SPONTANEOUS ANEURYSM OF THE DORSALIS PEDIS ARTERY.

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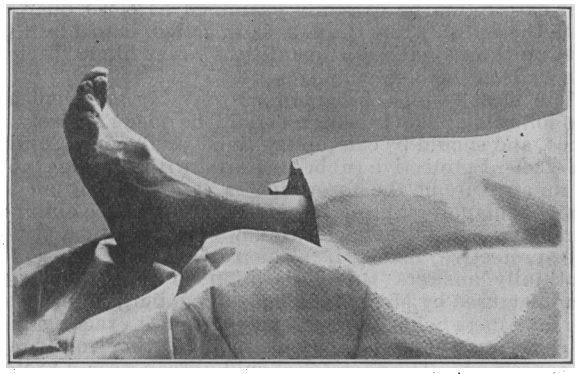
ANEURYSM of the vessels of the foot is of such rare occurrence (Chauvel, quoted by von Bergmann, could only collect the records of twenty such), and, when it does occur, is nearly always to be traced to definite trauma, that I have thought the history of the following case of spontaneous aneurysm occurring in my hospital practice worth recording.

The patient, a woman aged 53, had noticed a small swelling on the dorsum of her left foot for over two years. It had until the last four or five weeks given her very little inconvenience, but of late had been enlarging and had given her a good deal of pain. There had never been any injury of the foot, and no history of syphilis was to be obtained.



On the dorsum of the foot was a pulsating, expansile swelling about the size of a small walnut, over which the skin was slightly reddened and thinned. It presented all the typical and usual signs of aneurysm, and was situated towards the point of termination of the dorsalis pedis artery. The patient's arteries generally were slightly thickened, the pulse tension increased, and the second sound over the aortic valves accentuated. Nothing else abnormal was to be made out in her physical condition.

The treatment adopted was excision of the aneurysm, and the patient made a good recovery. Well-marked endarteritis of the resected portions of the artery was present, with very considerable thickening of its walls.

THE SCIENCE COMMITTEE

OF THE

British Medical Association.

REPORT CII.

UPON THE BACTERIOLOGY OF THE SUMMER DIARRHOEA OF INFANTS.

[SECOND COMMUNICATION.]

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SUMMARY OF LAST YEAR'S REPORT.

IN my previous report, which was published in the BRITISH MEDICAL JOURNAL of April 21st, 1906, a detailed account was given of my investigations into the bacteriology of the summer diarrhoea of infants in London during the course of the summer of 1905.

The non-lactose fermenting bacteria isolated from the stools or intestines of 58 cases of summer diarrhoea were compared with those isolated from the stools of 20 normal infants under 2 years of age. By this comparison it was possible to show that a certain bacillus pathogenic to animals, which has been designated by me as "No. 1 bacillus," was isolated in 28 out of the 58 cases of summer diarrhoea, whereas that bacillus was found in the stools of only 1 of the 20 normal cases, and even then its identity was doubtful, as in that case it was found to be non-pathogenic for experimental animals. The pathogenicity of Bacillus No. 1, which was isolated from cases of summer diarrhoea, was then tested by feeding experiments. A series of young rats and young rabbits were fed on various strains of the bacillus, half an agar tube being used in the case of the former, and one tube in the case of the latter, with the result that all the animals were attacked with diarrhoea and died within a few days, the bacillus being recovered from their spleens after death.

I made inquiries from Dr. Houston and also from Dr. MacConkey, both of whom had made extensive bacteriological examinations of water, sewage, human faeces and milk, as to whether either of them had ever isolated this bacillus from any of the above sources. They both very kindly looked up their notes, and were able to assure me that they had never isolated any such bacillus, and so far as I can ascertain the bacillus has not hitherto been described.

The characteristics of this bacillus are very distinctive. It is a motile rod about the size of the *Bacillus enteritidis* of Gaertner, it is non-sporebearing, does not liquefy gelatin, and gives a negative reaction on broths containing mannite, dulcite, lactose and cane sugar, but produces acid and a small amount of gas on glucose broth. The fact of its producing acid and gas on glucose broth, and not on mannite broth, brings this bacillus into a comparatively small group, the only important pathogenic member of which is the hog cholera bacillus of McFadyean from which, however, it is easily differentiated by other tests.

