A BACTERIOLOGICAL STUDY OF DRINKING FOUNTAINS

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This is to certify that the

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A BACTERIOLOGICAL STUDY OF DRINKING FOUNTAINS

By

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INTRODUCTION

Health officials have long been aware of the potential hazards connected with water supplies for drinking purposes. Standards have been established in order that the public will be assured a drinking water which would be above reproach. However, after the water has been tested and found to be fit for drinking, contamination may occur in the process of delivery to the consumer. In most cases the transformation of a reliable drinking water to one which is potentially hazardous may be caused by the methods by which the water is dispensed. Insanitary drinking receptacles, such as glasses and cups, frequently contribute to the transmission of disease-producing bacteria. Evidence of pure water being contaminated by back siphonage and cross connections in water lines has been found. Most of these causes have been studied extensively and steps taken to eliminate them.

One of the most frequently used devices for dispensing water to the public is the drinking fountain. The drinking fountain is used by all people, the healthy and diseased alike, hence the insanitary conditions of drinking fountains is of much importance to the public. In spite of the potential disease hazard which may be associated with drinking fountains, there has been insufficient investigation of the role played by drinking fountains in relation to public health.

In 1909 the health authorities in Kansas, realizing that the common cup was a public health hazard, passed the first law which prohibited its use in public places. They recommended that the bubble drinking fountain or single service cup replace the common cup. The bubble drinking fountain was considered by health officials to be the last word in supplying the public with safe drinking water.

It was not until 1914 that Berry (1), conducting a study of bubble drinking fountains, reported that, instead of being a sanitary improvement over the common cup, the bubble fountain was as much of a public health menace as the former. Berry recovered organisms from the rim of the bubble cup and from the water within the cup. On the basis of these findings, she recommended that the bubble fountain be redesigned so that the stream of water may always be above the surface of the cup. Pettibone, Bogart and Clarke (2) made a study of bubble drinking fountains following an epidemic of streptococcus throat infections at the University of Wisconsin. Streptococci were recovered from 50 percent of the drinking fountains at the university. Since the water supply was of excellent character, it appeared that the fountains were the means of transmission. These workers in an experimental study found that test organisms seeded on the bubble could be recovered from the fountain after 135 minutes. Experimenting with a fountain which sent out a stream from a 50° angle they were unable to recover any organisms from the fountain parts or stream and concluded that this design should be adopted. Whittaker (3) reported that 80 percent of 77 vertical jet drinking fountains were contaminated. He recommended that a suitable guard, placed over the jet, was desirable. Dieter (4) in a study on vertical drinking fountains found them to be quite unsatisfactory. He inoculated the stream with a glucose broth culture of Serratia marcesens and was able to recover the organism after five minutes. Incorporating sputum in the culture, he was able to recover the test organisms after 48 hours. This was accounted for by edddying effects, caused by differences in the velocity of the water in the center and at the periphery of the stream, which carried the organisms down to the orifice. Sputum and debris containing organisms carried down in this manner, could supposedly adhere to the nozzle and be released and washed up for some time. Dunlap (5) reported that most of the problems associated with vertical drinking fountains were due to poor design. Dunlap, Hinnman and Maffit (6) reported that both continuous and intermittent flow vertical type drinking fountains were not satisfactory from a sanitary point of view. These workers were of the opinion that a slanting jet fountain with a guard over the orifice was perfectly safe. Hillis (7) recommended the use of a vertical jet fountain surrounded by a metal cage to protect the orifice from the user.

After the introduction of the angle jet type drinking fountain, it appeared that the problem of drinking fountain sanitation had been solved. Dieter (8) investigating angle jet drinking fountains, found a few cases of high contamination. In a series of experiments with angle jet fountains he reported that results were erratic. Hitchens and Ross (9) undertaking a bacteriological study of drinking fountains, reported that bacteria remained from thirty minutes to two hours on fountain parts which had been experimentally contaminated. In one instance, the test organism which was smeared on the bowl was recovered from the orifice. The authors stated that water splashing up from the bowl might well disseminate bacteria to the surrounding area.

The possibility for the transmission of disease producing organisms from drinking fountains is not remote. Stiles (10) recovered diphtheria organisms from a vertical jet drinking fountain. He also reported that the transmission of poliomyelitis virus from drinking fountains was not an impossibility. Hitchens and Ross (9) reported that tubercle bacilli were recovered from the drain pipe of a drinking fountain. They were also able to recover beta hemolytic streptococci from all the fountain parts of the drinking fountain which they sampled. Birnkrant, Greenberg and Most (11) reported an outbreak of ameobic dysentery at a hospital. Investigating two drinking fountains which were of unquestionable character, they found cross connections in the fountain plumbing. Dieter (4) recovered *Escherichia coli* from the orifice of a vertical jet drinking fountain.

