Originally published by:
UNITED STATES NATIONAL MUSEUM
1894.

SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM

PROCEEDINGS

OF THE

UNITED STATES NATIONAL MUSEUM

Volume XVII 1894.

PUBLISHED UNDER THE DIRECTION OF THE SMITHSONIAN INSTITUTION

WASHINGTON: GOVERNMENT PRINTING OFFICE. 1895.

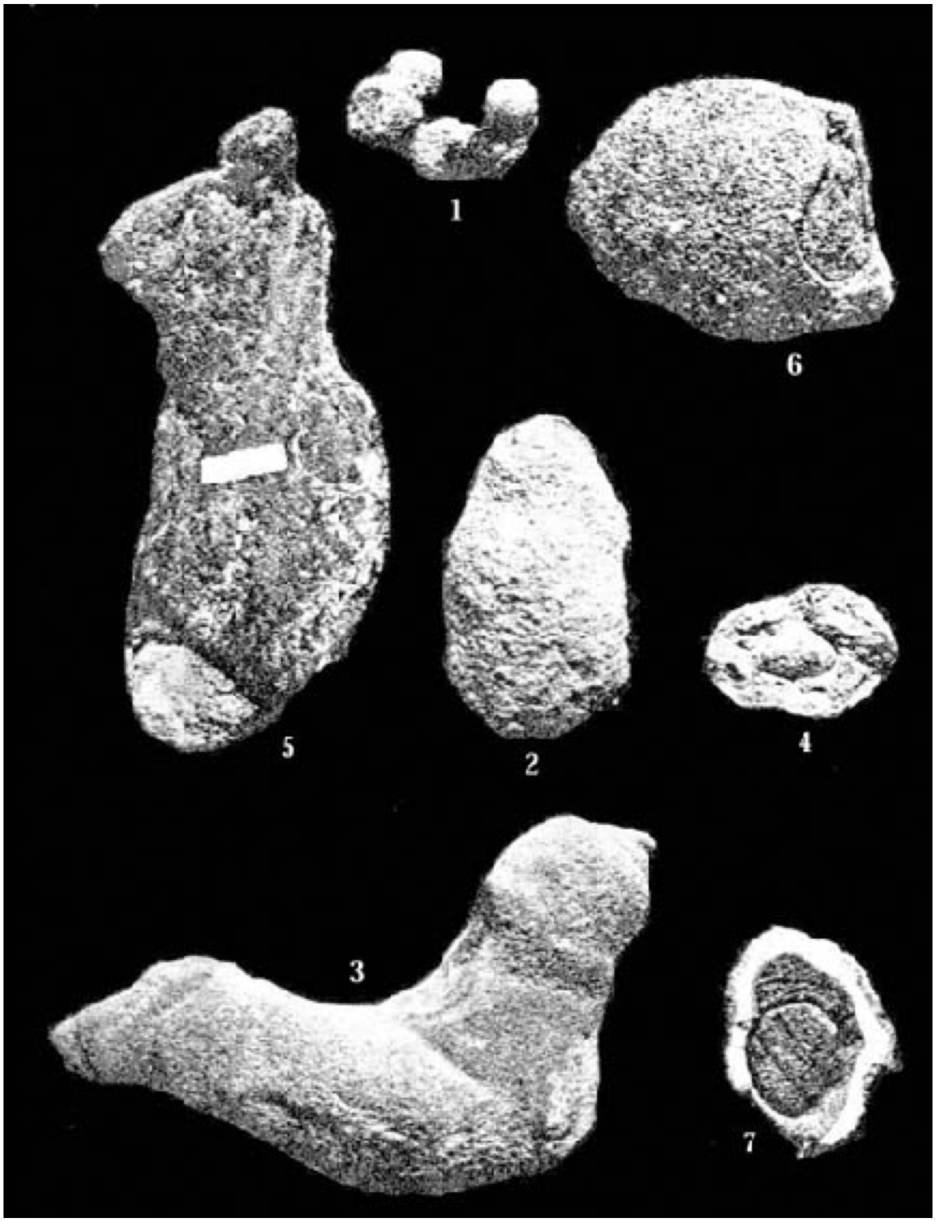

PLATE I. CONCRETIONS OF MARCASITE AND SILICEOUS SAND.

