A CASE
OF
ACTINOMYCOSIS HOMINIS OF THE URINARY
AND ALIMENTARY TRACTS.

RECOVERY.

BY
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W. K—, a married man, æt. 48, came to me on January 29th, 1891, complaining of "lead-poisoning." He said he had been quite well up to September, 1890, when a few days after painting his kitchen he was taken suddenly ill with colicky pains and vomiting. This attack subsided in a day or two, but since then he has been liable to indigestion, loss of appetite, occasional colic and vomiting, distension of the stomach, wind and constipation alternating with diarrhœa. He has not noticed anything peculiar in regard to his stools.

The urine has been thick at times; he has sometimes got up thrice in the night to pass water, and has occasionally had a little scalding pain at the end of the penis.

He has lost two stones in weight in the last six months.

His wife thinks he began to lose flesh and general vigour about the end of July, 1890.

Past history.—The patient has lived all his life in the north of Notts. When a young man he worked for three years on a farm, where he milked the cows. He then worked for a few years on a railway, but for the last fifteen has been settled as an insurance agent in Mansfield, and has had nothing to do with cattle.

Until now he has had no serious illness, but while employed on the farm he had a sore on the heel, which discharged for six months and then healed perfectly.

He has frequently in the summer chewed fresh ears of corn—wheat, barley, and oats,—and remembers last June eating both wheat and barley. He has not been in the habit of eating raw meat or vegetables.

State on January 29th, 1891.—On examination on January 29th the patient showed no signs of lead poisoning. He was pale and rather worn-looking, but not excessively emaciated. Heart and lungs normal. The abdomen was considerably and uniformly distended, and tympanitic on percussion. Loud gurglings were occasionally heard, and movements of the intestines were visible. The solid viscera could not be felt. Examination of the rectum showed a little tenderness of the prostate, which was, however, of normal size and shape. Above the prostate was felt an irregular firm swelling, apparently placed in or just in front of the anterior wall of the rectum.

Some urine passed in my presence was acid, and high-coloured, and deposited a quantity of small oval, translucent, jelly-like flakes of a pinkish colour, and about half a dozen granules, which placed under the microscope showed distinctly the characters of spherules of actinomyces. There was also a very little pus, and a small quantity of albumen.

The translucent “flakes” were mostly flat ovals, finely fibrillated in concentric rings, and turned opaque with water, but did not turn opaque or shrink with acetic acid. On one of them was a small prostatic concretion, and a

few spermatozoa were also found among them. The urine contained no casts, blood, sugar, bile, or fæcal products, and no bubbles of gas have been noticed during micturition.

Progress of case.—During the next ten days numerous specimens of urine were examined, and in all were the Actinomyces spherules found, *e. g.* from six to twelve in a six-ounce bottle of urine. The peculiar flakes I have not found again.

On February 2nd the patient brought me a portion of a slimy stool, in which were a few streaks of blood and two or three spherules of Actinomyces.

On February 11th he was admitted under my care into the General Hospital, Nottingham. The note made on February 15th remarks:—He has little to complain of but wind and distension of the abdomen. In especial, he makes no complaint about his water. The skin is everywhere healthy, the old wound on the heel being perfectly healed. His respiratory, circulatory, and nervous systems present no sign of disease. The temperature is normal. The appetite is fair, the bowels rather constipated; there is much flatulence, but no nausea or vomiting. The teeth are mostly decayed, and many are absent. Gums rather retracted and spongy, and bleed readily. There is no sign of alveolar abscess or of disease of the jaw. The pharynx and tonsils appear healthy.

In the abdomen the distension is somewhat less, but there is no other change. The stools occasionally have a little slime in them. The lump felt by rectal examination above the prostate is tender, fixed, firm, and feels about the size of an orange. The posterior wall of the rectum is quite moveable. There is slight frequency of micturition—once or twice in the night,—but no pain or vesical tenesmus.

