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By George F. Neillist

The existence of vast reservoirs of artesian water underlying the coastal caprock of leeward Oahu was proved in July, 1879, on Honouliuli ranch in the Ewa district.

The first artesian well in the Honolulu district was brought into production on April 28, 1880, at the home of Dr. Augustus Marques on Wilder Ave. near Metcalf St.

Discovery of artesian water was beyond question the most important single contribution to the development of Oahu and Honolulu as we know the island and city today.

Writing in 1882 of the Marques well Judge Lawrence McCully, himself a pioneer in the development of artesian water, penned these prophetic words: “It was hailed as the promise of beauty and fertility for thousands of acres of almost useless land.”

A truer prophecy was never made.

Before the production of artesian water there was little agriculture on Oahu except in the surface stream valleys of Palolo, Manoa, Nuuanu and Kalihi, in the well watered Waialua district, and the valleys of the windward side of the island.

Most of the coastal district from Kalihi to Kaimuki and beyond in both directions was a dry, dusty and barren area, almost a desert.

The arboreal and horticultural beauty and productiveness of the Honolulu of today are almost entirely gifts of artesian water, as are also the huge plantations which garden a large part of the island.

Also, before artesian wells the people of Oahu were entirely dependent for water on shallow wells, surface streams, and springs. These sources, under the fullest possible development, could not adequately supply a city one-fourth of Honolulu's present population.

The man primarily responsible for the discovery and development of artesian water on Oahu was James Campbell, Hawaii's first self-made millionaire, known to his Hawaiian friends as “Kimo Onamiliona” (James the Millionaire).

When the first well came in at Honouliuli the Hawaiians named it “Wai-aniani” (crystal waters).

On a visit to California Mr. Campbell engaged James Ashley, an experienced well borer, to drill a well at Honouliuli. Work started about July 1, 1879, at a location near the shore of Pearl Harbor and at an elevation of 10 feet above sea level.

Two weeks after drilling started, at a depth of 240 feet, water commenced to overflow the top of the pipe. The bore was continued to 273 feet.

The Pacific Commercial Advertiser of Oct. 4, 1879, published this item: “The Artesian Well—A recent visitor to Honouliuli reports the well as continuing to flow freely and without any diminution in the quantity of water discharged; constituting, in fact, quite a river which for the present and until planting can be accomplished is allowed to run into the sea.”

There is nothing in the contemporary record to indicate that Mr. Campbell expected to hit artesian water. Rather, it may be assumed that he had an idea fresh water might be located at a great depth and pumped to the surface for irrigation. He owned thousands of acres of land in the Ewa and Schofield plateau regions which, without water, were useless except for sparse pasturage for cattle.
Artesian water made possible the subsequent development of Ewa and Oahu sugar plantations.

It was some years after the first artesian wells were brought in before there was a general understanding of the formation of the coastal caprock and its vital importance in the creation and functioning of the artesian reservoirs.

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It might be well at this point to interpolate a brief description of Oahu's unique artesian structure; so far as is now known there is none other exactly like it anywhere in the world.

It is the result of three creations of nature, the prevailing tradewinds from the northeast, the Koolau mountain range, and the coastal caprock which fringes the Pacific on the leeward side of the island.

The moisture laden tradewinds are swept against the northeast slopes of the Koolaus and, rising to higher and cooler air strata in their journey across the mountains are forced by the natural process of condensation to drop the moisture in the form of rain.

The rain water falls on the upper slopes of the mountains and part of it, aside from that which flows to the sea in surface streams and other quantities which are absorbed by plants and by evaporation, seeps downward through porous strata of lava which constitute a large part of Oahu's volcanic structure.

In the subterranean movement, flowing through the pervious rock much as it would through a sponge, the water finally finds its way into strata which lie beneath the caprock.

The caprock is a thick layer of impervious soil, composed of clay and other watertight materials, washed down by surface water flow and also deposited by ocean action, at different ocean levels, during many thousands of years.

The caprock, at the coastline from 1,000 to 1,200 feet thick and extending for a considerable distance out to sea on the ocean floor, reaches inland one to two miles, gradually becoming thinner, to a contour elevation of approximately 100 feet on its mountain side boundary.

