yet been decided. The annual award of the Academy's grant-in-aid was made to Dr. E. R. Eller, of the Carnegie Museum, Pittsburgh, to finance his further search for Scolecodonts. The following officers were elected:

*President,* W. H. Thurston, Jr., Pennsylvania State College; *President-elect,* E. A. Vuilleumier, Dickinson College; *Vice-president* (western Pennsylvania), Anna A. Conn, Uniontown, (eastern Pennsylvania), Walter S. Lapp, Lansdale; *Secretary-Treasurer,* V. Earl Light, Lebanon Valley College; *Press Secretary,* Bradford Willard, Lehigh University; *Editor,* Robert T. Hance, Pittsburgh; *Junior Academy,* Karl F. Oerlein, California State Teachers College.

BRADFORD WILLARD,
*Press-Secretary*

# SPECIAL ARTICLES

## BISULFITE BINDING SUBSTANCES (B.B.S.) AND THIAMIN DEFICIENCY

THIAMIN plays an important role in the metabolism of pyruvic acid. Keto-acids and aldehydes, including pyruvic acid, react with bisulfite (and hence are termed bisulfite binding substances—B.B.S.) affording a basis for their determination.[1] Thompson and Johnson[2] found a marked increase in the quantity of B.B.S. in the blood of thiamin-deficient rats and pigeons. Estimations of pyruvic acid in the latter showed that the rise in B.B.S. was due almost entirely to this substance. Lu[3] found a marked increase of pyruvic acid in the blood of thiamin-deficient rats.

Adapting the technic of Clift and Cook[1] to urine we have investigated further the relationship of B.B.S. and thiamin deficiency with the view to working out a method of appraising the status of thiamin nutrition in humans and as a means of estimating the content of thiamin in foodstuffs and biological materials.

It was early found in working with rats that the quantity of food intake is an important factor in the results obtained. Consequently, the amount of food must be limited to an arbitrary level during urine collection periods. The addition of considerable NaCl to the diet during collection periods assures sufficient urine so that animals can be studied individually. The salt has no vitiating effects on the results.

There is a rapid and progressive rise in the urinary B.B.S. of young adult rats on a thiamin-deficient diet. Frequently in as little as one week, after restriction to the diet, the increase is 200 to 400 per cent., confirming the findings of Banerji and Harris[4] published while this study was in progress. In advanced deficiencies the increase is as much as 600 to 900 per cent. When the food intake is limited at a constant level and thiamin is given, the B.B.S. of deficient rats drops to normal within 24 hours. This effect is partially masked when food is given *ad libitum,* since thiamin quickly stimulates the appetite. In animals receiving the standardized level of the deficient diet, adequately supplemented with thiamin, consecutive daily B.B.S. values are within a narrow range, 3–8 ml (expressed as ml of 0.005 N iodine) per 24 hours.

It is generally recognized that high fat diets can prevent or cure polyneuritis in rats.[5,6] We have made some observations on this relationship, in connection with the effect of diet on B.B.S. values. When fat (autoclaved lard) is substituted isocalorically for sucrose in the thiamin-deficient diet, there is some immediate decrease in B.B.S., but the values remain high (300 to 400 per cent. above normal) with no further change even after feeding the fat for two weeks. During this interval the growth rate and appearance markedly improve. Thiamin administration causes a B.B.S. drop to normal within 24 hours. Control animals on the same schedule receiving adequate thiamin showed no change in B.B.S. It is hoped that our studies now in progress will contribute to a satisfactory interpretation of these results.

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## A NEW METHOD FOR STUDYING THE PROPERTIES OF LUBRICATING OILS BASED ON THE USE OF A NEW INSTRUMENT

WE have recently succeeded in making an automatic recording tensiometer. This instrument takes one measurement every two minutes, and being equipped with synchronous motors (of the electric clock type) will record the value of the surface tension practically indefinitely on a roll of paper. The recording box is connected to the tensiometer through an electric cable, so that the tensiometer itself can be placed in a separate room, an ice box, an incubator or even in a tightly closed chamber submitted to high pressure or vacuum.

[1] F. P. Clift and R. R. Cook, *Biochem. Jour.,* 26: 1788, 1932.
[2] R. H. S. Thompson and R. E. Johnson, *Biochem. Jour.,* 29: 694, 1935.
[3] G. D. Lu, *Biochem. Jour.,* 33: 774, 1939.
[4] G. G. Banerji and L. J. Harris, *Biochem. Jour.,* 33: 1346, 1939.
[5] W. D. Salmon and J. G. Goodman, *Jour. Nutrition,* 13: 477, 1939.
[6] F. E. Stirn, A. Arnold and C. A. Elvehjem, *Jour. Nutrition,* 17: 485, 1939.

