many have been described. All which show significant numbers of eroded remains of encrusting fauna, or channels or pits dissolved out by boring organisms, obviously represent an extended period of time (at least several years) before the next layer of sediment was added.

Wherever a repeating sequence of such hardground layers occurs we obviously have a record of a very long period of time. A few of the many repeating sequences which have been described are: (1) A formation of Jurassic limestones of Lorraine in France, containing 30 to 40 hardgrounds, with many encrusting and boring organisms represented (Jaanusson, 1961, p. 228; compare Bathurst, 1975, p. 396, Fürsich, 1979, p. 27, and Purser, 1969); (2) A Devonian formation in Russia in which hardgrounds with "a rich epifauna...occur at many different levels" (Jaanusson, 1961, p. 227); (3) An Ordovician formation in Sweden, slightly over 6 meters thick, containing a succession of fossiliferous hardgrounds, with the beds being from 2 to 20 cm thick, with marl or shale between them (Bathurst, 1975, p. 397-399); and (4) very thick Cretaceous chalk formations in northwestern Europe, including the Turonian Chalk Rock of England (Bathurst, 1975, p. 399; Kennedy, 1975, p. 311-386). These chalk beds, with alternating hardgrounds and soft chalk layers, are a truly impressive time record.

Stromatolites are limestone strata which have in them rounded masses of limestone or dolostone which are obviously composed of thin layers. A single rounded structure of this type is now called a stromatoid. Stromatolitic structures were largely a mystery until, in the early 1930's, biologists and geologists began to discover that stromatoids can be observed in the process of formation on the warm coasts of islands in the Caribbean, and of the Persian Gulf and Australia (Bathurst, 1975, p. 217-230). Each layer of the stromatoid is formed by a thin mat of fine, filamentous algae which collects sediments from the shallow, coastal waters in which it grows. Each time that the algae is coated with fine carbonate sediment spread over it by the tidal currents, the algal filaments grow up through the thin sediment coat, thus adding another layer to the algal mat. The mat may become as much as one or two meters in height and a meter in breadth, and in this case may be called a "stromatolitic column." After the stromatoids on a particular carbonate coast have formed, they may become cemented, and buried by sediments borne by heavy seas, finally becoming a stromatolitic limestone stratum.

Ancient deposits of stromatolitic limestone are both widespread and extensive in volume, both near the surface and thousands of feet deep in the sedimentary strata of oil fields. They are present in carbonate rocks of all geological periods, especially in the Precambrian, Cambrian, Ordovician, and Pennsylvanian Periods. In the United States, the best known of the great beds of stromatolitic limestone which are exposed (outcropping) are in Montana, Arizona, Michigan, Vermont, New York, and Pennsylvania (Johnson, 1961, p. 204-207, 245-246). The stromatolites and other algal-mat structures are regularly found in growth position, closely resembling the manner in which they are distributed in modern stromatolite beds. Geologists are careful not to assume that all ancient stromatolites were formed under exactly the same environmental conditions as those being formed today. However, the similarity of the modern and the ancient in this case is unmistakable, and in some ancient ones, identifiable algal filaments of several types are preserved in the laminations (Schopf, 1977; Johnson, 1961, p. 205). These, together with the many similarities of lamination patterns and of sediment particles, give more than sufficient evidence of the relationship of the modern and the ancient stromatolites.