STUDY OF AN OUTBREAK OF DIARRHEA IN A CONVICT CAMP NEAR SAN JUAN

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In the latter part of November 1927 we were requested by the Assistant Commissioner of Health and the Director of the Biological Laboratory of the Department of Health of Porto Rico to investigate an outbreak of acute diarrhea in a camp for convicts on the grounds of the Insular Tuberculosis Sanatorium, about five miles from San Juan. The study was undertaken as a part of an investigation of dysentery in Porto Rico which was already in progress at the School of Tropical Medicine.

PRELIMINARY OBSERVATIONS

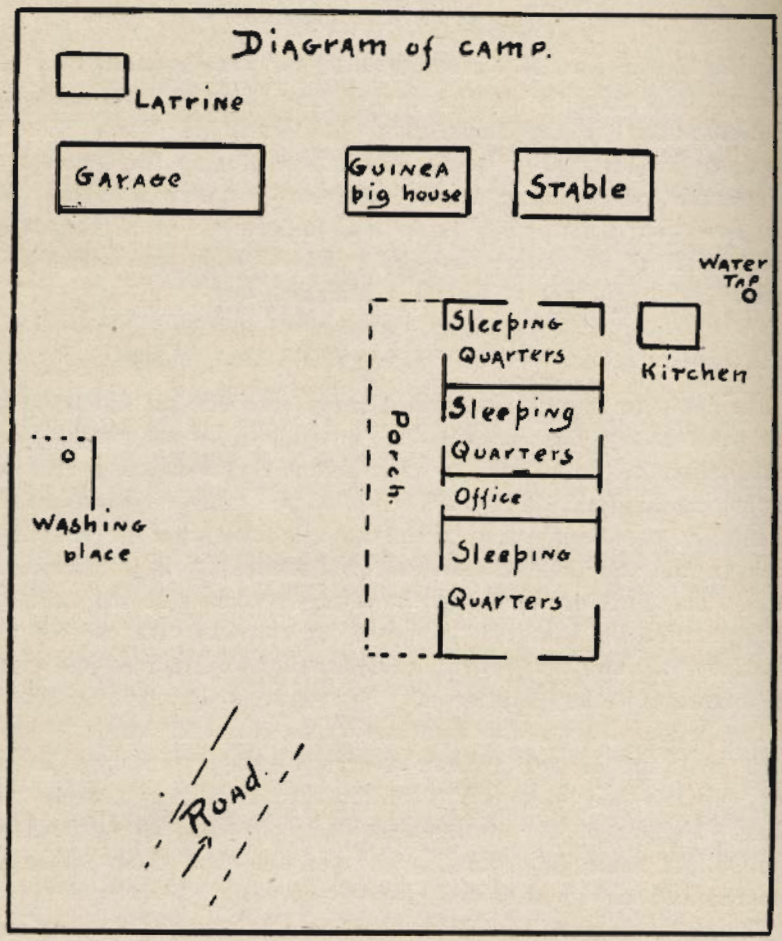
The camp in question contained forty convicts, all from the insular penitentiary, together with one guard and his assistant. These convicts live in three large rooms, arranged as shown in the accompanying diagram. They are supplied the same foodstuffs as the patients in the Sanatorium with the sole exception of the milk, which in the case of the convicts is condensed milk, "Milkmaid" brand. The food of the latter, however, is cooked at the camp itself by two of the convicts. Some of the convicts take care of and milk sixty-five cows that provide milk for the two hundred and eighteen inmates of the Sanatorium. The nearest living quarters of the institution is about five hundred yards from the camp.

At the time of our arrival (November 22), thirty-two of the forty convicts had been sick with diarrhea in the two weeks preceding. Neither of the two guards had been ill. The guards are supplied the same foodstuffs as the convicts but their meals are prepared and served at their homes.

The outbreak started on November 8th when twelve convicts were suddenly taken sick almost simultaneously. From that time until November 22nd, twenty more became similarly ill, and new attacks or relapses were noted in several of those first taken ill.

The following is a typical history of practically all of the cases: The patient would go to bed apparently well and during the night, generally in the early morning hours, would awake with an acute

pain over the lower abdomen and a violent desire to evacuate. He would have to hurry to the latrine, and sometimes before reaching it he would defecate in his clothing. Defecation was accompanied by tenesmus and pain. The stools were liquid and contained abundant mucus. In many cases there was also blood. Stools were very



frequent, four to ten or more in twenty-four hours. The patients would at once take a large dose of Glauber's salts (sodium sulphate) and in two or three days the symptoms would pass. In practically all the cases, however, a second or third attack occurred.

