

ART. V.—*The Galveston Deep Well*; by E. T. DUMBLE
and G. D. HARRIS.

The Section.—E. T. Dumble.

THE City of Galveston, Texas, desiring to secure fresh water on the island, if possible, rather than go to the mainland for it, and having failed to do so at moderate depths, decided to sink a well to the depth of three thousand feet unless suitable water was found before going so far. I therefore detailed Mr. J. A. Singley to watch the boring and to secure all the information possible from it.

Work began in April, 1891, and continued with various interruptions and delays until August, 1892. The method used

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—that of revolving and jetting by Chapman Bros., Aurora, Illinois—is fully described by Mr. Byrnes, the contractor, in the *Engineering News*, August 11th, 1892.

The piping of the finished well is as follows :

15 in.	868 feet.....	868 feet.
12 in.	629 feet.....	1499 feet.
9 in.	866 feet.....	2363 feet.
8 in.	75 feet.....	2438 feet.
7 in.	162 feet.....	2600 feet.
5 in.	470 feet.....	3070 feet.

Many hundreds of samples were taken at the mouth of the well throughout the work and those necessary to show the character and variations of the several beds that were penetrated together with all the fossils collected were carefully preserved and are now in the collections of the Geological Survey of Texas.

Mr. Singley's section, made after a critical study of the specimens taken by him from the well, differs a little from the log of the well-borers as given by Mr. Byrnes in the article referred to and by Prof. Hill in this *Journal* for November, 1892.* Therefore, although a part of it has already been published,† the entire section is given in a condensed form.

Nos.	T'kn's.	D'pth
1. Buffy gray sand.....	46—	46
2— 3. Clay brown and mottled, calcareous concretions, etc.....	54—	100
4— 5. Sandy clay underlaid by fine gray sand.....	67—	167
6—10. Alternations of clays and sands containing shells and fragments of lignite.....	291—	458
11—15. Clayey sands and sandy clays with some mica.....	154—	612
16—18. Sandy clays with shell fragments.....	94—	706
19—21. Sand and clayey sand.....	121—	827
22. Coarse silvery-gray sand—water bearing.....	55—	882
23—25. Sandy clay with lignite and few shells.....	29—	911
26. Indurated coarse gray quartz sand.....	3—	914
27—28. Sand and clayey sand, micaceous.....	118—	1032
29. Sandy clay.....	228—	1260
30. Coarse gray quartz sand—water bearing.....	28—	1288
31—32. Clay and sandy clay.....	42—	1330
33. Coarse gray quartz sand—water bearing.....	10—	1340
34—36. Clays.....	44—	1384
37. Coarse gray sand.....	9—	1393
38—40. Sandy clays, variously colored.....	55—	1448
41—43. Sand, sandy clay and clay.....	45—	1493

* The deep Artesian Boring at Galveston, Texas, p. 426.

† Geological Survey of Texas, Second Report of Progress, Artesian Water by J. A. Singley, p. 78.

Nos.	T'ku's.	D'pth
44. Greenish gray sand, micaceous—water bearing	18-1511	
45-47. Laminated clays with pebbles, etc., and clayey sand 243.....	243-1754	
48. Cream colored, gritty, calcareous conglomerate	4-1758	
49-53. Alternations of sand and sandy clays.....	118-1876	
54-57. Ditto with lignite, calcareous concretions, etc.	184-2060	
58-59. Sandy clay and clayey sand.....	37-2097	
60-61. Laminated clay, micaceous sand.....	56-2153	
62-63. Greenish clay, indurated gray sand.....	67-2220	
64. Dark clay with lignite, fruits, corals, fish remains, terrestrial and fluviatile shells...	29-2249	
65-70. Clayey sands, shell conglomerate and sand...	96-2345	
71. Coarse gray sand—water bearing.....	32-2377	
72-75. Clays with pyrites, lignite, fish remains and shells.....	55-2432	
76. Buff sand—water bearing.....	11-2443	
77. Mottled clay, lignite, fish remains and shells..	8-2451	
78. Lignite.....	2-2453	
79. Clay, vegetable and animal remains.....	23-2476	
80-83. Sand, micaceous in places—water bearing....	76-2552	
84-87. Alternations of clay and sand.....	85-2637	
88-89. Sandy clay and clayey sand, fossiliferous....	80-2717	
90. Greenish clay, vegetable and animal remains..	166-2883	
91. Gray sand—water bearing.....	37-2920	
92-93. Clayey sand and sandy clay....	105-3025	
94. Sandy clay, micaceous.....	22-3047	
95. Coarse gray sand—water bearing.....	23-3070	

The water found in this lowest bed, although apparently less saline than that above it, was not suitable for general use.

