A QUANTITATIVE AND QUALITATIVE BACTERIAL ANALYSIS OF THE SEWAGE DISPOSAL SYSTEM OF PERRYTON, TEXAS

THESIS

Presented to the Graduate Council of the
North Texas State College in Partial
Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

By

Troy G. Sullivan, B. S.

Denton, Texas

August, 1950

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

CHAPTER I

INTRODUCTION

In the year 1889, the town of Ochiltree was established on the banks of Wolf Creek and became the county seat of Ochiltree County, Texas. In 1910, the Santa Fe Railroad built a branch line from Shattuck, Oklahoma, to Morse, Texas, by-passing the town of Ochiltree by about ten miles. In 1921, the people of Ochiltree relocated their town by moving their business buildings and their homes ten miles north to the railroad. Here, they established the town of Perryton, Texas.[1]

During the first five years, this newly established town grew rapidly. Wheat farming was becoming highly developed and a more definite building program was begun. A county consolidated school, a large county court house, a hospital, a sewage disposal plant, and the widest main street in the Texas Panhandle were built.[2]

The wheat industry supports the town of Perryton. Nearly all of the wealth comes from the farming of wheat, storage elevators, industrial machinery, and the shipping

---

[1] Texas Almanac and Industrial Guide, 1925, p. 328.

[2] Letter, June 21, 1950, Lee Little, Secretary, Ochiltree County Chamber of Commerce.

of grain either by truck or railroad. This type of industry naturally demands many more laborers through harvest and plowing during June and July, than this industry can normally support during the remainder of the year. This condition results in an influx of transient workers every summer, the number of which amounts to at least half the permanent population. There are no housing facilities for so many migratory laborers; hence, there is created an alarming sanitation problem. Most of the laborers eat in the cafes or at the farms where they work. Many of them sleep in tents or under their trucks. The opportunity for the spread of disease is tremendous, for in proportion to the number of people, the places for cleaning and caring for one's self are few and undesirable. According to a report from D. B. Pearson, physician at the Perryton Hospital, there has been a surprisingly small number of diseases resulting from the seemingly unsanitary conditions. Though positive tests for typhoid bacteria were obtained from the sewage disposal plant during this investigation, Pearson stated that there have been no reported cases of typhoid in the town of Perryton for the past five years, and that there is no record of any cases in the history of Perryton.[3] The Texas State Department of Public Health, in answer to an inquiry,

---

[3]Letter, June 3, 1950, D. B. Pearson, physician at Perryton Hospital.

revealed that there have been no cases of typhoid fever reported from Ochiltree County.[4]

The Sewage Plant

The original sewage disposal plant, constructed in 1923, was built to take care of 75,000 gallons of sewage for a twenty-four hour period. During the progress of this investigation, approximately 150,000 gallons of sewage were passing into the plant daily. The Imhoff tank had not functioned properly for over a year, and the raw sewage was necessarily being pumped without sufficient time for any biochemical action of the plant or chlorination, directly into a lagoon which covers about fifty acres of land.[5] Figure 1 is a diagram of the original disposal plant. Figure 2 is a photograph of the lagoon with respect to the town of Perryton.

The town of Perryton is built on flat wheat land; therefore, drainage presents a great problem. The town's sewer system, an outfall sewer, consists of pipes laid in a gentle decline, which by the time they reach the collecting pump at the plant, are fifteen feet underground. The raw sewage passes from the pumphouse to the Imhoff tank; and, when the

---

[4] Letter, June 22, 1949, Texas State Department of Public Health.

[5] Interview, May 22, 1950, J. D. Maberry, Superintendent of Perryton, Texas, Water Works.

