Remarks

ON

INFECTION BY *B. COLI* IN THE PUERPERIUM,
AND ON THE INFECTIVE CONDITIONS
OF PREGNANCY.

BY

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FEVER during the puerperium is perhaps the cause of more anxiety to the medical practitioner than anything else, and the point of greatest importance at the outset of such cases is to determine the cause, and, if this be of an infective nature, to isolate the organisms with a view to specific treatment.

Etiologically, we may recognize two main groups according as to whether the cause be avoidable, as, for example, in septicaemia, or unavoidable, as in autogenous infections. Here we do not propose to deal with the septicaemic states, in which, though the methods of examination are the same, unfortunately the prognosis is less favourable. Our object is to place on record three striking examples of autogenous infection which we think will be instructive, inasmuch as they have been worked out both from a clinical and pathological aspect from the inception to the termination of the disease.

In many cases of infection which fall under the notice of the general physician the picture is incomplete as regards the onset of the disease, but, in such conditions as the obstetrician meets, this is not the case.

Furthermore, we are of the opinion that, notwithstanding the general acceptance, there is room for some widespread enlightenment on the subject, for of all infective states and acute pyrexias, perhaps these autogenous infections herein exemplified hold out more hope of speedy amelioration after proper diagnosis; indeed, the improvement and frequently the cure is often startling in its rapidity.

As a result of much work on the subject in recent years, the possibility of autogenous infection is now well recognized. Bacteria which normally inhabit certain parts of the body as saprophytes can, under favourable conditions of environment, acquire virulent characters, so that we find the streptococcus or the *B. coli* or the *B. pyocyaneus* (a less frequent inhabitant of the alimentary tract) at times settling down on a diseased endocardium or kidney or other part of the urinary tract and initiating pathological processes. It may be taken that the organisms are constantly entering the blood stream in some numbers, but, under ordinary conditions of health, are easily overcome by the defensive agents. But sometimes these bacteria may settle down to a saprophytic existence in parts of the body usually free from them, so that it is possible for the *B. coli* to live in the female bladder for long periods without producing any disturbance; such probably occurred in Case II of our series.

It is obvious that infection will depend on two factors—namely, the presence of the bacterium, which is a constant factor, and the resistance of the host, which is a variable factor; in conditions of health we find that even the more usually recognized pathogenic bacteria such as the pneumococcus or, less frequently, the diphtheria bacillus, can exist in a harmless state. In normal conditions the balance between these two factors is well maintained.

In pregnant and puerperal women a focus of diminished resistance is met with in the kidneys, taxed often to their utmost with the extra work thrown on them; consequently, infective nephritis is often encountered—so frequently as to have merited the title of “pyelonephritis of pregnancy” *—a suppurative lesion of one or both kidneys,

incited by the *B. coli* for the most part, though occasionally by other organisms, associated with fever and pyuria, and often fatal either during the course of pregnancy or in the puerperium. The lesions noted are often extensive destruction and abscess formation of one or both kidneys.

In more favourable cases the infection is restricted to the bladder, and it is important always to determine whether such is the case. During parturition the bladder is liable to mechanical damage of varying degree, so that here again there is a site of diminished resistance which favours the lodgement of bacteria which have been imported, or the exaltation of bacilli that are already present in the bladder.

B. coli is undoubtedly by far the most frequent cause of infection in these conditions, though other organisms, such as the *B. proteus*, staphylococcus, etc., may occur. The source of infection is the intestines, and there is experimental evidence to show that constipation aids the process.

There are several possible channels of infection. It may be by the blood stream, or the bacteria may spread from the exterior along the urethra to the bladder and again along the lymphatics: indeed the female urethra has been shown to possess a constant bacterial flora; it is highly suggestive also in some cases that the bacteria spread directly from the intestines to the bladder. In pyelonephritis it is most likely that infection is of haematogenous origin, whilst in cystitis, perhaps, the ascending infection is the rule, though the direct spread is probable, and, of course, it may be secondary to a renal infection. In many cases of acute *B. coli* cystitis in female children the ascending infection is certainly the most probable.

Now, although the *B. coli* is of intestinal origin, it is important to note that the organisms as found in the urine do not present the typical characters of *B. coli*. It is now well recognized that change of environment produces variations such as are met with, and consequently there are numerous varieties of atypical *B. coli*, so that in carrying out bacteriological investigations in these cases it is not necessary to adopt hair-splitting means of identification.

