which extend outward from the reef were formed by slow evaporative processes. Because of the fact that both anhydrite and gypsum are soluble in water, there is no possibility that these strata could have been formed by any aquatic activities such as floods or rapid inundation. Thus we have here another good example of a long series of cyclic changes of environment which produced interstratified layers of evaporite minerals and dolostone. Canada and the Delaware basin are only two of the many areas in the world where this type of cycle is present.

The Filling of the Delaware Basin

The length of time which the processes of reef formation required was only a small part of the total time represented by the deposits of the Delaware basin area. The thick deposits represented in Figure 18 by the white areas above the basin floor and reef are nearly all evaporitic deposits. Their extent and complexity are truly amazing to those who have studied them, and are one of the best sedimentary time records in the world. The entire basin, a part of which is shown on the left in Figure 18, is filled with very thin, alternating layers of calcium carbonate, anhydrite, and organic matter. These thin, evaporitic varves make up thousands of small cycles which represent periodic (probably annual) fluctuations in the environment. The environmental changes progressed each time from near normal sea water (when the organisms could form organic matter), to a concentration such that calcium carbonate could be precipitated, to a more concentrated brine from which anhydrite (calcium sulfate) could be precipitated. (Table 1 shows the sea-water concentrations necessary for the precipitation of these minerals.) Some of this evaporitic deposit in the deeper parts of the basin may have formed during the time the reef was still growing. In this case the brine would have been sinking into the bottom of the basin, because of its greater density, after having been produced by evaporation at the surface of some part of the basin. This kind of sinking of brines has been observed in modern marine environments in some parts of the world.[7]

Walter Dean, while at the University of New Mexico, made a detailed study of these thinly laminated deposits. By studying cores and drilling records from 415 wells of the Delaware basin, he found that there are more than 200,000 of these thin calcium carbonate-anhydrite-organic cycles, spreading over a broad area in the center of the basin. The total depth (thickness) of these 200,000 layers was found to be approximately 1,300 feet in most places.[8] This deposit makes up the main thickness of the sediments which filled the basin, and is part of what is known as the Castile Formation of that area. Geologists have been aware of this great body of thinly laminated sediments for several decades, calling them the "banded anhydrite" (because the thin layers, as seen in a well core, look like narrow bands on the core). There is a great deal of evidence that each of the thin cycles represents one year of deposition.

An examination of Dean's Ph. D. thesis, and the work which he later published on the same subject, will soon convince anyone who