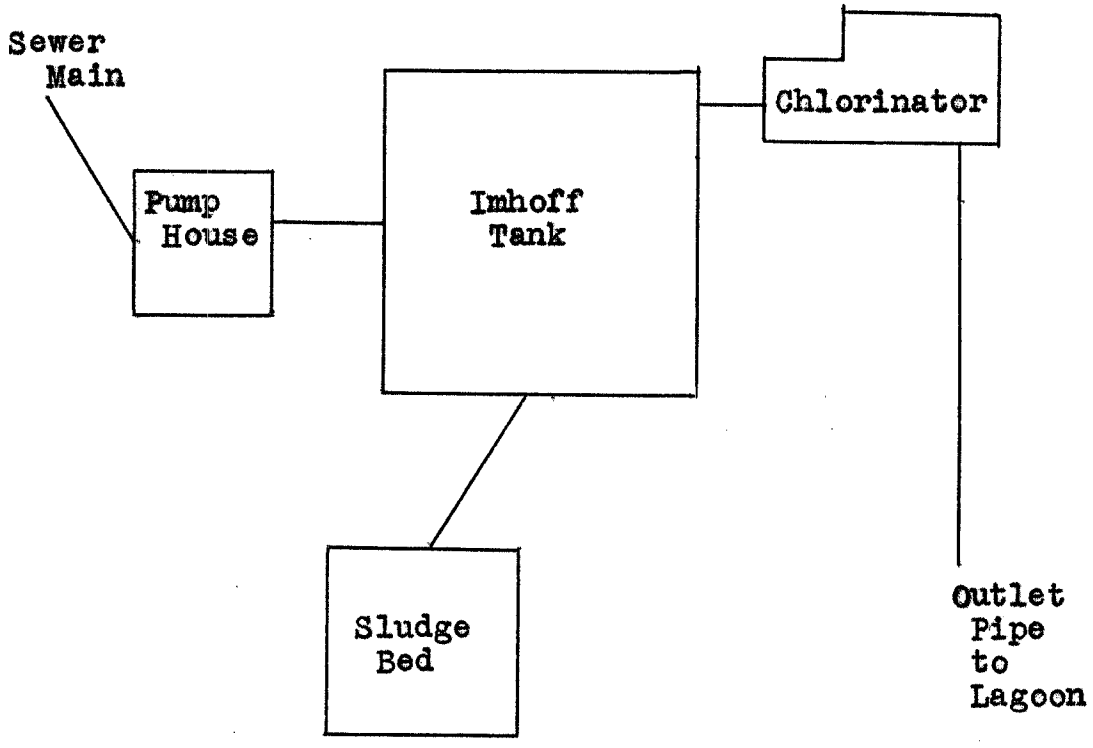


Fig. 1.--A diagram of the original sewage disposal plant of Perryton, Texas.

the plant was first put into operation, the effluent was pumped through a chlorinator and then into the lagoon, while the sludge was pumped into a sludge bed and dried. During this investigation, however, the Imhoff tank, chlorinator and sludge bed were not operating properly and consequently, because of excessive amounts, raw sewage was pumped directly into the lagoon.

The Problem

The primary purpose of a sewage disposal plant is to destroy the pathogenic bacteria commonly associated with human waste. Since this waste was being discharged from the Perryton, Texas, plant without the proper treatment, it was believed that the natural purification factors of the lagoon were being utilized in the destruction of potential epidemic microorganisms which should have been destroyed in the sewage disposal plant, had it been functioning properly.

This investigation has had for its purpose the determination of first, the inefficiency of the Perryton, Texas, sewage disposal plant proper; and second, the potential effectiveness of a lagoon now used to complete the sewage purification; and consequently, offset an apparent health hazard. The problem, as pursued, has consisted of first, the collection of sewage samples from the six sampling

Figure 2. An Aerial View of the Lagoon Showing Its Relationship to the Town of Perryton, Texas.

stations listed in Table 1 over the period of time from September 23, 1949, to May 14, 1950; second, a quantitative analysis of each sample in order to determine the number of bacterial organisms present; third, a qualitative analysis of each sample in order to determine more especially the presence of members of the genera Aerobacter, Escherichia, Salmonella and Shigella; and fourth, an attempt to evaluate the potentialities of the natural purification factors of the lagoon.

CHAPTER II

LABORATORY WORK AND EXPERIMENTAL DATA

The purpose of this study was to ascertain the inefficiency of the sewage disposal plant and the efficiency of the lagoon which constitute the sewage disposal system of Perryton, Texas. The laboratory work consisted of total plate counts and specific plate counts, using S-S agar, from which the number of Salmonella-Shigella organisms per unit volume could be determined. Qualitative tests were made in order to determine the occurrence of Aerobacter, Escherichia and Salmonella typhosa organisms throughout the plant and the lagoon.

Equipment

The sewage samples were collected in sterilized, glass-stoppered reagent bottles of two hundred fifty millliliters capacity. The petri dishes, fermentation tubes and media were all standard equipment obtained from the Biology Department of North Texas State College. A six-quart pressure cooker was used as an autoclave. The incubator, constructed of masonite, was heated by a covered light bulb. The heat was

TABLE 1

SAMPLING STATIONS

Station	Location
1	Discharge pipe of the Imhoff tank. Apparently raw sewage.
2	Outlet pipe into the lagoon. Considerable evidence still of raw sewage.
3	Approximately fifty yards west of the outlet pipe on the north shore of the lagoon.
4	About two hundred yards west of the outlet pipe on the west shore of the large part of the lagoon, near the culvert opening into the smaller part of the lagoon. This sampling area was protected from sunlight by numerous trees planted along the public highway which divides the lagoon.
5	About three hundred yards from the outlet pipe and on the south shore of the lagoon which is very shallow and not shaded.
6	The smaller part of the lagoon near the culvert which permits water to flow into this area. There is no shade and the water is extremely shallow.

controlled by a wafer-type thermostat of the baby-chick-incubator variety set for thirty-seven degrees centigrade.

Collection of Samples

The samples were collected by lowering the collecting bottles into the plant unit or lagoon by means of a string or, where practical, dipping the bottle by hand. The samples were taken in the afternoon and the analyses begun as soon as possible, usually without the need of refrigeration for the samples. An attempt was made to collect samples every two weeks. The definite schedule dates, however, are listed in Table 2.

