ever, is the fact that the amount of energy required to produce a given amount of retardation when the sperm was irradiated then used to inseminate an unirradiated egg was quite different from that required when the egg itself was irradiated. Thus in typical experiments a dosage of 50 ergs per mm² of incident energy given the sperm produced pronounced retardation, the first three divisions of the eggs inseminated with such sperm occurring two hours after the controls. A dosage of only 100 ergs given the sperm causes a delay of about 3 hours. A dosage as low as 300 ergs, given the sperm, causes irregular and abnormal development of the eggs inseminated with such sperm. On the other hand, a dosage of 50 ergs per mm² given the eggs caused only barely perceptible delay in division and a dosage of 816 ergs per mm² caused a retardation of the first three divisions of only about 1½ hours. The eggs will tolerate even 3,000 ergs per mm², cleaving slowly to form embryos.

These results indicate clearly the greater susceptibility of the sperm and therefore of naked nuclei to ultra-violet radiations. The nuclear material is present in the egg, but the radiations must pass through a thick layer of cytoplasm before reaching the nucleus. The greater resistance of the egg may be dependent upon the protection afforded by the cytoplasm to the nucleus. The radiations are unquestionably destructive to the cytoplasm[5] as well, but cytoplasmic injury is apparently less effective in retarding cell division than is injury to the sperm nucleus.

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A SPECIES OF AZOTOBACTER TOLERANT TO HIGH ACIDITY

ONE of the prominent characteristics of the aerobic, nonsymbiotic nitrogen-fixing bacteria, known as Azotobacter, is their sensitiveness to acid reactions. There is quite general agreement that pH 5.8 to 6.0 is the acid limit for growth in the absence of fixed nitrogen.[1] As stated by Burk and associates,[2] "The limit of fixation at pH 6.0 has been universally observed by all investigators." Even though Azotobacter has occasionally been recovered from mineral soils as acid as pH 4.5 and was reported as having been found in peat of pH 3.6,[3] there is no evidence that any of the isolated species of Azotobacter are able to develop upon nitrogen-free media which are more acid than the above-mentioned limit. Burk and associates[2,4] reported that the respiratory mechanism of Azotobacter is irreversibly destroyed by prolonged exposure to reactions below pH 5.0.

It is therefore of interest that there is a species of Azotobacter which grows and fixes nitrogen in very acid media. This organism was isolated from acid soils (pH 4.9 to 5.2) of India by P. K. De and has been cultivated in laboratory media for several years.[5] It develops well in nitrogen-free liquid media and upon agar slants from the acid limit which appears to be close to pH 3.0 up to at least pH 9.0. The organism develops well in nitrogen-free media similar to those commonly used for the well-known species of Azotobacter. Sucrose and glucose are readily utilized. During incubation for several weeks in a medium with an initial pH 3.1 and containing 1.5 gm of glucose, 9 mgm of nitrogen were fixed. Where the initial pH was 3.0, 3 mgm of nitrogen were fixed. Nitrogen fixation was greater between pH 3.8 and 8.0.

The acidity of the medium increases somewhat during development of the organism; the change in pH is greater in the alkaline and neutral media than in media which are close to the limiting acid reaction. During growth in media containing nitrate nitrogen the pH rises slightly, whereas in the presence of ammoniacal nitrogen the pH dropped from pH 6.5 to 3.5; this can be ascribed to the assimilation of the ammonium and nitrate nitrogen.

The unusual tolerance of the new organism to extreme acidity clearly distinguishes it from any of the previously described species of Azotobacter and indeed from practically all known bacteria. It appears to be at least as acid-tolerant as the anaerobic, nitrogen-fixing bacteria.[6] In fact, there are only exceptional species of bacteria which are able to develop at more acid reactions. Whether or not the acid-tolerant Azotobacter is widely distributed in soils or will develop in soils over as wide a range of reaction as in artificial media remains to be ascertained.

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HIPPOBOSCID FLIES FROM NORTH AMERICAN DOVES

G. R. COATNEY'S note in SCIENCE for September 16, 1938, on the possible carrier of dove Haemoproteus, may be supplemented with the following information.

Microlynchia pusilla (Speiser) is probably the most widely spread hippoboscid fly of doves. It is a strictly

[5] Giese, *Biol. Bull.*, 75: 238, 1938.

[1] S. A. Waksman, "Principles of Soil Microbiology," 2nd ed. Williams and Wilkins Company, Baltimore, 1932. P. L. Gainey, Proc. and Papers of First Int. Congr. of Soil Sci., Washington, D. C. 3: 107–117, 1928.

[2] D. Burk, H. Lineweaver and C. K. Horner, *Jour. Bact.*, 27: 325–340, 1934.

[3] J. K. Wilson and B. D. Wilson, N. Y. (Cornell) Agr. Exp. Station, Memoir 148, 1933.

[4] D. Burk, Ergebnisse der Enzymforschung, v. 3: 23–56, 1934. D. Burk and H. Lineweaver, *Jour. Phys. Chem.*, 38: 35–46, 1934. D. Burk, C. K. Horner, and H. Lineweaver, *Jour. Cell. and Comp. Phys.*, 1: 435–449, 1932.