Dunlap, Hinman and Maffit (6), after reviewing the scope of drinking fountain sanitation recommended:

1. "All vertical jet fountains be condemned.
2. Most angle jet fountains be condemned.
3. That the orifices cannot be touched by the user's hands or lips.
4. That the guards of the orifices be designed so that material from the mouth cannot be deposited on them."

Dieter (8) reported that the guards over the orifice are usually of little value, since users frequently touched them with their lips or face. In observing 1500 to 2000 drinkers he found that 40 percent of the drinkers touched their lips to the guard.

A field observation conducted by the Lily-Tulip Cup Corporation (12) showed that in general, drinking fountains were greatly misused. The survey showed that malpractices such as dragging clothes over the fountain parts, to spitting and blowing excretions into the bowl were not uncommon.

Ingram (13), from a survey questionnaire sent to physicians, sanitarians and bacteriologists associated with public health agencies and universities, reported that "There is a dearth of epidemological evidence of what might be called positive evidence that drinking fountains are not involved as a vehicle of disease transmission whereas on the other hand, there does not exist a mass of circumstantial evidence which makes drinking fountains suspect if not proven vehicles."

The effects of aerosols in connection with drinking fountain sanitation has not been investigated. As previously mentioned, Hitchens and Ross (9) realized the possibility of transference of bacteria by splashing water from the bowl.

Anderson, Stein and Moss (14), studying the effect of aerosol contamination from common bacteriological techniques, demonstrated that when drops of media containing bacteria fell from a pipette on to a hard surface, the bacteria were disseminated by aerosols. They showed that these bacterial aerosols remained suspended for some time.

The purpose of this study was to evaluate the drinking fountain from a public health standpoint. It was desirous to know the extent that drinking fountains were polluted; and what part they could play in the spread of disease-producing organisms from one person to another. Since many persons use the drinking fountains without touching the fountain parts with their mouth or faces, was it possible for them to be infected by organisms deposited on the fountain by previous users. Specific aims of this study were to determine:

(A) The role of splashing in the spreading of organisms

(B) The role of bacterial aerosols induced by splashing.

METHODS AND RESULTS

This work was divided into two phases as follows:

1. A survey of drinking fountains in public places under normal conditions.
2. A study of drinking fountains in the laboratory under controlled conditions.

Part I

The drinking fountains selected for the preliminary study were located in several public schools. The schools were selected so that all age groups would be represented. Furthermore, an attempt was made to include drinking fountains of various design. Fundamentally, there are four types of drinking fountains; the bubble fountain, the vertical jet drinking fountain, the angle jet fountain without an orifice guard and the angle jet fountain with an orifice guard. Many modifications of these types were encountered, but for the sake of convenience in this discussion, any mention of a particular fountain investigated will fall into one of the four main types.

Since the drinking fountains in public schools are used mostly during the recess periods, samples collected from the fountains were taken immediately after this period. Being present in the vicinity of the fountains while they were in use proved to be interesting, since the investigator was able to observe many of the habits of drinking fountain users.

The technique used for sampling the fountain parts was the swab rinse method used in food and milk sanitation. In essence, the technique consists of rubbing a sterile cotton swab which has been moistened in sterile Butterfield buffer solution over the surface which is being examined. The swab is returned to a vial containing a certain volume of the buffer solution and transported to the laboratory for analysis. In this study 10 ml of solution was used.

In studying the possible pollution of the drinking fountains, water samples were collected from the fountain to determine if the water was contaminated. The technique used to take the water sample was in accordance with Standard Methods (15). The water was allowed to run for two minutes after which a 100 ml sample was collected in a sterile salt-mouth bottle containing a few crystals of sodium thiosulfate. The water sample was transported to the laboratory for analysis.

The fountain parts selected for sampling were the orifice, the bowl and the orifice guard when present. The swab rinse technique is a means of evaluating the degree of contamination in that clean versus dirty conditions can be detected. The test determines the approximate number of bacteria present. inasmuch as some organisms are left on the surface and not all the organisms are removed from the swab by the rinse water. With this in mind, the swabbing was done as carefully as possible.

Immediately after sampling, the swabs and the water samples were taken to the laboratory. Ten ml portions of the water sample were seeded into each of five tubes of double strength lauryl tryptose broth (Difco) and five tubes each of azide dextrose broth (Difco). The tubes were incubated at 37C and observed after 24 and 48 hours. Coliform and streptococci indexes are reported as the most probable number.