TABLE 2

DATES OF SAMPLING BY WEEKS

Test Number	Date
1	September 23-30, 1949
2	October 8-15, 1949
3	October 22-29, 1949
4	November 6-13, 1949
5	November 13-20, 1949
6	December 1-8, 1949
7	December 11-18, 1949
8	January 3-10, 1950
9	January 30-February 5, 1950
10	February 18-25, 1950
11	March 18-25, 1950
12	April 2-9, 1950
13	April 14-21, 1950
14	April 21-28, 1950
15	May 7-14, 1950

Total Plate Counts

Twelve dilution plates were prepared for each sewage sample analyzed. Six of these contained nutrient agar, the other six S-S (Salmonella-Shigella) agar. Each dilution was

put into the nutrient agar for total plate count and into the S-S agar for the Salmonella-Shigella plate count. The first set with the exception of the nutrient agar, contained one milliliter of undiluted sample; the others were seeded with one milliliter of one to ten, one to one hundred, one to one thousand, one to ten thousand, and one to one hundred thousand dilutions, respectively.

Distilled water autoclaved in a pressure cooker at fifteen pounds for fifteen minutes was used in dilution of the samples. The various media used, with the exceptions of S-S and Bismuth Sulfite agars, were sterilized similarly. The dilutions were prepared by transferring one milliliter of the sample to a sterile nine milliliter water blank. This was shaken well and one milliliter of this one to ten dilution was transferred to a second nine milliliter water blank. One milliliter of this one to one hundred dilution was then transferred to a third nine milliliter water blank to make a one to one thousand dilution. One milliliter of the one to one thousand dilution was transferred to a fourth nine milliliter water blank making a one to ten thousand dilution. Only one tenth milliliter of the one to ten thousand dilution was plated into the sixth set of plates thus making an equivalent of a one to one hundred thousand dilution.[1]

---

[1] F. R. Theroux, E. F. Eldridge, and W. L. Mallmann, Laboratory Manual for Chemical and Bacterial Analysis of Water and Sewage, Third Edition, 1943, pp. 224-225.

The plates, each containing one milliliter of dilution, were poured with approximately ten milliliters of their respective agars, and incubated at thirty-seven degrees centigrade for twenty-four hours. The total number of colonies found on the positive plate with the highest dilution was multiplied by its dilution factor and recorded as the number of organisms per milliliter of sample. Tables 3 through 8 show the results of these tests. Figures 2 and 3 give a graphic comparison of the results.

Isolation and Identification of Organisms

The incidence of Escherichia organisms is used as an index of water pollution; therefore, qualitative tests were made on samples from various points in the sewage plant and the lagoon into which the plant material was being discharged. These tests were made in order to check for the presence, abundance, and distribution of these coliform organisms. In addition, concurrent tests were run for Salmonella typhosa in order to determine the possible presence of this water-borne, disease-causing organism.

The presumptive test for the Colon-Aerogenes group of bacteria was made by using Brilliant Green Lactose Bile liquid medium. The bile was used in order to inhibit the growth of other bacterial organisms which commonly occur in nature

along with the Colon-Aerogenes group. Members of this group, however, grow unhampered. This medium was prepared by dissolving ten grams of Bacto-Brilliant Green Bile in two hundred fifty milliliters of distilled water. Sterile fermentation tubes were used and approximately six milliliters of medium were placed in each. The tubes were autoclaved for fifteen minutes at fifteen pounds pressure. Each tube was inoculated with one milliliter of sample and incubated for twenty-four to forty-eight hours at thirty-seven degrees centigrade. Gas production as much as 10 per cent in the small inverted tube and the production of acid were considered a positive test.[2] Tables 3 to 9 show results of this test for each station.

Koser Citrate and Clark and Lubs media were used to confirm the presence of and to differentiate between the Escherichia and Aerobacter groups. The Koser Citrate Medium was prepared by dissolving 1.43 grams of the dehydrated medium in two hundred fifty milliliters of distilled water. The medium was tubed in sterile test tubes and autoclaved for fifteen minutes at fifteen pounds pressure. The Clark and Lubs medium was made up in five hundred milliliter quantities by dissolving 8.5 grams of the dehydrated medium in five hundred milliliters of distilled water. Six milliliter quantities were placed in sterile, cotton-stoppered

---

[2] Difco Manual (author not given), Eighth Edition, 1948, p. 32.

test tubes and autoclaved at fifteen pounds pressure for fifteen minutes. A loopful of the culture from each positive green bile tube was inoculated under sterile conditions into both Koser Citrate and Clark and Lubs media. The Koser Citrate medium is used to differentiate between Escherichia and Aerobacter organisms by means of citrate utilization. The members of the Genus Aerobacter use the citrate as a source of carbon and within twenty-four to forty-eight hours of incubation produce a marked turbidity in the otherwise clear liquid characteristic of members of the Genus Escherichia.[3] The Clark and Lubs medium is an additional differential medium between the Escherichia and Aerobacter groups. Escherichia organisms produce acid in this medium, and when tested with Methyl Red Indicator after five days incubation, give a distinct red color. This is indicative of a positive confirmative reaction for these organisms. The results of these tests are given in Tables 3 through 9.[4]

