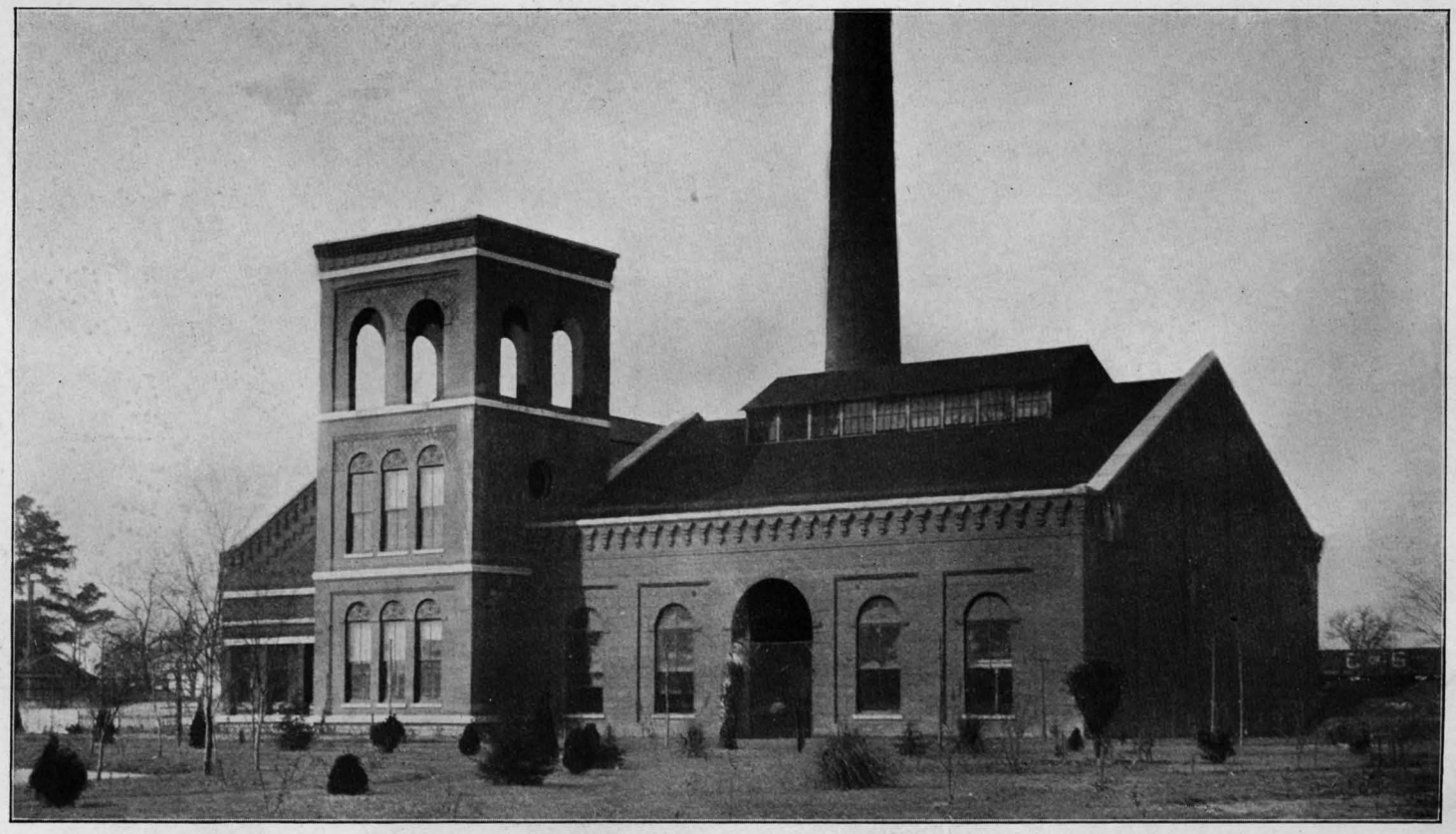

PUMPING STATION OF THE SAVANNAH WATER-WORKS.

GEOLOGICAL SURVEY OF GEORGIA

W. S. YEATES, State Geologist

BULLETIN NO. 7

A PRELIMINARY REPORT

ON THE

ARTESIAN-WELL SYSTEM

OF

GEORGIA

BY

S. W. McCALLIE

Assistant Geologist

1898

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October 20th, 1898.

To His Excellency, W. Y. ATKINSON, *Governor, and President of the Advisory Board of the Geological Survey of Georgia*,

SIR: — I have the honor to submit, herewith, the report of Mr. S. W. McCallie, Assistant Geologist, on the Artesian-Well System of Georgia. This report has been prepared, for the immediate benefit of the people of the southern part of the State; and it is intended to guide them, in the location of artesian wells, from which they may obtain a healthful water-supply. The value of such a work is so well known, as not to require comment. It is hoped, that this report will meet the want, it is intended to fill.

Very respectfully yours,

W. S. YEATES,

State Geologist.

THE ARTESIAN-WELL SYSTEM OF GEORGIA

CHAPTER I

INTRODUCTORY

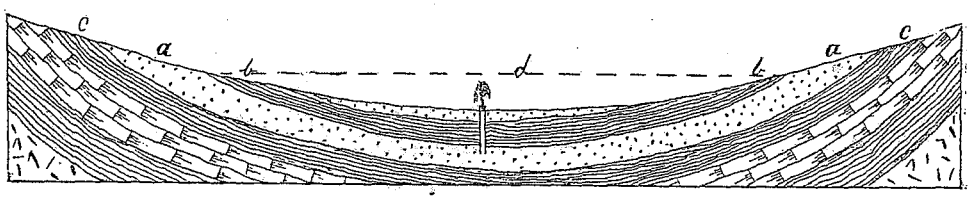
Artesian wells are so called from Artois, a province of France, where the first successful attempts were made in Europe to obtain water, by means of deep borings. The exact date of the completion of the first wells seems not to be definitely known. However; they probably date from the Eleventh Century; as one at Lillers has been in constant use, since the Twelfth Century. These original wells were all flowing, and consequently the term, *artesian*, was first limited to those wells, which overflowed the surface. The term is now often used in a much broader sense, embracing, not only the flowing, but the non-flowing deep wells. In this latter sense, it will be used in this report.

THE ESSENTIAL CONDITIONS OF SUCCESSFUL ARTESIAN WELLS[1]

The essential conditions, necessary for successful flowing artesian wells, are as follows: —

1st. An inclined, porous, water-bearing stratum, outcropping at

Fig. 1



Section through the Underlying Rocks of a Basin, Showing Favorable Conditions for Artesian Wells. a. Water-bearing Stratum. b. Confining Stratum above. c. Confining Stratum below. The Broken Line, d, Shows the Height, to Which Water Will Rise in an Open Pipe.

an elevation, greater than the surface at the location of the proposed well.[2]

2nd. Water-tight continuous beds, either of clay or some other impervious material, both above and below the water-bearing stratum.[2]

3rd. A sufficient rainfall, to supply the porous, water-bearing bed at its outcropping, with ample water for a continuous flow.

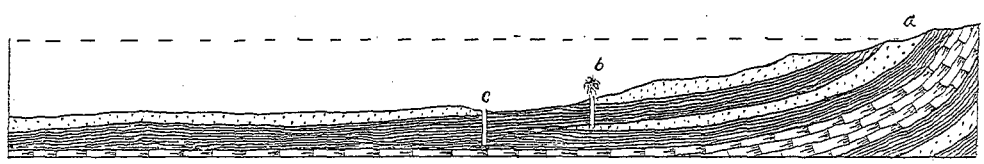
[1] For a more complete discussion of this subject, the reader is referred to Prof. T. C. Chamberlin's excellent paper, on Artesian Wells, 5th Annual Rep., U. S. Geol. Surv., 1883-'84, p. 131.

[2] See fig. 1.

WATER-BEARING STRATA

Many persons, who have made no special study of the movements of underground waters, are of the opinion, that artesian wells derive their water from subterranean streams or lakes. Such, however, is rarely ever the case. The source of the water, supplying these wells, is found to be, in almost every instance, a saturated porous deposit called a water-bearing stratum. The only strata, which can be relied upon, with any degree of certainty, to furnish

Fig. 2



Section Illustrating the Thinning out of Water-bearing Strata. (a) Water-bearing Stratum; (b) a Flowing Well; (c) a Dry Well.

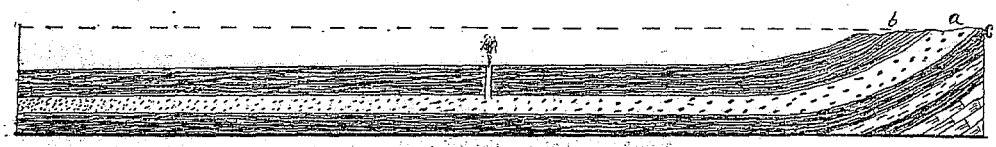
water, in large quantities, consist of sand, gravel, conglomerate or porous limestone. The crystalline rocks, including granites, gneisses etc., have, in a few instances, given a copious supply of water; but, as a general thing, this source of supply is too uncertain, to warrant extensive outlay of money in well-prospecting. It might be stated, as a common rule, that the more recent geological formations, including the Tertiary and the Quaternary deposits, are the chief sources of artesian waters. While the statement is true, in the main, there are, however, some notable exceptions; for instance, the Potsdam Sandstone of the Upper Cambrian.[1]

The amount of water, furnished by any given stratum, bears no

[1] Artesian Wells of Iowa, by W. H. Norton, Iowa Geological Survey; Vol. VI, p. 151.

relation, whatever, to its age; but, on the contrary, it depends almost entirely upon the porosity of the beds, and the rapidity, with which the water circulates through them. Other things being equal, the most copious flowing-wells are always obtained from strata having the largest spaces, between the individual particles constituting the beds. This condition is most nearly fulfilled, in very coarse sand or gravel beds. These beds, however, are usually of limited extent, and cannot be relied upon for water-supply over large areas.[1] Moderately fine sands and porous limestones are the more widely distributed water-bearing strata. These frequently

Fig. 3



Section Illustrating How Horizontal Strata, with Upturned Eroded Outcropping, May Become a Source of Artesian Waters. a. Water-bearing Stratum. b and c. Confining Strata.

underlie hundreds of square miles, and yield bountiful supplies of water, when pierced by the drill. If the sands are quite fine, and contain more or less clay, they become unimportant water-carriers, by reason of the slowness, with which a liquid oozes through a substance, containing minute interstices. Such beds may give the desired head of water; but they can never furnish a copious flow.

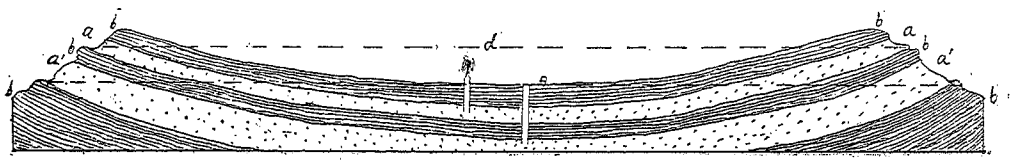
The inclination of a water-bearing stratum has much to do with its economic importance, as a water-carrier. If the stratum dips at a high angle, it not only soon reaches a depth, at which well-boring becomes impracticable; but it, also, at the same time, reduces the superficial extent of outcrop, which is the area of catch-

[1] See fig. 2.

ment, or intake. This is one of the chief reasons, why the more recent, undisturbed strata are usually the most fruitful source of artesian waters.

The water-bearing beds may slope, either gradually in one general direction, as along the Coastal Plain of the United States,[1] or they may dip toward a common center, as in the London and the Paris basins.[2] In the former case, the water-bearing stratum exposes only one edge, as an intake area, while the latter presents

Fig. 4



Section through the Underlying Rocks of a Basin, Showing Two Water-bearing Strata. The Upper Stratum, *a*, Furnishes a Flow; While the Lower, *a'*, Does Not, Because the Outcropping Is Reduced, by Denudation, to a Lower Level, than the Surface at the Mouth of the Well. This Section Shows Why the Lowest Water-bearing Stratum Does Not Always Have the Highest Static Head. a and a'. Water-bearing Strata. b. Confining Strata. d and e. Static Heads of the Water-bearing Strata, a and a', respectively.

four. Thus it is, that basin-shaped areas frequently furnish such enormous quantities of artesian water. It often happens, that strata dip, at a rather steep angle at their outcroppings, and then extend, for a long distance, nearly horizontal, or are again brought near the surface by gradual undulations or folds. In such instances, the outcropping of the water-bearing beds, which constitute the intake or catchment area, may be on the flank of the mountains, a hundred miles or more, distant from the location of the wells on the plains. These conditions are frequently met with,

[1] See fig. 19. [2] See fig. 4.

on our western prairies; and they also exist at many places on the rainless desert of Sahara.

At any one given locality, favorable for artesian wells, there are usually more than one water-bearing stratum. Often, there are several, separated by clay or other impervious material. Each of these water-bearing beds acts as a separate reservoir for water-storage,[1] so that, when one becomes exhausted by an overdraft from a multiplicity of wells, the other beds can be penetrated and drawn upon. This fact is well illustrated by the history of the artesian-well system of London. In the early part of the century, a great number of wells, from 80 to 150 feet deep, were sunk in that city, and a large supply of water was obtained; but, in a short time, the wells became so numerous, and the draft on the water-bearing stratum was so great, that many of the wells had to be abandoned, or driven to greater depths, in order to obtain a continuous flow.

It is a well-known law of physics, that water always seeks its level; that is, if allowed to move freely, it will stand at the same height in the pipes connected with a reservoir, as in the reservoir itself. According to this principle, it is practically impossible, to obtain a flow from a deep boring, unless the water-bearing stratum, which constitutes the reservoir, outcrops at a greater elevation, than the surface at the proposed well. Even when this condition is fulfilled, there is not always the desired flow, owing to the leakage of the confining strata, or the slowness, with which the water circulates through the water-bearing beds. From these statements, it will be readily understood, how important it is, for the practical well-borer to possess a knowledge of the topography and geology of the region to be prospected. This information enables him to predict, with a considerable degree of certainty, not only the different

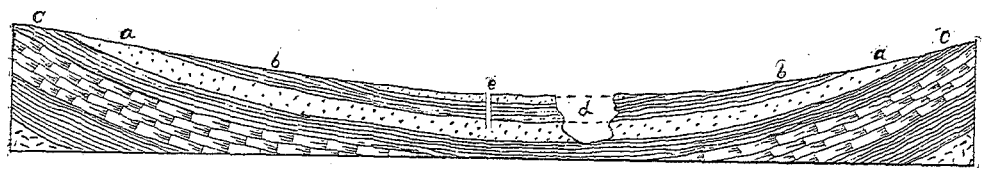
[1] See fig. 4.

formations to be penetrated, but also the practicability of securing water, at reasonable depths. The lack of such knowledge has frequently caused the expenditure of large sums of money, in fruitless efforts to obtain flowing artesian water, at places, where the geological structure shows that it cannot possibly exist.

CONFINING STRATA

The confining strata consist of clay, shale, marls and other deposits made up of exceedingly fine grains. The particles of these

Fig. 5



Section through the Underlying Rocks of a Basin, Showing Unfavorable Conditions for Successful Artesian Wells. a. Water-bearing Stratum. b. Confining Stratum above. c. Confining Stratum below. d. A Gorge Cutting the Upper Confining Stratum, and Allowing the Water to Escape in Springs at a Lower Level, than the Surface at the Mouth of the Well, e.

beds are so closely united, that there is no space between the individual granules, for the free circulation of water. The clays are the most impenetrable to water, of all confining strata, and are, at the same time, the most continuous. They are practically impervious, even under great pressure, and often extend, as unbroken beds beneath extensive areas. Shales, which differ from clay, chiefly in being indurated, or in a hardened condition,

also form important confining beds. These deposits, however, are liable to be jointed and fissured in the process of consolidation; and, for this reason, they are not so impervious as the clays. Marls, sandy clays and clayey limestones each form confining strata, of more or less impermeability; but, as they are of a somewhat porous nature, much of the water, confined by them, frequently escapes by leakage. Especially is this true, if the water be under great pressure. In all instances, where successful artesian wells are obtained, there must be at least two of these impervious beds, one of which lies above, and the other, below, the water-bearing stratum. Should either of these become fissured, or otherwise discontinuous, from any cause, the confined water escapes by leakage, and appears at the surface, forming springs.[1]

RAINFALL

The quantity of water, obtained from any given system of artesian wells, can never exceed the amount of rainfall, which enters the water-bearing stratum at its outcropping. Water, falling upon the surface of the earth in the form of rain, disappears by evaporation; is carried off by surface drainage; or is taken up by the porous soils. Only that portion of the rainfall, therefore, which is absorbed by the soils, has any direct bearing on the question of artesian wells. The amount of rain, taken up by any soil, depends upon its porosity, and its surface inclination; and, also, upon the rapidity, with which the rain descends. If the surface of the

[1] See fig. 5.

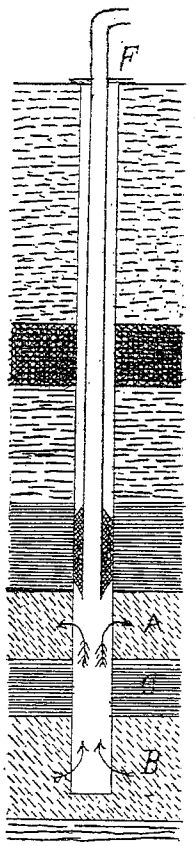
soil is nearly horizontal, and is made up largely of sand, it will absorb a high percentage of the total rainfall. But, on the other hand, if the surface slopes at a considerable angle, and the soil consists largely of clay, the greater part of the water will be carried off, by surface drainage. Furthermore, when the rain falls in heavy showers, the pores of the soil, however large, become overgorged, and much of the water escapes, in rills, to the adjacent brooks; whereas the same soil will absorb nearly the entire rainfall of more gradual showers. Thus it is, that heavy showers flood our streets and swell our brooks. It is impossible to state, with any degree of accuracy, the relative amount of the total rainfall actually absorbed by the soils; however, where the above conditions are most favorable, it is probable that a greater part of the entire precipitation is absorbed. Even when there is only a small percentage of rainfall taken up by the soils, the total amount, when collected over extensive areas, is enormous. Some idea of the vast quantity of water annually precipitated may be gained from the following statement: — The city of Atlanta consumes daily about 5,000,000 gallons of water. Yet, the average total daily precipitation, within the city limits, annually, exceeds this amount, many times. In other words, the most densely populated portion of the city does not use as much water, annually, as falls in its streets and upon its housetops, during the same interval. If only a thousandth part of such rainfall could become available for artesian wells, it would be ample, to supply the most thickly populated portion of the State, with abundance of water, for all domestic purposes.

UNSUCCESSFUL WELLS

The main cause of unsuccessful artesian wells is due chiefly, of course, to the absence of the required water-bearing strata. This, however, is not always the case. Frequently, such water-bearing beds exist; and they may even be penetrated by the *wet process* of well-boring, without giving any marked indication of their presence, at the surface. This point is admirably discussed, and is well illustrated, by Prof. Chamberlin, in his excellent paper on artesian wells, published in the Fifth Annual Report of the United States Geological Survey. In speaking of the defective flows of artesian wells, Prof. Chamberlin says: — 1. "Suppose that two porous beds, A and B (fig. 6), separated by an impervious layer, are traversed, and the testing of the first has been neglected, either because it failed to give encouraging indications or for other reasons. It is now desired to test these. Suppose the seed-bag or rubber packing be placed above the upper one. Now, if both bear a water-level equally high, the test will be fairly made, and the result will indicate their combined capacity; or, if both heads are at least as high, as the surface at the well, the test may be accepted. But suppose that the bed A has been cut into by erosion, or been reached by crevices, or is otherwise defective, while the other, B, remains intact and bears an elevated fountain head. Under these conditions, the water may flow from B, through the bore into A, and escape laterally through it, as illustrated in the figure. Now, in this case the result may be either simply negative, or positively false and misleading. If the lateral leakage through the stratum A effectually disposed of the flow from B, and there was no leakage in the upper portion of the well, the water in the test-tube would stand during the test at es-

sentially the same height as before, and the result would be negative, merely failing to indicate a possibility that really existed. If, on the other hand, there was lateral leakage through the upper strata, as well as through A, neither alone being quite competent to dispose of the flow from B, then the introduction of the test-pipe would cut off the upper leakage, leaving the bed A unable to dispose of the entire flow. In this case, there would be a rise of water in the tube, and, possibly, a flow. The mischievousness of a test of this sort lies in the fact that it appears to be a true test, because it shows some result, while in reality it is false and misleading. The true test in this case can only be made by placing the packing between the porous beds A and B.

Fig. 6

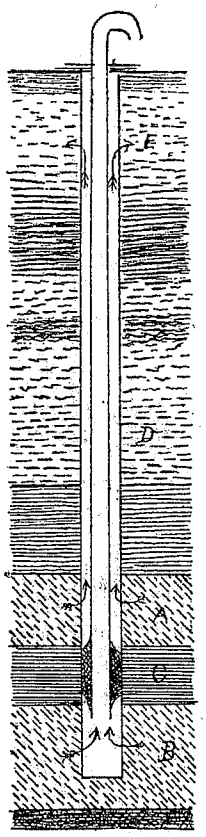


Section of a Well Illustrating a Negative Test (After Chamberlin).

2. Take another instance where two porous beds, as A and B (fig. 7), have been traversed. Let the packing be placed between these. Then (1), if A equals B in productive capacity, water will stand at the same height within and without the test-pipe *if there is no leakage in the upper beds.* (2) If the failure to flow was due to such leakage, then a flow will result from B, but the additional flow which might be secured from A, is lost (See figure). (3) If A has a greater head than B, and there is no loss above, the water in the test-pipe will actually be lower than that outside, as illustrated in figure 8. This may be said to be an *inverted test*, and is less misleading than the false and negative tests, since it plainly indicates an error of manipulation. I have known such a case of reduced head as the

result of an attempted test. (4) If, however, there is in this case considerable lateral waste in the upper strata, the valuable flow from A will be lost, just as before the test was made, while B may give a rise in the tube, or even a flow, which would foster the impression, that a fair test had been made, while in reality the greater flow has been lost. (5) If A gives a feebler flow than B, but has an equal head, the test will fail of being completely satisfactory only in excluding the feebler flow from A. (6) If, however, A has a lower head, and is a possible means of escape for the flowage from B, then the packing has been placed at the right point, and the test gives the best results.

Fig. 7

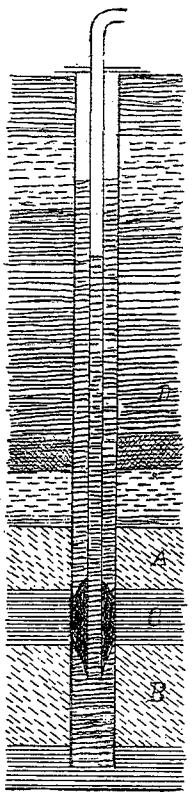


Section of a Well, Showing Partial and Misleading Tests (After Chamberlin).

3. In still another case let A and B represent porous beds (fig. 9) the lower of which is so conditioned as to drain the upper one by virtue of a lower outcrop. (1) First, if the drainage-loss below is not complete, and if the packing is placed above A, as shown in figure 9, I, the result will be negative, if there is no leakage in the upper strata. (2) Should there be considerable loss there, it will be cut off by the tube and packing; and some rise in the tube will be the result, in most cases. In either instance, the result is misleading, particularly in the last; because the small rise of the water is apt to allay any suspicion, as to the effectiveness of the test. The real fact, however, remains that the flow from the productive stratum is mainly lost below. (3) Suppose that the package is located between A and B, as in figure 9, II,

it will then shut off the flow from A, while that in B, because of a lower outlet, will fail to flow. Now, if there is opportunity for lateral leakage in the upper strata the water from A will rise in the well *outside* of the test-pipe, and pass off into these open upper beds. (4) But, if no such opportunity is afforded, it may rise to the surface and overflow *outside* of the test-pipe, while the water within the test-pipe will probably be found to be lower, than before the test was made. The proper method of testing wells known or suspected to present these conditions is to sink a simple bag of seed or other obstruction to a point in the impervious stratum between A and B, which, when it tightens in its place, will shut off the flow below. Then a tube with packing sunk to a point above A, will effectually cut off all leakage in the upper strata, and the full capacity of the water-bed, A, will be tested."

Fig. 8



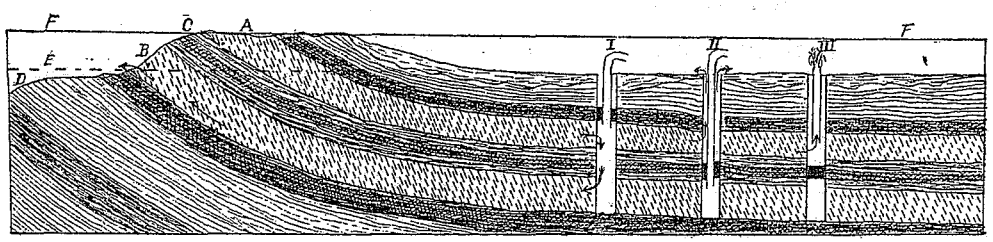
Section of a Well, Illustrating an Inverted Test (After Chamberlin).

LIFE OF ARTESIAN WELLS

It is the prevailing opinion among persons, unfamiliar with artesian wells, that they, like natural springs, will continue to furnish water for an indefinite period, without a diminution of flow. Such, however, is an erroneous idea. It is a rare thing, that a well furnishes a continuous flow, for many years, unless the pressure be unusually high. There are several causes, which tend to cut short the life of artesian wells, besides the actual decrease of the water-supply. The most important of

these are the decay of the casing and the accumulation of sand, or other foreign material, in the bore-hole. All wells, unless they penetrate solid rock or tough tenacious clays, have to be cased with iron piping, in order to keep the sand, or other loose material, from falling in, and closing up the bore-hole. In sinking a well through sands and other friable deposits, it is customary to drive the casing down, as the drill descends, so that, when the bore-hole is completed, it is cased to the bottom, and the water flows directly to the surface, without coming into immediate contact with

Fig. 9



Section of Strata and Three Wells, Showing One Correct and Two Erroneous Tests. These Wells Are Assumed to Be Independent of Each Other, and Are Placed Together on the Diagram Merely for Convenience (After Chamberlin).

the overlying strata. The casing, used for this purpose, is usually made of wrought-iron, in sections, from ten to fifteen feet in length, which are screwed into each other, forming water-tight joints. As these pipes are only a fraction of an inch in thickness, they undergo decay, in a few years, and have to be renewed; otherwise, the falling in, or the creeping of the walls of the bore-hole, stops the flow, and the well has to be abandoned. The length of time, that a casing will last, is quite variable, depending largely upon the character of the minerals, held in solution by the waters. If the waters are almost chemically pure, the casing may last, for many years; but, if, on the contrary, they contain hydrogen sulphide

and other rapidly corroding gases, the casing has to be frequently renewed.

The most fruitful cause of trouble, in flowing artesian wells, is the accumulation of sand in the lower portion of the bore-hole. This source of annoyance increases, as the pressure of the water in the well decreases. That is, a well, having a small discharge and, consequently, a low pressure, is more liable to become obstructed with sand, than one, having a large discharge and a high pressure. Should the pressure be unusually high, and the well is not immediately cased after its completion, there is sometimes danger of the well's causing its own destruction. This is brought about, by an enlargement of the bore-hole, which produces an overdraught on the water-bearing stratum. Prof. Norton gives the following description of a well of this nature, put down at Belle Plaine, Iowa, in 1886:—"Local historians of the well, which they please to term 'the eighth wonder of the world', state, that the beginning of the trouble lay in the fact, that the driller attempted to use the force of the flow, in reaming out the two-inch bore, which he had put down, for want of a larger drill, to three inches, the dimension specified in the contract. This task, the water speedily accomplished, in the unindurated clays and sands; but, not stopping there, went on and soon enlarged the bore to over three feet in diameter. Through this shaft the water boiled up in a fountain, five feet in height (the press reports, giving several hundred feet, as the height of this fountain, were exaggerated), flooding the streets and yards, and covering them with sand. It is estimated, that from 500 to 1,000 car-loads of sand were discharged from the well. The quantity was certainly so great, that, only with the greatest effort, could the ditches be kept open, to carry off the water. Gravel and small pebbles of northern drift were thrown out, and some pieces

of fossil-wood, two and three feet long. The maximum flow of water was variously estimated at from 5,000,000 gallons to 9,000,000 gallons per diem. Two weeks after the well was drilled, Chamberlin calculated its discharge at 3,000,000 gallons, for the same period. The enormous flow rapidly drew down the head of the other wells, until it sank beneath the surface. The attempts, to case and control the well, continued from August 26th, 1886, the date, when water was struck, to October 6th, 1887, when the task was successfully accomplished.

"During this time, the well, 193 feet deep, devoured, as local historians tell us, 163 feet of eighteen-inch pipe, seventy-seven feet of sixteen-inch pipe, sixty feet of five-inch pipe, an iron cone, three feet in diameter and twenty-four feet long, forty car-loads of stone, 130 barrels of cement, and an inestimable amount of sand and clay."

As is stated above, the diameter of a well, also, has much to do with rapidity, with which the bore-hole becomes clogged. The smaller the diameter, the more rapidly will it be obstructed, other things being equal. For this reason, flowing wells should never be less than three or four inches in diameter. The decrease of flow, when due to the accumulation of sand in the lower part of the casing, usually takes place gradually, and often extends through many months, before there is a complete cessation. In such instances, it is necessary only to use the sand-pump, in removing the obstruction, in order to regain the former water-supply.

USES OF ARTESIAN WELLS

The original artesian well in the province of Artois, France, was put down, with the object of obtaining water, for domestic purposes. The majority of wells, now constructed, have a similar object in view. Nevertheless, there are also many wells put down for other purposes, such as irrigation, water-power and heating. Artesian wells, constructed for irrigation purposes, are confined chiefly to arid regions, where the amount of rainfall is insufficient, to supply the growing crops. In such districts, the total annual precipitation, in the form of snow and rain on the adjacent mountains and elevated areas, is frequently quite large. Part of this precipitation is taken up, by evaporation; part of it is absorbed by the upturned edges of the porous strata, which extend beneath the arid region below; and the remainder rushes down the mountain-side to the plain, where it, in turn, is either evaporated, or absorbed by the hungry, parched soils. The water, thus taken in, by the upturned edges of the porous strata and hungry soils, gradually descends by gravitation to an impervious bed, which it follows, beneath the arid region, and becomes the source of artesian waters. These catchment or intake areas are frequently a hundred miles or more, from the location of the well.

Artesian wells, constructed mainly for the purpose of irrigation, have long been in use, in the desert of Sahara. Many of the beautiful garden spots, in that arid region, called oases, with their luxuriant growth of palms, are said to be solely due to the supply of water from flowing wells.

China, Italy, Spain and the western part of the United States, each annually utilize large quantities of artesian waters, for irriga-

tion purposes. The most extensive system of artesian wells, in this country, used for irrigation, are to be found in the San Joaquin Valley, California; in the Great Salt Lake Desert of Utah; and in South Dakota.

When the artesian waters escape from the bore-hole with great force, or under a heavy pressure, they frequently generate sufficient energy to operate extensive machinery. This is often the case, when the fountain-head is at a much greater elevation than the well, as in the Dakotas. Mr. N. H. Darton, in his excellent report on the artesian wells of Dakota, says:—"These waters rise to the surface with pressures, which are often over 100 pounds per square inch, and, in a few instances, over 150 pounds. At a number of locations, this pressure is directly used, for power, to run large flouring mills, electric-light plants, sewerage pumps, and other machinery". In a few instances, attempts have been made, to utilize the pressure of some of the wells in South Georgia, for the purpose of operating machinery; but they have met with only a partial success.

It is a well known fact of geology, demonstrated by all deep wells and mines, that below the point of no annual variation of temperature, there is a gradual increase of heat, downward, averaging about 1° Fahr. for every 55 or 60 feet of descent. That is, a well, say 2,000 feet in depth, will furnish water having a temperature of 80° or 85° Fahr. For this reason, waters obtained from very deep wells always have a high temperature. The amount of heat, daily liberated from such wells, is often very great; and, in some instances, it has been utilized and made of pecuniary value. The high temperature of the water, from one of the Grenelle artesian wells, is utilized, in heating a hospital. Large manufactories in Würtemberg, Germany, are warmed by the same means. Erfurt, Saxony, and Paris, France, each have large gardens, kept at uniform temperatures by artesian wells.

CHEMICAL COMPOSITION OF ARTESIAN WATERS

Artesian waters are never chemically pure; but they always carry, in solution, numerous minerals, either in the form of solids or gases. The diversity in the chemical composition of such waters is as varied, as the chemical composition of waters, obtained from natural springs. The former, however, by reason of their high temperature and the great pressure, under which they are confined, usually contain a much higher percentage of minerals, in solution, than the latter.

The most common gases found in artesian waters, are ammonia, hydrogen sulphide and carbon di-oxide. The ammonia seems to be derived, mainly from the decomposition of organic matter; and, when it exists, even in very small quantities, the water is often condemned for drinking purposes. This is not due to the ammonia's being hurtful within itself, but its detection indicates the presence of disease-producing organisms. Hydrogen sulphide is frequently met with, in artesian waters, especially if the well penetrates the more recent geological formations. This gas has a very disagreeable odor, but it rapidly disappears, when the water is exposed to the atmosphere. Carbon di-oxide is present, in all underground waters; but rarely does it exist in sufficient quantities to be detected, except by chemical means. When it is present in large quantities, it forms a natural soda-water, which has an acid taste and aids digestion.

The most common solids, found in artesian waters, are the various carbonates, sulphates and chlorides, together with silica, alumina and iron. These several compounds, when present in unusual quantities, give rise to chalybeate, saline, magnesian and other mineral waters, many of which possess medicinal properties.

METHODS OF BORING ARTESIAN WELLS

The method, usually adopted, in boring deep wells through solid rock, is similar to the process applied by the quarryman, in removing stones from their natural ledges. It consists in penetrating the rock by means of a steel chisel, called a drill. This instrument, which has a sharp cutting edge of hardened steel, is struck by a hammer, or is raised and let fall with its own weight, thereby imparting to the rock, at one point, a series of sharp, heavy blows. Small fragments of the rock are thus removed, at each blow, and the drill slowly penetrates the rock, form-

Fig. 10

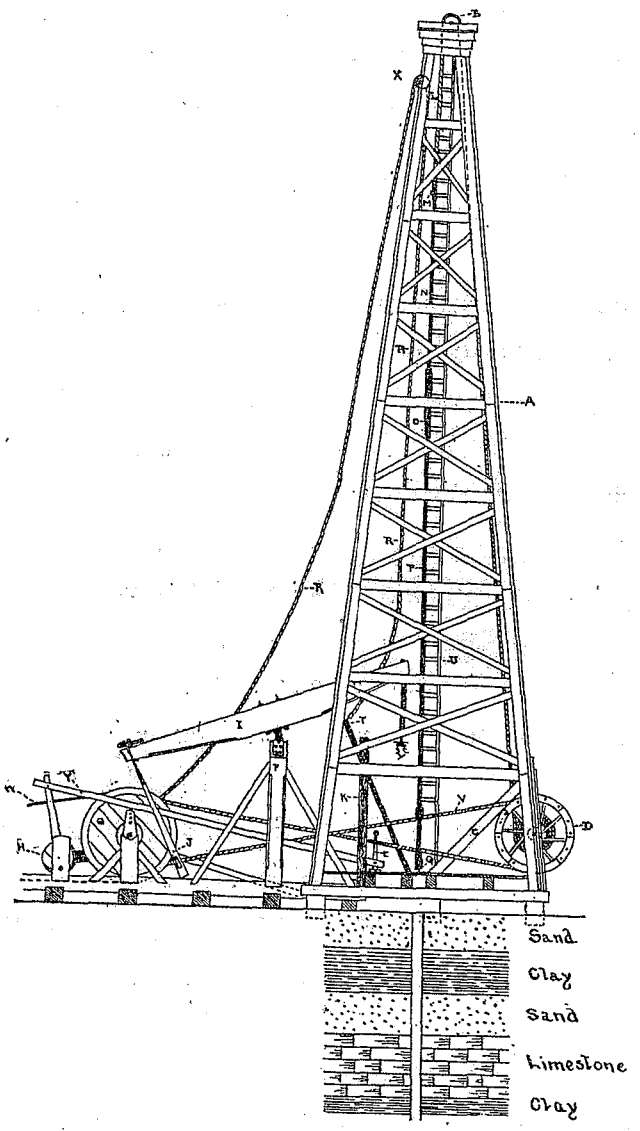
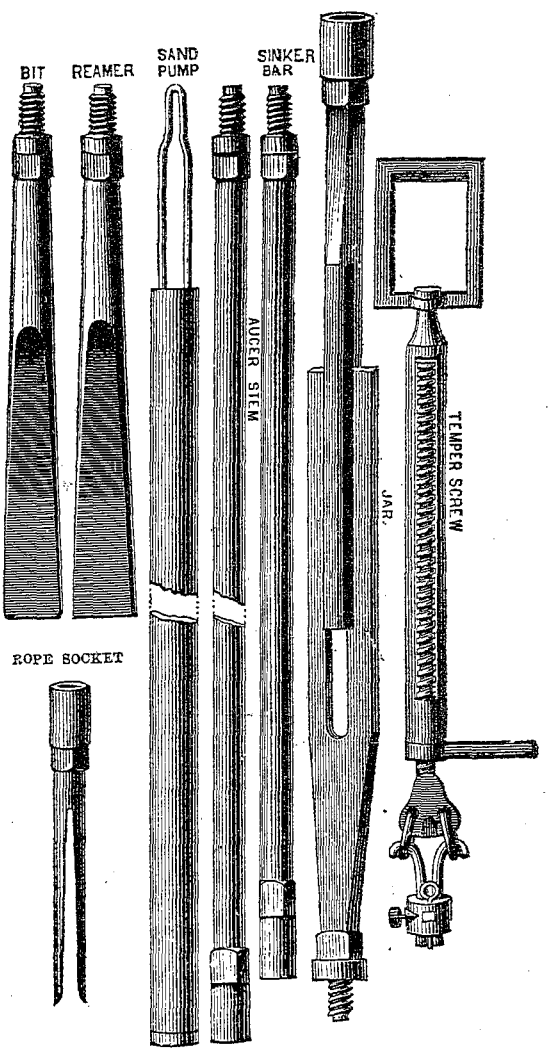


Illustration Showing Complete Artesian-Well Boring Outfit.

ing a circular hole. In boring deep wells for artesian waters, the boring tools are usually operated by steam-power, in the place of manual labor. A complete well-boring outfit consists of numerous tools and appliances, used only by the professional well-boring engineer. One of the first things to attract the attention of an observer, in approaching a well under construction, is the pyramidal frame-work, 30 to 57 feet in height, erected over the well.[1] This structure, known as the derrick, supports the pulleys, over which passes the cable, that is used, in removing and lowering the boring-tools in the well. The boring-tools consist of several parts, called the bit, the auger-stem, the jars, the sinker-bar and the rope socket. The bit is the chisel-shaped piece of steel, forming the cutting tool, attached to the lower end of the auger-stem. It varies in size, according to the diameter of the well to be bored, and can be readily detached from the auger-stem, when it

Fig. 11



Boring-Tools Used in Sinking Artesian Wells.