These results aroused the suspicion that this bacillus might be an important factor in the causation of the summer diarrhoea of infants, and this suspicion was strengthened by the fact that it was isolated in pure culture from the stools of one of the nurses who had contracted diarrhoea in the ward set apart for this disease in the Hospital for Sick Children, Great Ormond Street.

In view of the importance of the results obtained from one year's investigations, it seemed advisable to continue the work on the same lines during another summer epidemic. I therefore wrote to the authorities at the Hospital for Sick Children, Great Ormond Street, who very kindly promised to supply me with specimens for another year. Dr. Batten also undertook to supply the stools and *post mortem* specimens from the ward set apart for diarrhoea at that hospital, independently of whether he diagnosed them as suffering from summer diarrhoea or not, at the same time withholding his diagnosis until after the bacteriological examination.

THIS YEAR'S RESEARCH.

During last summer (1906) 54 cases from the special ward set apart for diarrhoea at the Hospital for Sick Children, Great Ormond Street, were examined bacteriologically in the same manner as during the previous year, except that on this occasion the spleens and mesenteric glands were examined as well as the stools and small and large intestines.

METHODS ADOPTED FOR THE ISOLATION OF THE BACTERIA.

A small portion of material, either from the faeces or scrapings from the mucous surface of the small or large intestine, was transferred to a tube of sterile peptone beef broth and an emulsion made; from this the bile-salt-neutral-red-lactose-agar plates of MacConkey were inoculated, and incubated for twenty-four hours at 37° C. In the examination of the spleens and mesenteric glands, the outside of these organs was previously sterilized in a Bunsen flame, and a small portion taken from the inside and rubbed direct on to the lactose agar plates, which were then incubated. On the following day all the colourless colonies—that is, the non-lactose fermenters—were picked off, and put into tubes of lactose broth. These tubes were then incubated for five days at 37° C., at the end of which time all those that had not produced acid and gas were retained and the rest discarded. The former were then used to inoculate gelatine tubes, and set aside for future investigation. In the numerous instances where no colourless colonies were to be found on the agar plates, the same material, which had been kept frozen in the cold room, was used for reinoculating fresh agar plates.

TABLE I.

Nomenclature.	Morphology.	Glucose.	Mannite.	Dulcite.	Lactose	Cane Sugar.	Litmus Milk.			Indol.	Sorbite.	Gelatine	No. of Cases in which Found.
							1 Day.	3 Days	15 Days.				
1	M. B.	A. G.	—	—	—	—	0	0	Alks.	+	—	—	19
3	N. M. B.	A.	A.	—	—	—	0	0	0	+	A.	—	3
4	N. M. B.	A.	A.	—	—	—	0	0	0	—	—	—	1
4A	N M. B.	A.	A.	—	—	—	A.	A.	A. C.	—	—	—	5
4B	M. B.	A.	A.	—	—	—	A.	0	Alk.	+	—	—	1
4C	M. B.	A.	A.	—	—	—	A.	0	Alk.	—	—	—	1
5	M. B.	A.	—	—	—	—	0	0	Alks.	+	—	—	4
6	M. B.	A. G.	A. G.	A. G.	—	—	A.	0	Alk.	—		—	4
7	M. B.	A. G.	A. G.	A. G.	—	—	A.	Alk.	Alk.	+		—	4
7A	N. M. B.	A. G.	A. G.	A. G.	—	—	A.	0	A. C.	+		—	1
10	N. M. B.	A. G.	A. G.	A. G.	—	A. G.	A.	A.	A. C.	+		—	1
11	M. B.	A. G.	A. G.	A. G.	—	A. G.	0	0	Alk.	+		—	2
11A	M. B.	A. G.	A. G.	A. G.	—	A. G.	A.	A.	Alk.	—		—	3
11B	M. B.	A. G.	A G.	A. G.	—	A. G.	0	A.	A. C.	+		—	1
13	M. B.	A. G.	A. G	—	—	A. G.	A.	A.	A. C.	+		—	3
13A	N. M. B.	A. G.	A. G.	—	—	A. G.	A.	A.	A. C.	+		—	2
14	M. B.	A. G.	A. G.	—	—	—	A.	A.	Alks.	+		—	1
14A	N. M. B	A G.	A. G.	—	—	—	A.	Alk.	Alk.	+		—	3
14B	M. B.	A. G.	A G.	—	—	—	A.	A.	A. C.	+		—	3
14C	N. M. B.	A G.	A. G.	—	—	—	A.	0	A. C.	+		—	2

TABLE II.

