

BACILLARY DYSENTERY IN PUERTO RICO *

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- I. Historical Account and Review of the Regional Literature.
- II. Epidemiological and Bacteriological Study of Three Outbreaks
- III. Study of Native Strains of *Bacterium dysenteriae*.
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INTRODUCTION

Bacillary dysentery is still a prevalent disease throughout the world, especially in tropical and sub-tropical regions. With modern methods in sanitation and public health the disease has been limited in extent and distribution, remaining latent in the form of sporadic cases, endemic foci or epidemics in certain localities of the world, specially in the vicinity of the equator.

The disease is also present in the form of local outbreaks in insane asylums, convict camps and military barracks. It is often associated with armies in active service, where overcrowding and unsanitary conditions prevail.

Whenever the general conditions are bad, whenever the soil is much fouled by excreta, wherever many people are crowded together in one building or camp, where food is coarse, monotonous or unsound, and specially in tropical or sub-tropical climates, according to Manson¹, dysentery is liable to break out.

In Puerto Rico, a small tropical island located north of the Equator in the Western Hemisphere, dysentery has been an important pathological entity ever since the early periods of the Spanish colonization in the beginning of the 16th century. During the last 70 years the disease has appeared with a definite periodicity, usually as a sequela to severe hurricanes. Since the big epidemic of 1899 which followed the hurricane of August 8th, until the epidemic of 1928, follow-

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ing the hurricane of September 13th, a period of twenty-nine years, dysentery was not a prevalent disease in the island of Puerto Rico and appeared only as sporadic cases or small limited local outbreaks now and then.

I. HISTORY AND REVIEW OF THE REGIONAL LITERATURE.

The first authentic historical reference to dysentery, which from the clinical description and mode of spreading suggests the bacillary type of the disease, is the citation of the first historian of Puerto Rico, Fray Iñigo Abbad y Lasierra², who describes a disease characterized by bloody diarrhea which was quite common among the Indians prior to the discovery of the Island by Columbus in 1493, and was also of frequent occurrence among the early Spanish colonizers of the Island.

“The disease was accompanied by fever and often extended itself in an epidemic form throughout the whole Island. It was specially prevalent after the hurricanes when it always became epidemic. Following the destruction of the crops by these storms, food became scarce and the Indians were forced to consume bread made from the roots of a tropical plant, *marunguey* (*zania portoricensis*), attributing this as the cause of the disease, but in years in which there was abundance of food they could not blame any particular item of their diet for the disease. The Indians claimed that decoctions of the fruit of the *pajuil* or *mercy* (*anacardium occidentale*) were useful in stopping the bloody diarrhea.”

Antonio de Herrera (cited by Brau³) relates that it was the habit of the Indians of the Windward Islands (Islas de Barlovento) to come to Puerto Rico and capture human beings with cannibalistic purposes. Several years before 1569 this practice was suddenly stopped due to the fact that the Indians of Dominica captured a monk on the Island of San Juan Bautista de Puerto Rico, and after having eaten his flesh practically every one of them suffered with very severe attacks of acute diarrhea (*múltiples camaras*) from which many died, and for this reason they stopped the practice of cannibalism and continued to visit the neighboring islands to steal cows and mares which were very abundant.

In 1598⁴ the British, under the command of the Count of Cumberland, stormed the Port of San Juan with several ships and armed men, landed, and had taken possession of the city, when epidemic dysentery broke out among the men who were forced to return to England, and thus, by the hand

of destiny, the island of Puerto Rico continued to be a Spanish colony.

Dr. Layfield⁴, who took part in the expedition, gives a typical description of the disease to which Spaniards and natives, as well as the British who were attacking the town, fell victims in more or less the same proportions.

“The epidemic occurred during the months of July and August, when the so-called Indian winter occurs in those tropical lands, so named on account of the large amount of rainfall. . . . The disease was a diarrhea characterized from the beginning by the passage of bloody mucus in the stools. At the beginning, the disease was very often accompanied by fever. The very severe and fatal cases were characterized by a feeling of general weakness, the extremities of the affected individual often became cold and clammy, this being taken as a sure sign of death. Sometimes the bowel movements numbered 60, 80 or even 100 in a day. The individuals were so weak that they could not perform their duties; and it was this, more than the number of deaths, which forced his Lordship to abandon the Island. The ships had lost practically all their crews. Of the 1,000 men which his Lordship landed in San Juan, about 400 died from the disease and as many more suffered from it and were so weak that they had to be carried on board the ships.”

There is quotation by the historian Coll y Toste⁴ to the effect that the disease described was dysentery.

Acosta⁵, in the revision which he made in 1865 of the first history of the island of Puerto Rico, includes a special chapter on dysentery and diarrhea.

