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Proceedings of the Iowa Academy of Science

Volume 12 | Annual Issue Article 25

1904

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Recommended Citation

Pammel, L. H. and Fogel, Estelle D. (1904) "Some Railroad Water Supplies," *Proceedings of the Iowa Academy of Science, 12(1),* 151-155.
Available at: https://scholarworks.uni.edu/pias/vol12/iss1/25

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SOME RAILROAD WATER SUPPLIES.

BY L. H. PAMMEL AND ESTELLE D. FOGEL.

Complaints are frequently made with reference to railroad water supplies. These complaints come from passengers as well as stockmen who are compelled to use the water for their stock.

To study some of these problems investigations were made of a number of the railroad wells of this state as well as some along the Northern Pacific railroad in Dakota and Montana. The work is not completed but the facts obtained may be of interest to the users of these public water supplies.

It may be of interest to state that the water supply of one municipal corporation, which was also used by the several railroads entering the city, contained Colon Bacillus. It makes it extremely desirable that railways should be very careful of the water used for their passengers. The railroads have, no doubt, in some cases been responsible for the conveyance of typhoid fever. The railroad water supply should be examined chemically and bacteriologically from time to time. The chemical analyses appended were submitted by Dr. J. B. Weems and C. E. Ellis.

Quite a number of different species have been found. In well waters from the west the following species have been determined.

Planosarcina mobilis (Maurea) Migula, *Micrococcus cinnabareus* Flügge, *Micrococcus coralinus* Centanni, *Bacterium glaucum* Maschek. *Bacillus aurescens* Ravenel, mealy orange.

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TABLE SHOWING BACTERIOLOGICAL

Where Located.	Temperature of water.	Date of plating.	Date of counting.	Depth of well.	Geological formation.	Character of Media			
						Agar.	Agar.	Agar Litmus Lactose.	Agar Litmus Lactose.
		1904							
C.& N.-W., Ames	.....	June 22	June 25..	.....	*a*	70	.....	20	10
Belle Plaine..	.....	July 7.	July 9 July 15	35...	*b*	790 800	560 800	.....	 310
Boone.....	.....	June 10	June 12..	.....	Drift	10	.....	30	.....
Carroll.....	.....	May 28	May 29 May 31	.....	*c*	 40	..... 50 10	 30	10 10 40
Co. Bluffs....	.....	June 14	June 16 June 18	.....	.....	250 300	1050 1050	420 420	 150
Eagle Grove..	51° F	June 20	June 23 June 25	.....	Drift	 100	 160	 80	 140
Elmore.....	.....	Sept. 6	Sept. 9 Sept. 10	.....	Drift	190	.....	.....	.....
Glidden.....	.....	June 21	June 24..	.....	.....	36000	42000	44000	17500
LaMoille.....	51° F	July 30	Aug. 1..	30 ..	Drift	.....	.....	250	200
Mason City..	50° F	July 7.	July 9 July 18	862...	St. Peter	790	560 1800	.....	.....
Mo. Valley...	.....	June 15	June 16 June 18	70.	Alluvial Silt....	 40	 50	 10	.....
Tama City ..	.....	July 7.	July 9 July 15	.....	Gravel Drift ..	850 850	250 450	....	.. 1400
Webster City.	55° F	June 20	June 23 June 25	.....	Drift	55 1000	100 350	 530	20 200
Marshalltown	.....	Nov. 28	Dec. 3..	.... ..	.....	220	330	230	200
C. G. W., Marshalltown	.....	Nov. 28	Dec. 3..	.....	.....	250	300	.....	.....
I. C., Marshalltown	.....	Nov. 28	Dec. 3..	.....	.....	1500	160	1250	300
		1905							
C., B. & Q., Clarinda.	50° F	Jan. 16	Jan. 24..	.....	.....	865600	767500	.....	.....
Creston.....	45° F	Jan. 16	Jan. 24..	60. ..	.....	560	.....	.....	.....
Villisca	35° F	Jan. 16	Jan. 24..	*	.....	65600	....	.....	.....
		1904	1904						
N.P. Billings (Yellowstone river.)	68° F	Aug. 16	Aug. 19..	.....	.....	4200	2800	2450	2000
N.P. Glendive (Yellowstone river.)		Aug. 14	Aug. 16 Aug. 18	.. ..	....	40	10500 14000	60 3200	250 .....
Miles City.....	51° F	Aug. 15	Aug. 19..	20...	*d*	80	240	190	1200
Fargo.....	.....	Aug. 12	Aug. 14 Aug. 16	.. ...	.....	1400 2800	20 2700	1400 5600	4200 4200
C., R. I. & P., Des Moines.	.....	Dec. 15	.....	.....	.....	1000	.....	.....	.....
C. & N.-W., Des Moines.	.....	Dec. 15	.....	.....	.....	1400	.....	.....	.....
U. R., Des Moines.....	.....	Dec. 15	.....	.....	.....	400	.....	.....	.....

* From Nodaway R.

a Sand and gravel, base of Wisconsin drift.

b Alluvial silt gravel.

c Gravel, base of Wisconsin drift.

d Alkali silt.