[1] See fig. 10.

needs repairing. The auger-stem is an iron rod, 20 or 30 feet long, uniting the bit with the jars, which is an ingenious device, consisting of two elongated links, having a play of several inches. One of the links is attached to the auger-stem, and the other to the sinker-bar. The one, united to the auger-stem, aids in giving the downward blow; while the other gives a sudden upward motion to the drill, which loosens the bit from the rock. The sinker-bar is an iron rod, several feet in length, extending from the jars to the rope-socket, which, in turn, is attached to the cable, used in raising and lowering the chain of tools into the well. The upward and downward motion is usually imparted to the boring-tools, by what is called a walking-beam, a ridged iron or wooden beam, working a pivot, operated by a crank, which is propelled by an engine or some other motive power.

Fig. 12

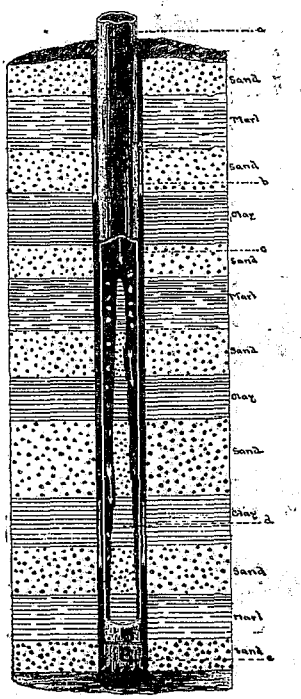


Diagram Illustrating the Hydraulic Revolving Process of Sinking Wells. a. Hollow Auger Stem. b. Water Exit. c. Water Inlet. d. Cone. e. Auger Bit.

The borings are removed from the well by a sand-pump. This is a long iron cylinder, with a valve in its bottom, opening upwards. When the sand-pump is lowered into the well, the borings, which are in the form of a liquid mud, rise into it, the valve closes, and the cylinder, with its contents, is elevated by means of a rope attached to its bail. There is another method of well-boring, now almost exclusively used in South Georgia, in deep-well construction. It is locally known, as the wet process, and it differs from the above described method, mainly in the manner of removing the

borings from the well. This is accomplished by forcing water, under a heavy pressure, down the hollow auger-stem to the bit, where it escapes through an aperture, and carries the loose fragments of rock etc. to the surface, through the open space between the auger-stem and the sides of the bore-hole. A third method, frequently used in boring wells in alluvial and unconsolidated deposits, is called the hydraulic revolving process. The boring apparatus, used in this case, consists of an iron-pipe, shod with a steel toothed cutting-edge at its base. As the pipe revolves, it cuts through the clays and sands leaving a cone in its center, which is washed out, by the water, forced into the pipe from the surface.[1] The principles, involved in this process, are identical with those used in the diamond drill, which is also sometimes used in well-boring.

THE COST OF ARTESIAN WELLS

The cost of artesian wells depends chiefly upon the character of the formations to be penetrated; the size of the bore-hole; and the depth of the well. If the formations penetrated consist of granite or other hard crystalline rock, the cost of actual boring will be many times greater, than if the formations were made up of sand, clay or other unconsolidated deposits. Only a few feet per day, at best, can be made, in the hard, crystalline rocks, with the best of outfits, under a skilled well-borer; whereas, fully as many rods can be accomplished in the same time, with less effort, in sands and clays. When the bore-hole is to be unusually large, it requires an

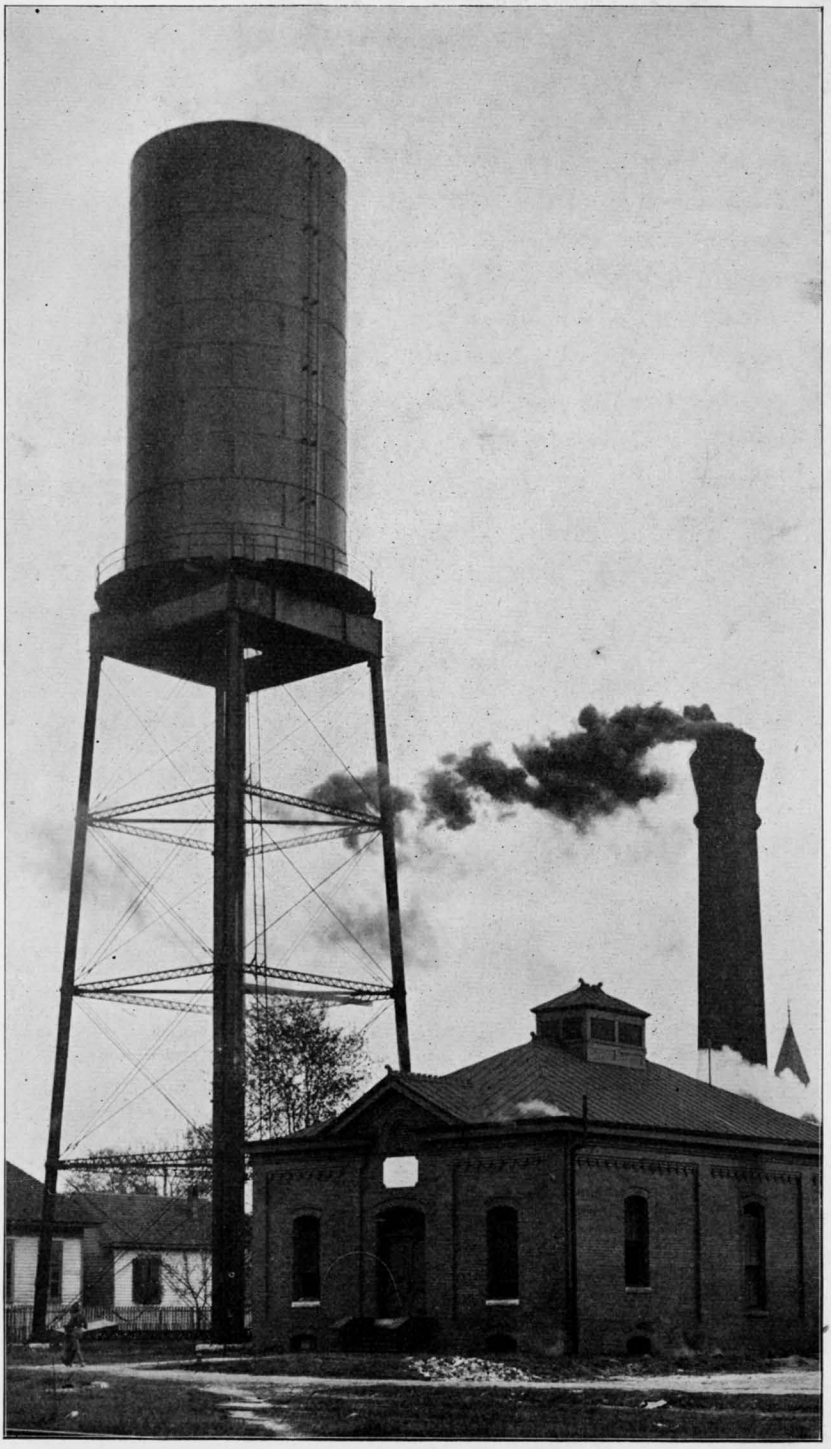
[1] See fig. 12.

enlargement of the boring-tools, which demands a corresponding increase of the motive power, used in driving the machinery. This difficulty is, however, sometimes overcome by first drilling a small hole, and, afterwards, increasing its size, by the use of the reamer. After a well has attained a depth of a few hundred feet, the difficulty of manipulating the boring-tools becomes greater; and, at the same time, the dropping of any portion of the drill in the well is more than likely to prove fatal. Portions of boring-tools, dropped into deep wells, frequently require great ingenuity and many weeks of labor, to remove them. It is said that, in putting down the noted artesian well at Grenelle, France, in 1841, a portion of the drill became detached, and dropped to the bottom of the hole, which had then attained a depth of 1,254 feet. To remove this obstruction from the well, required nearly fifteen months of constant labor.

Prof. Chamberlin, in discussing the cost of artesian wells, says:— "The driller, familiar with the general character of the strata of the region, demands an average price, depending on the depth. While this varies, an approximate idea of expense may be obtained by reckoning from $2.00 to $3.00 per foot for the first 1,000 feet, and an increase of a half a dollar per foot for each 500 feet below that, down to the limits practicable for boring. To this is to be added the cost of tubing, which will vary greatly with the situation and character of the strata".

Prof. Norton, in his report on the artesian wells of Iowa, gives the following notes on the cost of constructing artesian wells in that State: —

"The well at Anamosa penitentiary was constructed at the following prices, including casing, the penitentiary furnishing only coal and water and the work of two men: —



WATER WORKS PLANT AT ALBANY, GEORGIA.

From	1 to 1,200 feet		$1.75	per	foot
"	1,200 " 1,400	"	2.00	"	"
"	1,400 " 1,600	"	2.25	"	"
"	1,600 " 1,800	"	2.50	"	"
"	1,800 " 2,000	"	2.75	"	"

The Holstein well was constructed at the following scale: —

From	1 to 500 feet		$2.00	per	foot
"	500 " 1,200	"	2.25	"	"
"	1,200 " 1,500	"	2.75	"	"
"	1,500 " 2,000	"	3.00	"	"

The so-called artesian well in Atlanta, 8 inches in diameter, and 2,175 feet deep, was put down by the city authorities at a total cost, including machinery, of $34,000, an average of about $16.00 per foot. This well penetrated gneiss, its entire depth, which partially accounts for its unusual cost. The price, by contract, for 4-inch deep wells in South Georgia, including casing, runs from 75 cents to $2.00 per foot. These wells penetrate sands, clays and soft limestones, which reduce their cost to the minimum.

SOME NOTED ARTESIAN WELLS

The most noted deep wells of Europe are those of France, England and Germany. The wells of France are remarkable for their number, gigantic size and enormous flows. The Passy well of Paris, completed in 1857, attained a total depth of 1,923 feet. It has a diameter of 2⅓ feet, and furnishes, at a height of 54 feet above the surface, 5,588,000 gallons of water, daily. A still more

remarkable well is the mammoth well at La Chapelle, which has a diameter of 5½ feet, and extends to a depth of more than 1,000 feet below the surface. The well was put down, by means of a huge drill, weighing 4 tons, operated by a powerful steam engine, which imparted, to the boring instrument, 20 strokes per minute. The artesian well at Grenelle, in the vicinity of Paris, is also celebrated. This well, for many years the deepest in the world, was begun in 1834; and, after seven years of almost incessant toil and mishap, it was completed, having attained a depth of 1,798 feet. Near the bottom of the well, a large subterranean cavity was penetrated by the drill, from which, water, having a temperature of 82° Fahr., rose, with great force, to the surface, forming a perpetual fountain, many feet in height.

The most noted artesian wells of England are situated in the city of London, and along the east coast of Lincolnshire. In the early part of the present century, innumerable borings, from 100 to 400 feet deep, were put down in London, in order to secure water for domestic purposes. The water, thus obtained, was, for many years, one of the chief sources of supply to the city; but, owing to the large number of wells and the continual draught on the water-bearing stratum, the supply of each individual well has become greatly reduced; and, as a result, many of them, which formerly furnished large quantities of water, have since been abandoned, on account of the cessation of flow.

The artesian wells of Germany are quite numerous, and many of them are celebrated, for their remarkable depth and great size. The famous Sperenberg well, near the city of Berlin, has a diameter of 16 feet, to the depth of 280 feet, from whence it is continued to the unusual depth of 4,194 feet, with a diameter of 13 inches. The stratum, penetrated below the 280-foot level, consists

entirely of rock salt, which here attains a thickness of more than 4,000 feet. Probably the deepest well in the world, at present, is the well at Schladenbach, near Leipsic, completed a few years ago. It was extended to the extraordinary depth of 5,735 feet, nearly 1 ⅛ miles below the surface.

The successful completion of the deep wells of France and England, during the early part of the century, was soon followed, by attempts to obtain water, by deep-well borings in the United States. The earliest of these wells, to attract wide-spread attention, especially in the South, were the several borings at Charleston, S. C., begun more than 50 years ago. These first wells were only partially successful; and it was not until a quarter of a century afterwards, that they were put down to a sufficient depth, to secure the desired quantity and quality of water. The deepest of these wells are now sunk to the depth of nearly 2,000 feet, where a large quantity of wholesome water, having a temperature of 99½° Fahr., is obtained.

In 1858, ten years after the completion of the first artesian well at Charleston, a deep well was put down at Louisville, Ky. This well, three inches in diameter, was extended to the then unusual depth of 2,086 feet, where a strong flow was struck, furnishing daily 330,000 gallons of water, highly impregnated with mineral matter. Another notable well of the United States, and one that deserves special mention, on account of its great depth and early completion, is the deep boring at St. Louis, Mo., put down in 1868. The well has a total depth of 3,147 feet. The water is saline, and is unsuitable for domestic purposes.

It was during this decade, that the oil fields of Pennsylvania were attracting universal attention, and deep-well borings, which were seldom undertaken in this country, at once become a problem

of great economic importance. The well-boring industry now, for the first time, became a continuous and lucrative business. It soon attracted the attention of skilled engineers, whose ingenuity and patience overcame, to a great extent, many of the obstacles, previously encountered in deep borings, and thereby made it possible, to sink wells to great depth, at a greatly reduced cost. In these oil fields, were trained many of the engineers, who afterward went forth to all parts of the United States, plying their trade, in sinking deep wells, to obtain water for domestic, irrigation and various other purposes. The extent of the artesian-well system, thus established in the United States, probably now surpasses that of any other country. Their number, which already aggregates many thousand, is now being augmented each year, by the completion of hundreds of others. They are found in great numbers along the Atlantic sea-coast, from Maine to Florida. The Mississippi Valley is perforated by them, and they are common on the dry plains of the West. These wells vary, from a few rods to nearly a mile in depth. The deepest well in the country, at the present time, is one near Pittsburg, Penn., which has a total depth of 4,625 feet. Another noted deep well is the one at Wheeling, W. Va., completed in 1892. It attains a depth of 4,500 feet, and is remarkable, for containing little or no water below the 1,600-foot level, although it extends through nearly horizontal strata, more than half-a-mile below sea-level.

CHAPTER II

ARTESIAN WELLS OF SOUTH GEORGIA

TOPOGRAPHY

The artesian wells of South Georgia are confined to that portion of the State, lying south of an irregular line connecting Columbus, Macon and Augusta. The area, here included, called the Coastal Plain, embraces more than one half of the entire State. It is strictly an agricultural region, noted for its large yield of cotton and fruits, together with its extensive forests of long-leaf pine. The topography of the area, under consideration, differs but little from that of the northern extension of the Coastal Plain in the Carolinas and Virginia. It consists of a comparatively level country, having a gradual slope towards the sea. The surface is frequently diversified by low, well-rounded hills and ridges, or wide expanses of swamp lands. High bluffs and precipitous hillsides are often met with, in the vicinity of the large streams, producing a wild and picturesque scenery, not unlike that found in the more mountainous districts of the northern part of the State. Beautiful lakes, occupying depressions of former lime-sinks and old sloes, the abandoned beds of ancient streams, with their luxuriant growth of cypress and cane, are other common characteristic features of the Coastal Plain, along the Georgia-Florida State-line. The

streams are quite numerous, and are usually sluggish. Many of them, such as the Chattahoochee, the Flint, the Altamaha, the Ogeechee and the Savannah, carry large volumes of water, and are navigable, the greater part of the year, for steam-boats of considerable size. These streams occasionally have, on either side, high banks or bluffs; but, more frequently, they traverse low palmetto lands or swamps, which seem to be partly buried ancient valleys, cut by the streams, when the country stood at a higher level. As the coast is approached, the bluffs along the streams become less frequent, and the river-valleys or flood-plains, at the same time, increase in width. During the rainy season, these lowlands are frequently entirely submerged; and the rivers are often, thereby, increased to more than a mile in width. The silt, left by such overflows, adds fertility to the soil, which is admirably suited for the cultivation of rice.

Many of the smaller streams are evanescent, the water being absorbed by their sandy beds; or they disappear under ground in lime-sinks, during the dry season. In the more elevated areas, the small streams have considerable fall; and they sometimes flow in deeply eroded channels, with perpendicular walls. This is notably true of the small branches and creeks, where they enter the eroded valleys of the larger streams. The northern portion of the Coastal Plains, where it comes in contact with the Crystalline rocks, has an elevation of from 250 to 800 feet above tide-water, and shows a more advanced stage of denudation, than that portion of the Plain, lying further to the south. The streams have cut deeper channels, and the hills and ridges are more completely rounded. Extending off to the southward, from this more elevated region, are numerous low, flat, broad ridges, running parallel with the rivers. These seem to be the less eroded portion of a once practically level plateau.

Still further to the south, these topographic features become less marked; and they finally pass into a nearly level plain, occasionally carved into irregular hills along the larger streams. In the immediate vicinity of the coast, the surface becomes even more level; but, even here, sand-hills are sometimes seen, which add variety to an otherwise monotonous landscape. The rivers enter the ocean through wide bays and sounds, which are protected from the open sea by low, wooded islands, some of which, as the Cumberland, have an area of many square miles.

The following profiles of the several railroads of South Georgia will give a general idea of the topography of the region: —

RAILROAD ELEVATIONS

SAVANNAH, FLORIDA & WESTERN R. R.	
Station	Elevation [1]
Savannah	25.8
Little Ogeechee River	19.0
Crosstie, East End of Bridge	18.4
" West " " "	17.7
Bottom of River	9.8
Station No. 10	25.8
Burroughs, No. 12	17.8
Great Ogeechee Bridge	20.6
Bottom of River	9.8
Station No. 16, or Way's	21.1
Branch, 18½ Miles	22.2
Branch, 20½ Miles	22.6
Branch, 21¼	22.5
Mt. Hope Creek	23.3
Branch, 22½ Miles	24.2
Fleming No. 24	25.4

SAVANNAH, FLORIDA & WESTERN R. R. (*Continued*)	
Station	Elevation [1]
Branch, 25 Mile-post	23.0
" 26½ Miles	22.5
" 27½ "	22.3
" 29 Mile-post	22.1
" 29¼ Miles	22.3
McIntosh, No. 31	26.4
McIntosh Creek	22.8
Gauldin's Creek	29.6
Branch	31.9
" 38¼ Miles	102.6
Walthourville, No. 39	102.5
Branch	102.3
"	102.2
"	91.8
" 40¾ Miles	89.7

[1] In feet.

SAVANNAH, FLORIDA & WESTERN R. R. (*Continued*)

Station	Elevation [1]
Branch 41¾ Miles	74.3
Durham Creek	66.3
Johnston, No. 46	75.8
Jones Creek	52.6
Fountain Branch	50.8
Forrest Pond	51.2
Morgan Lake	51.7
Bottom of Lake	12.8
Water-surface of Lake	38.3
Altamaha River	75.9
High-water Mark	42.5
Mean-water surface	33.3
Bottom of River	21.3
Doctortown, No. 53	77.3
End of Cut	92.1
Jesup	102.9
" Warehouse	102.8
Turnout, No. 62	101.7
Dale's Mill, No. 67	140.0
Branch, 67½ Miles	126.8
" 68¼ "	121.8
Screven, No. 69	127.3
Turnout, No. 74	76.5
Offerman, No. 76	110.4
Patterson, No. 79	108.0
Turnout, No. 83	127.8
Blackshear, No. 87	125.8
Turnout, No. 89	141.0
Exeter, No. 93	96.8

SAVANNAH, FLORIDA & WESTERN R. R. (*Continued*)

Station	Elevation [1]
Big Satilla River	96.4
Bottom of River	68.8
Water-Level of River	71.8
Waycross, No. 97	140.8
Turnout, No. 99	147.1
Glenmore's, No. 103	112.1
Argyle, No. 116	164.2
Homerville, No. 123	179.8
DuPont, No. 131	184.1
Junction, No. 131	184.1
Stockton, No. 139	192.6
Naylor	195.6
Valdosta	218.8
Ousley	151.8
Quitman	176.7
Dixie	134.4
Boston	197.9
Thomasville	253.6
Cairo	242.4
Whigham	268.9
Climax	280.8
Bainbridge	113.6
Fowltown	292.8
Faceville	299.8
Recovery	192.8
Florida Railway & Navigation Co.	75.8
Chattahoochee	73.8
Pensacola Junction	74.8

[1] In feet.

WAYCROSS & JACKSONVILLE BRANCH
SAVANNAH, FLORIDA & WESTERN R. R.

Station	Elevation [1]
Waycross	140.8
Braganza	147.8
Fort Mudge	137.8
Race Pond	151.8
Uptonsville	87.3
Folkstone	83.8
Boulogne	73.8

BRUNSWICK & WESTERN R. R.

Station	Elevation [1]
Brunswick	17.8
Buffalo Swamp	7.8
Water-Level, Big Buffalo	3.8
Water-Level, Little Buffalo	3.8
Near Waynesville	53.8
Satilla River	18.8
Caney Bay	103.8
Big Creek, Water-Level	80.8
Waycross	140.8
Cox Creek	104.8
Waresboro	120.8
Dixonia Station	126.8
Poley Branch, Water-Level	123.8
Peach Creek, Water-Level	94.8
Gordonia	131.8
Duncan Branch, Water-Level	117.8
Red Bluff Creek	108.3
Branch, Red Bluff Station	147.3
Pearson Station	172.8
Kirkland	200.8
Westonia	196.8

BRUNSWICK & WESTERN R. R.
(*Continued*)

Station	Elevation [1]
Leliaton	203.8
Branch at 99 Mile-post	196.3
Pine Bloom	206.8
Willacoochee	222.8
Branch, 103 Mile-post	176.8
Willacoochee River	184.8
" "	179.3
Sniff Station	223.8
Allapaha River	121.8
Branch of the Allapaha River	241.8
Allapaha Station	268.8
Branch of the Willacoochee River	263.8
Branch of the Willacoochee River	259.8
Ridge, 116 Mile-post	388.8
Enigma Station	265.8
Henry's Branch, 119¼ Miles	248.8
Brookfield	306.8
Middle Creek	278.8
New River	282.8
Vanceville	290.8
Little River	303.8
Tifton	343.8
Branch, 130 Mile-post	304.8
Tucker Creek	255.8
Riverside Station	264.8
Little River	239.8
Hillsdale Station	303.8
Ty Ty Creek	275.8
" " " and Station	269.8
Sumner Station	350.8
Wiston Mill	351.8

[1] In feet.

BRUNSWICK & WESTERN R. R.
(*Continued*)

Station	Elevation [1]
Poulan Station	312.8
Warrior Creek	302.8
Hog-heaven	331.8
Isabella	341.8
Coleman's Station	354.8
Willingham Station	299.8
Acrosta Station	205.0
East Albany	186.0
Flint River Valley	154.0
Water-surface, Flint River	127.0
Albany	172.0

EAST GEORGIA & FLORIDA R. R. [2]

Station	Elevation [1]
Jesup	103.0
Cypress Flat	104.0
Pigeon Roost Swamp	95.0
Branch, 63 Mile-post	85.0
Buffalo Creek	66.0
Crossing, East Tenn., Va., & Ga. R. R. [3]	68.0
Turkey Swamp, 72 Mile-post	75.0
" " 72½ Miles	67.0
B. & W. R. R. Grade	73.0
College Creek	63.0
Little Satilla Swamp	61.0
Waverly Swamp	60.0
White Oak Swamp	60.0
Flowers' Swamp	56.0
Big Walker Swamp	61.0

EAST GEORGIA & FLORIDA R. R. [2]
(*Continued*)

Station	Elevation [1]
Little Walker Swamp	62.0
Rose Creek Swamp	71.0
Seal Swamp	61.0
North Fork of Crooked River Swamp	58.0
Crooked River Bottom	56.0
South Fork, Crooked River Bottom	55.0
Little Catfish Creek	56.0
Big Catfish Creek	44.0
St. Mary's Swamp	47.0
St. Mary's River, Low Tide	52.0

WESTERN & ATLANTIC R. R. [4]

Station	Elevation [1]
Atlanta	1,050.0
Simpson Street Crossing	1,025.6
Belt Crossing	969.7
Guano Works	937.8
Chemical Works	925.7
Bolton	848.3
Iceville	843.3
Joplin	837.6
Collins Brick-yard	851.6
Chattahoochee River, crosstie	833.0
Gilmore	900.2
Vining's Station	945.7
McIver's	967.0
Smyrna	1,068.4
Ruff's	1,065.6
Marietta	1,133.4

[1] In feet.

[2] Datum :—Reduced to Fort Pulaski by adding.

[3] Now a part of the Southern Railway.

[4] Datum :—Atlanta elevation, Union Depot, 1,050 feet above sea-level.

WESTERN & ATLANTIC R. R.[1] (*Continued*)

Station	Elevation [2]
Elizabeth	1,164.4
Big Shanty	1,107.8
Acworth	929.0
County Line	910.1
Allatoona Creek	877.7
Allatoona Station	879.6
Forty-one Junction	871.2
Bartow	847.8
Emerson	843.7
Etowah Junction	755.8
Etowah River	746.0
Cartersville	762.2
East and West Railroad Junction	748.0
Stream, 493 Mile-post	731.9
Rogers' R. R. Junction	740.0
Stream No. 40	744.0
" " 39	754.0
" " 38	758.9
Cassville	767.6
Stream No. 37	782.3
" " 36	759.9
Best's	750.0
Gaines' Mill	730.8
Two Run Creek, No. 35	729.6
Kingston	712.7
Cement	687.3
Hall's	787.8
Summit	800.1
Top of Grade	808.2
Oothcaloga River	734.3

WESTERN & ATLANTIC R. R.[1] (*Continued*)

Station	Elevation [2]
Stream, 68 Mile-post	708.3
Adairsville	722.1
Oothcaloga River	682.0
County Line	679.0
McDaniel's	669.9
Oothcaloga River	645.2
Calhoun	660.6
Resaca	657.5
Oostanaula River	657.4
County Line	659.3
Tilton	668.2
Beardsley	668.3
Stream No. 24	727.1
Dalton	773.2
Rock Face	782.2
104 Mile-post	783.3
Tunnel Hill	850.8
County Line	823.7
Greenwood	794.0
Catoosa	789.2
Ringgold	794.5
Graysville	711.0
State Line	715.0

GEORGIA, SOUTHERN & FLORIDA R. R.

Station	Elevation [2]
Station O	304.0
Switch	344.0
Southwestern Railroad	337.0
Macon & Birmingham Railroad	321.0

Datum :— Atlanta elevation, Union Depot, 1,050 feet above sea-level. [2] In feet.

GEORGIA, SOUTHERN & FLORIDA R. R. (*Continued*)

Station	Elevation [1]
River Swamp, North Edge	287.0
" " proper	283.0
" " proper	278.0
Macon & Birmingham Railroad	279.0
Last Lake	278.0
Ridge between River and Tobesofkee Creek	309.0
Creek Swamp	277.0
Ridge between Echeconnee and Tobesofkee Creeks	332.0
Ridge, Section-house, No. 7	363.0
Ridge, Section-house, No. 8	289.0
Avondale	339.0
Echeconnee Creek	253.0
Section-house, No. 14	298.0
Joe Frederick	286.0
Willston, No. 16	295.0
Sandy Reed Creek	280.0
Mrs. McBride's, No. 10	331.0
Section-house, No. 20	317.0
Ridge, 20½ Miles	344.0
Beaver Creek	292.0
Ridge, 23½ Miles	319.0
Sofkee Junction	335.0
Kathleen	318.0
Section-house, No. 26	290.0
Mossy Creek	258.0
Ridge between Big Indian and Mossy Creeks	288.0
Big Indian Creek	294.0
Limestone Creek	294.0

GEORGIA, SOUTHERN & FLORIDA R. R. (*Continued*)

Station	Elevation [1]
Hayneville Road	311.0
Section-house, No. 35	421.0
Top of Ridge, 35½ Miles	451.0
Holton Creek	400.0
Ridge, 38 Mile-post	426.0
Hawkinsville & Henderson Road	413.0
Big Creek	311.0
Ridge, 42½ Miles	410.0
John Croupler	400.0
Sub-grade, Macon & Bir. R'w'y	321.0
Section-house, No. 47	365.0
Fullington Mill	365.0
Vienna	319.0
Section-house, No. 58	336.0
Carnes Mill, 59½ Miles	342.0
Carnes Mill, 61¼ Miles	359.0
Georgia and Alabama R. R. Crossing	361.0
Cordele	388.0
Section-house, No. 67	375.0
Wenona, No. 69	394.0
Vinton, No. 70	400.0
Grady (?) Brown Place	443.0
Arabi Station	399.0
James's Saw-mill	398.0
Bedgood & Ryan	404.0
Pate's House	396.0
Section-house, No. 80	408.0
Deep Creek	350.0
Section-house, No. 81	384.0
Peckville	446.9
Marion, No. 85	451.0

[1] In feet.

GEORGIA, SOUTHERN & FLORIDA R. R. (*Continued*)

Station	Elevation [1]
Branch, 86½ Miles	409.0
Sycamore	397.0
Inaha Station	417.0
Bottom, 92 Mile-post	396.0
Brisham Road-grade	405.0
Cyclonetta	413.0
Wolf Pit	394.0
Section-house, No. 101	410.0
Section-house, No. 102	415.0
Brunswick & Western R. R. Crossing	373.0
Tifton Depot	379.0
Branch, 109½ Miles	361.0
Branch, 112¼ Miles	336.0
Hawell Mill	301.0
Laconte Station	307.0
120 Mile-post	272.0
121 Mile-post	276.0
Saw-mill and Still	275.0
122 Mile-post	273.0
123 Mile-post	276.0
Cypress Pond	261.0
Mill, 124½ Miles	247.0
Section-house, No. 125	253.0
Sparks Station	244.0
Troupville Road	246.0
Turkey Creek	241.0
127 Mile-post	249.0
Adel Station	252.0
129 Mile-post	248.0
130 Mile-post	240.0

GEORGIA, SOUTHERN & FLORIDA R. R. (*Continued*)

Station	Elevation [1]
131 Mile-post	246.0
Oxmoor Station	252.0
135 Mile-post	232.0
136 Mile-post	229.0
137 Mile-post	221.0
138 Mile-post	236.0
Vicker's Creek	211.0
Withlacoochee River	140.0
" " , Water-surface	124.0
Savannah, Florida & Western R. R. Crossing at Valdosta	219.0
Florida Midland R. R.	209.0
Center of Road-bed	205.0
Mike Bay	204.0
Mud Creek	176.0
154 Mile-post	203.0
155 Mile-post	204.0
156 Mile-post	190.0
157 Mile-post	182.0
Ulner's Mill	200.0
Long Pond	180.0
Lake Park	167.0
164 Mile-post	157.0
Wessenboke House	156.0
State Line	161.0
Tank, 171 Mile-post	151.0
Allapaha River	101.0
172 Mile-post	105.0
Savannah	46.0

[1] In feet.

CENTRAL OF GEORGIA R. R.

Station	Elevation [1]
Junction, Meldrim	39.3
Egypt	143.0
Oliver	140.0
Little Ogeechee	107.0
Halcyondale	112.0
Outland	110.0
Ogeechee Station	117.0
Horse Creek	136.0
Scarboro Station	157.0
Paramonis Hill	244.0
Ocains Branch	199.0
Ridge, 77 Mile-post	210.0
Millen Junction	156.0
Buckhead Creek	156.0
Rogers	162.0
Herndon	189.0
Sebastopol	201.0
Point, 98 Mile-post	207.0
Ogeechee River	205.0
Wadley Station	243.0
Bartow Station	237.0
Johnston Station	261.0
Davisboro	302.0
Sunhill Station	362.0
Tennille Station	477.0
Oconee Station	228.0
Toombsboro	237.0
Oconee River	221.0
McIntyre	264.0
Gordon	354.0
Pulaski	374.0
Griswold	476.0
Macon	310.0

CENTRAL OF GEORGIA R. R. (*Continued*)

Station	Elevation [1]
River Flat	300.0
Point, 163 Mile-post	300.0
Top of Ridge	481.0
Summit	475.0
Passenger Depot, Macon	377.0
Switch-back, M. & W.	401.0
Holt Place	584.0
Howards	485.0
Mims House	598.0
Crawford	621.0
Winn Road-crossing	669.0
Trammell's	590.0
Mrs. Thomas's	759.0
Collier's Station	781.0
The Jossey Estate	777.0
Gardner	857.0
Goggins Station	842.0
Goodwin's	905.0
Road-crossing, 232 Mile-post	933.0
Barnesville	903.0
Milner Station	894.0
Simms' Place	881.0
Gilbert Weaver's	882.0
I. Andrews'	944.0
B. F. Sorcircy	979.0
Cunningham	997.0
Thornton Station	915.0
Griffin	1,004.0
Cox Land	1,000.0
Pat Sullivan's	920.0
Ben. Barfield's	975.0
S. P. Campbell	937.0

[1] In feet.

CENTRAL OF GEORGIA R. R.

(*Continued*)

Station	Elevation [1]
G. Dorsey's	1,012.0
Lovejoy Station	1,002.0
J. McVickers	937.0
Jonesboro	995.0
Atlanta	1,085.0

GEORGIA & ALABAMA R. R.

Station	Elevation [1]
Meldrim Station	39.3
Black Creek	14.3
Ogeechee River	14.3
Ogeechee River, East Bank	30.3
Ogeechee River, West Bank	29.3
Cuyler	37.3
East Bank, Black Creek	45.3
West Bank, Black Creek	59.3
Road-crossing, 21¾ Miles	76.3
Section-house	74.3
Ellabelle	93.5
Malden Branch	58.5
Savannah Road Crossing	76.5
Toney Branch, 26⅓ Miles	63.5
Toney Branch, 27 Mile-post	69.5
Main Run	79.5
Pembroke Station	101.5
Savage Creek	96.5
Sam Baconfield's	110.5
Gin Branch	99.5
John Baconfield's	107.5
Harvey Branch	106.5

GEORGIA & ALABAMA R. R.

(*Continued*)

Station	Elevation [1]
Savannah Road Crossing	114.5
Dry Branch	107.5
Uphaupee Station	162.5
Cannouchee River	63.5
Conly Station	184.5
Mt. Vernon & Savannah Road Crossing, 45 Mile-post	180.5
Branch, 45½ Miles	155.5
Mt. Vernon and Savannah Road Crossing, 48¾ Miles	194.5
Mt. Vernon and Savannah Road Crossing, 49¼ Miles	196.5
Bull Creek Ch. Road Crossing	194.5
Haw Pond	201.5
Bellville Station	186.5
Branch, 54½ Miles	206.5
Manassas Station	217.5
Collins Station	238.5
Branch, 61¾ Miles	196.5
Bracewell Creek, 62½ Miles	168.5
Bed of Bracewell Creek, 64 Mile-post	184.5
East Side of Valley	128.5
Ohoopee River	99.5
West Side of Valley	115.5
Ohoopee Station	187.5
Branch, 69½ Miles	149.5
Mill Branch, 76¼ Miles	127.5
Pendleton Creek	110.5
East Side of Valley	140.5
West Side of Valley	138.5
Branch, 72 Mile-post	153.5

[1] In feet.

GEORGIA & ALABAMA R. R. (*Continued*)

Station	Elevation [1]
Branch, 72¼ Miles	160.5
Branch, 72½ Miles	160.5
Lyons Station	254.5
McLeod's House	253.5
Branch, 81 Mile-post	257.5
Branch, 82¾ Miles	249.5
Branch, 83¼ Miles	246.5
Black Creek	244.5
Rocky Creek	258.5

AUGUSTA DIVISION, CENTRAL R. R.

Station	Elevation [1]
Millen	157.5
Buckhead Creek	145.0
Road-crossing, 82¾ Miles	182.0
Lawton	225.6
Hines' Mill Creek	199.2
Road-crossing, 84¾ Miles	212.2
Road-crossing, 88 Mile-post	252.0
Long Branch	242.0
Branch, 89¼ Miles	255.0
Ridge, 89¾ Miles	275.0
Public Road, 90¼ Miles	263.4
Lumpkin Station	264.4
Branch, 91 Mile-post	252.0
Carter's Branch	253.0
Proctor's Branch	277.2
Ship Ridge	283.5
Pond's Branch	277.9
Thomas Station	285.7
Road-crossing, 96¼ Miles	300.7

AUGUSTA DIVISION, CENTRAL R. R. (*Continued*)

Station	Elevation [1]
Road-crossing, 97¼ Miles	302.2
McIntosh Creek	262.8
Waynesboro Station	286.7
Briar Creek	199.7
Green's Cut	284.9
McBean Creek	140.9
McBean's Station	134.6
Dickerson Canal	127.6
Little McBean Creek	117.2
McBean Mill	126.6
Barney Bluff	124.2
Valley, 119¼ Miles	122.1
Ridge, 120¼ "	140.9
Road-crossing, 121 Mile-post	133.6
Spring Creek	119.8
Allen's Station	139.2
Butter Creek	141.5
Passenger Depot, Macon	377.0
Starting Point	328.0
Tobesofkee Ridge	382.2
Tobesofkee Creek	313.0
Ridge, 198 Mile-post	396.9
Walden Station	390.6
Echeconnee Creek	303.1
Byron Station	515.6
Powersville	406.3
Fort Valley	531.3
Marshallville	500.0
Winchester	375.0
Montezuma	300.0
Flint River	303.1
Oglethorpe	313.0

[1] In feet.

SOUTHWESTERN DIVISION, CENTRAL R. R.

Station	Elevation [1]
Ridge, 249 Mile-post	398.0
Sweet Water Creek	366.0
Americus Ridge	469.0
Americus	350.0
Smithville Ridge	372.0
Smithville	319.0
Albany	184.4
East Albany	186.0

EUFAULA BRANCH, SOUTHWESTERN DIVISION CENTRAL R. R.

