and the use of cubical units having square units as their faces, and hence they establish numerical relations between entities of different dimensions. In fact, the ancient Babylonians used certain equations whose terms represent different dimensions. The developments of number and form are thus seen to have partly united long before the work of R. Descartes and others during the seventeenth century. The deep study of mathematical history tends to exhibit a much more gradual development of our subject than is commonly exhibited in the brief accounts which usually emphasize unduly the work of a few outstanding individuals.

G. A. MILLER

UNIVERSITY OF ILLINOIS

ILLUSIONS IN PRINTED MATTER

THERE may be "nothing new under the sun" but only something new to the writer of this note. For that reason he is recording an observed phenomenon to discover whether others have also experienced it, perhaps long, long ago.

If typewritten copy is produced with the original form on thin or "onion-skin" paper and the carbon copy on similar paper, thus usually making the second copy blacker than the first and if this copy is "single spaced," preferably, but not necessarily, with no paragraph separations, or better yet, without paragraphing, the materials are supplied for an interesting perception. The top sheet should be rotated over the lower sheet to the left or to the right to the extent of an angle no greater than about 20°, but without displacement in any other manner. An angular rotation of 5° appears to be optimal under the conditions tested.

The blank spaces between words, and to some extent the dark blocks made by the words, will form ten or twelve concentric circles like ripples on the surface of a pond into which a pebble has been cast. In the present psychobiological state of the writer, these rings did not seem to move, but the center or focus of the rings can be made to move in a direction at right angles to the line of displacement of the top sheet.

While the phenomenon appears to be illusory, because the printed words and spaces are obviously of different lengths, the circles seem to be by measurement about one centimeter in increment of radius from center to periphery. The other illusory feature is, of course, the completion of the circumferences in the perception of the concentric circles: only intermittent cues from the spaces between the words are physically furnished or, putting it obversely, many printed words obstruct or interrupt the smooth course of the spaces.

It also remains to be explained why a slight shift of about 5° around an axis should produce fairly complete circles, or at least partial circles, if the axis lies close to any one of the margins on the paper.

This brings to mind several other illusions observed in printed matter. Years ago a matter was referred to the writer concerning the bad alignment of a printed "letter-head" containing at the beginning of the address a number of 4's, thus

American Sawdust Company
4440 Austin Boulevard
Chicago, Illinois

A complaint had been registered with the printer regarding the improper assembly of the second line with respect to the first and third lines, so that the line in question seemed to be tilted downward at the left end. It was easy to show that the effect was due to the diagonal direction of the left portions of the three 4's, well known to psychologists as the Zöllner illusion and related also to the figures of Hering and Wundt. If the 4's had been printed in the type face which includes the script form, this difficulty would have been obviated.

A similar effect is noticed in those typewriters that include a triangular bracket to the right of the writing point into which a pencil is to be inserted for drawing horizontal lines on the paper moved by the carriage when released from one side to the other. Often the line, which has been typed half-way across the paper, appears to be dropping gradually to the right. The slanting side of the triangle is responsible in a similar way to the above for the distortion of the line away from its parallel relationship to the other lines.

CHRISTIAN A. RUCKMICK

C. H. STOELTING COMPANY,
CHICAGO, ILL.

CATALOGUE OF NORTH AMERICAN EARLY TERTIARY FOSSILS OF THE GULF AND ATLANTIC COASTAL PLAIN

THIS catalogue is prepared in a manner similar to the "Catalogue of North American Devonian Fossils" published by the Wagner Free Institute of Science in Philadelphia.

The Early Tertiary catalogue will contain descriptions and illustrations of the fossil invertebrates from the Paleocene, Eocene and Oligocene of the Atlantic and Gulf Coastal Plain of the United States. Each species will be described and illustrated on a card of heavy paper 8½ by 11 inches in size, fitting a letter file. The text of the cards will be printed; the figures will be printed by full-tone collotype process. Type specimens will be figured if available; if not, photographs of topotypes will be used wherever feasible. Photographs of topotypes will be used extensively as supplementary illustrations. Original descriptions will be quoted in every case. Additional remarks or complete redescriptions will be given where necessary.

Type localities and stratigraphic data have been checked in the field by specialists in nearly all cases and will be given explicitly and in an up-to-date manner. Therefore, the cards will contain much more information than is available in the literature to-day.