“In the early days of the colonization of the Island, dysentery was one of the most frequent and deadly diseases. The frequency of the disease was probably accounted for by the large number of forests and swamps which made the Island unhealthful. Today (1865), not only have the general conditions of the Island improved but also the habits of living of the individuals, all of which have contributed to a reduction in the incidence and severity of this disease. In the habitations near the swampy places the disease was common, the same as intermittent fevers, both of which were occasionally found in the same individual. The disease appeared in sporadic cases, small local outbreaks or very severe epidemics which extended throughout the Island, either in a benign or very severe form. . . . Diarrhea was considered in those times as the one disease which caused the largest number of deaths in the Island. The laity, considering the diarrhea *per se* as a clinical entity, made use of empirical medications which often aggravated the condition, which then took a chronic form. Excess in food, abuse in alcoholic beverages and an acute ailment of the gastro-intestinal tract not properly attended to, predisposed to the condition which often changed into a chronic disease that necessitated that those affected be moved to a more temperate climate in order to obtain a cure.”

From the beginning of the 17th century to the second half of the 19th century, we have been unable to find recorded

references of epidemics of dysentery. However, according to Lavandero (cited by Costa and Garrido⁶), epidemics of dysentery were most likely to have occurred in the barracoons where the gangs of slaves who worked on the *ingenios* or *haciendas* were kept, and written descriptions of the illness most probably exist in such documents as day-books, wherein would be written episodes of slave life. The same remark applies to the logs of the slavers, and outbreaks in pirate and merchant ships which touched the ports of the Island were common and were often mentioned in non-medical books of the time.

Undoubtedly the first publication on dysentery by a Puer-torrican was that of Agustín Stahl⁷ who based his doctoral thesis in 1864 in the University of Wurtzburg, Germany, on "Dysentery". The following year (1865), after his return to Puerto Rico, he was sent as ship's physician by the Crown of Spain to accompany a large number of Spanish soldiers who had contracted dysentery in the garrisons throughout the island of Puerto Rico. The disease was at that time causing considerable alarm to the Spanish authorities in the Island on account of the large number of soldiers that were incapacitated by it⁷.

In 1875, Dr. E. Dumont published a book entitled "Medical and Surgical History of Puerto Rico"⁸ in which can be found numerous references to a frequent disease occurring sporadically and in epidemic form, and resembling in its characteristics what we know today as bacillary dysentery.

"The most frequent epidemics we have encountered in Puerto Rico, because knowing of their presence we have gone in search of them or have met them accidentally in our travels throughout the Island, have been those of yellow fever, smallpox, whooping cough, measles and *dysentery*. With the exception of yellow fever, which is not met with in the mountains, the others are found both in the mountains and at sea level" (Vol. I, Page 14).

"In the houses of the hill dwellers all kinds of diseases are prevalent, the most frequent being intermittent fevers, cachexias, enteritis, and above all, dysentery, which was as common and as fatal to the native as to the foreigners."

Special reference is made to the severe hurricane (and accompanying floods) of October 29, 1867 (San Narciso) and to the earthquakes of November 1873. (Vol. I, Pg. 17-18).

In the family history of a case of elephantiasis is mentioned the fact that—

“Four children died and two remained in a very delicate and anemic condition as a result of attacks of acute dysentery which at that time (1872) prevailed in an epidemic form throughout the whole Island.” (Vol. I, pg. 221).

“The water employed for drinking purposes in the rural areas has been the source of epidemics, in one specific instance of acute dysentery, which appeared in epidemic form among the negro slaves of one of the *ingenios* and persisted until the source of the drinking water, a small stream employed until that time, was substituted by water from a well, dug out following the advice of a physician.” (Vol. II, Pg. 174).

Frequent mention is made in the book of acute dysentery met with as a postoperative complication, and characterized by fever and multiple evacuations accompanied by bloody mucus.

Following the hurricane of August 1899 (San Ciriaco) epidemic dysentery appeared in the island of Puerto Rico and was the cause of a great number of deaths and the incapacitation of a large proportion of the population. On this account, the Superior Board of Health of Puerto Rico issued a pamphlet⁹ relative to the possible cause of the disease and warning the people of the way in which the illness was contracted and giving the preliminary precautions to be taken. It stated that—

“The disease can be transmitted the same as typhoid fever, through the hands, cloth and eating utensils which had been in close contact with a sick patient, it being important to take great care with the things used by the sick individual, in order to prevent contagion. If a member of a family contracts the disease, he becomes a source of contagion to the other relatives living under the same roof. Latrines should be built near the houses and in a proper form; the use of calcium oxide in latrine pits is recommended from time to time to prevent the spread of the disease from fecal matter to other people; human excreta should not be dumped near possible sources of drinking water, and it was recommended at the same time that the people should boil the water to be used for human consumption in order to destroy the germs of the disease. Any case of the disease should at once be reported to the Insular Board of Health.”