Bacterium.	Morph.	Glucose	Mannite	Dulcite.	Lactose.	Cane Sugar	Litmus Milk.			Litmus Whey.		Indol.	Sorbite.
							1 Day.	3 Days.	15 Days.	1 Day.	7 Days.		
B. dysentery, Flexner, Philippines	B Non-motile	A.	A.	—	—	—	A	Alks.	Alks.	A.	Alks.	+	—
B. dysentery, Shiga ..	,,	A.	—	—	—	—	A	Alks.	Alks.	A.	Alks.	—	
B. typhoid	B. Motile	A.	A.	—	—	—	A.	A.	A.	A.	A.	—	A.
B. enteritidis, Gaertner..	,,	A. G.	A. G.	A. G.	—	—	A.	Alk.	Alk.	A.	Alk.	—	
B. paratyphoid B, Schottmüller	,,	A. G.	A. G.	A. G.	—	—	A.	Alk.	Alk.	A.	Alk.	—	
B. paratyphoid A, Schottmüller	,,	A. G.	A. G.	A. G.	—	—	A.	A.	A.	A.	A.	—	
B. hog cholera, McFadyean	,,	A. G.	—	—	—	—	A.	A.	A.	A.	A.	+ Slight	

A. = Acid. G. = Gas. C. = Clot. S. = Slight. — = No reaction. M. B. = Motile bacillus. N. M. B. = Non-motile bacillus.

It was thought advisable to continue the use of the lactose agar plates this year, in order to isolate as many of the non-lactose fermenters as possible, so as to compare the relative frequency of each species. If, however, Bacillus No. 1 had been looked for exclusively, mannite agar plates would have been more serviceable, since that bacillus does not ferment mannite. But if this method had been adopted, the frequent occurrence of some other organism might have been overlooked, since the non-mannite fermenting group of bacilli is relatively smaller than the non-lactose fermenting one.

The next step was to examine all the cultures that had not liquefied gelatine at the end of six weeks, and to cultivate them on the various media used for differentiation—namely, broth containing glucose, mannite, dulcite, lactose, cane sugar, and litmus milk—to examine their morphology, motility, etc., and their capability of producing indol in peptone beef broth when incubated for five days.

In Table I is shown the results of the examination of the morphology and cultural characteristics of sixty-seven organisms of the lactose non-fermenting class isolated from the spleens, mesenteric glands, intestines, or faeces of infants suffering from diarrhoea.

Table II gives the characteristics of some of the known pathogenic intestinal bacteria.

Bacillus No. 6.—It will be seen on comparing the two tables that this bacillus, which was isolated from four patients after death, resembles the *Bacillus enteritidis* of Gaertner, and it was subsequently proved by its agglutination reactions to belong to this group.

Bacilli Nos 3 and 4.—There is a partial resemblance between these bacilli and the Philippine dysentery bacillus of Flexner. No. 3, however, differs in its reaction on sorbite, on which it produces acid, whereas Flexner's bacillus does not do so, and No 4 does not produce indol, whereas Flexner's bacillus gives a well-marked indol reaction. Bacilli Nos. 3 and 4 also both fail to agglutinate with dysentery serum (Flexner).

Bacillus No. 5 resembles the *Bacillus dysenteriae* of Shiga in its cultural reactions, but differs in its distinct motility and its absence of agglutination with antidysentery serum (Shiga).

Bacillus No. 1, as was pointed out in my last year's report, resembles no other known pathogenic organism, except the bacillus of hog cholera of McFadyean, from which it differs, however, in its alkaline reaction on litmus milk, its greater production of indol, and its failure to produce acid and gas on arabinose, maltose, and dextrin.

As regards the cultural reactions of No. 1, a considerable amount of variation was found in the degree of alkalinity produced in various batches of litmus milk. The amount

of gas produced in glucose broth also varied considerably, certain strains of this bacillus producing so little gas that the Durham's tube failed to catch any, and it was only by making a glucose agar shake culture that the production of gas could be determined.