While the method of boring employed was not the best for keeping the fossils of each stratum entirely separated from those below it, yet the anchoring of the different sizes of pipe at the depths given has acted as a partial safeguard against the commingling of the faunas of those different zones.

The fossils secured by the untiring watchfulness of Mr. Singley were numerous and varied, comprising many parts of plants, fruits, a pine cone, etc., fish remains and a large number of invertebrate forms. The shells were turned over to Mr. Gilbert D. Harris for examination, and his preliminary report is given herewith.

The results of the investigation add a most important chapter to our knowledge of the history of the formation of the Gulf coast, and furnish a section for reference and comparison which could have been obtained in no other way.

The thickness of the different members of the series as stated by Mr. Harris indicates either a greater dip than we have hitherto supposed to be the case in these deposits or else

a greater thickening toward the Gulf. Even at the depth attained the drill has not yet penetrated the sandstones, clays and browncoals of the Fayette Beds as shown at the typical localities in Fayette county, but is still in the sands and limy clays which overlie them.

Although the landward extension of these beds may come today somewhere in the area of the Gulf slope our investigations have, up to this time, failed to bring to light any localities which furnish marine invertebrates of an age later than the Claiborne. So far all the fossils found above that horizon are in fresh water deposits of Miocene, Pliocene, and Pleistocene age, and consist entirely of vertebrates.

The Paleontology.—Gilbert D. Harris.

The conclusions drawn from a study of the molluscan remains* obtained from this well, may be summarized as follows:

1. Of the 11 species obtained from samples numbered from 1 to 10 inclusive, all, except a new form of *Eriphyla*, are recent and well known. In all probability therefore the strata passed through between depths ranging from 0 to 450 feet must be referred to a post-Tertiary or Pleistocene epoch. The small *Eriphyla* will probably be found recent on the Gulf shore.

2. The fauna is so sparse between numbers 10 and 61 inclusive that it is unsafe to attempt to state just where in the upper Tertiary it should be placed. In fact beds included between depths 450 and 1500 may not be Tertiary at all but Pleistocene. The undescribed, and probably for the most part extinct species occurring from depths 1500 to 2150 feet show conclusively that these beds are Tertiary.

3. The fossils obtained from samples numbered 61 to 91 inclusive show that this part of the well section must be referred to the Miocene series. Moreover, it is quite evident that upon the whole the fauna represented is that of the upper rather than the lower Miocene. Out of about 72 species, 26 are still living on the Atlantic or Gulf coast of the United States, while 6 more survive only in the Pacific. Of the 36 new or doubtful forms probably the great majority are extinct, though it is unsafe to predict what will yet be found in the Gulf of Mexico. *Arca Carolinensis*, *Turritella subgrundifera* var. *Chione*, sp. nov. of west Florida Miocene, *Terebra*, n. sp. of west Florida Miocene and *Natica emmuloidea* of the West Indian Miocene may be regarded as characteristic species, leaving no doubt, when taken in connection with the foregoing

* For a full account of the species obtained see Geol. Surv. Tex., 4th Annual Report.

facts that this portion of the well section belongs to the Miocene series, and in all probability to the upper part of the same.

The above conclusions may be stated diagrammatically as follows:

Sample Nos.	Depth in feet.	Geological horizons.
1-10	46- 458	Pleistocene.
10-44	458-1511	Doubtful.
44-61	1511-2153	Upper Tertiary.
61-91	2153-2920	Miocene (Upper)

Probably some of the strata between the depths of 458 and 2153 feet were deposited in Pliocene times, but not a trace of a species characterizing that series has been found.