Urine, about thirty ounces per diem, is neutral or faintly acid; sp. gr. 1020—1026; it is sometimes quite clear, sometimes turbid with urates, a little mucus and a very little pus. There is sometimes no albumen, some-

times a trace. Urea, 2 per cent. Most specimens contain from one to a dozen spherules of actinomyces. No other abnormal elements. The spherules are of a creamy or yellowish colour, no brown ones being found.

The scrotum, testes, and penis are normal.

The patient was ordered terebene by the mouth, with a mild aperient pill, and for a few nights had enemata with turpentine, with the result that the abdominal distension was considerably reduced, although it still tended to recur.

During the next ten days the bowels were opened regularly by the enema or pill; and the fæces, though unformed, became in other respects normal. The slime and blood disappeared, and I have never, except on the occasion already mentioned (February 2nd), found the fungus in the stools. The spherules in the urine also decreased in number, and on some days none were found. The albumen and pus disappeared and remained absent after February 19th.

On February 27th occurred the first and only rise of temperature. There was general malaise, some griping pain in the abdomen, and the temperature rose to 102° F. There was no rigor. The next day the patient had seven loose stools and vomited once. No pus or blood was noticed in the stools. The temperature remained at 100° on March 1st, but returned to normal on the next day.

On March 2nd the lump above the prostate was thought to be rather smaller than before.

On consideration of the case it appeared clear that there was an actinomycotic growth communicating with the bowel on the one hand, and the urinary tract on the other, and I considered it probable that the mass felt above the prostate was the growth, which communicated by different sinuses with the rectum and bladder. It also appeared probable that the opening into the rectum was closing, if not already closed up.

That this mass was the seat of the disease was also the opinion of those of my colleagues who examined the case.

After consultation it was accordingly decided to open the abdomen with a view to removing as far as possible the growth. It was felt that such a growth if left must prove fatal, and that, although complete removal might prove impracticable, it was right to give the patient the chance.

On March 3rd, therefore, my colleague, Dr. Herbert Owen Taylor, opened the abdomen by an incision from umbilicus to pubes. The result was somewhat of a surprise. There was no tumour, no abscess cavity, no large inflammatory growth, and no recent lymph. All that was found was a number of rather old vascularised adhesions between some coils of small intestine occupying the pelvis. Many of these were broken down by the operator, and a sufficient view obtained. Bimanual examination, with one finger in the rectum, could detect neither thickening nor ulceration of the wall of that viscus, and examination of the bladder, into which a sound was passed, likewise failed to show any morbid change. It was obvious that the mass which had been mistaken for the actinomycotic growth was really a piece of small intestine, containing fæces, which lay transversely across the pelvis, to which it was fixed by old adhesions.

No sign of the parasite was discovered within the abdominal cavity, though it must be added that to avoid further shock the upper part was not subjected to a prolonged examination.

The operation was therefore brought to a close, and the wound stitched up without washing out the peritoneal cavity, and without inserting a drainage-tube. The patient made an excellent recovery from the operation, had no rise of temperature and no pain, and on March 13th he was re-transferred to my care.

I may add that the bowels were opened freely by an enema on the fourth day after the operation, and that the stool, which I examined carefully, showed no sign of spherules, mucus, or blood.

During March, although the wound healed perfectly, the patient's abdominal troubles did not diminish. The

distension of the intestines remained considerable, there were irregular attacks of diarrhœa, occasional vomiting, and anorexia, and he lost nine pounds in weight. The stools, though loose, did not show blood or mucus, nor were any spherules of the fungus discovered in them. The temperature remained normal.

On April 1st he was ordered β -naphthol in three-grain doses every four hours, and three grains of calomel on alternate days. From that date improvement has been unimpeded.

The distension of the abdomen disappeared, the appetite became good, he gained a stone in weight during April, and passed without discomfort one or two formed and apparently normal stools daily. The calomel was stopped after three weeks, but he continued to take the β -naphthol till the end of June, though all abdominal symptoms had ceased by the end of April.

