Yuncker's address on "Parasitism as a Way of Life" was read by Dr. Winona Welch, DePauw University.

The officers chosen for the year 1940 are: *President,* Frank Wallace, state entomologist, Indianapolis; *Vice-president,* S. S. Visher, Indiana University; *Secretary,* W. P. Allyn, Indiana State Teachers College; *Treasurer,* W. P. Morgan, Indiana Central College; *Editor of the Proceedings,* Paul Weatherwax, Indiana University; *Press Secretary,* Will E. Edington, DePauw University.

The Junior Academy of Science held its meetings on Saturday with an attendance of 200. A number of papers were read by the young scientists, and the various high-school clubs had very interesting exhibits on display. The principal address was given by Dr. W. P. Allyn, Indiana State Teachers College, on "Indiana Fauna." Miss Ruth Downey, George Washington High School, Indianapolis, and Robert Bennett, Mishawaka High School, were chosen as the two outstanding junior scientists and were recommended for the honorary memberships in the American Association for the Advancement of Science. The officers of the Junior Academy for 1940 are: *President,* Jack Wilkie, Elmhurst High School, Fort Wayne; *Vice-president,* Dorothy Smitha, George Washington High School, Indianapolis; *Secretary-Treasurer,* Robert Karler, Mishawaka High School.

The state societies of taxonomists and entomologists, which are affiliated with the academy, held their meetings on Saturday.

The annual meeting of the academy for 1940 will be held in Muncie, Ind., with Ball State Teachers College as the host institution.

WILL E. EDINGTON,
Press Secretary

THE NEW ENGLAND INTERCOLLEGIATE FIELD GEOLOGISTS CONFERENCE

THE thirty-fifth annual conference of the New England Field Geologists was held in Hartford, Conn., on October 20, 21 and 22. Dr. Edward L. Troxell, of Trinity College, was in charge of local arrangements, and was assisted by geologists from Wesleyan and Yale Universities. More than 150 geologists attended the field trips and the discussion meetings at the College Lounge. Dr. Remsen Ogilby, president of Trinity College, welcomed the visitors.

The Friday afternoon field trip was led by Dr. Troxell. This trip included the relations between the lava flows and Triassic sandstones on the Trinity Campus, the pillow structure and mineral content of the flows near New Britain, and a spatter cone in a trap rock quarry near Farmington.

Dr. Chester R. Longwell, of Yale University, conducted a trip on Saturday to the eastern border of the Triassic Lowland. The geologists studied the evidence of the great eastern boundary fault, as recorded in sediments and structure of Triassic strata, in features of Triassic igneous rocks and in structure of pre-Triassic rocks. The distribution of fan-glomerate and increase of grain size away from the fault were emphasized.

The glacial geology of the Hartford-Middletown region was studied under the direction of Dr. Richard F. Flint, of Yale University. The features of the dissected clay plain, red gravel knolls, continuous knolls of "kame" type, ice-contacts, varved silt and clay, kettle complex in kame terraces and parallel-bedded dunes were discussed.

Dr. Joe Webb Peoples and Dr. Dave Keppel, of Wesleyan University, conducted an excursion on Sunday to show the lithology and structures of some of the crystalline rocks bordering the Triassic on the east between East Hartford and Portland. Parallelism between the structural lines of the crystalline Glastonbury gneiss, Bolton schist, Maromas gneiss and pegmatites with the Triassic was illustrated at numerous places. The trip was concluded at the Strickland quarry.

An excursion for glacial geologists was made to the Quinnipiac-Farmington lowland on Sunday under the leadership of Dr. Richard J. Lougee, of Colby College. A glacial delta with an attached esker was studied.

It was voted at the annual business meeting to meet at Dartmouth College, Hanover, N. H., in 1940, under the leadership of Dr. J. W. Goldthwait.

LLOYD W. FISHER,
Permanent Secretary

BATES COLLEGE

SPECIAL ARTICLES

THE MECHANISM OF THE BIOLOGICAL CITRIC ACID SYNTHESIS

THE role of pyruvic acid in the synthesis of citric acid in the animal organism has been studied earlier by Simola,[1] who found that administration of pyruvic acid to rats induces a comparatively powerful excretion of citric acid, and also by Simola and Alapeuso,[2] who demonstrated a synthesis of citric acid *in vitro* by adding pyruvic acid to finely ground tissue pulp. Continued research by Simola, Hallman and Alapeuso[3] showed that, under definite experimental conditions, addition of pyruvic acid together with fumaric or oxalacetic acid to the tissue pulp produced effects which were more pronounced than those caused by any

[1] P. E. Simola, *Skand. Arch. f. Physiol.,* 80: 375, 1938.

[2] P. E. Simola and H. Alapeuso, *Suomen Kemistilehti* (*Acta chemica fennica*) B, 11: 17, 1939.