The constitutional symptoms were very mild. Most of the patients kept at work except when evacuations were so frequent that

they had to remain in quarters. No fever was noticed except in one case (No. 32). All patients complained of pain on pressure on the lower abdomen.

Physical examination revealed nothing except marked tenderness over the hypogastric region and slight tenderness in both iliac regions on deep pressure. It is interesting to note that every one of the men blamed the red beans for their illness, although many of them had a second attack after omitting the beans from the diet.

With respect to the sanitary conditions of the camp we noted that there were great numbers of flies all around, that there was only one latrine (and to this flies and other insects had free access), that the kitchen was freely accessible to rats and vermin, that a stable for horses with manure and waste stood close to the camp, that there was free interchange in eating and drinking utensils among the men, and that all of the clothing of the camp was washed on the premises by one of the convicts.

It is noteworthy that during the whole month of November there were heavy rains.

METHODS OF STUDY

The general plan followed by us in the investigation of this outbreak was as follows:

1. Bacteriological study of all the foods and of the fresh stools of all the occupants of the camp.

The bacteriological technique employed was as follows: The stool was cultured immediately after passage, one hour at most after collection. A portion of the stool (about 0.5 gram) was placed in plain nutrient broth pH. 7.6, and shreds of mucus removed, washed in saline and seeded on one-half of each of four plates of Endo's agar pH. 7.6, and two of Levine's eosine methylene blue agar (pH. 7.6. The other half of the plate was planted with the supernatant broth after letting it set for thirty minutes. The plates were incubated twenty-four hours at 37°C and colonies, both lactose and non-lactose fermenters, were picked from all six plates, about 15–25 colonies in each case. The cultures were studied, other media inoculated, and agglutination reactions made until the organism recovered, was classified.

In the case of the foodstuffs, samples of each were placed in tubes of nutrient bullion, placed in the incubator for a half hour, and seeding made in the way described above with the supernatant broth.

2. Study of the gross and microscopic picture of the fresh stool and of stained smears of the same.

The technique followed in our fecal examinations was as follows: In our search for *Endamoeba histolytica* only fresh stools were examined. A bit of the fecal material, preferably that containing mucus, was diluted with normal salt solution and examined under the microscope without a warm stage. If cysts were found they were identified in a second smear made with iodin as the diluting fluid.

In cases where amoebae were found smears were fixed in Schaudinn's fixing fluid and stained with iron-hematoxylin. The same procedure was followed in the final examination for cysts except that in this case permanent preparations were made from all the stools examined.

3. Hemoglobin estimation (Dare), total white and red blood cell counts and differential counts were made in eighteen of the affected men and five of the unaffected.

FINDINGS

Bacteriological findings in case of the foodstuffs and feces are given in Tables I and IV.

At the first examination made by us most of the stools were very mushy and several were diarrhoeic. Mucus was present in them only in slightly abnormal amounts. Blood was visible microscopically in a large number of them, but only in four cases was blood discernible by the naked eye. *Endamoeba histolytica* were found in three cases. Actively motile amoebae with ingested red blood corpuscles were never observed. In three more cases small amoebae were seen but it was impossible to identify them because cysts were not present and stained preparations could not be made from the material. Vegative forms of *End. coli* were found in another case.

Stools passed after the taking of a saline purge were obtainable in seven cases out of the eleven to whom the purge was administered. The three cases previously found to be infected with *End. histolytica* again showed the amoebae in their stools, but the remaining four cases proved negative.

The results obtained in our final examination made fifty-four days after the cessation of symptoms are given in Table III.

All parasitological findings, actually made in one or another of the examinations are given in Tables II and IV.

The results of the study of the blood are given in Table IV.

DISCUSSION

In our bacteriological study we failed to make anaërobic cultures of the foodstuffs and feces.

The inability to find dysentery or other allied bacilli in any of the feces, although fresh samples of these were studied, leads us to discard this group of organisms as a possible factor in the outbreak. The absence of definite constitutional disturbances, including fever, in all of the cases is also against such an etiology although many cases of bacillary dysentery do present very mild manifestations at times.

The blood picture of the cases studied did not throw any light on the problem. The high percentage of eosinophiles and the anemia found in some can be explained by the presence of helminths.

Our protozoological findings clearly show that about one-half of the diarrhea patients must have been infected with *End. histolytica*. This estimated percentage incidence, though high, is not unduly high for Porto Rico. Hegner (1921) found *End. histolytica* in twelve per cent of eighty-three stools from healthy individuals from different parts of the Island. According to his figures the estimated incidence would have been thirty-six per cent. Hill and Hill (1927) examined 269 persons from the general population and found 10.4 per cent infected. From their figures the estimated incidence would have been 31.2 per cent for the general population. This figure for the whole population necessarily means a much higher percentage for the lower, poorer classes to which our convicts belong. If in addition it is recalled that they form part of an institution, an incidence of *End. histolytica* above the average would be expected.

