function; when all the factors which have determined the bodily structure have been determined and evaluated.

It is interesting to note that Dr. Nopsca's avowed method of procedure is to work from the end result back to the beginning, rather than from the simple, comprehensive type towards the highly specialized. Neither method can be entirely successful until far more material is collected and studied, but it may be seriously questioned whether a start with the primitive forms does not make it far more possible to determine fundamental structures and changes than to start with the most aberrant forms where the lines of genetic relationship are obscured by secondary adaptations, possible parallelisms, convergences and polyphyletism.

Dr. Nopsca offers us a careful comparative analysis of the structure of 25 forms which he considers the most aberrant or specialized; from this study he suggests a classification which contains ten Super-Orders, one of which is new, the Dranitesauria; 21 Orders, of which two, the Rhizosauria and Chainosauria, are new; and a correspondingly large number of sub-Orders and Families. In this arrangement we have a clear illustration of the unfortunate lack of uniformity; other authors are best satisfied to express conceived relationships by groups of lesser rank. To the experienced worker such shifts in the rank of groups means little, but to the student, to whom an Order is a positive concept, the matter is most confusing.

As is natural, Dr. Nopsca's opinions lead to a new mosaic of relationships, and, in the opinion of some, to strange fellowships among the reptilia. We find the Thallatosauria grouped with the Pelycosauria, the Mesosauria with the Ichthyosauria and the Family Caseidae next to the Edaphosauridae.

As a part of his paper, Dr. Nopsca gives us a valuable review of the known reptilian footprints and more or less closely allocates each to distinct families or even genera. This discussion is most helpful and illuminating, but one hesitates to concede the accuracy of some of his suggestions, as when animals known only from distant regions are suggested as the makers of footprints found in England.

It is an interesting commentary on the breadth of the work in modern morphology that Dr. Nopsca speculates upon the effect of vitamines and hormones upon the development of Paleozoic and Mesozoic reptiles. This is but one of many evidences that the mere comparison of parts is no longer sufficient to him who would determine the genetic relationships which alone can form the basis of a true phylogeny. Physiology, environment, function—all these must be considered to have their share and must be read in the shape of the bones and in the sediments which reveal the environment during life of the animal remains there buried.

Dr. Nopsca's work is a most valuable contribution to the history of the reptilia, filled with information and abounding in suggestive interpretations.

E. C. CASE

UNIVERSITY OF MICHIGAN

SPECIAL ARTICLES

THE EFFECT OF FORMALDEHYDE UPON THE VITAMIN CONTENT OF MILK

THE desirability of a wholesome milk supply for every household is, of course, granted by every one. Common experience and scientific investigation have both shown the unquestioned value of milk in the diet, particularly for the child. The great problem to be solved, however, is that of bringing the milk from the producing dairy to the consumer within such time and under such conditions as to prevent harmful changes in the milk before its utilization. To meet the situation various methods have been proposed and carried out, the ideal one being the cleanliness and icing method that results in "certified" milk. Unfortunately, the necessary expense of such a method makes the product cost so much that it is only comparatively few who are able to use such a product for the family supply. The more common method is that of pasteurization, and its value as a method of insuring a useful milk for home consumption is not to be questioned.

However, investigators and dieticians are fairly well agreed that the process of pasteurizing is not without its drawbacks. It is conceded that the process results in the destruction of at least one vitamin to a very large extent, and most workers feel that the other vitamins also are depleted. This would, perhaps, not be a serious drawback if the milk were to be used by adults using an otherwise satisfactory mixed diet, but when the milk is to be used as the sole article of the baby's diet then the question does become an acute one. Usually, such a diet is supplemented by fruit juices or other similar sources of vitamins under such conditions. Nevertheless, thousands of babies, whose parents never heard of vitamins, are given the insufficient pasteurized milk with disastrous results.

Knowing the preservative value of formaldehyde, the following work was carried out within the past year to determine its possible usefulness in preventing undesirable changes in milk. T. M. Price,[2] working

[1] From the Department of Physiology, Ohio State University.