In the report of the Superior Board of Health of Puerto Rico for the year 1900¹⁰ is found a table in which are engrossed the number of annual deaths of the more important contagious diseases in the island of Puerto Rico from the years 1890 to 1899, together with the percentage of the general mortality which these diseases caused (Pg. 97-98).

Using those figures and the estimated population of Puerto Rico for the same period of time^{11, 12}, we have computed in Table No. 1 the death rate per 100,000, population of

each disease enumerated, and one sees off-hand that dysentery was a most important cause of death in the years quoted.

TABLE No. 1

DEATH RATE (PER 100,000 POPULATION) FROM THE MORE IMPORTANT CONTAGIOUS DISEASES IN PUERTO RICO FROM 1890 TO 1899

Disease	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899
Smallpox.....	282.1	78.1	7.1	1.2	41.8	102.1	51.6	63.8	55.5	25.4
Yellow fever.....	18.2	11.4	21.4	15.2	13.	39.9	8.3	1.0	2.4	0
Typhoid fever.....	48.8	43.4	42.2	37.8	41.1	38.5	52.4	43.7	44.2	36.3
Meningitis.....	30.6	26.7	30.6	33.9	29.4	34.8	37.7	38.7	38.1	38.8
<i>Dysentery</i>	61.9	44.3	64.5	46.2	74.4	107.5	94.8	212.8	203.4	374.3
Diphtheria.....	1.2	5.0	5.1	4.3	5.6	7.0	4.7	4.7	7.1	4.7
Tuberculosis.....	209.5	179.7	195.	194.8	222.5	201.2	200.7	209.0	222.7	200.4
Tetanus.....	117.8	105.6	120.8	111.5	105.3	95.1	85.6	94.4	113.7	113.7
Anemia.....	412.1	352.2	406.5	369.9	387.9	390.4	426.9	509.2	783.6	941.7

Gen. Davis¹³, in his first military report of the island of Puerto Rico (Pg. 591), states that—

“Of the 5,497 deaths attributed to diarrheal conditions in the year ending May 31, 1900, 2,695 were reported as due to dysentery. This constituted 11.6 per cent of the total mortality. The infant mortality from this cause was not ascertained, but here, as elsewhere, these conditions are by far the most prominent cause of the children’s deaths, and we may assume that the deaths in this class were excessive from the fact that 34.5 per cent of total deaths were of children under five years, when for the same months in New York the rate was about 27.5 per cent in 1897. The annual rate would doubtless be much greater, as the statistics for the summer months are not included in the above.”

It is observed that in October and November the number of deaths were 1,264 and 1,391, respectively, and that in April only 360 were reported, there being rapid monthly increases.

The large number of deaths from this cause during the first three of these months may be attributed indirectly to the hurricane of the previous August (1899) which made the customary food supply unavailable. As a substitute, the Government distributed large quantities of beans, rice, and codfish. It was a notable fact that at first the natives paid little or no attention to the cooking of these articles, particularly the beans. The necessity for care in this particular has been impressed upon their minds by bitter experience. The intestinal tract, accustomed to plantains, bananas, and an occasional sweet potato, rebelled at uncooked beans, and no doubt these were a factor in the excessive mortality from diarrheal diseases in October, November and December. Nearly 50 per cent of the mortality was due to dysentery.

The “dysentery” of these returns is doubtless ‘a term applied to what is probably a group of diseases, whose principal pathological features is inflammation of the mucous membrane of the colon, and whose leading symptoms are pain in the abdomen, tenesmus, and the passage of frequent small stools containing mucus and blood (Manson)’.

As in all tropical countries, the pathological condition has always been

more or less prevalent in Puerto Rico, but reference to the preceding statistics will show that since 1893 there has been a marked yearly increase in the number of deaths from this cause; in that year 1.8 per cent of the total mortality was due to dysentery, as compared to 8.9 per cent in 1899. There were nearly twice as many deaths from this cause in 1899 as in 1898. From the fact that no death from liver abscess was reported during the seven months, it may reasonably be inferred that very little or none of the local dysentery was of the amoebic type. The distribution of the disease is practically that of anemia. It finds its victims among the poor of the inland mountainous districts, and is decidedly infrequent in the cities of San Juan and Ponce. Poverty is apparently the chief predisposing cause, and poverty is and has been rife in the country districts.