The urine, during the period of intestinal trouble in March, became scanty, but, except for the presence of a few *Actinomyces* spherules and an occasional deposit of urates, was normal. The administration of *Ol. Copaibæ* for a few weeks raised the daily average from twenty to fifty-five ounces, and since then, up to the present time (October, 1891), he has passed about fifty ounces daily. There has been no undue frequency of micturition, and no pain during the act; but he has, throughout his illness, occasionally had "springing" feels at the end of the penis.

During April and May a soft catheter was several times passed into the bladder, and the urine thus drawn off has never contained any spherules, except on one occasion when the instrument was withdrawn while the last portion of fluid was escaping, so that a spherule might easily have entered the eye of the catheter during its passage along the urethra. The bladder has also been washed out with boracic acid lotion without bringing away any spherules, although they still recurred in the urine as passed.

The patient was sent home on May 9th, and has since felt in perfect health. He has gained two stones in weight, has no digestive troubles, and can walk twenty miles a day. Symptoms of disease of the urinary tract have been absent except for occasional slight "springing" sensations, felt chiefly at night, at the urinary meatus. The urine, which has been otherwise normal, continued until the second week in October to show a few spherules of *Actinomyces*, but since that date *none have been observed*. While at home the patient measured his urine, collected the daily sediment in a bottle which I weekly examined, and on October 20th he again came into hospital for closer observation. There is no sign of extension of the disease into the abdomen; the prostate is of normal consistence, not tender, and I think a little smaller than it was, and no sign of disease is to be found in the penile urethra. The "springing" sensations are diminishing, and the patient sleeps all night without needing to pass water (October 30th).

Remarks.

Diagnostic.—The diagnosis of actinomycosis, though most unexpected, presented no difficulty when the patient passed water. The yellowish spherules, about half the size of a pin's head, were to the naked eye suggestive, and examination under a low power of the microscope of a fresh spherule in a drop of urine and slightly pressed by the cover-glass at once showed the characteristic yellowish-brown mulberry mass of the *Actinomyces* colony, with the usual outer layer of pus-cells. Even before the use of a high power there was no doubt of the diagnosis. Some points concerning the structure of the fungus I shall refer to later, but will now consider the probable seat of the disease.

The patient's troubles for the first seven months of his illness were chiefly connected with the alimentary canal. Intestinal irritation and intestinal atony were the prominent features of the case; and the discovery on one

occasion (February 2nd) of a few spherules in the fæces shows that the parasite was actually in the intestinal canal. The intestinal troubles, however, though for long persistent, have vanished. There is now neither symptom nor sign of disease of the alimentary canal, and no spherules have for eight months been found in the fæces.

In the urine, on the other hand, the spherules, though less abundant, continued till lately to occur, but caused practically no symptoms.

The absence of fever, of general peritonitis, of evidence of deposits in the liver or lungs, make it very improbable that metastasis has occurred, and that there is more than one focus of disease; so that we have to consider in what place has the actinomycotic growth spread from the alimentary to the urinary tract. (A spread in the reverse direction is extremely improbable.) It is a well-known characteristic of *Actinomyces* to grow without respect to boundaries from one organ to another, and it is conceivable that either kidney might be invaded from the colon, or the bladder or ureters from the small intestine or rectum. The absence of renal symptoms, and the fact of the urine being normal in every respect except in containing the spherules, render it improbable that the kidneys are affected, and the operation showed no sign of any inflammatory growth invading the bladder or ureters. Moreover the facts that bladder symptoms are absent, and that the urine drawn off by a catheter almost invariably contains no spherules, contra-indicate the view that the bladder is the seat of the disease.

The view to which I incline is that the prostate gland has contained a small actinomycotic focus, and that invasion occurred from the rectum. I imagine that the fungus located itself in the front wall of the rectum, and thence spread forwards till it burst into the prostatic urethra, but that, as not unfrequently happens in this disease, the rectal sinus healed while the urethral continued to discharge. The occasional presence of prostatic calculi among the spherules supports this view.

Against this view may be urged the absence of a considerable enlargement of the prostate or marked alteration in the consistency of the gland, there being neither fluctuation nor the wooden hardness sometimes found in actinomycotic growths. But it is very possible that the free drainage which has gone on will account for this peculiarity.

