous films. In the near future attempts will be made to get an independent check of this work by studying the diffusion of hydrogen through thin films on palladium and of helium through thin films on glass.

CONTRIBUTION FROM THE STONER-MUDGE,
INC., INDUSTRIAL FELLOWSHIP
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THE PENNSYLVANIA STATE COLLEGE W. K. SCHNEIDER
STATE COLLEGE, PA. J. G. ASTON

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[2] Young, *et al.*, *Ind. Eng. Chem.*, **29**, 1277, 1280 (1937); **30**, 685 (1938). See also paper to appear shortly.

[3] Flory, THIS JOURNAL, **59**, 466 (1937).

[4] Marvel, *et al.*, *ibid.*, **60**, 280, 1045 (1938).

# NEW BOOKS

**Catalysis from the Standpoint of Chemical Kinetics.** By GEORG-MARIA SCHWAB, University of Munich. Translated from the First German Edition, with additions from the recent literature by the author, by HUGH S. TAYLOR, Princeton University, and R. SPENCE, Leeds University. D. Van Nostrand Company, Inc., 250 Fourth Ave., New York, N. Y., 1937. xi + 357 pp. 39 figs. 16 × 23.5 cm. Price, $4.25.

The German edition [reviewed in THIS JOURNAL, **54**, 3017 (1932)] of Dr. Schwab's "Katalyse," which appeared in 1931, ably filled the need for an ordered and condensed theoretical treatment of the whole field of catalysis, both homogeneous and heterogeneous. The present translation, delayed by "the difficult economic conditions in the world," closely adheres to the original arrangement and purpose, but has been brought up to date by the addition of new material to the extent of some 15%. The result is a book admirably suited to graduate courses in catalytic theory, and useful to the prospective investigator as an orientation into the many unsolved problems in this field.

The reader is assumed to be familiar with the principles of theoretical chemistry, including the kinetics of uncatalyzed reactions, and with elementary mathematics. The emphasis is on the significance of theories as applied to selected examples rather than on formal mathematical statements. The treatment of the various types of catalysis is organized on a systematic rather than historical basis. Experimental examples are frankly chosen for their value in illuminating general principles, and details are naturally minimized. The book is about equally divided between homogeneous catalysis (in gases and solutions) and heterogeneous catalysis (of gas reactions). Bio-catalysis is treated briefly; technical aspects of catalysis are excluded, as is also experimental technique.

Some idea of the current activity in catalytic investiga-