

STENGEL (A.)

REPRINTED FROM

UNIVERSITY MEDICAL MAGAZINE.

EDITED UNDER THE AUSPICES OF THE ALUMNI AND FACULTY OF MEDICINE OF THE UNIVERSITY OF PENNSYLVANIA.

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MARCH, 1897

GONORRHEAL ENDOCARDITIS.

BY ALFRED STENGEL, M.D., PHILADELPHIA.



GONORRHEAL ENDOCARDITIS.¹

BY ALFRED STENGEL, M.D.,

Philadelphia.

THE liability of the endocardium to suffer acute inflammation in the course of gonorrhœa has been considerably discussed of late, though the subject is by no means new. Trousseau² took occasion as early as 1854 to deny the possibility of gonorrhœal endocarditis, while Brandes³ the same year described two cases. Subsequently Hervieux (1858), Lorain (1866), Tixier (1866), Voelker (1868), Lacasagne (1872), Marty (1876), Pfuhl (1878), Morel (1878), Träger (1880), Schedler and Leyden (1880 and 1882), Martin (1882), Dérignac (1884), Fraser (1885), von der Velden (1887), Weckerle (1886), Rothmund (1889), Genzinsery (1889) add reports of cases observed during life or post mortem, or discussed the question in a general manner. Interest, however, has recently been revived by the reports and dissertations of His (1892), Leyden, Wilms, Souplet, Councilman (1893), Fressel (1894), Litten (1895), Thayer and Blumer (1895), and Dauber and Borst (1896).

The older writers, in discussing the relation of gonorrhœa to endocarditis, were, for the most part, guided by clinical observations. Doubtless in some of these endocarditis was not present, and in cases in which it was certainly determined much question may exist as to the time of onset,—whether it began acutely, as alleged, or whether it had been present, but unsuspected, previous to the gonorrhœa. Suspicion would seem to have rested upon gonorrhœa as a cause of endocarditis mainly on account of the frequent occurrence of arthritis in that disease. Still, some of the first writers pointed out that joint-disease might or might not intervene between the attack of gonorrhœa and the cardiac affection. Thus Morel, in his dissertation in which thirteen cases are collected, contended that, though gonorrhœal rheumatism may be the intermediate affection between gonorrhœa and endocarditis, this does not always occur; and Genzinsery, after a study of thirty-one collected cases, concludes that (1) both endocarditis and pericarditis may occur; (2) there may or may not be rheumatic affection of the joints; (3) the disease manifests itself like ulcerative endocarditis, and tends to heart-failure.

A study of these older cases establish that endocarditis may

¹ Read before the College of Physicians of Philadelphia, May 6, 1896. Several later cases have been added.

² Gazette des Hôpitaux, 1854, p. 226.

³ Archives de Médecine, 1854.



occur in the course of gonorrhœa, but the nature and cause of the endocarditis could not be determined. After the discovery of the micro-organism peculiar to the disease by Neisser, and particularly after the discovery of accurate methods of studying this organism, the problem has been made somewhat more simple. In the first place, it has been shown that the gonococcus at times occasions metastatic lesions in the joints, the serous cavities, and the solid tissues and organs; in the second place, it has been shown that the gonococcus may occur in the vegetations of endocarditis. We leave out of consideration the lesions which may be considered as occurring by direct extension of the infection along the mucous tracts or otherwise.

Arthritis.—Experimental and bacteriological studies have now abundantly proved that arthritis may be due to the direct action of the gonococcus.

Neisser and Schäffer have recently summarized the contributions,¹ and I extract the following: Petrone, in 1883, and Kammerer, in 1884, found diplococci in the fluid drawn from arthritic joints, the bacteria in question having the morphological characters of gonococci. Deutschmann, in 1890, found diplococci in the knee-joint, and established the probable nature of these by the morphology and staining reactions and by their failure to grow upon ordinary media. Lindemann cultivated the organisms from the joints after the method of Werthheim, though his cultures were impure. Hock, E. Neisser, Respighi and Burci, Burdoni-Uffreduzzi, Finger, and Kickow have since obtained positive results. It must be confessed that other cases carefully studied have failed to reveal gonococci, but this does not remove the value of the positive results obtained.

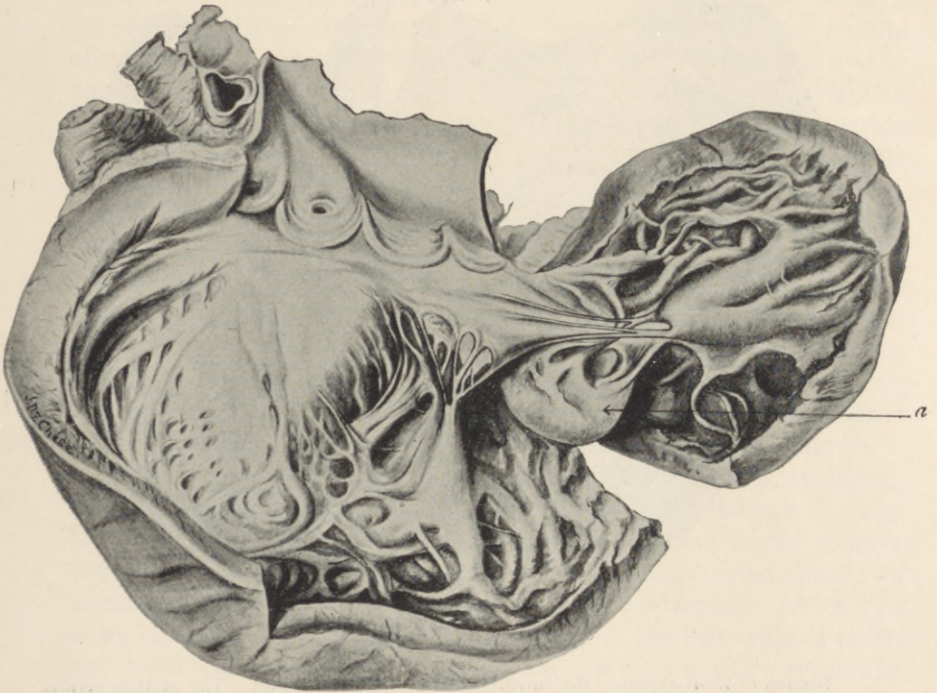
Synovial Membranes.—Similar results have been obtained in the study of the synovial sheaths of tendons. Tollemer and Macaigne found diplococci (probably gonococci) in a case of tenosynovitis of the forearm, and Jacoby found in the pus of a tendon sheath diplococci which stained like gonococci and refused to grow upon ordinary media. Flexner and Bloodgood (quoted from verbal communication to Thayer and Blumer) have recently obtained pure cultures from a similar case.