But, even if the rectal ulceration be healed, we have still to ask ourselves the question whether there may not still remain a deposit of the parasite higher up in the intestine. A remarkable case has been reported by Chiari, of Prague, in which the large intestine of a man who had died of progressive paralysis was found to contain on nearly the whole of its mucous membrane a diffuse film of actinomyces, which nowhere caused deep ulceration, and which was not known to have caused symptoms during life. It would seem that in the intestinal as in the respiratory tract the fungus may present two different habits; one a superficial, not destructive growth, the other parenchymatous and destructive. It is impossible to say positively that an actinomycotic deposit of the former character is not still present in my patient, though there is little probability of the existence of the parenchymatous form. And the marked recession of all symptoms of intestinal disease, with the gain in weight and general vigour, which has been maintained since the commencement of the β -naphthol treatment, leads to the hope that the fungus has been completely removed from the digestive tract.

Prognosis and treatment.—Although partial healing of an actinomycotic abscess may occur, and a tendency to encapsulation has been observed rarely in animals, I am not aware that any case of cure without operative interference by knife or caustic has been reported in man.

In the present case it seems probable that the disease is no longer present in the intestine; and it is possible, though we cannot as yet speak with certainty, that it is disappearing, or perhaps even gone from the urinary tract.

The free drainage that has been maintained into the urethra seems to have prevented growth inwards, and the fact that prostate and bladder still show no sign of disease, although the discharge has ceased, justifies the hope that the tissues have gained the victory and encapsuled or expelled the parasite. Some months must, however, elapse before a confidently good prognosis can be given.

With regard to treatment, the facts related offer, I think, fair grounds for concluding that the disappearance of signs of the intestinal disease was largely due to the enemata of turpentine at first, and the course of calomel and β -naphthol afterwards. After the stoppage of these drugs at the end of June the patient began to take Liq. Hydrargyri Perchloridi with iodide of potassium, and since September 24th he has taken the iodide only in doses of a drachm daily. During this time he developed an iodide rash on the face, and for the first few weeks no marked effect on the number of spherules in the urine was observed. The absence of spherules, however, since October 15th shows that the drug has done no harm, and may possibly have contributed to the suppression of the disease.

P.S. (April 5th, 1892).—The patient has remained free from all signs or symptoms of disease since October 15th, 1891, and to-day showed himself apparently in perfect health. No spherules have been found in the urine, although sought for. A sample examined to-day was normal. He has taken no medicine since October.

The lapse of six months without any return of the disease affords considerable support to the conclusion that the recovery is complete.

(August 7th, 1892.)—The patient is still in perfect health.

Ætiological.—The present case is of some interest in regard to the ætiology of Actinomyces. There is absolutely no evidence of it having been caught from cattle. (The sore heel twenty-four years ago can hardly be connected with the present illness.) There is, on the other

hand, evidence throwing suspicion on what Boström and Johne and others have accused, viz. ears of corn, and especially barley. The patient can recollect picking ears of barley at the end of June, and about the end of July his health seems to have begun to fail, though serious symptoms did not develop till September.

In connection with the remarkable fact of three cases of actinomycosis hominis having occurred in the last two years in the neighbourhood of Nottingham, I have made some inquiries of veterinary surgeons as to its occurrence in cattle. There seems no doubt that by many the disease is not recognised, and information has proved scanty.

But Mr. Brett, M.R.C.V.S.,¹ who for six years until lately practised as a veterinary surgeon in Mansfield, told me that he frequently saw cases in that neighbourhood. In one case it broke out in some calves, who, contrary to the usual practice in that district, had been littered on barley straw. Mr. Brett advised the substitution of oat straw, and this was done. But although the cow-shed had been disinfected, the next lot of calves got the disease even worse than the first; and Mr. Brett then found that although the barley had been taken out of the litter it had been put into the fodder. After complete exclusion of barley from the shed no more cases occurred.

I understand that in Norfolk and Lincolnshire, where the disease seems most common, barley straw is largely used for litter.