The swabs were shaken in the vials until the cotton was fluffy. This was done to insure thorough removal of organisms from the swabs. One, 0.1 and 0.01 ml portions of the swab rinse were plated out in tryptone glucose extrace agar (Difco) to ascertain the total number of organisms present. The plates were incubated at 37 C for 48 hours. Similar dilutions of the swab rinse were seeded into each of three tubes of single strength azide dextrose broth. The tubes were incubated at 37 C for 48 hours after which they were observed for growth..

Seligmann (16) reported that azide dextrose broth is an excellent selective medium for detecting streptococci. Tables I, II, III and IV show typical results obtained from several surveys.

Streptococci were recovered from the fountain parts in almost 100 percent of the cases. The water samples tested showed no coliform organisms. Table I shows the results obtained from a bubble type drinking fountain. Streptococci were recovered in large numbers from both the orifice and bowl. These data confirm the statement of Berry (1) 38 years ago, that bubble drinking fountains are insanitary. Since the water samples showed no coliforms yet showed the presence of

TABLE I

CONTAMINATION OCCURRING IN A

BUBBLE TYPE DRINKING FOUNTAIN

(Grades 9 - 12)

Day	MPN Streptococci/swab		MPN Index of Water	
	orifice	bowl	streptococci	coliform
1	430	430	2.2	0
2	3.6	1000+	16	0
3	118	1000+	39.	0
4	250	22	5.1	0
5	92	74	9.2	0
6	430	45	9.2	0
7	250	430	5.1	0
8	92	920	9.2	0

streptococci, we can assume that the streptococci came from the water in the cup which was probably highly polluted inasmuch as the orifice and bowl showed large numbers.

Results from an angle jet drinking fountain, not having an orifice guard, are shown in Table II. Streptococci and coliforms were not found in the water sample, again indicating that the water itself was not contaminated. Streptococci were recovered from the bowl and orifice in all samples taken. Tables III and IV are the data obtained from angle jet fountains with orifice guards. Streptococci indexes from the bowl were approximately the same as with the other type fountains.

The streptococci indexes from the orifices however were much lower. Evidently the orifice guard was playing a part in reducing contamination of the orifice to some extent. Nevertheless, in nearly all trials, streptococci were recovered, indicating that the contamination was possible even when a guard was present. The guard itself showed the presence of streptococci. This was expected since often times people touch their lips or faces to the guard.

Observation of the drinking fountain users showed that a large number of persons touched their lips to the orifice or orifice guard. Malpractices such as touching the fountain parts with the hands or clothes were also noticed.

There appeared to be no correlation between age groups and magnitude of pollution. The type of drinking fountain seemed to be the contributing factor.

TABLE II

CONTAMINATION OCCURRING IN AN ANGLE JET FOUNTAIN NOT HAVING AN ORIFICE GUARD

(Grades 1 - 8)

Day	MPN Streptococci/swab		MPN Index of Water	
	orifice	bowl	streptococci	coliform
1	92	92	0	0
2	3.6	24	0	0
3	92	250	0	0
4	250	250	0	0
5	118	92	0	0
6	250	430	0	0
7	92	920	0	0
8	92	920	0	0

TABLE III

CONTAMINATION OCCURRING IN ANGLE JET

DRINKING FOUNTAINS HAVING AN ORIFICE GUARD

(Grades 1 - 8)

Day	MPN Streptococci/swab			MPN Index of Water	
	orifice	guard	bowl	streptococci	coliform
1	9.1	3.6	220	0	0
2	0.	9.1	430	0	0
3	0.	3.6	920	0	0
4	43.	9.1	9.1	2.2	0
5	3.6	3.6	9.1	0	0
6	0.	3.6	920	0	0
7	15.	9.1	147	0	0
8	3.6	9.1	147	0	0

TABLE IV

CONTAMINATION OCCURRING IN ANGLE JET

DRINKING FOUNTAINS HAVING AN ORIFICE GUARD

(Grades 9 - 12)

Day	MPN Streptococci/swab			MPN Index of Water	
	orifice	guard	bowl	streptococci	coliform
1	250	9.1	430	0	0
2	43	9.1	250	0	0
3	3.6	3.6	0	5.1	0
4	9.2	9.1	24	0	0
5	4.3	3.6	15	0	0
6	3.6	0	3.6	0	0
7	9.1	3.6	920	0	0
8	24	9.1	43	0	0

Part II

The investigation in this phase of the study was carried out in the laboratory. This study was undertaken to determine the mode of contamination of drinking fountains. From the preliminary studies it was obvious that drinking fountains could be rendered insanitary by improper use. It would, however, be desirable to know if drinking fountains could be vehicles of bacterial transmission through causes inherent in the construction of the fountain, namely, splashing of large drops containing bacteria and bacterial aerosols. Hitchens and Ross (9) stated that splashing could be a contributing factor in the spread of organisms from drinking fountains.

