found in these rocks. Thus at various stratigraphic levels there was a considerable number of years during which the upper surface of the Bank was periodically exposed above sea level.

When all of the above-outlined growth and dissolution processes are taken into account, it is obvious that the Great Bahama Bank is not a structure which could have been formed in a mere few hundred thousand years. The present rate of production of sediments on the Bank is sufficient only to produce an upward growth of approximately 30 centimeters per 1,000 years (Goodell, 1969, p. 527-528). Earlier, when this carbonate body had more corals thriving on it, it undoubtedly had a faster growth rate. If we should apply the 30 cm per 1,000 years rate to the upper 35 meters of sediments (see the fifth paragraph of this section), and then the fastest rate estimated as possible for reefs by Mayor (8 mm per year) to the remainder of the column, we arrive at approximately 790,000 years for the entire 17,800-foot sedimentary series. This is of course far too low a figure, because of the many unconformities in the column, which represent periods of growth stoppage, rapid dissolution, and erosion. This simple time calculation is again far too short in that it assumes that the sea level was rising (or the base sinking) at a constant, optimum rate for coral growth during the whole life of the Bank—except for the upper 35 meters.

HARDGROUNDS AND STROMATOLITES IN LIMESTONE FORMATIONS

In addition to what we have termed "the great biologically-produced carbonate structures" in the sedimentary record, there are other, smaller, *in situ* carbonate growth structures occurring in most parts of the world. These are of less thickness than the atolls we have described above, but very often they occur in vertically repeating sequences in the rock formations in which they are found. Two of the types of growth structures to which we refer are stromatolites (which contain stromatoids) and hardgrounds. Because of requested limits on the length of this paper we can here present only a brief statement concerning each of these, together with suggested sources for further study.

A hardground, of the type best known, is a limestone layer of shallow-water marine origin, which was lithified and then exposed to water currents for an extended period of time. Such hardgrounds are often called "discontinuity surfaces," because they represent a period of sea-floor exposure without appreciable sedimentation. During this time of exposure the activity of encrusting and boring marine organisms and (or) mineral impregnations by glauconite, calcium phosphate, iron hydroxide, or manganese oxide takes place, before a minor (or sometimes major) change of environment results in burial of the layer. Very often, during the period when encrusting invertebrate animals are living on the hardground surface, some of the skeletal deposits they leave are eroded or partially eroded off, leaving various partial skeletons of these organisms (Bathurst, 1975, p. 395-401; Fürsich, 1979, p. 1-17, 29-49). Some of the most common encrusting fauna found in hardgrounds are bottom-dwelling Foraminifera, calcisponges, brachiopods, bivalves such as oysters, marine worms, and crinoids. Some common boring fauna found are boring sponges, echinoids, polychaete worms, and bivalves (Fürsich, 1979, p. 30-33). The channels made by boring organisms often are so clean-cut that one can, with magnification, see the cut ends of previously-cemented carbonate grains, thus demonstrating that a good degree of cementation had occurred earlier.

Limestone hardgrounds are common in many parts of the world, and