A highly selective medium, Bismuth Sulfite Agar, was used to test for the presence of Salmonella typhosa. In the preparation of this agar, thirteen grams of the dehydrated medium were suspended in two hundred fifty milliliters of cold distilled water and put into solution by raising to the boiling point. Because the medium is a very sensitive,

---

[3] Ibid., pp. 42-43. [4] Ibid., pp. 42-43.

selective one, autoclaving was not necessary. One milliliter of sample was placed in a sterile test tube and approximately six milliliters of medium were added and solidified with the test tube in a slanting position. The tubes were incubated at thirty-seven degrees centigrade for twenty-four to forty-eight hours. Salmonella typhosa organisms grow well on this medium while the growth of other gram-negative as well as gram-positive organisms is inhibited. The colonies of Salmonella typhosa formed on this medium appear as black surface and subsurface colonies. The results of these tests as observed are recorded in Tables 3 through 9.[5]

Experimental Data

The results of the analyses obtained during this investigation are recorded in Tables 3 through 9. Tables 3 to 8 show also the different media reactions indicative of each organism and the plate count results. Table 9 is a collective account of the type of organisms found at each station from each sample tested. Table 10 shows the percentage of occurrence of each organism for all tests made. Figure 3 gives the average and maximum Salmonella-Shigella plate count for all the tests at each station in graphic form. Figure 4 is a graphic comparison of the maximum, average and minimum total plate counts from all the tests at each station.

---

[5] Ibid., pp. 101-104.

CHAPTER III

DISCUSSION, SUMMARY, AND CONCLUSION

Discussion

This investigation showed that the Perryton, Texas, sewage disposal plant was inadequate in the destruction of enteric bacteria passing into it, and that these organisms were being discharged into a lagoon just outside the city limits, thus creating a potential health hazard. However, the results of tests recorded in Tables 3 through 9 show that the quantity and quality of bacterial organisms diminished markedly in the lagoon. The results in Table 3 show that each sample from station one gave a positive reaction for both Aerobacter and Escherichia organisms each time tested and usually a positive reaction for the Salmonella-Shigella organisms. The results at station two, as seen in Table 4, were very little different except for the slightly lower plate counts and two instead of one positive reactions for Salmonella typhosa. The results at the other stations were very encouraging in that the total plate counts and Salmonella-Shigella plate counts decreased markedly and no other positive tests for Salmonella typhosa were incurred during the investigation as shown in Tables 5, 6, 7, and 8.

The positive tests for Escherichia organisms were diminished at stations five and six as recorded in Tables 7 and 8. The results shown in Table 8 from station six indicate that the bacterial organisms viable in that area were usually of the non-pathogenic Aerobacter group normally associated with soil and surface water. Table 10 and Figures 3 and 4 show a definite reduction of enteric bacteria progressively farther away from the plant outlet into the lagoon.

It was very apparent that the natural purification factors of the lagoon were being utilized in order to destroy these organisms in question, thus alleviating the possibilities of a water-borne epidemic that could have had its origin from such conditions. Factors believed responsible for the reduction of the bacterial organisms are the effect of sunlight in such a shallow area, antibiotic action of both bacteria and algae present, wave action against the sandy shore, and the algal production of oxygen which oxidized the organic food material otherwise utilized by the bacteria.

Summary

1. Quantitative and qualitative bacterial analyses were made of the old sewage plant of Perryton, Texas, in order to determine the efficiency of the plant in destroying members of the enteric bacteria and to determine to what extent

TABLE 3

RESULTS OF TESTS AT STATION ONE

Test Number	Media Used						Organisms			
	Lactose Broth	Koser Citrate	Methyl Red Test	Bismuth Sulfite	Salmonella-Shigella Selective Agar Plate Count	Nutrient Agar Total Plate Count	Aerobacter Sp.	Escherichia Sp.	Salmonella typhosa	Salmonella-Shigella Sp.
1	✓	✓	✓	-	2,900	1,900,000	✓	✓	-	✓
2	✓	✓	✓	-	3,600	3,250,000	✓	✓	-	✓
3	✓	✓	✓	-	1,250	1,800,000	✓	✓	-	✓
4	✓	✓	✓	-	Negative	3,100,000	✓	✓	-	✓
5	✓	✓	✓	-	4,800	2,300,000	✓	✓	-	✓
6	✓	✓	✓	-	Negative	2,600,000	✓	✓	-	✓
7	✓	✓	✓	-	2,990	2,800,000	✓	✓	-	✓
8	✓	✓	✓	-	3,500	4,100,000	✓	✓	-	✓
9	✓	✓	✓	-	Negative	6,300,000	✓	✓	-	✓
10	✓	✓	✓	-	4,200	2,450,000	✓	✓	-	✓
11	✓	✓	✓	-	Negative	4,300,000	✓	✓	-	✓
12	✓	✓	✓	-	4,600	2,000,000	✓	✓	-	✓
13	✓	✓	✓	-	7,200	7,800,000	✓	✓	-	✓
14	✓	✓	✓	-	6,300	8,700,000	✓	✓	-	✓
15	✓	✓	✓	-	3,620	9,500,000	✓	✓	-	✓