Pleura.—Mazza found gonococci in the pleural exudate of a case of gonorrhœa in a girl of 11 years, in which arthritis, pericarditis, and endocarditis occurred. The cultures were made after Werthheim's method.

Meninges.—Cases of involvement of the meninges (meningitis and meningo-myelitis), of general septicemia, and of various eruptions

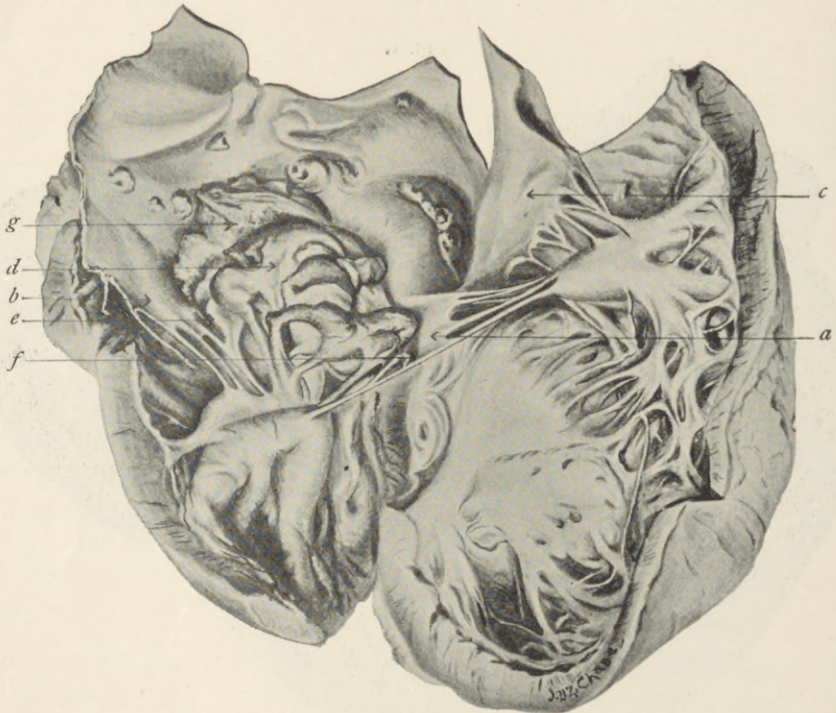
¹ Ergebnisse der Allgemeine Aetiologie, Lubarsch und Ostertag, 1896.

FIG. 1.



Section of heart exposing the left ventricle. The adventitious (anomalous) valvular segment (*a*) is seen projecting into the ventricle between the mitral segments.

FIG. 2.



Section of heart exposing the auricular and ventricular cavities. The section divides the anterior segment of the mitral valve into two parts, *b* and *c*. The posterior mitral leaflet is small (*a*). The adventitious (anomalous) valvular appendage (*d*) is seen to be continuous with the anterior segment at *e* and the posterior at *f*. The fresh endocardial vegetations are seen at *g*, and several older areas are scattered upon the wall of the auricle.

in the skin have been reported, but demonstrations of the micro-organisms are wanting.

Horwitz reported a case of subcutaneous abscess from Professor Lang's clinic. Gonococci were found and obtained in culture by Paltauf.

The absence of gonococci in the pus of lymphatic buboes may be due to the fact that such lesions are due to other causes, or that the gonococcus rapidly disappears. It is unnecessary for my present purpose to discuss this question at length. The positive results obtained in the case of diseases of various serous membranes, and in one case at least in a subcutaneous abscess, are sufficient to establish the fact that this organism sometimes gains access to the circulation and occasions metastatic lesions. It is, therefore, altogether probable that gonorrhœal endocarditis may occasionally occur.

The following case came under my own observation post mortem. The history and post-mortem study are given as minutely as possible.

Lillian D., a young woman, aged 20 years, was brought to the German Hospital, October 12, 1895, and was placed under the care of Dr. Lawrence Wolff, to whom I am indebted for the permission to publish the case. The following history was obtained:

The patient's father died of phthisis at 34 years. Her mother is still living and well. The patient had neither brothers nor sisters.

She herself had most of the diseases of childhood, including scarlet fever, measles, diphtheria, and mumps. At the age of 7 she had a severe attack of inflammatory rheumatism, and is said to have developed "heart-disease" at that time. The illness lasted about two months, and the convalescence was slow and protracted. About two years later she was ill again, and was told that she had typhoid fever, but the illness lasted only two weeks, and she does not now recall any of the symptoms.

From this date (when she was 9 years old) until the present time she has been well, excepting that her heart has troubled her greatly at times. Palpitations and dyspnea were frequent and easily provoked, but she never suffered with marked rupture of compensation.

A year before her admission to the hospital the patient had begun to have intercourse with a man, and soon developed a distinct and characteristic discharge. She was treated for this, but the discharge continued and was still present when she entered the hospital.

