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NITROGEN EXCRETION BY CHICKS INFECTED WITH SALMONELLA PULLORUM*

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Alterations in the nitrogen excretion pattern of chicks infected with *Salmonella pullorum* have been reported from our laboratory by Ross, Holtman and Gilfillan, (1956). Uric acid, urea, and creatinine were increased while the essential amino acids glycine, arginine, methionine, and tryptophan were decreased in concentration in both the blood and liver. Arginase activity in the livers of infected chicks indicated that the Krebs-Henseleit urea cycle was activated by pullorum infection. The injection of urea, in amounts less than those toxic to the chick, markedly affected the course of the disease, with approximately 15 per cent of the infected birds recovering.

Recently, we have shown that hemoglobin levels are reduced and that blood inorganic phosphate levels are increased during infection. Also, it has been observed that the blood ammonia levels of infected chicks are much higher than the values obtained in normal animals.

A scheme to correlate our observations has been postulated and is presented in figure 1. The scheme accounts for the disappearance of glycine, arginine, and methionine as well as the observed increases in urea, uric acid, creatinine, and inorganic phosphate.

The participation of arginine in the synthesis of urea and creatinine could account for the rapid disappearance of this amino acid from the host during infection. It could in turn account for the dramatic increase we noted in the survival time of chicks receiving injections of arginine. Since arginine can participate in the synthesis of urea and creatine, a dual role is suggested for this amino acid with reference to blood ammonia levels. The effect of arginine on the latter has been noted by several workers including Najarian and Harper (1956).

Ornithine, which is produced in the synthesis of guanidoacetic acid from arginine and glycine, also participated in the urea cycle. This could explain the limited protective effect of ornithine in infected chicks as reported previously by us.

Guanidoacetic acid is formed by the transfer of the amidine group of arginine according to the following reaction, arginine + glycine → guanidoacetic acid + ornithine. Methionine has been shown by Borsook and Dubnoff (1941) to participate in

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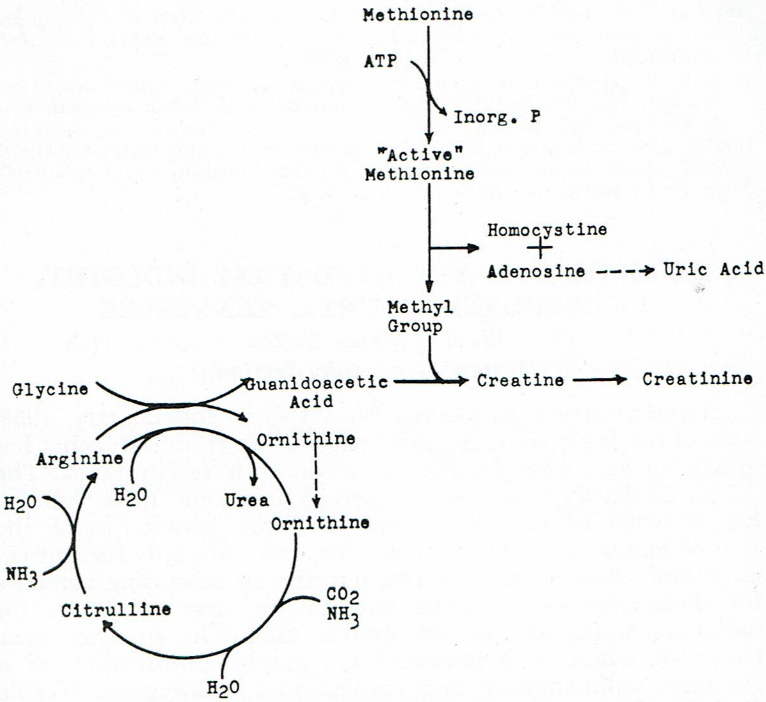

Figure 1. Scheme of reactions involved in the nitrogen excretion of chicks infected with *Salmonella pullorum*.

the methylation of guanidoacetic acid to form creatine. The reaction has been reported by Cantoni (1952) to involve two steps. The first is the formation of active methionine from L-methionine and ATP in the presence of the methionine activating enzyme. Inorganic phosphate is produced by this reaction. The second step involves the transfer of the methyl to guanidoacetic acid from active methionine in a reaction catalyzed by guanidoacetic acid methylpherase.

