ilization succeeded in making it produce wheat, their theory would seem to be without ground. My experiments in sterilization result in either good or bad wheat according to what I do to the seed planted therein, though there can not be any question but what in some soils increased amounts of ammonia through sterilization do have something to do with the results.

Experiment by Professor T. L. Lyon, of Cornell University, Bulletin 275, "Upon the Effect of Steam Sterilization on the Water-soluble Matter in Soils," attempts an explanation of the peculiarities of growth of the wheat plants upon soils after steam sterilization through differences in the soluble content of the soil resulting in differences in density of the soil solutions, etc. He also, however, seems to have great difficulty in accounting for some of the peculiar actions of the growing wheat plant upon such treated soils and solutions, especially in explaining what appears to be a really injurious effect upon the first growth from the seedlings, though finally followed by actual increase in crop.

In our experiments, we are able to explain most of these peculiarities of growth, noticed both in our cultures and those of Professor Lyon's admirably conducted trials, upon a biological relation of the wheat plant to certain actual disease-producing organisms and their growth relations to the crop plant, and to the various interreacting soil relations, which react both upon the crop plant and upon the disease producers.

In our experiments we find that both soil and seed may be, and usually are, infected by several very destructive wheat-destroying, parasitic fungi. Indeed, these are found to be apparently cosmopolitan in distribution with the wheat plant. They are especially transmitted in the seed internally, and, it seems quite certain, are sufficient in their influences to account for most of the causes of rapid first-crop deterioration, and for the difficulty which farmers have in introducing any sort of culture, which will again raise the standard of crop. Their exclusion, in so far as it is perfectly or imperfectly done, is sufficient to account for the anomalies indicated in soil sterilization experiments. However, in our experiments our results and conclusions have always been vitiated whenever these fungi were not eliminated.

I do not question that soil sterilization does change the bacterial content or that it does influence the soluble content of soils, but I am inclined to think that disease-infected seed and disease-infected soil will eventually be found to have much more to do with the irregularly corresponding conclusions, which have been drawn by various experimenters upon crop rotations, upon soil-fertilization experiments and upon soil-disinfection experiments than they have ever suspected. Indeed, I have but slight doubt that the whole theory of auto-intoxication (toxine theory) as applied to cropping plants, is virtually vitiated in its conclusions, because of a lack in eliminating the influences of pathogenic organisms in the experiments.

H. L. Bolley

Agricultural College,
North Dakota,
November 1, 1910

Tertiary Deposits of Northeastern Mexico

During the past two years, the geologic work under my direction in southwest Texas and northeast Mexico has resulted in the accumulation of a mass of information which materially adds to our knowledge of the Gulf Tertiaries. The fieldwork was carried on by Messrs. W. F. Cummins and W. Kennedy, assisted by Mr. J. M. Sands.

The first year's work by Professor Cummins was a general examination of the northeastern Mexico for artesian water. Following this, I had a careful section made of the Cretaceous and Tertiary deposits along the Rio Grande, and then traced the contact between the two systems southward into Mexico as far as this could be done within the scope permitted by our economic work. The widespread occurrence of the different phases of the Reynosa formation prevented direct connections of the exposures of the underlying deposits in some places, but we were able to

carry the Cretaceous-Tertiary parting with a fair degree of accuracy from the actual contact at the Arroyo del Caballero on the Rio Grande to a similar contact at Ramones, forty miles east of Monterey, and from Panalito on the Conchos River to the southern boundary of the state of Tamaulipas. We hope to fill the gap between Ramones and Panalito before we finish.

Numerous sections were made of the overlying Eocene to the eastward of this line of contact and good collections of fossils were made from various horizons in it, which prove that the substages recognized in Texas continue south as far as we found any deposits of this age. We were able to map approximately the areal distribution of each of these.

The highly fossiliferous deposits on the Rio Grande which constitute the upper member of the Cretaceous of that region and which are known as the Escondido beds, only continue southward in this character for forty miles to a point southwest of Laguna de la Leche, where they are covered by much later deposits. Where these later deposits end near the Salado river west of Rodriguez we find underlying them, in place of these fossiliferous beds, beds of blue shale without fossils, which have the same relation to the overlying Tertiary that the Escondido has through its whole extent. These blue shales, which we call the Papagallos shales, are therefore considered to be the extension or equivalent of the Escondido and are found to extend south to the limit of our investigations. To the south, these blue shales draw nearer and nearer to the coast until at their crossing of the Zarziza in southern Tamaulipas there is barely ten miles of Tertiary deposits between the outcrop of the shales and the waters of the gulf.

On the Rio Grande and at several other points between that stream and the Pesqueria we found deposits of Midway age, as proved by its characteristic fossils, resting directly on the Cretaceous, but for the most part this basal contact is covered or obscured by the overlapping Carrizo sand. The last of the Midway was seen at Ramones.

When we again pick up the contact at Panalito on the Conchos River, we find both the Carrizo sands and Marine beds in contact with the blue shales of the Cretaceous, while a few miles down the river the Yegua overlaps both of these and is the substage in contact almost to the Soto la Marina. A few miles north of this river, the Yegua, Fayette and Frio are in turn covered by the San Fernando beds and beyond that point we found no further exposures of the Eocene.