Station	Elevation [1]
Smithville	319.0
Kinchafoonee Creek	265.0
East Chickasawhachee Creek	334.0
Middle Prong of Chickasawhachee Creek	334.0
West Prong of Chickasawhachee Creek	312.0
100 Mile-post	362.0
Station, 292 Mile-post	326.0
Creek, 295½ Miles	283.0
Station, 298 Mile-post	379.0

EUFAULA BRANCH, SOUTHWESTERN DIVISION CENTRAL R. R. (*Continued*)

Station	Elevation [1]
Double Branch	387.0
Pachitla Creek	340.0
Cuthbert Depot	432.0
Railroad Junction	469.0
125 Mile-post	274.0
Station, 319½ Miles	235.0
Stream, 321 Mile-post	212.0
Station, 324 Mile-post	289.0
Tobenannee Creek	214.0
Georgetown Depot	189.0
Near River, 332½ Miles	178.0
Beyond River, 333 Mile-post	199.0
Eufaula, Alabama	211.0

FORT GAINES BRANCH, SOUTHWESTERN DIVISION, CENTRAL R. R.[2]

Station	Elevation [1]
Junction 311 Mile-post	469.0
126 Mile-post	424.0
Samocheehabbee Creek	161.0

[1] In feet.

[2] Datum:—Reduced to Fort Pulaski, Mean Low Tide, by adding constant 86 to all elevations.

NOTE.—It is impossible to harmonize the data of all railroads, centering in Macon; because the points, whose elevations are given, cannot be definitely located and united, by a line of levels. These elevations have been tied, when possible, in regions of level ground, rather than in the hills of middle Georgia, where a slight error in location would make a discrepancy of several feet in elevation. Waycross, Valdosta, Tifton, Albany, Smithville and Thomasville have been chosen for the tie-points; but harmony, at the above named places, causes discrepancies at Macon and Atlanta, that can be explained, only on the theory of gross errors in working out the levels in the original surveys.

FORT GAINES BRANCH, SOUTHWESTERN DIVISION, CENTRAL R. R.[1] (*Continued*)

Station	Elevation [2]
Fort Gaines	252.0
Fort Valley	531.0
Flint River	337.0
Reynolds	433.0
52 Mile-post	506.0
Butler Station	650.0
Station, 250 Mile-post	666.0
Bostick	669.0
Geneva	600.0
Upatoie	432.0
Upatoie Creek	413.0
Keaton	382.0
Station, 267 Mile-post	382.0
Far River	382.0
Kendall's Mill	392.0
Cox Creek	397.0
Station, 273 Mile-post	460.0
Randall Creek	313.0
Station, 276 Mile-post	460.0
Dozier Creek	439.0
Bull Creek	378.0
Station, 281 Mile-post	322.0
Columbus	262.0

MACON & DUBLIN R. R.

Station	Elevation [2]
2 Mile-post, Macon & North. R. R.	516.0
Swift Creek	536.0
Branch, 5 Mile-post	538.0

MACON & DUBLIN R. R. (*Continued*)

Station	Elevation [2]
Bottom of Swift Creek	512.0
Cut, Crosstie, 5¼ Miles	545.0
" Ground surface	575.0
Bottom of Branch, 7 Mile-post	539.0
" " " 8¼ Mile-post	570.0
Branch, 9 Mile-post	575.0
Branch Bottom	564.0
Dry Branch Station	589.0
Branch Bottom	659.0
1st Large Cut, 12 Mile-post	723.0
Ground-surface	769.0
2nd Large Cut, 12½ Miles	752.0
Ground-surface	793.0
Pike's Peak Station	755.0
Branch Bottom, 12¾ Miles	713.0
Fitzpatrick Station	762.0
Branch, Ground-surface, 17¾ Miles	738.0
Branch, 18¾ Miles	767.0
Branch Bottom	751.0
Macon Road Crossing	745.0
Allentown Road Crossing	752.0
Jeffersonville Station	747.0
Road-crossing	734.0
24 Mile-post	710.0
Branch, 26½ Miles	634.0
Palmetto Creek Bottom	591.0
Gallimore Station	594.0
Turkey Creek, 29 Mile-post	575.0
Hughes Station	572.0
Allentown Station	651.0
Montrose Station	612.0

[1] Datum:—Reduced to Fort Pulaski, Mean Low Tide, by adding constant 86 to all elevations.

[2] In feet.

MACON & DUBLIN R. R.
(*Continued*)

Station	Elevation [1]
Elsie Station	546.0
Branch, 44 Mile-post	516.0
Turkey Creek, 46¾ Miles	439.0
Spring Branch Bottom	424.0
Moore Station	479.0
Dublin	452.0
Moore Street, Dublin	442.0
Lawrence Street, "	442.0
Jefferson Street, "	440.0
Oconee River Bluff	413.0
High-water Mark	400.0
West Bank of Oconee	394.0
Bottom of Oconee	362.0
East Bank of Oconee	396.0
12 Mile-post	772.0
13 " "	773.0
14 " "	772.0
15 " "	764.0
16 " "	783.0
17 " "	761.0
18 " "	765.0
19 " "	749.0
20 " "	764.0
21 " "	751.0
22 " "	750.0
23 " "	732.0
24 " "	710.0
25 " "	662.0
26 " "	598.0
27 " "	586.0
28 " "	575.0

MACON & DUBLIN R. R.
(*Continued*)

Station	Elevation [1]
29 Mile-post	632.0
30 " "	664.0
31 " "	658.0
32 " "	643.0
33 " "	632.0
34 " "	632.0
35 " "	602.0
36 " "	608.0
Ravine, 55 Mile-post	409.0
Shaddock Creek	404.0
Mt. Vernon Road	408.0
Pugh's Creek Bottom	404.0
Branch, 67¾ Miles	445.0
Branch, 68½ Miles	509.0
Blackville Road	512.0
Alligator Creek	500.0
Branch, 72¼ Miles	495.0
" 73 Mile-post	484.0
Road, 74½ Miles	460.0
Branch, 75¼ "	453.0
Road, 77¼ "	457.0
Pendleton Creek	440.0
Branch, 78 Mile-post	442.0
Ridge, 80 Mile-post	489.0
Branch, 80 Mile-post	452.0
Red Bluff Creek	420.0
Ridge, 82 Mile-post	474.0
Branch, 82¼ Miles	449.0
Branch, 83 Mile-post	441.0
" 84½ Miles	461.0
" 86 Mile-post	477.0

[1] In feet.

MACON & DUBLIN R. R.
(*Continued*)

Station	Elevation [1]
Branch, 88¼ Miles	411.0
" 89½ Miles	377.0
Low Grounds	366.0
Bottom of Ohoopee	354.0
Righ-water Mark	372.0
Ridge, 94 Mile-post	440.0
Jack's Creek	356.0
Branch, 97¼ Miles	371.0
" 97¾ "	388.0
Ridge, 98½ "	428.0
Branch, 98¾ "	400.0
Ridge, 99¼ "	421.0
Branch, 99½ "	400.0
Ridge, 100½ "	465.0
Road, " "	460.0
Wolf Creek	484.0
1st Ridge, 101½ Miles	453.0
2nd " " "	453.0

MACON & DUBLIN R. R.
(*Continued.*)

Station	Elevation [1]
1st Branch of Wolf Creek	429.0
Branch, 103½ Miles	395.0
Ridge Road, 105¼ Miles	419.0
Branch, 105½ Miles	397.0
Road, 106 Mile-post	398.0
Cannouchee River	344.0
High-water Mark	348.0
Branch, 110¾ Miles	354.0
Reidsville Road	360.0
10-mile Creek	336.0
Road, 115¾ Miles	376.0
" 123¾ "	364.0
Lot's Creek	305.0
Road, 129 Mile-post	350.0
Bullock's Bay	328.0
Bay Gall	310.0
Road, 133¼ Miles	320.0
Road, 134¼ "	319.0

[1] In feet.

GEOLOGY OF THE COASTAL PLAIN

That portion of the coastal plain, lying within the State of Georgia, has attracted the attention of Geologists, ever since the visit of Sir Charles Lyell, in 1846. However, no complete systematic survey of the entire region has, so far, been attempted. The most extensive geological report, that has been made of that portion of the State, was submitted by Dr. J. W. Spencer, formerly State Geologist of Georgia, in his first Annual Report, published in 1891. This report is confined, mainly, to that portion of the Coastal Plain, lying between the Chattahoochee and Flint rivers. Scattered through the various publications, on the Cretaceous and Tertiary formations, are to be found numerous references to these deposits, as they occur in Georgia; but the notes are usually very general, or are confined to well known localities. It is to be regretted, very much indeed, that so little is really known about the areal geology of this region, as it would greatly aid, in tracing out and locating, with a considerable degree of certainty, the exact geological horizon of the several water-bearing horizons.

The following geological section along the Chattahoochee river, made out by Mr. D. W. Langdon,[1] together with the accompanying map of the area between the Chattahoochee and the Flint rivers, by Dr. J. W. Spencer, gives a general idea of the nature, extent and mode of occurrence of the Cretaceous and Tertiary deposits, in that portion of the Coastal Plain:—

"The following section is down the river; but it is in geologically ascending order:—

[1] Geological Survey of Georgia — First Report of Progress, 1890-91, p. 91.

TUSCALOOSA SERIES

1 Light-green, highly micaceous sand, resembling weathered schist, which, but for occasional water-worn pebbles, might be taken for schist . . . . . 3 feet

2 Hard clay, stained by ferruginous matter, and breaking with a conchoidal fracture . . . . . 1 foot

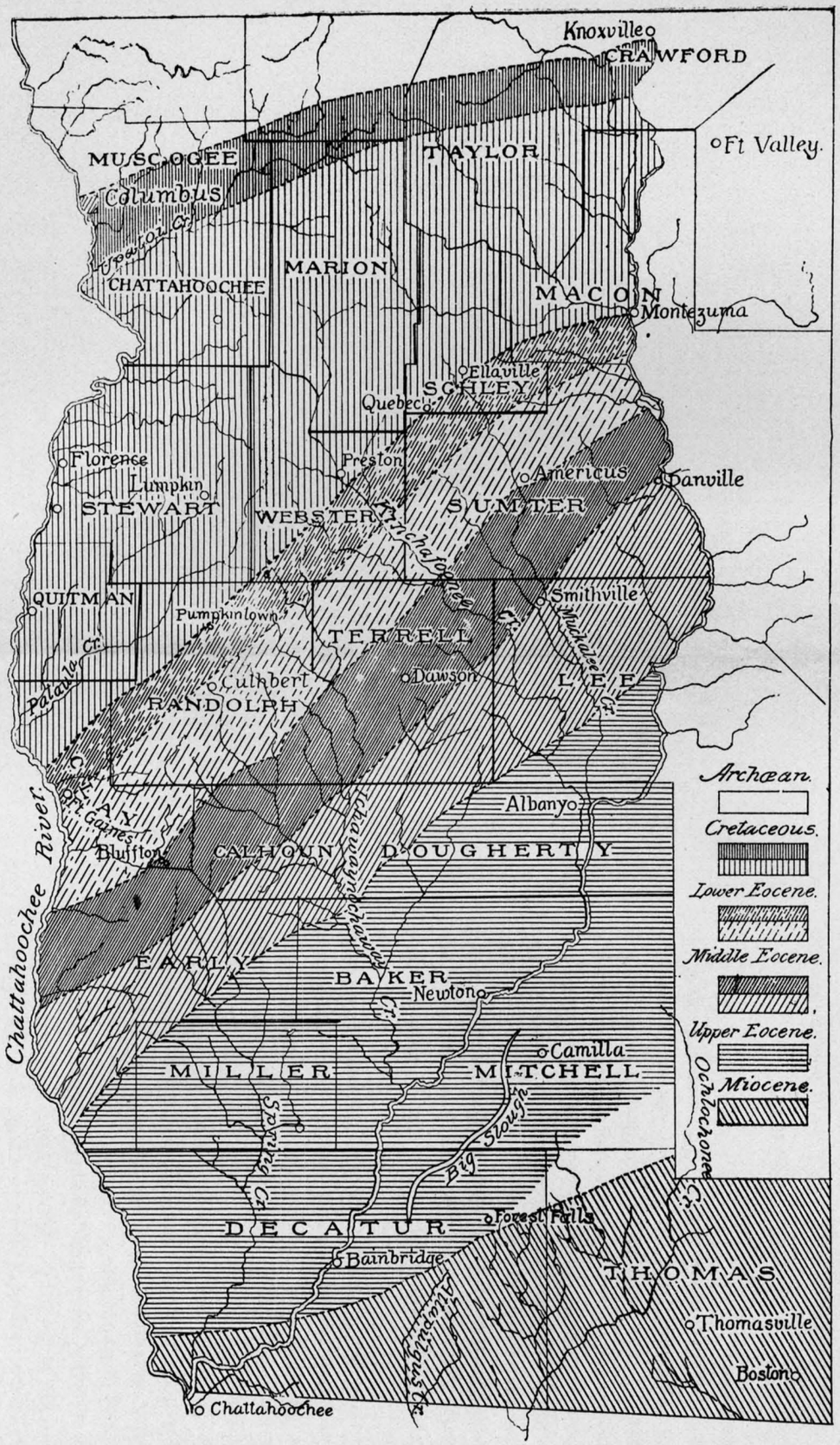
3 Hard, white, coarse-grained sand, held together by white clay 15 feet

4 Red and gray variegated sandy clays (typical Tuscaloosa), shows at water's edge, mouth of Bull Creek . . . . . .

EUTAW SERIES

5 Strongly cross-bedded coarse sand and pebbles, with some few fragments of schist, and just enough white clay to hold the mass together. The quartzose pebbles are all well water-worn; while the softer bits of schist are but slightly abraded. This stratum varies in color, from white to lemon-yellow, and, in places, green; while the upper part becomes purple and yellow, variegated. This last phase is most strongly developed at Thomas's Bluff, Georgia, due west of Fort Mitchell . . . . . 40 feet

6 Dark-gray calcareous sand, pyritous, and containing nodular masses, 6 to 12 inches in diameter, with calcite nuclei. These nodules are arranged in strata, about two feet apart, and terminate in an indurated stratum, about 12 inches thick. Small fragments of lignite are scattered about through this stratum, and one or two large masses filled with calcitized teredos are found. The only other fossils seen were an *Anomia* and an *Exogyra*,—probably the young of *E. costata* (Say). The fossils are all poorly preserved. Dip, at this point, 40 feet to the mile, southward . . . . . 15 feet



Map Showing the Distribution of the Cretaceous and Tertiary Formations of Southwest Georgia (By J. W. Spencer). Tuscaloosa Distinguished from the Remainder of the Cretaceous; the Midway, from the Remainder of the Lower Eocene; and the Buhrstone, from the Claiborne; all by Darker Shades.

7 Gray sand, of the same nature as the preceding, only no nodules were seen; and the shells increase in quantity, particularly in the lower part. The upper part of this stratum becomes more argillaceous and contains no fossils. Causes landslides in the banks, like the Black Bluff clays, which they resemble somewhat, physically. These sandy clays give rise to Uchee shoals . . . . . 100 feet

8 Laminated, dark-gray clays, with masses of yellow sand distributed, at irregular intervals, throughout the stratum; best developed just above the mouth of Uchee creek, Alabama . . . . . 25 feet

9 Yellow and white sand, with thin seams of lignitic sand, and an occasional "bunch" of gray, laminated clay. These sands are exposed in a bluff, about 100 yards from the river, just below the mouth of Rooney's Mill creek, Ga. . . . . 50 feet

10 Quartzose conglomerate, much like that at Havana, Hale county, Alabama. From the shoal at Beden's Rock, and the bluff at Hatcher's Landing, merges gradually into a yellow sand . . . . . 50 feet

11 Yellow sands and gray clay, containing bits of leaves. This stratum and the following are seen at Chimney Bluff, Ga. 60 feet

12 Light yellow and white sands containing beds of well-rounded quartz pebbles, sometimes 20 feet thick. Lignitized logs seen protruding from the bluffs. The sands contain a small *Exogyra* at rare intervals. The supposed top of the Eutaw group . . . . . 45 feet

RIPLEY SERIES

13 Gray, sandy, calcareous clay, with lines of boulder-like concretions projecting from the bank; first seen at Lawson's wood-yard. Few fossils occur in the lower part of this stratum, except *Exogyra costata*. A mile above Bluffton,

	Georgia, characteristic Ripley shells, mostly bivalves, are found in a much decomposed state, throughout the stratum, 6 to 8 feet thick. The uppermost ten feet of this stratum, highly fossiliferous. The river washes out little cave-like recesses in the banks. Near Jernigan Landing, Alabama, slight rolls in the strata are seen, involving about 20 feet of the sands; these miniature anticlinals and synclinals continue, to within two miles of Florence; the dip, estimated from the line of boulders, averages about 20 feet to the mile, and is normal in direction	120 fe
14	Two miles above Florence, and making a part of a bluff 50 feet high, at that place, is a gray sand, interlaminated with thin seams of more argillaceous sand, all of which is unfossiliferous. Dip about 40 feet to the mile	26 feet
15	Gray, calcareous sand, containing a small *Anomia*, and a line of hard, rounded, concretionary boulders	40 fee
16	Gray and yellow sands, resembling, in physical characters, those of the Tertiary at Lower Peach Tree, Alabama . .	30 fee
17	Gray, highly fossiliferous marl; the fossils are nearly, if not quite, all bivalves, and are mostly comminuted, as if they formed an ancient shore-line. There are numerous sharks' teeth, a hard, black substance in sections, resembling the under side of a turtle, black coprolitic pebbles and fragments of lignite	3 feet
18	Sandy stratum, indurated, and containing *Ostrea* sp. (?) . .	1 foot
19	Cross-bedded, gray sands and clays	15 feet
20	Fossiliferous marl, about the same in character as 17; only a little or no lignite was seen, the marl appearing to be somewhat glauconitic. (The strata, from 17 to 21 inclusive, form a bluff on the east side, five miles below Florence.)	2 feet
21	Gray, glauconitic, calcareous sand, weathering into fucoidal masses, and containing a few soft, white phosphate nodules	10 feet

22 Gray, fossiliferous marl, shells much decomposed. An occasional lignitized log, and the numerous slightly phosphatic nodular masses, containing fossils, occur in this stratum . 3 feet.

23 About the same in general character as 21, but contains indurated ledges about one foot to the mile, with numerous rolls; ends just above mouth of Cowikee creek . . . . 170 feet.

24 Soft, less coherent sand, gray in color, appears at the mouth of Cowikee creek, where the south bank of this creek, composed of this strata, may be seen to rise 50 feet from the water . . . . . 60 feet.

25 Gray, calcareous sand, with indurated edges, *Exogyra costata*, *Gryphæa mutabilis*, *Hamulus onyx*, *Plicatula urticosa*, *Anomia* (?), forms the shoal at Frances' bar and the bluff at Eufaula . . . . . 190 feet.

26 Light-gray and yellow sands, interlaminated with sand, darker in color, more argillaceous, and containing bits of lignitized leaves and twigs; no other fossils seen; crops out in the gullies of Eufaula, next below the drift . . . . . 20 feet.

27 A massive, gray sand, with a few fragile fossils and boulders. This sand is only slightly calcareous, and is more or less lignitic. Dip, here, about 150 feet to the mile . . . . . 40 feet.

28 A more calcareous sand, filled with *Exogyra costata*, and many indurated ledges, giving rise to the first bar below Eufaula . . . . . 70 feet.

29 Light-yellow, cross-bedded sands, between indurated ledges . 20 feet.

30 Calcareous *Exogyra* sands, with boulders . . . . . 50 feet.

31 Yellow sands and indurated ledges, filled with casts, *Exogyra costata*, and echinoderms set fast in the ledge. The sands are cross-bedded, and contain some lignitic streaks . . . 35 feet

32 Gray fossiliferous sands, with boulders; the sand is massive, and is fossil-bearing only in the lowest five feet . . . . 40 feet.

33 Brown, laminated argillaceous sand; disappears at the mouth of Pataula creek, Georgia . . . . . 5 feet.

.34 Light-yellow sand, and interstratified very irregularly, with a gray, micaceous sand, filled with friable Ripley fossils. Mouth of Pataula Creek . . . . . 30 feet

.35 Hard, sandy ledge, weathered surface jagged; contains *Exogyra costata* and echinoids; very light yellow in color; white, when dry and unweathered . . . . . 30 feet

.36 Gray sand, with indurated ledges; no fossils seen; merges gradually, in the upper part, into a dark, almost black, sand, containing large nodular masses, and interstratified with light yellow sands . . . . . 35 feet

.37 White, coarse conglomerate, the matrix material being calcareous. The quartzose pebbles decrease in size towards the top, and the stratum becomes more argillaceous; there are many casts, but all too obscure for identification . . . . 18 feet

.38 Massive blue clay; contains a few bits of teredo-eaten lignite (probably the top of the Cretaceous) . . . . . 6 feet

MIDWAY OR CLAYTON SERIES

.39 Massive sandstone, coarse-grained and almost a conglomerate 3 feet

.40 Light-yellow siliceous limestone, containing a large *Ostrea* and numerous obscure casts. Five miles above Fort Gaines, Georgia . . . . . 10 feet

.41 White calcareous sand, containing a few obscure casts and Ostreas. The sand sometimes becomes irregularly indurated, and is the source of small lime springs. Forms the lowest part of the bluff at Fort Gaines, Georgia, and, in its uppermost ten feet, contains pockets of white sand inclosed by black clay resting in "pot-holes" in the limestone. Estimated at . . . . . 200 feet

NANAFALIA SERIES

.42 Glauconitic sand filled with *Gryphæa thirsæ*, *Ven. planicosta* and *Crassatella* . . . . . 6 to 12 ft.

43 Gray, calcareous, sandy clay, containing boulders of clay and a few decomposed *Gr. thirsæ* . . . . . 15 feet

44 White and lignitic and cross-bedded sands, and sandy gray clay, containing one or two ledges of pseudo-buhrstone . 50 feet

45 Dark-gray argillaceous sand, with new fossils and fragments of water-worn clay balls. The lower part becomes more fossiliferous, containing *Osteodes caulifera*, *Ven. planicosta* and *Gr. thirsæ* . . . . . 6 feet

46 Greenish-gray, fine-grained calcareous sand, very firm, and holding decomposed shells, mainly bivalves . . . . . 6 feet

47 Coarse glauconitic sand, filled with large *Ostrea compressirostra*, *Ven. planicosta*, and a small *Pecten*, resembling the species occurring at Yellow Bluff on the Alabama river . . . . 3 feet

48 Cross-bedded sands, yellow, the bedding planes being marked by streaks of gray clay . . . . . 10 feet

49 Yellow and gray sandy clays, containing occasional beds of *O. compressirostra* and *Gr. thirsæ*. The indurated ledges which sometimes occur, seldom over two feet thick, are of the nature of pseudo-buhrstones and are filled with bivalves; the only exception being *T. mortoni* (large). This disappears below the surface at the mouth of the first creek flowing from the Georgia side, below Fort Gaines . . . 75 feet

TUSCAHOMA (OR BELL'S LANDING) SERIES

50 Light-yellow and gray sandy clays, containing, in the sandier portion, boulders much like those seen at Bell's Landing. No fossils seen. These are undoubtedly the Lower Peachtree clays and sands. They become more sandy on ascending . . . . . 170 feet

51 Light greenish yellow sands, filled with bits of decomposed shell and large *O. compressirostra* and *Ven. planicosta* . . 3 feet

An interval of fifty yards, and then,

BASHI (OR WOOD'S BLUFF) SERIES

52 Gray sand filled with decomposed fossils. An irregular, indurated ledge (non-fossiliferous) occurs in this stratum. This is probably Bashi, though the only fossil, that could be determined with any degree of accuracy is the small oyster so common at the typical locality . . . . . 18 feet

53 Blue clay, slightly sandy . . . . . 6 feet

54 Light-yellow siliceous (sandy) limestone, filled with casts and containing pockets of *O. compressirostra* . . . . . 18 feet

HATCHETIGBEE SERIES

55 Gray lignite sandy clay (Hatchetigbee) . . . . . 10 feet

BUHRSTONE SERIES

56 Coarse, white sand, containing *O. divaricata* and a few other friable shells in the upper part . . . . . 12 feet

57 Buhrstone, the first flexures since leaving Eufaula occur in the stratum: Rather sandy . . . . . 40 feet

58 Light yellowish green sand, containing numbers of small *O. sellæformis* . . . . . 45 feet

59 Buhrstone . . . . . 55 feet

60 Greenish-yellow calcareous clay, with a few decomposed fossils, and an occasional large *O. sellæformis* . . . . . 12 feet

CLAIBORNE SERIES

61 White sandy limestone with small *O. sellæformis* in abundance, and pockets of large sized shells. Makes capping edge to island at mouth of Omussee creek, where the bluff is about twenty feet high. This stratum is made up of alternate beds of hard and soft strata, all containing more or less of *O. sellæformis*. The harder strata weather out into root-like shapes, and are sometimes rather argillaceous.

Many return dips occur in this stratum, stringing it along the banks for many miles further than it would be normally. The dips are all steep, both ways, and many gaps in the succession are caused by the washing out of the softer beds. Owing to these gaps and return dips, it is rather hard to estimate the thickness of the stratum with much accuracy. It dips below the surface of the river, two miles below Gordon, Alabama, and is last seen on the Georgia bank. At Gordon, there is a very pronounced return dip, estimated at, and not exceeding . . . . . 60 feet

WHITE LIMESTONE SERIES

62 The *Scutella* bed, from the beginning, weathers so as to make it not possible to count up its thickness. It is literally full of fossils; mainly *Scutella Lyelli* and *Pecten nuperus*, with a few smaller and thicker Scutellæ. A bluff about twenty feet high occurs opposite the mouth of Sowhatchee creek, Georgia . . . . . 25 to 30 ft.

63 White orbitoidal limestone, seen first at Dougherty's wood yard, Georgia, and on the Alabama side, nine miles by river from Neal's Landing. This limestone contains numbers of echinoids about five miles above Neal's. The limestone continues as far as Miriam's Landing, at which place the thickness is . . . . . 200 feet

CHATTAHOOCHEE SERIES

64 Argillaceous and sandy limestone, alternating with strata of purer character. Contains a *Pecten* and an *Ostrea* very close to our recent Virginica. This may be termed the Chattahoochee group, as it is well developed there and along the eastern river bank for the next ten miles . . . 25 feet

ALUM BLUFF SERIES

65 Light-yellow sand, containing pockets of fossils. Where there are no shells, the sand is very calcareous. Fossils resemble those described by Conrad, as Miocene from York county, Virginia, and Maryland . . . . . 35 feet

66 Gray sand, slightly calcareous . . . . . 5 feet

67 Gray calcareous sand filled with shells. The leading fossil is a Mactra . . . . . 10 to 15 ft.

68 Black lignitic sand. This contains much pyrites, and from the efflorescence of ferrous sulphate, arises the name Alum Bluff. Varies with the preceding . . . . . 10 to 15 ft."

Besides the several deposits, here described, there are two others, which are of very great importance, especially from an agricultural standpoint. Both of these are superficial soil-forming deposits, covering more or less completely the entire surface of the coastal plain. They are known as the Lafayette and Columbia formations; and they have been extensively studied by Mr. W J McGee.[1] The Lafayette is the older of the two deposits; and it lies unconformably upon the eroded surfaces of the Cretaceous, Eocene and Miocene formations. It consists of orange and vari-colored clays and sands, with local beds of gravel, of limited extent. The total thickness of these various beds frequently aggregate many feet; and, in the more elevated areas of the Coastal Plain, they give rise to the red soil, which is well adapted for the cultivation of fruit, cotton, corn etc. Where the Lafayette formation is made up largely of clay, it forms an impervious, water-bearing stratum, which protects, to some extent, the eroded surfaces of the porous strata below. This condition no doubt exists, over a considerable part of

[1] The Lafayette Formation, by W J McGee. Twelfth Annual Report, U. S. Geol. Surv., 1890-91; Part I, p. 353.

South Georgia; and it must lessen, to some degree at least, the total intake area of the artesian-well system, for the entire Coastal Plain.

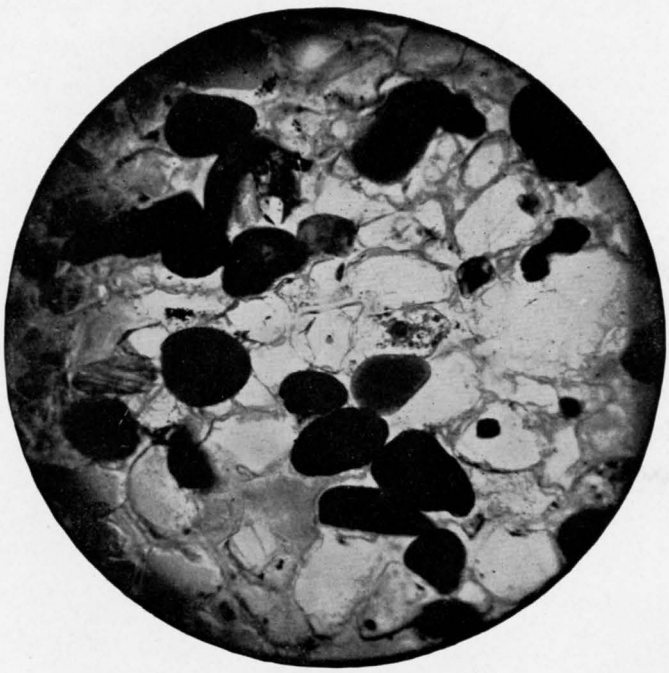
The Columbia formation, which overlies the Lafayette, is made up largely of sand. It varies from a few inches to several feet in thickness, and is the chief source of water-supply for many of the surface wells throughout South Georgia. The porous nature of this deposit enables it to take up a high percentage of the total rainfall. It thus acts as a reservoir, retaining the surface waters, until they can seep through, and enter the porous Cretaceous and Tertiary beds, which, further to the South, become the source of artesian-water supply.

HISTORY OF THE ARTESIAN WELLS IN SOUTH GEORGIA.

Soon after the completion of the first artesian well at Charleston, S. C., several attempts were made, in South Georgia, to obtain flowing wells, by deep borings. Col. John P. Fort, formerly of South Georgia, but now of Mt. Airy, informs the writer, that he recalls as many as six attempts to obtain artesian water in South Georgia, between 1840 and 1850. Some of these bore-holes attained a depth of 700 feet; but, for some reason, probably mismanagement, none of them ever furnished the desired supply of water. These unsuccessful attempts to secure artesian waters were, for a number of years, pointed out, as a conclusive evidence, that it was impossible to obtain flowing water, by deep borings in South Georgia. This opinion appears to have been generally accepted by the planters

throughout South Georgia; and no further attempts seem to have been made, to obtain water, by deep boring in that region, until 1881. It was during this year, that Col. John P. Fort sank the first successful artesian well in South Georgia, on his plantation, sixteen miles west of Albany. The well was commenced, with a very crude boring-outfit, in February; and, after six months of continuous labor and mishap, it was completed at a depth of 550 feet. The well furnished a copious flow of pure water; and thus was proved the practicability of obtaining artesian waters, in that part of the State.

Four years after the completion of the Fort well, Capt. D. G. Purse began an artesian well in Savannah. Capt. Purse, in speaking of this well, says:—"In 1885, in company with Col. J. H. Estill, I started the first artesian well in this section. It was bored upon a lot near Laurel Grove Cemetery, in the southwestern portion of the city. Before an artesian flow had been obtained, Col. Estill withdrew; and I continued the work at my own expense, until artesian water was obtained, at the depth of 450 or 500 feet, which arose within 18 inches of the surface. This well was afterwards bored 150 feet deeper; but the water remained at the same level." The successful completion of these two wells, in different parts of South Georgia, greatly stimulated well-boring throughout the entire region; and, ere long, many cities and towns, by deep borings, demonstrated that much, if not all of the Coastal Plain, was underlaid by porous beds furnishing copious water-supply. The total number of deep wells, now in use in South Georgia, is between two and three hundred, which number is being increased annually, by the completion of from 5 to 20 new wells.



MICROPHOTOGRAPH OF COPROLITIC PARTICLES IN SAND AND CLAY, FROM AN ARTESIAN WELL AT WAYCROSS, GEORGIA.

For description, see pages 77 and 78.

WATER-BEARING STRATA

There are several water-bearing strata, known to exist, at present, throughout the Coastal Plain of South Georgia; but the records of the wells are so meager, that it is almost impossible to trace out, with any degree of certainty, these several beds over extended areas. It is only along the coast, where the wells are numerous and where more or less complete records of the borings have been kept, that any attempt has been made to correlate the water-bearing strata of the several wells. By an examination of the section, extending from St. Mary's to Savannah,[1] it will be observed, that there are two water-bearing beds, separated by an impervious stratum from 75 to 100 feet in thickness, which continues, for many miles, along the coast. These beds dip at a very low angle, going southward from St. Simon's; but, north of this point, they seem to dip in the opposite direction, as far as Darien, where they again dip to the southward. This variation of dip appears to be due to a low, shallow basin, or buried estuary, at the mouth of the Altamaha river. The water, supplying the Savannah wells, probably comes from a different horizon, from that of the wells along the coast, further south. The two water-bearing strata at St. Simon's, together with another, of less importance, at a higher level, extend inland, for many miles, underlying the greater part of Camden, Glynn, McIntosh and Liberty counties. The lower stratum, which furnishes the chief water-supply of this area, continues, apparently, as far north as Millen,[2] where it becomes of minor importance. About three hundred feet below the last named water-bearing stratum

[1] See Section 1.

[2] See Section 2.

is another, which was struck near the bottom of the well at Egypt. It seems quite likely, that this latter stratum corresponds with the water-bearing bed at Millen and Savannah. However, the well-records were too meager, to verify this statement. In several other sections, here given,[1] no attempt has been made to correlate the various water-bearing strata, but only to show, in a general way, the profile of the Coastal Plain along certain lines, together with the relative depths of the various water-bearing beds, penetrated by numerous wells. It is to be hoped, that, in the future, more complete records of the well-borings will be kept; and that the extent of the water-bearing strata will be determined, throughout the entire Coastal Plain.

[1] See Sections 4, 5, 6, 7 and 8.

A LIST OF THE ARTESIAN WELLS

LOCATION	Elevation above Sea-Level	Depth	Diameter	Capacity per Minute	Height to Which Water Rises [1]	Depth of the Different Water-Bearing Strata	REMARKS
	Feet	Feet	Inches	Gallons	Feet	Feet	
St. Mary's	10	525	4	Many	+50	300 and 500	Sulphurous Water
Fernandina	21	640	8	800	+50	400 " 618	" "
Cumberland Island .	16	680	6	Many	+51	. . . . .	" "
" " .	50	600	4	"	+12	. . . . .	. . . . .
Kingsland	75 (?)	500	2	14	+20	. . . . .	. . . . .
"	. . .	475	2	60	. . . .	. . . . .	. . . . .
Woodbine	. . .	350	2	. .	+50	250 and 350	. . . . .
"	. . .	350	2	60	+40	250 " 350	. . . . .
Satilla Bluff	20	340	2	. .	+34	210 " 340	. . . . .
" "	20	350	2	75	+30	250 " 350	. . . . .
White Oak	5	450	4	300	+60	130 " 450	Sulphurous Water
Bailey's Mill	. . .	345	2	Many	+50	200 " 300	" "
Tarboro	20	360	6	"	+50	175 " 360	Two Wells
Brunswick	12	460	3	200	+28	350 " 460	16 Wells
"	12	460	8	Many	+28	350 " 460	
St. Simon's Island . .	15	438	6	250	+40	350 " 435	Used for Boiler Purposes
Jekyl Island	8	480	6	250	+45	260 " 475	" " " "

[1] The + sign indicates the height, to which water rises above the surface of the earth; and the — sign indicates the height, to which water rises below the surface of the earth.

A LIST OF THE ARTESIAN WELLS — *Continued*

LOCATION	Elevation above Sea-Level	Depth	Diameter	Capacity per Minute	Height to Which Water Rises [1]	Depth of the Different Water-Bearing Strata	REMARKS
	Feet	Feet	Inches	Gallons	Feet	Feet	
Bladen	15 (?)	480	3	100	+30	. . . . .	. . . . .
Evelyn	20	420	3	. .	+14	370	Sulphurous Water
Waycross	140	450	12	750	—60	300 and 670	. . . . .
Jesup	118	500	2	525	—(?)	285 " 500	Well not a Success
Darien	20	530	8	200	+15	500	Sulphurous Water
Wolf Island	5	500	2	. .	+45	. . . . .	" "
Doboy	10	128	4	. .	+10	128	. . . . .
Barrington	. . .	450	3	200	+20	350 and 430	. . . . .
Crescent	10	414	3	. .	+50	. . . . .	. . . . .
Riceboro	. . .	430	4	100	+24	. . . . .	Two Wells
St. Catherine's Island	22	300	3	. .	+33	. . . . .	Five Wells
Way's Station . . .	. . .	460	3	200	+20	340 and 440	. . . . .
Tybee Island	. . .	240	2	. .	+15	. . . . .	Affected by Tides
Savannah	18.62	380	10	Many	Non-flowing	Not Given	Wells at the Old Water-works
"	18.62	380	10	"	"	"	" " " " " "
"	18.07	380	10	"	"	"	" " " " " "
"	17.73	380	6	"	"	"	" " " " " "
"	18.37	380	6	"	"	"	" " " " " "
"	19.37	380	6	"	"	"	" " " " " "
"	19.15	380	6	"	"	"	" " " " " "

[1] See foot-note, page 67.

