*Pholadomya* sp.
*Cardium congestum* Con.
*Buccinopsis parryi* Con.
*Rostellaria?* (*Volutomorpha*) *texana* Con.
*Pugnellus* sp. Etc.

Las Isletas:
*Sphenodiscus pleurisepta* Con.
*Mactra texana* Con.
*Cardium congestum* Con.
*Turritella* sp. Etc.

Arroyo Toro Colorado, 1 m. below Las Isletas:
*Sphenodiscus pleurisepta* Con.
*Nautilus dekayii?*
*Ostrea* sp.
*Mactra texana* Con.
*Crassatella* sp.
*Cardium congestum.*
*Breviarca* sp.
*Buccinopsis parryi* Con.
*Pugnellus* sp.
*Natica collina* Con.
*Natica texana* Con.
*Rostellaria?* (*Volutomorpha*) *texana* Con.
Etc.

This locality also furnishes a number of specimens of crabs.

A selection of specimens representing several of the species under discussion, together with a number of others occurring in the same beds, were submitted to Dr. T. W. Stanton, of the United States National Museum, and my identifications of the Conrad forms were confirmed by Dr. L. W. Stephenson, who states that the *Rostellaria?* of Conrad is a Volutomorpha.

Major Emory, in the first part of the Boundary Survey report, on page 68, gives a description of Las Isletas and the falls of the Rio Grande with a full-page illustration opposite. This description would indicate that the falls of the Rio Grande and Las Isletas were the same. The truth is that Las Isletas is located about the mouth of Castaño Creek, while the falls are some four miles lower down the river just below the mouth of Caballero Creek.

It will thus be seen that our collections were made from localities directly on the line of travel of the Boundary Survey party and it seems highly probable that the original specimens described by Mr. Conrad were in reality obtained from these same beds.

The horizon is the uppermost portion of our Escondido beds. The fossils are among the latest Cretaceous forms of which we have any present knowledge in this region.

The Cretaceous-Eocene contact is well shown three miles below Toro Colorado, just above the falls of the Rio Grande and on Caballero Creek.

The only other records I can find of any of these forms are as follows:

Professor G. D. Harris, in "The Tertiary Geology of Southern Arkansas," gives a list of fossils collected by Dr. C. A. White in 1887 at his camp eighteen miles southeast of Eagle Pass, Texas, which were supposed to be basal Tertiary. Among these there is a cardium which Mr. Harris figures both in this paper and later with his Midway fauna "Bulletin of American Paleontology, No. 4," without giving it a specific name.

This camp was probably at the Eagle Pass-Laredo road crossing near the junction of Cuevas and Peña creeks and on or near the Cretaceous-Tertiary contact. The cardium is unquestionably the *Cardium congestum* of Conrad, while the other forms named by Professor Harris are from the overlying Midway.

Mr. T. W. Vaughan in his Report on the Rio Grande Coal Fields of Texas gives a list of fossils collected 18½ miles southeast of Eagle Pass. This must also have been in the same vicinity. His list contains a form identified as "*Mactra* cf. *mooreana*" which, in view of our later discovery, may be more properly called *Mactra texana,* and *Cardium* cf. *eufalense* may be *Cardium congestum.*

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## BACTERIOLOGICAL METHODS FOR THE ESTIMATION OF SOIL ACIDITY

THE general prevalence of acidity in the older soils of the United States has been the cause of increasing comment, within the past few years. It is well known that the tendency of cultivated soils to become acid is intensified by the use of commercial fertilizers, and, gen-

erally, by the more intensive methods in vogue in portions of the eastern states. Since profitable cropping becomes impossible in soils that are strongly acid, the liming of soils is now receiving a good deal of attention. The subject of lime and liming is freely discussed in the agricultural press, and the experiment stations are asked to supply farmers with detailed information as to the amounts and kinds of lime needed for different soil types, and for different systems of cropping. In view of the constantly increasing interest in lime and its application, it is desirable that reliable methods be provided for estimating the lime requirements of soils. The search for chemical methods that would supply the desired information was begun many years ago, and a considerable number of methods have been proposed as suitable for this work; unfortunately, however, agricultural chemists find themselves unable to decide on any chemical method that would give reliable results. Some years ago a method was proposed by Tacke that proved of certain value for the moor soils of Germany. More recently Süchting has attempted to improve the method by correcting certain defects in it, but even in its improved state the method leaves much to be desired; it is cumbersome and far from reliable. Similarly, methods have been proposed in the United States by Pettit and Hopkins and, also, by Veitch. These methods have been tested under different conditions, and have failed to give concordant results.