The first reference as to the actual causative agent of some of the dysentery prevalent in the island of Puerto Rico, dates from 1902. In that year Flexner¹⁴ studied bacteriologically and pathologically a case of chronic dysentery in an American soldier who fought in Puerto Rico during the Spanish-American War, the disease being contracted while in service on the Island. A dysentery bacillus belonging to the Flexner group was isolated from the sigmoid flexure at autopsy.

In the year 1912, González Martínez¹⁵ (Director of the Biological Laboratory of the Health Department of Puerto Rico), studied a small localized outbreak of dysentery in San Juan and isolated from the feces of 5 cases a dysentery bacillus which he classified as Park. In 1930 (cited by Costa and Garrido⁶) while discussing a paper on dysentery presented at the Annual Meeting of the Puerto Rico Medical Association by Costa Mandry and Garrido Morales⁶ he indicated that at the time he performed his studies a large number of organisms belonging to the Flexner group were classified under different subgroups depending upon their action on specific carbohydrates, but that the organisms which he classified as Park really belong in the Eberthella paradysentery group (Flexner).

During the year 1927, Costa-Mandry became interested in the study of dysenteric conditions in Puerto Rico. The preliminary report of his work carried out at the School of Tropical Medicine of the University of Puerto Rico under the auspices of Columbia University, includes the bacteriological study of the feces of 77 cases of acute diarrhea and of 72 supposedly normal individuals¹⁶⁻¹⁷.

The 77 cases of acute diarrhea occurred sporadically

during a period or approximately six months, and in 6 (7.7%), a dysentery bacillus of the Flexner group was isolated, the cases being located in different towns of the Island, Ponce, Maunabo, Sunoco (Santurce), Arecibo, Vega Alta and Canóvanas. The case from Ponce was studied at the same time at the Presbyterian Hospital at San Juan, where a dysentery bacillus (Flexner) was isolated, the bacteriological diagnosis being based on the fermentation reactions with various sugars. The case from Sunoco had a fatal outcome.

In the report published, the author presents charts to indicate the mortality in Puerto Rico due to diarrhea and enteritis and the results of a questionnaire sent to all the physicians of Puerto Rico, inquiring as regards the incidence of acute diarrhea with blood and mucus in the stools, the presence of liver abscess, and the response of cases of diarrhea accompanied by fever and multiple evacuations with blood and mucus to treatment with different medications.

In the conclusions of the paper the author states that bacillary dysentery exists in Puerto Rico as a definite pathological entity and that in a certain proportion of the cases studied, a bacillus of the paradysentery group (Flexner) was demonstrated in the feces. No epidemic outbreak of the disease was prevalent at the time the study was carried on. A detailed clinical description is given of each of the 6 cases from which a *Bacillus dysenteriae* was isolated.

In 1930, the statement was made that,—

“Indeed it is very doubtful if bacillary dysentery is at all present in the Island but until further search has been made this statement should not be taken as final.”¹⁸

However, subsequent investigations carried out by Costa Mandry and Garrido Morales in 1930⁶, demonstrated that the epidemic of dysentery which followed the big hurricane of September 13, 1928, was bacillary dysentery (Flexner type), as has also been proved by the investigations of Jordan and McBroom in 1930¹⁹, and the present study.

During 1930, Smetana (cited by Costa Mandry and Garrido Morales⁶), professor of Pathology of the School of Tropical Medicine of the University of Puerto Rico, under the auspices of Columbia University, made an autopsy (No. 321—March 1930) on a child one year and seven months old who had suffered from chronic enteritis which had been diagnosed

clinically as such at the Presbyterian Hospital of Santurce. At the autopsy it was demonstrated, pathologically and bacteriologically, that the case was one of bacillary dysentery, and a bacillus of the Flexner type was isolated.

In 1931, Costa Mandry and Garrido Morales⁶ published their studies of two epidemic outbreaks of bacillary dysentery (Flexner) occurring in Puerto Rico. The first of these two outbreaks followed the big hurricane of 1928 (San Felipe) and spread in the form of a big epidemic throughout the entire Island, but in greater extent and severity in the central and mountainous area in the northern and eastern portions. Lavandero⁶, medical officer of the Board of Health, appointed by that Institution to work on the control of the epidemic, presented in detail the clinical and epidemiological studies which he carried out in the towns of Comerío and San Lorenzo during the same epidemic. His findings correlated in every way with those of Costa Mandry and Garrido Morales.

The other outbreak was a small localized epidemic outbreak which occurred among the inmates of the Insular Penitentiary at Río Piedras.

An extract of the studies carried out in both epidemics is given further on in this paper.