Savannah	18.14	380	6	Many	Non-flowing	Not Given	Wells at the Old Water-works
"	20.66	380	6	"	"	"	" " " " " "
"	20.76	380	6	"	"	"	" " " " " "
"	18.85	380	6	"	"	"	" " " " " "
"	17.97	380	6	"	"	"	" " " " " "
"	17.34	380	4	"	"	"	" " " " " "
"	19.40	380	6	"	"	"	" " " " " "
"	18.36	380	6	"	"	"	" " " " " "
"	10.14	380	6	"	"	"	" " " " " "
"	17.07	380	6	"	"	"	" " " " " "
"	16.07	380	6	"	"	"	" " " " " "
"	17.47	380	6	"	"	"	" " " " " "
"	16.12	436	6	"	"	"	" " " " " "
"	16.60	470	6	"	"	"	" " " " " "
"	10.35	402	6	"	"	"	" " " " " "
"	10.77	417	6	"	"	"	" " " " " "
"	10.25	430	6	"	"	"	" " " " " "
"	13.14	500	10	"	"	"	" " " " " "
"	15.96	500	10	"	"	"	" " " " " "
"	11.30	591	12	"	— 2	"	Wells at the New Water-works
"	20.82	580	12	"	Non-flowing	"	" " " " " "
"	18.13	586	12	"	"	"	" " " " " "
"	20.48	484	12	"	"	"	" " " " " "
"	11.84	490	12	"	"	"	" " " " " "
"	13.95	488	12	"	"	"	" " " " " "
"	11.63	500	12	"	"	"	" " " " " "

A LIST OF THE ARTESIAN WELLS — *Continued*

LOCATION	Elevation above Sea-Level	Depth	Diameter	Capacity per Minute	Height to Which Water Rises [1]	Depth of the Different Water-Bearing Strata	REMARKS
	Feet	Feet	Inches	Gallons	Feet	Feet	
Savannah	12.40	500	12	Many	Non-flowing	Not Given	Wells at the New Water-works
"	. . .	1,500	12	"	"	"	" " " " " "
Meldrim	39	538	6	. .	Flowing	. . . . .	. . . . .
Eden	34	280	6	130	+ 12	274	Sulphurous Water
Egypt	143	750	4	. .	+ 45	300 and 750	Well Not in Use
Statesboro	. . .	320	. .	. .	Non-flowing	. . . . .	Well Not Completed
Rocky Ford	117	180	4	45	+ 15	100	. . . . .
Millen	157	450	4	. .	+ 19	165 and 430	. . . . .
Sylvania	. . .	285	3	. .	— 80	. . . . .	. . . . .
Waynesboro	286	992	6	. .	— 14	250, 300 and 900	. . . . .
Rogers	201	351	4	80	+ 24	180 and 330	. . . . .
Sebastopol	201	676	6	. .	— 2	200, 345 and 500	. . . . .
Herndon	189	300	2	30	+ 14	. . . . .	. . . . .
Augusta	327	814	8	15	—196	500, 600 and 700	. . . . .
"	327 (?)	879	6	. .	— 45	Several Strata	Chalybeate Water
Wadley	243	445	6	. .	+ 20	170, 330 and 430	" "
Louisville	. . .	450	4	. .	Flowing	200 and 300	. . . . .
"	. . .	325	4	20	+ 20	150 " 300	Well two Miles S. of Louisville
Old Town	. . .	225	3	. .	+ 28	160 " 200	. . . . .
Tennille	477	990	4	. .	—190	426 " 830	Well Not Used

[1] See foot-note, page 67.

Davisboro	302	300	3	5	+ 5	100	
Sandersville	. . .	375	. .	. .	— 55	. . . . .	
Wrightsville	275	672	8	. .	— 60	430 and 672	
Irvinville	. . .	300	. .	. .	Flowing	300	Sulphurous Water
"	. . .	600	. .	. .	— 50	. . . . .	
Toombsboro	237	320	1¼	8	+ 3	. . . . .	Not in Use
Gordon	355	365	2	. .	— 19	360	
Hawkinsville	235	490	6	. .	+ 12	265 and 490	
Cochran	379	365	6	. .	— 85	. . . . .	
Swainsboro	. . .	400	2	10	— 90	. . . . .	
"	. . .	400	6	. .	— 80	. . . . .	
Dublin	452	295	4	100	+ 30	185 and 295	
"	452	850	8	. .	+ 30 (?)	350 " —	
Eastman	390	680	3 and 4	. .	—120	— " 625	
Chauncey	320	525	6	. .	— 70	. . . . .	
Lyons	. . .	400	3	. .	— 80	175 and 375	
McArthur	245	900	3	. .	— 60	419 " 890	
Collins	238	800	8	. .	—142	. . . . .	
Manassas	217	498	6	. .	—148	. . . . .	
Baxley	216	507	6	40	—129	320 and 408	
Lumber City	161	400	2½	Many	+ 14	350 " 400	
Abbeville	. . .	540	4	. .	— 25	90, 136 " 296	
Fitzgerald	430	680	3 and 6	. .	— 90	. . . . .	
Tifton	343	360	8	. .	— 80	. . . . .	
Adel	246	280	4½	. .	—144	229	
Jesup	118	525	3	. .	. . . .	287 and 500	

A LIST OF THE ARTESIAN WELLS — *Continued*

LOCATION	Elevation above Sea-Level	Depth	Diameter	Capacity per Minute	Height to Which Water Rises [1]	Depth of the Different Water-Bearing Strata	REMARKS
	Feet	Feet	Inches	Gallons	Feet	Feet	
Waycross	140	691	12	750	— 60	300 and 670	
Valdosta	223	522	4 and 10	Many	—113	360, 450 " 515	
Quitman	181	500 (?)	6	. .	— 30	109	
Thomasville	258	480	8	Many	—210	394	
"	258	394	10	"	—210	394	
"	258	1,900	5⅝	"	—210	394	
Bainbridge	118	900	2 and 6	. .	— 50	280 and 370	Sulphurous Water
"	118	1,325	6 (?)	Many	— 50	280 " 370	
Camilla	. . .	600	. .	. .	Non-flowing	. . . . .	
Doles	. . .	258	3	. .	— 12	. . . . .	Sulphurous Water
Warwick	. . .	497	2 and 8	. .	— 5	. . . . .	Not Completed
Paulan	315	235	6 " 8	. .	— 75	. . . . .	14 Wells in City
Albany	175	732	4, 6 " 10	Many	+ 30	300 and 660	First Successful Flowing Well in the State
Ducker Station	. . .	550	2	3½	+ 10	165, 490 " 550	
Damascus	. . .	547	2	. .	— 7	200 " 547	
Arlington	. . .	625	6	. .	— 20	300 " 500	
"	. . .	328	5	. .	— 50	. . . . .	
Fort Gaines	152	650	2 and 5	150	— 20	500	
Dawson	326	650	2 " 3	. .	— 45	. . . . .	

[1] See foot-note, page 67.

Cuthbert	452	1,000	4 " 5	. .	— 30	340 and 550	. . . . .
Smithville	319	900	2½" 4	. .	+ 20	500 " 900	. . . . .
Americus	348	1,725	3 " 4	. .	— 30	1,000	. . . . .
"	348	400	4	. .	— 10	. . . . .	. . . . .
"	348	500	8	Many	— 10	. . . . .	. . . . .
"	348	900	. .	"	— 2	. . . . .	. . . . .
Cordele	336	550	8	. .	— 20	. . . . .	Sulphurous Water
Richwood	358	170	6	. .	— 40	. . . . .	Used for Steam Purposes
Unadilla	412	189	3½	. .	— 80	. . . . .	. . . . .
Penia	375 (?)	320	4	45	—120	. . . . .	. . . . .
Fern	. . .	160	8	. .	— 20	. . . . .	. . . . .
Coney	. . .	360	3 and 6	20	— 6	150, 225 and 340	. . . . .
"	. . .	285	4½	Many	+ 8	Several	. . . . .
" 3 miles north .	. . .	216	6	. .	+ 4	60, 96 and 200	. . . . .
Montezuma	300	500	2 and 6	Many	+ 62	60, 150, 350, 500	Montezuma Has 16 Wells
Fort Valley	522	1,075	4 " 6	. .	—100	300 Etc.	Not Used
Macon	377	955	12	. .	. . . .	. . . . .	Unsuccessful
Reynolds	433	700	4 and 8	60	—800	250	. . . . .
Stewart County . . .	. . .	300	3	. .	+ 9	. . . . .	. . . . .
Buena Vista	746	583	10	. .	—240	331 and 364	Well Not Finished

DESCRIPTIVE NOTES BY COUNTIES

CAMDEN COUNTY

There are a number of Artesian Wells in Camden county, all of which flow, and are apparently supplied, from the same water-bearing strata. They vary in depth from 300 to 680 feet. The chemical properties of the water, from the several wells, differ but slightly. It is almost invariably heavily charged with hydrogen sulphide, contains more or less lime, and is what is generally known as hard water. The wells are located chiefly on the coast, or at the various stations along the Florida Central & Peninsular R. R., only a few miles inland.

ST. MARY'S WELL

ST. MARY'S

Elevation, 10 feet; diameter, 4 inches; depth, 525 feet. Water rises 50 feet above the surface.

The most southern of the wells, referred to, above, is at St. Mary's, the county-site of Camden county. It was completed in 1893, at a cost of about $1,000. The water is said to be quite wholesome; and it is now universally used by the town for all domestic purposes. It has a very decided odor of hydrogen sulphide; and it deposits a somewhat abundant white precipitate about the overflow pipes. The following chemical analysis of the water was made by Dr. George F. Payne, State Chemist: —

"Total Solids per U. S. Gallon . . . . 29.56 grains
Chlorine " " . . . . 2.49 "
Free Ammonia per million . . . . . 0.20 part
Albuminoid Ammonia per million . . 0.60 "

The Water also contains Iron, Alumina, Lime, Magnesia, Sulphuric Acid, Soda and Potash."

Two water-bearing strata were struck in the well — one at 300 feet and the other at 500 feet. The present water-supply is obtained from the 500-foot stratum, the other being cased off. No casing is used in the well, below the 350-foot level, at or near which point, hard rock is said to have been struck. No reliable information was obtained, concerning the character of the various strata penetrated, further than that they consisted of sand, clay and hard rock.

THE FERNANDINA WELL

FERNANDINA

Elevation, 21 feet; diameter, 8 inches; depth, 640 feet. Water rises 50 feet above the surface.

This well, although it is beyond the limits of the State of Georgia, is here described, on account of its throwing light upon the nature of the underlying strata.

Fernandina lies only about five miles, in a direct line, southeast of St. Mary's, near the northern extremity of Amelia Island. The well was bored by the city, in 1887, at a cost of about $2,000. It flows 800 gallons per minute, and supplies the entire city with water for domestic and other purposes. Chemically, the water differs but little from that obtained from the St. Mary's well. The bore-hole is cased, to a depth of 618 feet. Two strata, bearing artesian

water, were struck, one at 400 feet and the other, at 618 feet, the latter being the one, from which the water is now obtained. The flow of this well is said to have gradually decreased, for a short time, after its completion, and to have caused considerable alarm; but, by the use of the sand-pump, for removing the obstruction, the former flow was again secured. The flow from the second water-bearing stratum is reported to have begun at 618 feet, and to have gradually increased to the bottom of the well, 640 feet.

MRS. LUCY CARNEGIE'S WELL

DUNGENESS, CUMBERLAND ISLAND

Elevation, 16 feet; diameter, 6 inches; depth, 680 feet. Water rises 51 feet above the surface.

This well was bored in 1887, at a cost of $2,200. It is located on the beach, near the southern extremity of Cumberland Island; and it has been estimated to flow daily about 800,000 gallons. The water, which is used for general domestic purposes, is heavily charged with hydrogen sulphide; but it rapidly disappears, on being exposed to the atmosphere.

The following notes are made from a small glass tube of the well-borings, furnished by the well-contractor, Mr. O. H. Wade, of Jacksonville, Fla. Unfortunately, the depth of these various samples, from the surface, was not given. The specimens are here described, in the descending order of their occurrence: —

Specimen No. 1 Coralline limestone, with a few rounded grains of quartz sand.

Specimen	No. 2	Black, carbonaceous, clayey marl.
"	" 3	Fine, dark sand.
"	" 4	Fine, dark-gray sand, with fragments of greenish, flint-like clay-stone.
"	" 5	Gray sand, with chips of greenish flint.
"	" 6	White, sandy marl, made up largely of minute, rhombohedral crystals of calcite.
"	" 7	Dark, sandy marl, with much carbonaceous material.
"	" 8	White, chalky limestone (first flow, 400 feet from the surface).
"	" 9	Black marl.
"	" 10	Chips of smoky-gray flint.
"	" 11	Very fine, brown sand.
"	" 12	Chips of greenish sandstone and gray marl.
"	" 13	Gray, sandy marl, with fragments of dark-colored calcareous rock, containing coprolitic particles.
"	" 14	Dark-gray sand, with numerous coprolitic particles. The specimen also contained many minute crystals of calcite.
"	" 15	Gray marl, formed largely of calcite crystals.
"	" 16	Dark-colored, sandy marl.

The term, *Coprolite*, or *coprolitic particle*, as used in this report, is applied to small, rounded, dark granules, occurring, more or less abundantly, in the sands and clays, obtained from the deep-well

borings along the Atlantic Seaboard. These particles vary from 1-32 to ¼ of an inch, in diameter. They are always rounded; have an enameled polished surface; and are dissolved readily by hydrochloric acid, leaving a residue of dark specks, which, when examined under the microscope, appear to be undigested particles of food material. Chemical analysis shows, that they consist largely of calcium phosphate. They are frequently quite abundant, making up fully 5 per cent. or more, of the entire mass of sand. The sands, in which they occur, are often consolidated into hard, compact quartzite, the cementing material being opalized quartz. These specimens can be easily cut into microscopic sections, and studied at will under the microscope.[1] Such an examination, however, reveals nothing, except innumerable minute, dark specks, in a dark-yellowish, homogeneous mass. These particles are undoubtedly of organic origin; but whether they are true coprolites or not, the writer is, at present, unable to determine.

THE NEW CUMBERLAND ISLAND COMPANY'S WELLS

CUMBERLAND ISLAND

Well No. 1. Elevation, 50 feet; diameter, 4 inches; depth, 600 feet. Water rises 12 feet above the surface.

Well No. 2. Elevation, 50 feet; diameter, 4 inches; depth, 485 feet. Water rises 12 feet above the surface.

Both these wells are located on the northern end of Cumberland Island, and they furnish the hotels and the various cottages of this

[1] See Plate III.

famous resort, with an abundant supply of wholesome water. It is claimed, that the water from these wells possesses medicinal properties, which relieve dyspepsia and other similar disorders. Chemical analysis shows, that the water contains sulphur, lime, silica, soda, manganese, iron and lithia.

These wells were put down in 1889 and 1890, No. 1 costing $600, and No. 2, $400. No reliable information concerning the different water-bearing strata, or the various formations passed through, was secured.

Two other artesian wells are reported from Cumberland Island, one at the Benson Place, near Cumberland Landing, over 400 feet in depth; and another at Stafford, on the west side of the island, six or eight miles north of Dungeness.

W. H. KING'S WELL

KINGSLAND

Elevation, 75 feet(?); diameter, 2 inches; depth, 500 feet. Water rises 20 feet above the surface.

This well was completed in 1895, at a cost of $250. It is reported to flow 800 gallons per hour. The water is said to be somewhat hard. Nevertheless, it is used for general domestic purposes. Sand, clay, marl, beds of shells and hard rock were penetrated, in boring the well; but neither their thickness nor their order of occurrence have been reported.

Messrs. Julius and Robert King also have, each, flowing wells, at Kingsland; but no information concerning their depth etc., has been received.

T. A. WHITFORD'S WELL

WOODBINE

Elevation, unknown; diameter, 2 inches; depth, 350 feet. Water rises 50 feet above the surface.

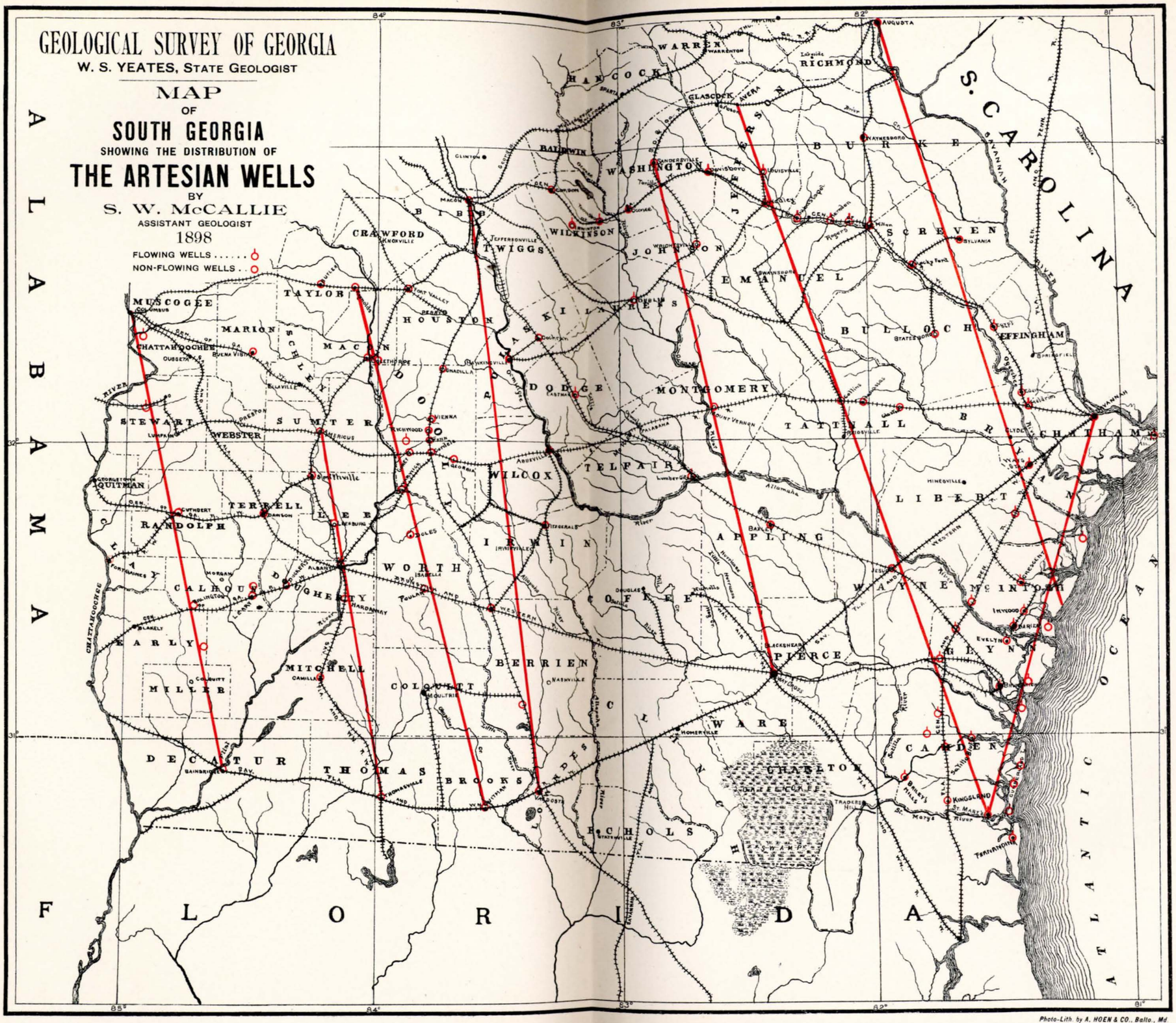
This well was bored in 1894; and it has since furnished a continuous flow of potable, hard water. Two water-bearing strata were struck in the well, one at 250 feet and the other at 350 feet. Water, from the 250-foot level, rose to the surface; but it did not produce the desired flow. Much blue clay, black or white sand, and a few thin layers of rock are said to have been penetrated, in sinking the well.

J. K. BEDELL'S WELL

WOODBINE

Elevation, unknown; diameter, 2 inches; depth, 350 feet. Water rises 40 feet above the surface.

This well, which is located only a short distance from the Whitford well, has been in use, for about three years. The character of the water; the nature of the different formations encountered in digging the well; and the amount of flow (60 gallons per minute) are practically the same as those of the Whitford well.


GEOLOGICAL SURVEY OF GEORGIA
W. S. YEATES, STATE GEOLOGIST
MAP
OF
SOUTH GEORGIA
SHOWING THE DISTRIBUTION OF
THE ARTESIAN WELLS
BY
S. W. McCALLIE
ASSISTANT GEOLOGIST
1898
FLOWING WELLS . . . . . .
NON-FLOWING WELLS . .
ALABAMA
FLORIDA
S. CAROLINA
ATLANTIC OCEAN
AUGUSTA
RICHMOND
WARREN
HANCOCK
GLASCOCK
BURKE
JEFFERSON
WASHINGTON
JOHNSON
EMANUEL
SCREVEN
EFFINGHAM
BULLOCH
TWIGGS
WILKINSON
BIBB
CRAWFORD
TAYLOR
MUSCOGEE
MARION
CHATTAHOOCHEE
HOUSTON
MACON
PULASKI
DODGE
MONTGOMERY
TATTNALL
BRYAN
CHATHAM
LIBERTY
STEWART
WEBSTER
SUMTER
TELFAIR
WILCOX
QUITMAN
TERRELL
LEE
RANDOLPH
DOUGHERTY
IRWIN
APPLING
WORTH
COFFEE
WAYNE
McINTOSH
GLYNN
EARLY
CALHOUN
CLAY
MITCHELL
BERRIEN
PIERCE
MILLER
COLQUITT
CLINCH
WARE
CAMDEN
DECATUR
THOMAS
BROOKS
LOWNDES
ECHOLS
CHARLTON
Photo-Lith. by A. HOEN & CO., Balto., Md.

THE HILTON & DODGE WELL

SATILLA BLUFF

Elevation, 20 feet; diameter, 2 inches; depth, 340 feet. Water rises 34 feet above the surface.

The well was completed, about two-and-a-half years ago, at a cost of $200. Water-bearing strata were struck at 60, 210 and 340 feet. Sand, marl, blue clay, pebbles and quick-sands are reported to be the principal formations passed through, no mention being made of hard rock.

J. A. FOSTER'S WELL

SATILLA BLUFF

Elevation, 20 feet; diameter, 2 inches; depth, 350 feet. Water rises 30 feet above the surface.

The well was completed in 1895, at a cost of about 60 cents per foot. It flows 75 gallons per minute. Two water-bearing strata were struck, one at 250, and the other, at 350 feet. The water-bearing strata are said to contain many shark's teeth and fragments of small shells. Sand, clay and marl make up the principal part of the formations penetrated. Another well is reported on the Satilla, at Bailey's Mill, several miles further up the river; but no information, as to its depth etc., has been received.

L. T. McKINNON'S WELL

WHITE OAK

Elevation, 5 feet; diameter, 4 inches; depth, 450 feet. Water rises 60 feet above the surface.

The well was bored in 1894, at a cost of about $600. The flow is 300 gallons per minute. The water is a hard, sulphur water. It is used for general domestic purposes, and for a turpentine distillery, located near by. Two flows are reported, one at 130 feet, and the other at 450 (?) feet. The well is cased to the depth of 200 feet, beneath which, limestone is reported to occur. Overlying the limestone, beds of sand, marl and clays, containing many shells of oysters etc., are reported to have been penetrated.

W. C. LANG'S WELL

TARBORO

Elevation, unknown; diameter, 2 inches; depth, 345 feet. Water rises 50 feet above the surface.

This well was completed in 1894, in order to obtain water for a steam-mill and for domestic purposes. The water is hard, and is highly charged with hydrogen sulphide. The first flow was obtained at 250 feet, and the second, at 300 feet, the latter being the one, from which water is now secured, the other being cased off. A tough, blue clay is said to extend from the surface to a depth of 100 feet, underlying which is a cavernous white limestone, that is

continuous to the bottom of the well. Between the 200- and 300-foot levels, two cavities were encountered, in which the drill dropped two or three feet.

J. S. BRUCE'S WELL

TARBORO

Elevation, unknown; diameter, 2 inches; depth, 414 feet. Water rises 50 feet above the surface.

This well is located 1½ miles northeast of Tarboro. It was bored the year following the completion of the Lang well. The water, which is used only for domestic purposes, is hard and sulphurous. The first flow was obtained 200 feet from the surface, in quick-sand; the second, at 300 feet, in cavernous limestone. The flow from the second water-bearing stratum is said to have increased, whenever a cavity in the rock was struck. The strata, reported as occurring in the well, are as follows: —

Surface sand	12 feet
Clay	12 "
Shell marl	5 "
Sand and clay	175 "
Cavernous limestone	220(?)"

N. B. STAFFORD & BROS.' WELLS

TARBORO

Elevation, 20 feet; diameter, 6, 6 and 2 inches, respectively; depth, 360 feet. Water rises fifty feet above the surface.

There are three wells, owned by the Stafford Brothers; two, 6 inches, and one, 2 inches, in diameter, all located within a radius of 100 yards of each other. The wells were put down, in 1895, at an average cost of $350.00 each. The water is used for domestic purposes; and, also for generating power, to operate a small rice-mill, and a circular saw, for cutting wood. Two water-bearing strata are reported to have been perforated in these wells — one at 175 feet, and the other at 360 feet. No data was secured, concerning the formations passed through, in sinking these wells.

H. T. McKINNON'S WELL

KINGSLAND

Elevation, unknown; diameter, 2 inches; depth, 475 feet. Water rises above the surface; height, not stated.

This well flows about 60 gallons per minute. Sand, indurated clay and beds of shell are said to have been passed through, in sinking the well.

GLYNN COUNTY

The city of Brunswick has 16 flowing wells, varying in depth from 450 to 490 feet. The main water-supply for the city is, at present, obtained from three of these wells, located at the water-works pumping-station, near Oglethorpe Hotel, a short distance from the Union depot. The first well, in the city, was put down, in 1884. Since then, they have gradually increased, from year to year, until they have now become so abundant, that it seems quite probable, that much further increase in number will likely affect the amount of flow. This conclusion is based on the observations, made at the water-works station. It is stated, by the engineer in charge of the station, that, since the wells in the city have become so numerous, there has been a perceptible decrease in the flow of their wells. It is quite probable, as has been suggested by a practical well-borer, who put down many of the wells in the city, that the diminution of flow results chiefly from the filling of the lower part of the casing, by sand or other foreign material, and not by a reduction of the pressure, by lowering the head in the water-bearing stratum. This theory, which seems quite plausible, might be easily tested, by the use of the sand-pump.

There is but little difference in the nature of the water, or in the character of the various strata, penetrated, in the several wells in the city. Consequently, the following notes on the well, recently bored at the public school building, will apply, with slight, unimportant modifications, to any other well within the city limits.

THE PUBLIC SCHOOL WELL

BRUNSWICK

Elevation, 12 feet; diameter, 3 inches; depth, 490 feet. Water rises 28 feet above the surface.

This well, which now flows about 200 gallons per minute, was completed last year, at a cost of $400. The water is hard and slightly sulphurous; and it is said to be quite wholesome.

Mr. Fred. Baumgardner, the contractor for the public school well, furnishes the following data, concerning the different strata passed through in this well:—

Yellow sand	55 feet
Thin layers of sandstone, interlaminated with clay	57 "
Blue clay or marl	100 "
Thin layers of fossiliferous limestone, with clay and sand	100 "
Soft, porous limestone, with shells	20 "
Coarse sand and pebbles	25 "
Hard rock	2 "
Blue marl or clay	100 "
Thin layers of limestone, with clay and sand	20 "
Very fine, white sand	(?)

Additional notes, made from specimens of well-borings furnished by Mr. Baumgardner: —

Sample labelled "Sand between the upper layers of rock," consists of very coarse, sharp sand with fragments of shells.

Sample labelled "Bed of shells just below the first water-bearing stratum," consists of chips from a compact dark- or light-gray claystone, with no trace of organic remains.

Sample labelled "Water-bearing rock," consists of a light-gray siliceous, highly fossiliferous, porous limestone, with many fragments of gastropods, lamellibranchs and corals.

Two water-bearing strata are reported in all the wells. The first, which just flows at the surface, occurs at 350 feet; and the other, from which the supply of water is now obtained, at 460 feet.

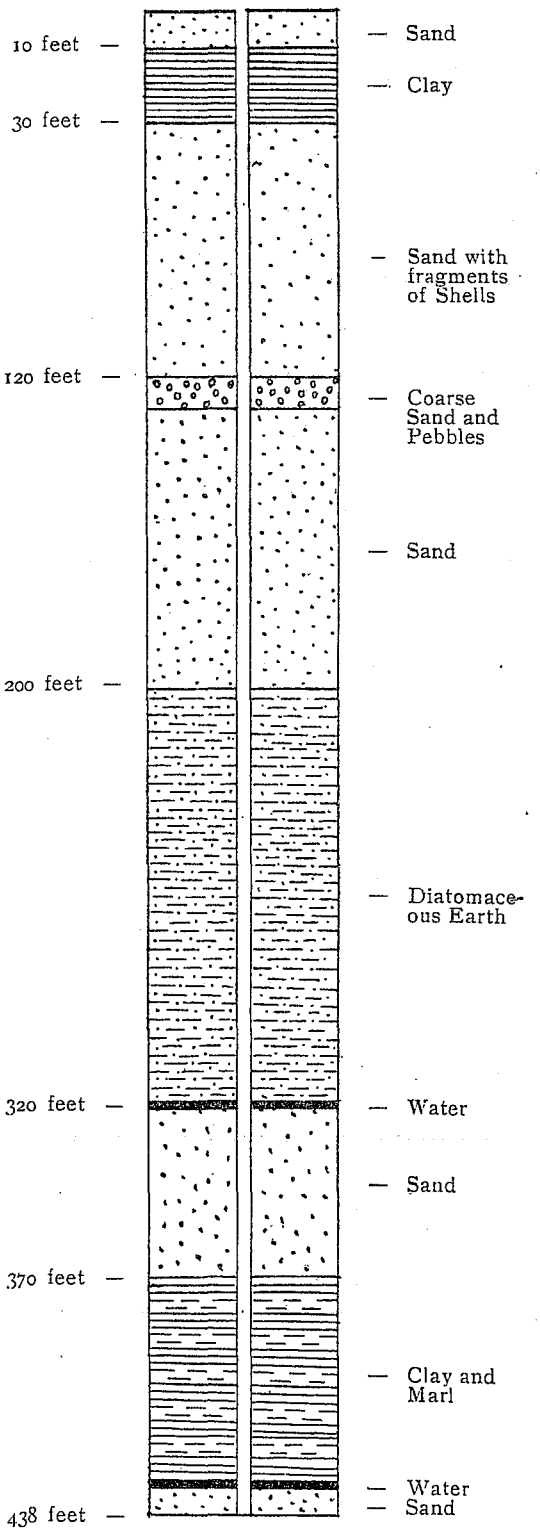
ST. SIMON'S ISLAND WELL

ST. SIMON'S MILLS

Elevation, 15 feet; diameter, 6 inches; depth, 438 feet. Water rises 40 feet above the surface.

The well at St. Simon's Mills was put down, in 1886, in order to secure water for boilers and for domestic purposes. The flow has been estimated at 250 gallons per minute. The water is

Fig. 13



Section of the St. Simon's Island Well.

impregnated with hydrogen sulphide; and it contains a considerable amount of mineral matter, although it is rather soft, for artesian water. There is formed within the boilers, after the use of this water for many days, a white, porcelain-like deposit, in the form of thin scales. The deposit consists largely of silica; and it probably originates from the sedimentation of minute particles of clay, held in suspension by the water.

The first flow in the well was struck, at 350 feet from the surface, and yielded 8 gallons per minute. The second flow began, at the depth of 435 feet, and gradually increased to the bottom of the well. The following notes on the different strata, penetrated in the well, are made from a series of borings furnished by The Hilton & Dodge Lumber Company:—

10 feet — Very fine, gray sand, with numerous magnetic scales, which were evidently derived from the iron instruments used in boring the well.

20 " — Dark-colored, marsh clay, containing fragments of shells.

40 " — Rather coarse, gray sand, with fragments of oyster and other shells.

50 " — Quite similar to the over-lying sand, but somewhat coarser, and with only a few shells.

60 " — Coarse, gray sand and shells, as above.

70 " — Very coarse sand, and water-worn pebbles of quartz and feldspar. The pebbles are often an inch or more in diameter.

80 " — Moderately coarse sand, pebbles and comminuted shells.

90 " — Fine, dark-gray sand, and a few small, water-worn pebbles. Microscopic examination of the sample shows it to contain many minute angular particles, of a green or brown color. The particles are probably fragments of hornblende.

100 " — Fine, brown sand, and a few angular quartz pebbles, with a clay matrix.

110 " — Fine, dark-gray sand, similar to that found at the 90-foot level.

115 " — A conglomerate of quartz pebbles and coarse sand, with a clay matrix. There occurs in the conglomerate a few dark- or brown-colored, small, rounded particles, consisting largely of calcium phosphate, which are probably of coprolitic origin.

120 feet — Coarse, gray sand and fragments of shells. The sand granules are all well rounded, and many of them consist of feldspar, and are of a dark color.

125 " — The same as above, except that it contains more fragments of shells.

133 " — Fine, gray sand, with a few flakes of mica and fragments of hornblende.

143 " — Fine, dark-gray sand, with a few quartz pebbles and a small amount of clay.

153 " — Similar to the above, except that it has less clay and a darker color.

160 " — Fine, gray sand, with mica and a few small quartz pebbles.

170 " — The same as above.

180 " — Fine, gray sand.

190 " — Fine, light-gray sand, with much mica and some fragments of hornblende. Some of the granules of sand are cemented together by iron oxide.

200 " — Fine, dark-gray, clayey sand, with mica, diatom shells and spicules of sponges.

230 " — This specimen differs from the above, only in being of a darker color.

250 " — Diatomaceous earth and fine sand. The diatom shells and spicules are quite abundant, and make up a large percentage of the entire sample.

310 " — Diatomaceous earth, containing an innumerable number of microscopic rhombohedral crystals of calcite.

320 feet — Fine, light-gray sand, with considerable mica, fragments of hornblende, coprolitic particles, and very minute teeth, resembling those of the gar-pike.

324 " — Rather coarse, gray sand, containing sharks' teeth, dental plates of rays (?), fragments of bones, coprolitic particles, and small lumps of clay made up chiefly of diatom shells and sponge spicules.

327 " — Gray sandstone passing into hard, flinty quartzite containing casts of shells and numerous coprolitic particles.

330 " — Moderately coarse, gray sand.

350 " — Coarse sand particles, well rounded. Small sharks' teeth, common; and, also, other teeth, one variety being very minute, and bifid on the cutting surface.

360 " — The same as above, except that it contains fragments of shells and a limited amount of clay, which, when examined under the microscope, is seen to contain minute rhombohedral crystals of calcite.

370 " — Dark-gray marl, made up largely of microscopic crystals of calcite. Coprolitic particles are present, but not abundant.

380 " — Dark-gray marl, as above.

390 " — Dark-gray marl.

400 " — The same as above.

410 " — A very compact, fine, dark-gray clay, slightly tinged with green. The particles of sand in

the clay are few in number; but they are all quite angular.

420 feet — Fine, dark-gray clay frequently becoming indurate, forming a hard, compact shale; coprolitic material, abundant; but the particles are unusually small.

430 " — Coarse, dark-colored sand, containing small teeth of sharks, and other organic remains. The dark color of the sand is largely due to the abundance of coprolitic material present.

435 " — Very coarse, dark-colored sand, with rounded pebbles of feldspar and quartz.

438 " — White sand, containing many brown or dark-colored particles, which are probably of organic origin.

Two other wells are reported on St. Simon's Island; but no reliable information has been received, concerning their depth etc.

J. A. WARD'S WELL

BLADEN

Elevation, 15 feet (?); diameter, 3 inches; depth, 480 feet. Water rises about 30 feet above the surface.

The well, located at the crossing of the Florida Central & Peninsular Rwy. and the Brunswick & Western R. R., was completed in 1894, at a cost of $530.00. It now flows at the rate of about 100 gallons per minute. The water, which is hard and sulphurous, is

used for both boiler and domestic purposes. A partial chemical analysis of the water shows it to contain a considerable amount of lime and magnesia. Nevertheless it is extensively used by the Florida Central & Peninsular Rwy., for boiler purposes.

Three different flows are reported in the well. The first is said to have occurred at 160 feet from the surface; the second, at 260 feet, and the third, at 475 feet. Nothing is know of the strata passed through, further than that they consist of clay and sand, with a few beds of hard rock and oyster shells.

R. H. EVERETT'S WELL

EVERETT CITY

Elevation, unknown; diameter, 2 inches; depth, 460 feet. Water rises 38 feet above the surface.

This well, situated within a few rods of the intersection of the Florida Central & Peninsular and the Southern Railways, was completed the same year as the Ward Well, at about one-half of the cost. The water is used for boiler and domestic purposes. No information has been received, concerning the character of the strata penetrated, the number of flows struck, or the chemical composition of the water.

JEKYL ISLAND WELL

Elevation, 8 feet; diameter, 6 inches; depth, 480 feet. Water rises 45 feet above the surface

The well, when first completed, furnished about 250 gallons per minute; but it is now said to be gradually decreasing in the amount of flow, which is probably due to a partial filling up of the casing by sand. Prof. H. C. White, formerly State Chemist, gives the following as the result of an analysis, of the water from this well:—[1]

Solid Contents Dissolved	Grains per Gallon
Carbonate of Lime	8.083
Sulphate of Soda	3.864
Sodium Chloride	1.457
Potassium Chloride	0.085
Sulphate of Lime	1.324
Sulphate of Magnesia	0.615
Silica	0.068
Organic Matter and Combined Water	1.256
Total	16.752

J. T. DENT'S WELL

EVELYN

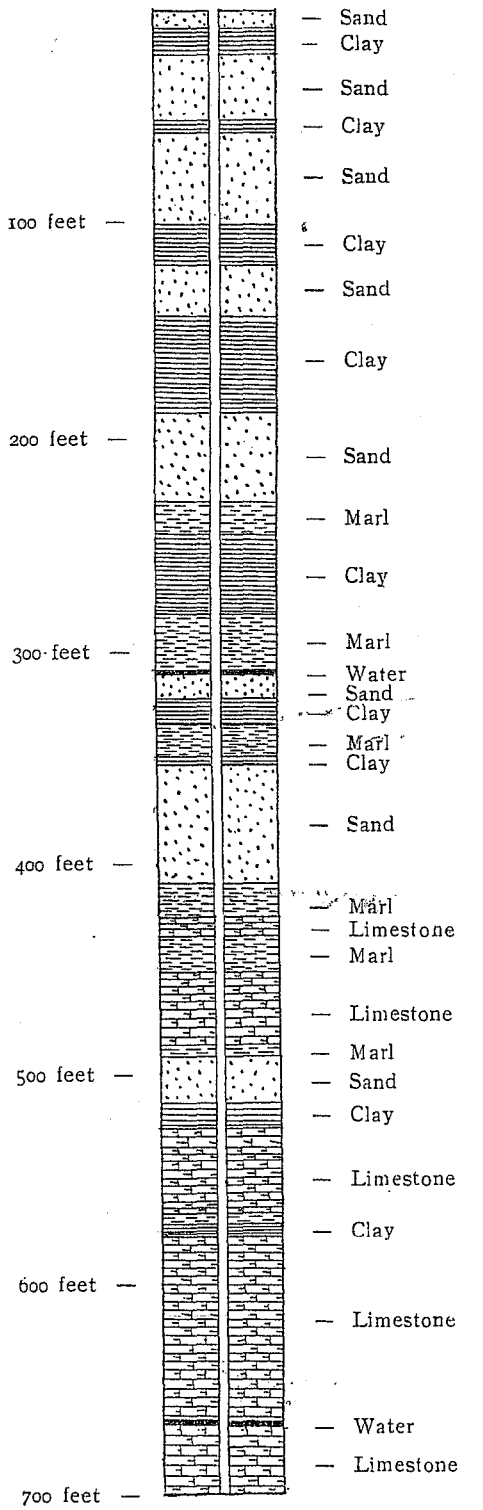
Elevation, 20 feet; diameter, 3 inches; depth, 420 feet. Water rises 14 feet above the surface.