The use of glucose agar shake cultures seems to be important when looking for this organism, in order to differentiate it from Bacillus No 5, which culturally closely resembles it, except that it produces acid, but no gas on glucose. The gas-producing power of Bacillus No. 1 on glucose media seems to be decreased by its being kept for some time on artificial media. It has been observed that cultures which shortly after their isolation gave a measureable amount of gas in the Durham's tube failed to do so after eighteen months' growth on artificial media. When, however, agar shake cultures were made from them, their gas production became quite evident.

MATERIAL FROM WHICH BACILLI NOS. 1 AND 6 WERE ISOLATED.

Bacillus No. 1 was isolated from the stools of 16 cases, from the scrapings of the large intestines of one case, from the scrapings of the large and small intestines of one case, and from the mesenteric glands and large and small intestines of another. It was never found in the spleen of any case examined, which was disappointing in so much as it had been invariably found present in the spleens of young rats and young rabbits fed on it experimentally. It will be seen later, however, that invasion of the mesenteric glands and spleen did not occur in feeding experiments on monkeys.

Bacillus No. 6, or the Gaertner type of bacillus, was isolated from the spleens and mesenteric glands in 3 cases, and from the spleen only in the fourth case.

RELATIVE FREQUENCY OF THE BACILLI ISOLATED: PREPONDERANCE OF BACILLUS NO. 1.

Material from 54 cases was examined, and of these 27 had been diagnosed clinically as being due to acute infective diarrhoea, 7 to catarrhal diarrhoea, 2 to Gaertner infections, and the remaining 18 to various ailments complicated with diarrhoea.

Bacillus No. 1 was isolated from 12 out of the 27 acute infective diarrhoea cases, and from 3 of the 7 catarrhal diarrhoea cases; in other words, this bacillus was isolated in 15 out of 34 cases of summer diarrhoea, giving it a large preponderance over any other bacillus isolated. The bacillus which held the second place in frequency of occurrence was No. 4a, which was found in only 5 cases out of the 54 examined.

Bacillus No. 1 was also found in 4 out of the remaining 18 cases, the 4 in which it was found having been diagnosed clinically as being due respectively to marasmus, tuberculosis and diarrhoea, cleft palate and diarrhoea, and bronchopneumonia and diarrhoea. Considering, however, that these 4 cases were complicated with diarrhoea, and were taken from the ward set apart for that condition, it is not surprising that this bacillus should have been isolated from their stools.

AGGLUTINATION REACTION EXPERIMENTS.

The agglutination of certain of the bacilli was tested with serums obtained from animals immunized with known pathogenic micro-organisms.

Bacilli Nos. 3 and 4 were tested with the Lister Institute dysentery serum, which gives a reaction with dysentery bacilli in a dilution of 1 in 100,000; but no reaction was obtained with either No. 3 or No. 4 in a dilution of 1 in 1,000, which, together with their slight difference in cultural characteristics from Flexner's dysentery bacilli, excluded the possibility of their belonging to that group.

The four strains of Bacilli No. 6 were next tested against the serums of three rabbits immunized against the *Bacillus enteritidis* of Gaertner, the *Bacillus enteritidis* of Aertrycke, and the *Bacillus paratyphoid* B. of Schottmüller respectively. These serums agglutinated their own bacilli in a dilution of 1 in 2,000. Two of the strains of No. 6 gave a distinct reaction with Gaertner serum, and two with the Aertrycke serum, in a dilution of 1 in 2,000, but all failed to give any reaction with the paratyphoid B. serum.

The inter agglutination of the various strains of Bacillus No. 1 was next investigated. A rabbit was immunized by intravenous injection with the bacillus isolated from Patient No. 33, and a serum was obtained which agglutinated this bacillus in a dilution of 1 in 2,000.

TABLE III.—*Agglutination of Various Strains of Bacillus No. 1, with Serum Agglutinating Strain 33 M in a Dilution of 1 in 2,000.*

Strain of Bacillus.	Dilution of 1 in 20.	Dilution of 1 in 200.	Dilution of 1 in 2,000.
33 M	3	3	3
7	3	3	0
12	3	3	0
15	3	3	2
16	3	0	0
19	0	0	0
22	3	2	0
26	0	0	
28	0	0	
30	0	0	
33	3	3	2
36	3	0	0
41	0	0	0
44	0	0	0
46	3	3	0
47	3	3	0
51	3	3	2
52	3	3	2

3 = Complete reaction; 2 = distinct reaction; 1 = slight reaction.