Six days before her admission to the hospital the patient became ill, the onset being rather sudden. The first symptom was diarrhea, but tympanitic distention of the abdomen and pain over the heart promptly followed. She suffered with headache, vertigo, and a tendency to syncope on slight exertion. Her appetite was not much

impaired, but vomiting interfered with the taking of food. The abdomen was uniformly though only moderately distended; the pain was diffuse. There were from two to five loose, yellow stools daily; and the patient complained of slight burning pain on urination. The cardiac pain was constant but not severe. The pulse was weak and rapid; the rate was 124 per minute. Temperature 38.5° C. (101.2° F.).

Physical Examination.—The patient was quite prostrated; dyspnea was evident. The apex-beat of the heart was found in the seventh interspace and outside the nipple line. It was vigorous and fairly regular. On percussion the cardiac outline was found enlarged, mainly to the left and downward. Auscultation discovered peculiar cardiac sounds. In the sitting posture a loud and distinctly marked presystolic murmur was heard over the apex, followed by a less distinct systolic murmur. Another systolic murmur was audible in the aortic region. The pulmonary second sound was accentuated. In the recumbent posture the presystolic murmur was scarcely or not at all audible, but the systolic murmur could be heard at the apex and as far to the left as the axilla or angle of the scapula.

Examination of the lungs revealed no abnormality. The abdomen was moderately distended; the skin was normal (no eruption); there was tenderness on palpation, but nothing abnormal beyond this. The belly was tympanitic, and the area of splenic dulness somewhat enlarged.

The patient was depressed. Reflexes, sensation, etc., normal. Between 850 and 1200 cubic centimetres of urine were passed daily. The examination gave the following results: Specific gravity, 1014; reaction, acid; color, reddish-yellow; small amount of albumin; no sugar. Microscopically granular and hyaline casts, red corpuscles, and kidney epithelium were discovered.

The patient remained in the hospital thirty-two days, until her death. During this period her temperature varied from 36.7° to 40° C. (98.5° to 104° F.), but for the most part it was regular and continuous. A short time before death it became irregular, and immediately before death there was a rapid decline to 35° C. (95.2° F.).

During the latter part of the illness signs of respiratory and cardiac embarrassment became more pronounced. Dulness, impairment of the breath-sounds, and liquid râles were detected at the bases of the lungs posteriorly; and there was some yellowish expectoration. Gradually the patient grew weaker, the pulse and breathing failed, and death occurred on November 13, 1895.

Autopsy.—(Six hours after death.) The body is that of a well-formed young woman. Rigor mortis slight. Post-mortem lividity is marked; the ankles are slightly edematous.

On opening the thorax a considerable quantity of clear serous liquid was found in both pleural cavities. There were no adhesions. The lungs were heavy, and on removal both bases were found to be more or less consolidated. This affected the posterior or dependent portions much more than the anterior parts. On section the consolidated areas were found to be mottled in appearance, some areas being slate-colored, others dark red or violaceous. Areas of distinct, hemorrhagic infiltration merged insensibly into others which were merely congested. The latter in turn were continuous with areas of light color from which liquid flowed abundantly. The upper lobes were somewhat congested and edematous, but not decidedly so.

The pericardium contained but a small quantity of serous liquid. The heart was decidedly enlarged, the hypertrophy involving the left and right ventricles. The superficial vessels seemed normal. A few small "milk spots" were seen in the epicardium. On section the muscle of the heart was found to be fairly firm, but was rather light-colored. For the most part the muscle seemed granular or opaque, but in places was decidedly fatty in appearance. The cavities of the heart were all somewhat enlarged. A striking peculiarity of the mitral valve became evident at once on opening the left ventricle. Viewed from the ventricular side, this consisted in a pouch-like protrusion from the auricle, lying between the anterior and posterior leaflets of the mitral valve. On close inspection this was found to be an endocardial reflexion and had thick chordæ tendiniæ attached to it. When examined from the auricular side, the pouch alluded to was found to be an anomalous appendage of the mitral valve formed in the following manner: At the right extremity of the anterior leaflet of the mitral valve instead of a free edge there was an abnormal continuation of the endocardial reflexion, attached to the wall of the left auricle and held by thick chordæ tendiniæ springing from a supernumerary papillary muscle in the upper and anterior part of the wall of the left ventricle. The anomalous continuation of the edge of the mitral valve extended from the right border of the anterior leaflet in a serpentine manner upward and then downward upon the wall of the auricle, and was continuous at its other extremity with the right edge of the posterior mitral leaflet. The edge of this adventitious valvular segment, as it may properly be regarded, was contracted and thick so that the body or part between the attachment and edge was pouch-like, and it was one part of this which projected through the mitral orifice into the ventricle.

In addition to the anomalous valve there was seen in the auricle wide-spread endocarditis, both old and recent. The wall of the auricle in several places presented small nodular elevations of more

or less sclerotic character, and some of them calcareous. The anomalous portion of the valve was thickened in all parts by interstitial change, but in one part was involved by a fresh inflammatory and necrotic process. This extended to the wall of the auricle at the base of the valve, involving this to a considerable distance. The area of disease was in all two or three centimetres in diameter and one centimetre thick, and presented itself as a mass of fibrinous deposit of a friable character, and papillomatous in appearance. Its color was gray or white in most parts, but was somewhat reddish in other portions. When portions of the deposit were torn from their bases the latter were found to be eroded and necrotic in character.

The aortic valves and the valves of the right heart seemed normal in appearance.

Abdomen.—The peritoneum was healthy. The stomach and intestines presented no special abnormality. The latter were carefully examined, but beyond some prominence of the lymphoid follicles nothing varying from the normal was discovered. The liver was slightly enlarged, and on section was found to be paler in color and more homogeneous in appearance than normal. The pulp was decidedly friable. The kidneys presented much the same appearance as the liver. They were enlarged and lighter in color than normal; the cortex was wide; the capsules stripped easily. In the left was found a recent hemorrhagic infarction of small size. The spleen was decidedly enlarged and was very soft. On section, the Malpighian bodies were found to be prominent and a number of small hemorrhagic infarcts were discovered. The latter were small in size and showed no evidence of retrograde changes. The suprarenal bodies were normal. The pancreas was not noticeably altered. The uterus and its appendages were removed with the bladder and urethra.