RESULTS OF RAILROAD WELL WATERS.

and Number of Organisms per c. c.								
			Glucose Bouillon.					
Gelatine.	Gelatine.	Liquefying.	CO_2	Vol.	H.	Vol.	Acid species.	Remarks.
40	30	10	.....	....	.....	...	....	Water clear, colonies all white.
.....	.....	....	.....	..	.....	..	..	Water clear from tank. Carried
.....	.....	....	37.58	1.1	62.42	1.8	....	through pipes one mile.
.....	.....	....	.....	....	.5	....	..	Water clear, rapid, colonies white.
.....	.....	....	.....	....	.....	....	....	
.....	210	10	.....	....	.....	....	....	*Sarcina lutea* 10, water clear.
.....	.....	....	.....	....	.....	....	....	
10	140	....	.....	....	.....	....	..	Water somewhat turbid, all white.
Liquefied	Liquefied	....	40.54	3	59.46	4.4	30	Uses city water from Mo. river.
40	30	....	.....	....	.....	....	....	
70	30	....	57.89	5.5	42.11	4	....	*Sarcina aurantiaca* 10, water clear.
.....	.....	....	.....	....	.....	....	....	Water clear, white colonies.
3500	5600	100	.....	....	.....	....	....	Water collected on June 9 in sterile tubes and shipped to Ames.
.....	.....	....	33.33	1.6	66.67	3.2	....	Water clear.
.....	.....	....	.....	....	.....	....	....	Normal level 24 feet, water clear, all
.....	.....	....	25	.5	75	1.5	....	colonies white.
.....	10	....	.....	....	.....	....	....	Water clear, white colonies.
.....	.....	....	.....	....	.....	....	....	
250	.....	....	.....	....	.....	....	....	Water clear from tank
250	.....	....	.....	....	.....	....	....	Water plated after five hours.
.....	.....	....	.....	....	.....	....	....	Water from tank clear, all colonies
.....	.....	....	27.77	.5	72.23	1.3	....	white.
200	130	300	.....	....	.....	....	....	
.....	.....	....	.....	....	.....	....	..	
.....	.....	..	....	....	.....	....	....	
Liquefied	.....	....	.....	....	.....	....	....	No gas.
Liquefied	.....	....	.....	....	.....	....	....	
Liquefied	.....	....	.....	....	.....	....	....	10 minutes pumping, water clear and rapid.
.....	.....	....	.....	....	.....	....	..	Alkaline.
.....	.....	....	.....	....	.....	....	*i*	Water turbid, temperature 70° F.
.....	.....	....	.....	....	.....	....	....	Pumped from river in tank.
.....	.....	....	.....	....	.....	....	....	Water clear, alkaline.
.....	.....	....	.....	..	.....	....	....	Water turbid, taken from Red river,
.....	.....	....	.....	....	.....	....	300	200 yellow colonies.
.....	.....	....	.....	....	.....	....	....	
e 720 liq.	*f* 670 liq.	....	*g*	2	*h*	3	....	

e 400 non-liq., 250 liq.
f 460 non-liq., 3 liq.
g Present.
h Present.
i Acid species present.

Several other species were also identified, but in some cases the identification is doubtful. Of these one is a new species of Sarcina occurring in capsules and of a canary color. Of the rod-shaped organisms are Bacterium n. sp. color oleaginous, Bacterium near *B. Havaniensis*, rose pink, and a Bacterium of lemon yellow color. These colors are described as they appeared on nutrient agar.

Biological and morphological characters were determined. Under the latter head a study was made of the form and arrangement of the organisms. On the different media, the size, staining powers, motility, spores, and such special characters as capsules, involution forms, etc., were studied under the one-twelfth Homogeneous oil immersion lens.

The biological characters were determined from their growth in the following media: gelatin plate, agar plate, milk, litmus milk, blood serum, gelatin stab, agar stab, agar slant, potato streak, lactose bouillon, glucose bouillon, saccharose bouillon, anærobic glucose agar, Dunham's solution, litmus agar. In all cases duplicate cultures were made.

TABLE SHOWING RESULTS OF WELL AT AMES FOR ONE WEEK.

Place.	Date Plated, 1904.	Agar.		Lit. Agar.		Gelatin.		Temperature.	Remarks.
C. & N.-W., Ames..	Nov. 29.	5400	4800	....	....	900	600	.....	No gas.
C. & N.-W., Ames..	Nov. 30.	380	500	....	....	560	500	.....	No gas.
C. & N.-W., Ames...	Dec. 2..	840	1000	....	....	Lique.	Part lique-480	.....	No indol.
C. & N.-W., Ames..	Dec. 3..	750	...	....	....	Lique.	Lique.	.....	No indol.
C. & N.-W., Ames..	Dec. 5..	280	....	....	....	Total liq.	Total liq.	65° C.	No indol.
C. & N.-W., Ames..	Dec. 8..	52	40	100	140	500	.....	.....	No indol.
C. & N.-W., Ames...	Dec. 9..	230	170	200	180	Part liq.	250 Non-liq.	.....	*

*Lit. agar incubated at 37½° C.

CHEMICAL ANALYSIS.

Name of well.	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids on evaporation.	Solids on evaporation. 180° C.	Solids on ignition.	Nitrogen as Nitrites.	Nitrogen as Nitrates.	Oxygen consumed boiling 10 minutes.
C.& N. W. at Carroll	2.12	.07	3.5	504	500	448	Trace	.30	1.20
C. &. N. W at Boone after use of lime..	1.80	.056	7.	184	172	146	.04	None	1.10
C. & N. W. at Boone before use of lime	1.91	.094	4.	482	451	404	None	None	2.10
C. &. N. W. at Mo. Valley.....	1.66	.07	27.	958	932	814	None	None	.75