During the month of September I have examined a large number of specimens of barley, both ears and stalks, from the Mansfield district, but have found nothing that could be identified with the ray fungus. Smut is almost universal, and I also observed a few *Leptothrix* filaments containing spores. These filaments closely resembled threads of *Actinomyces*, as seen in a cover-glass preparation; but as no branching ones were seen, and no tendency to aggregate into colonies, there was no evidence to show a relation.

¹ I regret to say that he succumbed this summer to an attack of influenza.

But on this point the experiments of Liebman¹ are of great interest. This observer planted beans, wheat, and barley in earth which had already been sown with a pure cultivation of *Actinomyces*, and found on them after the plants had grown, to all appearance normally, the rods which appear to be characteristic of certain stages of the life of the ray fungus.

It seems probable that the *Actinomyces*, if found on or in cereal and other plants, will not appear as spherules, but in the form of rods and threads, such as it often takes in artificial cultivations.²

Morphological.—I have been able to examine the structure of *Actinomyces* in specimens from the urine of my own case, both fresh and preserved, and in sections of the hardened tissues from the cases of my father and Mr. Anderson.³

Observers differ chiefly in their views as to the nature of what has been considered the chief characteristic of the ray fungus, the clubs; and to these, therefore, I will first refer.

Two facts help to explain the discrepancies of authors. The first is one mentioned by Boström and supported by my observations, that in young spherules the clubs may not be developed; and the second is that they are readily destroyed or altered by various reagents.

In bovine *Actinomyces*, where the clubs are so conspicuous, certain chemical changes appear to be undergone by the fungus sooner than in the human form; thus calcification is more common, and the clubs become early resistant to reagents.

The specimens obtained from the urine of my patient were probably all fairly young; they were all small in size, and all whitish or pale yellow in colour. In some of the smaller ones, examined directly after micturition, no trace of clubs could be discovered. And in those

¹ 'Arch. per le scienze med.,' vol. xiv, No. 18.

² Boström, 'Ziegler's Beiträge,' Bd. ix, 1890; Israel and Wolff, 'Virchow's Archiv,' Bd. cxxvi, Heft 1, 1891.

³ Reported in this volume, pp. 63 and 103.

spherules which bore clubs abundantly these structures were not, as the drawings of some authors suggest, at first sight the most conspicuous objects. The most obvious feature in many *Actinomyces* spherules are the radiating and sometimes branching filaments which project from the edge of the colony. Pl. II, fig. 1, shows a portion of a fresh spherule in which the clubs were as conspicuous as any I have seen. Even here the filaments are more numerous and project further than the clubs.

In deciding as to the existence of clubs it is necessary to be aware of their behaviour to reagents. Broadly I have found that acids preserve, while alkalies dissolve them. Fresh acid urine proved an excellent medium for their study, but so soon as phosphates were precipitated the clubs disappeared. Very weak potash was sufficient to dissolve them. Tap water caused most to disappear after a little time.

Salt solution of 10 per cent. shrivelled them, while 5 per cent. showed them excellently. Alcohol caused them to shrink considerably, and heat broke them up into fragments.

These facts may explain the frequent failure to demonstrate the clubs from human autopsies where post-mortem changes may have altered their characters.

The clubs, whether fresh or after treatment with alcohol, stained with eosin, and still better with rubin (Crookshank) (Pl. III, fig. 3).

The true significance of the clubs is one of the most important questions connected with *Actinomyces*. The view at one time held that they were comparable to the asci of lichens has lately lost ground, but Professor Crookshank, who has paid much attention to the subject, in his latest writings still compares them to the basidia of the higher fungi, and holds that they are organs of fructification.

Boström, on the other hand, in his recent exhaustive paper, brings forward strong arguments against this view, and considers them products of involution or degeneration.

My observations agree closely with those of Boström. He describes the club as a gelatinous sheath on the ends of filaments, and finds no special tendency of the ensheathed filaments to form spores. The older the spherule the more conspicuous the clubs, and only in quite old artificial cultivations of the fungus does he find any clubs. He therefore concludes that the club formation is a sign of degeneration.

