

ART. XVI.—*Clay of Probable Cretaceous Age at Boston, Massachusetts**; by FREDERICK G. CLAPP.

Discovery of the deposit.—During the past few years a great many deep borings have been made in Boston by the Boston Transit Commission. These have been studied in detail by Professor Crosby,† who has suggested the probable pre-Pleistocene age of clays in certain wells situated elsewhere in Boston. In 1906 the present writer had occasion to examine some samples of recent borings in connection with his study of Pleistocene succession, and a number of samples of probable pre-Pleistocene deposits were seen. Generally the Transit Commission borings have not been sunk over 20 to 60 feet in depth; they penetrate various types of glacial drift, and commonly end in “hardpan”, which is nearly always till. Sometimes they pass through a few feet of stratified blue clay, which, judging from its structure and relations, is Glacial or inter-Glacial in age. The underlying bed-rock of the region consists of Carboniferous slate and conglomerate, which are seldom reached by the Transit Commission borings, but when found are nearly everywhere overlain directly by till.

Description of deposit.—No deposits between Carboniferous and Pleistocene in age were found until July, 1905, when a boring made at the Ames Building, on Washington at the head of State street, started at an elevation of 33 feet above mean tide, and was sunk to the unusual depth of 228 feet. A previous test here had reported bed-rock at a depth of 77 feet, directly underneath the drift. Not being satisfied with the original report, the engineers decided to make a new test, with the result that in the 228-foot boring the following strata were penetrated:

Record of boring at Ames Building, Boston.

	Thickness (feet)	Depth (feet)
10. Coarse sand and gravel.....	17	17
9. Sand.....	1	18
8. Gravel and sand.....	5	23
7. Coarse gravel and white clay.....	3	26
6. Stony sand, gravel and clay with much water (very hard).....	16	42
5. Blue clay.....	18	60
4. Fine sand.....	5	65
3. Clay, sand, and gravel, with water (till)...	12	77
2. Hard dry nearly white clay, with bowlders	136	213
1. Slate (Carboniferous).....	15	228

* Published by permission of the Director of the U. S. Geological Survey.

† W. O. Crosby: A study of the geology of the Charles River estuary and the formation of Boston Harbor. In Report of the Committee on Charles River Dam, Boston, 1903, pp. 345-369.

According to the system of the Transit Commission, samples were collected from the boring at intervals of every few feet, and are preserved at the office of the Commission, where they were seen by the writer through the courtesy of Mr. Howard A. Carson, chief engineer. Down to 77 feet from the surface the materials are the ordinary sand, gravel, clay and till of the region, shown by their character to be entirely of Pleistocene age. They are mostly rather wet and yield considerable water. The material below 77 feet is dry, and in a previous boring had been called rock and not entered by the drill. All the samples of this bed were seen by the writer and found to consist mostly of a very fine-grained gray to white clay, which became plastic when wet. It varied from very soft and putty-like to nearly as hard as the underlying slate. The material when examined by Dr. W. T. Schaller of the United States Geological Survey was found to consist of $\text{SiO}_2 = 59.18$ per cent and $(\text{Al}_2\text{O}_3, \text{Fe}_2\text{O}_3, \text{P}_2\text{O}_5, \text{TiO}_2) = 27.11$ per cent, thus being a very pure clay.

Two masses, one consisting of sandstone, the other of fine-grained conglomerate, were found in the clay, and each measured about $1\frac{1}{2}$ feet in thickness. These may be interstratified beds of rock, or, as their relations and character seem to indicate, they may be boulders. No other foreign matter was found in the clay. Since the surface of the Carboniferous bed-rock buried underneath the city of Boston is very hilly and is eroded into deep river channels, it seems possible that boulders might become detached from a near-by ledge due to action of currents, and incorporated in the clayey sediments during their deposition.