✓ Positive reaction
- Negative reaction

✓ Organism isolated
- Organism not isolated

TABLE 4

RESULTS OF TESTS AT STATION TWO

Test Number	Media Used						Organisms			
	Lactose Broth	Koser Citrate	Methyl Red Test	Bismuth Sulfite	Salmonella-Shigella Selective Agar Plate Count	Nutrient Agar Total Plate	Aerobacter Sp.	Escherichia Sp.	Salmonella typhosa	Salmonella-Shigella Sp.
1	✓	✓	✓	-	2,850	990,000	✓	✓	-	✓
2	✓	✓	✓	-	Negative	2,600,000	✓	✓	-	✓
3	✓	✓	✓	-	3,200	1,890,000	✓	✓	-	✓
4	✓	✓	✓	-	2,300	2,500,000	✓	✓	-	✓
5	✓	✓	✓	-	4,500	885,000	✓	✓	-	✓
6	✓	✓	✓	-	Negative	2,100,000	✓	✓	-	✓
7	✓	✓	✓	-	2,100	1,900,000	✓	✓	-	✓
8	✓	✓	✓	-	3,620	4,200,000	✓	✓	-	✓
9	✓	✓	✓	-	3,890	4,600,000	✓	✓	-	✓
10	✓	✓	✓	-	4,750	2,750,000	✓	✓	-	✓
11	✓	✓	✓	-	6,500	4,100,000	✓	✓	-	✓
12	✓	✓	✓	-	5,800	5,700,000	✓	✓	-	✓
13	✓	✓	✓	-	6,820	6,300,000	✓	✓	-	✓
14	✓	✓	✓	-	6,750	7,000,000	✓	✓	-	✓
15	✓	✓	✓	-	5,350	6,500,000	✓	✓	-	✓

✓ Positive reaction
- Negative reaction

✓ Organism isolated
- Organism not isolated

TABLE 5

RESULTS OF TESTS AT STATION THREE

Test Number	Media Used						Organisms			
	Lactose Broth	Koser Citrate	Methyl Red Test	Bismuth Sulfite	Salmonella-Shigella Selective Agar Plate Count	Nutrient Agar Total Plate Count	Aerobacter Sp.	Escherichia Sp.	Salmonella typhosa	Salmonella-Shigella Sp.
1	+	+	+	-	62	900,000	+	+	-	+
2	+	+	+	-	Negative	1,080,000	+	+	-	+
3	+	+	+	-	2,124	950,000	+	+	-	+
4	+	+	+	-	3,420	800,000	+	+	-	+
5	+	+	+	-	Negative	850,000	+	+	-	+
6	+	+	+	-	Negative	980,000	+	+	-	+
7	+	+	+	-	Negative	950,000	+	+	-	+
8	+	+	+	-	Negative	1,200,000	+	+	-	+
9	+	+	+	-	Negative	900,000	+	+	-	+
10	+	+	+	-	Negative	860,000	+	+	-	+
11	+	+	+	-	6,800	2,200,000	+	+	-	+
12	+	+	+	-	4,500	900,000	+	+	-	+
13	+	+	+	-	6,500	1,360,000	+	+	-	+
14	+	+	+	-	6,800	2,700,000	+	+	-	+
15	+	+	+	-	5,800	1,450,000	+	+	-	+

\+ Positive reaction
\- Negative reaction

\+ Organism isolated
\- Organism not isolated

TABLE 6

RESULTS OF TESTS AT STATION FOUR

Test Number	Media Used						Organisms			
	Lactose Broth	Koser Citrate	Methyl Red Test	Bismuth Sulfite	Salmonella-Shigella Selective Agar Plate Count	Nutrient Agar Total Plate Count	Aerobacter Sp.	Escherichia Sp.	Salmonella typhosa	Salmonella-Shigella Sp.
1	+	+	+	-	40	1,880,000	+	+	-	+
2	+	+	+	-	Negative	850,000	+	+	-	-
3	+	+	+	-	38	700,000	+	+	-	+
4	+	+	+	-	56	1,900,000	+	+	-	+
5	+	+	+	-	Negative	950,000	+	+	-	-
6	+	+	+	-	Negative	865,000	+	+	-	-
7	+	+	+	-	Negative	910,000	+	+	-	-
8	+	+	+	-	Negative	1,750,000	+	+	-	-
9	+	+	+	-	Negative	2,200,000	+	+	-	-
10	+	+	+	-	75	780,000	+	+	-	+
11	+	+	+	-	Negative	1,050,000	+	+	-	-
12	+	+	+	-	1,600	4,100,000	+	+	-	+
13	+	+	+	-	Negative	3,200,000	+	+	-	-
14	+	+	+	-	520	2,930,000	+	+	-	+
15	+	+	+	-	Negative	3,100,000	+	+	-	-