These findings, together with some theoretical consideration, we believe rule out *End. histolytica* as the cause of the diarrhea. From the work of Walker and Sellards (1913) it is clear that only a minority of the individuals infected with *End. histolytica* show symptoms at one time or another and it also becomes apparent that there is not a definable incubation period in amoebiasis. With these two facts in mind and from what we know about the transmission of *End. histolytica* it is impossible to understand how the forty men could have become infected simultaneously or how eighty per cent of them should have come down with symptoms at nearly the same time.

The presence of Charcot-Leyden crystals in about fifteen per cent of the stools examined has no significance because they are known to be commonly found associated with hookworm and other helminths (Ashford, 1911).

SUMMARY AND CONCLUSIONS

The results of a bacteriological and parasitological study of an outbreak of diarrhea affecting thirty-two out of forty persons living under the same conditions in a convict camp were essentially negative, in that no bacterium or protozoa was found that could be

considered responsible for the disturbance. No organisms of the typhoid-dysentery group were demonstrated and *End. histolytica* was ruled out on the basis of the comparative incidence.

Since anaërobic cultures were not made, the possibility of an anaërobe as the cause must be considered.

Another possibility is a non-living chemical irritant derived from or associated with one of the foodstuffs in the common dietary.

These negative findings are considered worthy of publication largely because the frequency of intestinal disorders in Porto Rico makes it advisable to place on record all systematic studies, whether conclusive or not.

We wish to thank Dr. A. Fernós Isern, Assistant Commissioner of Health, and Dr. P. Morales Otero, Director of the Public Health Laboratory, for affording us the opportunity to study this outbreak. We are greatly indebted also to Dr. Roure, acting Director of the Tuberculosis Sanatorium, who cooperated with us in every way, placing all the facilities of the Sanatorium at our service.

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TABLE I

BACTERIOLOGIC STUDY OF FOODSTUFFS

No.	Food	Findings
14	Rice (uncooked)	Flavobacterium racemosum
15	Lard	Negative
16	Chick peas	Escherichia coli (B. coli communis)
		Staphylococcus albus
17	Condensed milk "Milkmaid" brand	Negative
18	Table salt	Escherichia coli
19	Water	Negative
20	Beans (white)	Escherichia coli
21	Brown sugar	Staphylococcus albus
22	Ground coffee	Negative
23	Annato	Escherichia coli
		Flavobacterium racemosum
24	Beans (red)	Negative
25	Bacon	Negative
26	Cod fish	Negative

TABLE II

RESULTS OF EXAMINATIONS OF STOOLS FOR HELMINTHS

Cases studied	Number	Per cent	Total positive helminths: Number	Total positive helminths: Per cent	Hookworm: Number	Hookworm: Per cent	Trichuris trichiura: Number	Trichuris trichiura: Per cent	Strongyloides stercolaris: Number	Strongyloides stercolaris: Per cent	Schistosoma mansoni: Number	Schistosoma mansoni: Per cent	Ascaris lumbricoides: Number	Ascaris lumbricoides: Per cent
With diarrhea.....	32	76.1	27	84.3	22	68.7	15	46.8	3	9.3	1	3.1	1	3.1
Not affected.....	10	25.3	7	70	6	60	2	20	1	10	1	10	0	...
Total.....	42	....	34	80.9	28	66.6	17	40.4	4	9.5	2	4.7	1	2.3

TABLE III

RESULTS OF ONE EXAMINATION FOR INTESTINAL PROTOZOA FIFTY-FOUR DAYS AFTER CESSATION OF SYMPTOMS

Cases	Number of cases	Endamoeba histolytica: Number	Endamoeba histolytica: Per cent	Endamoeba histolytica: Estimated Per cent	Endamoeba coli: Number	Endamoeba coli: Per cent	Endamoeba coli: Estimated Per cent	Endolimax nana: Number	Endolimax nana: Per cent	Endolimax nana: Estimated Per cent	Iodamoeba williamsi: Number	Iodamoeba williamsi: Per cent	Iodamoeba williamsi: Estimated Per cent	Dientamoeba fragilis *: Number	Dientamoeba fragilis *: Per cent	Trichomonas hominis: Number	Trichomonas hominis: Per cent	Giardia lamblia: Number	Giardia lamblia: Per cent
With diarrhea.	27	5	18.5	55.5	4	14.8	44.4	3	11.1	33.3	1	3.6	10.8	1	3.6	1	3.6	1	3.6
Not affected ..	6	0	...	....	1	16.6	49.8	0	..	....	0	...	....	0	...	0	...	0	....
Total.....	33	5	15.1	45.3	5	15.1	15.3	3	9	27	1	3	9	1	3	1	3	1	3

* This is the first case of infection with *Dientamoeba fragilis* reported for Porto Rico. Dr. W. H. Taliaferro, professor of protozoology in the University of Chicago, at present visiting lecturer to the School of Tropical Medicine, has examined the slides and corroborated our diagnosis of this rare intestinal amoeba of man.