Captured and confined by the caprock formation, the continuous downward flow of water through the mountain strata creates sufficient pressure at the present time to force it up through artesian wells, drilled through the caprock, to an elevation of about 28 feet above sea level in the Honolulu district.

Salt water from the ocean also seeps into the porous lava underlying the caprock. However, as salt water is heavier than fresh water, the rain from the mountains floats upon, or is "perched" upon, the ocean water.

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Encouraged by the success of James Campbell's well, a group of islanders organized to carry on the development of artesian water sources.

The Pacific Commercial Advertiser of March 6, 1880, announced: "An Important Enterprise—By the Zealandia last week arrived Mr. A. D. Pierce ... an experienced well-borer, from the East, who comes to these islands under employment to Messrs. G. W. Macfarlane & Co. and others with a complete outfit of steam well-boring tools, which will be used for testing the chances of obtaining water on some of our plantations by the artesian process. . . . .

"Among those who are interested in this matter are Hon. H. A. Widemann, A. Marques, F. A. Schaefer & Co., Hon. James J. Dowsett, Ookala Sugar Co., and Cornwall & Co., and experiments will be made on lands owned by those parties—the first trial, however, will be made on the premises of Mr. Marques, on the Waikiki Plains, where operations will begin next week."

On March 27, 1880, the editor noted that he had visited the Marques property and that the drill then was down fifty feet. He added, "Among the visitors yesterday were His Majesty the King (Kalakaua)."

Flowing water was struck in the Marques well on April 28, 1880, at a depth of 273 feet and rose to an elevation of 42 feet above sea level, establishing the artesian head in the Honolulu district.
The second productive Honolulu well was drilled on the property of Judge McCully on South Beretania St., near the present McCully St., where a fine flow was obtained on Sept. 15, 1880.

The third Honolulu well was brought in at the “Old Plantation” home of Curtis P. Ward, on South King St. Other wells quickly followed on another of Judge McCully’s lots, at Kamollili, and on the Jaeger homestead between Beretania and King Sts. near Kalakaua Ave.

Writing of the Jaeger well, Judge McCully noted that “a very interesting fact in this boring was that a piece of coconut wood was found at 222 feet.”

Urging the development of artesian water sources and the conservation of watershed forests the Pacific Commercial Advertiser of June 19, 1880, published this editorial: “We understand that His Excellency the Minister of the Interior, with his usual enterprise, has inserted an item in the Appropriation Bill to provide for boring artesian wells in localities where water is needed for irrigation purposes.

“The sum asked for—$10,000—could not be expended for a better object, for, if running water is obtained, which late experiments should lead us confidently to expect, the result will be to bring into profitable cultivation many places that are now comparatively deserts.

“But don’t let us forget a matter still more important—and that is the protection and replanting of our forests. Where shall the water come from to supply artesian wells when our mountains become denuded of trees, and the rains that fall run at once into the sea instead of being detained by the trees, grass and mosses and allowed to percolate through the earth to fill the underground reservoirs?

“If this supply fails, there will be little use for artesian wells. We trust that the Legislature will not adjourn without taking some action for the preservation of the forests.”

By 1889 a hundred wells had been bored on Oahu and in the 21 years to June, 1910, 330 had been added. Most of these were uncapped and unregulated and the water that was not productively used was wasted. A consequent reduction in artesian heads was soon noted.

So far as the general public was concerned, the artesian wells in the Honolulu district had one drawback. The flow from them was limited to 42 feet above sea level. Property above that elevation could only be served by pumping, and there were no pumps, or by carrying the water by hand.

Therefore government officials continued to press for development of high level water, from surface streams and springs, which would distribute itself by gravity flow. It was not until 15 years after the Marques well was brought into production that artesian water made a substantial contribution to the municipal supply and that was when the Beretania station began steam pumping in 1895.

Concurrently with the discovery of artesian water, 1879-80, Honolulu's first major reservoirs were built, both of masonry. One, in Makiki, had a capacity of 725,000 gallons. The other was located in Nuuanu valley on the Queen Emma property. Both were supplied by gravity flow from surface streams and springs.

From the Makiki reservoir an 8-inch pipe was laid to Beretania St. where a connection was made to permit general distribution of the water in the downtown area.