During the year 1930, Jordan and McBroom¹⁹ carried on bacteriological studies on a number of fecal specimens from residents of Puerto Rico. Among the cases studied they found two which showed the presence of dysentery bacilli. From one, an enteritis patient, they isolated a bacillus which culturally resembled the Sonne bacillus, except that it fermented xylose and produced hydrogen sulphide. From a diabetes patient who had no gastro-intestinal symptoms, was recovered a bacillus regarded by them as belonging to the Flexner group. In the discussion of their findings they suggest that in tropical countries, such as Puerto Rico, where "enteritis" is frequently reported as a cause of death, particularly among children, systematic bacteriological examinations would show a considerable number of unrecognized typhoid infections and also many infections with various types of paratyphoid and dysentery bacilli. In conclusion they state that bacteria culturally identical with Sonne and Flexner types of dysentery bacilli were also found in several instances. Although these organisms did not show serological correspondence with the type strains with which

they were tested, it does not seem possible to deny them a place in the group of "dysentery bacilli".

II. EPIDEMIOLOGICAL AND BACTERIOLOGICAL STUDY OF THREE OUTBREAKS.*

EPIDEMIC OF 1928⁶.—Two weeks after the hurricane of September 13, 1928, information was received by Dr. Garrido Morales, then Epidemiologist of the Department of Health of Puerto Rico, to the effect that a large number of cases of a disease characterized clinically by gastro-intestinal symptoms, abdominal pain and diarrhea with blood and mucus, had appeared in a rural district of the town of San Lorenzo. Very soon reports were received to the effect that the same disease had made its appearance in the towns of San Lorenzo, Comerío, Caguas, Cidra, and Naranjito. The peak of the epidemic occurred during the month of November, when 1907 cases of the disease were reported in the following distribution: 527 in San Lorenzo (27%), 307 in Cidra (16.2%), 109 in Comerío (5.7%), 465 in Cayey (24.3%), 185 in Caguas (9.7%), and the remainder of the cases (17%) distributed in the other municipalities of the Island. The clinical course of the disease was characteristic and more or less alike in all the cases, pointing to a disease produced by an infectious agent. In the towns of Cayey and Cidra the disease was quite severe and it became necessary to establish an emergency hospital in coöperation with the American Red Cross to take care of the cases.

The first symptom noticed by those affected was abdominal pain and a feeling of tenderness to pressure generalized over the whole abdomen; fever was a constant symptom in practically all the cases, accompanied by headache and by diarrhea, with an average of 5 to 50 bowel movements in 24 hours, depending upon the severity of the individual case. The dejections were liquid, contained some fecal matter together with mucus and blood. In some of the cases burning and tenesmus were noticed. The symptoms lasted 5 to 15 days, the patient recovering in an apparently cured condition.

A complete epidemiological study was carried out, and of

* The epidemiological study was made by Dr. Garrido-Morales in two of the outbreaks and by Dr. Abel de Juan in the last one studied. We wish to acknowledge the credit due to them and to the field personnel of the Department of Health working under their direction.

the 936 cases of the disease which were studied in Caguas, Cayey and San Lorenzo, 71.9 per cent lived in the rural zone and 27.9 per cent in the urban zone.

The disease was particularly frequent in the towns in which tobacco was one of the main industries. Flies were very abundant in these towns, probably as a result of the destruction of the tobacco barns with the subsequent fermentation and decomposition of tobacco stored in these places.

During the fiscal year 1928-29, the year when the hurricane occurred, 6,473 cases of dysentery with 717 deaths were reported from the 77 municipalities of the Island. During the previous year only 192 cases with 73 deaths were reported due to the same cause. Sixty-three per cent of the deaths produced by dysentery during the year of the hurricane occurred in the towns of San Lorenzo, Cidra, Caguas, Cayey, Comerío and Naranjito, where the epidemic was most severe. It is interesting to note that the epidemic of 1928 was distributed in towns which were neighbors of those where the big epidemic of dysentery appeared after the hurricane of August 1899.