[1] Furnished by the Superintendent of Jekyl Island.

This well was completed in 1892. The first flow was struck, at 370 feet from the surface; but the well was continued to 420 feet, without any increase in flow, which was probably due to the well's being cased only to the depth of 100 feet. The water, which is used for farm and general domestic purposes, is said to be soft and highly sulphurous.

There is another well in Glynn county, located at the Altamaha mill, near Brunswick, and belonging to the Hilton & Dodge Lumber Co. This well is said to resemble very closely the one at St. Simon's Mills, in the character of the formations passed through, the amount of flow, etc.

Fig. 14



Section of the Waycross Well, Constructed from Samples of the Well-borings.

WARE COUNTY

THE WAYCROSS WELLS

WAYCROSS

There are two 12-inch wells in Ware county, both of which are located at Waycross, the county-seat. The first of these wells was completed in 1893, and the second, which is only a few feet from the first, in 1895. Each well, together with its casing, cost about $3,750; and each has supplied as much as 750 gallons to the pump per minute, without lowering the head. The water from these wells is now universally used throughout the city; and also for the boilers of the engines of the various branches of The Plant System of railroads, radiating from this point. The city has, in successful operation, a very complete system of water-works, costing about $35,000.

Prof. H. C. White, of the State University, in making a report on the chemical analysis of the water from these wells, says: — "The water is faintly turbid from suspended silica, which, however,

PUBLIC ARTESIAN WELL AT ALBANY, GEORGIA.

speedily settles on standing, and becomes clear and limpid. It possessed no odor, and was found to be organically absolutely pure. Chemical analysis yielded the following results:—

Solids Dissolved	Grains per U. S. Gallon
Carbonate of Lime	7.502
Carbonate of Iron	0.120
Sulphate of Lime	0.531
Sulphate of Magnesia	0.162
Sulphate of Potash	0.061
Sulphate of Soda	0.084
Sodium Chloride (Common Salt)	0.349
Silica	0.582
Organic Matter and Combined Water	0.965
Total	10.356

This water contains the dissolved solids, usually found in artesian waters of South Georgia. It contains them, however, in rather smaller quantities than usual; and it is one of the best of such waters, that I have examined. It is pure and excellent water, suitable for domestic and manufacturing purposes."

Two different water-bearing strata are reported, as occurring in the wells, one, in a bed of coarse sand or gravel, about 300 feet from the surface. The water from this stratum rises to within 50 feet of the surface; but the supply was thought to be not sufficient for the needs of the city; consequently, the wells were continued to the second water-bearing stratum, 670 feet from the surface, where the second water-supply is now obtained. The water from the second stratum rises to within 60 feet of the surface, which at this point has an elevation of 140 feet above sea-level.

The following is a description of the various specimens of well-borings, obtained from Mr. H. Murphy, Chairman of the Water-works Commission:—

Surface — The surface is overlain, to the depth of about 9 feet, by a medium coarse-grained sand. The sand particles are all water-worn and round. Especially is this true of the larger grains, which often measure 1-16 of an inch in diameter.

9 feet — Motley-red, yellow and white clays, containing much fine, sharp sand, intermingled with small flakes of mica. The sample resembles very closely highly decomposed mica-schist.

20 " — A rather coarse-grained, water-worn reddish sand, with sufficient clay, to bind the particles into a coherent mass. Under the lower power of the microscope, the clayey matrix is seen to contain numerous small fragments of hornblende and garnets.

30 " — This specimen differs mainly from the above, in being more of a reddish-brown color; also, in having a few flakes of mica.

40 " — Coarse quartz sand, cemented by iron oxide into a somewhat spongy mass.

50 " — Dark-gray, plastic clay, containing many sharp grains of quartz sand, fragments of feldspar and flakes of mica.

55 " — Very coarse, white sand. The particles are often a quarter of an inch in diameter; and all are well water-worn. They consist mainly of quartz, feldspar and hornblende; but fragments of other rock-making minerals occur.

80 " — This sample differs from the above, chiefly in having a drab-colored clay matrix.

100 feet — Dark-gray clay, much like that found at the 50-foot level.

115 " — Yellowish, sandy clay.

130 " — Fine, gray sand, containing thin scales of mica and numerous dark-colored particles, with polished enameled surfaces. The particles consist largely of calcium phosphate, and are probably of coprolitic origin.[1]

140 " — Dark-gray clay, similar to the clays found at the 50- and 100-foot levels.

145 " — Gray, sandy clay. When closely examined, the clay is seen to contain many fragments of feldspar, and dark, rounded particles, probably coprolitic.

160 " — Fine, dark-gray, sandy clay, with fragments of feldspar and coprolitic particles.

185 " — Very coarse, white sand. The grains are well rounded, and often partially coated with a thin coating of iron oxide. Coprolitic particles are present.

215 " — Dark-gray marl, of greenish tint, made up largely of microscopic crystals of calcite.

217 " — Medium fine-grained, water-worn sand, containing fully 5 per cent. of dark coprolitic material, and numerous fragments of bones, which appear to be ribs of small fishes. There also occur, in the sand, tiny pieces of reddish-brown mineral, which are probably fragments of garnets.

[1] See description, p. 77.

226 feet — Hard, flinty, drab-colored claystone, containing thin seams of sandstone.

228 " — Drab-colored, calcareous, sandy clay, with fragments of flint and limestone, which seem to form thin beds, or layers, in the sand.

230 " — Hard, vitreous sandstone, having many coprolitic particles, highly phosphatic. The sand grains are all well-rounded, and are firmly cemented by opalized silica.

232 " — Gray, coprolitic marl.

234 " — Fine, dark-gray sand, with fragments of shells and flakes of mica.

236 " — Light-blue, compact clay, having small, sharp granules of quartz and feldspar, and minute scales of mica.

275 " — Gray, sandy marl, containing a few large, water-worn quartz grains and coprolitic particles.

300 " — Coarse sand and phosphatic pebbles, frequently a half-inch in diameter; small teeth of sharks and dental plates of rays (?) occur in the sand. Minute coprolitic particles are also abundant.

302 " — Fine sand, containing a few large, well-rounded quartz grains and pieces of very fine, white clay. Minute teeth of sharks and numerous small coprolitic particles are also found, the latter being very abundant.

310 " — Hard, compact sandstone, similar to sample from 230-foot level.

312 " — Dark, sandy clay, with, coprolitic material and dental plates of rays.

325 feet — Gray marl, containing fragments of pectens, spines of sea-urchins, etc.

340 " — Very hard, compact sandstone, almost identical with the samples from the 230- and 310-foot levels.

343 " — Fine, gray sand, with more than 5 per cent. of coprolitic material.

400 " — Light-gray marl, made up largely of the fragments of shells of small lamellibranchs; it contains, also, numerous coprolitic particles, and a few small, well-rounded quartz pebbles.

415 " — Highly fossiliferous limestone, containing remains of lamellibranchs, corals, bryozoans and orbitolites, sharks' teeth, coprolitic material and fragments of bones.

425 " — Gray marl, with pectens, spines of sea-urchins, etc.

440 " — White, chalky limestone, somewhat sandy.

450 " — Dove-colored, fossiliferous limestone, having a concretionary structure.

455 " — White, chalky, arenaceous limestone.

475 " — Gray, sandy marl, similar to specimens from the 425-foot level.

480 " — Fine, yellow argillaceous sand, with fragments of feldspar.

500 " — Gray sandstone and clay-stone.

510 " — White, chalky limestone.

525 " — A very compact, dark-gray limestone, having numerous coprolitic particles and fragments of corals and shells.

527 feet — Shell marl.

530 " — White, chalky limestone.

550 " — Dark-gray marl, with many fragments of shell; coprolitic particles, more or less abundant.

555 " — A very hard, compact, dove-colored clay-stone, highly coprolitic.

560 " — White, chalky limestone.

600 " — Gray, porous limestone, containing casts of gastropods.

610 " — White, chalky limestone.

650 " — White, compact, fossiliferous limestone.

665 " — Very compact, gray limestone, highly fossiliferous, with coral, foraminifera, bryozoans and coprolitic material, abundant.

670 " — White, chalky limestone.

675 " — White limestone, made up largely of the tests of foraminifera, some of which are an inch or more in diameter; shells of small gastropods are also common.

680 " — White, chalky limestone with many small, rounded, compact, calcareous particles, probably of organic origin.

685 " — Dark-gray, fossiliferous limestone.

691 " — Fossiliferous limestone, similar to that found at the 675-foot level.

WAYNE COUNTY

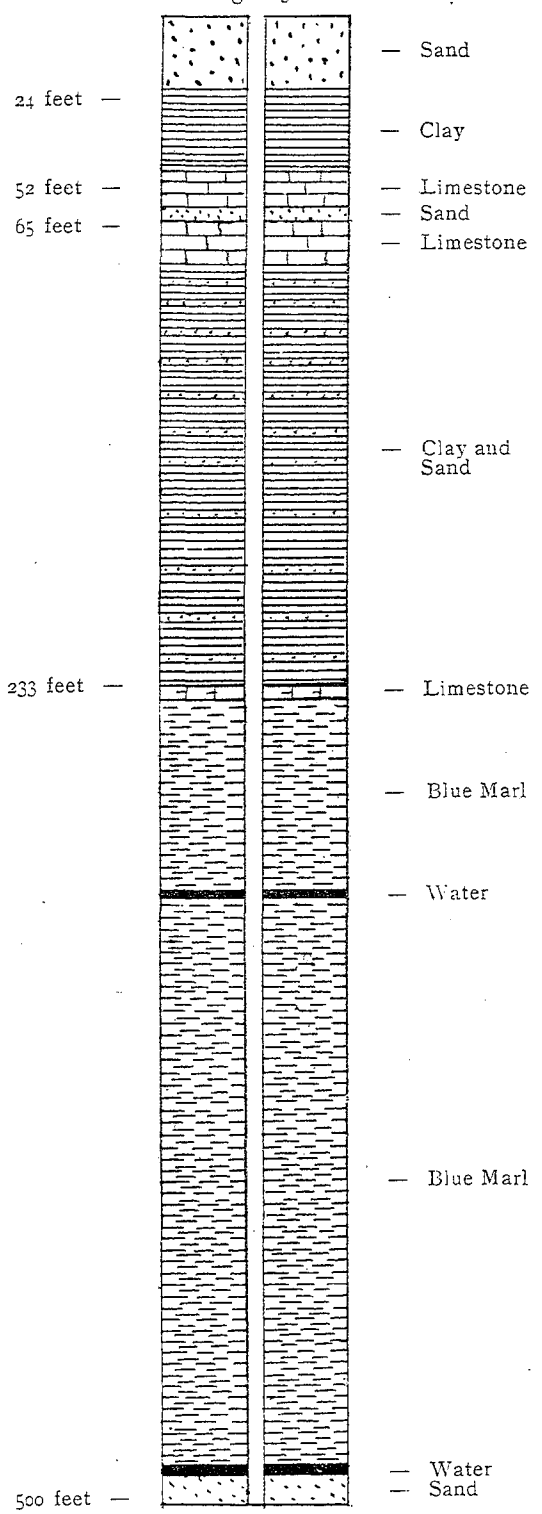
THE JESUP WELL

JESUP

The only deep well, reported from Wayne county, is located, at Jesup, at the intersection of the Plant and the Southern railroads. The well, which is only two inches in diameter, was put down by the town council in 1890, at a cost of about $500; but, for some reason, it appears to have been badly managed, and has never given entire satisfaction. Two water-bearing strata are said to have been struck in the well, one, at 287 feet, and the other, at 500 feet from the surface. The first stratum is thought by some, to have furnished flowing water; but, for personal gains of the contractor, it is said to have been cased off, and the well, sunk to the second stratum.

Dr. J. W. Spencer, formerly State Geologist, in his

Fig. 15

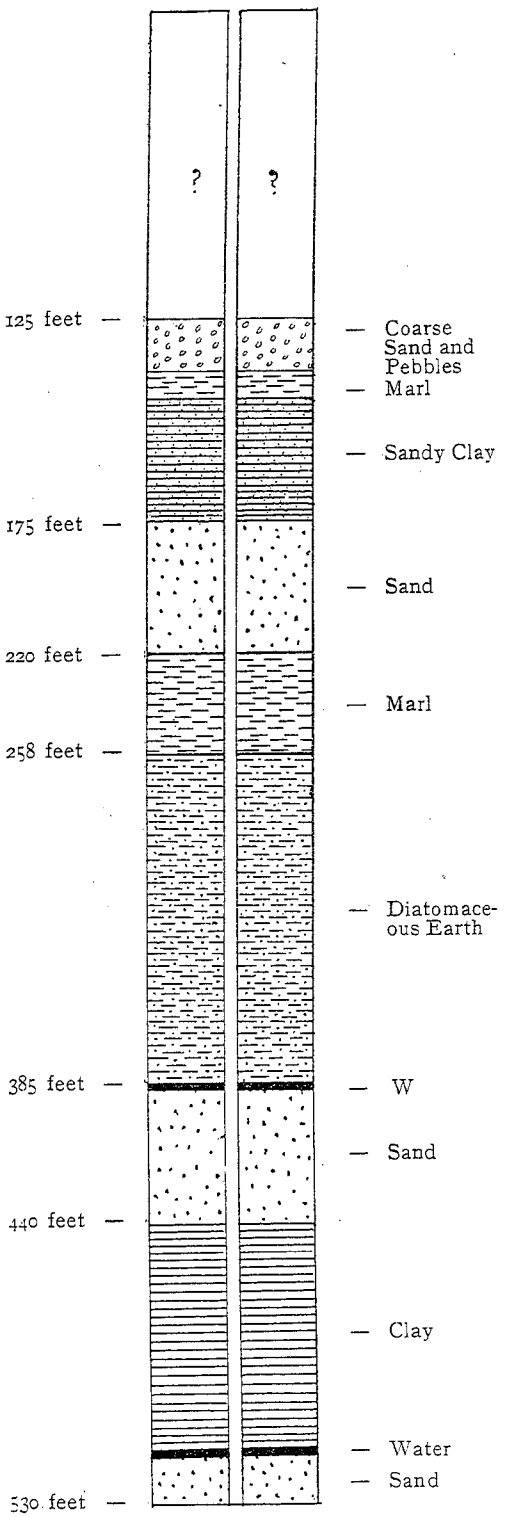


Section of the Jesup Well.

"First Report of Progress" of the Survey, published June 1st, 1891, gives the following notes on the Jesup well: —

1	Sand to	10	feet
2	Quicksand to	14	"
3	Yellow-clay soil, with layers of quicksand, to	26	"
4	Quicksand to	52	"
5	Limestone to	55	"
6	Quicksand to	65	"
7	Limestone to	78	"
8	Clay, with sand, to	233	"
9	Soft, spongy rock to	237	"
10	Blue marl to	490	"
11	Water-bearing quicksand. Water rose to within 33 feet of the top.		

Fig. 16



Section of the Darien Well, Constructed from Samples of Well-borings.

McINTOSH COUNTY

There are a number of artesian wells in McIntosh county, most of which are situated near the coast. They are all flowing wells; and they apparently obtain their water-supply from the same water-bearing stratum.

THE DARIEN WELL

DARIEN

Elevation, 20 feet; diameter, 8 inches; depth, 530 feet. Water rises 15 feet above the surface.

The first attempt, to obtain artesian water at Darien, was made in 1885, by sinking a 4-inch well to the depth of 492 feet. This well supplied the city with water, until 1891, when the large 8-inch well was completed. The 8-inch well flows about 200 gallons per minute. The water is hard and sulphurous, but quite wholesome; and it is very generally used throughout the town, for all domestic purposes. The

main water-bearing stratum seems to be located near the bottom of the wells. Other strata, however, were reported nearer the surface, though the flow was not satisfactory.

The following notes were made from a partial series of borings taken from the well: —

125 feet — Very coarse sand and pebbles. The pebbles, which consist of both quartz and feldspar, are only slightly rounded, and are often incrusted with a yellowish, ochreous deposit, adhering to which are frequently to be seen small fibrous crystals of selenite.

133(?) " — Dark-gray marl, having a greenish tint, and containing numerous microscopic rhombohedral crystals of calcite.

143 " — Very fine, gray sand, with a considerable amount of clay. Throughout the entire sample, occur many fibrous crystals of selenite, and also a few large, well-rounded quartz grains.

167 " — Fine, brown, arenaceous clay, having numerous fragments of shells.

176 " — Coarse sand, pebbles and fragments of shells.

188 " — The same as above, except that it contains a few coprolitic particles.

220 " — Gray marl, made up largely of microscopic rhombohedral crystals of calcite. The sample also has a few grains of coarse sand, as in the beds immediately above.

221 " — Fine, gray sand, with much mica, and a few fragments of shells; also minute crystals of selenite.

258 feet — Diatomaceous earth, of a greenish-gray color. Diatoms make up about 5 per cent. of the entire mass.

280 " — Diatomaceous earth, with a few small crystals of selenite.

330 " — Diatomaceous earth; spicules of sponges are also common.

350 " — Diatomaceous earth, containing a few small coprolitic particles.

375 " — Diatomaceous earth. Shells of diatoms, not abundant.

385 " — Coarse sand and pebbles, forming a conglomerate, which contains sharks' teeth, small dental plates (possibly of the ray), fragments of shells and pieces of lignite, the latter often an inch in diameter. The sample also has a small amount of marl, which is made up chiefly of crystals of calcite and diatom shells.

388 " — Rather fine, gray sand, having sharks' teeth, coprolitic granules, a few diatoms, fragments of bone and moluscan shells.

391 " — Indurated, highly calcareous, light-gray marl, resembling chalk.

400 " — Fine, dark-gray sand, containing small flakes of mica, diatoms, spicules of sponges and coprolitic particles.

420 " — Fine, yellow sand, with fragments of shells, coprolitic granules, spicules of sponges, diatoms and minute rhombohedral calcite crystals.

440 " — Hard, compact, greenish clay, breaking with a conchoidal fracture.

500 " — The same as above.

515 feet — Fine, dark-gray sand, having numerous coprolitic particles.

524 " — The same as above, except that it contains fragments of shells.

530 " — Hard, compact clay-stone, with sand, as above.

THE WOLF ISLAND CLUB WELL

EVELYN

Elevation, 5 feet; diameter, 2 inches; depth, 500 feet. Water rises 45 feet above the surface.

The well was put down in 1891, at a cost of $500. The water is said to be soft and highly sulphurous. No information was furnished, concerning the amount of flow, the number of water-bearing strata, or the nature of the different formations passed through.

JESSE C. WOODHULL'S WELL

DOBOY

Elevation, 10 feet; diameter, 4 inches; depth, 128 feet. Water rises 10 feet above the surface.

The well was put down in 1887; and it has furnished a continuous flow of sulphurous water, ever since. The water evidently comes from the upper water-bearing stratum, which is reported in the various wells along the coast farther south.

THE BARRINGTON WELL

BARRINGTON

Elevation, unknown; diameter, 3 inches; depth, 450 feet. Water rises 20 feet above the surface.

This well, which furnishes 200 gallons per minute, was completed in 1895, at a cost of $600. The water is used for general domestic purposes, and also to supply the engines of the Florida Central & Peninsular R. R. Two flows are reported in this well — one, at 350 feet, and the other, at 450 feet. The strata, passed through, are said to be about the same, as in the Brunswick wells.

THE CREYTON'S ISLAND WELL

NEAR CRESCENT P. O.

Elevation, 10 feet; diameter, 3 inches; depth, 414 feet. Water rises 50 feet above the surface.

In this well, at the depth of 320 feet from the surface, a dark-colored rock, 20 feet in thickness, is reported to have been penetrated. Samples of this rock, forwarded to the writer by Mr. Geo. E. Atwood, the owner of the well, were found to be an impure manganese deposit. Coral rock and beds of water-worn gravel are also said to occur; but neither their thickness nor depth from the surface was given.

Other wells are reported in the county, located at Ridgeville, Inwood and Doboy, and on Union and Sapelo islands.

LIBERTY COUNTY

There are seven artesian wells in Liberty county, all of which, except two, are located on St. Catherine's Island.

H. H. GILMER'S WELL

RICEBORO

Elevation, unknown; diameter, 4 inches; depth, 430 feet. Water rises over 24 feet above the surface.

This well, which was put down in 1896, flows about 100 gallons per minute. The water is medium soft, and is used for general domestic purposes. The strata, passed through, are said to have been sand, clay, marl and flint. The latter, which was struck at 400 feet from the surface, is reported to have been 15 feet in thickness. Wells, of the above size and depth, are said to cost, in the vicinity of Riceboro, only about $1.00 per foot. The unusually low price per foot is due to the scarcity of hard rock in the wells.

THE FLORIDA CENTRAL & PENINSULAR R. R.'S WELL

RICEBORO

Elevation, unknown; diameter, 3 inches; depth, 460 feet. Water rises more than 20 feet above the surface.

This well was constructed in 1895, by the Florida Central & Peninsular R. R., for the purpose of supplying the boilers of its locomotives with water. Two flows are reported — one at 350 feet,

and the other at 450 feet. The strata, passed through, were sand, clay and a few thin layers of hard rock. The flow is estimated at 150 gallons per minute.

THE ST. CATHERINE'S ISLAND WELL

Elevation, 22 feet; diameter, 3 inches; depth, 300 feet. Water rises 33 feet above the surface.

There are five wells on St. Catherine's Island, all of the same size and depth. They are owned by J. Raners of Savannah. These wells were bored in 1889, at a cost of about $250 each. The flow is said to be slightly affected by the tides, which cause a difference of pressure equal to a variation of about 18 inches in head. Four of these wells are cased to the depth of 200 feet; and they have shown no perceptible variation in flow, since their completion; while the fifth, cased to a much less depth, has become filled with sand, and has ceased to flow. The formations, passed through, are said to consist mainly of sand and marl, with a few thin layers of hard rock. The water contains a considerable amount of hydrogen sulphide.

BRYAN COUNTY

The only artesian well, so far reported from Bryan county, is located at Ways Station, on the right bank of Ogeechee river, 15 miles southwest of Savannah. This well, which is 3 inches in diameter, and 460 feet in depth, was put down in 1895, by the Florida Central & Peninsular R. R., in order to obtain water for steam pur-

poses. Two water-bearing strata are reported — one at 340 feet from the surface, and the other at 440 feet. The water is hard and sulphurous, and rises to a height of 20 feet above the surface. The flow is estimated at 200 gallons per minute. Much sand, some clay and a few thin layers of rocks are reported in the well.

CHATHAM COUNTY

There are a great number of artesian wells in Chatham county, many of which are flowing, and furnish an abundant supply of excellent water, suitable for domestic and steam purposes.

THE TYBEE ISLAND WELLS

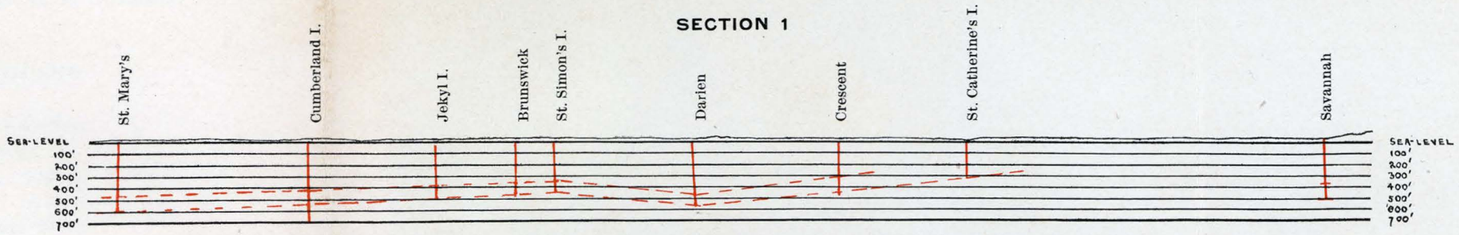
TYBEE ISLAND

Among the earliest successful artesian wells, bored in Chatham county, are those located at the famous Tybee Island resort, 12½ miles southeast of the city of Savannah. The first of these wells, which is only two inches in diameter, was put down in 1885, under the direction of Capt. D. G. Purse, formerly, owner of the greater part of the island. The well has a depth of 240 feet, and furnishes a strong flow of water, rising 15 feet above the surface. Shortly after the completion of this well, two others were bored, furnishing the same flow, at an equal depth. One of these last wells, which is located at the north end of the island, near the steamboat landing, is affected by the tide; but the water differs but little, chemically, from that obtained from the other wells. The water, which

GEOLOGICAL SURVEY OF GEORGIA

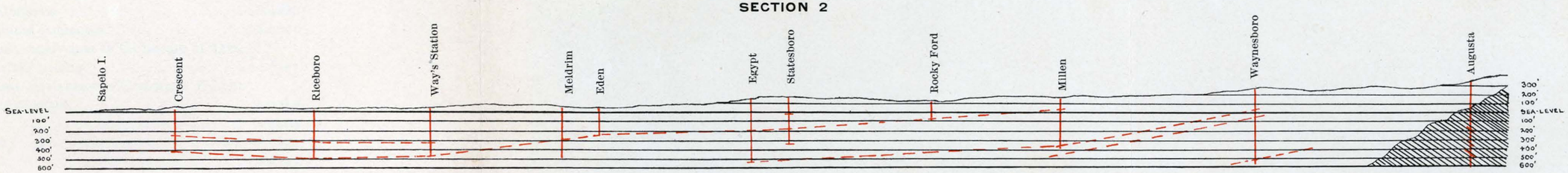
THE ARTESIAN-WELL SYSTEM OF GEORGIA

SECTION 1



CROSS-SECTION FROM SAVANNAH TO ST. MARY'S, SHOWING THE ARTESIAN WELLS AND WATER-BEARING STRATA IN RED. See Map.

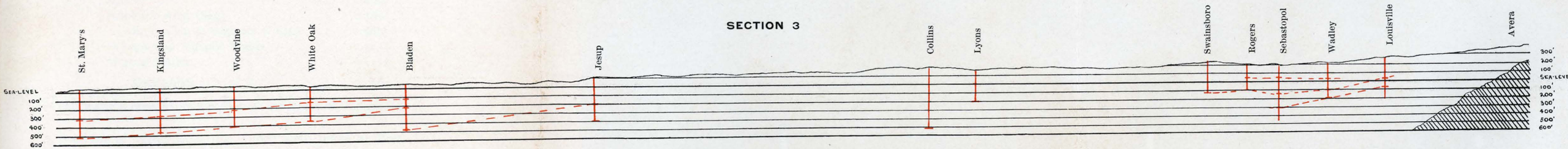
SECTION 2



CROSS SECTION FROM AUGUSTA TO SAPELO ISLAND, SHOWING THE ARTESIAN WELLS AND WATER-BEARING STRATA IN RED. See Map.

Shaded Lines Indicate Crystalline Rocks.

SECTION 3



CROSS-SECTION FROM AVERA TO ST. MARY'S, SHOWING THE ARTESIAN WELLS AND WATER-BEARING STRATA IN RED. See Map.

Shaded Lines Indicate Crystalline Rocks.

is used for general domestic purposes, is shown by the following analyses, kindly furnished by Captain D. G. Purse, President, Savannah & Tybee Rwy. Co., to be of excellent quality: —

Analysis of water from the Tybee well, by Dr. C. F. Chandler, of New York City, in 1886:—

Appearance in two foot tube, clear, very light straw color. Odor, none. Taste, none.

	Grains in one U. S. Gallon of 231 cubic ins.
Chlorine in Chlorides	0.7231
Chlorine, equivalent to Sodium Chloride	1.1920
Phosphates	Faint traces
Nitrites	None
Nitrogen in Nitrates and Nitrites	0.0134
Free Ammonia	0.0026
Albuminoid Ammonia	0.0055
Hardness, equivalent to Carbonate of Lime — before boiling	5.6327
Hardness, equivalent to Carbonate of Lime — after boiling	3.7715
Soda	1.3464
Potassa	0.1844
Lime	1.8142
Magnesia	1.0322
Oxide of Iron and Alumina	0.0233
Silica	2.4902
Sulphuric Acid (SO_3)	0.5691
Equivalent to Sulphate of Lime	0.9675
Organic and Volatile Matter	0.5832
Mineral Matter	6.4152
Total solids at 110° C.	6.9984

This water is remarkably free from all evidences of contamination.

Analysis of water from the Tybee well, made by Prof. H. C. White, of the University of Georgia, in 1885:—

Solid Matters Dissolved	Grains per U. S. Gallon
Carbonate of Lime	6.1328
Chloride of Sodium	1.4411
Sulphate of Soda	2.1263
Sulphate of Lime	0.7542
Sulphate of Magnesia	0.0563
Carbonate of Iron	0.0182
Silicate of Soda	0.1232
Silica	0.0655
Organic Matter and Combined Water	0.1022
Total Solids Dissolved	10.8198

Nitrates, free and albuminoid ammonia, practically none.

Prof. White gives the following additional notes on the water from the Tybee well:—

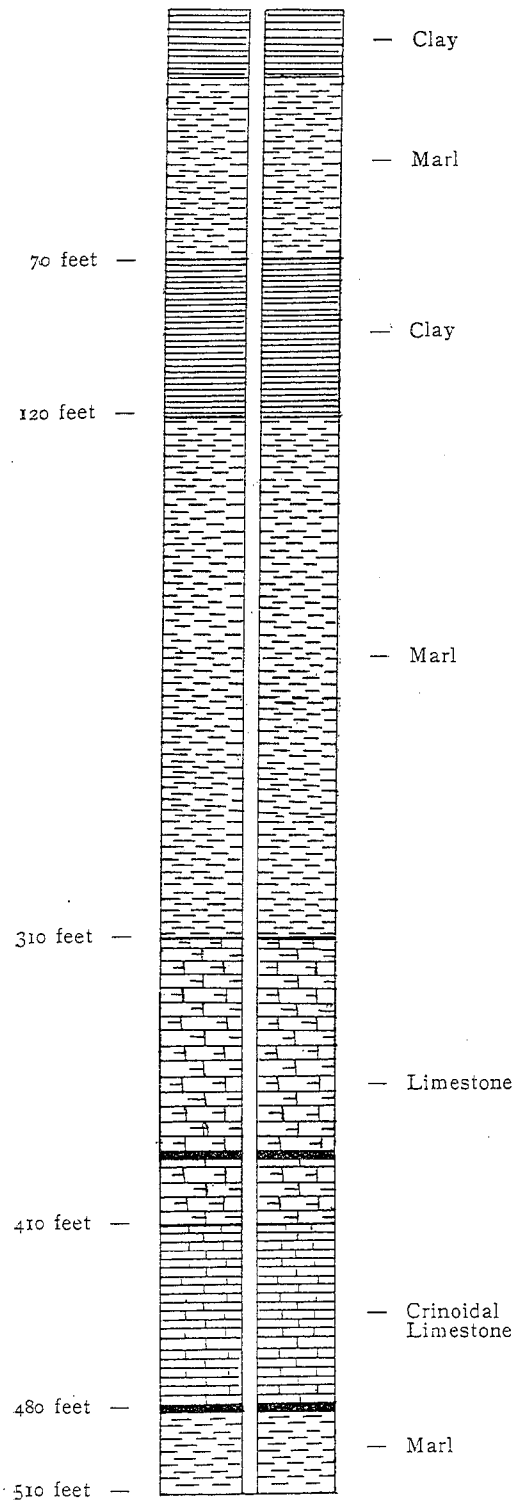
"It closely resembles, in the character and relative proportions of dissolved matters, the water from your artesian well in Savannah, but differs from this in the total contents of solid matter. The Tybee water is consequently of rather better quality. This is true artesian water of the very best quality. It is totally free of injurious matters, mineral or organic, and is all that can be desired as an excellent drinking water. I have no hesitation in asserting my belief that you have secured an unfailing supply of excellent, healthful water."

SAVANNAH WELLS

SAVANNAH

There are at present, within the corporate limits of Savannah, no less than 50 artesian wells, 38 of which belong to the city. On page 64, a letter from Capt. D. G. Purse is given, in which the history of the well sunk by himself and Col. J. H. Estill is detailed.

Fig. 17



Section of the Savannah Artesian Wells, Constructed from Samples of Well-borings.

The success of this well demonstrated the fact, that there existed beneath the city an extensive supply of artesian water; and, in a short time, other wells were begun and successfully completed.

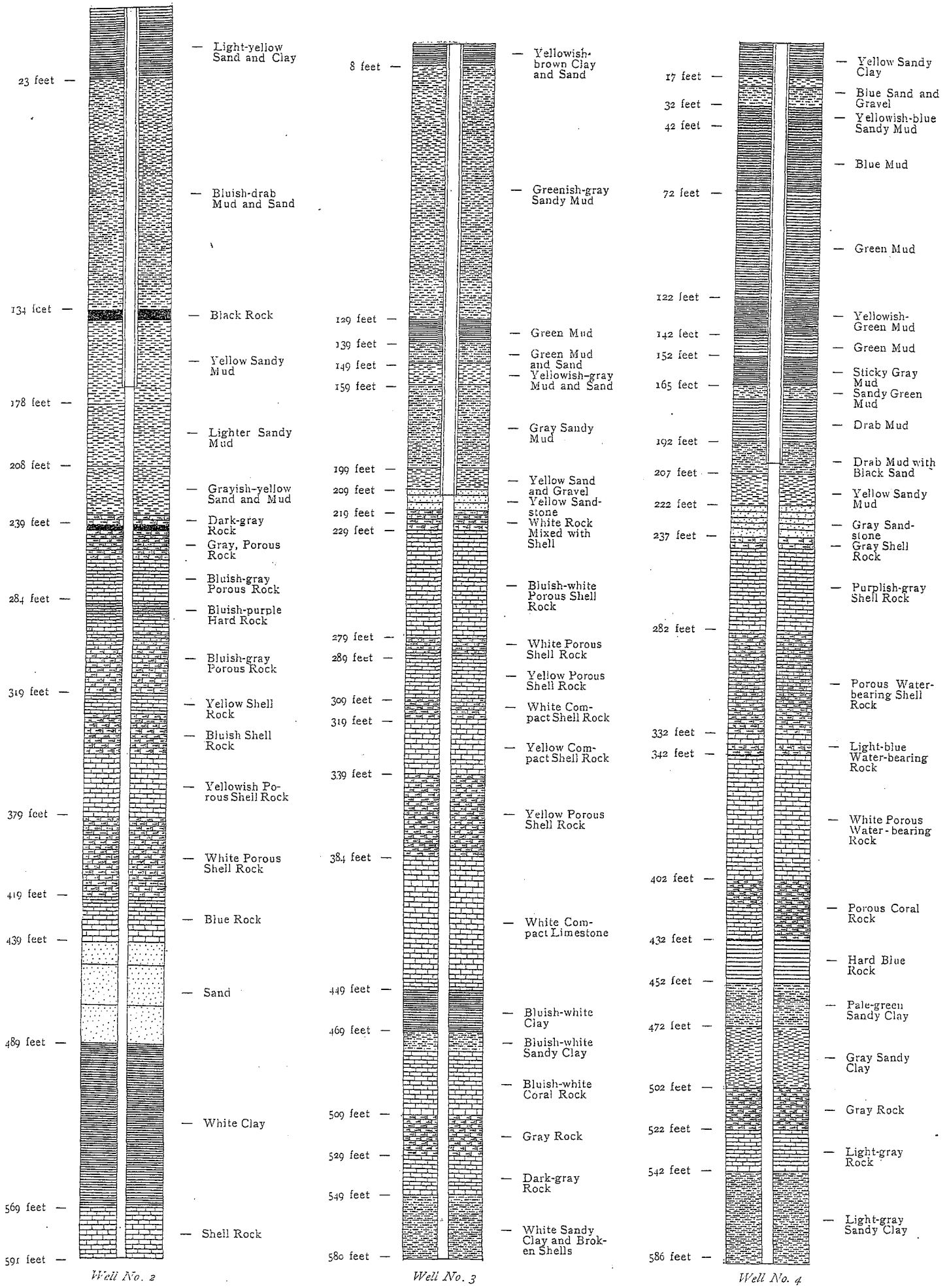
There is now probably no city in the South, which possesses a more complete and wholesome water-supply system, than the city of Savannah. The water, at present, is obtained from thirteen 12-inch artesian wells, varying from 475 to 700 feet in depth. These wells, which supply to the city 7,000,000 gallons of pure, crystal water daily, are located, along an irregular line, about 100 yards apart. The water from all the wells flows into a common aqueduct, which has sufficient grade to carry the water, with a considerable current, to the pumping-station, from whence it is forced into the mains, by powerful engines, and is finally distributed throughout the city, without the intervention of reservoirs or stand-pipes.