Three drinking fountains, all of which were of the angle jet type, were set up in the laboratory. The fountains differed in the dimension of the bowl, the type of orifice and the type of orifice guard. The drinking fountains represented the types which are most commonly found in the field.

Effect of Splash

The fountains were thoroughly cleaned with a detergent and sanitized with water containing 200 ppm chlorine. Control swabs were taken from the bowl, the orifice and the orifice guard. In order to establish whether or not organisms from the bowl could be splashed up to the orifice or orifice guard it was necessary that these parts be free from any organisms prior to the experiment.

The test organism which was used throughout this study was *Streptococcus faecalis*. Ten ml of an 18 hour culture of *S. faecalis* grown on azide dextrose broth was spread on the inner surface of each fountain bowl by means of a sterile swab. The water was turned on and allowed to run continuously for one hour periods after which samples were taken from the orifice and orifice guard. The swabs were placed in vials containing 10 ml of sterile physiological saline. One ml portions of the swab rinse were seeded into azide dextrose broth tubes. The tubes were incubated at 37 C for 48 hours after which they were observed for growth. It is evident from the results shown in Table V that organisms on the bowl could be splashed on the orifice as shown by data obtained from fountain A. Fountain C did not manifest any contamination on the orifice or guard. This can be explained on the basis of design. The orifice of fountain A was within the bowl *per se* and about one inch from the bottom of the bowl. The orifice of fountain C was above the bowl and about four inches from the bottom of the bowl. The important point to notice is, however, that three hours after smearing, the test organism was splashed up from the bowl, showing that even with a continuous flow of water, the organisms were not washed down the drain.

The next phase of this work was to study what effect the height of the stream had in the contamination of the drinking fountain.

In order to simulate a person drinking from the fountain, an apparatus (see Figure 1) was set up over the experimental