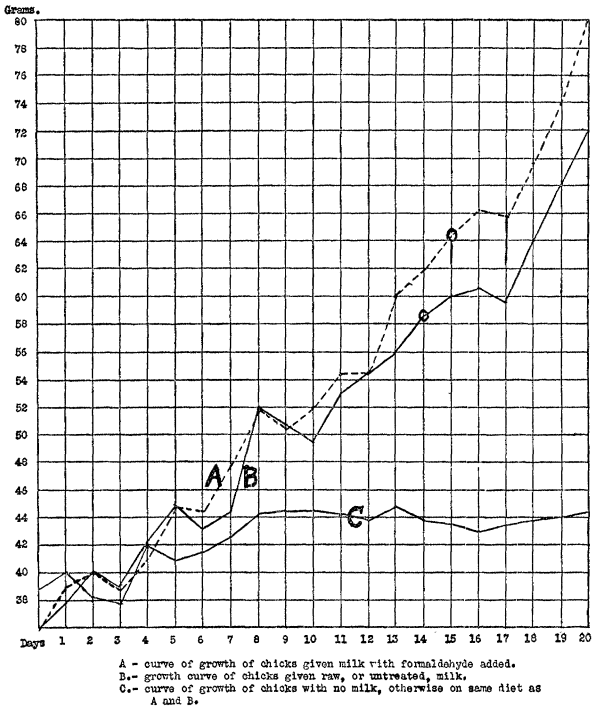
[2] T. M. Price, Centr. Bakt. Par., Abt. 2, 1905, 14, 65–75.

in the Biochemic Division of the U. S. Department of Agriculture, showed by a long series of experiments upon calves that formaldehyde, in proper amount to prevent souring of milk, had no ill effects whatever. Some of Price's conclusions were as follows:

"Formaldehyde in the proportion of 1:20,000 preserves the milk for 48 hours; used in twice that strength (or 1:10,000) it does not interfere with the digestion of milk when fed to calves." "Upon feeding calves through a long period with milk preserved with formaldehyde the calves remained healthy and gained in weight." "Much stronger solutions of formaldehyde (1:2,500) have no effect upon the activity of fresh enzymes—rennet, pepsin, pancreatin—in vitro."

The conclusions of Price are confirmed by the work done by Rideal and Fullerton,[3] although other workers have declared that formaldehyde does affect the coagulation of milk protein. However, those investigators finding such possibly harmful effects have universally used solutions of formaldehyde of much greater concentration than would be necessary to prevent milk souring—usually amounts varying from 1:25 to 1:2,000 being employed. At the time of Price's work vitamins were as yet unknown, and so it seemed possible that the effects of formaldehyde upon the vitamins of milk might be such as to preclude its usefulness as a preservative. An effort to determine the effects, if any, resulted in the following experiments.

Four years ago Seymour and Durrant[4] pointed out the utility of chicks as experimental animals in determinations of vitamin deficiency. During the past year Emmett and Peacock[5] confirmed these findings while using considerably larger numbers of chicks. Both sets of experiments showed that baby chicks are particularly susceptible to a lack of vitamins and thus lend themselves admirably to the determination of whether any particular diet is lacking in these essential substances. In the present experiments baby chicks were fed a diet practically free from vitamins (highly milled cornmeal baked into cakes, rice flour cakes, unleavened white flour cakes, etc.) with free access to grit, shell, charcoal, etc. Such a diet gives early evidences of lack of vitamins and results in a growth curve similar to "C" as shown upon the chart. Added to this diet in the present tests, however, was milk, both ordinary raw milk and milk treated with sufficient formaldehyde (1:20,000) to prevent souring at room temperature for at least 24 hours. The effect of the addition of the milk is readily seen by comparing growth curves "A" and "B" with the curve of growth when milk was lacking.



A—Curve of growth of chicks given milk with formaldehyde added.
B—Growth curve of chicks given raw, or untreated, milk.
C—Curve of growth of chicks with no milk, otherwise on same diet as A and B.

The chicks were divided into two groups of equal number and approximately equal weights. Each group had identical food, had access to the same brooder and were under the same conditions as to light, heat, etc. The sole source of liquid for the chicks was milk. Group B was given raw milk just as it came from the dairy, while Group A was given only milk that had formaldehyde added in the amount mentioned. The milk was "winter" milk, notably low in vitamin content, and hence, if the formaldehyde had any destructive action on the vitamins it should have been all the more readily noted, particularly when fed to the very susceptible chick. Two separate tests were run, one in March, 1922, and the second in November. The results of both were practically identical. The growth curves shown are those obtained in March, that of November differing only in that the chicks fed milk that had been treated with formaldehyde outstripped the other chicks to an even

[3] Rideal & Foulerton, Exp. Sta. Rec., 1900, 11, 582 (also, Rideal, Lancet, 1900, I, 228–230).

[4] Seymour & Durrant, *Ohio Jour. of Sci.*, 1919, XIX, No. 8, 509–512 (also, SCIENCE, N. S., XLIX, No. 1271, 448).

[5] Emmett & Peacock, *Jour. Biol. Chem.*, 50, Feb., 1922 (Proc. Amer. Soc. Biol. Chem.).

greater degree than is shown by the March curve presented.

