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DRINKING FOUNTAINS

INVESTIGATION OF FOUNTAINS AT THE UNIVERSITY OF MINNESOTA

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DRINKING FOUNTAINS.

INVESTIGATION OF FOUNTAINS AT THE UNIVERSITY OF MINNESOTA.[1]

By H. A. WHITTAKER, Director, Division of Sanitation, Minnesota State Board of Health.

This investigation was undertaken to determine the sanitary condition of the drinking fountains in use at the University of Minnesota and, if they were found to be unsatisfactory, to offer recommendations for correcting defects. The work consisted of a study of the mechanical features of each fountain, bacteriological examinations of the parts of the fountain exposed to the lips of the consumer, and bacteriological examinations of the water supplied to and discharged from the fountain.

The method of conducting this investigation was briefly as follows: Samples of water were collected from taps in the various buildings to represent the water supplying the fountains, and from the jet on each fountain to represent the water discharged from the fountain. A swab was rubbed over all parts of the fountain that might easily come in contact with the lips of the consumer, in order to determine the presence or absence of streptococci. The water samples were examined for the total number of bacteria per cubic centimeter, for *B. coli* in 1 and 100 cubic centimeter amounts, and for streptococci in 100 cubic centimeter amounts. The bacterial counts were made on agar after forty-eight hours' incubation at 37° C. The determinations for *B. coli* were made in accordance with the routine methods[2] used by this division. The examinations for streptococci in 100 cubic centimeter samples of water were made by enriching the samples with quadruple strength dextrose broth and examining microscopically after forty-eight hours' incubation at 37° C. The examinations for streptococci on the swabs were made by inoculating directly into dextrose broth and examining microscopically after forty-eight hours' incubation at 37° C. The presence of streptococci was used to indicate possible contamination from the mouth of the consumer, as these organisms are commonly found in abundance in the mouths of human beings. It must be admitted that streptococci might be contributed from other outside sources, but this is not probable under existing conditions. The presence of *B. coli* was used as an indication of contamination of fecal origin.

[1] Reprint from the Public Health Reports, vol. 32, No. 19, May 11, 1917, pp. 691-699.
[2] Public Health Reports, vol. 29, No. 20, May 15, 1914, p. 1228-1229.

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Following the collection of the specimens for bacteriological examination, a study of the mechanical features of each type of fountain was made by removing various parts so that the details of construction could be observed.

The water supply of the main campus of the University of Minnesota is obtained from the public supply of the city of Minneapolis. This water is taken from the Mississippi River and is subjected to sedimentation, coagulation, filtration, and liquid chlorine treatment before distribution for consumption. The water supply of the department of agriculture is obtained from two drilled wells located on university property.

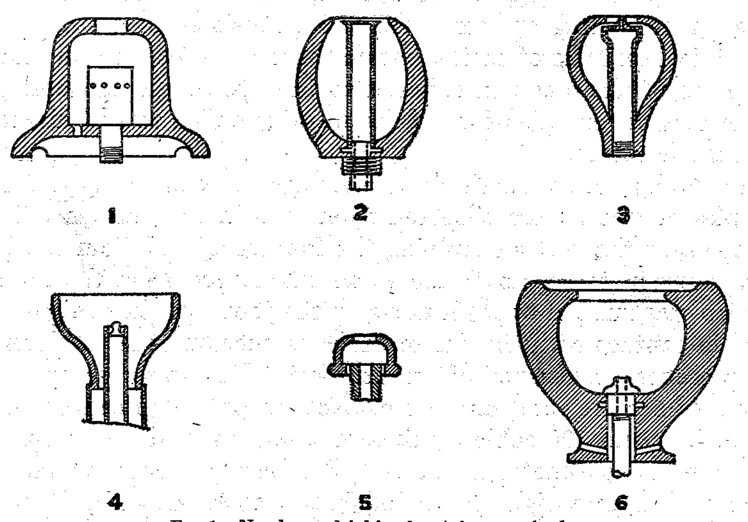

FIG. 1.—Nozzles on drinking fountains examined.