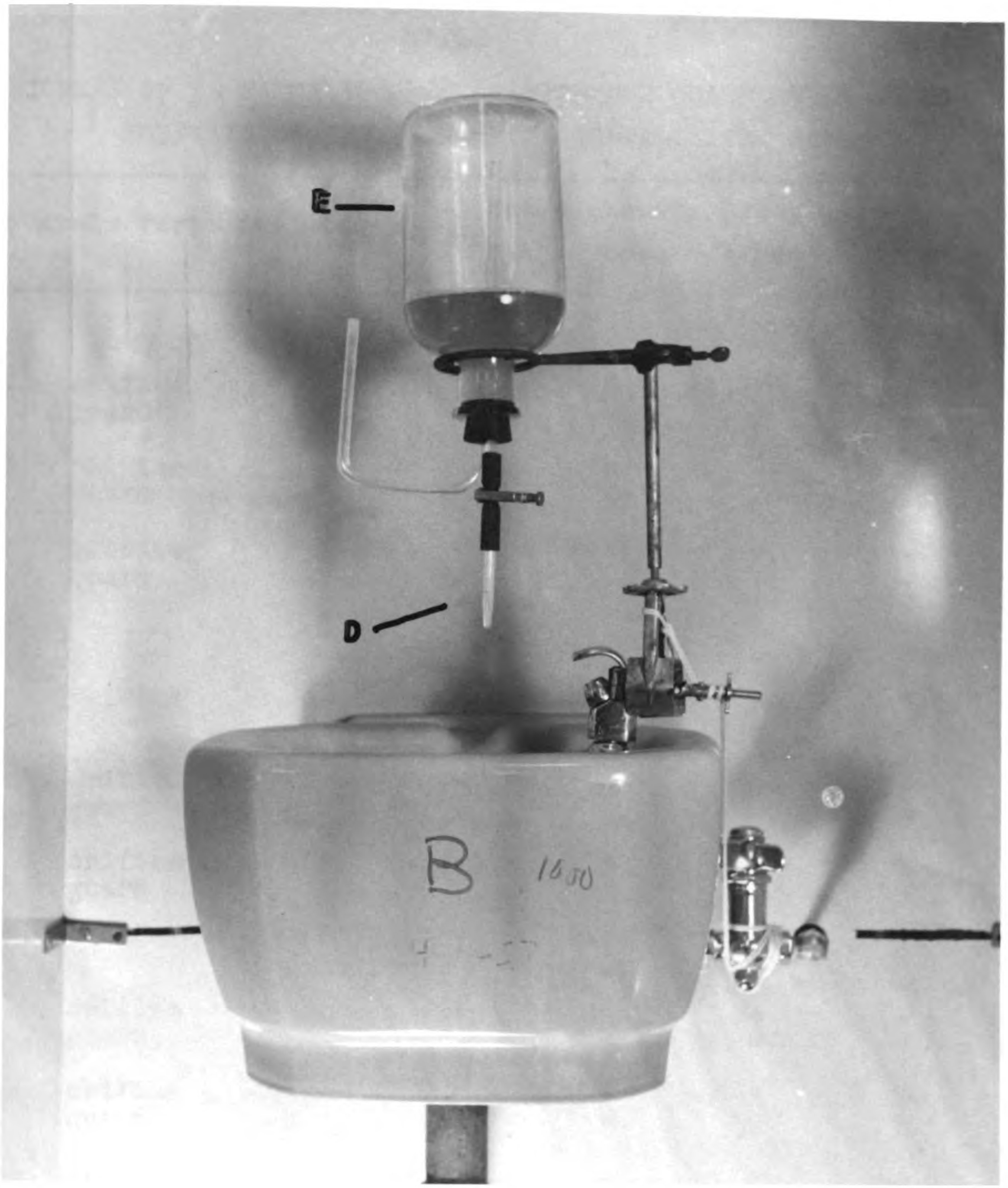

FIG. 1

TABLE V

RECOVERY OF S. FAECALIS FROM ORIFICE AND GUARD AFTER RUNNING FOUNTAIN ON EXPERIMENTALLY CONTAMINATED BOWL

Fountain Parts Swabbed	Tubes Showing Growth after			
	1 hr.	2 hrs.	3 hrs.	4 hrs.
	Fountain A			
orifice	-	+	+	-
guard	-	-	+	-
orifice	-	-	-	-
guard	-	-	-	-
orifice	-	-	+	-
guard	+	-	-	-
	Fountain B			
orifice	-	-	-	-
guard	-	-	-	-
orifice	-	+	-	-
guard	-	-	-	-
orifice	-	-	-	-
guard	-	-	-	-
	Fountain C			
orifice	-	-	-	-
guard	-	-	-	-
orifice	-	-	-	-
guard	-	-	-	-
orifice	-	-	-	-
guard	-	-	-	-

+ indicates organisms present

- indicates no organisms present

drinking fountain. The flask (E) contained the broth culture of the test organism. The culture was fed into the stream by means of a capillary (D) which could be adjusted so that the tip would be at the apex of the stream. The fountain was run intermittently employing a 10 second flow period and a five second off period. The height of the stream was adjusted so that several trials could be made with the stream at normal, below normal and above normal height.

The fountain was sanitized as previously described and control swabs were taken from the orifice. The fountain was operated and experimentally contaminated for different periods of time. A swab was taken from the orifice at the end of each period. The swabs were rinsed in 10 ml of sterile physiological saline. One, 0.1 and 0.01 ml portions of the swab rinse were plated on azide dextrose agar. The plates were incubated at 37 C for 48 hours after which the colonies on the plates were counted. The results are presented in Table VI. From an examination of these data it is evident that the test organism was splashed on the orifice. Apparently when the stream of water fell in the bowl, splashing occurred and drops of water carrying the bacteria were disseminated. In one instance the test organism was recovered from the orifice after one minute of operation when the stream was at normal height. When the stream was above normal height, numbers of the test organism recovered was high; whereas recovery was almost negligible when the height of the stream was below normal. The results indicate that there was an increase in the number of

TABLE VI

RECOVERY OF S. FAECALIS FROM ORIFICE WITH CHANGE IN HEIGHT OF STREAM AT INCREASING TIME OF OPERATION

Time of Sampling	Height of Stream					
	Trial I			Trial II		
	Normal	High	Low	Normal	High	Low
1 minute	5	80	0	0	8	0
3 minutes	1	30	0	0	35	0
5 minutes	11	30	1	21	7	0
10 minutes	30	70	5	18	43	0
30 minutes	85	140	0	40	61	4
60 minutes	71	110	0	62	115	0
Controls	0	0	0	0	0	0

organisms recovered with increasing time of operation. It can be conjectured from these data that the organisms could be disseminated throughout the area around the fountain.

