American geographies like that of Payne (New York, 1798) commonly included sections on the globes. Payne discusses (Vol. I, pp. xxxiii–xxxviii) "Problems performed by the globe; Jedidiah Morse (American Geography, 3d ed'n, Boston, 1796) gives a ten-page discussion, with problems, on both Terrestrial and Celestial globes, and the same space is devoted to this topic in the first American edition (Philadelphia, 1794) of Guthries's Geography. It is worthy of note that David Rittenhouse contributed to the astronomical portion of the American edition.

The first astronomical book printed in America was the "Phisica, Speculatio . . . Accessit compendium sphere Campani," by Alonzo de Vera Cruz (Mexico, 1557). An examination of this work and later Mexican works in astronomy and geography would be likely to reveal some use of globes in Spanish America.

These notes are intended to indicate some of the various sources of information concerning early American uses of the globes and also their intimate connection with early astronomy and mathematics in the New World.

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## ON THE EXCRETORY APPARATUS IN PARAMECIUM

CERTAIN observations[1] on the morphology of the contractile vacuole and feeding canals in *Paramecium caudatum* warrant the following conclusions:

The pore, contractile vacuole and canals (eight to eleven in number) form a continuous, permanent ectoplasmic *structure*. There is here, therefore, neither evidence of nor necessity for a sol-gel reversibility of the cytoplasm, as set forth by Taylor ('23) to explain the mechanism of the contractile vacuole in *Euplotes*.

In a longitudinal section through the cortex, at right angles to a perpendicular line drawn through the pore to the bottom of the vacuole, the pore is seen on the surface as a clear, circular opening continuous with the vacuole below, showing no intervening membrane. Longitudinal and cross sections through the axis of pore and vacuole also show that the pore and vacuole are continuous. The vacuole can be distinguished in all stages of systole and diastole so far observed. During the stage of maximum contraction it is a minute central space with delicate radiating tubes, each of which leads to the bulbous end of a feeding canal. As the canals give up their contents to the vacuole, the vacuole gradually increases in size; meanwhile, the bore of the canals diminishes. The distention of the vacuole in stages of diastole is at the expense of the proximal ends of the feeding canals. Thus, the walls of the canals are directly continuous with the wall of the vacuole. The pore, vacuole and canals make a permanent continuous structure.

The canals are slender tubes varying in extent and size according to their disposition and the stage of contraction of the vacuole. At the end of systole, when the vacuole may be said to be collapsed, each canal is markedly bulbous in that portion immediately distal to the radiation from the vacuole. In such a stage the canals may be likened to long-handled Indian clubs radially disposed with their bulbous ends in close proximity. As diastole progresses, the canals present more nearly parallel sides throughout their length. Toward the end of diastole and the beginning of systole, the canals show distentions farther away from the vacuole.

There is no evidence that the contractile vacuole is formed by accessory vacuoles, as described and figured by Khainsky ('10), nor does any section show a pulsatorial papilla or evagination, such as he describes.

This study, therefore, indicates that the excretory apparatus of *Paramecium caudatum* is a permanent, continuous *structure*.

A detailed account with illustrations will be published later.

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[1] These observations were largely on serial sections of Paramecia fixed with Gilson, Bouin, Meves, Benda, Flemming and Altmann among others, including solutions of iodides (*e.g.*, Lugol's and 2 per cent. anhydrous iodic acid). The Altmann fixation gave by far the best results: absolutely no shrinkage; mitochondria, oil drops and cilia perfectly preserved. Of the various staining methods used, iron hematoxylin gave the best results. I am indebted to Dr. E. E. Just for turning over to me these slides, study of which served as a basis for these observations.

## THE RESISTANCE OF THE TYPHOID BACILLUS TO FREEZING

IN spite of the published work of Pearse, Sedgwick and Winslow, Park and North, most text-books on bacteriology state that Eb. typhi will resist freezing for a considerable time; and quote Taylor's investigation of the historic Plymouth epidemic in support of their views.

In a series of experiments conducted in this laboratory during the past year, Mr. W. A. Kreidler, a graduate student, obtained results which clearly indicate that this hypothesis is incorrect. Using artificial culture media, water, sterile and normal feces as the media in which the organisms were frozen, he was unable to obtain any growth of typhoid bacilli or the "Paras" after freezing for three weeks.