The results of the bacteriological examinations of the water from both sources are shown in Table 1. The water supply of the department of agriculture is represented by Nos. 1 and 2, and that of the main campus by Nos. 3 to 18, inclusive. The results of the examinations of the drinking fountains are recorded in Table 2, while the sketches of the various types investigated are shown in figures 1 and 2. The summarized results of the entire investigation are included in Table 3.

A résumé of the results shows that 77 drinking fountains, which represented 15 different types, were examined. Sixty-five per cent of these fountains were of the continuous-flow type and 35 per cent of the intermittent type operated by the consumer. The nozzles on all of these fountains discharged the water vertically. The height of the water jet above parts of the fountain that could be touched by the lips of the consumer was less than 1 inch in 40 per cent of the fountains. On examination of the various types shown in figures 1 and 2, it is seen that all are subject to contamination by the consumer, either directly by the lips or by water falling back from the lips onto the jet or the surrounding parts. Certain of these types have closed receptacles around the point of discharge, which retain a part of the water discharged from the outlet. Coloring matter added to these receptacles was not entirely removed for long periods of time.

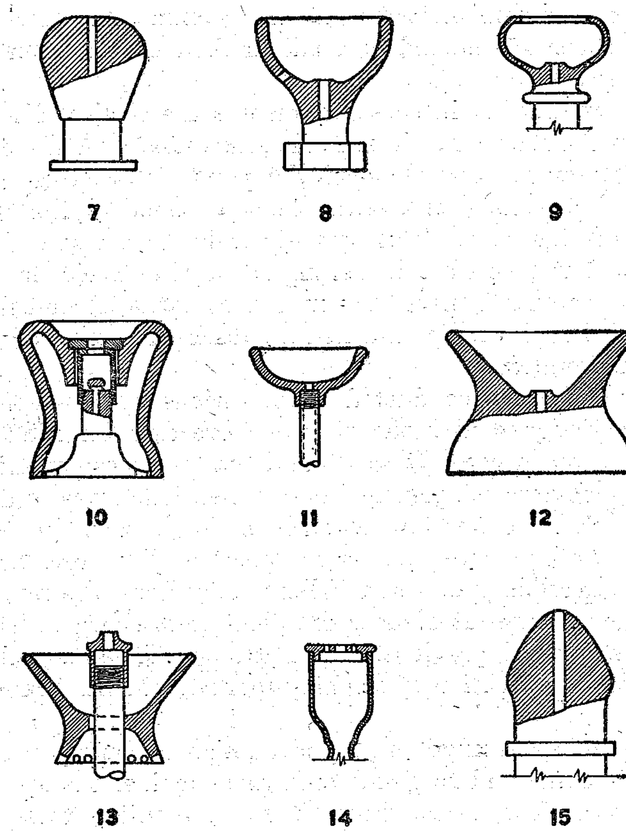

FIG. 2.—Nozzles on drinking fountains examined.

The bacteriological examinations of the water supplied to 18 university buildings show consistently low bacterial counts, and *B. coli* and streptococci were not found present in 100 cubic centimeter amounts. The results on water discharged from the fountains show higher bacterial counts in a few instances, and the presence of streptococci in 11 per cent of the fountains examined, but *B. coli* was not found present in 100 cubic centimeter amounts in any case. The examinations of the swabs show the presence of streptococci on the parts exposed to the lips of the consumer in 80 per cent of the fountains. To summarize these results, they show: (*a*) That a large proportion of the fountains were infected with streptococci, which it is reasonable to assume came from the mouths of the consumers as these organisms were not found in the water supplying these fountains; (*b*) that streptococci were actually present in the water discharged from the fountains and could be transmitted to the mouth of a consumer, even though the lips were not touched to the infected parts. These facts suggest the possibility of the fountains being a factor in the transmission of certain communicable diseases, and that certain changes should be made in their construction to eliminate this danger.

The principal defect in construction was the vertical discharge of water from the fountain. This made it necessary for the consumer to place the mouth directly over the point of discharge, and the majority of persons drank with the lips touching the discharge nozzle of the fountain. This was especially true where the water jet was low, but even when it was high enough to avoid this practice the average consumer placed the mouth over the jet and then lowered the head until the lips touched the discharge nozzle or adjacent parts of the fountain.