It will be seen from Table III that of the 17 strains of Bacillus No. 1 which were investigated, 4 were agglutinated in a dilution of 1 in 2,000, 5 in a dilution of 1 in 200, 2 in a dilution of 1 in 20, and 6 failed to react at all. Very similar results to these were obtained last year from the various strains of this bacillus isolated during the previous summer.

THE PATHOGENICITY OF THE BACILLI ISOLATED FROM THE PATIENTS.

One of the two bacilli which were so readily agglutinated by the serum made by the injection of Aertrycke bacilli, and classed under No. 6, was injected subcutaneously into a rabbit in the dose of ¼ c.cm. of a

TABLE IV.

No. of Case from which Bacillus was Isolated.	Experimental Animal.	Dose.	Diarrhoea.	Died No. of Days after Experiment.	Bacillus Recovered from Spleen.
7	young rat	½ agar tube	?	8	0
12	,,	,,	?	9	0
15	,,	,,	+	19	+
16	,,	,,	?	12	0
19	,,	,,	+	3	0
20	,,	,,	+	11	0
22	,,	,,	+	2	+
26	,,	,,	+	11	+
28	,,	,,	+	10	+
30	,,	,,	+	3	+
33	,,	1 agar tube	+	1	+
35	,,	,,	+	1	+
36	,,	,,	+	1	0
41	,,	,,	?	lived	—
44	,,	,,	?	6	0
46	,,	,,	+	1	0
47	,,	,,	+	1	+
51	,,	,,	+	2	+
52	,,	,,	?	lived	—

24-hours old broth culture, for the purpose of immunization, with the result that the rabbit died on the sixth day, and the organism was recovered from the heart blood, thus proving that this organism is a virulent race of the Aertrycke bacillus.

In order to test the virulence of the various cultures of No. 1 bacillus, each of these was used for feeding experiments on young rats. Half an agar culture of each of the nine different strains of No. 1 was used for feeding nine young rats, one rat being used for each strain, and an equal number of control rats being kept. In the next experiment young rats were fed on the remaining ten strains of No. 1, a whole agar culture in this case being used for each rat, an equal number of control rats being kept. Table IV shows the result of these experiments.

It will be observed that all the rats died with the exception of two, in which case the experiment was repeated three times with fresh rats with the same result, showing that these two strains of No. 1 were of a lower virulence for rats than the rest.

Diarrhoea was observed in 12 out of the 19 rats, but its occurrence in the others might easily have escaped detection. The bacillus was recovered from the rats' spleens after death in 9 cases out of the 19; it was not looked for in any of the other organs.

It was then thought that monkeys, being more closely allied to human beings, might be more suitable than rats as experimental animals. Four small full-grown monkeys were fed on one agar tube of Bacillus No. 1. A different strain was employed for each monkey. The results of these experiments are shown in Table V.

TABLE V.

No. of Case from which Bacillus was Isolated.	Experimental Animal.	Dose.	Diarrhoea No. of Days Before Death.	Died No. of Days After Experiment.	Stools or Organs from which Bacillus was Recovered.
35 R	Monkey	1 agar tube	1 day	3	Bile.
35	,,	,,	2 days	12	Faeces and small intestine.
30	,,	,,	6 days	8	Faeces 3rd and 7th day. large and small intestines.
52	,,	,,	3 days	15	Faeces 13th day.

It will be observed that the onset of the diarrhoea varied from two to twelve days after the feeding. The bacillus was recovered from all four of the animals after the onset of the diarrhoea, from three after death, and from the faeces of three after the onset of the diarrhoea. The bacillus was not found in the spleens of these animals, a condition analogous to that found in infants suffering from summer diarrhoea.

It will be seen that Strain 52, which proved non virulent for rats, produced diarrhoea and death in a monkey, the only difference from the other strains being that the incubation period before the onset of the diarrhoea was longer.