There will be running numbers for the whole catalogue, one for each card. These numbers will begin with 1 and continue as long as new catalogue cards are being published. Also, there will be running numbers restricted to each class. Thus the class Gastropoda will have its own numbering apart from the numbers for the entire catalogue. The numbers will make it easy to arrange the cards and to refer to them in the literature.

The following cards are ready for publication:

Tetrabranchiate Cephalopoda (Nautiloidea)
28 species on 43 cards
Gastropoda—Genera Cryptochorda and Lapparia
12 species on 12 cards
Gastropoda—Family Turritellidae
81 species on 81 cards
Brachiopoda
27 species on 28 cards

The cards may be obtained from the Bureau of Economic Geology, Austin, Texas. Any further information will be furnished gladly.

H. B. STENZEL,
Editor of the Catalogue

SPECIAL ARTICLES

PRODUCTION FROM SUCROSE OF A SEROLOGICALLY REACTIVE POLYSACCHARIDE BY A STERILE BACTERIAL EXTRACT

THIS report deals with the production from sucrose of a serologically reactive polysaccharide by an enzyme or some similar heat labile principle contained in sterile filtered extracts prepared from cultures of *Leuconostoc mesenteroides*. The possibility that polysaccharides possessing serological properties might be synthesized from the proper substrates by enzymes obtainable from appropriate bacteria would seem indicated by the recent proof of the enzymatic syntheses of glycogen and of starch. The production of gum-like material from sucrose by sterile preparations derived from various species of spore-forming bacilli has been reported by others.[1] But in these earlier studies the products were not identified chemically nor tested serologically, whereas in our studies the product formed by the enzyme or active principle has been proved to be an immunologically reactive polysaccharide similar in both chemical and serological properties to the product formed in cultures of the living bacteria.

Leuconostoc mesenteroides, which is a Gram-positive coccus widely distributed on plants, seemed especially suitable for the investigation because the production of reactive polysaccharide by these bacteria can be referred to a known constituent of the medium: not only are abundant amounts formed apparently only in the presence of sucrose, but also the polysaccharide product (dextran) has been proved[2] to be composed entirely of units (glucose anhydride) which sucrose could supply. An additional advantage was that the leuconostoc polysaccharide was not only recognizable by its chemical properties but could also be identified by its capacity to react with the antiserums of types 2 and 20 pneumococci[3] as well as with the antiserum of the homologous bacteria.

We have not yet obtained the active principle entirely free of preformed polysaccharide. However, although more highly purified extracts would be desirable, the present ones are adequate to establish the general mechanism of the reaction and to permit the isolation of the purified polysaccharide product for chemical as well as serological study.

During the past 12 months 14 different lots of leuconostoc extract have been tested and all were found to have the capacity to form the reactive material from sucrose. The extracts had been filtered through Berkefeld W candles and had been subjected to rigorous tests for sterility. Aseptic technique was used in the preparation and subsequent handling of all the enzyme-substrate test mixtures, and their sterility was controlled at appropriate intervals during the incubation periods by microscopic examination and by culture in a series of liquid and solid mediums which were known to be adequate for detection of small numbers of leuconostoc bacteria. As a result of these controls we feel certain that the observed reactions occurred in the absence of microorganisms. The results of the tests of the isolated polysaccharide and a description of the preparation of the extracts, together with data on the influences of temperature and of pH and on the serological differences in the products yielded by extracts prepared from different strains of leuconostoc will be given in a later paper now in preparation.

The substrate specificity and the general mode of action upon sucrose can be illustrated by the data on

[1] M. W. Beijerinck, *K. Akad. v. Wetensch.*, Amsterdam, Proc. sect. sc, 12: 635, 1910; F. C. Harrison, H.L. A. Tarr and H. Hibbert, *Canadian Jour. Research*, 3: 449, 1930; L. Dienes, *Jour. Inf. Dis.*, 57: 12, 22, 1935.

[2] F. L. Fowler, I. K. Buckland, F. Brauns and H. Hibbert, *Canadian Jour. Research*, 15 B: 487, 1937; S. Peat, E. Schluchterer and M. Stacey, *Jour. Chem. Soc.*, 581, 1939; W. Z. Hassid and H. A. Barker, *Jour. Biol. Chem.*, 134: 163, 1940.

[3] J. Y. Sugg and E. J. Hehre, unpublished manuscript.