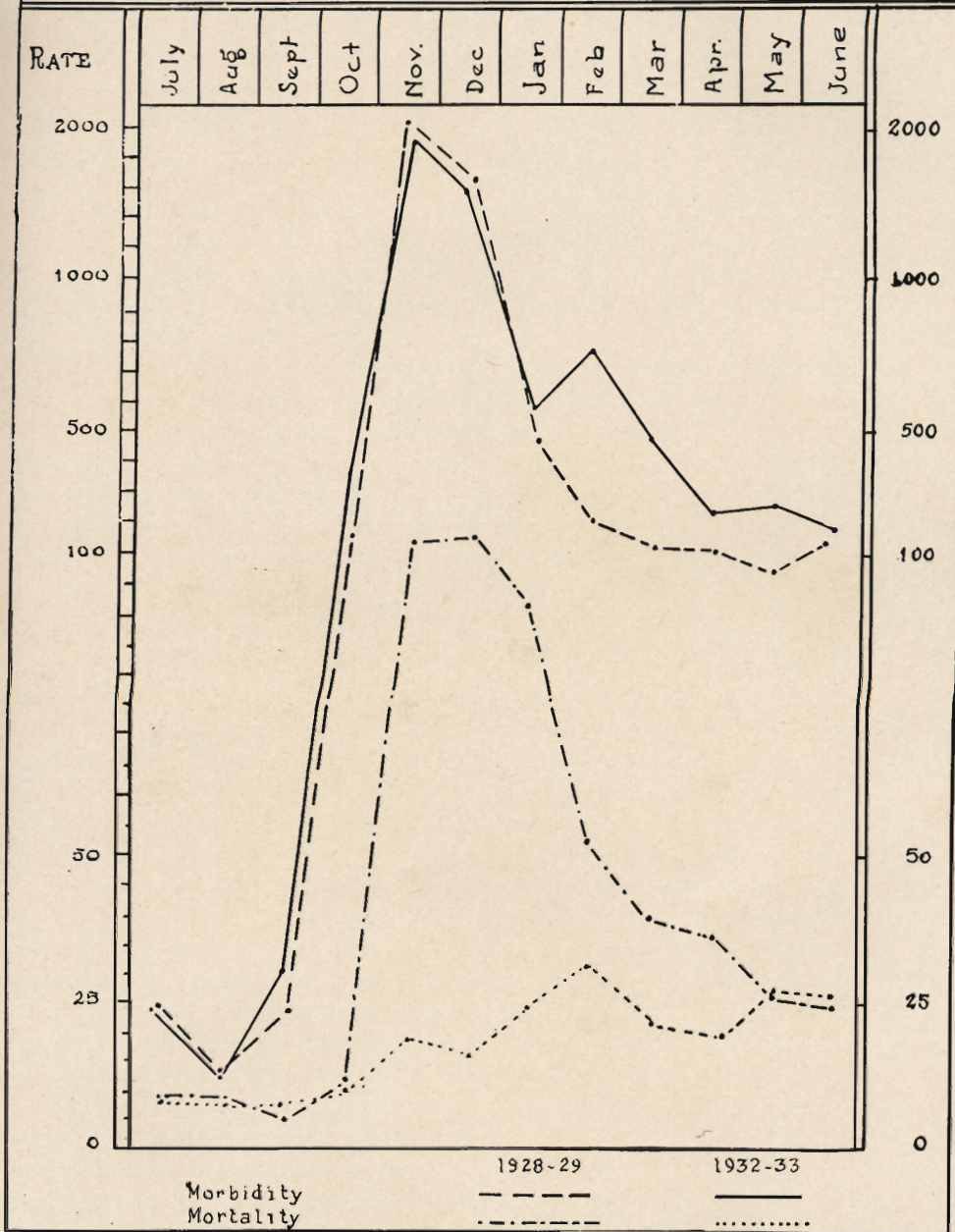
At that time the towns of Utuado, Corozal, Barranquitas, Aibonito, Ciales and Barros were most severely attacked, and the largest number of cases occurred during the months of October and November.

During the epidemic of 1928, the mortality curve and the morbidity curve (dysentery) followed a similar course, demonstrating that a decided part of the general mortality was due to the epidemic of dysentery (See Fig. I).

The destruction of houses, with the corresponding agglomeration of people, the diminished food supplies, the destruction of latrines and the lowered resistance of the population after the hurricane, can to some extent account for the spread of the disease throughout the Island; 76.8 per cent of the 936 cases studied occurred in persons living in the same house or in adjacent houses to dysentery cases, only 23 per cent in houses that were not in close proximity to cases of the disease, and 45 per cent of the cases occurred in houses in which other cases of the disease had been reported.

The feces of 137 of the cases were examined bacteriologically and microscopically. These specimens were sent to the Laboratory for examination and arrived 24 hours or

Fig 1. Morbidity and mortality curve (rate per 100,000 population, computed by months on annual basis) from Dysentery during the years 1928-29 and 1932-33.



more after their collection, making it more difficult to isolate dysentery bacilli from them, if present. In 18 of these feces we isolated a bacillus which culturally (sugar fermentations) and from its agglutination reactions with stock dysentery antiserum resembled an organism of the Flexner group. All the feces were examined microscopically and for ova of intestinal parasites, the great majority showed the presence of blood and mucus and in some instances, pus.

OUTBREAK IN THE NEW INSULAR PENITENTIARY ⁶.