The fragment of active methionine remaining after the methylation reaction is composed of adenosine and hemocystine. The adenosine could represent a possible source of the increased uric acid occurring in infected chicks.

The reactions discussed in this note have been shown to occur in avian livers, either in homogenates or in the intact animal. At present the scheme is the subject of intensive investigation in our experiments with pullorum disease.

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BEGINNING OF THE SANDSTONE INDUSTRY, CUMBERLAND COUNTY, TENNESSEE

W. B. JEWELL, EDITOR
Geology-Geography Section

A recent article by George W. Webb in the January, 1958, issue of the *Journal* has focused attention on an industry that has grown to very considerable proportions in recent years. The "Crab Orchard" stone, as it generally has come to be known, has widened its market beyond even the boundaries of the United States. It has found wide acceptance not only for churches, schools, houses and the like, but also in increasing amounts for dimension stone, sawed and cut to close tolerances, in monuments, memorials and similar uses. The quarries near Crossville where it is produced are graphic illustrations of a rhythmic sedimentation and regularity of bedding remarkable for such clastic rocks. Those who visit the quarries for the first time almost universally marvel at this regularity and speculate on what "peculiar" conditions must have obtained to produce it.

The circumstances surrounding the start of the sandstone industry in Cumberland County, Tennessee, will interest many readers of the *Journal*. A recent letter from Wilbur A. Nelson, now head of the Geology Department, University of Virginia, and formerly State Geologist of Tennessee, explains how the industry started. He says:

> Around 1920, Mr. Henry Hibbs, one of the leading architects in Nashville, Tennessee, called on me in my capacity as State Geologist of Tennessee, to locate for him some thin-bedded sandstone which could be used in an undressed condition in building churches and school buildings in Memphis and Nashville, so that the cost of such stone buildings could be held to a minimum. Shortly thereafter, I took Mr. Hibbs on a trip to the Crab Orchard district on the Tennessee Central Railroad and we took samples of the thin-bedded sandstone which we called the Crab Orchard sandstone. Soon after this, he made arrangements with certain of the natives of this section to quarry sufficient stone by prizing up the individual thin layers of sandstone and breaking them into irregular blocks with a sledge hammer to construct a church in Memphis, and the Scarritt Theology buildings in Nashville.
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> This was the first use and the beginning of this Crab Orchard industry, which this article [by Webb] states has a yearly value of over two million dollars. This industry was the direct result of geological work done by the Tennessee Geological Survey under my direction.

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ERRATUM

The title of the following paper was omitted by mistake from the table of contents of the April, 1958, issue of the *Journal*: A New Cave Beetle of the Genus Ptomaphagus (Catopidae) from DeKalb County, Tennessee. Thomas C. Barr, Jr. Page 170.

PRELIMINARY ANNOUNCEMENT

9TH ANNUAL FISK UNIVERSITY INFRARED SPECTROSCOPY INSTITUTE

Fisk University is sponsoring its Ninth Annual Infrared Spectroscopy Institute during the week of August 25-29, 1958. The Fisk Infrared Institute serves to introduce chemists, biologists, physicists, and engineers, to infrared spectroscopy and its use in industrial and academic research and in teaching.

The faculty this year includes:

N. B. Colthup, American Cyanamid Company
Edward Covington, E. I. DuPont DeNemours and Company
Nelson Fuson, Fisk University
Glenn Gentry, University of Mississippi, School of Medicine
Ernest A. Jones, Vanderbilt University
Wilbur I. Kaye, Beckman Instruments Company
James R. Lawson, Fisk University
William B. Mason, University of Rochester, School of Medicine
Henry W. Morgan, Oak Ridge National Laboratory
Van Zandt Williams, Perkin-Elmer Corporation

Morning sessions will be devoted to introductory lectures, afternoons to laboratory work, and evenings to lectures on topics of a specialized nature. Laboratory facilities will include a variety of single and double beam spectrometers of recent design, together with the latest sampling accessories.

Besides being introduced to the methods and scope of infrared spectroscopy, Institute participants have ample opportunity during the week to discuss problems of their own particular interest with the Institute faculty.

Further information as well as application forms may be obtained by writing Nelson Fuson, Infrared Spectroscopy Institute, Fisk University, Nashville, Tennessee.