Experiments were conducted with various types of fountains which were designed with the view of correcting the defects noted in those already in use. It was found that the most practical construction to obviate the principal defect mentioned was to discharge the water from the fountain at such an angle that the consumer could drink without approaching the point of discharge, thus eliminating the possibility of water falling back from the mouth onto parts of the fountain at or near the point of discharge. This principle was suggested previously by Pettibone, Bogart, and Clark[1] following an investigation of drinking fountains at the University of Wisconsin.

It was found necessary in a practical design to entirely protect the point of discharge and to guard the nozzle against the approach of the consumer. The nozzle shown in figure 3 fulfills these requirements, and can be substituted for the nozzle used on practically any of the common types of drinking fountains. This type of nozzle protects the point of discharge by inclosing the small discharge tube in a larger tube which is cut at an angle with its upper surface extending beyond the outer extremity of the inner tube. The wire muzzle prevents the consumer from approaching the point of discharge. This nozzle can be used on the constant or intermittent flow type. In cases where the water pressure varies to a large degree, pressure regulators should be installed. Doubtless there are many other mechanical possibilities of accomplishing the same result, but the one shown is simple and inexpensive, and it can be attached to practically any fountain.

[1] Journal of Bacteriology, Vol. 1, No. 5, Sept. 1916, p. 471.

Figure 4 shows a consumer drinking from an unprotected type of fountain with the mouth directly over the jet. A cross section of the nozzle of this fountain is shown in figure 2, No. 7. Figure 5 shows a consumer drinking from the same fountain with the improved nozzle shown in figure 3. This improved nozzle was installed on a fountain located in the main corridor of one of the university buildings. It was kept in operation for several weeks, during which time a large number of persons used the fountain daily. The regular tests were applied to this fountain at different times during this period, with the results shown in Table 4. These results indicate that this type of fountain nozzle will protect the consumer.

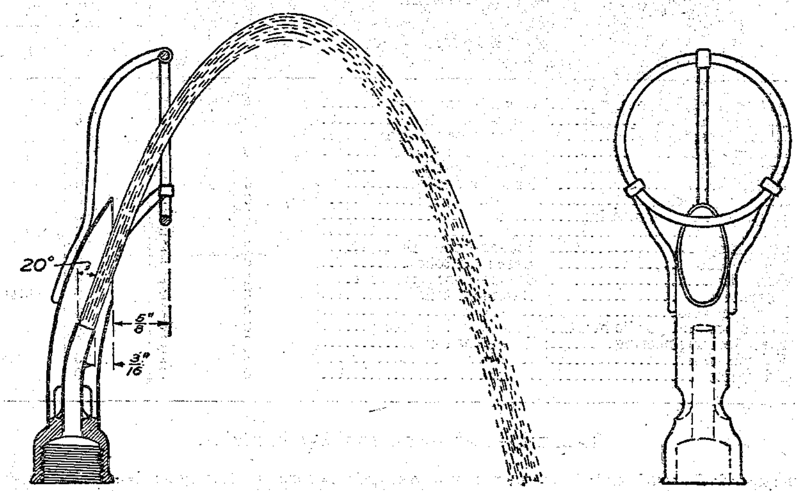

Fig. 3.—A protected type of drinking fountain nozzle.

CONCLUSION.

This investigation included the 77 drinking fountains in use at the University of Minnesota. These fountains represented 15 different types, all of which were found to be improperly constructed to prevent them from contamination by the consumer. The bacteriological examinations conducted on these fountains showed that 80 per cent were infected with streptococci, and that the water from 11 per cent of these fountains contained organisms of this type when they were not found present in the water supplied to the fountains. These results indicate that drinking fountains may be a factor in the transmission of communicable diseases, a condition which should be remedied.

Experiments were conducted with various fountain nozzles to supplant those in use, and a type was designed which is economical to construct and safe from a sanitary point of view.

The writer wishes to acknowledge the valuable assistance of Mr. George W. Putnam in connection with this investigation.

TABLE 1.—*Results on water supplies at buildings.*

[+=positive result; 0=negative result.]

