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Notes on the Occurrence of Oolitic Limestone in the Otis Beds of the Devonian, Kenwood, Iowa

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NOTES ON THE OCCURRENCE OF OOLITIC LIMESTONE IN THE OTIS BEDS OF THE DEVONIAN, KENWOOD, IOWA

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A very prominent outcrop of the Otis limestone occurs along the valley of Indian creek, at a point known as Horse Thief Cave, about one-half mile south of the town of Kenwood, Iowa. At this place the exposed beds contain the characteristic *Spirifer subumbonus* Hall.

Near the top of the exposure of limestone and slightly below the entrance to the cave occurs a thin layer of oolitic limestone. The bed is as much as one foot in thickness in places and is a grayish white rock which weathers to a yellowish brown. The oolitic structure can hardly be detected with the naked eye but upon examination with a lens the structure is at once apparent.

The oolitic grains are composed entirely of calcium carbonate. They effervesce very readily in hydrochloric acid and no residue is left. In most of the oolite grains there is a series of coats of calcium carbonate which peel off in concentric layers. Occasionally the entire mass of the grain breaks loose from the rock leaving a circular cavity. The central part of the grain is usually dark colored and contains dark particles. The central nucleus is composed of calcium carbonate, usually crystalline, which in many instances contains, under the microscope, dark rod-like structures. These are often arranged radially.

The grains are both round and elongate with much variation in size. They occasionally show some evidence of being grouped, usually three occurring close together, suggesting colonies of individuals.

A number of casts of the fossil *Spirifer subumbonus* have been replaced entirely by the oolitic grains without losing any of the form of the Spirifer. This suggests that the formation of the oolitic grains may have been due to the chemical action of sea water. It also indicates a possible enzymic action by algae, since the radial arrangement of the tubes within the nucleus cannot be explained as chemical work of sea water.

If, as is believed by the writer, the oolitic grains are the result of secretion of calcium carbonate by blue-green algae in the Otis sea, then the replacement of the *Spirifer subumbonus* shells is a secondary replacement and indicates that the algae were capable of destroying shells much larger than themselves by working in great numbers. Whether this replacement was accomplished through enzymic action by the algae or is a chemical replacement is uncertain, however enzymes are known to be able to bring about changes in various substances and that they are produced by the cells of plants and animals. The appearance in the replaced Spirifers indicates that the individual algae were able to penetrate the shell and to either remove the original calcareous material of the Spirifer shell, or to use that calcareous material to form the concentric layers of calcium carbonate now seen in the oolite. This is suggested by the fact that the modern blue-green algae become coated in concentric layers, or encrusted with a coating, from minerals in the water of hot springs and geysers. The penetration of a shell by the blue-green algae may indicate an activity on their part in connection with the disposal of waste material, as the modern algae act as an aid in transforming waste material into food; and probably act as scavengers in the sea.

A review of the oolite problem has been made by Van Tuyl (Journal of Geology, Vol. 24, pp. 792-7, in which he cites the work of Wethered (Quart. Jour. Geol. Soc. London, XLVI) and that of Rothpletz (Botanische Centralblatt, No. 35, pp. 265-268 (English translation by F. W. Cragin, American Geologist X, pp. 279-282)).

Rothpletz cites a radial and tube-like arrangement in *Girvanella problematica* Nicholson. Wethered has shown the close relationship between Girvanella and the true oolite, showing that certain Carboniferous and Jurassic oolites of England consist in part at least, of rounded calcareous masses secreted by Girvanella.

Van Tuyl further cites specimens of oolite from the Prairie Du Chien formation of the Ordovician of Northeastern Iowa which he collected and studied. His description is as follows:

"Typically the well-preserved oolite grains consist of an inner structureless nucleus, followed by a narrow intermediate band showing radial structure, and this again by an outer band bearing sinuous fibers. In some instances, however, the two outer bands grade gradually into each other without any distinct line of demarkation; or indeed the radial structure may be entirely wanting and the concentric structure may continue into the nucleus."

The similarity in structure between the Kenwood oolite and that of the Prairie Du Chien oolite may readily be seen, however, the Kenwood oolite is entirely calcareous while the Prairie Du Chien is silicified.

