This result compares with 70.8 e. u. calculated by Pitzer and 74.04 by Kassel. The agreement in the latter case is to some extent fortuitous since there remains a discrepancy of 2.0 e. u. in the entropy of isomerization. Since 0.5 e. u. of this may be experimental error, however, the previously advanced belief [*ibid.*, **4,** 441 (1936)] that equilibrium constants could be calculated within a factor of 2 (1.4 e. u.) appears not to have been greatly over-optimistic.

Since the third law value for isobutane is wrong to a far greater extent than that for *n*-butane, it is perhaps reasonable that the still more highly branched molecule, tetramethylmethane, should give a particularly low third law value. The discrepancy actually found between third law measurements and free rotation calculations is 8.6 e. u. [Aston, Siller and Messerly, THIS JOURNAL, **59,** 1750 (1937)].

UNIVERSAL OIL PRODUCTS CO. LOUIS S. KASSEL
RIVERSIDE, ILLINOIS

RECEIVED NOVEMBER 13, 1937

CONTACT POTENTIALS OF MULTILAYER FILMS ON METAL PLATES

Sir:

Blodgett [THIS JOURNAL, **57,** 1007 (1935)] and Blodgett and Langmuir [*Phys. Rev.*, **51,** 664 (1937)] have recently described the building up of multilayer films of stearic acid on metal plates by successive dippings of the plates into aqueous solutions covered with a monomolecular layer of the acid under constant compression. If the solution contains $KHCO_3$ (10^{-3} *m*) and calcium ions (10^{-4} *m*) at a *p*H above 9 a layer of film is deposited only as the plate enters the liquid, and it is assumed that in each layer the molecules are oriented in the same direction. On the other hand, at a *p*H less than 7, after the first dip a layer is deposited both as the plate enters and as it is withdrawn from the solution, and in this case it is assumed that the molecules are oriented oppositely in successive layers. These two types of films have been termed by Langmuir *X* and *Y* films, respectively.

Clearly, if the hypothesis is correct, these two kinds of film should produce quite different effects on the contact potentials of the metal plates. In the case of the *Y* films, the potential changes due to successive layers should cancel one another; in the case of the *X* films, very large potential changes should result from the cumulative effect of the added layers. We have recently studied the potential changes associated with such films by means of the vibrating plate method [Zisman, *Rev. Sci. Instruments*, **3,** 7 (1932); E. F. Porter, THIS JOURNAL, **59,** 1883 (1937)]. Castor oil was used to provide constant surface pressure at a temperature of 25–26°. The very different results obtained with *X* and *Y* films are shown in the accompanying figure. A potential change of 8.6 volts was obtained with 170 similarly oriented layers of an *X* film, while the potential change remained constant at 0.12 volt from 10 to 220 layers of a *Y* film. In the former case the maximum slope is 62 millivolts per layer, and it should be noted that the sign of the potential change is such that the molecules in these layers are oriented with their negative ends toward the metal. These results are clearly in accord with Langmuir's hypothesis regarding the orientation of the molecules in the two types of film; nevertheless, they do not of themselves imply anything so specific. All that they demand is some continued electrical asymmetry in the arrangement of the

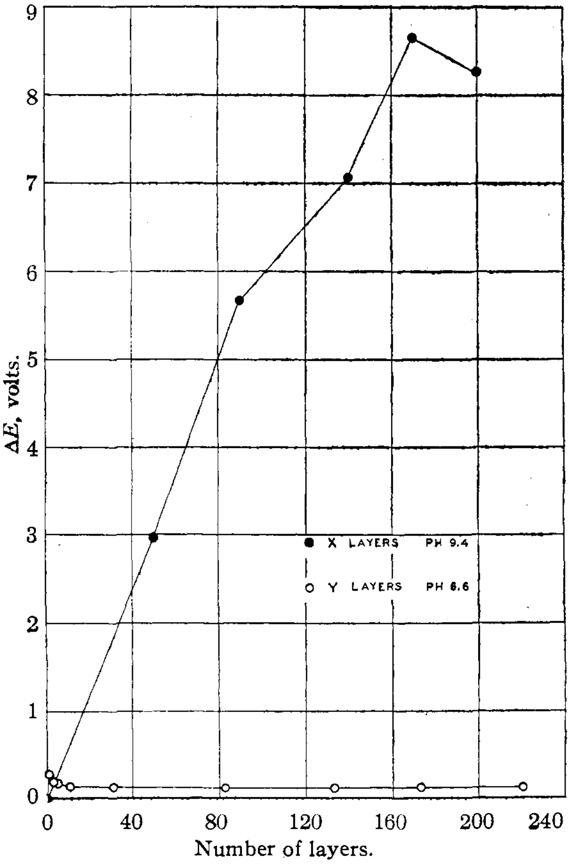

Fig. 1.

layers in the X films as opposed to an electrical symmetry in the case of the Y films. In this connection it should be pointed out that Holley and Bernstein [*Phys. Rev.*, **52,** 525 (1937)] have shown that the X-ray grating space of X and X barium–copper–stearate films is approximately the same.