No.	Building.	Location.	Bacteriological examination. Streptococci, 100 c. c.	Bacteria, 1 c. c.	B. coli. 1 c. c.	B. coli. 100 c. c.
1	Agricultural, engineering	Second-floor toilet	0	2	0	0
2	Agricultural, main	First-floor toilet	0	2	0	0
3	Elliott Hospital	Third-floor corridor	0	3	0	0
4	Millard Hall	Basement corridor	0	1	0	0
5	Anatomy	First-floor toilet	0	1	0	0
6	Biology	Basement toilet	0	1	0	0
7	Main engineering	do	0	2	0	0
8	Experimental engineering	do	0	1	0	0
9	Mines	do	0	2	0	0
10	Chemistry	Second-floor toilet	0	2	0	0
11	Men's Union	Basement toilet	0	4	0	0
12	Dentistry	Second-floor corridor	0	2	0	0
13	Pharmacy	Basement toilet	0	2	0	0
14	Mechanic arts	do	0	2	0	0
15	Pathology and public health	First-floor laboratory	0	0	0	0
16	Electrical engineering	Basement toilet	0	3	0	0
17	Folwell Hall	do	0	1	0	0
18	Education	do	0	2	0	0

TABLE 2.—*Results on drinking fountains.*

[N=north end; S=south end; E=east end; W=west end; c=constant-flow type; i=intermittent-flow type; ci=intermittent type used as constant-flow type. + =positive result; 0=negative result.]

No.	Building.	Location.	Type.	Height of water jet in inches.	Bacteriological examination. Swab. Streptococci.	Swab. Streptococci in 100 c. c.	Water. Bacteria, 1 c. c.	Water. B. coli. 1 c.c.	Water. B. coli. 100 c. c.
1	Agricultural engineering.	Corridor, second floor N	1	0.1 c	0	0	2	0	0
2	do	Corridor, first floor S	1	.4 c	+	0	100	0	0
3	do	Corridor, third floor	1	.3 c	+	+	6	0	0
4	do	Blacksmith shop	2	.4 c	+	+	2	0	0
5	do	South shop	2	1.0 c	+	+	2	0	0
6	Agricultural, Main	Corridor, first floor	3	3.0 i	+	+	4	0	0
7	do	Corridor, second floor	3	.8 i	+	+	4	0	0
8	Agricultural, power plant.	Tool room	4	.5 ic	+	+	3	0	0
9	Elliott Hospital	Corridor, third floor	5	3.0 i	+	0	4	0	0
10	do	Corridor, fourth floor	5	1.5 i	+	0	5	0	0
11	do	Corridor, fifth floor	5	.6 i	+	0	4	0	0
12	do	Corridor, second floor	5	4.0 i	+	0	8	0	0
13	do	Corridor, first floor	5	6.0 i	0	0	10	0	0
14	Millard Hall	Corridor, third floor N	6	.6 c	0	0	5	0	0
15	do	Corridor, third floor S	6	.5 c	+	0	5	0	0
16	do	Corridor, second floor N	6	1.4 c	+	0	25	0	0
17	do	Corridor, second floor S	6	.3 c	+	+	2	0	0
18	do	Corridor, basement N	6	1.4 c	+	0	1	0	0
19	do	Corridor, basement S	6	1.3 c	+	0	1	0	0

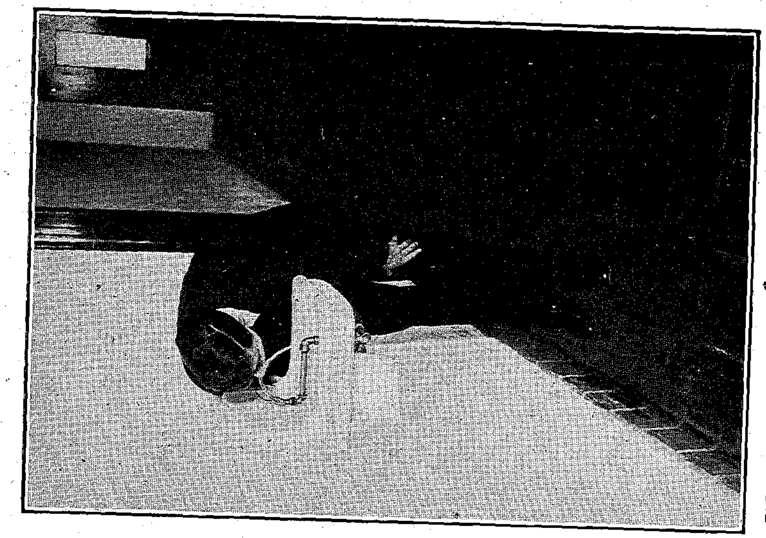

FIG. 5.—CONSUMER DRINKING FROM PROTECTED TYPE OF FOUNTAIN.