This arrangement will make it possible to obtain measurements of surface tension under conditions never realized thus far, and to record variations occurring over long periods of time, during the process of biological reactions (fermentations, growth of bacteria, etc.) in an incubator, for instance.

We applied it first to the study of the properties of lubricating oils. A new technique had to be developed, inasmuch as the surface tension of pure oils fails to supply information concerning the presence of the polar groups to which the lubricating properties are due. An oil devoid of polar, adsorbable molecules, such as paraffin oil, does not become adsorbed on the metallic surfaces, and therefore constitutes a very bad lubricating oil. It has been shown by measurements of interfacial tension against water, by means of du Noüy interfacial tensiometer[1] that the addition of highly polar molecules, such as oleic or stearic acid, in small quantity, is sufficient to transform paraffin oil into a good lubricating oil.

In order to observe such changes which up to now could be detected only by variations in the interfacial tension, we experimented no longer on pure oils, but on a small quantity of water polluted by a trace of oil.

Records of the surface tension show that while the surface tension of paraffin oil is somewhat lower than that of the average motor oil, the surface tension of water polluted by oil is decreased (by a few dynes: 5 to 12) by the presence of motor oil, while it is unchanged by the presence of non-spreading paraffin oil.

If the surface of the polluted water is then touched with a thin glass rod previously dipped in oleic acid, the surface tension falls abruptly, no matter what oil is floating on the water. But thereafter, the records are quite different: in the case of paraffin oil, over a period of four or five hours, there is no rise in the surface tension, or, when the amount of oleic acid was extremely small, a slight and progressive increase, which may attain 3 to 8 dynes, is observed. In the case of a good lubricating oil, however, we observe a rise, which may attain 15 to 20 dynes within one or two hours; this rise follows a beautiful geometric curve (see Fig. 1).

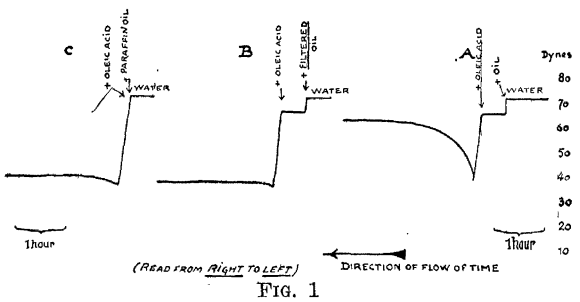


FIG. 1

[1] See J. J. Trillat, International Congress of Chemistry, Rome, 1938.

This phenomenon is apparently due to the adsorption of the polar molecules of oleic acid by the polar molecules of the oil. Should this be true, any process which would deprive a lubricating oil of its polar molecules, thereby decreasing its lubricating properties—such as filtration, for instance—should result in yielding an oil which would react to our test in the same way as paraffin oil. Fig. 1 shows that such is the case: Curve A is a record obtained with a good motor oil, unfiltered, while curve B is a record obtained with the same oil *after filtration* over four layers of filter paper. Curve C is obtained with paraffin oil.

This experiment shows definitely that filtration of lubricating oils is a dangerous process when the lubricating properties must be preserved. By means of interfacial measurements, J. J. Trillat had arrived at the same conclusions.

It seems safe to admit, tentatively, that this new phenomenon is very closely related to that which we described first in 1922 under the name of "antagonistic phenomenon."[2]

Of course, it would be possible, by means of an ordinary, non-recording tensiometer to perform the same experiments. But in order to obtain a perfect curve, it would require a large number of measurements of surface tension, over a period of hours, and this is a rather trying procedure.

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## AUTOPHAGIA IN RATS TRAUMATIZED DURING INANITION[1]

IN an inanition experiment with male adult albino rats, during which the rats were wounded, 50 per cent. of the traumatized rats ate their bodies at the wounded areas. In none of the inanition experiments performed by the author in which the rats were not wounded has there been any evidence of autophagia.

Thirty male adult albino rats were placed in adjoining individual cages with wire screen walls of a mesh large enough for the penetration of the fore paws or the tip of the tail into the adjoining cage. All the rats were placed on a complete starvation diet, and one half of them were given an ample sufficiency of water at all times. Fourteen, or approximately one half, of the rats received wounds on their fore paws or tails, which occasionally penetrated the mesh of the wire screen between the cages and were bitten by their

[1] The investigation was initiated in the Department of Zoology of the University of Maryland, College Park, Maryland.

[2] Lecomte du Noüy, *Jour. Exp. Med.*, 36: 115, 1922, and "Surface Equilibria of Biological and Organic Colloids," (A. C. S. Monograph) New York, 1926, p. 155.