\+ Positive Reaction
\- Negative Reaction

\+ Organism isolated
\- Organism not isolated

TABLE 7

RESULTS OF TESTS AT STATION FIVE

Test Number	Media Used						Organisms			
	Lactose Broth	Koser Citrate	Methyl Red Test	Bismuth Sulfite	Salmonella-Shigella Selective Agar Plate Count	Nutrient Agar Total Plate Count	Aerobacter Sp.	Escherichia Sp.	Salmonella typhosa	Salmonella-Shigella Sp.
1	✓	✓	-	-	Negative	580,000	✓	-	-	-
2	✓	✓	-	-	62	760,000	✓	✓	-	✓
3	✓	✓	-	-	Negative	800,000	✓	-	-	-
4	✓	✓	-	-	Negative	550,000	✓	-	-	-
5	✓	✓	-	-	Negative	600,000	-	-	-	-
6	✓	✓	-	-	Negative	1,500,000	✓	-	-	-
7	✓	✓	-	-	Negative	2,300,000	✓	-	-	-
8	✓	✓	-	-	Negative	1,930,000	✓	-	-	-
9	✓	✓	-	-	Negative	2,820,000	✓	-	-	-
10	✓	✓	✓	-	160	1,650,000	✓	✓	-	✓
11	✓	✓	-	-	Negative	975,000	-	-	-	-
12	✓	✓	-	-	Negative	1,500,000	✓	-	-	-
13	✓	✓	✓	-	180	3,250,000	✓	✓	-	✓
14	✓	✓	✓	-	1,200	1,700,000	✓	✓	-	✓
15	✓	✓	✓	-	Negative	1,980,000	✓	✓	-	-

✓ Positive reaction
- Negative reaction

✓ Organism isolated
- Organism not isolated

TABLE 8

RESULTS OF TESTS AT STATION SIX

Test Number	Media Used						Organisms			
	Lactose Broth	Koser Citrate	Methyl Red Test	Bismuth Sulfite	Salmonella-Shigella Selective Agar Plate Count	Nutrient Agar Total Plate Count	Aerobacter Sp.	Escherichia Sp.	Salmonella typhosa	Salmonella-Shigella Sp.
1	✓	✓	-	-	Negative	450,000	✓	-	-	-
2	✓	✓	✓	-	Negative	640,000	✓	✓	-	-
3	✓	✓	-	-	Negative	560,000	✓	-	-	-
4	✓	✓	-	-	Negative	300,000	-	-	-	-
5	✓	✓	-	-	Negative	650,000	✓	-	-	-
6	✓	✓	-	-	Negative	1,350,000	✓	-	-	-
7	✓	✓	-	-	Negative	580,000	✓	-	-	-
8	✓	✓	-	-	Negative	1,300,000	✓	-	-	-
9	✓	✓	-	-	Negative	660,000	✓	-	-	-
10	✓	✓	-	-	Negative	1,250,000	✓	-	-	-
11	✓	✓	✓	-	Negative	780,000	✓	-	-	-
12	✓	✓	-	-	Negative	1,100,000	✓	-	-	-
13	✓	✓	-	-	Negative	1,800,000	✓	-	-	-
14	✓	✓	-	-	Negative	980,000	✓	✓	-	-
15	✓	✓	-	-	Negative	860,000	✓	-	-	-