Towards the end of July, 1930, the Division of Epidemiology of the Health Department of Puerto Rico was notified of the presence of an epidemic disease which had made its appearance in the new Insular Penitentiary at Río Piedras.

The disease was characterized by abdominal pain, tenderness to pressure over the abdomen, specially the lower half, fever, vomiting, and diarrhea accompanied by mucus and blood. The symptoms would last from three to ten days, more or less, the fever about three days and the disease itself about eight. From the beginning of the epidemic until the time we were notified, 27 cases had occurred. During the whole epidemic, out of the 192 prisoners who lived in the institution, 38 (19.2%) suffered from the disease, 71 per cent of the cases having occurred before health authorities were notified.

The evidence collected in the studies carried out pointed to an infectious agent as the cause of the outbreak.

Bacteriological examination of the feces of 18 cases was performed. In 12 of the cases (66.6%) a dysentery bacillus of the Flexner group was isolated. In the 6 cases in which no bacilli could be isolated, the feces were examined after the patient had been suffering with the disease anywhere from six to nineteen days. Bacteriological examinations of the feces from the four cooks of the camp revealed negative results in respect to dysentery organisms. It is of interest to know that the hygienic conditions of the camp—since the penitentiary had not been officially inaugurated—were very poor, there being ample opportunities for contamination of foods through individual contact or through flies which were extremely abundant in the neighborhood.

The feces were liquid or semi-liquid, contained a small

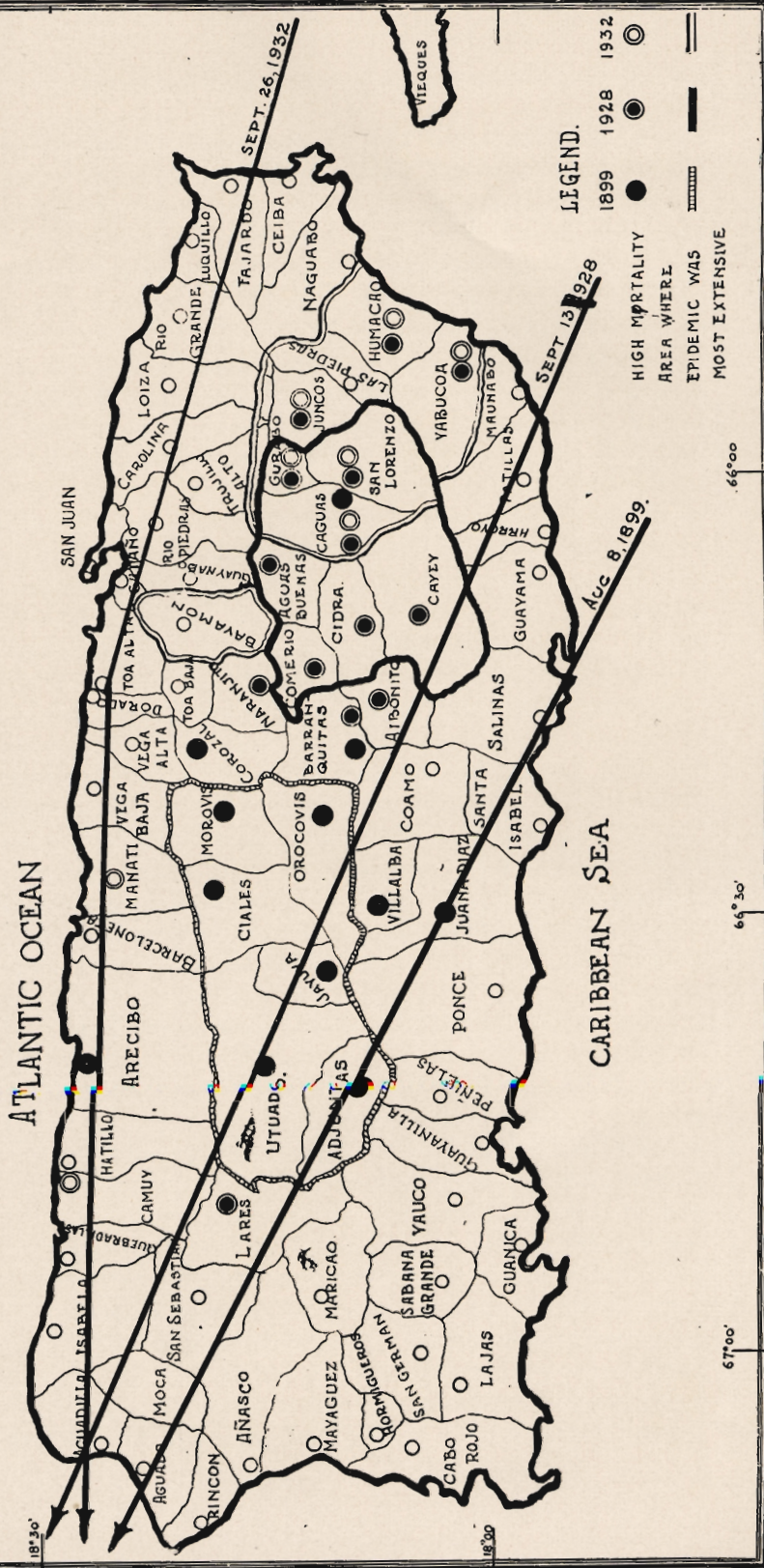
amount of fecal matter rather foul in odor, and an abundant amount of bloody mucus. No amoebae or intestinal parasites were found in the feces. After the isolation of dysentery bacilli from the feces of the first four cases which we studied, a subculture of two of them was sent to the National Institute of Health in Washington and to the Division of Laboratories and Research of the Department of Health of New York in Albany. The National Institute of Health confirmed our diagnosis in that the organism studied was found to be an *Eberthella paradysenteriae* Flexner. The Division of Laboratories of New York reported that the organism in question was a mannite fermenter of the dysentery group.