Symptoms.

Where there exists disease of the bladder or the kidneys the manifestations are fever of indefinite duration, often rigors, and invariably the urine is of high acidity, containing pus and swarming with bacilli. The urine is so acid as to produce scalding in passage. Though the pyrexia may continue for some time, the patient does not manifest general symptoms of such severity as are met with in septicaemia; nor can micro-organisms be found in the blood stream by cultural methods. The condition is one of toxæmia. There is but slight leucocytosis, though in more extensive diseases of the kidneys, where abscess formation is advanced, this may be more marked.

Diagnosis.

The diagnosis of the condition is not difficult; it is futile to rely solely on the clinical manifestations, for the sooner pathological aid is invoked, and the earlier the infection is defined, the more likely will be the patient's chances of recovery. The diagnosis must be made between bacilluria, sapraemia, septicaemia, and septic phlebitis. In all these the course of procedure is the same. Swabs should be taken from the cervical canal and the interior of the uterus, whilst at the same time a catheter specimen of urine should be taken and blood examinations proceeded with. A morphological examination of the blood will reveal the leucocytosis that accompanies inflammation, and purulent accumulations; by blood cultures the micro-organisms in cases of general septicaemia (for the most part streptococci) can be rapidly obtained, and by examination of the urine the characteristic findings in *B. coli* infections—namely, acidity, pyuria, and bacilluria—can be immediately determined, whilst, by cultural methods, the *B. coli* itself can be readily grown. In addition, though merely of corroborative evidence and in no way delaying the treatment, serological methods of diagnosis may be adopted, in order to show the specific relationship between the organism and the disease; in some cases an agglutinative reaction is well developed, and in one of our cases the serum agglutinated the *B. coli* in question when diluted up to four-hundredfold. Though

* Three Cases of Pyelonephritis of Pregnancy (with literature), by Carling and Bernstein, *Westminster Hospital Reports*, vol. xv, 1907.

in others no agglutination reaction can be obtained, yet it is highly probable that by applying more exact serological methods of diagnosis more constant results will be obtained.

Prognosis.

The course of the disease is very variable. Provided one is not dealing with pyelonephritis associated with pregnancy, the condition is not of such gravity as in infections originating in the uterus. It is possible that by general treatment alone these cases may drag on for many weeks and ultimately recover, as no doubt must have occurred in earlier days without the true significance of the infection being determined. It was indeed generally recognized that the severity of puerperal fever had a direct bearing on the time of onset, the most severe cases starting in from one to three days after labour, whilst the onset of the more hopeful cases was often delayed from one week up to as long as three weeks (Case II). With these latter must now be grouped the infections that we recognize as originating in the urinary tract.

It is evident that with modern methods we have eliminated to a large extent the uterine infections which we have already grouped under the heading of avoidable infections, and now with our present knowledge it seems that by prophylactic methods we may be able to avoid or control the infections arising in the urinary tract.

We may summarize the results of treatment under three groups: (1) Cure may result and the bacilli disappear from the urinary tract; or (2) the symptoms may be relieved and the bacilli disappear so long as the patient is kept under treatment, but it will be necessary to give prophylactic doses of vaccines at increasing intervals of time; or (3) the condition may subside and the bacteria continue to inhabit the bladder as harmless saprophytes.

Treatment.

Recognizing, then, that urinary infections may cause serious complications both in pregnancy and during the puerperium, the earlier the condition is determined the better. We have pointed out that the *B. coli* may be present in the bladder for years, and often there is a history of bladder trouble of long standing; no doubt in two of our cases attacks of "ague" were due to transitory exacerbations of such a condition.

So, then, in all cases of pregnancy, and especially in primiparae, if there be symptoms pointing to bladder irritation, or a previous history of so-called ague or malaria, the bacterial examination of a catheter specimen of the urine is indicated. If a condition of bacilluria be found, then a prophylactic course of vaccines is called for, and may prevent serious complications later on.

As regards treatment of the actual infection itself during the puerperium, there can be no doubt that autogenous vaccines give by far the best results. In puerperal fever there has been a tendency to administer immediately antistreptococcus serum; but, though

this may give favourable results occasionally in puerperal septicaemias, it is obvious that it can be of no use in *B. coli* infections.