While we must realize that we can not exactly simulate natural conditions in the laboratory, it would seem that organisms which had been leading a saprogenic life for years would be more resistant to the conditions of the experiment than would the same organisms in a highly virulent parasitic condition.

The Plymouth typhoid epidemic was caused by a fresh and vigorous strain, as is indicated by the severity of the early cases. It is not likely, therefore, that it was caused by organisms which had been in a frozen medium for any length of time. I would suggest the theory that the epidemic was caused by the organisms in the feces which were deposited within a few days of the time the reservoir was opened, about the time of, or after, the thaw.

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## ANALYZED SOUND

IN the issue of SCIENCE for July 4, 1924, an interesting discussion of "Analyzed sound" by Alexander Forbes appeared. This description of the several instances coming to his attention brought to mind an experience of mine with a similar phenomenon occurring at Oxford, Massachusetts, many years ago. Having very carefully kept journal records almost daily since 1898 of my thoughts, experiences, etc., in contact with all natural phenomena, I made a search of my journal and found the following record which I will copy just as written:

Aug. 11, 1902. Oxford, Mass.

As an early train passed by this morning, I noted a most remarkable echo every time it whistled. The first echo was immediate, sharp and distinct, appearing to rebound from a neighbor's buildings nearby. Some seconds after all was quiet, another faint, far-away musical echo came stealing up the valley, apparently emanating from a wooded hillside far away. The echo ever increased in intensity until it seemed to pervade every corner of the landscape, filling it with a wonderful harmony of sound that beat upon the air in ever fainter waves, ever becoming farther away, until the sounds could no longer be heard. At no time were the sounds loud but seemed to fall upon the ear in infinite waves, as if thrown back from some invisible dome overhead. It did not seem to be a terrestrial echo, but seemed to fill the skies overhead with sweet, spiritual sounds, that seemed also to reecho far back in the skies, one could not tell where. I think some obscure atmospheric condition overhead was responsible for this remarkable echo, the most exquisite, the most sweetly celestial sound I have ever heard in the skies.

At the time I was greatly impressed with this remarkable sound phenomenon, but I have never since heard anything even approaching this strange breaking up and reflection of a sound into musical tones such as occurred in this instance.

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IN connection with the article in SCIENCE of July 4, 1924 (page 5), on "Analyzed Sound," attention should be called to Lord Rayleigh's discussion of the phenomena half a century ago (*Nature,* 1873, Vol. VIII; "Theory of Sound," Chap. XV) under the title "Harmonic echoes." His conclusions from a mathematical investigation of the reflection of sound-waves from small surfaces, as tree trunks, were that the intensity of the reflected wave varied inversely as the fourth power of the wave length. The overtones in the echo of the voice would therefore be very much stronger relatively to the fundamental than in the original sounds and the effect might easily be called a change to the octave.

Many years ago there was such an echo at the Adirondack resort, Loon Lake, Franklin County, N. Y.

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## SCIENTIFIC BOOKS

*Extinct Plants and Problems of Evolution.* By D. H. SCOTT. Pp. xiv + 240. Macmillan & Co. London, 1924.

THIS little book, founded upon a course of lectures given at the University College of Wales in 1922, is a largely non-technical and very readable account of the main points in our knowledge of fossil plants, written for the non-specialist.

The first chapter is an all too brief, but very illuminating, sketch of the present status of the various theories that have been advanced to explain the facts of evolution. A consideration of extinct floras is preceded by a very brief sketch of recent floras, and the former are taken up in the sequence from youngest to oldest. The great transformation periods of floral history are considered to have been the middle Devonian, the Permian and the mid-Cretaceous, ushering in respectively the so-called Carboniferous flora, the Mesozoic flora and the flowering plants. The consideration of the early Devonian flora is almost entirely devoted to considerations growing out of the recently discovered petrified material in the Rhynie chert, and showing certain bryophytic and algal characteristics. It seems to the reviewer that a somewhat misleading impression is given of the extent of the Permian transformation, which was really a gradual process when viewed in the true geological perspective. The consideration of the Mesozoic floras is