The next study was concerned with the extent of splashing in relation to contamination of the area around the drinking fountain. A partition (See F, Figure 2) was designed so that the distance from the orifice to the partition could be varied. A section about 36 square inches was marked off on the partition at a point perpendicular to the fountain and about the same height as the orifice. This section, as well as the drinking fountain, was sanitized before each trial at the various distances. The fountain was operated intermittently as described in the previous study for a period of 5 minutes. At the end of each period, the area was swabbed carefully with a sterile swab. The swabs were rinsed as before and 1, 0.1 and 0.01 ml portions plated out on azide dextrose agar. The plates were incubated at 37 C for 48 hours, after which the colonies that developed were counted. This experiment was carried out with the heights of the stream at normal, subnormal and above normal. The results of this study are shown in Tables VII, VIII and IX. These data verify the assumption that bacteria-laden droplets are disseminated quite readily. Even when the height of the stream was below normal, recovery of the organism was possible at a distance of approximately 27 inches from the fountain. Since the section of the partition which was swabbed was in the trajectory plane of the splashing water it was expected that the number of organisms

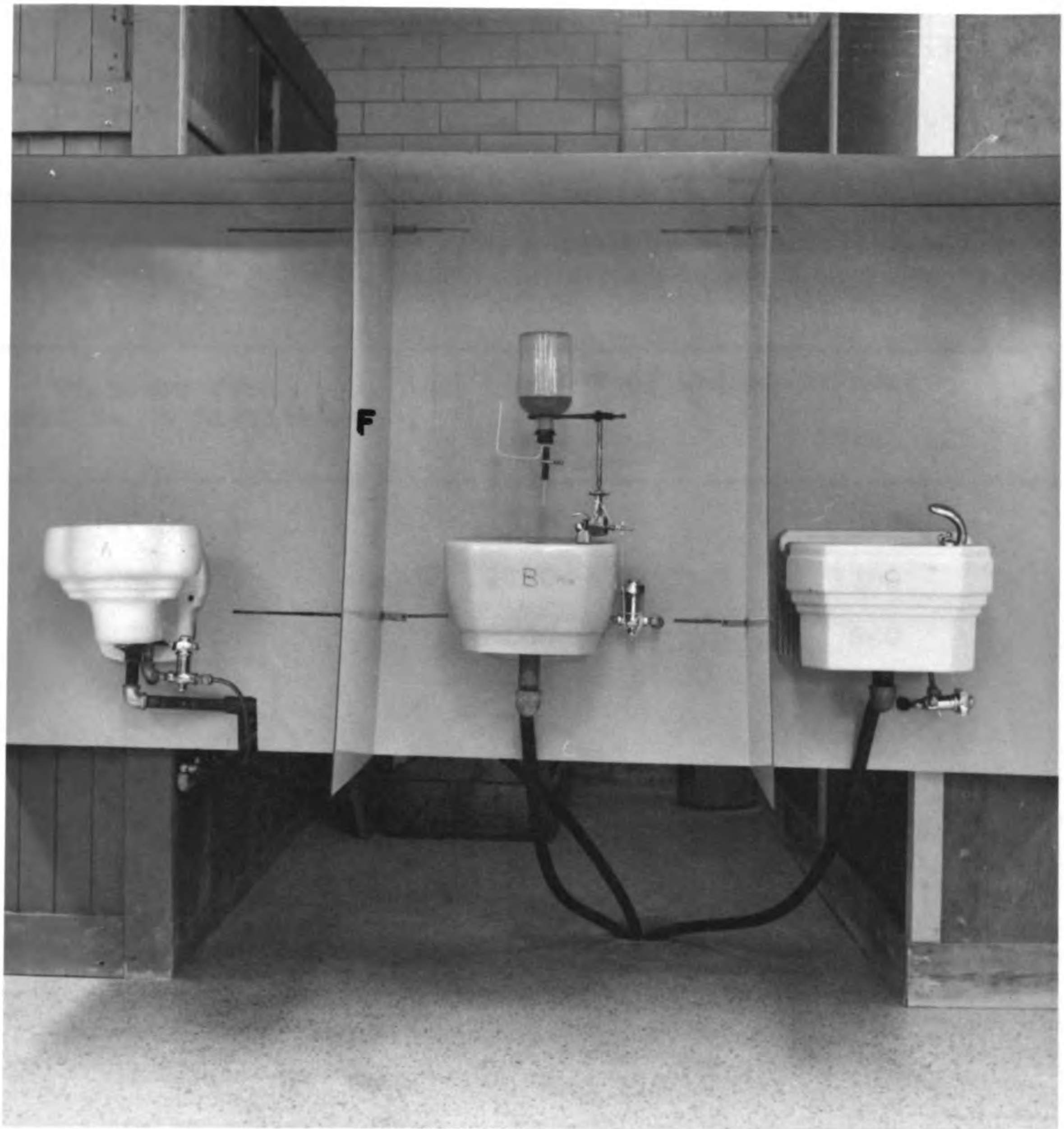

FIG. 2

TABLE VII

RECOVERY OF *S. FAECALIS* FROM A WALL AT DIFFERENT DISTANCES FROM THE FOUNTAIN WHEN THE HEIGHT OF THE STREAM WAS NORMAL

Distance from orifice to partition	Number of Organisms/swab	
	Trial I	Trial II
27 inches	510	490
25 "	1150	1120
23 "	560	960
21 "	430	1410
19 "	1850	1700
17 "	1800	1530
15 "	2120	1420
Controls	None	None

TABLE VIII

RECOVERY OF *S. FAECALIS* FROM A WALL AT DIFFERENT DISTANCES FROM THE FOUNTAIN WHEN THE HEIGHT OF THE STREAM WAS SUBNORMAL

Distance from orifice to partition	Number of Organisms/swab	
	Trial I	Trial II
27 inches	0	0
25 "	1	0
23 "	0	0
21 "	15	150
19 "	41	19
17 "	80	1
15 "	153	25
Controls	None	None

TABLE IX

RECOVERY OF S. FAECALIS FROM A WALL AT DIFFERENT DISTANCES FROM THE FOUNTAIN WHEN THE HEIGHT OF THE STREAM WAS ABOVE NORMAL

Distance from orifice to partition	Number of Organisms/swab	
	Trial I	Trial II
27 inches	1530	1790
25 "	1400	2170
23 "	1920	2930
21 "	1790	TNTC
19 "	3270	3120
17 "	TNTC	TNTC
15 "	TNTC	TNTC
Controls	None	None

TNTC - Too numerous to count

recovered would be great. It is a well known fact that when a liquid falls through air or when it falls on a surface, splashing or bubbling occurs. When the bubble bursts it releases into the air aerosols of small enough particle size to remain suspended for some time. It was established by this study that drops containing bacteria are thrown into the air. It is therefore logical to suspect that bacteria-laden aerosols were set up simultaneously.

