

# EARLY MUNICIPAL WATER WORKS AT PANAMA.\*

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MUNICIPAL engineering problems of the early period of American operations on the Isthmus of Panama occupy a more important place in the history of the canal than is indicated by the relative magnitude of the work involved. As an item in the total construction required for the successful completion of the canal, the municipal works are insignificant; but as an essential step in the sanitary renovation of the Canal Zone and the adjacent cities of Panama and Colon, these works must be accorded a position of considerable prominence.

It is the intention of this paper to record briefly certain phases of the water works construction at Panama, from the inception of the American work up to the time when yellow fever was practically eliminated from the Isthmus, or from July, 1904, to October, 1905.

The treaty between the United States and the Republic of Panama under which the United States acquired the right to construct the canal ceded to the United States the Canal Zone, with full sovereignty therein. The treaty likewise gave to the United States control of all health matters in the adjacent cities of Panama and Colon, and provided that the United States should construct water and sewerage systems in those cities, stipulating that rates collected should be sufficient for the amortization of the cost, principal and interest, in fifty years.

The formal transfer of the canal properties from the French Company to the United States took place May 4, 1904, and shortly thereafter the Isthmian Canal Commission proceeded to exercise the rights conferred by the treaty. Mr. John F. Wallace, Chief Engineer, and Col. William C. Gorgas, Chief Sanitary Officer, arrived on the Isthmus the latter part of June, and active

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steps in organization, sanitation, and preparation to build the canal began immediately.

When this work started, Panama City had a population of about 20,000. It had no public water supply. The inhabitants depended upon cisterns and an irregular dispensing by wagons which brought water from certain wells on the outskirts of the town. The city had no sewer system, although a few inadequate underground drains existed which were more of a sanitary nuisance than a benefit.

Colon had a population of about 8000. The Panama Railroad Company had a water supply in that city capable of delivering about 60,000 gallons a day. But, as this water was required for railroad, steamship, and allied purposes, the residents depended upon cisterns and similar collectors, as was the case in Panama. The railroad supply, moreover, was drawn from a watershed area of twenty-four acres back of Mount Hope, on which about fifty people were resident. As no sanitary precautions were taken, the use of the water for domestic purposes was at least questionable.

The Panama Railroad Company had installed in Colon one or two small sewers serving their works, but the city proper was even more lacking in sanitary drainage facilities than was the city of Panama.

Several of the construction towns along the line of the canal, such as Paraiso, Culebra, Empire, Gorgona, and Bohio, had been furnished by the French Company with water from nearby springs or streams. These supplies were incomplete and inadequate, being limited to providing water for bathing at a few buildings. The chief reliance was tanks and cisterns, as in the cities of Panama and Colon.

In brief, the lack of public water supplies resulted in tanks, cisterns, barrels, and similar receptacles being universally prevalent throughout the entire line of the canal, with a great concentration of such containers at the critical terminal points of Panama City and Colon. These receptacles formed ideal breeding places for the *Stegomyia*, or yellow-fever transmitting mosquito. These mosquitoes do not breed in the open swamps or larger bodies of water, but require the protection of buildings, grass, and foliage. Until household water containers could be eliminated by the substitution of modern water works and the accompanying sewers, it was a practical impossibility to exterminate the *Stegomyia*. Yel-

low-fever control at the Isthmus, then, was very largely a question of the early introduction of water supplies.

Very little yellow fever existed on the Isthmus when the Americans assumed control. The entire population was practically immune. With the arrival from the United States of hundreds of non-immunes, however, the situation changed. Yellow-fever cases gradually increased, until in June and July of 1905 the conditions approached those of an epidemic. At this critical period the laying of water mains in Panama City had sufficiently advanced to permit turning on the supply, with an accompanying decrease in cisterns and other water receptacles. The drop in yellow fever was at once apparent, as is shown in the following table:

	Deaths
July, 1904-January, 1905, inclusive .....	13
February, 1905 .....	6
March .....	4
April .....	2
May .....	8
June .....	19
July .....	13
August .....	9
September .....	4
October .....	2
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	80

Only the infinite patience, unremitting efforts, and constant vigilance of Colonel Gorgas and the sanitary corps working under his direction, coupled with skill and experience, prevented a veritable epidemic, handicapped as they were by the presence of thousands of mosquito-breeding foci. With the elimination of these breeding places, the triumph of the sanitarian was complete.

From the beginning, Panama City was looked upon as the centre from which the introduction and spread of yellow fever was most to be feared. This city had constant communication with South American ports where yellow fever was endemic, and a single imported case escaping quarantine regulations would be sufficient to spread serious trouble. The water supply for that city was therefore considered of primary importance. It was not a question of the best system, but a matter of how soon a suitable supply could be introduced. The selection of a permanent

source could very well be left until the plans for the canal were sufficiently developed to determine what relation the water supply would bear to that major product.

Some years prior to 1904 a project for a water supply for Panama made some progress until stopped by a revolution. The Juan Diaz River, some fifteen miles to the east of the city, had been selected as the source. This was an excellent stream, but by no means as readily available for rapid introduction as the Rio Grande River, adjacent to the Culebra Cut, some ten miles from the city. Availability being a controlling factor, the Rio Grande was adopted for Panama, and a complete system of water works and sewers was worked out and submitted to the Canal Commission. The work thereunder was authorized by the commission on August 9, 1904.

