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.