100 to 125 feet above the Upper Freeport coal. From 60 to 90 feet above this is the Pine Creek limestone, while the Ames limestone is about 125 feet above the Pine Creek and 300 feet below the Pittsburg coal. Under various names these limestones have been reported from a large area in western Pennsylvania, northern West Virginia and southeastern Ohio. As these limestones are all very thin and are included in a great mass of shales and sandstones of debatable origin, the discovery of two more layers containing marine fossils is of some interest.

The first of the layers is about 50 feet below the base of the Ames limestone on Brighton Road, just west of Wood's Run, Allegheny, Pa. This stratum was noted by the writer in 1907, but as it was found in only one place, it was thought at the time that it might be a disturbed block of the Ames limestone. It was, however, mentioned in a paper just published in the *Annals of the Carnegie Museum*, Volume V., page 174, and its correct stratigraphic position indicated in the diagram on Plate XII. As exposed at the type-locality on Brighton Road, the fossiliferous layer is about three inches thick and contains numerous crinoid stems, *Producti*, and cup-corals. It is a hard clayey limestone, with most of the lime leached out at the outcrop. It outcrops at a number of places within two miles of this locality, but has not yet been traced to any distance. At some of the other outcrops the layer is thicker, the greatest thickness noted being eighteen inches.

In an article on the Conemaugh formation in southern Ohio just published in the *Ohio Naturalist*, Mr. D. Dale Condit describes a thin marine limestone about half-way between the Ames and the Upper Cambridge limestones. This limestone occupies the same stratigraphic position as the one here described, but as they are separated by a very wide area in which neither has been sought, it is too early to attempt to correlate the two.

The credit for the discovery of the second layer with marine fossils belongs largely to the Rev. P. E. Nordgren, of Duquesne, Pa., who found loose blocks of fossiliferous shale along the railroad tracks about two miles west of Duquesne. The writer was able to trace these blocks to their source in a layer of green sandy shale at the top of the Birmingham shale. This layer is about 65 feet above the Ames limestone. In the vicinity of Pittsburg the Birmingham shale is a conspicuous formation in the cliffs which border the rivers. It is from 40 to 50 feet in thickness and the base is about 25 feet above the top of the Ames. At the base of the Birmingham there is always a layer of very thin-bedded black shale, and sometimes a coal which is supposed to represent the Elk Lick. Above this carbonaceous layer are thin-bedded dark shales which contain pinnules and stems of ferns, and numerous *Estherias* and fish-scales. Higher up the shales become lighter colored, often sandy, and are very barren of fossils. The only fossils so far found in these light-colored layers are a few specimens of an *Aviculopecten* like *A. whitei*, a shell which is often found associated with fossil plants. At the top of the Birmingham there is an abrupt change in the color, the upper 8 to 15 feet being a red fissile shale. Just beneath the red shale, or sometimes a few feet above the base of the shale, there is a rather prominent layer of sandy shale which has now been found to contain marine fossils. The fossils are species of *Productus, Allorisma* and other pelecypods, and *Tainoceras occidentale*. Fossils have been found in this layer in Riverview Park, Allegheny, below Kennywood Park near Duquesne, at Glassport, at Wilmerding and at East Pittsburg. It is most fossiliferous at the locality discovered by Mr. Nordgren below Kennywood Park, and that should be considered as the type-locality.

In Riverview Park *Aviculopecten* may be found in a layer 25 feet above the layer just described and a further search for fossils may show that the Ames is far from being the last marine deposit in western Pennsylvania.

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CARNEGIE MUSEUM,
May 7, 1909

NEW FACTS ABOUT BACTERIA OF CALIFORNIA SOILS

THE bacteriological study of California soils at this Experiment Station during the past year marks the beginning of research on the biology of soils of the arid regions. Some of the facts gleaned in these studies present such striking features that it was thought wise to make a brief preliminary report on them in this journal. The facts may be categorically enumerated as follows:

1. Nitrite formation from ammonia compounds formed by the ammonifying bacteria has been found to take place markedly at depths of twelve feet in a soil from Haywards, Cal. Further, in samples gathered under the greatest precautious to avoid contamination, nitrite formation was found to go on actively at a depth of five and one half feet in a soil gathered at Riverside, Cal. Below five and one half feet there was a compact layer of hardpan in which there was little or no bacterial growth and nitrite formation could not, therefore, be expected deeper down in that particular soil. In six other soils collected in different parts of this state nitrite formation was found to depths of six feet or as far down as we had gone for samples.

2. Contrary to expectations *nitrate* formation, unlike nitrite formation, has thus far been noted only down to a depth of two feet. Further experiments, however, will be instituted to ascertain if this holds true for all California soils.

3. A bacteriological examination of a soil from Auburn, kept in a tightly stoppered bottle on the museum shelves for thirty-one years, reveals at least one representative of each of the groups of nitrogen-transforming or nitrogen-assimilating bacteria, except *B. radicicola*. Of these, several species of ammonifiers were found, one species of nitrosomonas (obtained in the motile and also in the zooglœa form) and one spiecies of *Azotobacter*. The latter exhibits marked differences from the other *Azotobacter* species thus far described, both morphologically and physiologically, and it was therefore named *A. hilgardii* in appreciation of the eminent services of Professor E. W. Hilgard to scientific agriculture. Briefly, the organism may be described as a small elliptical cell, which forms no pigment and only a very thin membrane at the surface of mannite solutions. It is non-motile and has a slight nitrogen-fixing power.

4. The species of nitrosomonas found in the old soil mentioned above was found to have spores. This is particularly interesting, since Winogradsky stated in a report of results of his wonderfully thorough experiments on the nitrifiers, that spores were *never* observed.

No *Nitrobacter* species or nitrate organism has as yet been found in the old soil.

The above facts are probably due chiefly to the great perviousness of the soils of the arid region, owing to the very slow formation of clay substances; whereby moisture, air and roots are enabled to penetrate to depths rarely found in the humid regions.

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May 12, 1909

A SCHEME TO REPRESENT TYPE HEREDITY IN MAN

Efforts to reconcile Mendel's laws with the prevailing views of blended effects in heredity need not be unavailing, if the two may be considered as phases of the same process acting at different times during the life history of an elementary species.[1]

Heredity represents all the changes of organic life by three factors:

1. *Determinants,* which are in the germ plasm.
2. *Modifiers,* which are all influences through time and space that act on the germ plasm, and
3. *Laws of change,* which are the rules of conduct by which the determinants and the modifiers interact.

These factors are variable when looked at through all space and during all time, but for any elementary species in a given space and for a limited time they are fixed.

I present herewith a tentative scheme to supplement my theory of heredity.[2]

D and *R* represent homozygotes of an

[1] Spillman, Science, N. S., Vol. XXVII., 1908, pp. 47–57.

[2] Bean, *Philippine Journal of Science*, 1908.