Actual construction work was subject to many annoying delays and was carried out under difficulties and amid some confusion. The general situation on the Isthmus at this period has been the subject of sharp criticism, much of which is easily explained at this time and at this distance from the actual work.

From the present viewpoint, it is apparent that a large part of the confusion attending the early Panama construction was due to the too prevalent American characteristic of hurry and rush without adequate preliminary preparation. The French Companies had failed in their effort to construct the canal. With the typical and commendatory American desire to make the canal a success, and break all speed records, the motto of "Now let the dirt fly" was impressed on those in charge. Immediate results in actual canal construction were demanded, irrespective of whether or not conditions were ripe for such work.

As a matter of fact, at the time the United States began operations there were about six hundred laborers, largely Jamaica negroes, actually at work upon the canal. There were, in addition, about five hundred more laborers scattered throughout the Isthmus who were possibly available to augment this force actually at work. A large percentage of this body of men was incapacitated to some degree by malaria fever, so that as a potential force for real work under American standards the numbers above given should be greatly decreased. Moreover, the entire plant and equipment turned over to the Americans was inadequate, out of repair, and generally inefficient and insufficient.

At the time water works construction was begun the Department of Health was organizing to put hospitals in shape, to cut down vegetation, to ditch, drain, and fumigate. The Building Department was getting ready to repair old houses, to make them habitable, and to build new ones. The Material and Supply Department was sorting old French stock, revamping the storehouses, and preparing to receive stores and deliver supplies. The Mechanical Department was putting the shops in order and repairing some of the machinery.

Transportation for all this work was practically limited to the Panama Railroad, which was barely able to handle ordinary trans-isthmian business, and entirely unable to cope with the additional operations incident to the canal work. Steamship docks were lacking, so that the necessary increased shipments of freight were almost out of the question.

Available for all work, there were perhaps a thousand or twelve hundred inefficient and incompetent Jamaica negroes. Each department needed more men, and yet no more men were wanted on the Isthmus until there was opportunity to house them, until water and food were ready, until there was provision to care for them if they should be sick. Each department depended upon and needed the other departments, and yet in a sense they were rivals.

With these handicaps and with the inherited incubus of disease and fevers not yet overcome, conditions governing work were necessarily somewhat primitive. Yet work on the Isthmus kept pace with the deliveries of supplies. To quote from a report of the Governor of the Canal Zone, under date of February 20, 1905: "It is now the middle of the dry season, water is scarce and very dear, and no increase in the supply can be expected from the new aqueduct for many months. The laying of the pipe is being done with expedition, and, in fact, a single cargo of water-pipe that has already been received was almost laid—every joint of it—before the last train-load pulled out from the railroad station. The pipe is sufficient in quantity to reach Pedro Miguel, but there now must be a wait of several weeks—and, I fear, months—before it can be completed."

Notwithstanding various obstacles, the water was finally introduced in the city of Panama, July 4, 1905. To quote from the report for that year of the Isthmian Canal Commission: "The

water was turned on for the first time on July 4th of this year. It would be difficult to describe the gratification and gratitude of the inhabitants at the consummation of their long-deferred hope. Formal expression took the form of a special session of the Municipal Council and the adoption of resolutions of thanks and the appointment of a committee to present a copy thereof to the Governor of the Zone. The *Te Deum* was sung in the Cathedral, attended by President Amador and his cabinet and the principal officials of the commission on the Isthmus and of the government of the Canal Zone."

The water supplies for Colon and the various towns along the line of the Canal followed the introduction of the water system in Panama. As before stated, yellow fever was put under control, and its definite elimination was begun from the time of that introduction. As an important factor in the sanitation of the canal, the water supplies cannot be overlooked.

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**Ultra-violet Radiation and the Eye.** W. E. BURGE. (*Transactions Illuminating Engineering Society*, September 20-23, 1915.)—It has been recognized for some time that, unless protected by a glass globe, the radiation from a quartz mercury arc or from an iron arc or from any light source emitting large quantities of ultra-violet rays is harmful to the eye. In a general way it has been assumed that all radiation of shorter wave-lengths than  $350\ \mu\mu$  is injurious to living tissues. An organ (*e.g.*, the eye) is composed of tissues—connective tissue, nervous tissue, etc. The tissues are composed of cells. Ultra-violet radiation kills living cells and tissues by changing the protoplasm of the cells in such a way that certain salts can combine with the protoplasm to form an insoluble compound or coagulum.

Cataract is an opacity of the crystalline lens. Many observers have demonstrated that it is impossible to produce an opacity of the lens or cataract in a normal living animal by exposure of its eye to ultra-violet radiation. Analyses of human cataractous lenses from America show a great increase in the salts of calcium and magnesium, and those from India show, in addition to these salts, silicates. Glass blowers who develop cataract form a relatively small proportion of those engaged in that occupation, and it is assumed that those who do develop it have a disturbed condition of nutrition, which expresses itself in an increase of those substances which can precipitate the portion of the lens acted upon by ultra-violet radiation.

An opacity of the lens or cataract can be produced in fish living in solutions of those salts, found to be greatly increased in human cataractous lenses, by exposing the eye of the fish to ultra-violet radiation. This cannot be done with fish living in tap-water.