It is certain that the stock *B. coli* vaccines are not nearly so efficacious as are the autogenous vaccines, for we have already said that the bacillus alters its characters with its environment, and it is usually one of the many atypical varieties of the *B. coli* which causes the infection. In Case I of our series no improvement followed the administration of a stock *B. coli* vaccine. It may be urged that there must be delay in preparing an autogenous vaccine; but, then, there is no extreme urgency in these infections, and it is possible to hasten the process so that the first dose may be given in less than twenty-four hours.

Urotropin, or washing out the bladder, sometimes gives local relief, but in Case II neither of these methods was adopted, whilst in Case I they had already been tried prior to the vaccine without success, although the bacterial content of the urine was so lessened that a cursory bacterioscopic examination of the urine failed to reveal any of the organisms; as it happened, however, a culture was readily obtained. It is possible that the urotropin may interfere with the growth of the organisms in some cases, and so interfere even with an accurate diagnosis.

The result of vaccine treatment is, as a rule, rapid, and after the first dose even the temperature may fall and the toxic symptoms be relieved, whilst the bacteria may disappear from the urine. But even so, one must be guarded in giving a prognosis of rapid return to health or in discontinuing the treatment too soon; for, though it is easy to control the bacterial activity, in some cases it is difficult and occasionally impossible to entirely inhibit them. Consequently, the vaccines should be continued in increasing doses at increasing intervals of time for several weeks and the further treatment controlled by periodical examinations of the urine. This is well shown in Case II, in which, after ceasing treatment for some weeks, the patient suffered an acute outburst of bacterial activity, which was immediately checked by recourse to the vaccine; two months later, though she appeared perfectly well, a few bacilli were still to be found in the urine, and at present she is under observation.

CASE I.—Primipara, aged 40. (See Chart 1.)

Previous History.—Except that four years ago she was somewhat seriously ill in Italy with a form of "low fever" she was perfectly healthy. An examination of the urine had shown a very slight cloud of albumin on boiling; the reaction was acid; the frequency of micturition was not increased, and there was no other symptom pointing to bladder or kidney trouble.

Parturition.—Labour commenced soon after 9 p.m. and went on normally until 1.30 a.m., when she was seized with intense bladder tenesmus, passing water every two or three minutes, and suffering such severe pain that a hypodermic injection of scopolamin and morphine was given, and the bladder gently irrigated with warm boracic solution. This treatment relieved the urgent symptoms, but

CASE I.—A, Antistreptococcus serum given. B, Stock mixed *B. coli* and streptococcus vaccine. C, Autogenous *B. coli* vaccine given in doses of 10, 25, 32, 50, and 100 million. The chart dates from the time of parturition, and after the thirtieth day there was no further pyrexia.

she became very hysterical when the effect of the morphine began to wear off, and at 6.30 a.m., the os being fully dilated and the head well engaged, forceps were applied, and the child delivered easily.

After-History.—Recovery was normal until the fourth day, when the temperature rose to 100°, and she had another severe attack of bladder tenesmus lasting about two hours, and not relieved until the bladder was again irrigated with boracic solution.

Fifth day. Temperature 99°. Lochia sweet and plentiful, urine passed every three hours, but no severe pain.

Sixth day. Slight rigor with temperature 102°, some frequency of micturition, lochia normal.

Seventh to tenth days. Swinging temperature, 97° to 103°. Although the lochia still appeared to be normal, the patient

was given an anaesthetic, and while in the lithotomy position a careful examination was made to see if there was any pelvic cellulitis. Everything was quite normal, but swabs were taken from the cervix and interior part of the uterus. After this the uterus was washed out with iodine solution, but when pressure was being made on the fundus of the uterus just before passing the syringe into the uterus about 2 oz. of urine escaped from the bladder and trickled into the vagina and to the cervix. The urine was at once swabbed out and the intrauterine douche given.

Tenth to fifteenth days. The temperature varied between 99° and 101°. Three injections of polyvalent serum were given and a vaginal douche twice daily. The reports on the swabs from the cervix and uterus were negative.

Seventeenth day. About 4 p.m. the patient became very drowsy and by the evening the temperature had risen to 102°, and she could hardly be wakened up.

Eighteenth to twenty-second days. The abdomen became distended, the spleen was enlarged, bowels loose and offensive (twelve actions in the first twenty-four hours). In fact a typical typhoid state with the addition that for three or four hours on the morning of the eighteenth day there was a third attack of bladder tenesmus with actual incontinence of urine for part of the time.

Swabs were again taken from the cervix and uterus, but in addition cultures were made from the urine and blood.