✓ Positive reaction
- Negative reaction

✓ Organism isolated
- Organism not isolated

TABLE 9

ORGANISMS FOUND AT EACH STATION

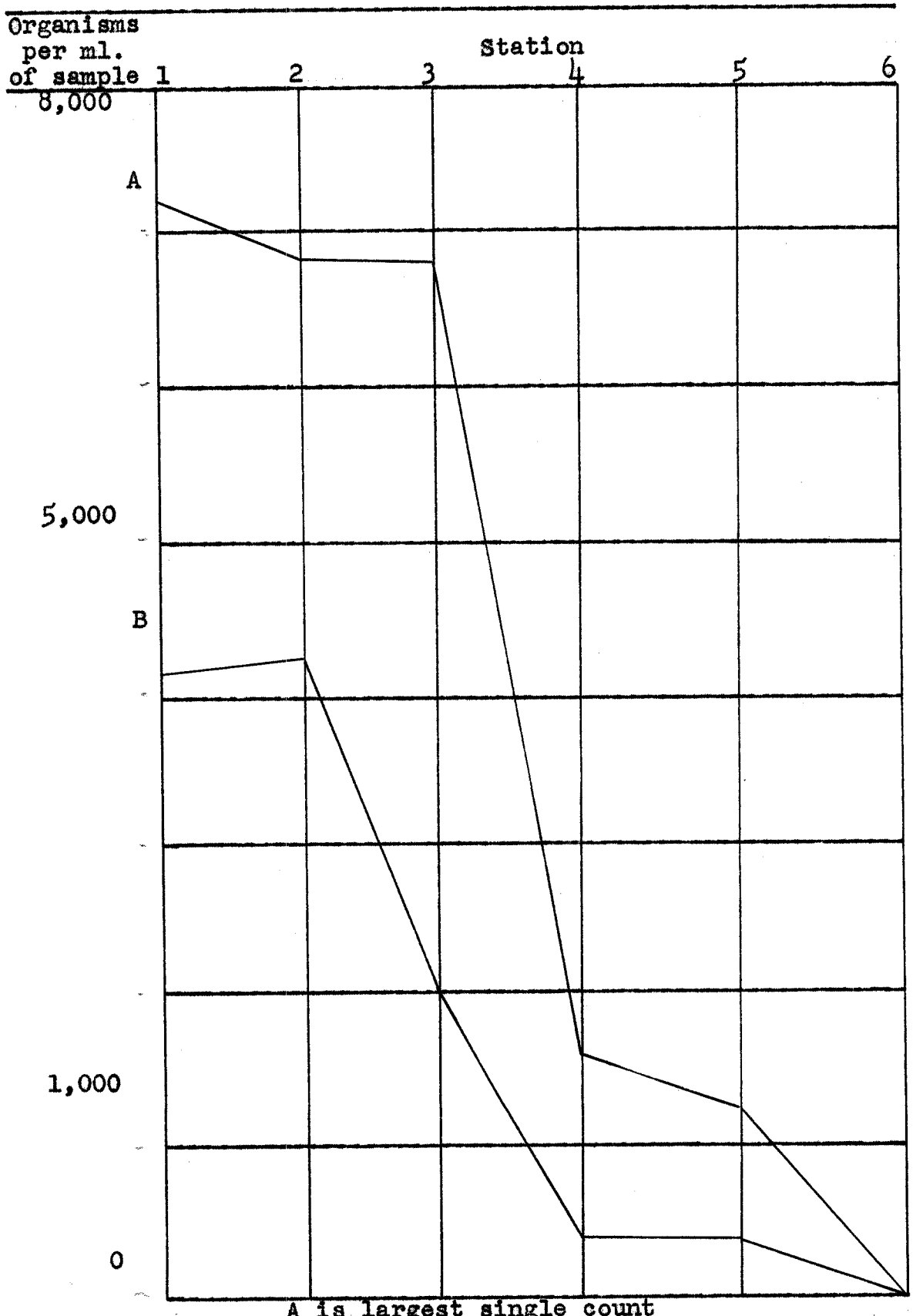
Station	Organism	Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Aerobacter Sp.		≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠
	Escherichia Sp.		≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠
	Salmonella typhosa		-	-	-	-	-	-	-	-	-	-	-	-	-	≠	-
	Salmonella-Shigella		≠	≠	≠	-	≠	-	≠	≠	-	≠	-	≠	≠	≠	≠
2	Aerobacter Sp.		≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠
	Escherichia Sp.		≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠
	Salmonella typhosa		-	-	-	-	-	-	-	-	-	-	-	-	≠	≠	-
	Salmonella-Shigella		≠	-	≠	≠	≠	-	≠	≠	≠	≠	≠	≠	≠	≠	≠
3	Aerobacter Sp.		≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠
	Escherichia Sp.		≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠
	Salmonella typhosa		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Salmonella-Shigella		≠	-	≠	≠	-	-	-	-	-	-	≠	≠	≠	≠	≠
4	Aerobacter Sp.		≠	≠	-	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠
	Escherichia Sp.		≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠
	Salmonella typhosa		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Salmonella-Shigella		≠	-	≠	≠	-	-	-	-	-	≠	-	≠	-	≠	-
5	Aerobacter Sp.		≠	≠	≠	≠	-	≠	≠	≠	≠	≠	-	≠	≠	≠	≠
	Escherichia Sp.		-	≠	-	-	-	-	-	-	-	≠	-	-	≠	≠	≠
	Salmonella typhosa		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Salmonella-Shigella		-	≠	-	-	-	-	-	-	-	≠	-	-	≠	≠	-
6	Aerobacter Sp.		≠	≠	≠	-	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠
	Escherichia Sp.		-	≠	-	-	-	-	-	-	-	-	≠	-	-	≠	-
	Salmonella typhosa		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Salmonella-Shigella		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

≠ Organisms isolated; - no organisms isolated.

TABLE 10

PERCENTAGE OF OCCURRENCE OF ORGANISMS PER STATION

Station Number	1	2	3	4	5	6	% of Total Tests
Organisms	%	%	%	%	%	%	
Aerobacter Sp.	100	100	100	94	87	94	96
Escherichia Sp.	100	100	100	100	20	20	76
Salmonella typhosa	8	13	0	0	0	0	3
Salmonella-Shigella	67	87	53	40	27	0	47