[5] A description of this organism will soon appear in *Soil Science*. In this report the organism is described as a new species of Azotobacter.

[6] W. H. Willis, Iowa Agr. Exper. Sta., *Res. Bul.*, 173, 1934.

New World species, which I have seen from Bexar County, Texas, off mourning dove, *Zenaidura macroura carolinensis* (J. M. Brennan Collection); Carey, Blaine County, Idaho, off western mourning dove, *Zenaidura macroura marginella* (R. Matheson Collection); and from Pasadena, California, off the introduced and naturalized Chinese spotted dove, *Spilopelia chinensis* (Miss Josephine R. Michener Collection). Professor M. H. Swenk informs me that there is a specimen in the Department of Entomology of the University of Nebraska, taken in Nebraska, from the western mourning dove, April 20, 1920, by C. E. Mickel and R. W. Dawson. Ferris[1] recorded it from squabs of domestic pigeon at Thatcher, Arizona. I have seen many specimens from road-runner and Arizona quail, and a few from meadowlark, canyon towhee, Abert's towhee and western mockingbird. The species is known in the United States from Texas, Nebraska, Arizona, Idaho and California; and a specimen was taken in a market at Washington, D. C., off Arizona quail, evidently an accidental importation. Farther south it is recorded from Cuba, St. Croix, Grenada, Venezuela, Brazil, Paraguay and the Galapagos.

Stilbometopa podopostyla Speiser, also a strictly New World fly, is now known from Nebraska, Arizona, Texas (Bexar County, off *Zenaidura macroura carolinensis*.—J. M. Brennan Collection), Guatemala, the Republic of Honduras (Lancetilla near Tela, without host), Costa Rica (La Fuente, without host), British Guiana, Brazil and Paraguay (San Bernardino, without host). This fly is rare and host records are as yet few; but of the six species of birds from which it has been taken five belong to the dove family.

Ornithoctona erythrocephala (Leach), another fly restricted to the New World, is much more common than the Stilbometopa. It has a fairly large and varied host list. In the West Indies and tropical America it is reported from at least six species of wild doves and from domestic pigeon, as well as from a variety of other birds. Although by no means rare in North America, it has been taken there mostly from birds of prey, never from doves or pigeon. I have seen specimens from British Columbia, Alberta, the Province of Quebec, Maine, Massachusetts, Pennsylvania, North Carolina, Florida and Minnesota.

Ornithoica confluenta (Say), also strictly American, is one of the most common and most widely spread hippoboscids in this country. Its host list is very extensive, but it is most frequent on small migratory birds. Birds of prey and wading birds are probably stray hosts only. No doubt Herman's single record from eastern mourning dove at North Eastham, Mass., is likewise based on an accidental occurrence.

The pigeon fly, *Pseudolynchia canariensis* (Macquart) (Syn.: *maura* Bigot; *lividicolor* Bigot) is at present cosmopolitan. In North America it is known from Washington, D. C., South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Arkansas and California. In the New World it is often common on domestic pigeon, but has never been found on a wild host. On the other hand, it has been taken from at least eight species of wild doves in Europe, Africa and the Philippines. Evidently this was originally an Old World fly, introduced by man into the Americas.

From the foregoing it would seem that *Microlynchia pusilla* is the most likely natural vector of dove Haemoproteus in North America. This fly, moreover, transmits *Haemoproteus columbae* from pigeon to pigeon, according to H. de Beaurepaire-Aragão.[2] Both *Stilbometopa podopostyla* and *Ornithoctona erythrocephala*, although perhaps potential carriers, are probably too rare in this country on wild doves to be of much importance. *Ornithoica confluenta* is not likely to act as the vector in nature. While *Pseudolynchia canariensis* has been shown to transmit the dove Haemoproteus from dove to pigeon in the laboratory, it probably never carries it from dove to dove in nature in North America.

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STOMATAL INDEX AND TRANSPIRATION RATE OF LEAVES

BOTANISTS studying number of stomata in unit surface areas of leaves have noticed great variation between leaves from the lower to the higher levels of plants. Because of this variation it has been impossible to determine, for purposes of comparing plants in breeding work dealing with stomatal number and transpiration rate, whether a leaf at any particular level is typical. Also, it has been impossible to anticipate rate of transpiration on the basis of stomatal number.

In studying different levels of Kentucky wonder bean plants I have observed that the leaves differ significantly in stomatal number for unit surface area from the lower to the higher levels but do not differ in transpiration rate or in stomatal index. Young plants of the Kentucky wonder variety were found to be uniform for the upper epidermis transpiration rate and for stomatal index; they were not uniform for stomatal number except for the upper surface of the juvenile leaves.

In studying juvenile leaves of the Kentucky wonder, black wax and pinto varieties and four segregates of a cross between the black wax and pinto varieties I have noticed that stomatal number of juvenile leaf is

[1] Ferris, *Canad. Entom.*, 62: 66, 1930.

[2] H. de Beaurepaire-Aragão, *Brazil-Medico*, 30: 353, 1916.