The old water-works, long since abandoned, were sup-

plied with water from 25 wells, having the following diameter, depth and elevation above the sea-level: —

Number	Diameter	Depth	Elevation above Mean Low Water
1	10 inch	380 feet	18.62 feet
2	10 "	" "	" "
3	10 "	" "	18.07 "
4	6 "	" "	17.73 "
5	6 "	" "	18.37 "
6	6 "	" "	19.15 "
7	6 "	" "	10.14 "
8	6 "	" "	20.66 "
9	6 "	" "	20.76 "
10	6 "	" "	18.85 "
11	6 "	" "	17.97 "
12	6 "	" "	17.34 "
13	4 "	" "	19.40 "
14	6 "	" "	18.36 "
15	6 "	" "	19.14 "
16	6 "	" "	17.07 "
17	6 "	" "	16.07 "
18	6 "	" "	17.47 "
19	6 "	436 "	16.12 "
20	6 "	470 "	16.60 "
21	6 "	402 "	10.35 "
22	6 "	417 "	10.77 "
23	6 "	430 "	10.25 "
24	10 "	500 "	13.14 "
25	10 "	500 "	15.96 "

Fig. 18


23 feet
Light-yellow Sand and Clay
Bluish-drab Mud and Sand
134 feet
Black Rock
Yellow Sandy Mud
178 feet
Lighter Sandy Mud
208 feet
Grayish-yellow Sand and Mud
239 feet
Dark-gray Rock
Gray, Porous Rock
Bluish-gray Porous Rock
284 feet
Bluish-purple Hard Rock
Bluish-gray Porous Rock
319 feet
Yellow Shell Rock
Bluish Shell Rock
Yellowish Porous Shell Rock
379 feet
White Porous Shell Rock
419 feet
Blue Rock
439 feet
Sand
489 feet
White Clay
569 feet
Shell Rock
591 feet
Well No. 2
8 feet
Yellowish-brown Clay and Sand
Greenish-gray Sandy Mud
129 feet
Green Mud
139 feet
Green Mud and Sand
149 feet
Yellowish-gray Mud and Sand
159 feet
Gray Sandy Mud
199 feet
Yellow Sand and Gravel
209 feet
Yellow Sandstone
219 feet
White Rock Mixed with Shell
229 feet
Bluish-white Porous Shell Rock
279 feet
White Porous Shell Rock
289 feet
Yellow Porous Shell Rock
309 feet
White Compact Shell Rock
319 feet
Yellow Compact Shell Rock
339 feet
Yellow Porous Shell Rock
384 feet
White Compact Limestone
449 feet
Bluish-white Clay
469 feet
Bluish-white Sandy Clay
Bluish-white Coral Rock
509 feet
Gray Rock
529 feet
Dark-gray Rock
549 feet
White Sandy Clay and Broken Shells
580 feet
Well No. 3
17 feet
Yellow Sandy Clay
32 feet
Blue Sand and Gravel
42 feet
Yellowish-blue Sandy Mud
Blue Mud
72 feet
Green Mud
122 feet
Yellowish-Green Mud
142 feet
Green Mud
152 feet
Sticky Gray Mud
165 feet
Sandy Green Mud
Drab Mud
192 feet
Drab Mud with Black Sand
207 feet
Yellow Sandy Mud
222 feet
Gray Sandstone
237 feet
Gray Shell Rock
Purplish-gray Shell Rock
282 feet
Porous Water-bearing Shell Rock
332 feet
Light-blue Water-bearing Rock
342 feet
White Porous Water-bearing Rock
402 feet
Porous Coral Rock
432 feet
Hard Blue Rock
452 feet
Pale-green Sandy Clay
472 feet
Gray Sandy Clay
502 feet
Gray Rock
522 feet
Light-gray Rock
542 feet
Light-gray Sandy Clay
586 feet
Well No. 4

The following chemical analysis of the artesian water was made by Dr. C. F. Chandler, of New York City, in 1886: —

Appearance in two foot tube . . .	Clear, colorless
Odor	None
Taste	None
Grains in one U. S. Gallon of 231 Cubic Inches	
Chlorine in Chlorides	0.6192
Equivalent to Sodium Chloride	1.0218
Phosphates	Traces
Nitrites	None
Nitrogen in Nitrates	0.0288
Free Ammonia	None
Albuminoid Ammonia	0.0017
Hardness, equivalent to Carbonate of Lime — before boiling	4.0463
Hardness, equivalent to Carbonate of Lime — after boiling	1.7804
Soda	0 7987
Potassa	0.1252
Lime	2.0344
Magnesia	0.7093
Oxide of Iron and Alumina	0.0233
Silica	3.1929
Sulphuric Acid (SO_3)	0.5160
Equivalent to Sulphate of Lime	0.8772
Organic and Volatile Matter	0.5832
Mineral Matter	12.8299
Total Solids at 110° C.	13.4131

Biological Analysis: — 227 colonies in 1 cubic centimeter.

NOTES ON WELL-BORINGS OF THE SAVANNAH WELLS

From a series of thirty-four samples of well-borings, now kept on exhibition at the water-works station, the writer has made the following notes: —

10 30 feet — Fine, arenaceous, yellow clay, with a few fragments of fossiliferous limestone, more or less rounded by the action of water.

30 – 50 " — Dark, greenish-gray marl, containing rounded pebbles and fragments of oyster shells, with a few coprolitic particles.

50 – 60 " — The same as above.

60 – 70 " — " " " "

70 – 80 " — Very tough, dark-colored clays, with quartz pebbles and coprolitic granules.

80 – 90 " — Brownish-colored clay, containing dental plates of rays and minute rhombohedral crystals of calcite.

90 – 100 " — Greenish-gray clay, having fragments of shells and sharks' teeth.

100 – 120 " — The same as above; it also contains dental plates of rays.

120 – 130 " — Greenish-gray clay, frequently hardened into claystone.

130 – 160 " — The same as above.

160 – 180 " — Gray marl, with round pebbles and coprolitic material. Microscopic examination shows the marl to consist largely of rhombohedral crystals of calcite.

180 – 190 " — Greenish-gray marl, having water-worn pebbles of feldspar and quartz. Calcite crystals are also abundant.

190 – 200 " — The same as above.

200 – 210 " — " " " "

210 – 230 feet — Dark-gray clay, with a few water-worn pebbles.

280 – 290 " — Dark-gray, highly calcareous clay, containing fragments of corals, sea-urchins etc.

300 – 320 " — White, porous, concretionary, fossiliferous limestone, foraminifera, fragments of oyster shells and spines of sea-urchins, common.

320 – 330 " — More or less compact, gray limestone, having fossils similar to those of the overlying beds; also a few remains of gastropods.

330 – 400 " — White, concretionary limestone, with fossils similar to the above.

400 – 410 " — Gray marl, often hardened into a porous rock, containing fragments of oysters, pectens, crinoid stems, foraminifera and small crystals of calcite.

410 – 413 " — The same as above, except that it has fewer crinoid stems.

413 – 440 " — Very white, chalky limestone, made up largely of coral.

440 – 450 " — Gray coralline limestone, having many crinoid stems and grains of green sand or glauconite.

450 – 475 " — The same as above; glauconite granules, common.

475 – 510 " — Dark, greenish-gray marl, with glauconite forming casts of corals and foraminifera.

The specimen also contains fragments of compact coralline limestone, which probably formed thin layers in the marl.

Besides the city wells, each hotel, ice factory and brewery owns from one to five artesian wells. None of the wells are flowing; but, however, each furnishes large quantities of water, which rises to within a few feet of the surface. One of the wells within the corporate limits, is said to have been driven to a depth of about 1,500 feet. This well, which is reported to pass through limestone below the 700-foot level, yields a considerable quantity of water in excess of the shallower wells.

Near the city limits at Thunderbolt and Bonaventure, are flowing wells, all of which attain about the same depth, and penetrate formations, similar to those in the city.

EFFINGHAM COUNTY

Only four artesian wells are reported from Effingham county. These wells all belong to the Central of Georgia Railway; they were constructed, in order to obtain water, for use in boilers. These wells are located at Meldrim, Eden and Egypt.

THE MELDRIM WELL

MELDRIM

Elevation, 39 feet; diameter, 6 inches; depth, 538 feet. Water, flowing.

No information was received, concerning the nature of the different strata perforated in this well, the character of the water obtained, or the number and the depth of the water-bearing beds.

THE EDEN WELLS

EDEN

Elevation, 34 feet; diameter, 6 inches; depth, 280 feet and 311 feet. Water rises 12 feet above the surface.

Each of these wells is said to flow about 130 gallons of sulphurous water per minute. Only one flow is reported, which was struck, about 275 feet from the surface. The strata penetrated are said to have been clay and marl, with thin layers of hard rock.

THE EGYPT WELL

EGYPT

Elevation, 143 feet; diameter, 4 inches; depth, 750 feet. Water rises to within 45 feet of the surface.

Two water-bearing strata were struck in the well — one at about 300, and the other, at 750 feet. Neither, however, brought the water nearer than 45 feet to the surface. The strata, passed through, are said to have been sand, clay and marls, followed by white limestone. The Central Railway had this well put down, to supply their engines with water; but, for some reason, it was never supplied

with a pump; and, consequently it has never been used, except to a limited extent.

BULLOCH COUNTY

Only one attempt to obtain artesian water has been reported from Bulloch county. This well, belonging to W. D. Davis, of Statesboro, has been put down to the depth of 320 feet, without obtaining a flow. It was learned, that the well would soon be extended to a greater depth, in order to obtain the desired flow.

SCREVEN COUNTY

There are fifteen artesian wells reported from Screven county, located, severally, at Rocky Ford, Ogeechee, Millen, Sylvania and Haides.

THE ROCKY FORD WELLS

ROCKY FORD

Elevation, 117 feet; diameter, 4 inches; depth, 180 feet. Water rises 15 feet above the surface.

Rocky Ford has seven artesian wells, all of the same size and depth, with similar flows. All these wells have been put down

since 1893, at an average cost of about $200 per well. Each well flows about 45 gallons per minute. The water is sulphurous, and contains calcium carbonate, magnesia and other mineral substances. The first flow is said to have been obtained at one hundred feet from the surface, gradually increasing to the bottom of the wells. Sand, clay, marl and five or six beds of consolidated rock, probably limestone, are reported to have been perforated, in sinking these wells.

The following sanitary analysis, of the water from the Rocky Ford wells, has been furnished by Dr. George F. Payne, State Chemist:—

Solid Matter per U. S. Gallon . . .	13.53 grains
Chlorine " " " . . .	.41 "
Free Ammonia, parts per million . .	.061
Albuminoid Ammonia, parts per million	.050

THE MILLEN WELLS

MILLEN

Elevation, 157 feet; diameter, 4 and 6 inches; depth, from 430 to 450 feet. Water rises 19 feet above the surface.

There are five artesian wells within the corporate limits of Millen, all of which attain about the same depth, and are supplied with water from the same stratum. Two different water-bearing strata were struck in each of these wells — one, at 165, and the other, at 430 feet from the surface. The water-supply, at present, is obtained from the lower stratum, the upper being cased off. In digging these wells, the contractor reports red and yellow clays, to the depth of 90 feet. Beneath the clays, and extending to the bot-

tom of the wells, occur bluish marls, interlaminated with beds of limestone, which vary in thickness from 2 to 16 feet. Lignite and pyrite are also reported to occur in the wells; but their depth from the surface could not be ascertained. The water from all the wells, which is now used for general domestic and boiler purposes, has a very decided odor of hydrogen sulphide. This unpleasant smell, however, disappears upon being exposed to the atmosphere.

THE SYLVANIA WELL

SYLVANIA

Elevation, unknown; diameter, 3 inches; depth, 285 feet. Water rises to within 80 feet of the surface.

This well was put down in 1895 by L. H. Hilton, at a cost of $350. Only one water-bearing stratum is reported in the well; and this was struck immediately beneath a hard, compact rock, about 280 feet from the surface. The water is hard, and apparently exists in large quantities, as continued pumping fails to lower the head.

The following strata were passed through, in boring the well: —

1 Red clay ---------- 60 feet
2 Light-colored clay ---------- 100 "
3 Thin layers of hard rock, interlaminated with coarse black sand, to bottom of well.

BURKE COUNTY

Successful artesian wells are reported in Burke county, at Waynesboro, Herndon, Rogers and Sebastopol, and on Dr. Johnson's plantation, 10 miles northeast of Louisville.

THE WAYNESBORO WELL

WAYNESBORO

Elevation, 286 feet; diameter, 6 inches; depth, 992 feet. Water rises to within 14 feet of the surface.

The Waynesboro well, which belongs to Mr. W. A. Wilkins, was put down in 1888, at a cost of $1,600. Water-bearing strata are reported at 250, 300 and 900 feet. The water-supply, at present, is obtained from the upper stratum, which furnishes large quantities of wholesome, hard water, which is used for general domestic purposes.

Through the kindness of Mr. R. G. Edenfield, of Augusta, the contractor for the Waynesboro well, the writer has received a number of samples of borings from the well, on which were made the following notes:—

40 – 60 feet — Fine, red sand.
60 – 150 " — Yellow sand.
150 – 230 " — Coarse, sharp, white sand, with fragments of shells.
230 – 240 " — Rather coarse, gray sand.
240 – 290 " — Gray, sandy marl.

290 – 310 feet — Fine, yellow sand.

310 – 340 " — Very coarse sand, with dark-colored pebbles, numerous minute crystals of gypsum, and somewhat rounded pieces of very compact, tough clay.

340 – 360 " — Gray, coarse sand with some clay.

360 – 380 " — Dark, sandy clay with numerous fragments of bones and sharks' teeth.

380 – 410 " — Coarse, gray sand, the particles quite angular.

410 – 500 " — The same as above, except that the particles are somewhat finer.

500 – 700 " — Coarse, red sand. Considerable limestone and flint are reported to have been taken from this well; but the thickness and depths of the beds are not given.

THE ROGERS WELL

ROGERS

Elevation, 201 feet; diameter, 4 inches; depth, 351 feet. Water rises 24 feet above the surface.

The Rogers well was put down in 1889, by Mr. W. O. Wadley, at a cost of $400. It furnishes 80 gallons of water per minute, which is used for domestic and boiler purposes. Two water-bearing strata were struck in the well, one, at 180, and the other, at 330 feet from the surface. The formations, passed through, are said to be similar to those in the Millen wells.

THE SEBASTOPOL WELL

SEBASTOPOL

Elevation, 201 feet; diameter, 6 inches; depth, 676 feet. Water rises to within 2 feet of the surface.

The Sebastopol well is a private property, belonging to Mr. T. J. Jones. Water-bearing strata were struck at 200, 345 and 500 feet; but neither yielded a flow. No information has been received, concerning the different formations penetrated.

THE HERNDON WELL

HERNDON

Elevation, 189 feet; diameter, 2 inches; depth, 300 feet. Water rises 14 feet above the surface.

The Herndon well was completed in 1885, at a cost of about $300. It flows 30 gallons of water per minute, which is said to be quite hard, but very wholesome; it is used, generally, for domestic purposes. Quicksand, marl and honeycombed limestone are said to have been passed through in sinking the well; but their order, thickness etc. were not ascertained. The water-supply is reported to be obtained from the porous, cavernous limestone, near the bottom of the well.

DR. JOHNSON'S WELL

DRY CREEK

Elevation, unknown; diameter, 2 inches; depth, 763 feet. Water rises to within 30 feet of the surface.

Two water-bearing strata were struck in this well — one, at 280, and the other, at 375 feet from the surface. The water from the former rises to within 30 feet of the surface, and the latter, 80 feet. The strata passed through are said to be similar to those of the Louisville wells.

RICHMOND COUNTY

Only two deep wells have been attempted in Richmond county, both of which are located within the corporate limits of Augusta. They yield an abundant supply of palatable water. The first of these wells was put down, soon after the civil war, by The Georgia Chemical Company, and the other, in 1889, by the United States Government, at the Arsenal.

THE ARSENAL WELL

AUGUSTA

Elevation, 327 feet; diameter, 8 inches; depth, 814 feet. Water rises to within 196 feet of the surface.

ARTESIAN WELL ON THE PROPERTY OF MR. E. J. WILSON, AT MONTEZUMA, GEORGIA, THE FLOW OF WHICH RISES TO A HEIGHT OF SIXTY FEET ABOVE THE SURFACE.

Capt. D. M. Taylor, of the Ordnance Department of the U. S. A., has furnished the following notes on the Arsenal well: —

"Three water-bearing strata were struck in the well, at 500, 600 and 700 feet, respectively. As much as 1,080 gallons per hour has been pumped from the well, without perceptibly lowering the head. The water is hard, and slightly chalybeate. The first 85 feet, passed through, consisted of sand, red clay and gravel. Hard, chloritic slate was reached at 280 feet, which was followed by a similar rock, with occasional thin seams of quartz, to 700 feet. The rock varied in hardness, occasionally being comparatively soft, but, generally, very hard and tough, the softer rock being met with immediately above the water-courses and including them; and the hardest, immediately below these water-courses. Near the bottom of the well, was found a greenish quartz rock."

Capt. Taylor is of the opinion, that there is another water-bearing layer, not noted above, between the 150- and 200-foot levels. This belief he bases on the fact, that there are several wells in the city, and one at the arsenal, which are supplied by water from this depth. In speaking of these wells, Capt. Taylor says: — "I have one at the Arsenal, from which the main supply of water is now obtained. It is about 160 feet deep, and five or six feet in diameter; and the water stands in it at a constant depth of between 9½ and 11 feet, not varying at all, from local rains or droughts. It is usually pumped dry every day, and fills again, for the next day's pumping. This water I consider much better, than that from the artesian well."

Ideal Section from Augusta to Darien, Showing How the Strata Dip toward the Ocean.

Fig. 19

THE GEORGIA CHEMICAL WORKS' WELLS

AUGUSTA

Elevation, 327(?) feet; diameter, 6 inches; depth, 879 feet. Five different water-bearing strata are reported to have been perforated in this well, at the following depths:—

1	Between	150	and	190	ft.,	water	rising	90	ft.	from	the	surface
2	"	200	"	300	"	"	"	80	"	"	"	"
3	"	500	"	600	"	"	"	75	"	"	"	"
4	"	600	"	700	"	"	"	75	"	"	"	"
5	"	800	"	900	"	"	"	45	"	"	"	"

Water from the fourth water-bearing layer is said to be somewhat brackish; while that obtained from the other layers is hard and slightly chalybeate. The greater part of this well was driven in hard, compact crystalline rock. The first water-supply is probably obtained near the base of the cretaceous sands and gravels, overlying the crystalline schists and gneisses.

JEFFERSON COUNTY

The artesian wells of Jefferson county, 19 in number, are located at Wadley, Old Town and Louisville. These wells, with only one or two exceptions, are flowing, and furnish excellent water for domestic purposes.

THE WADLEY WELLS

WADLEY

Elevation, 243 feet; diameter, from 2 to 6 inches; depth, from 330 to 445 feet. Water rises 20 feet above the surface.

There are 13 wells at Wadley, all flowing, and furnishing about the same character of water. The first of these wells was put down, about 10 years ago. Since then, they have become so numerous, that the amount of flow from the older wells is said to have been perceptibly decreased. An attempt was made, a short time ago, to run a mill, by water from two or three of these wells; but the experiment proved unsuccessful. At present, the power from one of these wells is utilized to operate a hydraulic ram, which forces water into the tank of the Central Railway, located on a high elevation, several hundred yards away.

Three water-bearing strata were struck in these wells, at the 170-, 330- and 430-foot levels. The water from these different strata, which is slightly chalybeate, rises from 4 to 20 feet above the surface. It is used for general domestic purposes, and also by the Central Railway for its boilers.

Mr. M. M. Caldwell, one of the contractors, furnishes the following notes on the various strata, passed through, in sinking these wells:—

1	Yellow clay	60 feet
2	Blue marl	100 "
3	Sand	2 "
4	Marl and limestone	250 "
5	Sand	(?)

THE LOUISVILLE WELLS

LOUISVILLE

There are five artesian wells at Louisville; only three, however, which are located on low ground at the Fair Grounds, are flowing. These wells vary in depth from 350 to 450 feet, and are from 2 to 4 inches in diameter. They supply the city with an abundance of wholesome water, which is used for both domestic and boiler purposes. Water-bearing strata were struck in these wells at 200 and 300 feet, the main water-supply being obtained from the latter stratum.

The following notes, on the strata penetrated in putting down the wells, were obtained from Mr. G. H. Harrell: —

1	Red, motley clays	25 feet
2	Fine, yellow sand	40 "
3	Quicksand	6 "
4	Marl, with fragments of shells	8 "
5	Blue marl	100 "
6	Flint	½ "
7	Marl, honeycombed rock and lignite	100 "
8	Coarse sand, with much mica	(?)

There is also another well, located at a water-station, two miles south of Louisville, on the Louisville and Wadley R. R. This is a 4-inch well, 325 feet in depth; and it furnishes 20 gallons of water per minute. Two water-bearing strata were struck in the well — one, at 150, and the other, at 300 feet from the surface. The former furnishes only a slight flow; while the water from the latter rises 20 feet above the surface.

THE OLD TOWN WELLS

OLD TOWN

Elevation, unknown; diameter, 3 inches; depth, 225 feet. Water rises 28 feet above the surface.

There are two artesian wells at Old Town, both having about the same flow, and furnishing water, of a similar character. They were put down, about ten years ago, at a cost of about $400, each. Water-bearing strata are reported at the 160- and 200-foot levels. Clays, sands, marls and limestones are said to have been passed through, in sinking the well; but their thickness and depth from the surface are not given.

WASHINGTON COUNTY

Artesian wells have been attempted in Sandersville, Tennille and Davisboro; but only at the last named place has complete success been met with.

THE TENNILLE WELL

TENNILLE

Elevation, 477 feet; diameter, 12 inches at the top and 4 at the bottom; depth, 990 feet. Water rises, at present, to within 190 feet of the surface.

This well was begun in 1892; and, after the expenditure of several hundred dollars, it was abandoned before its completion. It was started as a 12-inch well; but it was decreased in diameter at several levels, until it was finally reduced to four inches, near the bottom. The two principal water-bearing strata in the well were struck, at 426 and 830 feet from the surface. Water from the first stratum rose to within 90 feet of the surface; while that, obtained from the second stratum, lacked a hundred feet of rising to the same level.

The following notes were copied from the records, made by the contractor, at the time the well was being bored. They do not appear to be very accurate; but, nevertheless, they give a general idea of the character of the various strata penetrated:—

1	Sandy clay	38 feet
2	White clay	14 "
3	Yellow, sandy clay	28 "
4	White sand	11 "
5	Yellowish limestone, in the form of boulders	5 "
6	Gray sand	7 "
7	White sand	27 "
8	White sandstone, containing shells	10 "
9	Bluish marl	45 "
10	Yellow clay	9 "
11	Brownish-colored sand, containing sharks' teeth and fragments of oyster shells	15 "
12	Blue marl	50 "
13	Quicksand	10 "
14	Blue marl	30 "
15	White clay	10 "
16	Blue clay	40 "

17	Blue and gray sands	10 feet
18	Blue clay	44 "
19	Quick sand	32 "
20	White clay and sand	4 "
21	Coarse, white sand	30 "
22	White, "sticky" clay	30 "
23	Red clay	30 "
24	White clay	20 "
25	Clay and sand to the bottom, except at the 820-foot level, where a sandstone was penetrated.	

The writer was able to secure a few specimens from this well, on which were made the following additional notes:—

30 – 50 feet — White clay or kaolin.

55 " — Brown clay and sand. The grains of sand are water-worn, and are often as large as 1-16 of an inch, or more, in diameter.

90 " — White limestone, with many fragments of corals and shells.

150 " — Light-brown sand, containing pieces of oyster shells.

190 " — An imperfect peat.

250 " — Specimen of lignite.

347 " — Oyster shell, well preserved, and 8 inches in length.

In addition to the above, there were also secured specimens of fossil soil, containing beautiful impressions of leaves and casts from branches of trees, formed of sand and marcasite; also many well-rounded quartz and feldspar pebbles, from ⅛ to 1½ inches in

diameter. Unfortunately, none of these last named specimens were labelled; and it is impossible to say, at what depth they were obtained.

THE DAVISBORO WELLS

DAVISBORO

Elevation, 302 feet; diameter, 3 inches; depth, from 200 to 300 feet. Water rises 5 feet above the surface.

Davisboro has two artesian wells, one belonging to Mr. T. L. Brown, and the other, to the city. The former is said to flow 300 gallons per hour, and the latter, only 5 gallons. The stratum, furnishing these flows, is located about 100 feet beneath the surface. No water-bearing stratum, yielding a flow, is reported, below the 100-foot level.

The water from each well is very wholesome, and is used for general domestic purposes. It has a uniform temperature of about 62° Fahr.

The following record of strata is given:—

1 – 20 feet — Loamy clays.
20 – 60 " — Hard, compact rock.
60 – 300 " — Marls, shell beds, sands and clays.

THE SANDERSVILLE WELLS

SANDERSVILLE

There are two deep wells at Sandersville, neither of which are flowing. Of one of these wells, owned by Louis Cohen, the following meagre notes are given:—

Depth ..... 375 feet
Water rises to within 55 feet of the surface.

The following is an analysis of the water by Dr. Geo. F. Payne, State Chemist:—

Solid Matter per U. S. Gallon . . .	14.35 grains
Chlorine " " " . . .	.26 "
Free Ammonia in parts per million .	.12
Albuminoid Ammonia in parts per million	.05

JOHNSON COUNTY

There are deep wells in Johnson county at Wrightsville and Hodo; but neither of them are flowing.

THE WRIGHTSVILLE WELL

WRIGHTSVILLE

Elevation, 275 feet; diameter, 8 inches; depth, 672 feet. Water rises to within 60 feet of the surface.

This well was put down in 1892, at a cost of $2,700. Water-bearing strata are reported, at 430 and 672 feet. No information was obtainable, concerning the different strata penetrated, except that they consisted of sand, marl, clay and hard rock.

WILKINSON COUNTY

Artesian wells were reported from Wilkinson county, at Irwinville, Toombsboro and Gordon. Two attempts have been made at Irwinville to obtain artesian water. The first of these wells, located on low ground in the city, was put down to the depth of 300 feet, at which point a water-bearing stratum, yielding a small flow, was obtained. This well continued to flow, for a time; but it finally became filled with sand; and it has since been abandoned. The water is said to have had a rather offensive odor, and an unpleasant taste, which were probably due to the presence of hydrogen sulphide and iron in solution.

Another well, located on high ground, was extended to the depth of 600 feet; but the water did not rise higher, than 50 feet from the surface.

THE TOOMBSBORO WELL

TOOMBSBORO

Elevation, 237 feet; diameter, 1¼ inches; depth, 320 feet. Water rises 3 feet above the surface.

This well was completed in 1882, at a cost of about $320. When first finished, it furnished about 8 gallons per minute; but it gradually decreased, until the flow entirely ceased, some four years after its completion. The gradual cessation of flow appears to have been due to the filling of the casing with sand.

THE GORDON WELL

GORDON

Elevation, 355 feet; diameter, 2 inches; depth, 365 feet. Water rises to within 19 feet of the surface.

Only one water-bearing stratum is reported to have been perforated in this well, which is located within a few feet of the bottom. Twenty feet of soft limestone, marl, sand and clay occur in the well.

PULASKI COUNTY

Artesian wells in Pulaski county are located at Hawkinsville and Cochran. No further attempts, as far as is known, have been made in the county, to obtain artesian water at other points.

THE HAWKINSVILLE WELLS

HAWKINSVILLE

Elevation, 235 feet; diameter, 2 and 6 inches; depth, 265 to 490 feet. Water rises 12 feet above the surface.

There are seven wells within the corporate limits of Hawkinsville, three of which belong to the city, while four are owned by private individuals. Two water-bearing strata were struck in the deeper wells, at 265 and 490 feet from the surface. Both strata furnish flowing water, which is soft but slightly sulphurous. The water is used for general domestic and boiler purposes.

The following record is given by Mr. L. L. Deering, a well-contractor:—

1	Red and yellow clays	40 feet
2	Limestone, with layers of blue clay	140 "
3	White limestone and clay	40 "
4	Blue clay	40 "
5	Coarse, water-bearing sand, containing sharks' teeth	100 "
6	Limestone interstratified with clay	130 "
7	Coarse, water-bearing sand	(?)

THE COCHRAN WELL

COCHRAN

Elevation, 379 feet; diameter, 6 inches; depth, 365 feet. Water rises to within 85 feet of the surface.

This well was put down, about two years ago, at a cost of $1,300. Only one water-bearing stratum is reported to have been perforated in this well; and this was struck at about 250 feet from the surface.

The different strata passed through, are said to be similar to those in the Hawkinsville wells.

LAURENS COUNTY

Six artesian wells are reported in Laurens county, five of which are situated in Dublin, the county-seat, and one at Alambrasia. The latter well belongs to J. H. Yopp, who reports it to be unsuccessful. No further information has been obtained about this well, except that it has an elevation of 50 feet above Dublin.

THE DUBLIN CITY WELL, No. 1

DUBLIN

Elevation, 452 feet; diameter, 4 inches; depth, 295 feet. Water rises 30 feet above the surface.

The various formations passed through in this well, are reported by Mr. L. L. Deering, the well-contractor, to be similar to those penetrated in the Hawkinsville wells, except that the limestone appears nearer the surface. Two water-bearing strata were struck in the well — one, at 185, and the other at 295 feet from the surface, both of which yield flowing water. The well furnishes about 100

gallons per minute. It cost, supplied with casing, $1,000. The water is used for general domestic and boiler purposes.

THE DUBLIN CITY WELL, No. 2

DUBLIN

Elevation, 452 feet; diameter, 8 inches; depth, 850 feet.

The first flow in the well was struck, at 350 feet from the surface. Between this point and the bottom of the well, other water-bearing strata were reported; but the height of flow was not given. The record of the borings from this well was not preserved.

A. A. COWART'S WELL

DUBLIN

Elevation, 452 feet; diameter, 3½ inches; depth, 275 feet. Water rises 24 feet above the surface.

The water-supply from this well comes from the upper water-bearing stratum. The amount of flow has been placed at 64 gallons per minute. The well was completed in 1896, at a cost of $200. Dr. L. B. Clifton, of Macon, by chemical analysis, found a sample of the water from this well to contain sodium chloride, calcium carbonate, iron carbonate, lithium bromide and aluminum silicate. The total amount of these solids, he places at 4.48 parts in a 1,000.

EMANUEL COUNTY

Emanuel county has three deep wells, two at Swainsboro and one at Stillman. A fourth well is reported, in this county, as formerly belonging to H. G. Smart & Co.; but its exact location and record have not been obtained.

JESSE THOMPSON & CO.'S WELL

SWAINSBORO

Elevation, unknown; diameter, 6 inches; depth, 400 feet. Water rises to within 80 feet of the surface.

The water-bearing stratum, which supplies this well, was struck at a depth of 370 feet from the surface. A trial test with a pump, having a capacity of 30,000 gallons per day, is said to have had no effect on the static head. The borings from the well are reported to have showed, that the different strata penetrated consisted of sand, clay, blue marl, and hard and soft rock, the last named being the most abundant. This well was put down in May, 1897, at a cost of $400.

R. J. WILLIAMS'S WELL

SWAINSBORO

Elevation, unknown; diameter, 2 inches; depth, 400 feet. Water rises to within 90 feet of the surface.

Three different water-bearing strata are reported to have been perforated in this well; but the height, to which the water rises from each, is not given. No information was obtained, concerning the formations penetrated. The static head in this well is said to vary slightly, from time to time. The amount of water furnished per hour has been placed at 600 gallons. The well, which was put down in May, 1894, cost $400.

No records of the other wells in Emanuel county have been received.

DODGE COUNTY

Two deep wells are reported from Dodge county, neither of which are flowing. One of these wells is at Eastman, the county-seat, and the other, at Chauncey, a station on the Southern Railway, several miles further to the southeast.

THE EASTMAN WELL

EASTMAN

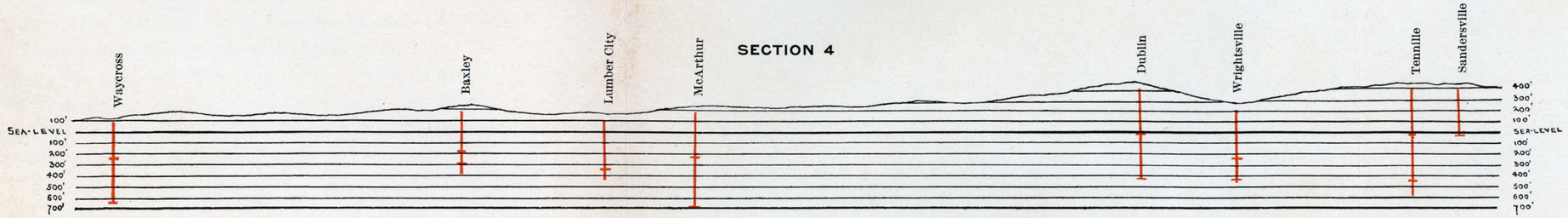
Elevation, 390 feet; diameter, 4 inches at the top and 3 at the bottom; depth, 680 feet. Water rises to within 120 feet of the surface.

Two or three different water-bearing strata are reported in this well; but the present water-supply is obtained from cavernous limestone, 625 feet from the surface. No record of the well-borings

GEOLOGICAL SURVEY OF GEORGIA

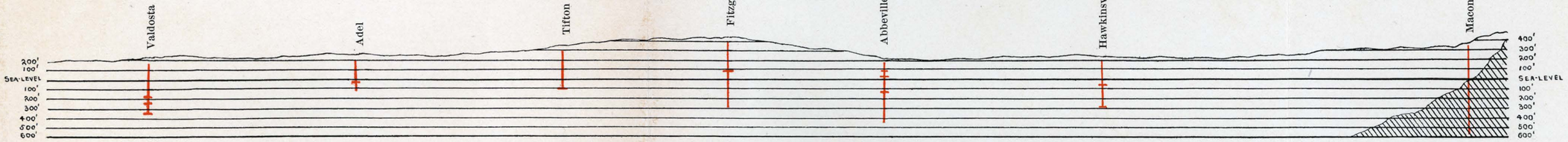
THE ARTESIAN-WELL SYSTEM OF GEORGIA

SECTION 4



CROSS-SECTION FROM SANDERSVILLE TO WAYCROSS, SHOWING THE ARTESIAN WELLS AND WATER-BEARING STRATA IN RED. See Map.

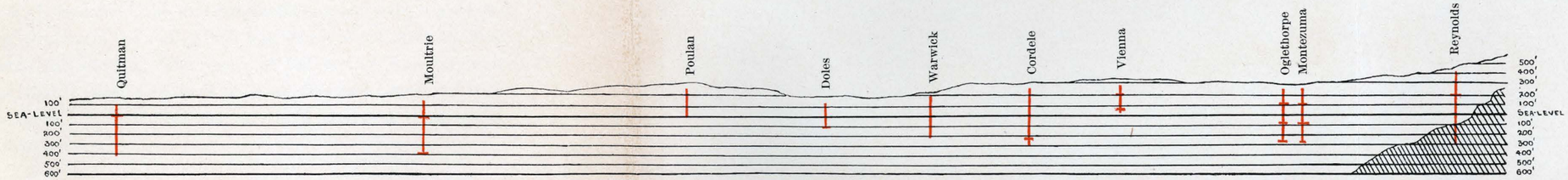
SECTION 5



CROSS-SECTION FROM MACON TO VALDOTA, SHOWING THE ARTESIAN WELLS AND WATER-BEARING STRATA IN RED. See Map.

Shaded Lines Indicate Crystalline Rocks.

SECTION 6



CROSS-SECTION FROM REYNOLDS TO QUITMAN, SHOWING THE ARTESIAN WELLS AND WATER-BEARING STRATA IN RED. See Map.

Shaded Lines Indicate Crystalline Rocks

was kept, and nothing is known of the formations penetrated, further than that they consist of sand, clay and hard rock, the latter being most abundant, and, in places, consisting largely of boulders, which greatly interfered with the drilling. The well was put down in 1892, at a cost, including casing, steam-pump etc., of about $3,000. Continuous pumping or long droughts do not affect the static head. The well furnishes daily about 30,000 gallons of water, which is used for general domestic purposes. Dr. George F. Payne, State Chemist, furnishes the following chemical analysis of a sample of water from the Eastman well:—

Total solids per U. S. gallon	15.16 grains
Chlorine " "	.23 "
Free Ammonia in parts per million .	.04
Albuminoids	.02

THE A. B. STEELE LUMBER CO.'S WELL

CHAUNCEY

Elevation, 320 feet; diameter, 6 inches; depth, 525 feet. Water rises to within 70 feet of the surface.

Mr. R. J. Edenfield, the well-contractor, reports only one water-bearing stratum in the well, which was struck about three hundred feet from the surface. The record of the borings from this well showed, that it penetrated beds of sand, clay and limestone, with an occasional layer of flint, one of which attains a thickness of more than ten feet.

MONTGOMERY COUNTY

Two deep wells are reported from Montgomery county — one at Lyons, in the eastern part of the county, and the other, at McArthur, in the southern part, near the Oconee river.

W. O. DONOVAN'S WELL

LYONS

Elevation, unknown; diameter, 3 inches; depth, 400 feet. Water rises to within 84 feet of the surface.

Mr. M. M. Caldwell, the contractor, furnishes the following notes on the well:—

1	Clay to	75 feet
2	Quicksand to	90 "
3	Blue clays, alternating with hard rock, to bottom of well.	

The first water-bearing stratum was struck, at 175 feet, from which water rose to within about 85 feet of the surface. The water-supply is obtained, at present, from the second water-bearing stratum, about 375 feet from the surface.

The well was completed in 1896, at a cost of $350. It is supplied with a steam-pump, and furnishes about 600 gallons of water per hour, which is used for domestic and steam purposes.

MRS. VICTORIA McARTHUR'S WELL

MCARTHUR

Elevation, 245 feet; diameter, 3 inches; depth, 900 feet. Water rises to within 60 feet of the surface.

The different formations, passed through in this well, are similar to those in the Lumber City well, to a depth of 500 feet. Below this depth, Mr. J. B. Spencer furnishes the following record: —

Hard flint	500 – 502 feet
Sandstone	502 – 525 "
Shell formations	525 – 625 "
Soft, white limestone	625 – 890 "

Water-bearing strata are reported to have been perforated in this well, at 419 and 890 feet, water from each rising to about the same level.

TATNALL COUNTY

The deep wells of Tatnall county are situated at Collins, Manassas and Claxton. No information has been received from the last named, further than that it belongs to the Georgia & Alabama R. R. Co., and is used to supply water for steam purposes on that road.

THE COLLINS WELL

COLLINS

Elevation, 238 feet; diameter, 8 inches; depth, 800 feet. Water rises to within 142 feet of the surface.

The only water-bearing stratum is said to be within a few feet of the bottom of the well. No record of the borings has been obtained. This well was put down by the Central Railway, in order to obtain water for steam purposes.

MRS. M. F. CUMMING'S WELL

MANASSAS

Elevation, 217 feet; diameter, 6 inches; depth, 498 feet. Water rises to within 148 feet of the surface.

This well was put down in 1895, at a cost of $700. No information about the water-bearing strata, or the various formations penetrated, has been obtained.

APPLING COUNTY

THE BAXLEY WELL

BAXLEY

Elevation, 216 feet; diameter, 6 inches; depth, 507 feet. Water rises to within 129 feet of the surface.

Two water-bearing strata are reported to have been perforated in sinking this well — one, at 320 feet, and the other, at 408 feet from the surface. The well cost about $800. It furnishes daily 50,000 gallons of water, which is used for general domestic purposes. Sandstone, marl and shell rock are said to have been passed through, in boring the well; but neither their order nor thickness was given.