In 1881 a severe smallpox epidemic stimulated action toward securing a purer water supply and also a sewer system. The purity of artesian water was undisputed and for the first time plans were discussed for pumping it to higher elevations for general distribution by gravity flow.
A filtering plant for the Nuuanu reservoir was constructed in 1881 on the John A. Wood property. This was the first effort to purify the surface mountain water.

A report by the minister of the interior in 1882 made this contribution to public thinking:

"Before the successful boring of artesian wells, water was obtained wholly from Nuuanu and Makiki valleys. . . . The water is not wholesome and is more or less dangerous to public health.

"Artesian well water is perfectly pure and it is now evident that it can be obtained in quantities sufficient to supply the city . . . to supply it at a height of 100 feet above sea level will require the adoption of a steam pumping system . . . The artesian wells so far throw water 42 feet above sea level . . . the fact that an abundance of this water may be had makes it possible to change the water supply system with great advantage."

In 1887, to replace the municipal steam driven electric lighting plant, two small reservoirs were constructed in Nuuanu valley, one at Luakaha and the other near the old Half Way House, and a connecting pipeline provided water for the turbine of an electric plant, which proved to be a great success, providing lights for the city's streets.

However, as the city continued to grow, the electric plant became inadequate to meet the public demand for street lighting. The streets were frequently dark, even on moonlit nights, when the water supply was low.

The Hawaiian Electric Co. in January 1926, began supplying part of the power required by the city and took over the entire service October 1, 1929, and the old water driven plant was abandoned.

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During the winter of 1888-89 Honolulu experienced a severe drought, so severe that a water famine was threatened. Residents were notified to use water sparingly and irrigation was limited.

The situation became so alarming that a horse-drawn fire engine was called into service to pump water from the Thomas Square artesian well to the Makiki reservoir. This was the first proof of the feasibility of pumping artesian water to higher elevations for general distribution throughout the system.

Stimulated by public fear for future droughts, in 1890 work was started on Nuuanu earth reservoirs Nos. 1, 2 and 3, and they were completed the following year. Those reservoirs had respective capacities of 21,300,000 gallons, 7,300,000 gallons and 10,700,000 gallons. Plans were then made for the immensely larger No. 4 reservoir, at the head of Nuuanu valley, but work on it was not undertaken until 1905 and it was not completed until 1910, with a capacity of 625,000,000 gallons.

In 1891 the city again suffered from a drought and a fire engine pumped water from Thomas Square well to the Makiki reservoir for 47 days. A fire engine was again called into this emergency service in 1893 and this experience brought quick action and a steam pumping plant was installed at the Makiki artesian well which had been bored in 1881.

When drought conditions were again experienced in 1894 this pumping station proved its worth by raising 1,500,000 gallons of water to the Makiki reservoir in 24 hours and steam pumping was generally accepted by the public as promising the best safeguard against future droughts.

Plans were immediately undertaken for the installation of the first units of the present steam pumping station at Beretania and Alapai Sts., which began operations in 1895 when three million gallons per day were delivered from two 10-inch artesian wells.

For better distribution of water from the Beretania station, a masonry reservoir with a capacity of 1,500,000 gallons was completed on Punchbowl in 1897.

In 1899 three 12-inch wells were drilled for the Kalihi pumping station and in 1900 the station began operations with a daily production of 5,000,000 gallons.
Also in 1900 the old Diamond Head reservoir, capacity 876,000 gallons, was completed.

In 1903 the Kaimuki pumping plant and water system, which had been privately installed and operated, was acquired by the government for $75,000.

In 1905 the Kalihi reservoir, mauka of the old Kamehameha Schools, was placed in commission. Water was pumped to it from the Kalihi station. This installation solved the problem of giving adequate water service to the upper floors of buildings in downtown Honolulu.

In 1910 two 12-inch wells were drilled at the Beretania station and a high lift pump was installed, adding another 3,000,000 gallons per day to the city's water supply.

In 1912 the first reinforced concrete reservoir built by the government was completed on Kaimuki ridge. It had a capacity of 750,000 gallons.

In 1913, by act of the legislature, the water system was transferred from the territory to the city-county of Honolulu at a price of $1,142,031, payable over a period of 30 years.

In 1920 work began on mountain tunneling in the hope of developing additional sources of water. Tunnels were bored in Nuuanu, Palolo and Makiki valleys and later in Kalihi and Manoa. This program continued for four years but with unsatisfactory results.