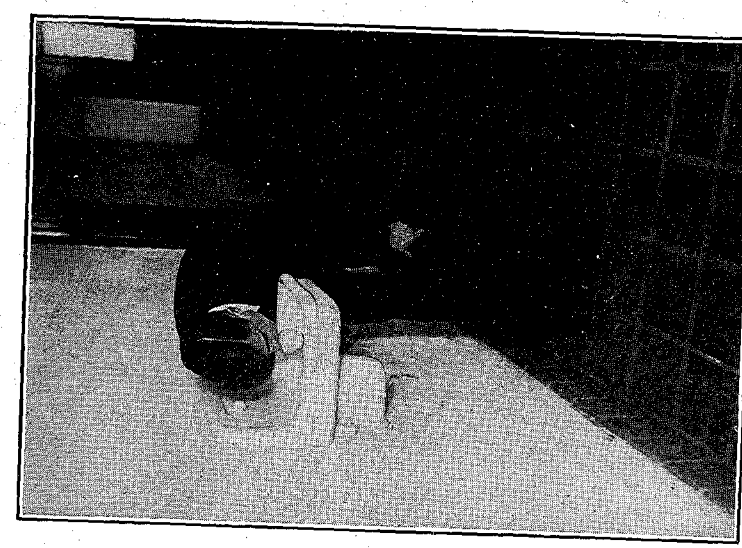

FIG. 4.—CONSUMER DRINKING FROM ONE OF THE UNPROTECTED TYPES OF FOUNTAIN.

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TABLE 2.—*Results on drinking fountains*—Continued.