Difference from Pleistocene clays.—This clay is important for the reason that it is unlike the general type of clay found at Boston. All the Pleistocene clays of the vicinity are of blue-gray to brown or buff colors; this clay is light gray to nearly white. The Pleistocene clays contain numerous boulders and pebbles composed of all kinds of rock found in New England, but in this clay only two boulders have been discovered, and these consist of rock only found in the vicinity of Boston, and which forms the bed-rock of the region. The Pleistocene clays are interstratified with glacial deposits; this clay rests on bed-rock and is separated from the overlying Pleistocene clay by a bed of till. This clay is much dryer than the overlying Pleistocene clay.

Similar clay in other borings.—In a boring at Dock Square, Boston, also made by the Transit Commission, samples of which were examined by the writer, a number of fragments of white clay (No. 2 in the record) were scattered through the brown Pleistocene clay at depths of 23, 30, and 31 feet from

the surface. Some of these fragments are as much as half an inch in diameter. Mr. B. F. Smith, a prominent well driller of Boston, reports a number of wells in the city, in which peculiar soft white deposits were found directly underneath the till. The material is said to cave badly and sometimes contains much water.

To Professor Crosby, who has made extensive investigations regarding the borings of Boston, belongs the credit of being the first to suggest the pre-Pleistocene age of this clay. Professor Crosby writes as follows:*

“We may profitably note the fact that some of the borings reporting bed-rock in the section of Boston south and east of Beacon Hill have clearly not reached any of the hard and thoroughly solid rocks (slate, conglomerate, trap, etc.) such as make up the whole of the bed-rock surface wherever it is exposed in ledges and shallow excavations; but instead the drill has passed from the glacial drift to imperfectly consolidated sands, clays, marls, etc., in part of colors unknown to the drift, and probably representing Tertiary strata underlying the drift and filling deep depressions and valleys in the harder formations or true bed-rocks of the region. The artesian well of N. Ward & Co., on Spectacle Island, 560 feet deep, passed through at least 360 feet of unconsolidated material, only part of which could be regarded as glacial drift; and the deep well at the corner of High and Purchase streets in Boston, reported as reaching the bottom of the drift at about 100 feet, is in soft materials comparable with the Tertiary deposits of Martha’s Vineyard and Long Island, to a depth of at least 500 feet.”

Conclusions.—Samples of the white clay from the Ames Building boring were compared at the office of the United States Geological Survey with samples of clay collected by Mr. Veatch from a number of borings on Long Island, New York, and found to agree very closely with them in appearance. Mr. Veatch has correlated the Long Island deposits with the Raritan formation of New Jersey.† If this correlation is correct, it is possible that the Boston deposits may be of similar age. This is rendered more probable by the similarity of the material in the Boston borings to some of the clays on Martha’s Vineyard, and by the fact that the beds on that island referred to by Professor Crosby as “Tertiary” are said by paleontologists to be in part of Cretaceous age.

Previous most northern known Cretaceous and Tertiary.—Cretaceous and Tertiary deposits have been known for years

* W. O. Crosby, Report of the Committee on Charles River Dam, Boston, 1903, p. 354.

† A. C. Veatch, Outlines of the Geology of Long Island, Prof. Paper, U. S. Geol. Survey, No. 44, 1906, pp. 22 et seq.

at Martha's Vineyard,* and Miocene greensands have been noted at Marshfield, 25 miles southeast of Boston.† In 1905 Tertiary deposits were identified by Mr. Bowman at Third Cliff, Scituate, 20 miles southeast of Boston, underneath drumlin till and earlier glacial deposits.‡ As Tertiary and Cretaceous deposits were once of considerable thickness in this region, it is not improbable that future well-drilling may reveal them below sea-level at points farther north on the New England coast.

U. S. Geological Survey,
Washington, D. C.

* References in N. S. Shaler's Report on the Geology of Martha's Vineyard, 7th Ann. Rept., U. S. Geol. Survey, 1888, pp. 303-363.

† Edward Hitchcock: Final Report on the Geology of Massachusetts, vol. i, p. 91-95, and 427, 1841.

‡ Isaiah Bowman, Pre-Pleistocene deposits at Third Cliff, Massachusetts, *Science*, vol. xxi, June 30, 1905, pp. 993-994; and (for more complete conclusions) this *Journal*, vol. xxii, Oct. 1906, pp. 313-325.