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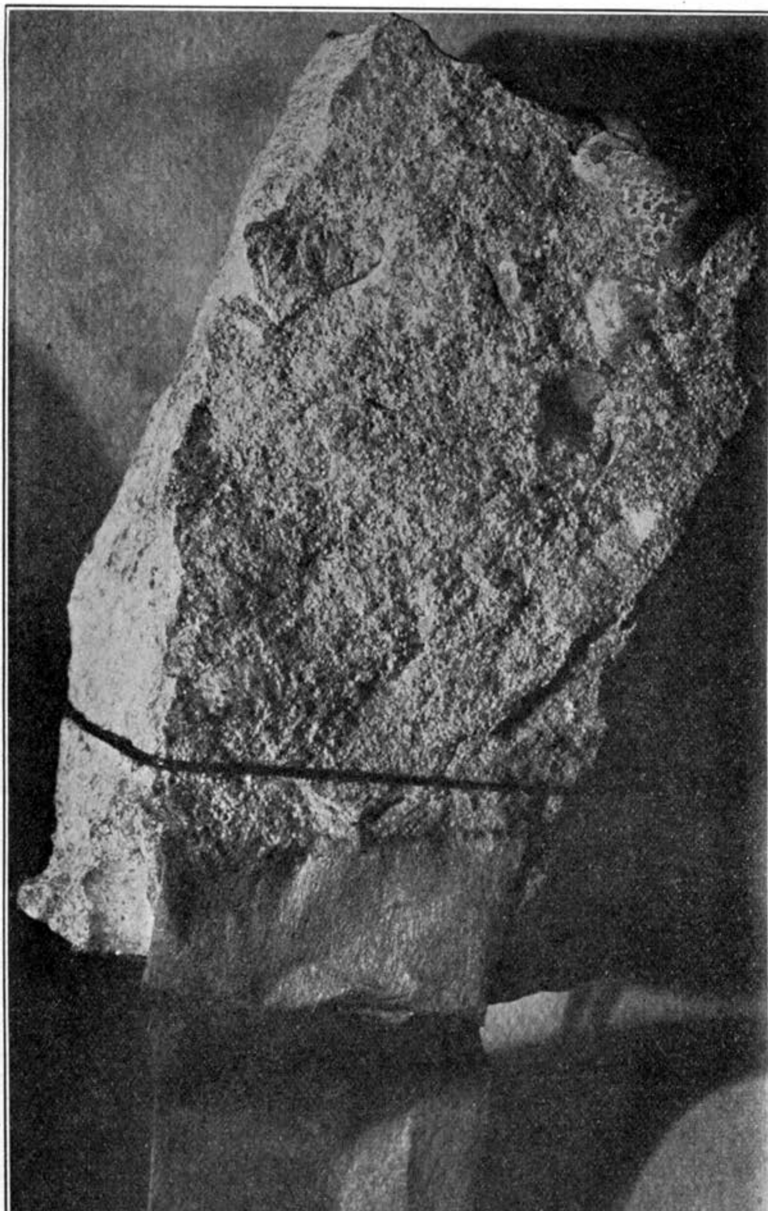
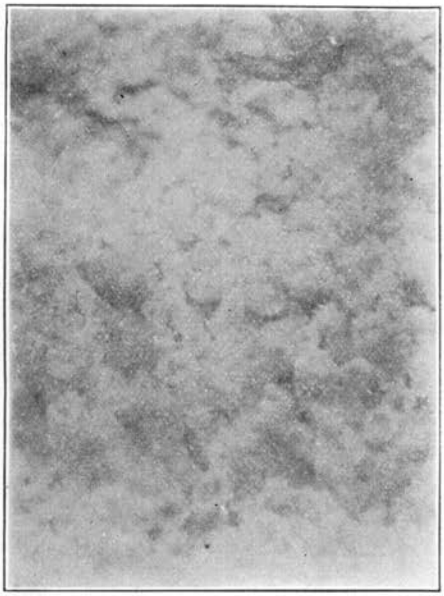
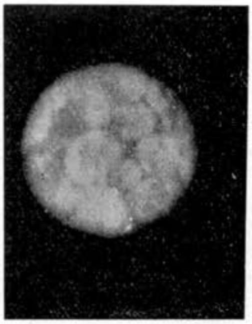


No. 1. Enlargement of Otis limestone, showing oolitic structure. From the Devonian at Kenwood, Iowa.

No. 2. Showing oolitic grains throughout rock, also *Spirifer subumbonus* Hall with oolitic structure.

No. 3. Enlargement of No. 2, showing oolitic replacement of fossil *Spirifer subumbonus* Hall.





No. 4. Oolitic grains in Otis limestone, Kenwood, Iowa. Note dark nucleus.

No. 5. Note spherical depressions where grains have been removed. Also radiation of central nuclear mass.

No. 6. Photo-micrographs showing concentric rings and radial arrangement of nucleus. Photos by W. F. Kubichek, Coe College.