In view of the lack of a satisfactory method for the quantitative estimation of soil acidity, and in view of the evident need for a method of this character, it is eminently proper to make a careful study of new methods that seem at all promising. Among the new methods that could be suggested, for this work, the writer would include methods based on certain bacteriological reactions. It is well known that the development of bacteria in any culture medium is directly affected by the reaction of the latter. When the acidity of the medium is increased beyond a certain point, bacteriological development is retarded, or entirely stopped. For this reason, it appears evident that if to any neutral medium there be added increasing quantities of acid soil, a point will be finally reached when the acid in the soil added would preclude further development of the organisms. Following out this line of thought, the writer prepared a series of media of varying reaction. Several portions of bouillon were prepared and adjusted to the following reactions: (*a*) Neutral, (*b*) one half per cent. acid, (*c*) one per cent. acid, (*d*) one and a half per cent. acid, (*e*) two per cent. acid, (*f*) three per cent. acid.

When portions of these media were inoculated with pure cultures of *B. mycoides* or *B. subtilis,* growth occurred in the bouillon containing up to two per cent. of acid; beyond that the growth was very slight. When similar portions of bouillon had added to them one half gram, one gram, three grams, five grams and ten grams of soil, respectively, growth occurred in the different tubes depending on the amount of acid present in the medium, or that supplied by the soil. If, previous to the addition of the soil, the latter was mixed with ten per cent. of its own weight of calcium carbonate, growth occurred in all of the tubes, even those that had contained bouillon with three per cent. of acid.

These preliminary experiments demonstrated, therefore, that the amount of acid present in cultivated soils may be determined quite accurately by comparing bouillon of varying reactions with equivalent quantities of neutral bouillon containing varying amounts of soil. The proposed method may be utilized in still another direction, in that varying quantities of soil be added to measured amounts of bouillon, and, after sterilization, the bouillon be inoculated with a standard culture of ammonifying bacteria. At the expiration of a certain length of time the ammonia formed could be distilled off and determined in the usual way. Since the acid added by the varying quantities of soil would affect the development of the organisms to an unequal extent, the amounts of ammonia formed might be used as a fairly accurate measure of the retarding effect of the acid present in the soils. The quantitative rela-

tions may be established by comparing bouillon thus provided with varying amounts of soil with equivalent portions of bouillon, to which varying amounts of standard acid had been added.

Instead of employing ammonifying bacteria for estimating the acid present in soil samples, nitrogen-fixing species of the *Azotobacter* group could be used. It is well known that *Azotobacter* will grow by preference in neutral or slightly alkaline media; hence, mannite solutions could be made up and portions of it treated with varying amounts of soil as described above. After sterilization and cooling, the several portions could be inoculated from some pure culture of *Azotobacter*. At the end of a given length of time, the total nitrogen present could be determined and the amounts fixed used as a guide in measuring the retarding effect of the acid present in the soil sample. In the same way, nitrifying or other bacteria could be utilized for the quantitative estimation of soil acidity. It is expected that the data accumulated by us will be available for publication at an early date.

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## AN INTERESTING OLD WEAVING TECHNIC

ON a recent expedition of the American Museum to the Pima-speaking tribes of southern Arizona there was found the remnant of an old technic in basket-work which has almost entirely disappeared from this people.

It is a crude wrapping of a pliable binding element over stiff slats which are arranged in parallels—a wrapped weaving and found with three variations.

It appears on a few old house doors, shelves, cradles and cages in the out-of-the-way villages where the people have still preserved the early mode of construction and it seems the simplest way of uniting stiff slat-like strips by means of a soft pliable binding element.

This binding element was formerly of thong or native string—both occasionally met with now—but more recently it is of White man's rope, strips of cloth or even wire. The slats are generally the smooth, light ribs of the giant cactus Saguara. These are placed in a parallel series, while in the simplest forms of wrapping the binding element passes forward over two slats on the outside, backward over one on the inside and then repeats the process, thus forming a simple wrapped weaving. When greater strength is needed an extra slat is placed perpendicularly across the parallel series and bound to them by each wrap of the binding element, which in more frequent varieties gives an extra turn about each slat. This last technic is known as lattice wrapped weaving.

The possible evolution of the last crude basket technic from the simple process of the tying of twigs and fibers in their latticed house construction is interesting; as well as a similar development of the wrapped weaving from the plain bindings on one type of their cradles.

Indeed the thought suggests itself, might it not be possible that this crude wrapped weaving, because of its great simplicity, was one of the earliest to develop, especially in regions as destitute of suitable basket material as the desert country of the Pima? May not this technic hold a place with the others which lay claim to be the earliest technics—plaiting, with its over and under passing strips; wicker, with its interlacing twigs; wattling, with its twining elements?

Lattice wrapping repeats itself among the wild tribes in a number of the Malaysian Islands in crude traps and baskets, and on the Lower Congo in more refined basket work. Could its distribution through the desert region of America during early times be more closely traced, no doubt, we would find it a frequent technic, for it appears as far south as Mexico in the wagon box of the old ox-cart. A close surface of the same technic also exists to the north among the Pomo, the Nez Perce, the Makah and on some of the old Salish blankets.

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