Shown by a small circle upon the growth curves is the first appearance of any "vitamin-lack" symptoms. In each case the symptoms appeared first in the chicks given untreated milk, but not at a period enough earlier to have any especial significance. The results did show however that "winter" milk, at least, does not possess sufficient vitamins to prevent the appearance of symptoms of vitamin lack in the chick. Nevertheless, it is equally shown that the use of formaldehyde had no deleterious effect upon the growth processes. The results of a future test in which it is planned to compare the results obtained with pasteurized milk with those from the use of milk treated with formaldehyde should prove of interest.

If it can be shown that the use of formaldehyde in proper amounts does not have a harmful effect upon milk, it would seem that the question of preserving the milk from the dairy to the home would be much simplified, with the possibility that such treatment would be less harmful than the process of pasteurization.

A. M. BLEILE
R. J. SEYMOUR

OHIO STATE UNIVERSITY

AMERICAN MATHEMATICAL SOCIETY

THE two hundred and thirty-first regular meeting of the American Mathematical Society was held at Columbia University, New York City, on Saturday, October 27, 1923, extending through the usual morning and afternoon sessions. At the beginning of the afternoon session a paper was read, at the request of the Program Committee, by Professor Anna J. Pell, of Bryn Mawr College, on bilinear and quadratic forms in infinitely many variables.

The attendance included 68 members of the society. The secretary announced the election of 49 persons to membership in the society; 14 applications for membership were received.

The meeting was signalized by the passing from the unincorporated body known as the American Mathematical Society to a corporation of the same name, organized under the code of the District of Columbia. A revised set of by-laws was adopted, and the various legal formalities necessary to the transfer of the property were attended to. The following 31 persons constitute the Board of Trustees: J. W. Alexander, R. C. Archibald, B. A. Bernstein, G. D. Birkhoff, E. W. Brown, F. N. Cole, L. P. Eisenhart, H. B. Fine, W. B. Fite, T. C. Fry, H. E. Hawkes, Robert Henderson, H. L. Hodgkins, E. V. Huntington, S. A. Joffe, O. D. Kellogg, E. H. Moore, W. F. Osgood, A. J. Pell, M. I. Pupin, R. G. D. Richardson, J. F. Ritt, L. P. Siceloff, C. E. Smith, D. E. Smith, W. M. Strong, H. W. Tyler, Oswald Veblen, H. S. White, J. K. Whittemore, J. W. Young.

Votes of thanks were tendered to the committee on incorporation, to the incorporators and to the lawyers who gave their services.

A committee on the first Josiah Willard Gibbs Lecture was appointed, consisting of Professors H. E. Hawkes (chairman), E. W. Brown, J. L. Coolidge and H. S. White.

The following appointments were announced: To represent the society at the inauguration of President Updegraff of Cornell College on October 19, 1923, Professor E. E. Moots; to represent the society at the inauguration of President Comstock of Radcliffe College on October 20, 1923, Professor E. V. Huntington; to represent the society at the inauguration of President Hadley of Washington University on November 10, 1923, Professor W. H. Roever.

It was voted to print both the *Bulletin* and *Transactions* of the society for the year 1924 in Hamburg.

The following papers were read at this meeting:

Spaces of continuous matter in general relativity: L. P. EISENHART.

The deformation of ruled surfaces: J. K. WHITTEMORE.

Analytic vector functions: G. Y. RAINICH.

Systems of ∞^{2n-2} curves in a Riemann space in which the sum of the angles of every triangle formed by three of the curves is two right angles: J. DOUGLAS.

Necessary and sufficient conditions that a system of ∞^4 curves in space consist of the mutual intersections of ∞^3 surfaces: J. DOUGLAS.

On Ricci's coefficients of rotation: J. LIPKA.

Types of alignment charts in three variables: J. LIPKA.

On the mean-value theorem corresponding to a given linear homogeneous differential equation: G. PÓLYA.

Note on stability à la Poisson: F. H. MURRAY.

On infinitely connected plane regions: J. W. ALEXANDER.

On the deformation on an n-cell: J. W. ALEXANDER.

On the reality of the zeros of a λ-determinant: R. G. D. RICHARDSON.

Sets of completely independent postulates for cyclic order: E. V. HUNTINGTON.

Some corollaries of Bernstein's theorem: D. JACKSON.

Theory of generalized differentiation: E. L. POST.

The society will hold two meetings in the last week in December: the annual meeting, in New York City on December 27–28, and its twentieth western meeting, in Cincinnati, in conjunction with the American Association for the Advancement of Science on December 28–29.

R. G. D. RICHARDSON,
Secretary.