Of the existence of the axial thread in the club there is no doubt; Boström, Crookshank, and Delépine have figured it in specimens stained by Gram's method in combination with a red stain, and I have seen it both in such preparations, and in spherules examined fresh in urine or in 5 per cent. salt solution. This solution causes the filaments to break up largely into short rods and round coccus-like bodies, and brings out the clubs conspicuously (Pl. II, fig. 2). No cell-wall can be made out to the club, the hyaline substance of which shows frequently cross fractures, which in some cases are bridged by the axial thread.

The mode of fracture of the clubs, and especially the irregular shrinkings which they undergo on drying, are strongly suggestive of a jelly-like substance without cell-wall. The hyaline substance of the expanded club can sometimes be traced as a narrowing sheath down the filament, and in preparations stained by Gram's method with gentian-violet and rubin one can sometimes see on most of the filaments a narrow sheath of high refractive index with a faintly pink tinge. Moreover if a preparation showing clubs stained red with eosin be crushed, it will be found that nearly all the clubs have vanished, and that among the threads is an irregular mass of red homogeneous matter, which appears to be formed of confluent club substance. That the club-bearing threads are not specially differentiated organs is probable from the fact that every gradation in size from the smallest thread to the largest club is met with, as well as from the fact just mentioned that indications of a sheath of the same nature

may be traced down the filaments. One may compare the club of *Actinomyces* to the capsule of the pneumococcus, which, in its behaviour to acids and alkalies, resembles it closely. Probably all the filaments of *Actinomyces* tend to secrete this mucin-like substance, which accumulates in larger quantity on the free ends of the older threads. In sections of a colony one often finds no distinct clubs, but a felt-work of threads, staining blue with aniline dyes, embedded in a homogeneous eosinophilous substance, in the periphery of which faint indications of radial striation may sometimes be found, while in others the periphery may be clearly composed of clubs. It would seem as if this homogeneous substance existed throughout the mycelium, the threads of which it held together (Pl. III, fig. 1).

There seems no evidence to connect the clubs with the reproductive function, but neither does it seem necessary to assume the opposite extreme—that they are products of degeneration. The secretion of a jelly-like substance is not uncommon in the Schizomycetes, and the regular occurrence of clubs in what are apparently healthy colonies appears to me opposed to Boström's doctrine on this point. It may be added that Bujwid, of Warsaw, has observed the formation of clubs in cultivations grown in an atmosphere of nitrogen.

Of the mode of reproduction of *Actinomyces* but little certain is known. At the margin of every fresh spherule one sees swarms of coccus-like bodies, and preparations teased and stained by Gram's method, or methyl-violet only, frequently show what appear to be spores in the course of the filaments (Pl. III, fig. 3). I have also seen clusters of these spore-like bodies adhering to a club, and rarely they are visible in the central filament of a club. But the readiness with which the filaments break up into rods like bacilli of various lengths, and into round bodies like cocci, suggests caution in forming conclusions as to the nature of these so-called spores.

Moreover in the sections of hardened spherules,

whether from the urine or tissues, these "cocci" were not seen—a fact which suggests that they may be produced by the crushing or heating of a cover-glass preparation.

The study of *Actinomyces* in the tissues can only be satisfactorily made after embedding in paraffin or celloidin, as nearly all the colonies otherwise drop out. I have cut serial sections of the organs of my father's case, and of the parts removed by Mr. Anderson at the operation on his case, after embedding in paraffin, the sections being fixed to the slide by Mayer's albumen method and then stained.

It is remarkable, and somewhat annoying, to find what a large number of sections must be cut, even through the tissues which, to the naked eye, appear the focus of disease, before one comes across a colony. In other words, the tissues are changed for a long radius round the parasite.

The granulation tissue is remarkable and almost characteristic from the abundance of very large round granular cells undergoing fatty degeneration. Baumgarten, in his text-book on mycology, alludes to this, and I have certainly never seen anything like the granulation tissue from these two cases. There would seem to be a special tendency to fatty degeneration in this disease, for the liver in my father's case, far beyond the granulation tissue, showed the most intense fatty change.