EPIDEMIC OF 1932.—On September 26, 1932, a severe hurricane swept over the east and northern portions of the island of Puerto Rico²¹ (See Fig. 2), causing the destruction of a great number of dwellings and bringing about the agglomeration of large groups of the population and a corresponding exposure of the people to the weather. In various localities of the Island epidemic dysentery made its appearance following the storm. Bacteriological and epidemiological studies of the epidemic were carried on by the Health Department of Puerto Rico. The epidemiological work was first directed by Garrido Morales, Epidemiologist of the Department, who prepared the epidemiological record sheets. After the work was planned and started, Dr. Garrido left the Department of Health, and Dr. A. de Juan, Chief of the Bureau of Transmissible Diseases, undertook the work. A summary of the data collected was presented before the Fifth Congress of the Pan American Medical Association at San Juan, Puerto Rico, March 26, 1934²⁰.

I. EPIDEMIOLOGICAL STUDY.—Since the hurricane of September 13, 1928, which was followed by a widespread epidemic of bacillary dysentery, the disease has prevailed in an endemic form in various localities of the Island, especially in San Lorenzo, where the epidemic of 1928 first made its appearance.

Two days after the hurricane of 1932, an abnormal number of cases of an acute disease similar in its manifestations to that of 1928 began to appear in the town of San Lorenzo. It was about two weeks later that the Department of Health

FIG. II. MAP OF PUERTO RICO SHOWING TOWNS WHERE EPIDEMIC DYSENTERY WAS MOST SEVERE AFTER HURRICANES OF 1899, 1928 and 1932 AND TRAJECTORY OF EACH STORM.



was notified as to the presence of this condition, which seemed to be rapidly spreading among the population of the town and into the rural districts. An investigation was immediately started and it revealed that the distribution of the cases with classical symptoms of bacillary dysentery was specially pronounced along the course of the river, Río Grande, which surrounds the city, and which had become the source of the water supply of part of the town since the public aqueduct was damaged by the storm. This, together with the sudden and explosive nature of the outbreak and its rapid extension, suggested water as the origin of the town cases. It was found that, before the hurricane, sporadic cases of a similar disease were prevalent in two rural districts of the municipality (Cayaguas and Hato), sections which were in close contact with the river basin. On account of the destruction of latrines, the people were forced to defecate in the open, and the heavy rains which followed the storm washed their excreta and that from the pits of the destroyed latrines, into the river. The disease was very prevalent among the rural areas, especially so in those along the course of the river. When the aqueduct was repaired and the chlorinating plant installed, the epidemic in the town subsided, but it had already attained great magnitude and had spread to neighboring towns. During a period of two months more or less, 398 cases of dysentery were registered in the town of San Lorenzo. The cases were especially common in the houses close to the river, the poorer section of the town, which used the river water; in the center of the town where the better classes live, well water was consumed and very few cases of dysentery occurred (See Fig. 3). The disease next appeared in Gurabo and Caguas; in the first town it was rather extensive and from there it rapidly spread to Juncos, Humacao and Yabucoa. The epidemic persisted in these localities of the Island for varying lengths of time, having followed a determined line of continuity. In Bayamón, a town rather distant from the first area of the epidemic, where overcrowding and unsanitary conditions prevailed, the disease also made its appearance in one of the poor sections (Vista Alegre) affecting a large number of people. Here the beginning of the epidemic was attributed to the unsanitary conditions prevailing in an emergency camp where about 300 refugees were collected. It appears that a case of dysentery, which