No.	Building.	Location.	Type.	Height of water jet in inches.	Bacteriological examination.				
					Swab.		Water.		
					Streptococci.	Streptococci in 100 c. c.	Bacteria, 1 c. c.	B. coli.	
								1 c.c.	100 c. c.
20	Millard Hall	Corridor, first floor S	6	.4 c	+	0	2	0	0
21	do	Corridor, first floor N	6	1.5 c	+	0	2	0	0
22	Anatomy	Corridor, third floor	6	.8 ic	+	0	5	0	0
23	do	Corridor, second floor	6	.8 i	0	0	5	0	0
24	do	Corridor, first floor	6	1.3 i	+	+	3	0	0
25	do	Corridor, basement	6	1.0 ic	+	0	3	0	0
26	Biology	do	7	.4 i	0	0	2	0	0
27	do	Corridor, first floor	7	1.1 ic	+	0	2	0	0
28	do	Corridor, second floor	7	2.0 i	0	0	3	0	0
29	do	Corridor, third floor	7	1.6 ic	+	0	2	0	0
30	Main engineering	Corridor, basement S	8	1.0 i	+	0	5	0	0
31	do	Corridor, basement N	8	1.0 i	+	0	7	0	0
32	do	Corridor, first floor N	8	1.0 i	+	0	9	0	0
33	do	Corridor, first floor S	8	.9 i	+	0	2	0	0
34	do	Corridor, second floor S	8	1.0 i	0	0	4	0	0
35	do	Corridor, second floor N	8	1.3 i	+	0	4	0	0
36	do	Corridor, third floor N	8	1.0 i	+	0	3	0	0
37	Experimental engineering.	Corridor, first floor	8	.5 ic	+	0	2	0	0
38	Chemistry	Corridor, third floor N	9	1.3 i	+	0	2	0	0
39	do	Corridor, second floor S	9	.4 i	+	0	45	0	0
40	do	Corridor, first floor S	9	2.5 ic	+	0	8	0	0
41	do	Corridor, first floor N	9	.6 ic	+	0	6	0	0
42	do	Corridor, basement N	9	1.5 i	0	0	4	0	0
43	do	Corridor, basement S	9	1.3 i	+	0	3	0	0
44	Mines	Corridor, third floor	7	1.8 ic	+	0	2	0	0
45	do	Corridor, second floor	7	1.8 ic	0	0	1	0	0
46	do	Corridor, first floor	7	.8 ic	+	0	2	0	0
47	do	Corridor, basement	7	2.5 i	+	0	2	0	0
48	Men's Union	Corridor, first floor	10	.1 ic	+	+	2	0	0
49	Dentistry	Corridor, second floor	12	1.8 c	+	0	2	0	0
50	do	Corridor, first floor	12	1.0 c	+	+	1	0	0
51	do	Corridor, basement	12	1.3 c	+	+	1	0	0
52	Pharmacy	Corridor, first floor	8	1.8 c	0	0	3	0	0
53	Mechanic arts	Corridor, basement	11	1.0 c	0	0	2	0	0
54	Library	Corridor, first floor	11	.5 c	0	0	3	0	0
55	Women's gymnasium.	do	7	.6 i	+	0	33	0	0
56	Pathology and public health.	Corridor, second floor N	14	12.0 i	+	0	2	0	0
57	do	Corridor, second floor S	14	1.3 i	+	0	4	0	0
58	do	Corridor, first floor	13	.5 c	+	0	2	0	0
59	Mechanical engineering.	do	11	.6 c	+	0	6	0	0
60	Electrical engineering.	Corridor, first floor	11	.5 c	+	0	2	0	0
61	Pillsbury Hall	Corridor, basement	11	1.0 c	+	0	5	0	0
62	Armory	Corridor, first floor S	11	.8 c	+	0	2	0	0
63	do	Corridor, first floor N	11	.1 c	+	0	2	0	0
64	Folwell Hall	Corridor, basement	13	2.0 c	0	0	5	0	0
65	do	Corridor, first floor W	13	1.8 c	+	0	3	0	0
66	do	Corridor, first floor E	13	1.5 c	+	0	1	0	0
67	do	Corridor, second floor W	13	3.0 c	+	0	8	0	0
68	do	Corridor, third floor	13	2.0 c	+	0	5	0	0
69	Physics building	Corridor, basement	11	.5 c	+	0	5	0	0
70	Music	do	11	.5 c	+	0	5	0	0
71	Law	Corridor, first floor	11	.8 c	+	0	4	0	0
72	Education	Corridor, basement W	15	1.5 c	0	0	5	0	0
73	do	Corridor, basement E	15	1.0 c	+	0	3	0	0
74	do	Corridor, first floor E	15	1.5 c	+	0	4	0	0
75	do	Corridor, first floor W	15	1.0 c	0	0	4	0	0
76	do	Corridor, second floor W	15	.5 c	+	0	3	0	0
77	do	Corridor, second floor E	15	1.5 c	+	0	4	0	0

TABLE 3.—*Summarized results of investigation.*

Number examined		77
Number of types		15
Height of water jet:		
Continuous—		
Minimum	inches	0.1
Maximum	do	3.0
Intermittent—		
Minimum	do	0.4
Maximum	do	12.0
Bacteriological examination:		
Swab from fountains—Streptococci positive	per cent	80
Water from fountains—		
Streptococci in 100 c. c. positive	do	11
Bacteria per c. c. average		6
B. coli positive—		
1 c. c		0
100 c. c		0
Water from buildings—		
Streptococci in 100 c. c. positive		0
Bacteria per c. c. average		2
B. coli positive—		
1 c. c		0
100 c. c		0

TABLE 4.—*Results on drinking fountain with improved nozzle.*

Number of examinations	3
Bacteriological examination:	
Swab—Streptococci positive	0
Water from fountains—	
Streptococci in 100 c. c. positive	0
Bacteria per c. c. average	3
B. coli—	
1 c. c	0
100 c. c	0
Water from building—	
Streptococci in 100 c. c. positive	0
Bacteria per c. c. average	0
B. coli—	
1 c. c	0
100 c. c	0

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