The condition produced in monkeys by these feeding experiments closely resembled infective diarrhoea in infants, the diarrhoea being acute and progressive in severity, accompanied by rapid emaciation followed by death. No vomiting was observed in any of the monkeys. Control monkeys kept under identical conditions remained quite healthy all the time.

The virulence of Bacillus No. 1 was also inadvertently tested on a goat, which for the purpose of immunization had been injected intravenously with an agar culture of a strain of that bacillus, which had been isolated from the mesenteric glands of a child that had died of acute infective diarrhoea. The goat died in about eighteen hours, and the bacillus was recovered from the heart blood, spleen, and liver. Considering that a rabbit not one-twentieth part of the weight of this goat had been successfully immunized with half the dose of the same culture of Bacillus No. 1 intravenously injected, this experiment points to the much greater susceptibility of the goat to this organism.

CONCLUSIONS.

In the course of the present investigation into the bacteriology of summer diarrhoea, there has been isolated a bacillus, designated Bacillus No. 1, which, so far as I have been able to ascertain, has not hitherto been described, and which appears to me to be entitled, in the absence of further knowledge, to be regarded as a factor, perhaps the most important factor in the causation of the disease. The reasons on which this conclusion is based are as follows:

It has never been isolated in any other morbid condition, nor has it been observed in water, milk, sewage, or human faeces.

In all the cases of the disease examined during two consecutive summers, it was found to preponderate in frequency over all other non-lactose fermenting bacilli—for example, out of 58 cases examined during the summer and autumn of 1905 it was isolated from 28, and out of 34 cases in 1906 it was isolated from 15 cases.

It is pathogenic for animals, producing diarrhoea and death in young rabbits, rats, and monkeys, when these animals are experimentally fed on cultures.

It differs from the bacillus of hog cholera of McFadyean, to which it appears to be most closely allied, in its reaction on litmus milk, in the production of a larger amount of indol, and in its failure to produce acid and gas on arabinose, maltose, and dextrin.

It is probable that the difficulties of clinical diagnosis in such a condition lead to the classification under one name of cases due to different micro-organisms. An analogy to this is seen in the case of enteric fever, under which all cases now designated as paratyphoid were till recently included.

It is improbable, from the bacteriological standpoint, that a sharp line of demarcation should be found to exist between acute infective diarrhoea and catarrhal diarrhoea in infants, and this is borne out by the results obtained in the present investigation.

In one case of acute infective diarrhoea the *Bacillus enteritidis* of Gaertner was isolated from the spleen and mesenteric glands, and it seems probable that other allied micro-organisms which produce a condition with even less marked clinical features (than does that organism) may not infrequently be involved in the production of what is designated clinically "infective diarrhoea of infants."

It is remarkable that again this summer no bacilli of the true dysentery Flexner type were found, whilst Duval and numerous workers at the Rockefeller Institute found that organism to be the causal agent of the disease in America.

It is true that bacilli somewhat resembling *Bacillus dysenteriae* (Flexner) were isolated from four cases, but they were not culturally identical with any of the various types of this bacillus, nor were they agglutinated by anti-dysentery (Flexner) serum.

This emphasizes what was said in my last year's communication, that the type of summer diarrhoea of infants in America appears to be clinically and bacteriologically different from that which occurs in this country.

My thanks are due to Dr. Batten, who took the greatest interest in this research, and for the second summer supplied me with the material from the Hospital for Sick Children, Great Ormond Street; also to Dr. Dean and Dr. Boycott, of the Lister Institute, for their most valuable assistance and advice.

MEMORANDA:
MEDICAL, SURGICAL, OBSTETRICAL

AMBIGUOUS REACTIONS IN SUGAR TESTING.

THE article by Dr. Maclean in the BRITISH MEDICAL JOURNAL for June 22nd, On the Causes and Significance of Certain Ambiguous Reactions Obtained in Testing Urine for Sugar, is of great clinical interest, more especially to general practitioners, who have not the time to devote to prolonged urinary tests, and who no doubt are frequently puzzled by these doubtful reactions.

My object in writing this letter is to draw attention to a test described some few years back, which may be performed rapidly and appears to be a reliable confirmatory test after doubtful reactions with Fehling's solution. The test I have used regularly in asylum practice in examining the urines of new acute cases of insanity where sedative