On section into the uterus and vagina there was found a considerable amount of muco-purulent exudate in the cervix, and less within the uterus. The mucous membrane was thickened, red, and granular in appearance in the fundus of the uterus and roughened, but less congested in the cervical region. The vagina contained a certain amount of muco-purulent material, but was not itself noticeably affected. The urethra was somewhat reddened and thickened at the external orifice, but the mucosa throughout the canal was not diseased. The bladder was normal. The Fallopian tubes were both somewhat enlarged and on section were found to contain slightly turbid liquid. The walls were thicker than normal. The ovaries presented no evidence of disease.

Microscopic and Bacteriological Examination.—I wish to acknowledge my indebtedness to Dr. S. S. Kneass for his aid in the bacteri-

ological studies of this case. In the course of our autopsies it had been customary to make cultures from the heart's blood and from the various organs; but as no suspicion had been entertained as to the primary infection in this case we were provided with merely the ordinary agar and serum culture-tubes. Cultures were made from the blood of the right ventricle, from the endocardial vegetations, from the lungs, and from the spleen. Cover-glass preparations were made of the muco-purulent matter found in the uterus, of bits of the vegetations of the heart, and of scrapings from the lungs. (Unfortunately the uterus and its attachments were misplaced and thus lost.)

Growths were obtained from the lungs, blood of the right ventricle, and spleen. Those from the lungs appeared as a sparse growth upon the surface of the culture medium, and on microscopic examination proved to be a streptococcus. The blood of the right ventricle and spleen contained a small coccus of the staphylococcus group. The tubes inoculated with bits of the endocardial vegetations remained entirely sterile.

Microscopic examination was made of portions of the various organs (except uterus, etc.) and of the cardiac vegetations. The sections were stained with hematoxylin and eosin, Löffler's blue, Kühne's blue, carbol-thionin, and by Gram's method. The lungs were found to present a mixed form of cellular pneumonia. In many parts the alveoli were filled with large epithelial cells, separated by fluid, or here and there a leucocyte; in other parts the air-spaces were densely packed with leucocytes, while in still others hemorrhagic exudation was pronounced. There were scattered masses of cocci lying in groups like staphylococci and staining with Gram's method or the other methods. No distinct chain formations or streptococci were discovered. Sections of the liver and kidney showed marked epithelial degeneration, the cells presenting a granular appearance, and the nuclei in many places refusing the stain or staining irregularly. In certain areas complete granular degeneration of the nuclei of the cells was observed. The sections of the spleen were marked by the amount of hemorrhagic infiltration observed. Staining for micro-organisms in these organs was negative. The infarcts were studied with particular care, but no organisms were visible.

The sections and examination of the cardiac vegetations gave surprising results. The scrapings made at the autopsy disclosed diplococci in the leucocytes and to a less extent outside of these. These diplococci were well stained with the blue stains, and especially with thionin; they were decolorized in Gram's stain. The portions, rapidly hardened in alcohol which were sectioned, were found to consist of masses of polynuclear and, to a small extent, mononuclear leu-

cocytes, held together by a small amount of fibrin in the form of a wavy network or of a homogeneous matrix. Stained with Löffler's or Kühne's blue, or especially with thionin, large numbers of diplococci were discovered in and between the leucocytes. Those within the cells invariably occupied the protoplasm, never the nucleus. Those between the cells were very sparse and were always grouped in pairs, though clusters of these might be associated. In staining the sections it was found that prolonged decolorization with alcohol decolorized the diplococci. This was much more marked in the case of the blue stains and the aniline oil-gentian violet stain than in the case of thionin. The latter gave by far the most satisfactory results of all the stains employed. It was peculiarly effective when the sections were placed in it for twenty-four hours. The diplococci constantly took on a reddish or violet hue, while the nuclei of the cells were stained a brilliant blue. The nuclei in many parts were almost without exception degenerated and broken into small, round, granulation-like fragments, which made the recognition of the diplococci more difficult in the sections in which other stains were employed. In the sections treated with thionin the micrococci could be readily distinguished from all of such granulations.

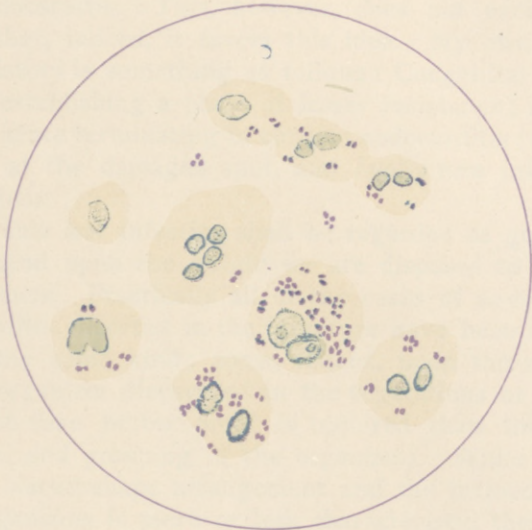
In sections treated by Gram's method the organisms were rapidly and completely decolorized. In studying the micrococci more minutely it was found that, though they occurred in pairs almost exclusively, there were some single forms and other groups in which four were associated in the characteristic tetragonal (merismopedial) form. The separate cocci were in many places characteristically reniform or biscuit-shaped, the longer axes being parallel and the concavities opposed to each other. In other parts this appearance did not exist, though in every group of the micro-organisms some at least were of the biscuit-form.

Cover-glass preparations made from the mucopurulent matter in the vagina and cervix uteri disclosed no diplococci, but merely a short bacillus. Unfortunately, the loss of the specimen prevented a more minute examination of the genital organs, and the presence or absence of diplococci in the deeper tissues could not be determined.

In reporting this case as one of probable gonorrhoeal origin, I am aware that a certain amount of doubt exists, and must therefore detail the reasons that seem to justify its acceptance as a genuine case.