THE FORMATION OF SANDSTONE CONCRETIONS.

by GEORGE P. MERRILL
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MANY an interesting and instructive lesson in geological processes is frequently to be gained by observation of what is going on almost at our doors, but which is overlooked by the amateur because his attention has never been properly directed to it and perhaps by the professional as well, because as is so frequently the case, he is more interested in larger problems at a distance.

Such a lesson may be learned from the study of the globular and irregular rounded masses or concretions of ferruginous sand, sometimes quite hollow, or again partially filled with loose sand which falls out when the concretion is broken, leaving but the empty, deeply convex shells. As to what these are and what their method of formation may be, one may consult his geology long and in vain for a satisfactory solution.

The abandoned reservoir for the waterworks extension near Howard University in Washington, D.C. furnishes in all its details so plain and interesting an explanation that he who runs may read, and I am tempted to describe it in detail even at the risk of wearying those to whom the illustration is neither new or needed.

The excavation above noted was made in the so-called Potomac division of the Cretaceous, consisting here of rather loose beds of sand and gravel, containing not infrequently fossilized logs of considerable size, both silicified and in the partially carbonized state known as lignite. It is with the last, only, that we have to do here.

In close contact with these lignites, either in the form of rounded and irregular nodular masses or as veins in the mass itself are numerous globular aggregates of siliceous sand and iron disulphide in the form known as marcasite. (See figs. 1, 2, 3, and 4 of Pl. VI). So long as protected from atmospheric influences which seem to have preserved their mineralogical identity fairly well. When disturbed, however, either in the work of excavation or through other means, so as to be attacked by atmospheric agencies, they have undergone rapid decomposition. When lying on the immediate surface this decomposition (so far as the sulphide is concerned) consists mainly in the production of sulphates which are rapidly removed in solution, or which during the dry part of the year accumulate in the form of a thin, sulphur-yellow coating on the surrounding surface. When, however, buried in the loose siliceous sand the result is noticeably different. Here, owing presumably to an insufficient supply of sulphuric acid, a considerable portion of the sulphide passes into the condition of sesquioxide, which segregates in a narrow zone about the nucleal pyrite, cementing together the granules of siliceous sand and forming a crust or shell-like coating which is often quite dense and hard. All stages of the process are to be found, from those in which there is merely a thin crust of oxide (figs. 5 and 6) to those in which the sulphide has nearly disappeared (fig. 7). As the original concretionary mass rarely consisted of pure pyrite, but enclosed more or less sandy material, this last becomes liberated and not infrequently remains as loose sand partially filling the geode-like cavity.

The chemical processes involved in this change are presumably simple, though as we do not know for a certainty the exact conditions attending either solution or precipitation we can not be expected to describe them in detail. On the assumption that the iron was originally in solution as a ferrous sulphate, we can readily account for the presence of the pyrite concretions through the reducing action of gases given off by the decomposing wood. If, however, the iron existed, as at first seemed more probable, as a ferrous carbonate, the precipitation is less readily accounted for since it seems doubtful if the small amount of sulphuretted hydrogen liberated would be sufficient for the production of so large a quantity of pyrite as is here found.

EXPLANAT1ON OF PLATE I.

Figs.1, 2, 3 and 4. Characteristic forms of concretions formed of granules of siliceous sand cemented by marcasite. In fig. 4, there has been internal shrinkage, causing cracks suggestive of an intermediate stage in the formation of septaria.

Figs. 5, 6 and 7, Nodules showing stages of oxidation. In fig. 5, the oxidation has barely commenced, giving a red brown coating perhaps one-eighth inch thick on the outer surface. This coating has been removed from the lower end exposing the marcasite. In fig. 6, the nucleal mass carries so much sand as to be distinctly granular, but the line of demarkation between the oxidized and unoxidized portion is plainly evident. In fig. 7 the loose sand fell away in process of cutting, leaving the unoxidized portion as shown.