As a rule, the colonies found by me in the tissues have been surrounded by a broad zone of leucocytes, many of which were degenerating, so that the fungus came to be practically lying in a mass of pus (Pl. III, fig. 1); but in one specimen from the subcutaneous tissue of Mr. Anderson's case the fungus was surrounded by firm granulation tissue (Pl. III, fig. 2), which formed a kind of capsule. This specimen, of which I have serial sections, shows points in the structure of the *Actinomyces* colony which have not, I believe, been before illustrated. Boström regards the typical colony as a hollow sphere, the shell or mantle of

which is composed of a dense felt-work of branching threads from which clubs may project outwards, and the cavity of which is occupied by irregularly arranged, sparsely branching threads. At one point the shell is broken, and here the filaments grow into the surrounding tissues. Pl. III, fig. 2, shows clearly this arrangement of the hollow sphere and the opening into the shell, but it also shows, what Boström did not mention, the cavity of the sphere almost entirely filled with small round cells of the granulation tissue. The mycelium is entirely absent from the centre. The peripheral zone is also composed partly of leucocytes, and I was not able in any of the sections to distinguish clubs. It is possible, however, that the indistinct red-staining matter of this zone may be partly composed of club substance.

In the sections of the liver of my father's case I nowhere found this structure of a hollow sphere. The appearances were always such as that shown in Pl. III, fig. 1, a central blue mycelium with radiating threads extending into the pus-cells around, and a more or less homogeneous matrix, in which rarely faint indications of radial striation could be found, which might be composed of club substance, or perhaps in part of the detritus of dead pus-cells. Some of the blue filaments extend beyond this matrix, just as in the fresh spherule they project beyond the clubs.

Serial sections through spherules from the urine of my own case helped, however, to explain these apparently different types (Pl. III, fig. 3).

Each fully developed spherule is a mulberry-like colony of ray groups, which groups may tend to form a kind of mantle at the surface, while centrally they are connected by a more scanty mycelium. Broken-down pus-cells and detritus form a uniting medium for the whole. In the smaller spherules, on the other hand, the central portion is still occupied by ray groups, such a spherule thus having a close resemblance to a segmenting ovum. Growth then takes place at the periphery, and a central cavity is

left, which is occupied by degenerated products of the tissues of the host.

In regard to the systematic position of *Actinomyces*, the facts mentioned tend, so far as they go, to support the doctrine of Boström, that it is not one of the higher fungi, but one of the schizomycetes, probably one of the pleomorphic bacteria allied to *Cladothrix*.

(For report of the discussion on this paper, see 'Proceedings of the Royal Medical and Chirurgical Society,' Third Series, vol. iv, p. 16.)

DESCRIPTION OF PLATES II AND III.

Actinomyces Hominis of the Urinary and Alimentary Tracts.
Recovery. (Dr. W. B. RANSOM.)

PLATE II.

FIG. 1.—Part of an *Actinomyces* spherule examined in the fresh urine of W. K.— ($\frac{1}{8}$ inch.)

FIG. 2.—Clubs treated with 5 per cent. NaCl solution, showing fractures and the axial thread. ($\frac{1}{12}$ inch.)

FIG. 3.—Threads breaking up into rods and enclosing spore-like bodies, from Dr. W. B. Ransom's case, W. K.— (Methyl violet, $\frac{1}{12}$ inch.)

PLATE III.

FIG. 1.—*Actinomyces* at margin of hepatic abscess in Dr. W. H. Ransom's case. (Gram, alum-carmin, and eosin; $\frac{1}{12}$ inch, reduced.)

FIG. 2.—Section of granulation tissue of cheek of Mr. Anderson's case, showing the arrangement of the filaments as a hollow sphere broken at one point and filled with granulation tissue. Clubs are not visible. (Gram and Rubin; $\frac{1}{8}$ inch.)

FIG. 3.—Section of an *Actinomyces* spherule from the urine of W. K.— (Gram and Rubin; $\frac{1}{12}$ inch.)

Fig. 3.

Fig. 1.

Fig. 3.

Fig. 2.

Fig 1.