A is largest single count
B is average count of positive tests

Fig. 3.--Salmonella-Shigella Plate Count Results

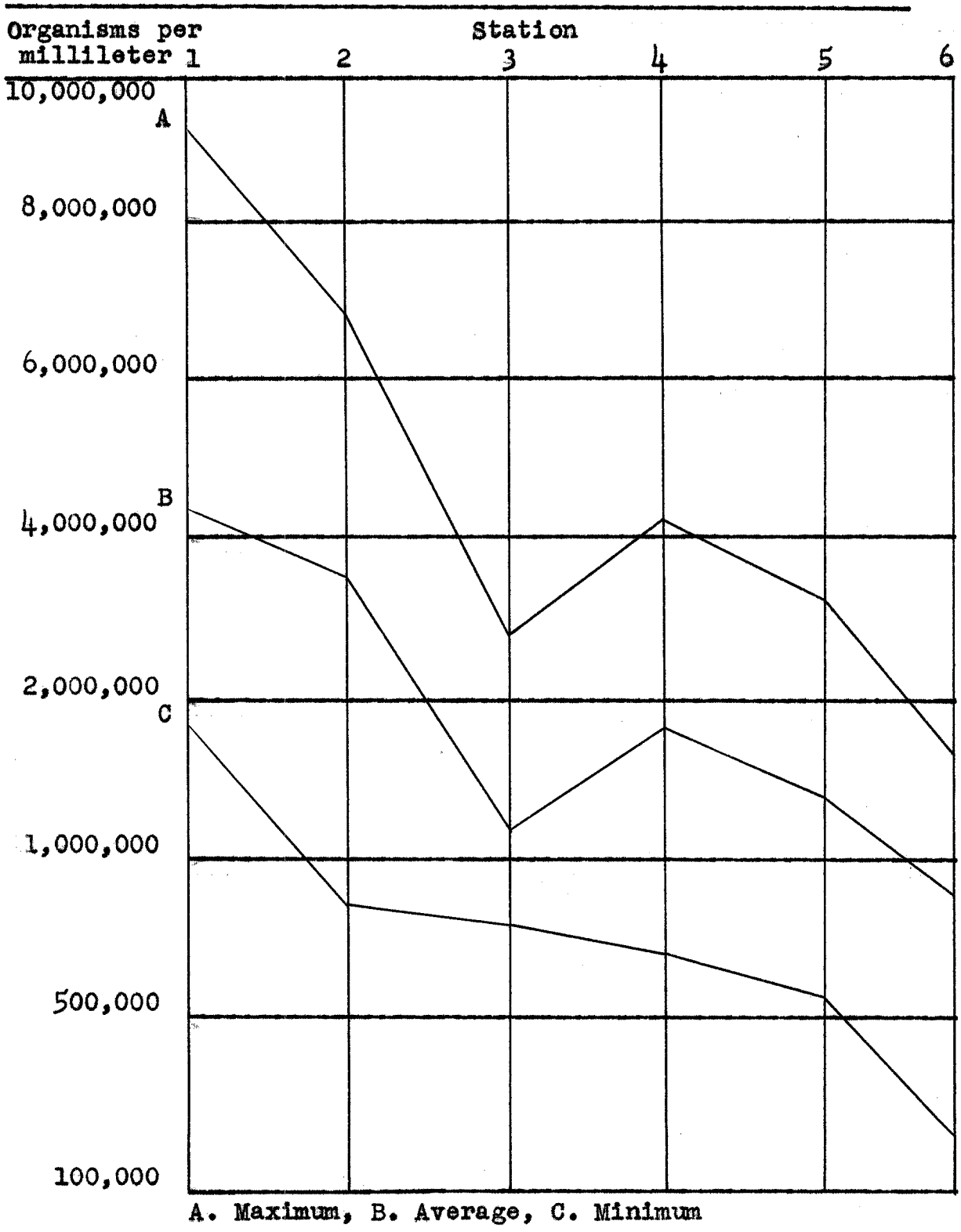


Fig. 4.--Total plate count

pathogenic organisms of the genera Salmonella and Shigella were being discharged into a lagoon just outside the city limits.

2. Tests were made approximately twice a month from September 23, 1949, to May 14, 1950.

3. Samples were taken from the sewage plant and the lagoon into which the plant material was discharged. These were analyzed from a bacterial standpoint, both quantitatively and qualitatively.

4. Experimental work included total plate counts, presumptive tests, confirmative tests, and tests using special selective media for total plate counts of Salmonella-Shigella organisms.

5. Results of the various tests were recorded in tabular and graphic form.

6. The number of bacteria discharged from the plant into the lagoon diminished markedly from station to station away from the plant.

7. The disposal plant was found very inefficient in destroying members of the enteric group of bacteria.

8. Natural purification factors of the lagoon were found very effective in the destruction of members of this group.

Conclusion

Results of this investigation show that the sewage disposal plant of Perryton, Texas, was inefficient. This inefficiency resulted in the discharge of enteric bacteria into a lagoon just outside the city limits. However, the natural purification factors of the lagoon apparently destroy pathogenic bacteria, thus alleviating potential health hazards created by an inefficient sewage disposal plant.

BIBLIOGRAPHY

Burrows, William, and others, Jordan-Burrows Textbook of Bacteriology, Fifteenth Edition, Philadelphia, W. B. Saunders Company, 1950.

Difco Manual of Dehydrated Culture Media and Reagents for Microbiological and Clinical Laboratory Procedures, Eighth Edition, Detroit, Difco Laboratories, 1948.

Smith, David T., Martin, Donald S., and others, Zinsser's Textbook of Bacteriology, Ninth Edition, New York, Appleton-Century-Crofts, Inc., 1948.

Texas Almanac and Industrial Guide (no author given), 1925.

Theroux, Frank R., Eldridge, Edward F., Mallmann, W. LeRoy, Laboratory Manual for Chemical and Bacterial Analysis of Water and Sewage, Third Edition Revised, New York, McGraw-Hill Book Company, 1943.