In the first place, the curious condition of the mitral valve requires discussion. This, I have no doubt, was largely a congenital anomaly. The possibility of compensatory hypertrophy of the valvular segments to which Sibson called attention must undoubtedly

FIG. 3.



Gonococci in the cells and between cells. Drawn from one field of the microscope (Zeiss, one-twelfth oil immersion; ocular, No. 3).

be admitted in chronic cardiac disease, and I have seen instances which presented such an appearance; but in the present case there was an appendage of such anomalous character and so extensive that the suspicion of a developmental condition could not have been entertained, even if there had not been a distinct supernumerary papillary muscle to evidence the congenital nature of the condition.

Further, there was a distinct history of rheumatism at the age of 7 and of cardiac disease at that time. Some of the endocardial lesions also showed that there had been an ancient endocarditis. In the light of these facts the attack of endocarditis which led to the patient's death might be put down as one of "efflorescing" or recurring endocarditis. This, however, does not exclude a new infection; rather, indeed, it favors this idea. My own interpretation of the history is something as follows: Congenital anomaly of mitral valve establishing a place of lesser resistance; rheumatism at seven with acute terminating in chronic endocarditis; further loss of resistance at the damaged spot, and finally new infection with fatal endocarditis.

Whether this last infection shall be regarded as gonorrheal or not must depend upon the weight we are disposed to place upon negative evidence. Practically all of the cases of so-called gonorrheal endocarditis reported in the literature have been based upon evidence of the same kind; some, indeed, upon the morphology alone of the organism discovered in the vegetations or elsewhere. At the present time better proof is required than the mere appearance, size, and grouping of the organisms. While it remains true that the biscuit-shape arrangement and the intracellular position of the organisms is more or less characteristic, these features are not entirely distinctive. Bacteriologists uniformly recognize that staphylococci, streptococci, and certain other organisms may be arranged in pairs in practically identical fashion at some stage of their growth. It is proper, however, to add that this is not regularly the case with any given culture, or in any instance in which such organisms are found in tissues, while the gonococcus habitually and almost uniformly presents the grouping alluded to.

The second point of peculiarity that has been relied upon, the intracellular position, is even less satisfactory. A long list of bacteria, including staphylococci, streptococci, and other micrococci, together with various bacilli, might be prepared to show that this feature is by no means characteristic.

Two forms should be referred to more particularly: the diplococcus intracellularis meningitidis, described by Weichselbaum and Goldschmidt in 1887, and the diplococcus albicans tardisimus,

found by Wachholz and Nowak in a medico-legal case of supposed gonorrhoea. The former of these two has been studied with greater care, and while it presents morphological similarities is readily distinguished from the gonococcus by the ease with which cultures are obtained on ordinary media, and, according to Jaeger and others, by the fact that decolorization does not occur with Gram's stain when cover-glass preparations are studied, though it does take place in sections. As far as the bearing of these facts upon my own case is concerned, I have no hesitation in excluding this organism. Cultures with the ordinary media failed entirely, though the number of bacteria in the parts of the vegetations implanted upon the media was enormous. Further complete decolorization with Gram's stain was regularly observed.

Dauber and Borst found in their case an organism which presented the same appearances as the gonococcus, and decolorized with Gram's stain, but showed a different appearance in culture upon blood-serum agar from that of the gonococcus. The difference in culture observed in this single case seems to me too slight to warrant absolute deductions, and I have not hesitated to include this case (as I have also that of Wilms), despite the view of the authors that it was not gonorrhoeal.

Allusion has several times been made to the behavior of gonococci towards Gram's stain, and formerly much stress was placed upon this. It must be recognized, however, that other micrococci behave in a similar manner. Bumm described such forms, some of them diplococci, in his work on gonorrhoeal disease of the mucous membranes, and a number of other authors have reported similarly. Even the staphylococcus in later generations may show this peculiarity, so that the importance of Gram's stain must not be over-estimated.

The final diagnostic criterion is the culture. This includes the medium upon which a growth is obtained and the appearance of the growth itself. The difficulty of cultivating the gonococcus is too well known to require comment. Ordinary media, such as agar, glycerin agar, or the ordinary blood-serum remain sterile. This fact is one of great importance in the diagnosis of some of the reported cases in which no culture of any kind could be obtained, and it was particularly important in my own case. The ease with which I have obtained growths from other cases of endocarditis (due to staphylococci and streptococci) contrasts strongly with their entire absence in this case, and especially as the microscopic examination showed such a wealth of micrococci. As far as our knowledge of bacteria extends, the gonococcus is the only organism of similar morphology likely to behave in this manner.

Taking the evidence all in all, I am therefore led to believe that this case was one of true gonorrheal endocarditis, and not one of a second or other infection. The facts favoring this view are briefly: the entire correspondence with gonococci in morphology, position, and behavior to stains; and the entire failure of cultivation experiments.

The following cases are abstracted to show the character of the clinical manifestations and the pathological lesions in reported instances that may with a certain degree of probability be looked upon as cases of genuine gonorrheal inflammation of the endocardium.

CASE I.—SCHIEDLER ("Casuistik der Herzaffection bei Tripper," Inaugural Dissertation, Berlin, 1880) reported a case from Leyden's clinic occurring in a young man of 22 years. The patient had gonorrhea during the summer of 1879, but this soon subsided. Later the testicle was swollen, and after three weeks arthritis, fever, and night-sweats developed. Three weeks later he was apparently well. In March, 1880, after a chill, he entered the hospital, where enlargement of the heart and a diastolic aortic murmur were discovered. He had marked dyspnea, stupor, and died after a month.

Post mortem, the aortic segments were found to be covered with polypoid vegetations. The author contends that the diagnosis of gonorrheal endocarditis was established by exclusion, no other cause being apparent for the malignant endocarditis.