[3] P. E. Simola, N. Hallman and H. Alapeuso, *Suomen Kemistilehti* (*Acta chemica fennica*) B, 12: 10, 1939.

of these acids alone. This combined effect is illustrated particularly clearly by Hallman's[4] work with the heart muscle.

Detailed investigations have now convincingly shown that pyruvic acid and the 4-carbon acids act in the animal organism as primary sources of the enzymic citric acid synthesis. In these investigations it was possible, under suitable conditions, to produce in the heart muscle enzymically about 0.2 per cent. of citric acid within a short period of time. The most pronounced effect was noted when pyruvic acid together with malic acid was used as substrate under aerobic conditions. Table 1 shows the results of one of such combination experiments.

TABLE 1

20 g MINCED HEART MUSCLE; 50 ml BICARBONATE BUFFER. INCUBATED AEROBICALLY; 30 MINS. AT 37°.

Substances added	Na pyruvate 15.0 mg	Na malate 39.0 mg	Na pyruvate 15.0 mg Na malate 39.0 mg
Citric acid produced	1.2 mg	3.1 mg	25.0 mg

When larger quantities of malic and pyruvic acid were employed, under the above conditions, the amount of citric acid could be substantially increased. For instance, in an experiment with 325 mg Na pyruvate and 510 mg Na malate, 20 g heart muscle produced in 30 minutes 151 mg citric acid.

In the synthesis of citric acid, malic acid is obviously first dehydrated enzymically to oxalacetic acid, which then immediately reacts with the excess pyruvic acid to form an intermediate compound of citric acid. (That citric acid can be synthesized by purely chemical methods from pyruvic acid and oxalacetic acid, has been shown earlier by Knoop and Martius.[5])

To our surprise we found, however, that the effect of oxalacetic acid in the heart muscle was distinctly less pronounced than that of malic acid. The effect of fumaric acid was approximately equal to that of oxalacetic acid. In the other tissues examined, oxalacetic acid produced the best effects.

When boiled tissue was used, synthesis of citric acid could not be demonstrated—even in the presence of oxalacetic acid. Hence it can be concluded that under the conditions of our experiments, the citric acid formation is ascribable to enzymic processes.

It should also be observed that in the combination experiments the effect of *phospho-pyruvic* acid was definitely less than that of pyruvic acid alone.

Our experiments indicate that at least in the heart muscle—which, according to unpublished work of Hallman, effects a very powerful decomposition of citric acid—pyruvic acid is transformed to a large extent via citric acid. From the citric acid stage the decomposition follows the course discovered by Martius and Knoop,[6] to α-keto-glutaric acid and then further to succinic, fumaric, malic and oxalacetic acid. Following the union of the 4-carbon skeleton with pyruvic acid, to form the primary stage of citric acid, the cycle proceeds further. (It is probable that the vitamin B_1 plays an important role in the decarboxylation of this precursor of citric acid, formed from pyruvic and oxalacetic acids.) As a result of successive dehydrations and additions of water molecules, pyruvic acid is in this process ultimately burned to carbon dioxide and water, whereby each molecule of pyruvic acid requires 5 atoms of oxygen and produces 3 molecules of carbon dioxide.

NIILO HALLMAN
P. E. SIMOLA
DEPARTMENT OF MEDICAL CHEMISTRY,
UNIVERSITY OF HELSINKI, FINLAND

[4] N. Hallman, *Suomen Kemistilehti* (*Acta chemica fennica*) B, 12: 11, 1939.

[5] F. Knoop and C. Martius, *Zeits. f. Physiol. Chem.*, 242: I, 1936.

[6] C. Martius and F. Knoop, *Zeits. f. physiol. Chem.*, 246: I, 1937.

LOSS OF BIOLOGICALLY FIXED NITROGEN FROM SOILS AND ITS BEARING ON CROP PRODUCTION

IT is well known that application of readily fermentable carbohydrates to soil leads to increased microbial activity, resulting in the fixation of considerable quantities of atmospheric nitrogen. With a view to finding out how far the nitrogen thus fixed is available for plant nutrition, a number of pot and field trials were carried out with different crops. Using molasses (a waste product obtained from the local sugar factory which is rich in sugars, having a total percentage of from 50 to 60 per cent. of sugars), it was found that although useful amounts of nitrogen are fixed in the soil, the major part of it was somehow not available for plant growth. Thus, in a typical field experiment using Ragi (*Eleusine coracana*) the results given in Table 1 were obtained:

TABLE 1

Treatment	Yield of grain in gms.
Control (untreated)	3,560
Hongay cake	5,704
Sugars* (as molasses)	4,810

* The sugar (as molasses) was applied in quantities such that it fixes the same amount of nitrogen in the soil as supplied in the form of Hongay cake.

From the foregoing table, it is evident that only a part of the fixed nitrogen is rendered available to the crop; probably the rest is being lost from the soil system. Mirchandani[1] has reported a similar type of nitrogen loss.

[1] T. J. Mirchanuani, *Proc. Nat. Inst. Sci.*, Vol. III, 185, 1937.