During this period considerable additions were made to the capacities of the pumping stations. A 5,000,000 gallon centrifugal motor-driven pump was installed at the Kaimuki station and a 3,000,000 gallon pump of similar design was added to the Beretania station.

Completion of a 2,725,000 gallon concrete reservoir in Nuuanu, No. 5, in 1923 resulted in the abandonment of the earlier open, earthen reservoirs as sources of city water. These reservoirs have since been maintained solely for flood control. For the first time in history residents of Nuuanu were assured of clear, pure water.

During all of these transitional years following the development of artesian water Honolulu had been slowly reaching a crisis in regard to its water supply. The artesian supply was being overdrawn as evidenced by its steadily falling head and mountain tunneling had failed to develop water on a scale sufficient to meet the requirements of a rapidly growing city. The distribution system and pumping facilities also had become inadequate. Honolulu had completely outgrown its old water system.

This situation was largely due to the fact that the system had just "grewed" like Topsy, and it had become an unintegrated pattern of haphazard patch work, reflecting a lack of continuity of management and a consequent absence of long range, over-all planning.

Arthur C. Alexander, in a paper read to the Social Science Association on May 10, 1915, pointed to a solution which was not adopted, however, until 10 years later.

Mr. Alexander said: "The wise and economical development and administration of Honolulu's water supply is a task that is going to require time and careful planning. The demands of the future must be provided for as well as those of the present. It is too important to be left to the judgment of any one man, or to any body of men in control for a comparatively short period of time. For these reasons the writer believes that the control of Honolulu's water supply should be placed in the hands of a commission of able and clear-headed men appointed for a long term of years. . . ."

The legislature of 1915 created a water commission of the Territory of Hawaii to study the water problem. Commission members were G. K. Larrison, Arthur G. Smith and T. F. Sedgwick. In its report of January 13, 1917, to Governor L. E. Pinkham the commission recommended that the Legislature enact a law giving the government control of and supervision over
all artesian wells to the end that wastage of water could be prevented. Such action was suggested by A. E. Chandler, member of the California State Water Commission, who was an advisor to the Hawaiian commission.

Also in 1915 a Honolulu water commission was created by the board of supervisors to investigate and report "upon the present and future water system of Honolulu."

Appointed by Mayor John C. Lane members of this commission were Lorrin A. Thurston, Charles R. Forbes, Jorgen Jorgenson, James Gibb and John H. Wilson. Their chief of staff was James T. Taylor, hydraulic engineer. This commission made a comprehensive report in 1917, replete with statistical information and containing many recommendations for improvement of the water system.

The report also contained this warning:

"The water supply system of the city has been created at haphazard, no comprehensive plan for its development having been formulated or adopted.

"... the demonstrated fact that the system is already overtaxed; that the artesian water level is steadily falling, and that if radical remedial steps are not promptly taken, its complete failure, or at least extreme diminution, is due at an early date."

Despite the reports of the two water commissions it took another long and severe drought to arouse Honolulu to constructive action. This drought started in May 1923, and was not broken until December 1926. When the first artesian well was drilled in Honolulu in 1880 the artesian head was 42 feet. When the long drought started in May 1923, the head had been reduced to 30.8 feet and by October 1926, it had fallen to 23.5 feet. Another drop of five feet probably would have resulted in the destruction of Honolulu's artesian wells by salt intrusion. (Note: Sealing of leaking wells and the metering of the city eventually reversed the artesian head trend and in March 1932, it again reached the 30.8 feet mark.)

During the early years of the long drought another menacing public problem developed in the community. Lack of an adequate sewer system had created a threat to public health, a situation that was partly due to the water shortage.

The legislature of 1925 met this double challenge to the public welfare by creating the Honolulu Sewer and Water Commission and directing it to "expedite and complete the sewer and water system, and to insure its adequacy and to safeguard the watersheds and artesian basins of Honolulu."

It can be said that the sewer and water commission, and its successor body in the management of the water works, the board of water supply, which took over the system on Feb. 1, 1930, met the challenge with brilliant success.

It can also be said that creation of the sewer and water commission marked the inception of the "modern era" in the development and management of Honolulu's water system, a chapter that is yet to be written.
The discovery and development of artesian water, by George F. Nellist.
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