The following study was an attempt to detect the presence of bacteria in the air around the fountain. It was determined by preliminary tests that the area directly above the fountain was less liable to be in the path of splashing drops. The fountain was operated intermittently and experimentally contaminated as previously described. Petri plates containing tryptose agar were exposed over the fountain at varying distances. The agar plates were given a 10 second exposure and immediately covered. Fresh agar plates were held for ten seconds exposures until 30 minutes had elapsed. The plates were incubated at 37 C for 48 hours. The data in Table X show that bacterial aerosols were being evolved from the fountains. Both agar plates which were held one and two inches above the fountain developed colonies which were too crowded to be counted. Apparently large drops, containing heavy populations of organisms, splashed onto the agar at these points. This effect was not observed on the plates held at the higher levels. Distribution of the colonies on the plates indicated that the area

TABLE X

THE RECOVERY OF *S. FAECALIS* FROM AEROSOL ABOVE FOUNTAIN

Height Above Fountain	Total Number of Colonies From 120 Agar Plates
15 inches	5 colonies
12 "	180 "
8 "	900 "
6 "	3410 "
5 "	5600 "
4 "	9400 "
3 "	3150 "
2 "	TNTC
1 "	TNTC

above the fountain was highly contaminated with bacteria-containing aerosols. Since the agar plates represented only a small area above the fountain, and the organisms recovered on the agar plates were subject to random distribution, the magnitude of the aerosols above the fountain was not demonstrated.

The results of the survey of drinking fountains in public schools showed that the fountains were polluted. The experimental studies which are described in this paper showed that a drinking fountain could be contaminated by various means. With this information in hand the author decided again to examine a drinking fountain which was used by the public and evaluate it in the light of this information. The drinking fountain selected for this work is located in a large classroom building. This fountain is located near several classrooms, laboratories and offices and is frequently used throughout the day. The drinking fountain is an angle jet type with an orifice guard. The drinking fountain is a current model made by a leading manufacturer of drinking fountains. The fountain was in excellent operating condition at the time of the investigation. The stream was at the proper height and the drainage was rapid and complete.

The fountain parts were thoroughly cleaned and sanitized as previously described. This was done in the early morning before anyone was using the building. Swabs of the bowl, orifice and orifice guard were taken for controls.