Pathological Findings.—A blood count was performed with a view to determining the possibility of some hidden focus of suppuration. But the leucocytes on no occasion, during the several days that they were examined, reached beyond 15,000 with a normal differential count; so that suppuration was contraindicated. Blood cultures made by inseminating varying quantities of blood taken from the median basilic vein remained sterile throughout. The urine was acid, though not highly so, as urotropin had been given; it contained leucocytes, epithelial cells, and an occasional bacillus. But cultures rapidly produced prolific growths of a coliform bacillus (Gram negative, motile bacillus which produced acid and gas). The cervical swab contained a similar bacillus, but also staphylococci, both of which appeared in cultures. The blood serum withdrawn at the same time was used to carry out the agglutination test with the *B. coli* obtained in cultures; positive results were readily obtained with serum diluted 400 times.

As the lochia still remained normal to all ordinary observations, no further intrauterine or vaginal douches were given; all treatment was directed to diminish the infective condition of the urine. Urotropin and acid sodium phosphate merely caused an improvement in the state of the urine. Antistreptococcus serum had previously been given. To save time an injection of a stock vaccine consisting of a *B. coli* and streptococcus was given, but it was not until a vaccine prepared from her own organism was given that any real progress was made. An interesting observation was that, with this stock mixture, marked activity was noted round the sites of the previous inoculations of the antistreptococcal serum; these were surrounded by extensive erythematous areas. The sudden fall in the temperature on the twenty-second day was immediately after the second dose of the autogenous vaccine.

Twenty-second to twenty-eighth day. Although there was still a certain amount of pyrexia, the patient's general condition was very markedly improved, and, except for a typical attack of joint pain and an urticarial rash after the third dose of autogenous vaccine, there was an excellent recovery.

CASE II.—Primipara, aged 22. For several years had suffered from "feverish attacks" at fairly long intervals. These were put down to influenza. Two years before marriage she was in South Africa, where she had a severe attack of fever, which was said to be due to "some horrid tropical microbe." During the pregnancy she was extremely well, and her mother remarked that the baby was going to put her all right. There were no bladder symptoms, and the labour was uneventful, except that, owing to uterine inertia and a muscular pelvic floor forceps

were applied after the second stage had lasted two hours. During the first week the evening temperature was usually between 99° and 100°. There was considerable difficulty in passing urine, but a catheter was never used, the patient being allowed to get out of bed in order to empty the bladder. During this time there was also some trouble with the breasts. Nursing was attempted, but by the ninth day the flow of milk ceased. On the tenth day the temperature remained normal, and so continued until the twenty-first day. The lochia had been quite normal throughout and had ceased at the end of a fortnight. With a rise of temperature to 100° F. on the twenty-second day, there was a return of the lochia, the patient complained of severe frontal headache, and felt very ill. There were marked frequency and difficulty in passing the urine, which became thick and cloudy. On the twenty-third day the

CASE II.—The pyrexia began on the twenty-third day after parturition. C denotes administration of autogenous vaccines in doses of 10, 25, 50, 100, 150, and 200 million. This chart shows a four-hourly temperature after each injection.

temperature gradually rose until at 5 p.m. it reached 104.8°. The headache was intense. An examination of the blood revealed nothing abnormal by morphological or cultural methods of examination. A catheter specimen of the urine taken on the morning of the twenty-third day showed the usual findings in *coli* bacilluria. Sufficient growth was obtained in eight hours to proceed with the vaccine, and on the evening of the twenty-fourth day the first dose was given. In this case agglutination tests were entirely negative.

Treatment.—The only treatment consisted in administering vaccines, and it was a noteworthy feature that within a few hours after each of the first four injections of the vaccine the patient always became bright and the headache entirely stopped. The temperature was 103° on the twenty-fourth day before the first injection of vaccine, on the twenty-fifth day it reached 102°, on the twenty-sixth day 101°, and on the twenty-eighth day 99°. For three days there were no symptoms of any kind, but there was a slight recrudescence on the twenty-eighth day. Increasing doses of the vaccine were given on the thirty-second, thirty-sixth, and thirty-eighth day, and then at longer intervals. The lady then went to Scotland, and ceased taking the vaccines, but a few weeks later there was an acute exacerbation, with pyrexia, malaise, and toxæmia, resembling the earlier attack. This, however, responded immediately to vaccines, and she was given doses of 350, 400, 450, and 500 million, and then ceased to attend. On her return (eight weeks later) she appeared to be in perfect health, and then on examination of her urine a few *B. coli* were still to be found, but all treatment has since ceased, and it is hoped that the bacteria have settled down to a saprophytic existence. We are indeed of the opinion that such was the case for some years preceding the pregnancy.