TELFAIR COUNTY

All the artesian wells, reported from Telfair county, are at Lumber City, in the eastern part of the county, only a short distance from the Ocmulgee river. Lumber City has six of these wells. The following record of Mr. Day's well, furnished by the owner, will answer as a general record for all the wells at Lumber City.

JOHN L. DAY'S WELL

LUMBER CITY

Elevation, 161 feet; diameter, 2½ inches; depth, 400 feet. Water rises 14 feet above the surface.

The first flow in this well was obtained at 300 feet from the surface, the water rising three feet above the surface. The second flow, which furnishes 60 gallons per minute, was struck at the depth of 400 feet; it rises to a height of 14 feet above the surface.

Mr. J. B. Spencer gives the following record of the borings, obtained from the Lumber City wells:—

0 – 4	feet	— Top soil.
4 – 20	"	— Red clay.
20 – 30	"	— Coarse sand.
30 – 250	"	— Hard, blue clay, with a few streaks of sandstone.
250 – 350	"	— Quicksand.
350 – 430	"	— Limestone, with water-seams, from 380 to 430 feet. This limestone contains fragments of Eocene shells.

The following analysis of the artesian water, from Lumber City, is furnished by Dr. Geo. F. Payne, State Chemist:—

Total solids per U. S. gallon	10.960 grains
Chlorine, per gallon	.580 "
Free Ammonia, parts per million . .	.013
Albuminoids	.030
Hardness, degrees	8.200

WILCOX COUNTY

The only deep wells, reported from Wilcox county, are located at Abbeville. The first of these wells was put down in 1893, by a private party. Since then, the town council has completed a second well, which furnishes water to the city. The following meager notes, as to the private well, have been furnished.

THE ABBEVILLE WELL

ABBEVILLE

Elevation, unknown; diameter, 4 inches; depth, 540 feet. Water rises to within 25 feet of the surface.

Water-bearing strata are reported at 90, 139 and 296 feet from the surface. The formations, passed through, are said to consist of sand, clay and limestone. The latter, which occurs in the deeper part of the well, is cavernous and water-bearing. No record of the larger well, put down by the town council, has been obtained.

IRWIN COUNTY

The only efforts, made to secure artesian water in Irwin county, were made at Fitzgerald, during 1897, by the Georgia & Alabama R. R. Co.; and by the City Water Co. The latter well has never

been completed; while the former has been used by the railroad company for several months. No reliable record of either of these wells seems to have been kept; and only a few general notes could be secured.

THE GEORGIA AND ALABAMA R. R. COMPANY'S WELL

FITZGERALD

Elevation, 430 feet; diameter, 6 and 3 inches; depth, 680 feet. Water rises to within 90 feet of the surface.

Clay and sand are said to have been penetrated in the well, to the depth of 100 feet, below which, cavernous limestone continues to the bottom. A water-bearing stratum is reported to have been struck, at some point between 140 and 300 feet, from which the water rose to within 27 feet of the surface; but, at the depth of 680 feet, a cavern was struck in the rock, and the water suddenly disappeared from the bore-hole; but, in a few minutes, it again rose to within 90 feet of the surface, at which point it remained.

BERRIEN COUNTY

Two deep wells are reported in Berrien county, one of which is located at Tifton, and the other at Adel. The former was completed in 1896, and the latter, in 1893.

H. H. TIFT'S WELL

TIFTON

Elevation, 343 feet; diameter, 8 inches; depth, 360 feet. Water rises to within 80 feet of the surface.

Two or three water-bearing strata are reported in this well; but their depth from the surface is not given. No record of the borings was secured, except that limestone was struck at 260 feet.

THE ADEL WELL

ADEL

Elevation, 246 feet; diameter, 4½ inches; depth, 280 feet. Water rises to within 154 feet of the surface.

Mr. J. B. Spencer, of Lumber City, gives the following record of this well:—

1	Sandy soil	2 feet
2	Red clay	10 "
3	White sand	10 "
4	Blue clay, with sandstone boulders	125 "
5	Fine, white sand	25 "
6	Limestone, with thin layers of flint	100 "

The main water-supply in this well is said to come from the limestone, 229 feet from the surface.

LOWNDES COUNTY

THE VALDOSTA WELL

VALDOSTA

Elevation, 223 feet; diameter, 10, 8 and 4½ inches; depth, 522 feet. Water rises to within 113 feet of the surface.

This well was put down in 1893, at a cost of about $1,600. The following notes are made, from the report of the contractor, Mr. J. Arthur Durst, to the town council. The 10-inch hole was drilled to the depth of 185 feet; the 8-inch hole was continued to the hard ledge, at about 257 feet; and the test-hole, 4½ inches in diameter, was continued to the depth of 522 feet, the bottom of the well.

The first water-bearing stratum was struck, at 360 feet, the second at 450, and the third at 515. The water-supply from each horizon is said to be derived from a porous or cavernous limestone. The strata, penetrated, in sinking the well, are reported to consist largely of soft, calcareous rock with considerable sand, clay and flint; but unfortunately their relative thickness and order of occurrence are not given.

The following report of the chemical analysis, and notes on the physical appearance of the water, obtained from the three different water-bearing strata, were made by Prof. H. C. White, Professor of Chemistry of the University of Georgia:—

"No. 1, from depth of 360 feet.
No. 2, from depth of 460 feet.
No. 3, from depth of 515 feet.
The physical characteristics of these waters are as follows:—

COLOR — No. 1, faint, yellow-brown tinge.

No. 2, faint, yellow-brown tinge, due in both cases probably to iron.

No. 3, colorless, but slightly turbid from suspended material, which is chiefly fine sand with a little fine, white clay.

ODOR — No. 1, none; No. 2, none; No. 3, none.

It is possible that (as is usual with artesian waters) these waters may have had a faint odor of sulphuretted hydrogen on issuing from the well, but, if so, the odor had entirely disappeared before the samples reached the laboratory. No traces of sulphuretted hydrogen could be detected in them.

CHEMICAL ANALYSIS

SOLIDS DISSOLVED	Grains per U. S. Gallon		
	No. 1	No. 2	No. 3
Carbonate of Lime	5.524	4.726	5.429
Sulphate of Lime	0.763	0.654	0.813
Sodium Chloride	0.461	0.398	0.268
Sulphate of Soda	0.074	0.086	0.085
Sulphate of Potash	0.055	0.072	0.038
Sulphate of Magnesia	0.165	0.193	0.201
Oxide of Iron	0.101	0.096	0.121
Oxide of Alumina	0.065	0.054	0.104
Silica	0.392	0.468	0.714
Organic matter and combined water	1.161	1.317	0.951
Nitrates	none	trace	trace
Total	8.761	8.055	8.724
Suspended sediments	. . .	. . .	1.321
			10.045

ORGANIC PURITY—Parts in 1,000,000

	No. 1	No. 2	No. 3
Free Ammonia	None	None	None
Albuminoid Ammonia	Trace	Trace	None

These waters are all of remarkably fine quality, and each of them is pure and wholesome, and admirably suitable for domestic use. The quan-

tities of solid matters held in solution are unusually small for artesian waters. I am of opinion, that the colors of Nos. 1 and 2, and the turbidity (on account of suspended sediment) of No. 3, are due to the fact, that the well is freshly bored. It is probable that these characteristics will disappear after the well has been in operation a short time."

The city of Valdosta has, now, in successful operation, a complete system of water-works, which furnishes, for various uses, about 300,000 gallons daily.

BROOKS COUNTY

The only artesian well in Brooks county is located at Quitman, the county-seat.

THE QUITMAN WELL

QUITMAN

Elevation, 181 feet; diameter, 6 inches; depth, 500(?) feet. Water rises to within 30 feet of the surface.

This well was bored in 1884, at a cost of about $3,000; but, not being properly cased, it soon became partially filled with sand. In 1894, the obstruction was removed, casing was put in, and the well was supplied with a pump, at an additional cost of $1,600. The water, which is said to be quite wholesome, is now used for general

domestic purposes. Dr. J. W. Spencer, formerly State Geologist of Georgia, gives the following record of the Quitman well:—[1]

"1	Clay and sand to	70 feet
2	Soft rock in seams	100 "
	(Rock 3 feet, after which drill fell 6 feet into a stream of water to)	109 "
3	Soft rock and sand to	186 "
4	A hard flint rock	Thin layer
5	Quicksand and hard rock in beds, 1 to 3 feet thick, to	300 feet
6	Sand and clay to	340 "
7	Sand to	385 "

"The water rose from the stream at 109 feet to within 30 feet of the top of the well." This subterranean stream must contain a large volume of water, as it is said, that it could be distinctly heard several yards from the mouth of the well, when it was first bored.

THOMAS COUNTY

Thomas county has three deep wells, all of which are in the city of Thomasville. Two of these wells were put down, several years ago; while the third has just been completed.

[1] See First Report of Progress, Geological Survey of Georgia—1891, page 74.

THE THOMASVILLE WELL, No. 1

THOMASVILLE

Elevation, 258 feet; diameter, 5⅝ inches; depth, 1,900 feet. Water rises to within 210 feet of the surface.

THE THOMASVILLE WELL, No. 2

THOMASVILLE

Elevation, 258 feet; diameter, 10 inches; depth, 394 feet. Water rises to within 210 feet of the surface.

THE THOMASVILLE WELL, No. 3

THOMASVILLE

Elevation, 258 feet; diameter, 8 inches; depth, 480 feet. Water rises to within 210 feet of the surface.

From the above notes, it will be seen, that no water-bearing stratum was struck beyond 394 feet, having a static head greater than 210 feet below the surface. The following notes on the Thomasville wells are taken from Dr. J. W. Spencer's First Report of Progress of the Geological Survey of Georgia, published in 1891:—

"This meagre record was furnished by Mr. E. O. Thompson, Superintendent of the water-works. It is greatly to be regretted, that the full record of this well was not preserved.

1	Red and blue clay and sand to	162 feet
2	Limestone to	225 "
3	Shell rock with water at	310 "
4	Rubble rock at (From this level, water rises to within 210 feet of the surface.)	360 "
5	Shell rock, with copious flow, at	410 "
6	Water at	1,400 "
7	Bottom of limestone	1,680 "
8	Quicksand thence to	1,820 "

"The water derived from 410 feet evidently comes from the Miocene deposits. The quicksand beneath 1,680 feet, probably belongs to the Lignitic Series."

The first well put down at Thomasville cost $6,000; the second, $2,200; and the third, $1,100. These three wells now furnish the city of Thomasville with an abundant supply of wholesome water.

DECATUR COUNTY

No attempt has been made, as far as is known, to obtain artesian water in Decatur county, except at Bainbridge.

THE BAINBRIDGE WELLS

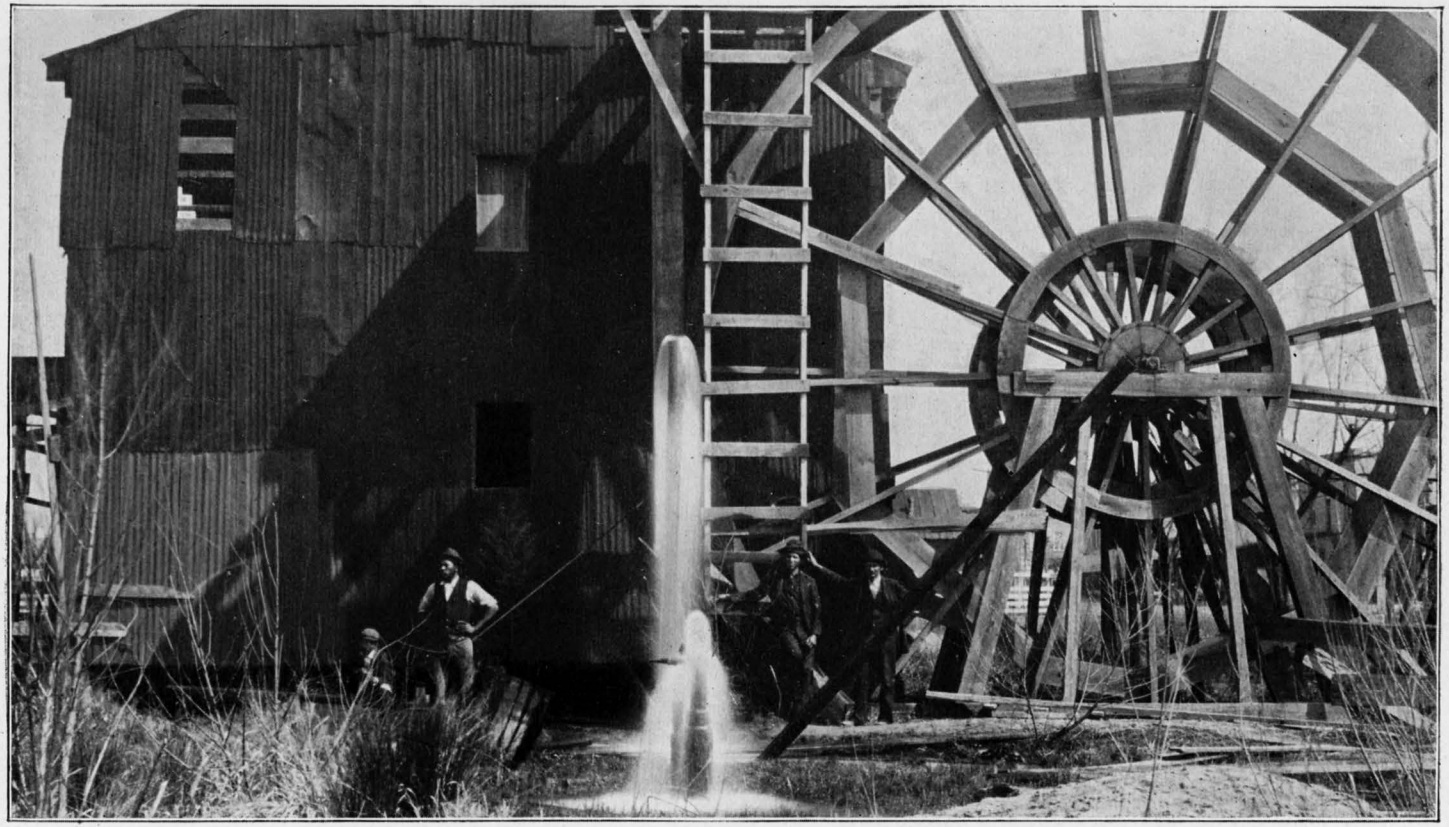
BAINBRIDGE

Elevation, 118 feet; diameter, 2 and 6 inches. Water rises to within 50 feet of the surface.

Dr. J. W. Spencer, formerly State Geologist, makes the following notes on the Bainbridge well:—

"1	Sand and clayey sand	75 feet
2	Limestone (the upper 200 feet the softer); no clay layers	700 "
3	Soft limestone	50 "
4	Quicksand to the bottom of the well	75 "

"A second well was sunk, within three feet of the first, which penetrated, below the limestone, to a depth of 425 feet in quicksand. Sharks' teeth, lignite and pyrite concretions came from some of the layers of sand. Several cavities in the limestones were passed through, the deepest being three feet." Dr. Spencer, in speaking of the geological formations penetrated in the wells, says:— "The thickness of the White Limestone formation is here placed at 500 feet. From 700 feet of harder limestones shown at the Bainbridge well, 240 feet have been deducted, as belonging to the Claiborne



ARTESIAN WELLS IN MONTEZUMA, GEORGIA. THE POWER IS USED FOR OPERATING THE MILL.

series, corresponding to the thickness derived from the mean dip of the Middle and Upper Eocene in Southwest Georgia. To the remaining 450 feet, assumed as the White Limestone, 40 feet more have been added; for Bainbridge is a short distance north of the boundary of the formation, as it crosses Decatur county. This thickness is in harmony with the average dip of the system. The whole belt has a breadth of 25 to 28 miles."

Three different water-bearing strata are reported, as occurring in each of these wells. The first was struck, at a depth of 280 feet, and the second, at 370 feet. Both these strata, which are said to be cavernous beds of limestone, yield a good supply of water. The third water-bearing stratum is a bed of quicksands below the limestone, the water obtained from the latter horizon being now used, to supply the city, for all domestic purposes.

Analyses of the water from these wells, 900 and 1,325 feet deep, respectively, made by Prof. H. C. White, formerly State Chemist, are as follows: —

WATER FROM THE FIRST WELL

Solid Matter in Suspension	*Grains per U. S. Gallon*
Oxide of Iron	0.791
Organic Matter	1.150
	1.941
Solid Matter Dissolved	
Carbonate of Lime	8.215
Sulphate of Soda	2.222
Sodium Chloride	2.065
Sulphate of Lime	1.156
Sulphate of Magnesia	1.323
Silica	0.229
Organic Matter Undeveloped	0.012
	15.222

WATER FROM THE SECOND WELL

Solid Matter Dissolved	*Grains per U. S. Gallon*
Carbonate of Lime	3.6146
Carbonate of Soda	4.6521
Sodium Chloride	1.6543
Sulphate of Soda	1.8562
Sulphate of Lime	0.7543
Sulphate of Magnesia	0.0424
Carbonate of Iron	0.0114
Silicate of Soda	0.1013
Silica	0.1875
Organic Matter and Water	0.0556
Total	12.9297

Free Ammonia, none.
Albuminoid Ammonia, a trace.

MITCHELL COUNTY

THE CAMILLA WELL

CAMILLA

A non-flowing well, 600 feet deep, was sunk at Camilla, some years ago; but no definite information has been obtained, concerning the water-bearing strata, or the character and thickness of the various formations passed through.

WORTH COUNTY

Worth county has three deep wells, none of which furnishes flowing water. All these wells were put down in 1896, at a cost, varying from $300 to $500.

J. M. CHAPMAN'S WELL

DOLES

Elevation, unknown; diameter, 3 inches; depth, 258 feet. Water rises to within 12 feet of the surface.

The following record of this well was furnished by the well-contractor: —

1	Clay to	15 feet
2	Blue marl to	96 "
3	Limestone to	108 "
4	Coarse pebbles to	123 "
5	Limestone with shells to	143 "
6	Blue marl, or clay, to	193 "
7	Limestone, containing corals and shells, to	209 "
8	Flint	(?)

C. P. ROME'S WELL

WARWICK

Elevation, unknown; diameter, from 2 to 8 inches; depth, 497 feet. Water rises to within 5 feet of the surface.

Twenty-two feet from the surface, a stream is reported, 8 feet in depth. The borings from the well are said to have shown, that the formations, passed through, consisted largely of limestone. The well furnishes from 500 to 1,000 gallons of sulphurous water per day. A trial test, of two hours with a pump, had no effect on the static head of the water.

J. G. McPHAUL'S WELL

PAULAN

Elevation, 315 feet; diameter, from 6 to 8 inches; depth, 235 feet. Water rises to within 75 feet of the surface.

Mr. McPhaul has made two or three unsuccessful attempts to obtain flowing water at Paulan; but, each time, he met with some mishap, and had to, finally, abandon the undertaking. However, the writer was informed, that he contemplated, continuing the well to the depth of several hundred feet, in order to obtain a flow, if possible. The following record of the well-borings is furnished by Mr. McPhaul:—

1	Red clay to	15 feet
2	Yellow clay to	20 "
3	White clay to	35 "

4	Blue clay to	55 feet
5	Limestone to	60 "
6	Limestone, containing flint, to	69 "
7	White sand to	74 "
8	Blue, sandy clay to	82 "
9	Yellow sands to	88 "
10	Blue clay to	128 "
11	Cavernous limestone (water disappeared) to	133 "
12	Clay	(?)

DOOLY COUNTY

The artesian wells of Dooly county are situated at Cordele, Vienna, Richwood, Unadilla, Penia, Fenn, Coney and Arabi. The only flowing-wells in the county are those, near the Flint river in the western part of the county.

THE CORDELE WELL

CORDELE

Elevation, 336 feet; diameter, 8 inches; depth, 550 feet. Water rises to within 20 feet of the surface.

This well was put down in 1890, at a cost of about $1,000. The well has never been properly equipped with pump etc.; and, consequently, the water has not been generally used by the city.

The following record was obtained from Mr. E. R. Hathaway, the well-contractor:—

1	Soil, clay and "chalk"	40 feet
2	Coarse, red sand to	60 "
3	Loose boulder rock, through which the tubing was driven (fine white sand was also found) to	68 "
4	Different colored marls (clays or true marls(?))	168 "
5	Limestone and shell-rock, with an intervening layer of sand, to	400 "
6	Sand and shell-rock to	475 "
7	Quicksand to	535 "

The water, which contains hydrogen sulphide, comes from the quicksands below the limestone. This is the only water-bearing stratum reported in the well. At a depth of between 200 and 300 feet from the surface, a cypress log, about two feet in diameter, is said to have been penetrated by the drill. It appears, that no satisfactory pump-test has been made, to ascertain the amount of water, which the well will furnish.

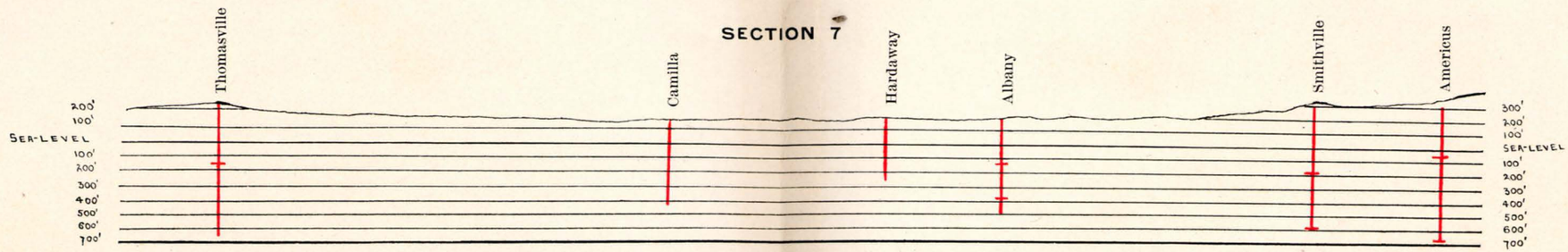
THE PARROTT LUMBER CO.'S WELLS

RICHWOOD

Elevation, 358 feet; diameter, 6 inches; depth, 170 feet. Water rises to within 40 feet of the surface.

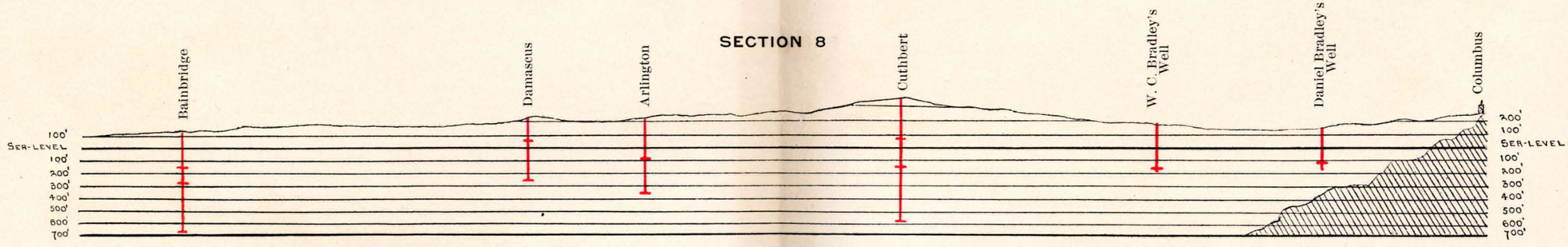
The Parrott Lumber Co. has two wells at Richwood, both of which are about the same depth, and furnish the same kind of water. The first water-bearing stratum was struck in these wells

SECTION 7



CROSS-SECTION FROM AMERICUS TO THOMASVILLE, SHOWING THE ARTESIAN WELLS AND WATER BEARING STRATA IN RED. See Map.

SECTION 8



CROSS-SECTION FROM COLUMBUS TO BAINBRIDGE, SHOWING THE ARTESIAN WELLS AND WATER-BEARING STRATA IN RED. See Map.

Shaded Lines Indicate Crystalline Rocks.

at a point between 85 and 95 feet from the surface; but the main supply is, at present, obtained, at a depth of from 130 to 170 feet from the surface. The wells furnish daily about 75,000 gallons of water, which is used mainly for steam purposes. It is said that, during long, continual drought, the head of water, in each well, is lowered as much as 75 feet. Hard rock was reported to have been struck at a depth of 60 feet, and to have continued to the bottom of the wells. One of these wells was put down in 1890, and the other, in 1893, at an average cost of about $2.00 per foot.

THE UNADILLA WELL

UNADILLA

Elevation, 412 feet; diameter, 3½ inches; depth, 189 feet. Water rises to within 80 feet of the surface.

Mr. E. J. Wilson, the contractor for this well, completed it in December, 1896, at a total cost, including pump etc., of $1,000. Mr. Wilson furnishes the following meagre records of the strata penetrated:—

1	Red, sandy clays to	50 feet
2	Rock, in form of boulders, to	66 "
3	Clay to	150 "
4	Sand interstratified with hard rock	189 "

At the depth of 150 feet from the surface, the water used in washing out the drill-borings disappeared. This was accounted for, by the cavernous limestone struck at that point. The only water-bearing stratum occurs near the bottom of the well. Three thousand

gallons of water per hour, the capacity of the present pump, have been obtained from this well, without lowering the static head. The water, which contains iron and hydrogen sulphide, is used for general domestic purposes.

B. P. O'NEAL'S WELL

PENIA

Elevation, 375 feet (?); diameter, 4 inches; depth, 320 feet. Water rises to within 120 feet of the surface.

This well was completed in November, 1890, at a cost of about $1,000. It is supplied with a steam-lift pump, which furnishes about 45 gallons per minute. No information was obtained, concerning the number of different water-bearing strata, or character of the clay, sand and hard rock penetrated.

THE ENSIGN LUMBER COMPANY'S WELL

FENN

Elevation, unknown; diameter, 8 inches; depth, 160 feet. Water rises to within 20 feet of the surface.

The well was completed in 1891, costing, with pump, casing etc., about $1,000. It furnishes 30 gallons of water per hour, which is used mainly for steam purposes. The static head is said to remain at the same level, throughout the year. No record of the water-bearing strata, or the different formations passed through, in sinking this well, was obtained.

J. B. LEWIS'S WELL

CONEY

Elevation, unknown; diameter, 6 and 3 inches; depth, 360 feet. Water rises to within 6 feet of the surface.

Three different water-bearing strata are reported to have been perforated in this well, at 150, 225 and 340 feet, respectively; but the height, at which the water rises from each, is not known. By making an excavation of a few feet, this well is made to flow, furnishing about 1,200 gallons per hour. The cost of the well, including casing, is estimated by its owner to have been $225. Mr. Lewis gives the following record of the strata, passed through, in sinking the well:—

1	Clay and sand to	100 feet
2	Sand to	150 "
3	Gray marl to	195 "
4	Limestone to	200 "
5	Blue marl to	275 "
6	Shell-rock (?) to	335 "
7	Flint and coarse sand to	360 "

J. M. CAMPBELL'S WELL

CONEY

Elevation, unknown; diameter, 4½ inches; depth, 285 feet. Water rises 8 feet above the surface.

The well was completed in the fall of 1895, at a cost of $250. The flow, which is said not to be affected by drought, is several hundred gallons per hour.

The following record was obtained from the well-contractor: —

1 Water-bearing stratum struck at 50 feet. Water rose to within 12 feet of the surface.
2 Water-bearing stratum struck at 146 feet. Water rose to within 10 feet of the surface.
3 Water-bearing stratum struck at 196 feet. Water rose to within 8 feet of the surface.
4 Water-bearing stratum struck at 221 feet. Water rose to within 6 feet of the surface.
5 Water-bearing stratum struck at 260 feet. Water rose to the surface.
6 Water-bearing stratum struck at 285 feet. Water rose 8 feet above the surface.

The following description of the different formations, passed through, in boring the well, is also given by the contractor: —

1	Yellow clay to	20 feet
2	Soft limestone to	45 "
3	Hard, compact limestone to	51 "
4	Limestone containing shells to	91 "
5	Blue clay to	136 "
6	Hard, compact limestone to	144 "
7	Blue clay to	180 "
8	Limestone with shells to	200 "
9	Marl and coarse sand, to bottom of the well.	

P. C. CLEGG'S WELL

SIX MILES WEST OF CONEY STATION

Elevation, unknown; diameter, 6 inches; depth, 216 feet. Water rises 4 feet above the surface.

The flow of this well is said to vary, at different times of the year. Its average flow is about 6 gallons per minute. The well was bored in 1895, at a cost of $150. The contractor furnishes the following information on the Clegg well: —

1 Water-bearing stratum struck at 60 feet. Water rose to within 6 feet of the surface.
2 Water-bearing stratum struck at 96 feet. Water rose to within 6 feet of the surface.
3 Water-bearing stratum struck at 200 feet. Water rose to within 8 feet of the surface.

The well-borings showed, that the following strata were penetrated: —

1 Gray, sandy clay to ---------- 15 feet
2 Blue clay to ---------- 96 "
3 Limestone to ---------- 108 "
4 Coarse sand to ---------- 123 "
5 Fossiliferous limestone to ---------- 143 "
6 Blue clay to ---------- 193 "
7 Shell-rock and coral to ---------- 209 "
8 Flint, in thin layers of limestone to the bottom of the well.

DANIEL WELLS'S WELL

THREE MILES WEST OF CONEY

Elevation, unknown; diameter, 3 inches; depth, 336 feet. Water rises 5 feet above the surface.

A number of water-bearing strata are reported to have been perforated, in sinking this well; but none of them are flowing, except the one struck at 336 feet from the surface.

The contractor furnishes the following record of the borings: —

1	Yellow clay to	12	feet
2	Limestone to	40	"
3	Subterranean cavity to	48	"
4	Limestone to	56	"
5	Pebbles to	61	"
6	Clay to	89	"
7	Limestone to	91	"
8	Bluish clay to	131	"
9	Limestone to	145	"
10	Dark-colored sand, with shells and sharks' teeth, to	216	"
11	Flint to	217½	"
12	Dark-colored sand to	220½	"
13	Limestone	(?)	

This well was bored in 1896, at a cost of $170.

JAMES BYRON'S WELL

NEAR FLINT RIVER NORTHWEST OF CONEY

Elevation, unknown; diameter, 2 inches; depth, 369 feet. Water rises 8 feet above the surface.

Five different water-bearing strata are reported to have been encountered, in boring the well, the last, only, yielding flowing water.

The following is a record of the well-borings:—

1	Yellow clay to	54 feet
2	Limestone to	82 "
3	Cavity to	90 "
4	Limestone to	100 "
5	Cavity to	114 "
6	Bluish clay to	154 "
7	Dark-colored sand to	254 "
8	Limestone to	260 "
9	Cavity to	265 "
10	Limestone to	272 "
11	Flint to	274 "
12	Fine white sand to	302 "
13	Flint to	304 "
14	Dark-colored sand and pebbles	(?)

SUMTER COUNTY

The deep wells of Sumter county, six in number, are all located at Americus. Three of these wells belong to the city, and supply the water-works with an abundance of pure, wholesome water. The other wells are owned by private parties and the Central Railway.

THE WINDSOR HOTEL WELL

AMERICUS

Elevation, unknown; diameter, 8 and 4 inches; depth, 1,725 feet. Water rises to within 30 feet of the surface.

This well was put down in 1883; but, for some reason, it has never proved a complete success. Several water-bearing strata are reported to have been encountered in the well. Only one, however, which was struck at the 1,000-foot level, brought water to within 30 feet of the surface. No record of the well-borings are now obtainable.

THE CITY WATER-WORKS WELLS

AMERICUS

Elevation, 348 feet; diameter, 4 and 8 inches; depth, 400, 500 and 900 feet. The water from the 400- and 500-foot wells rises

to within 10 feet of the surface; while the 900-foot well is a flowing well.

Dr. J. W. Spencer gives the following record of the 500-foot well: —[1]

"1	Surface clay	3	feet
2	Blue clay	70	"
3	White marl and limestone	11	"
4	Hard limestone	6	"
5	Blue clay	7	"
6	Limestone layer	½	foot
7	White sand	5	feet
8	Rock and clay	123	" "

The main water-supply, which is furnished to the city, is said to be derived from the 350-foot level.

The following analysis, of the water from these wells, was made by Prof. H. C. White, formerly State Chemist, several years ago: —

	Grains per U. S. Gallon
"Carbonate of Lime	6.322
Chloride of Sodium	1.306
Chloride of Potassium	0.114
Sulphate of Soda	0.552
Sulphate of Lime	1.015
Sulphate of Magnesia	0.125
Silica	0.104
Organic Matter and Combined Water	1.120
Total Solids Dissolved — grains per gallon	10.658

Sulphuretted Hydrogen Gas dissolved, 125 cubic feet per gallon.

"This water has the general composition of artesian waters of considerable depth, with the addition of an unusually large quantity of

[1] Op. cit. p. 80.

sulphuretted hydrogen gas in solution. This quantity of mineral matter held in solution by the water is not large; but it is sufficient to impart a mild medicinal quality to the water. The sulphuretted hydrogen is also a valuable medicinal agent. I should class this water as alkaline sulphur water."

Besides these wells in the city, there is another well, located at the depot, and owned by the Central Railway. It is a flowing well; but the water has not sufficient head, to force it to the tank. Consequently, a small engine is used for that purpose. The water from this well supplies the engines of the Central Railway; and, as far as is known, it gives satisfactory results.

LEE COUNTY

Artesian wells are reported from Lee county, at Smithville and Leesburg; but no record has been obtained from the wells at the latter place.

THE SMITHVILLE WELLS

SMITHVILLE

Elevation, 319 feet; diameter, 2½ and 4 inches; depth, 900 feet. Water rises 20 feet above the surface.

The first of these wells was put down in 1882, by the Central Railway, at a cost of about $1,400. Two water-bearing strata were reported to have been found in each well — one, at 500, and the other, at 900 feet from the surface. Mr. G. W. Warwick gives the following record of the borings:—

1	Clay and sand to	40 feet
2	Clay of various colors to	140 "
3	Cavernous rock (?) to	240 "
4	Blue clay, with shells and sharks' teeth, to	340 "
5	Limestone to	345 "
6	Cavernous limestone with corals	(?)

At the bottom of the well, the drill struck a very hard rock, that could not be penetrated.

DOUGHERTY COUNTY

Dougherty county has 16 wells, all of which, except two, are located in Albany. The first of these wells was put down, by Mr. J. P. Fort, on his plantation in the western part of the county. The successful completion of this well led to the first attempt to obtain artesian water in Albany. The great success of the Albany wells, together with the remarkable effect the use of the water has had on the general health of the city, has done much toward the development of the artesian-well system throughout South Georgia. Through the kindness of Mr. Charles Tift, Superintendent of the Albany City Water-Works, I am able to give the following record of well No. 2, which was completed in 1885: —

ALBANY WELL No. 2

ALBANY

Elevation, 175 feet; diameter, 10 inches; depth, 732 feet. Water rises 30 feet above the surface.

The borings show the following strata to have been passed through:—

1	Red clay to	9½	feet
2	Red and white clay to	15	"
3	Thin layers of limestone, with sand and clay, to	33	"
4	Very tough clays, sands and some hard rock to	43	"
5	Strata of hard and soft rock, with thin layers of clay, to	60	"
6	Rock, more solid, with only a few soft seams, to	90	"
7	The same as above, except that the rock becomes harder, to	118	"
8	Hard rock, 9 feet thick, followed by softer rock and clay, to	157	"
9	Rock, difficult to drill, and alternating with soft seams, to	275	"
10	Soft rock, containing hard lumps, to	335	"
11	Quicksand to	337	"
12	Hard rock to	340	"
13	Quicksand to	351	"
14	Quicksand, alternating with hard rock, to	470	"
15	Thin layers of blue clay and black sand to	486	"

16	Very hard, black clay to ----------	497	feet
17	Thin layers of rock and sand to ----------	503	"
18	Blue and soft rock to ----------	506	"
19	Very hard rock, with sand and clay, to---	685	"
20	A water-bearing stratum, consisting of a cavernous rock, formed of shells and gravel, continues to the bottom of the well.		

Dr. J. W. Spencer, formerly State Geologist of Georgia, gives the following additional notes on samples of borings from the Albany wells:—[1]

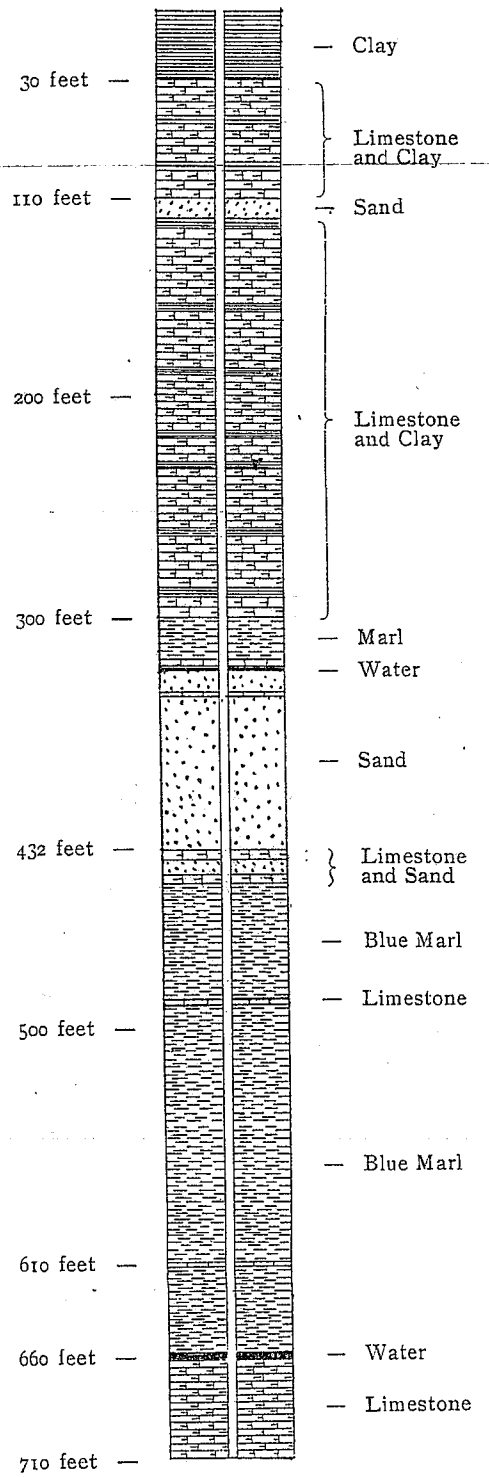
"Marl, at 26 feet; limestone, at 40 feet; oölitic or coral sand, from 100 to 115 feet; a lime-rock, 5 feet thick, at 160; gray rotten limestone, from 180 to 200; shell-rock, at 310; shell-marl, at 315 to 320; lignite, at 330; coarse quartz sand, with chips of gray limestone, 350; shell limestone, 360; clean, sharp, white sand, in different beds, between 360 and 425; lignite, at 440; green, slightly calcareous, fine sand, with a little clay, between 485 and 678; a water-bearing, coarse quartz sand, with calcareous particles, at 660.