A sample of the water was also taken at the same time. The orifice, orifice guard and bowl were swabbed at 15 minute intervals, beginning 15 minutes after the fountains were first used. The swabbing continued in this manner until two hours had elapsed, then swabs were taken at the end of the third and fourth hours. The swabs were placed in vials containing 10 ml of sterile physiological saline and taken into the laboratory. The swabs were examined as previously described.

From data shown in Table XI it is obvious that the drinking fountain became contaminated almost immediately after use by one person. The author did not observe any person misusing the fountain; hence it is assumed that the bacteria must have been rinsed from the mouth and lips of the drinkers. In most cases the orifice guard was contaminated, showing that the drinkers may have touched the guard with their lips or face. Since the orifice was well guarded and was not touched by anyone the contamination must have been due to splashing drops carrying the organisms or by aerosols set up by the splashing drops. These data confirm the conclusions reached in the experimental studies.

TABLE XI

NUMBER OF STREPTOCOCCI RECOVERED FROM DRINKING FOUNTAIN PARTS WHICH HAD BEEN SANITIZED PREVIOUS TO BEING USED

Time of Sample	Number of Streptococci		
Beginning 15 min. after first person used the fountain	Bowl	Orifice	Guard
15 minutes	1030	0	1
30 "	18	50	1
45 "	26	5	0
60 "	350	60	38
75 "	80	0	0
90 "	88	42	0
105 "	1235	102	12
120 "	920	81	30
3 hours	240	6	0
4 "	190	3	1

DISCUSSION

The results of these studies verify the assertions made by several early workers, that the drinking fountain is a potential health hazard. It was shown conclusively that the bubble type drinking fountain is a reservoir for bacteria of buccal origin. As early as 1914 this fact was established by Berry (1) yet it is not an uncommon thing to find bubble type fountains in schools, factories and on street corners. In the interest of public health the author strongly recommends that this type of drinking fountain be prohibited by law in public places. The new type angle jet fountain is a step in the right direction. However this investigator showed that it too may be a vehicle for the transmission of microorganisms. The prediction that water splashing on the drinking fountains is capable of disseminating organisms was justified. Bacteria which were seeded onto the stream in the same manner, which might take place when the fountain is in actual use, were later recovered from the orifice of the drinking fountain. Furthermore, it was demonstrated that bacteria seeded in the stream were splashed into the area in the immediate vicinity of the fountain. The test organism was recovered from a wall 27 inches from the fountain. It was established that the height of the stream was a factor to be considered; the higher the stream the greater the splashing. Splashing was decreased as the height of the stream was lowered.

It must be remembered, however when the stream of water is low the chances of the users' lips coming in contact with the orifice and orifice guard increase.

The possibility of bacterial aerosols being evolved over the fountain was investigated and demonstrated. Large numbers of organisms were recovered on agar plates held over the fountains at various distances while the fountain was in operation.

From the results of these studies, it is apparent that the drinking fountain can contribute to the spread of pathogenic microorganisms even when the fountains are properly used. Splashing drops, containing organisms rinsed from the mouths and lips of infected persons, can be transmitted to the orifice of the drinking fountain and subsequently to the mouths or lips of the next drinker. Bacterial or viral aerosols over the drinking fountain could be a means of disease transmission from one person to another.

SUMMARY

A survey of drinking fountains in public places revealed that insanitary conditions existed. In nearly 100 percent of the fountains examined, streptococci were recovered from the drinking fountain bowl, orifice and orifice guard. The bubble type fountain proved to be the greatest offender followed by the angle jet fountain without a guard over the orifice. There appeared to be no correlation between the age of the persons using the fountains and the amount of pollution. Water samples taken at the time of swabbing showed the water to be of excellent quality, hence the pollution was caused by the persons using the fountain.

Experimental studies on drinking fountains revealed that bacteria could be transferred from the bowl of the drinking fountain to the orifice. Evidence of bacteria remaining on the bowl for several hours, even when the fountain was run continuously, was obtained.

The height of the stream was shown to be a factor in the spread of organisms from the bowl to the other fountain parts. The number of bacteria recovered from the orifice increased when the height of the stream was increased.

Bacteria seeded in the stream of the drinking fountain were recovered from the walls surrounding the fountain at a distance of 27 inches. It was shown that this was caused by splashing when the streams struck the bowl.

It was found that bacterial aerosols were created and disseminated over the drinking fountain.

Drinking fountains are rapidly contaminated in normal use under the most ideal conditions.

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