CASE III.—Primipara, aged 28.

Previous History.—Had twice been in a nursing home for insomnia and nervous breakdown, and for some years before marriage had been subject to attacks of malaria, supposed to have been initiated abroad. Came to England about the eighth month of pregnancy, but was in excellent health. The pelvis was justo-minor.

As soon as labour commenced she complained of the severity of the pains and was given a hypodermic injection of scopolamine and morphine. While the effect of this lasted she was comparatively quiet and the os dilated well. When dilatation was about half accomplished she became extremely excitable and the bladder was found to be distended nearly to the umbilicus. As she was unable to pass urine, a catheter was passed and 15 oz. of urine, containing sufficient bright red blood to give the appearance of being almost half blood, was drawn off. An attempt was made to deliver with forceps through the partially dilated cervix, but this was unsuccessful and so the child was delivered by turning. For the first week there was nothing special to note except difficulty in passing urine. At the end of the week, however, the temperature rose to 102°. The lochia was quite normal. A catheter specimen of the urine was examined and the *B. coli* found.

The blood examinations in this case were also normal, the leucocytes only numbering 9,000 to the cubic millimetre. The urine contained an extraordinary amount of pus, was highly acid, and contained bacteria, notwithstanding the fact that urotropin had been administered. The blood serum gave slight agglutination reactions with her own *B. coli* when

diluted twenty times. We prepared a vaccine and administered the first dose in twenty-four hours; the reaction from this was very marked, but there was so much improvement that a second injection was given. As insomnia set in again, the patient insisting that this was due to the vaccine, no more was given. She was treated with urotropin and acid sodium phosphate. She continued to have some pyrexia, but the chief trouble was the insomnia, and she was presently sent away for a rest cure, and we lost sight of her.

CONCLUSIONS.

It is of practical importance to note that the pathological investigations followed immediately on the clinical examination, and were carried out by ourselves, for the most part at the patient's house; the cultures were made immediately, and in ten hours sufficient growth was obtained to allow us to proceed with the preparation of the vaccine. The first doses were diluted with 0.5 per cent. lysol in normal saline and sterilized at 60° C., incubated for a few hours and again heated to 60° C., and were ready for use within twenty-four hours after seeing the patient. There can be no question as to the advantage of such bedside pathology in rapidly arriving at a diagnosis, or, at least in some cases, in eliminating the possibility of certain diseased states.

PLAGUE IN CEYLON.

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As is well known, no indigenous cases of plague have ever been known in Ceylon; in fact, various theories have been put forward from time to time to explain this peculiar apparent immunity of the island. In January of this year rumours began to circulate as to the appearance of a new and unknown malady in the Chetties quarter of Colombo. On Saturday, January 24th, a pseudonymous letter, purporting to have been written by a resident in Sea Street, was received at the Public Health Office stating that a new and very fatal disease had appeared in Sea Street about January 15th, and that some 12 or more deaths had occurred. It stated further that the patients were attacked with fever in the morning and died in the evening. A house-to-house inspection, made the same afternoon, disclosed nothing beyond the fact that the residents in Sea Street, and particularly the Chetties, believed that a new and very fatal disease had recently appeared and they were in consequence much alarmed; in fact, they held processions to propitiate their gods and put a stop to the new disease.* The medical registrar of deaths for this district, Miss Rudd, was interviewed, but stated that she had no information on the point. She was, however, asked to report at once any sudden deaths or suspicious cases.

CASE I.

On the following afternoon, January 25th, she reported a sudden death in Sea Street. The deceased was a young coast Moorman, named Seyadu Ibrahim Sahib, aged 16, who lived at 64, Sea Street, where he carried on the trade of a dealer in empty packing cases and boxes. He had come from Tondi in India about two months previously, and had been residing at 64, Sea Street ever since, with the exception of a trip to Kurnegalle from January 18th to 22nd. He had been seen in the evening of January 24th, and appeared to be then quite well. At 7.30 a.m., January 25th, he went to consult Dr. Rudd, who found that he had a temperature of 103°. This raised the suspicion of malignant malaria, a disease rampant in Kurnegalle district. He appeared to have no other symptoms. He died at 4.30 p.m. the same day. A judicial *post mortem* examination was carried out that night at 2 a.m. in the presence of both of us, but disclosed nothing to account for the death. The body was well nourished and all the organs looked healthy. There was nothing at all abnormal apparent beyond a very slight congestion of the meninges and a slight enlargement of the spleen; there was no enlargement of any lymphatic glands. By means of a sterile pipette blood was taken by one of us from the heart, and several broth, agar, and serum tubes inoculated;