TABLE IV

CLINICAL AND LABORATORY FINDINGS IN ALL CASES

Case number	Gross Exam.			Stools microscopic					Number of attacks of diarrhea	Months of residence at Arp	Blood								Organisms isolated from the feces
	Diarrhea	Blood	Mucus	Red blood cells	Leukocytes	Epithelium	Charcot-Leyden crystals	Parasites or ova			% hemoglobin (Dare)	Number of leukocytes per c. mm.	Millions of r b c per c. mm	Differential count					
														Lymph %	Polys %	Eosino %	Trans %	Other %	
1c	+	—	+	—	+	+	—	Amoeba (?)	2	14	82	7520	3.720	33	64	1	1	1	Escherichia coli *
2	+	—	+	+	+	+	—	Endamoeba histolytica. Hookworm	3	7	94	7800	5.624	29	60	9	2	..	Escherichia coli
3	+	—	+	+	+	+	—	Trichuris trichiura	3	5	81	9230	3.910	30	58	6	2	4	Escherichia coli
4	+	—	+	+	—	+	—	Trichuris trichiura Hookworm	2	11	58	8320	2.480	30	55	8	4	3	Escherichia coli
5	+	+	+	+	+	—	—	Hookworm Trichuris trichiura Endamoeba histolytica.	2	11	72	6940	4.610	25	58	16	0.2	0.7	Escherichia coli
6c	+	+	+	+	—	+	—	Endamoeba histolytica. Schistosoma mansoni	3	6	79	8040	3.800	34	57	5.6	1.5	1.5	Escherichia coli
7	+	—	+	—	—	+	—	Hookworm Ascaris lumbricoides. Trichuris trichiura	2	1	62	7890	2.810	40	48	11	1	..	Escherichia communior
8	+	+	+	+	+	+	—	Endolimax nana Hookworm Trichuris trichiura	2	19	..	.....	.....	..	..	..	.	..	Escherichia coli
9	+	—	+	+	—	+	—	Endamoeba histolytica	3	4	85	7170	4.736	37	50	9	2	2	Escherichia coli
10	+	—	+	+	—	—	—	Amoeba (?) Hookworm Trichuris trichiura	3	20	72	8740	4.240	32	55	10	2	1	Escherichia communior
11	+	—	+	—	—	—	—	Trichuris trichiura	2	2	88	7500	4.060	24	70	2	2	2	Escherichia communior Aerobacter aerogenes

12	+	—	+	—	—	—	+	Hookworm	1	20	..	.....	.....	..	..	..	..	..	Escherichia coli *
13	+	—	+	+	—	+	—	Endamoeba histolytica. Hookworm Trichuris trichiura..	3	3	..	.....	.....	..	..	..	.	..	Escherichia coli
27	+	—	+	+	+	+	—	.. ..	2	14	..	.....	.....	..	.	..	..	..	Escherichia coli Aerobacter aerogenes
28	+	—	+	+	+	+	+	Endamoeba histolytica. Endamoeba coli Iodameba williamsi Hookworm	2	8	74	9.100	3.760	20	69	9	1	1	Escherichia coli Aerobacter aerogenes
29	+	—	+	+	+	+	—	Trichomonas hominis... Trichuris trichiura....	4	1	83	9.900	2.140	45	47	6	2	..	Escherichia coli Aerobacter aerogenes
30	+	—	+	+	+	+	—	Hookworm Trichuris trichiura.....	2	5	84	8.140	4.810	26	60	13	1	..	Escherichia coli
31	+	—	—	+	+	+	—	Hookworm Strongyloides stercolaris Endolimax nana.....	3	24	..	.....	.....	..	..	..	..	..	Escherichia communior Aerobacter cloacae
32w	+	—	+	+	+	+	+	Hookworm Strongyloides stercolaris	1	8	35	14.550	2.46	21	56	22	0.6	0.7	Escherichia coli Aerobacter aerogenes Staphylococcus albus
33	—	—	—	—	—	—	—	Dientamoeba fragilis.... Endamoeba coli..... Trichuris trichiura.....	0	18	86	5.800	4.404	28	66	1	3	2	Escherichia coli
34	+	—	—	—	—	+	—	Endamoeba histolytica. Endolimax nana. ..... Trichuris trichiura..... Hookworm.....	2	21	81	5.810	4.312	28	69	1	1	1	Escherichia coli
35	—	-	—	—	—	+	—	....	2	7	..	.....	.....	..	..	..	..	..	Escherichia coli
36	—	—	—	—	—	—	—	Endamoeba coli ..... Trichuris trichiura..... Hookworm . ..... Strongyloides stercolaris	0	9	85	11.400	4.386	22	53	23	2	..	Escherichia coli
37	—	—	—	—	—	—	—	Hookworm.. ..... Trichuris trichiura.....	1	39	..	.....	.....	..	..	..	..	..	Escherichia coli Proteus valeriae
39	+	+	+	+	+	+	—	Endamoeba coli ..... Giardia lamblia..... ... Hookworm..	2	20	95	4.300	4.120	30	55	12	2	1	Aerobacter aerogenes Escherichia coli
40	—	—	—	—	—	—	—	Hookworm	0	19	..	.....	.....	..	.	..	..	..	Escherichia communior