CASE II.—WECKERLE ("Ulceröse Endocarditis," München, 1886) describes a case which occurred in a young woman of 24 years. On admission to the hospital, April 24, 1886, the patient was suffering with acute gonorrhea and right-sided inguinal bubo. Soon the symptoms of a simple, uncomplicated rheumatism developed. The heart was unaffected. In June, cardiac symptoms had developed, and endocarditis of the pulmonary orifice was diagnosed. Death occurred a month later, the symptoms being those of an acute, malignant endocarditis.

Post mortem the heart was found enlarged, and advanced endocarditis of the pulmonary valve was discovered. The segments were greatly distorted and covered with a friable and irregular deposit, beneath which the valve was necrotic. The lumen of the pulmonary orifice was greatly encroached upon by these vegetations, which scarcely permitted the passage of a lead-pencil. The vagina contained yellowish pus.

Micrococci in clusters and chains were discovered, but these were larger than gonococci. The author does not believe this a gonorrheal case, but, as one of the reviewers has said, he did not make sufficient examinations to assert that gonococci were not present.

CASE III.—ROTHMUND ("Endocarditis Ulcerosa nach Gonorrhöa," Dissertation, Zürich, 1889) reports a case occurring in a man aged 51 years. The patient was admitted on November 7, 1885, with signs of arthritis which followed an attack of gonorrhœa by eight or nine weeks, the gonorrhœa being still present. On November 30, a loud systolic murmur was heard over the mitral and tricuspid areas. On December 10, a high-pitched diastolic murmur was heard over the aortic and pulmonary regions. The day following, the patient sank into collapse, and in a few days perished.

The post-mortem examination, enlargement of the left ventricle and advanced disease of the aortic valve. Two of the leaflets of the latter were covered with vegetations or distorted and perforated. The bladder and urethra contained much thick pus. The right knee-joint and the left ankle-joint were swollen and contained sero-hemorrhagic liquid.

In the liquid of the joints as well as in the blood of the right heart were found micrococci having form and grouping of gonococci.

CASE IV.—HIS (*Berliner klinische Wochenschrift*, No. 40, 1892) reports a case occurring in a young man of 19 years. In February the patient had gonorrhœa which subsided after three weeks. In March he had attacks of syncope and chills; petechiæ were noted in the skin. In April he entered the hospital. The heart was enlarged and a loud systolic murmur was audible over the apex, but especially over the aortic region. No pus in the urethra, and attempts to demonstrate gonococci in the navicular fossa were negative. The temperature was 40.2° C.; the pulse, 194. The patient became somnolent, had continuous remittent fever varying from 38.6° to 40.7° C., and rapid pulse and respirations. Some swelling of the feet. Soft, moist râles at bases of lungs. Death occurred suddenly.

Post mortem the heart was found enlarged; the aortic valves were covered with fibrinous deposits and ulcerated beneath. Hemorrhages beneath pericardium and endocardium and pleuræ. Petechiæ in skin; a puriform clot at apex of heart; slight interstitial myocarditis; edema of lungs; infarcts in various organs. In the diseased areas micrococci were discovered which presented the form and general features of gonococci when stained with carbol-fuchsin, and which, like the latter, were decolorized in Gram's method. Unfortunately the heart was preserved in Müller's fluid, and the examinations, therefore, lose in value. During life, blood obtained from the ear was examined microscopically and attempts at culture made, but failed. After death, no growths obtained from the spleen or infarcts.

CASE V.—HIS (*Berliner klinische Wochenschrift*, 1892, No. 40) reports a case in a young man of 19 years. Six weeks after the

beginning of the discharge swelling of several joints occurred, and later chills, fever, and sweats ensued. In July he was admitted to the hospital, presenting edematous swelling of the face and increased heart action. A blowing systolic murmur was heard at the apex and to the right of the sternum; a diastolic murmur was audible under the sternum. There was a chill, and the temperature rose to 41.1° C. Fever at first intermittent, then remittent. Pain and subsequently an abscess were noted in the forearm. The patient died in a condition of cyanosis and extreme dyspnea. Slight edema of lungs. Death four months after onset.

Post mortem, "acute endocarditis recurrens" of the aortic valve was discovered, and the left ventricle was enlarged. Small aneurismal dilatation of the aorta with fibrinous deposits; infarcts in spleen; beginning acute parenchymatous nephritis; edema of lung, hydrothorax and hydropericardium. The diagnosis, "acute endocarditis recurrens," was made by Dr. Huber, and subsequently changed by Professor E. Wagner to ulcerative endocarditis.

CASE VI.—LEYDEN (*Deutsche medicinische Wochenschrift*, September, 1893) reported a case in which a man of 22 years, suffering with chronic gonorrhœa, epididymitis, and joint troubles, was seized with malignant endocarditis. The patient had remittent fever, frequent chills, signs of aortic regurgitation, and possibly of mitral regurgitation, vomiting, rapid anemia, and general weakness. Finally, marked evidences of infectious nephritis, and death from exhaustion.

Post mortem, deposits and ulcerations were found upon the aortic and mitral valves, and there were small foci of disease in the heart muscle. Cultures made during life with blood from a vein and post mortem with blood of the left ventricle were entirely negative. Sections of the vegetations showed in places near the surface and edges masses of cocci, and near these typical diplococci of the general appearance of gonococci. The latter were mostly within cells and varied in number from one or two pairs to the cell to very many. Leyden and Michaelis regarded these as gonococci, because of their general appearances and form, their ready decolorization by Gram's method, their decolorization with alcohol, and their intracellular position. (Leyden also alludes to a case seen by himself in Traube's clinic when he was assistant, and to one presented in his clinic at Strassburg.)

CASE VII.—WILMS (*Münchener medicinische Wochenschrift*, October 3, 1893) denies the rôle assigned to the gonococcus in Leyden's and other reported cases. He asserts that the studies of the microorganisms in question prove conclusively that it is incapable of producing true abscesses or ulcerations, and never causes metastatic

foci of disease. He himself reports a case of ulcerative endocarditis occurring in a patient who had suffered with gonorrhoea six months before. Three weeks after a second attack he had chills and swelling of his knee. A week after the joint trouble began he had cardiac murmurs and all of the signs of aortic regurgitation. Fever was quite high. Death occurred one and a half months after the onset of the gonorrhoea.