* It is remarkable that though accustomed to plague in their own country (all Chetties come from India) they never thought of this malady, and till very recently have always persisted in believing that it was a new disease. This is probably due to the absence in practically all the cases of the signs of the bubonic type of the disease with which they are acquainted.

films were also made. The whole spleen was removed, and also several inguinal lymphatic glands, though not enlarged, and apparently quite normal. The organs were placed in a sterile Petri dish, and fifteen minutes later bacteriologically examined by one of us at the Bacteriological Institute, films being made, and a large series of various culture media inoculated.

The films from the spleen stained by the Giemsa method revealed the presence of numerous bipolar staining bacilli, Gram-negative. Films made from the heart blood, too, revealed the presence of bipolar staining bacilli. Such germs were absent in the films made from the inguinal lymphatic glands. Given the presence of bipolar staining bacilli we considered at once the case to be probably one of plague. After thirty-six hours the agar tubes inoculated with heart blood and spleen juice presented numerous delicate dew-like colonies, and the further investigation proved the germ to be the true *Bacillus pestis*.

CASE II.

The second case, also a coast Moorman, named Mohamed Gummie, aged 24, occurred on January 29th at 15, Martie's Lane, which is over half a mile from the first case. The deceased in this case carried on the trade of a tea boutique keeper at 2, Cross Street, which is also half a mile from the first case. He was not seen alive by a doctor. His friends stated that he had been ill for only two days, but he had not been to his shop for six days. It was not known whether he had been to Sea Street. He had been in Colombo for over a year. The only history which could be obtained of his illness was that he had high fever and no other symptoms.

The *post-mortem* examination disclosed extreme congestion of the lungs, but not true pneumonia; there was extreme congestion also of the meninges. Otherwise the organs appeared normal and the body was well nourished. The bacteriological examination was positive.

CASE III.

The third case was a Tamil male, aged 17, named Muttusamy. Nothing is known of the history of this case beyond the fact that he was brought to the General Hospital by a friend on January 25th. He is stated to have been brought from the Pettah—address unknown. He died on January 29th. At the *post-mortem* examination held by Dr. Mack and one of us nothing abnormal macroscopically could be found to explain the cause of death. The spleen was somewhat enlarged. Bacteriological examination was positive.

In addition to the above three cases, forty-five cases more have occurred to date.

Clinical Type of the Disease.

The type of the disease in our first three cases, and in the enormous majority of the cases seen later, has been septicaemic and most virulent, death taking place within twenty-four to forty-eight hours. The clinical diagnosis of such cases was most difficult; the patient merely complained of high fever and headache; none of the lymphatic glands were enlarged. This explains how so many cases were reported by medical men as cases of pernicious malaria. Recently two cases with buboes (axillary) have been observed. So far we have not come across any cases of the pneumonic type.

Description of the Strains of *Bacillus pestis* found in our Cases.

The strains derived from the above-mentioned three cases—and we may say from all the other cases we have examined—are culturally identical, and have all the characteristics of the plague bacillus; the germs in the human body and the tissues of animals inoculated with pure cultures are bipolar, staining to 2 to 3 microns in length, and Gram-negative. They are non-motile. On agar, when isolated direct from the tissues, they grow slowly, giving rise to delicate roundish translucent colonies, which later become somewhat more opaque and seldom coalesce. After several transplantations the germ grows much more abundantly, and the colonies may coalesce. Preparations from young agar cultures reveal the presence of very short, almost coccoid, bacilli. On 2½ per cent. salt agar the well-known degenerated, swollen, yeast-like forms appear. In broth the growth is rather scanty, mostly at the bottom of the tubes; the germ grows, forming long chains. On serum the growth is very scanty. Neither serum nor gelatine are liquefied. Milk is not coagulated. Our strains presented the following reactions:

Glucose	} Acid, no gas.	Lactose	} No change.
Levulose		Cane sugar	
Galactose		Dulcitol	
Maltose			
Mannite			
Dextrose			

All our strains produce indol.