We wish to express our gratitude to Dr. Langmuir through whose kindness one of us was shown the technique of multimolecular film formation at his laboratory in Schenectady.

BIOLOGICAL LABORATORIES
HARVARD UNIVERSITY
CAMBRIDGE, MASS.

ELIOT F. PORTER
JEFFRIES WYMAN, JR.

RECEIVED NOVEMBER 12, 1937

NEW BOOKS

The Biochemistry of Cellulose, the Polyuronides, Lignin, etc. By A. G. NORMAN, Ph.D., D.Sc., Biochemist, Rothamsted Experimental Station. Oxford University Press, 114 Fifth Avenue, New York, N. Y., 1937. ix + 232 pp. 16 × 24.5 cm. Price, $5.00.

Dr. Norman has brought together in one volume and discussed critically the most important results obtained during the past two decades on the biochemistry of cellulose and closely related cell wall compounds. He does not attempt to cite every publication in the field nor does he review the great mass of earlier publications.

The chapters dealing with cellulose, the polyuronide hemicelluloses, pectin, lignin, the gums and mucilages are excellently written and sufficiently complete. In these chapters the author discusses such general topics as the occurrence, preparation, properties, hydrolysis, biological decomposition, constitution and structure of the materials in question.

In the chapter on the metabolism of plant cell wall constituents he summarizes the work that has been done on the subject and discusses the various suggestions that have been made relative to the interrelation of these materials.

The last chapter deals with work that has been done on bacterial and fungal polysaccharides. The appendix is devoted to a brief discussion of the uronic acids and the quantitative determination of pentoses in the polyuronides.

The work has been carefully and critically prepared and will be a great help both to the general student of plant biochemistry and to investigators in this special field.

ERNEST ANDERSON

The Structure and Composition of Foods. Vol. III. Milk (Including Human), Butter, Cheese, Ice Cream, Eggs, Meat, Meat Extracts, Gelatin, Animal Fats, Poultry, Fish, Shellfish. By ANDREW L. WINTON, Ph.D. and KATE BARBER WINTON, Ph.D. John Wiley and Sons, Inc., 440 Fourth Ave., New York, N. Y., 1937. xviii + 524 pp. 15.5 × 24 cm. Price, $8.00.

This third volume of this series is divided into three principal parts: I, Milk and milk products; II, Eggs; and III, Animal products. In each instance there is an introductory section which covers the usual chemical constituents of the materials in question. This is followed by a series of sections in which the special types of animal food materials are described in detail. Thus in Part I the milks of different animals are covered separately, followed by an extensive discussion, under separate headings, of the numerous milk products including, for example, evaporated, condensed, dried, and malted milk, butter, cheese and ice cream as well as numerous other milk products. Part II dealing with eggs occupies fewer pages, but appears to be sufficiently extensive and is replete with information. Not only do the authors describe the average fresh egg, but they include references to the influence of breed of hen, feed, conditions of storage and other factors upon its composition and properties. Factors contributing to egg spoilage are discussed also.

Part III, Animal products, occupies about half of the volume. Not only are the ordinary forms of flesh meats included, but fish, shellfish, and various meat products such as sausages, fats, gelatin, meat extracts, and the like.

Unlike the two earlier volumes in this series covering: I, Cereals, nuts, oilseeds and forage plants; and II, Vegetables and fruits, respectively, the structure, including gross morphology and histology, occupies a very minor position in this third volume on animal products. The volume under review is concerned almost wholly with composition, using that term in the broad sense.

It is doubtless too much to expect that such an encyclopedic treatment as has been accorded food chemistry in these three volumes by the writers should be complete and balanced in every section. Certain inadequacies might be suggested, as in the discussion of the nature of milk fat globules (p. 32). This book should be of large service to all who are interested in animal products as foods, however, and particularly when supplemented with other specialized texts and monographs.

Errata and Addenda to Volumes I and II of the series are included in this volume. These chiefly comprise additions to the data recorded in the earlier volumes, with particular emphasis upon the chemical constitution of the vitamins, the vitamin content of fruits, the acid, and trace elements of fruits and vegetables.

C. H. BAILEY