"The upper 320 feet represents the lower portion of the White Limestone and the whole of the Claiborne Series. The next 40 feet most nearly resembles the harder beds of the Upper Buhrstone. Below this horizon, the well penetrates the Lower Buhrstone, and passes into the middle or lower portion of the Lower Eocene formations. Part of the lignite beds are situated near the Bashi Series."

All the wells of the city of Albany, 14 in number, have practically the same depth; and the water rises to the same height above

[1] Op. cit., p. 75.

Fig. 20



Section of the Albany Well, Constructed by Charles Tift.

the surface, in each. The 4-inch wells flow from 100 to 125 gallons per minute; while the large 10-inch well at the water-works flows 225 gallons per minute. From the description of these wells, given by Mr. Tift, there appears to be two water-bearing strata. The first is the quicksands below the 300-foot level, and the other, the coarse sands and porous limestone, at the bottom of the well. The first flow begins at 660 feet, and gradually increases, as the water-bearing stratum is penetrated. No casing is required in any of the wells below the quicksands. Since the number of wells in Albany has become so numerous, the great draught on the water-bearing stratum has materially reduced the static head. Formerly, water rose, in an open pipe, to the height of 30 feet above the surface; but, now, it is reduced to 20 feet. A long continued drought is also said to decrease the flow.

The following analysis and notes were made, several years ago, by Prof. H. C. White, on the water of the Albany artesian wells: —

"Mean temperature of the water (result of examination made by Mr. W. R. Leaken three times daily for one week)	73.5° F.
Mean temperature of air (obtained as above)	67.0° F.

The water is perfectly clear, limpid and entirely free from suspended matter. It is said to have, on issue, a decided odor and taste of sulphuretted matter. This passes off, when the water is allowed to stand uncovered for a few hours. The samples received were odorless and without sulphur taste. The following are the results of examination, made by me upon a quantity of water, sent in carefully sealed vessels by Mr. W. R. Leaken. These results are calculated to the mean temperature of the water (73.5° F.): —

Specific gravity	1.0011
Hardness	6.25

ANALYSIS

One United States gallon contains, dissolved: —

Carbonate of Calcium	4.360	grains
Sulphate of Calcium	0.956	"
Carbonate of Magnesia	1.868	"
Alkaline Chlorides	0.425	"
Oxides of Iron and Alumina	0.412	"
Silica	0.868	"
Organic Matter	0.104	"
Total solids	8.993	"
Free Carbonic Acid Gas	7.852	cub. in.
Sulphuretted Hydrogen (result obtained by Mr. Robinson and Mr. Leaken at the well)	3,000	cub. in."

The city of Albany has a very complete system of water-works which cost about $80,000. The water is pumped directly from the wells to the water-tower, from which it is distributed through the city by hydrostatic pressure. This plant furnishes to the city, daily, about 25,000 gallons of water, which is used for all purposes.

J. P. FORT'S WELL

NEAR DUCKER'S STATION

Elevation, 185 feet; diameter, 2 inches; depth, 547 feet. Water rises 10 feet above the surface.

This well, which was the first successful artesian well put down, in the State, is situated on Mr. Fort's plantation, about 16 miles west of Albany. Dr. J. W. Spencer gives the following record of the Fort well:—[1]

"1	A few feet of surface clay, followed by limestone boulders, to	65 feet
2	Limestone, with silicified layers, containing shells, and traversed by subterranean streams, to	150 "
3	Blue marl (clay?) to	165 "
4	Shell-rock, sand, rock and marl (clay); water rose to within 14 feet of surface, to	260 "
5	Sand, tinted blue; a layer of very fine, white sand at 370 feet, below which some coarse sand with shell fragments and sharks' teeth, to	380 "
6	Blue clay and sand rock, in alternate layers, to	410 "
7	Blue clay with soft sand rock to (flowing water)	490 "
8	Sand and clay, forming water-bearing stratum, to hard rock at	530 " "

[1] Op. cit., p. 77.

F. F. PUTNEY'S WELL

HARDAWAY STATION

Elevation, unknown; diameter, 6 inches; depth, 315 feet. Water rises to within 50 feet of the surface.

This well was put down in 1896; but, unfortunately, no reliable record was kept of the various formations penetrated. Mr. J. D. Stephens, of Albany, gives the following meager record of the borings:—

1	Yellow clay	50 feet
2	Sand	50 "
3	Hard rock, alternating with sand and clay, to the bottom of the well.	

EARLY COUNTY

The only deep well, reported from Early county, is located at Damascus, in the eastern part of the county. This well is owned by Mr. C. C. Green, who had it put down, last June. Mr. C. W. Sirmons furnishes the following information, concerning the Green well.

C. C. GREEN'S WELL

DAMASCUS

Elevation, unknown; diameter, 2 inches; depth, 547 feet. Water rises to within 7 feet of the surface.

Considerable hard rock is reported in this well; but the exact thickness and character of the various formations have not been given. Two water-bearing strata were struck in the well — one at 200 and the other at 547 feet. Water, from the former, rises to within 20 feet of the surface; and, from the latter, to within 7 feet of the surface.

CLAY COUNTY

THE FORT GAINES WELL

FORT GAINES

Elevation, 152 feet; diameter, 4 and 3 inches; depth, 650 feet. Water rises to within 20 feet of the surface.

The Fort Gaines well was put down in 1885, at a cost of about $2,000. The well is now supplied with a steam-pump, which forces the water into a reservoir, which, in turn, supplies the city. The well furnishes about 150 gallons per minute. The water is used for general domestic purposes and for boilers. No reliable record of the strata penetrated could be obtained. The water-supply comes from the 500-foot level. When the water-bearing stratum was first struck, it is said, that the water rose rapidly, and flowed for a few minutes; but it soon sank to within 20 feet of the surface.

CALHOUN COUNTY

The deep wells of Calhoun county are situated at Arlington, Leary and the Boyd plantation, three miles north of Leary. All these wells, except the last mentioned, furnish abundance of pure, wholesome water.

THE ARLINGTON WELL

ARLINGTON

Elevation, unknown; diameter, 6 inches; depth, 625 feet. Water rises to within 20 feet of the surface.

Dr. J. W. Spencer, formerly State Geologist of Georgia, gives the following record of the Arlington well: —[1]

" 1	Chalky clay	20	feet
2	Sand and white clay	(?)	
3	Shell-rock	5	"
4	Very coarse sand	(?)	
5	Shell-rock etc. to	355	"
6	Hard rock, siliceous, with soft places, to	390	"
7	Hard, dark clay	500(?)	"
8	Coarse, dry, micaceous sand	540	" "

The water is raised by means of a hand-pump, and is used for general domestic purposes.

[1] Op. cit., p. 77.

THE ARLINGTON OIL & FERTILIZER COMPANY'S WELL

ARLINGTON

Elevation, unknown; diameter, 5 inches; depth, 328 feet. Water rises to within 50 feet of the surface.

This well was put down in 1896, at a cost of $600, including pump etc. It furnishes the oil-mill with all the water, necessary to operate the plant. A private well, 500 feet deep, is also reported from Arlington; but no record is given.

From the above notes on the Arlington wells, it seems that two water-bearing strata were struck, in the deep wells — one, at about 300 feet from the surface, and the other, at a depth of something over 500 feet from the surface.

THE LEARY WELL

LEARY

Elevation, unknown; diameter, 5 and 2 inches; depth, 672 feet. Water rises 30 feet above the surface.

Two or more water-bearing strata are reported to have been struck, above the one, that produces the flow; but their depths are not given. The well furnishes 23 gallons per minute. The water is used for boiler and domestic purposes; and it is said to have produced a remarkable effect upon the health of the town.

The following meager record is given of the well-borings: —

1	Red clay	40	feet
2	Limestone	20	"
3	Blue clay	150(?)	"
4	Hard rock in thin layers	30	"
5	Quicksand	200(?)	"
6	Hard rock containing shells	10	"

Another well was commenced at Leary, and continued to the depth of 300 feet; but the drill became fastened, and the well was abandoned.

J. E. BOYD'S WELL

NEAR LEARY

This well is located on Mr. Boyd's plantation, three miles north of Leary. It has a depth of 400 feet; but, on account of its yielding no flow, it has never been used. No reliable information of the formations penetrated was obtained.

TERRELL COUNTY

THE DAWSON WELL

DAWSON

Elevation, 326 feet; diameter, 5 and 2 inches; depth, 650 feet. Water rises to within 45 feet of the surface.

Dr. J. W. Spencer gives the following notes on the well-borings:— [1]

" 1	Clayey, white sand to	40 feet
2	Coarse sand to	80 "
3	Limestone, followed by sand and rock, repeated, to	650 "
4	Quicksand to	660 " "

Another attempt was made to bore an artesian well at Dawson; but it was abandoned, at the depth of 300 feet, on account of the bore-hole being too small to successfully operate the drill.

The deeper well is now supplied with a small hand-pump; and it furnishes the city with water, mainly for drinking purposes.

RANDOLPH COUNTY

The only attempt to secure artesian water, as far as is reported, in Randolph county, was made at Cuthbert, the county-seat, in 1889. Between $1,500 and $2,000 was expended by the city on the well; but, for some reason, it has not been used.

THE CUTHBERT WELL

CUTHBERT

Elevation, 452 feet; diameter, 6 and 4 inches; depth, 1,000 feet. Water rises to within 30 feet of the surface.

[1] Op. cit., p. 79.

Dr. J. W. Spencer makes the following notes on the Cuthbert well: — [1]

"This well was sunk to a depth of 1,000 feet; but the record was not kept. From a point between 340 and 400 feet, water rose to within 30 feet of the surface, and at 550 feet, the water rose to within 70 feet of the surface."

A test trial, with a steam-pump, was made on the water-supply obtained from the 340-foot level; but it seemed to have no effect on the static head.

MACON COUNTY

Some of the most noted artesian wells in the State are to be found in Macon county. They are located at Montezuma and Oglethorpe, two small towns on opposite sides of the Flint river. The wells are noted for the large number of water-bearing strata, height of flow, and variety in the chemical composition of the waters.

THE MONTEZUMA WELLS

MONTEZUMA

Elevation, 300 feet; diameter, 2 and 6 inches; depth, from 60 to 500 feet. Water from the deeper wells rises 62 feet above the surface.

[1] Op. cit., p. 79.

Montezuma has 15 artesian wells, all of which are flowing. Mr. E. J. Wilson furnishes the following record of the deep wells: —

1	Sand to	6 feet
2	White clay to	18 "
3	Limestone to	20 "
4	Sand and clay to	50 "
5	Bluish, tough clays to	60 "
6	Sand with mica to	75 "
7	Blue clay to	95 "
8	Sand and blue clay to	155 "
9	Fine, micaceous sand to	160 "
10	Sand and clay to	190 "
11	Sand, with thin layers of flint, to	310 "
12	Clay and fossil wood to	350 "
13	Limestone containing shells to	352 "
14	Micaceous sand to	356 "
15	Clay, interstratified with sand, to	416 "
16	Fossiliferous limestone, with thin layers of sand, to	480 "
17	Clay to	496 "
18	Sand to	500 "

First water-bearing stratum, struck at 60 feet, flowed 8 feet above the surface.

Second water-bearing stratum, struck at 150 feet, flowed 20 feet above the surface.

Third water-bearing stratum, struck at 350 feet, flowed 30 feet above the surface.

Fourth water-bearing stratum, struck at 500 feet, flowed 62 feet above the surface.

Two of these wells receive their water-supply from the first water-bearing stratum; eleven, from the third; and two, from the fourth. One of the water-bearing strata furnishes water, highly charged with hydrogen sulphide; another carries a large quantity of iron oxide; while a third is quite free from all mineral impurities. So abundant is the flow from the deep wells, that Mr. Wilson attempted to use the water, from two of them, for operating a cotton gin; but the project proved only partially successful.[1] The total amount of water furnished daily by these wells, is very great; and it must necessarily cause a very heavy draught on the water-supply. However, it is stated, that there has not yet been any perceptible variation in the static head.

THE OGLETHORPE WELL

OGLETHORPE

The Oglethorpe well has a similar record to the Montezuma wells, and needs no separate description. It is a 2-inch flowing well.

HOUSTON COUNTY

The only effort, to secure artesian wells, in Houston county, has been made at Fort Valley. These wells were all unsuccessful; and they have long since been abandoned. The town is now supplied with water, from a large spring near the corporate limits.

[1] See Plate VI.

H. C. HARRIS'S WELL

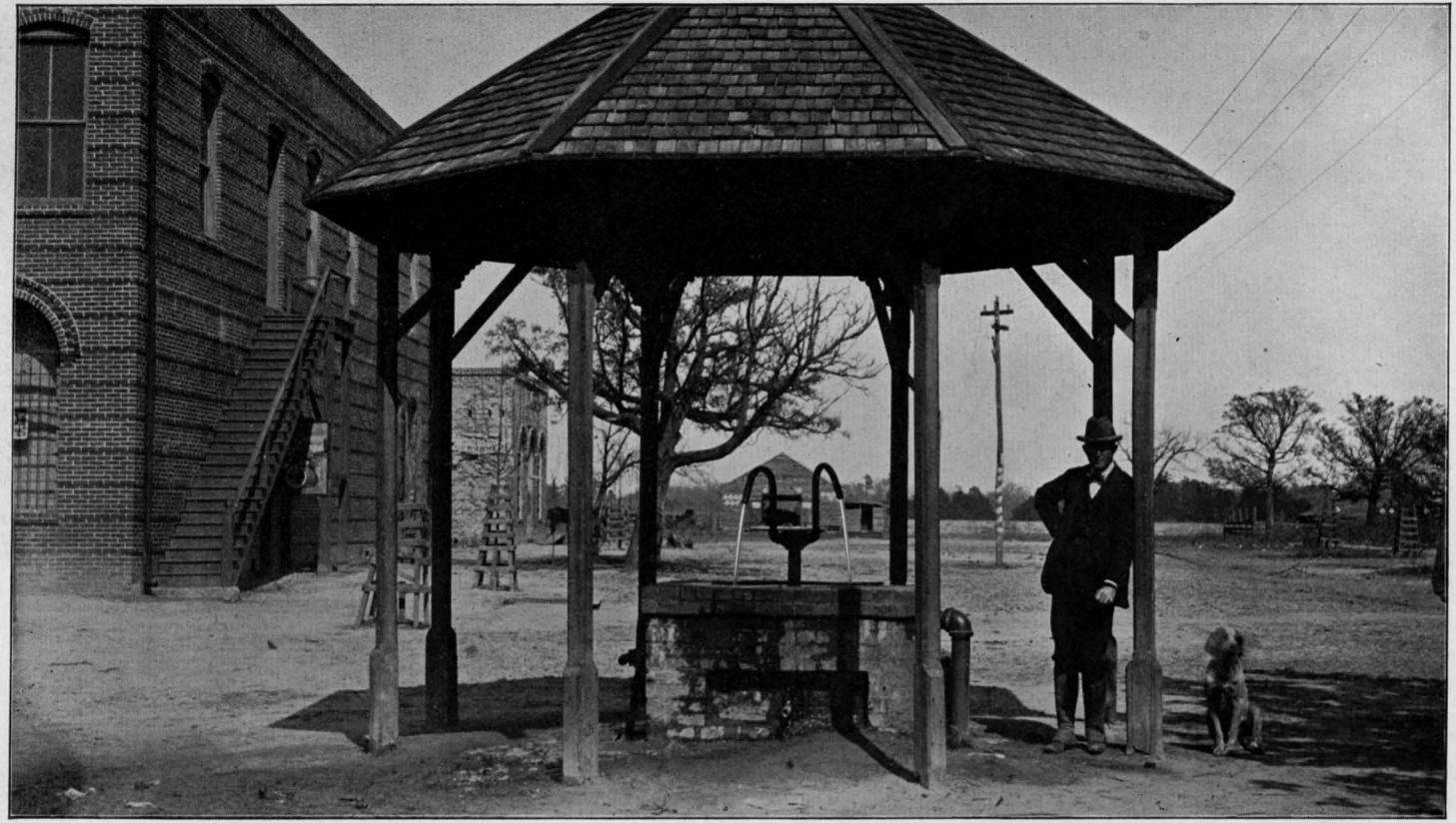
FORT VALLEY

Elevation, 522 feet; diameter, 6 and 4 inches; depth, 1,075 feet. Water rises to within 100 feet of the surface.

Mr. Harris has furnished the following record of the well-borings: —

1	Red clay	20 feet
2	Sand	20 "
3	White clay	8 "
4	Yellow sand	40 "
5	White clay	10 "
6	Quicksand with pebbles	400 "
7	Hard rock	(?)
8	Quicksand	(?)

At a depth of 300 feet from the surface, a water-bearing stratum is reported to have been struck, which forced the water, for a few minutes, 20 feet above the surface; but the pressure, which was evidently due to compressed gas, was soon relieved, and the water subsided to the 100-foot level. Other water-bearing strata were struck in the well, below the 300-foot level; but the static head remained unchanged. A second well was attempted, by Mr. Harris, by what is known as the dry method of well-boring; but the process was found unsuccessful in the quicksands, and the well was finally abandoned.



PUBLIC ARTESIAN WELL AT OGLETHORPE, GEORGIA.

BIBB COUNTY

Two or three fruitless efforts have been made, in Bibb county, to obtain artesian water. All these wells are situated within, or near, the corporate limits of Macon. The Acme Brewing Company, which spent, in 1890, several hundred dollars, in putting down a well, at their plant in the southern part of the city, has furnished the meagre record given below.

THE ACME BREWING COMPANY'S WELL

MACON

Elevation, 377 feet; diameter, 12 inches; depth, 955 feet. Sand and clays were penetrated, to the depth of 303 (?) feet, beneath which the crystalline rocks continued to the bottom of the well.

The well was practically dry, its entire depth, no water-bearing strata having been struck. The other wells have a similar record, and require no separate description.

TAYLOR COUNTY

The only attempt, to obtain artesian water in Taylor county, was made by the Central Railway at Reynolds station, soon after the completion of the well at Smithville.

THE REYNOLDS WELL

REYNOLDS

Elevation, 433 feet; diameter, 8 and 4 inches; depth, 700 feet. Water rises to within 80 feet of the surface.

Sand, clay and soft rock were passed through, in the well, to the depth of 600 feet, below which a very hard, dark-colored rock, probably hornblende-gneiss, continued to the bottom of the well. So difficult was the rock to drill, that only about four inches were made, each day.

The only water-bearing stratum, in the well, was struck, at a depth of 250 feet from the surface. The well has furnished, by pumping, about 60 gallons per minute. This rate of discharge, continued for some time, is said to lower the static head about 16 feet. The water is used by the Central Railway for boiler purposes.

MUSCOGEE COUNTY

THE BASS WELL

NEAR COLUMBUS

Elevation, unknown; diameter, 3 inches; depth, 425 feet. Water flows 4 feet above the surface.

This well, which is located on the Bass plantation, three miles south of Columbus, was completed in 1897, at a cost of $400.00. The only water-bearing stratum, reported in the well, was struck at the depth of about 400 feet. No record of the well-borings was kept; and, consequently, nothing is definitely known of the character of the different strata passed through. It seems quite prob-

able, however, that the water-bearing stratum, struck in this well, is the coarse sands and gravels of the Cretaceous formation, which are known to overlie the Crystalline rocks, in the vicinity of Columbus. The well furnishes from 90 to 100 gallons of soft, potable water per hour; and, so far, it seems to be unaffected by draughts.

The successful completion of the Bass well caused some of the leading citizens of Columbus to believe, that similar results could be obtained in that city, by deep borings. This question, which was submitted to the Geological Survey for solution, was investigated, personally, by Prof. Yeates, last fall, who visited the locality, and was able to demonstrate, by use of a geological section, that the conditions for successful artesian wells, within the city limits, of Columbus, were very unfavorable.

CHATTAHOOCHEE COUNTY

The only well, reported from this county, is located in the northwest corner, near the Chattahoochee river.

W. C. BRADLEY'S WELL
BRADLEY'S PLANTATION

Elevation, unknown; diameter, 3 inches; depth, 315 feet. Water rises 16 feet above the surface.

This well was put down in May, 1897, at a cost of $200. It furnishes about 600 gallons of water per hour, which is used for general farm purposes. No hard rock is reported from this well. The formations consist of clay, marls and sand. The latter is water-bearing, and occurs at a depth of 285 feet from the surface.

STEWART COUNTY

Six wells are reported from Stewart county, all of which belong to Messrs. W. C. and Daniel Bradley, of Columbus. They are located in the northwestern part of the county, on the Chattahoochee river.

W. C. BRADLEY'S WELL, No. 1
BRADLEY'S PLANTATION

Elevation, unknown; diameter, 3 inches; depth, 300 feet. Water rises 9 feet above the surface.

W. C. BRADLEY'S WELL, No. 2
BRADLEY'S PLANTATION

Elevation, unknown; diameter, 3 inches; depth, 290 feet. Water rises 9 feet above the surface.

W. C. BRADLEY'S WELL, No. 3
BRADLEY'S PLANTATION

Elevation, unknown; diameter, 3 inches; depth, 315 feet. Water rises 22 feet above the surface.

These three wells are all located in the river bottom, not over a mile apart. They were put down in 1897, at a cost, varying from

$150 to $400 each. No hard rock is reported from the wells, the formations being clay, marl and sand. The water-supply, from each of the wells, comes, apparently, from the same stratum. However, the quality of the water is said to be entirely different. The water from well No. 1 contains sulphur and iron; from No. 2, sulphur; and from No. 3, magnesia. It is used for general domestic and farm purposes.

Mr. Bradley reports two other wells, on his plantations in Stewart county; but neither are flowing. One of them was continued to the depth of 715 feet; but no increase of static head was obtained, below the 315-foot level, at which point the water rose to within 16 feet of the surface. Both of these wells are now supplied with pumps; and they furnish all the water necessary for farm purposes.

DANIEL BRADLEY'S WELL

BRADLEY'S PLANTATION

Elevation, unknown; diameter 3 inches; depth, 740 feet. Water rises only a few feet above the surface.

A water-bearing stratum was struck, at 475 feet from the surface. There is no increase of flow, below this point. Mr. Bradley gives the following record of the strata penetrated:—

1	Clay	12 feet
2	Sand	60 "
3	Marl, with an occasional stratum of hard rock, continued to the bottom of the well.	

This well was completed in January, 1897, at a cost of $300. The water, which is used for domestic purposes, is highly charged with hydrogen sulphide.

MARION COUNTY

THE BUENA VISTA WELL

BUENA VISTA

Elevation, 746 feet; diameter, 10 inches; depth, 583 feet. Water rises to within about 240 feet of the surface.

The following well-record was obtained from Mr. E. J. Wilson of Montezuma, the contractor:—

1	Red clays to	35 feet
2	Sand and clays to	105 "
3	Soft limestone to	155 "
4	Marl to	158 "
5	Rock to	159 "
6	Marl to	252 "
7	Flint to	254 "
8	Indurated marl to	263 "
9	Hard rock to	270 "
10	Marl to	297 "
11	Limestone (water-bearing) to	331 "
12	Coarse, gray sand to	343 "
13	Marl (water-bearing) to	364 "
14	Marl to	551 "
15	Hard, compact rock to	583 "

Two water-bearing strata were struck in the well — one, at 331, and the other, at 364 feet from the surface. The first of these beds yielded a large quantity of water; but it was found impossible to keep the bore-hole from filling with quicksand. Several weeks were spent, in trying to control the inflowing sand; but all efforts were unsuccessful. The quicksand was finally cased off, and the well was continued to the depth of 583 feet, when the $2,400 appropriated by the town council was expended, and the work was discontinued.

CHAPTER III

SURFACE WELLS IN SOUTH GEORGIA

The majority of the small towns, villages and plantations in South Georgia, at present, obtain the greater part of their water-supply, for domestic purposes, from surface wells. These wells vary from 15 to 75 feet in depth; and, where there is no surface contamination, the water is usually pure and wholesome. The geological conditions, existing throughout the Coastal Plain, are quite favorable for surface wells. The Columbia sands, which take up a high percentage of the total rainfall, overlie the more impervious Lafayette clays. The ground-water, being retarded by the water-tight beds, in its downward course, saturates the lower layer of the sandy stratum, which is the chief source of water-supply for the majority of the surface wells. There are, however, some notable exceptions to this general rule; viz., where the sand, when deposited, came in immediate contact with the eroded outcropping of the Eocene and Miocene formations. Where this condition exists, the water is more frequently impregnated with calcium carbonate, and is not so desirable for domestic purposes.

The Columbia sands act, as an admirable filter; and, where they form beds, several feet in thickness, they remove much, if not all, of the surface impurities, and furnish an excellent quality of pure, soft water. On the contrary, where the beds are comparatively thin, and the surface layers are more or less always saturated by

impurities, as in cities and towns, the well-water, sooner or later, becomes contaminated, and is thereby rendered unsuitable for drinking purposes. The injuries, from this source, are usually due to the fact, that the surface-water commonly contains disease-producing organisms, developed in that part of the soil, from which the well obtains its water-supply. It is a well known fact, now demonstrated by the medical profession, that typhoid fever, and various other diseases, originate from drinking-water, which has become contaminated with surface-sewage. From this cause, the pure water from the well of the village school-house has been known

Fig. 21

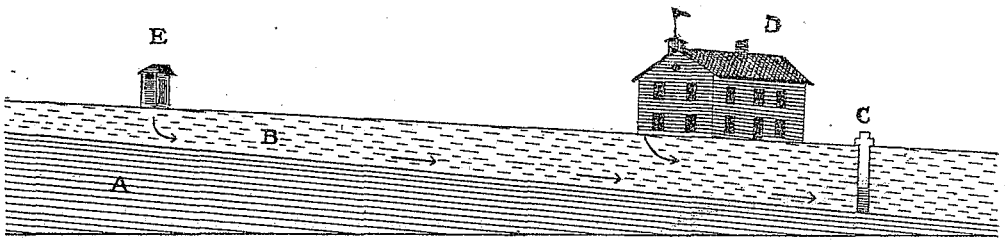


Diagram Showing How Surface Wells May Become Contaminated with Sewage. A — Impervious Stratum. B — Porous Stratum. C — Well. D — Village School-house. E — Cesspool. The Arrows Indicate the Direction of the Surface Water to the Well.

to be the source of epidemics, of the most aggravated nature.[1] Prof. S. G. Williams, of Cornell University, says:—[2] "Nor should it be forgotten, that the apparent purity and clearness of the water afford no reliable criteria to its freedom from dangerous contaminations. The germs of disease lurk, unsuspected, in many a bright and sparkling draught, and it is, to use very moderate language, to say, that a very considerable proportion of the ailments, with which human beings are affected, arise from the tainted waters, which they drink. Indeed, in most long settled, highly cultivated and densely peopled districts, the soil becomes so saturated with or-

[1] See fig. 21.

[2] See Applied Geology, by S. G. Williams, p. 57.

ganic substances, that no comparatively shallow and open surface-wells can be considered safe."

The following instance, related by Prof. Ira Remsen before his class in Chemistry, at the Johns Hopkins University, a few years ago, demonstrates the impure condition of surface well-water in cities and towns, and, at the same time, illustrates how completely ignorant the common people are, of the nature of the water, they use for drinking purposes. Prof. Remsen said, that, some years previous, when he was first called to the University as Professor of Chemistry, there existed, in the suburbs of the city of Baltimore, a remarkably fine spring, from which flowed an abundance of clear, crystal water. The spring was reported to have certain medical properties; and many instances were related, of persons becoming healed of various ailments, by the use of its water. It was a favorite resort for the laboring people of the city, who, on Sundays, went to the spring in great numbers, to while away the time, and to drink the crystal water. So noted had the spring become, locally, that Professor Remsen undertook to investigate the medicinal properties of the water, by making a chemical analysis. The result of the analysis revealed the fact, that the water was highly contaminated with sewage, and wholly unfit for drinking purposes. This spring, during the early days of Baltimore, no doubt, furnished pure and wholesome water; but, as the city increased in size, the underlying sand became saturated with impurities, which, in turn, were carried into the subterranean stream, supplying the spring.

The writer, while collecting information on the artesian wells of South Georgia, had occasion to make an examination of numerous surface-wells in small towns, where no deep wells had been put down. While the water from these surface-wells may be said to

be usually quite pure and wholesome, there were noticed, however, one or two marked exceptions to this general rule. One of these wells in question furnished water to a public boarding-house, or small hotel, in a village, of one or two hundred inhabitants. The well is situated in the back-yard of the hotel, where the slops from the kitchen were thrown, and the cow was penned during the nights. Near by, scarcely three rods away, were the stable and cesspool, all adding their fetid effluvia to the porous, sandy soil. An examination of the well revealed the following section, in the descending order:—

1	Rather coarse sand, stained by carbonaceous material	5 feet
2	Clay	3 "
3	Sandy Clay	8 "
4	Sand	Undetermined

The most rational speculation, on these several conditions, may be summed up, as follows:— The rain falls upon the sandy soil, where it is contaminated with surface impurities. The water, thus loaded with organic material, is rapidly taken up by the hungry sands, and conducted to the impervious bed of clay below, along which it is conducted to the well, which it finally enters, to mingle with the purer waters from lower levels. That this is a true explanation of the several conditions, here exhibited, was further demonstrated by an actual observance of the impure waters trickling down the side of the well, along well-marked lines. Such extreme cases of surface contamination, as the above, are probably not often met with, in South Georgia. Nevertheless, it fully illustrates what may likely occur, in almost any densely populated portion of that section, unless strict sanitary conditions are rigidly enforced. It is encouraging to know, that these surface-wells, which are so liable to become

contaminated with organic impurities, are not the only available sources of water-supply, for the various towns and villages of South Georgia. The numerous successful artesian wells, put down in the last few years, throughout that section of the State, fully demonstrate, that there underlies much, if not all, of the entire Coastal Plain, porous beds of sand and limestone, which furnish large quantities of excellent artesian water, absolutely free from all surface contamination.

CHAPTER IV

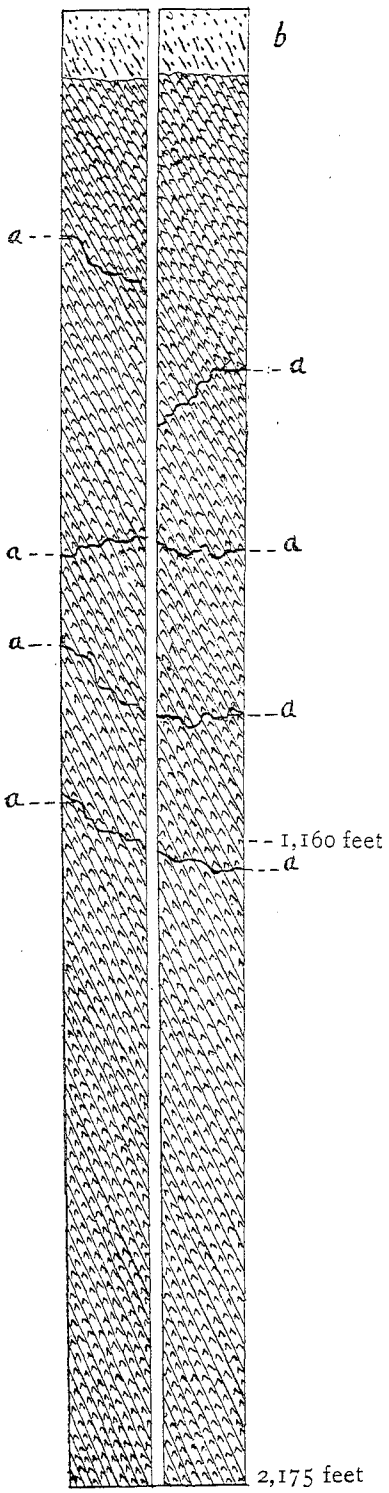
ARTESIAN WATERS IN NORTH GEORGIA

All of that portion of the State, lying north of the Cretaceous and Tertiary formations, and embracing the Crystalline and Paleozoic areas, has a geological structure usually quite unfavorable for artesian wells. The Crystalline area is made up of much-folded and contorted gneisses and schists, together with extensive intrusive masses of granite and diorites, all of which are practically impervious to water, except along parting planes or fissures, made by earth-movements. These natural openings in the rock, where the water is allowed to circulate freely, become less numerous, or of smaller size, as the earth's surface is penetrated, and the chances for obtaining a copious supply of water correspondingly decreases. This fact is well illustrated, in the case of the Atlanta well, which attained a total depth of 2,175 feet. Several small fissures, furnishing a limited amount of water, were struck in the well, about the 1,200-foot level; but, below that point, the bore-hole was practically dry to the bottom of the well. Even if these fissures carried large quantities of water, at reasonable depth from the surface, the likelihood of striking them is too uncertain, to warrant an outlay of money in prospecting for artesian waters in such areas. Professor Chamberlin, in discussing this question, says:—"A little computation will show, that, even if such compact rocks were notably fissured, they would be a very questionable resource in deep,

expensive wells. Suppose, that vertical fissures or tubular channels traversed a given stratum, at intervals of only 10 feet. It would be possible to sink twenty average bores between each two of them. If the fissures averaged as much as six inches, chances of success would be about one in twenty, or only 5 per cent. of the whole, or, with a similar system of cross fissures, 10 per cent."

Furthermore, the structural geology of the Crystalline area is such, that waters, even if obtained from very deep borings, are likely to become, sooner or later, contaminated by local drainage. Especially is this true, where the wells are located in cities of thickly populated districts. This fact is also well illustrated by the Atlanta well. When the well was first completed, a chemical analysis was made of the water, and it was found to be quite pure; but, after continual use for a few years, the water became so contaminated, that it was finally pronounced, unsuitable for domestic uses. The change in the chemical composition of the water was

Fig. 22



Ideal Section of the Atlanta Artesian Well, Showing the Water-bearing Fissures and the Dip of the Gneissoid Rock.
a. Water-bearing Fissures. b. Decomposed Rock, or Saprolite.

evidently due to the continual draft on the water-bearing fissures, which lowered the static head and allowed the surface waters to gradually seep into the well from above, without being properly filtered.

The amount of money expended in the cities of Atlanta, Macon, Augusta and Washington, Ga., in fruitless efforts to obtain flowing artesian waters from the crystalline rocks, aggregates, in the last few years, many thousand dollars, a sufficient amount, if judiciously expended, to make a complete geological survey of the entire crystalline area. There can be no question, about this area's furnishing an ample supply of wholesome water for common surface wells in the rural districts; but the structural geology of the region, and experience, also, demonstrates, that the sinking of deep wells in the crystalline rocks, for city water-supply should be discouraged.

The Paleozoic area, which includes most of the northwestern portion of the State, has a geological structure, more favorable for successful artesian wells, than the crystalline area; but the water-bearing strata consist chiefly of compact limestone and sandstones, neither of which are likely to be the source of large supplies of artesian water. The structural geology of this area has been admirably worked out by Dr. C. W. Hayes, of the United States Geological Survey; and his geological maps and sections will greatly aid the well-prospector, in determining the places, where the conditions are most favorable for the location of bore-holes, to obtain artesian water.

CHAPTER V

CONCLUSIONS

By an examination of the notes, on the numerous artesian wells in the various counties of South Georgia, herein given, it will be observed, that but few attempts have been made to obtain water by deep boring, that have not been successful. The majority of these failures are probably attributable to mismanagement in well-construction, rather than the lack of the necessary geological conditions, essential to artesian waters. While there is much, yet to be learned about the underground water-system of the Coastal Plain, there is, nevertheless, sufficient known already, to warrant the statement, that almost this entire portion of the State is underlaid by pervious beds, which will furnish large quantities of pure, wholesome artesian water, when pierced by the drill. It is not to be inferred by this statement, however, that these water-bearing beds will furnish flowing wells. On the contrary, the flowing wells will be found to be limited to certain areas, not yet fully defined. They can hardly be expected, at an elevation of more than three or four hundred feet above the sea-level. There are, however, a few flowing wells, occurring at higher elevations; but such water-bearing beds are confined to limited districts, and cannot be relied upon, over extended areas.

It will be further noticed, that the wells rarely attain the depth of a thousand feet, the average being about four hundred and fifty feet; and that the various strata penetrated consist of soft lime-

stone, clays and sand, which reduce the cost of well-construction to a minimum. The question of flowing wells, although an element in artesian wells, of very great significance to the average person, is, after all, only of minor importance in cities and towns, unless the static head be unusually high. This is well illustrated in the case of the Brunswick and Albany wells. Both these cities have flowing wells; but the pressure is insufficient to force the water to the stand-pipes, from whence it can be distributed throughout the city.

The question, as to the sanitary effect of the artesian waters on the general health of the towns and communities, where they have been in use for a number of years, has received some attention; but the statistics obtained are so meagre, that only general statements can be made. It can be affirmed and verified, by numerous examples, that the use of these waters has materially lessened the prevalence of chills and fever in South Georgia. Albany is a good illustration of the point in question. This city, which has a population of 8,000 or 10,000, is situated on the right bank of the Flint river. The location is low and level, with numerous swamps and low-lands near by. Before the completion of the artesian wells, the drinking-water was obtained from shallow surface wells; and the city was considered to be one of the most unhealthy places in the State. Since the use of artesian water has become universal, there, and the sanitary conditions of the city have been further improved by drainage, the effects on the general health have been remarkable; and Albany is now looked upon, almost as a health resort. Brunswick, Bainbridge, Leary and Fort Gaines have experienced similar results; but, probably, not in such a marked degree.

Mr. J. E. Peterson of Fort Gaines, in answer to a communication, making inquiry about the effect of artesian water on the health

of the town, says:— "It would be hard to estimate the beneficial effects to the health of our community, derived from the use of artesian water. We have no statistics; but suffice it to say, that chills and fever are things of the past, in our town, where, formerly, a summer never passed, without many cases in the community."

Similar letters, from other towns in South Georgia, verify the statement, in a no less certain degree, that the artesian waters have a marked beneficial effect on the health of the communities, where they are used.

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