Post mortem, an ulcerative and polypoid lesion was found upon the posterior aortic leaflet, and there were abscesses in the heart muscle. There were very many micrococci having the characteristic arrangement and appearance of gonococci in the leucocytes upon the surface of the vegetations, and fewer organisms in the abscesses. Besides, the typical diplococcus form the organisms occurred singly, and in all cases they were rapidly decolorized by Gram's or Weigert's method of staining. The leucocytes were in places quite filled with the cocci. Still he denies that these were certainly gonococci, and refers to an observation of Weichselbaum in which organisms presenting the appearances of gonococci were observed, and in which cultures showed streptococci. In the urethra there were but few diplococci, and these in the submucous tissue.

CASE VIII.—COUNCILMAN (*American Journal of the Medical Sciences*, 1893) reported a case of a patient who, ten days after the onset of gonorrhoea, suffered with polyarthritis, dyspnea, pain in the chest, and enlargement of the heart. He died of asphyxia after five weeks.

The post-mortem examination showed swelling and redness of the synovia of the knee-joint, and deposit of small tubercle-like granulations upon the surface, hemorrhagic pericarditis, and purulent foci in the prostate. The urethral mucosa was infiltrated with round cells, and gonococci were present in small numbers in and between the epithelial cells, while the leucocytes upon the surface contained large numbers. They were absent from the deeper layers of the mucosa, and, though present in small numbers at the openings of the prostatic tubules, were not found in the pus of the abscess. Besides gonococci only a few short bacilli were found in the urethra. The heart muscle was marked by spots of hemorrhagic infiltration and others of a waxy appearance. Microscopically round-cell infiltration and hemorrhagic foci were found, and gonococci were found in the infiltrating cells of the heart muscle, especially in the left auricle. None were found outside the leucocytes. A few were found in the pericardium. The micro-organisms were also detected in the infiltrating cells of the synovial membranes. Councilman points out that in the absence of cultures the occasional diplococcic arrangement of streptococci is to

be recalled, though the decolorization with Gram's method and the absence of fever in the course of the case are opposed to the supposition of a streptococcus infection.

CASE IX.—FRESSEL (*Inaugural Dissertation*, Leipzig, 1894) reports a case occurring in the person of a maid-servant, aged 26 years, who was admitted to the hospital in a dying condition. No history could be obtained except that the patient had suffered with an inflamed foot four weeks before her admission to the hospital. Severe symptoms began a few days before her admission, and at the time of admission extreme weakness, emaciation, anemia, and orthopnea were noted. There were numerous râles in all parts of the lungs; the heart-sounds were weak and altered; the pulse 140 and scarcely palpable; the temperature was 36.6° C. There was edematous swelling and great pain in the left ankle. Death occurred after two hours.

The autopsy performed twenty-four hours after death. Malignant endocarditis of ulcerative and polypoid character was found upon the anterior mitral and the aortic leaflets. In the former the auricular face was specially affected, and the disease had perforated the base of the valve. The aortic segments were less involved. The heart muscle (left ventricle) was grayish or yellowish. The lungs presented edema, hemorrhagic infiltration, and partial consolidation. The kidneys and spleen were practically normal. The bladder contained a small quantity of pus, and the rugæ were very red. The mucous membrane of the urethra was deep red in color. The mucosa of the vagina was granular and hard; the color was dark red, and there was considerable purulent exudate; at one place there was a prominence, which on incision was found to contain pus. The veins of the right parametrium were enlarged and contained fresh thrombi.

The bones and joints of the left foot were normal, but the subcutaneous tissues were markedly edematous.

Microscopic studies of the heart valves showed micrococci having the characters of the gonococcus. Some of the diplococci occupied cells. They were decolorized in Gram's method.

CASE X.—WINTERBERG (*Festschrift zum 25. Jährlicher Jubiläum des Vereins der deutsche Aertze*, San Francisco, 1894).—Man, aged 25 years, suffered from gonorrhœa, later epididymitis, and then swelling of elbow-joint, chills, fever, and great weakness. Six weeks after onset of gonorrhœa had cyanosis, dyspnea, edema of lungs, systolic and diastolic aortic murmur. Other joints became affected; bloody diarrhea developed; irregular remittent fever, vomiting, albuminuria. Death from exhaustion in seven or eight weeks.

Post mortem, pleural and pericardial effusion, the latter somewhat purulent. Heart muscle pale and with points of pus. The aortic

and pulmonary valves showed extensive destruction, being converted into friable masses; the mitral and tricuspid valves were similarly affected, but less destructively. The liver and spleen showed numerous hemorrhages, and the kidneys had the appearance of amyloid change (?). The intestines presented ecchymoses.

Portions of the vegetations were examined and diplococci of characteristic appearance were discovered in the leucocytes. They were found singly and in pairs. They were readily decolorized by Gram's method. No cultures.

The author refers to a second case in which swelling of knee and ankle-joints, chills and fever developed after acute gonorrhœa in a young man of 25 years. A systolic murmur was audible over the aortic region, and a harsher one over the apex. Under treatment the cardiac signs disappeared and the patient recovered in six weeks.