* Escherichia coli has been recently adopted as the name for *B. coli communis.*

TABLE IV—Continued

CLINICAL AND LABORATORY FINDINGS IN ALL CASES—Continued

Case number	Gross Exam: Diarrhea	Gross Exam: Blood	Gross Exam: Mucus	Stools microscopic: Red blood cells	Stools microscopic: Leucocytes	Stools microscopic: Epithelium	Stools microscopic: Charcot-Leyden crystals	Stools microscopic: Parasites or ova	Number of attacks of diarrhea	Months of residence at camp	Blood: % hemoglobin (Dare)	Blood: Number of leukocytes per c mm.	Blood: Millions of r b c per c mm	Blood: Differential count: Lymph %	Blood: Differential count: Polys %	Blood: Differential count: Eosino %	Blood: Differential count: Trans %	Blood: Differential count: Other %	Organisms isolated from the feces
41	—	—	—	—	—	—	+	Strongyloides stercolaris	1	11	..	.....	.....	..	.	..	..	..	Escherichia coli
42	+	—	—	—	—	—	—	Hookworm	1	14	..	.....	.....	..	.	..	..	..	Escherichia coli
44	+	—	+	+	+	+	—	Hookworm	1	15	65	8.200	2.040	23	56	19	2	..	Escherichia communior
46	+	—	—	+	+	—	+	Giardia lamblia Hookworm	1	7	92	9.400	3.240	24	66	5	2	2	Escherichia coli Aerobacter aerogenes
47	+	—	—	—	—	—	—	Hookworm Trichuris trichiura	1	32	..	.....	.....	..	..	..	..	..	Escherichia coli Aerobacter aerogenes
48	+	—	—	—	—	—	—	Strongyloides stercolaris	1	10	..	.....	.....	..	..	..	..	..	Escherichia coli
49	—	—	—	—	—	—	—	Endamoeba histolytica. Hookworm Strongyloides stercolaris Trichuris trichiura	2	6	..	.....	.....	..	..	..	..	..	Escherichia coli
50	—	—	—	—	—	—	—	Hookworm Schistosoma mansoni	0	48	74	8.000	4.030	26	67	7	..	..	Escherichia coli
51	—	—	—	—	—	—	—	Iodamoeba williamsi. Endamoeba coli	0	10	..	.....	.....	..	..	.	..		Escherichia communior Staphylococcus albus
52	—	—	—	—	—	—	—	.....	1	6	..	.....	.....	..	..	..	..	..	Escherichia coli
53	—	—	—	—	—	—	—	Hookworm Trichuris trichiura Endamoeba histolytica.	2	10	..	.....	.....	..	.	..	..	..	Aerobacter aerogenes Escherichia coli
54	—	—	—	—	—	—	—	.....	0	20	91	8.100	4.290	27	66	1	3	3	Escherichia coli
55g	—	—	—	—	—	—	—	Hookworm	0	4	..	.....	.....	..	..	..	..	.	Escherichia communior
56g	—	—	—	—	—	—	—	.....	0	9	..	.....	.....	..	..	..	..	..	Escherichia coli
58	—	—	—	—	—	—	—	Hookworm	0	36	..	.....	.....	..	..	..	..	..	Escherichia coli
59	—	—	—	—	+	+	+	Hookworm	0	4	89	6.930	4.110	37	57	9	..	..	Escherichia coli

\+ present — absent c = cook w = laundryman g = guard