South of the Soto la Marina River the beds of the Eocene seem to be entirely wanting, if they were ever laid down. Our drilling records as yet show no evidence of them, unless some part of the blue shale on which the San Fernandan rests be proved later to be of Eocene age. No fossils have yet been found in this shale, but its general character and relations to overlying Tertiary as well as to the Escondido and to other known Cretaceous deposits seem to warrant its reference to the latter period.

The San Fernando beds, which are regarded as Oligocene, were first observed at San Fernando on the Conchos or Presas River and have an extensive development to the south, entirely overlapping or replacing the Eocene deposits and resting directly upon the Cretaceous. This formation, with its beds of nummulitic limestone and great numbers of cristellaria, carries an extensive and varied fauna and has a much greater development than previously observed. It is succeeded by other beds of similar composition, but of distinctly later age, which in turn overlap it and reach the underlying Cretaceous shales.

These later beds continue down the coast as far as Tecolutla. They are well exposed at Tuxpam, where they have a highly characteristic fauna, including two very heavy oysters which are nearly round. Both are of the same general shape, but one of them has on one valve four or five deep plications. The echinoderms of these beds are especially noteworthy, there being probably eight species in our collection. The most abundant form is a *Clypeaster* which attains a diameter of

seven inches and which occurs in great numbers in the yellow sands around Tuxpam.

There are also casts of a large variety of other forms of bivalves and gasteropods, and as a whole the fauna is later than that of the San Fernando beds and is probably Miocene. We have called these the Tuxpam beds.

The evidence now before us indicates that the upper Tertiary deposits mark a gradually sinking coast line along the gulf border in Texas and Mexico which was arrested in the Tampico-Tuxpam region before it was further north. Thus while early Miocene deposits are on the surface almost at the present water's edge at Tampico and have only a small depth of later deposits overlying them, deposits of the upper Miocene are buried 2,300 feet on Galveston Island and are found in drilling at Saratoga seventy miles inland at a depth of over 1,000 feet.

E. T. Dumble

SOCIETIES AND ACADEMIES

THE AMERICAN PHILOSOPHICAL SOCIETY

In an address on modern physics before the American Philosophical Society, recently, Professor Ernest Fox Nichols, president of Dartmouth College, said in part:

"I shall try to review very briefly the principal ideas upon which modern physics rests and shall say something about where we think we have arrived in our search for knowledge. I need scarcely remind you that in the natural sciences as in more practical affairs, *how* we have arrived is as important as *where* we have arrived. I shall therefore spend some time in presenting detached fragments of the experimental evidence and inferences upon which certain conclusions are based, hoping in this way to illustrate some of the constructive methods of reasoning employed in research.

"The ideas which underlie all our thinking are space, time and inertia or mass. With space and time as a background, the physicist must pursue inertia and everything related to it, along every conceivable path. In this pursuit he comes upon four ultimate though related conceptions: matter, ether, electricity and energy.

It should be remembered that an important part of our present knowledge of matter, and nearly all that we know of ether and electricity, has been gained not immediately but by inference. In so many cases we see or know directly only the first and last link of a chain of events and must search by indirect means for the mechanism lying between.

"At bottom, I suppose, the ether, electricity, force, energy, molecule, atom, electron, are but the symbols of our groping thoughts, created by an inborn necessity of the human mind which strives to make all things reasonable. In this reasoning from things seen and tangible, to things unseen and intangible, the resources of mathematical analysis are applied to the mental images of the investigator, images often suggested to him by his knowledge of the behavior of material bodies. This process leads first to a working hypothesis, which is then tested in all its conceivable consequences, and any phenomena not already known which it requires for its fulfilment, are sought in the laboratory. By this slow advance a working hypothesis which has satisfied all the demands put upon it gradually becomes a theory which steadily gains in authority as more and more new lines of evidence converge upon it and confirm it.

"As we take up what we believe to be the relations of electricity to matter, we come in places upon slippery ground and the bases of our faith rest on recent foundations.

"At the outset we encounter one striking difference between electricity and matter. Every free charge of electricity exerts a force upon every other charge in the universe, just as every particle of matter exerts a force on every other particle of matter, however distant. But with matter the particles are invariably urged toward each other while electric charges may be either drawn together or forced apart depending on the kinds of charges. We have both positive and negative electricity but only one kind of matter. The bald statements of the laws of gravitation and electric force bear a strong resemblance to each other. The laws tell us how the forces *vary*, but reveal no hint of the machinery by which they *act*. Of the intimate association of electricity with matter we have learned much from careful study of the processes of electric conduction in solutions and gases."

The contributions to our knowledge gained from the recent discoveries of cathode rays, X-rays, spectroscopic studies and the amazing properties of radio-active substances were next discussed and in closing Dr. Nichols said:

"The electron has but a thousandth part of the inertia of the lightest known material atom, and this inertia it doubtless borrows from the kindly