CASE XI.—THAYER and BLUMER (*Archives de Médecine expérimentale*, November, 1895) report a most interesting case of acute endocarditis due to the gonococcus. The patient was a female, of 34 years, who entered the hospital complaining of cough, weakness, and general pains. She had had two miscarriages. Her illness dated from an attack of rheumatism, which occurred three months before, and in which most of the joints were affected, the disease passing rapidly from one joint to another. The day previous to the admission there was a chill. On examination there was enlargement of the heart with a presystolic and systolic murmur at the apex, and an accentuated second sound in the pulmonary area. She lived nineteen days, showing during this time irregular exacerbations of temperature, often attended with chills, and marked emaciation. The spleen was palpable and there was considerable anemia. Acute ulcerative endocarditis of the mitral valve with infarcts in the lungs and spleen was discovered post mortem. Cultures from the blood during life, on a mixture of blood and agar, showed growths of the appearance of gonococci, and the organisms corresponded in their staining reactions (Gram's method) with gonococci. Cover-slip preparations made at the autopsy from the vagina, uterus, and vegetations on the mitral valve gave similar results, but cultures failed, and a mouse inoculated with a portion of the vegetation remained unaffected. It seems unquestionable that this case was one of true gonorrhœal endocarditis.

CASE XII.—DAUBER and BORST (*Deutsches Archiv für klinische Medicin*, Bd. LVI, Hefte 3 and 4) report a case occurring in a young man, aged 20 years. Ten days before his admission to the hospital a purulent urethral discharge set in, and he came to the hospital on account of pain in the inguinal region. There was a red and tender

swelling in the palm of the left hand. The inguinal glands were enlarged on both sides, and the right spermatic cord was swollen.

The urethral discharge contained diplococci of the characters of gonococci. No other organisms were found. A small paraurethral abscess developed and gonococci were discovered in the pus,—other organisms being absent. The temperature was moderately elevated (the highest point being 38.7° C.), and declined abruptly on the sixth day. On the fourth day after the decline of the temperature there was a sudden chill and rise of fever to 39.2° C., but a gradual decline followed, and after two days the temperature reached 37.4° C. After this there was a mild remitting fever. The spleen seemed enlarged on percussion. The heart was normal in size; the sounds at the apex clear; at the aortic and pulmonary regions the first sound was dull. During a month his condition remained unaltered except that he complained of violent pains in his back and muscles. After the expiration of a month the fever began to be more pronounced and irregular. Finally, evidences of aortic insufficiency (murmur, pulsus celer, arterial sounds, and murmurs) developed, and the patient died three months after the onset of the gonorrhoea.

The gonococci had grown steadily less numerous, and were finally replaced by other bacteria. Among the latter were diplococci of rounded form, without the characteristic biscuit-shape, occurring outside of as well as in cells, and decolorizing with Gram's method. Gonococci were absent from the pus during the last two weeks.

The post-mortem examination was performed five hours after death. Cultures were made with the blood and splenic pulp after the method of Kral.

The heart was enlarged and presented an elevated and papillomatous, but necrotic, area upon the aortic valve. The myocardium beneath this was infiltrated and excavated.

The kidneys presented evidences of septic nephritis; the bases of the lungs were consolidated by pneumonic infiltration.

The spleen was considerably enlarged. The urethra was somewhat reddened in its membranous portions. Sections of the diseased portion of the aortic valve showed it to be composed of fibrin, leucocytes, and thrombi of blood plaques. In these were embedded large numbers of micrococci. The latter occurred in groups in and outside of the cells, and in many places were arranged in pairs and had the characteristic biscuit-shape of gonococci. They were decolorized by Gram's stain and by alcohol. They were absent from the spleen, the lungs, and from the other tissues; but the cover-glass preparations made with blood taken from the heart and with the splenic pulp showed micro-organisms which presented similar ap-

pearances, and behaved in the same manner towards stains as the ones referred to.

The culture-tubes all remained sterile with the exception of one blood-serum-agar tube. Upon this small punctiform, yellowish-brown, transparent colonies developed after thirty-six hours. With moderate magnification these appeared round, and the outlines were sharp. Moreover, there were none of the smaller surrounding colonies such as are characteristic of growths of the gonococcus. The organisms found in these cultures proved to be diplococci having the same general characteristics as those of the cover-glass preparations and of the vegetations in the heart.

The authors conclude from these studies that the case in question is one of endocarditis due to a micro-organism resembling the gonococcus. They look upon the urethra or the paraurethral abscess as the starting-point or portal of entrance of the micro-organisms.

CASE XIII.—ZAWADSKI and BREGMAN (*Wiener medicinische Wochenschrift*, February 15, 1896) record a case in a girl of 17 years, who had been exposed to infection and had a muco-purulent discharge from the uterus and vagina. Cultures demonstrated the presence of staphylococci and the micrococcus tetragenus, but no gonococci grew on the acid gelatin of Turro. About a month previously, shortly after first exposure, she had suffered with headache, chills, fever, and pain in the limbs. After a week she improved, but soon relapsed, and was admitted to the hospital with right hemiparesis and loss of sensation on the right side, even involving the face. The heart was enlarged and a presystolic murmur was detected at the apex. The second pulmonary sound was accentuated. The other organs were healthy. A week later the palsy disappeared and diarrhea set in temporarily, but recurred after relief. Chills and fever continued and pleurisy developed. Subsequently signs of nephritis, cerebral embolism, and stupor. The autopsy showed verrucose endocarditis of the aortic valves, embolism of the left Sylvian artery, edema of the lungs, large, white kidneys, pleural and pericardial effusion, and pneumonia. Organisms showing the morphological characters of gonococci and the characteristic behavior towards Gram's stain were found in and between the cells. Examination of the pleural exudate during life showed streptococci, staphylococci, and the micrococcus tetragenus.

CASE XIV.—FINGER, GHON, and SCHLAGENHAUFER, (*Archiv für Dermatologie und Syphilis*, Bd. xxxiii, Heft 1-3) report a case in a young man, 19 years old, previously healthy. The patient acquired gonorrhoea (the second attack) in March, and on April 15 had severe

pain and swelling of one knee. There was no previous history of rheumatism, cardiac disease, syphilis, or alcoholism. Cultures from the urethra on his admission to the hospital, April 29, showed gonococci. The next day a loud diastolic murmur was heard over the aortic valve, and this increased in loudness. The urethral discharge ceased the same day. On May 3 death took place from edema of the lungs. The autopsy showed acute endocarditis of the aortic valves with hypertrophy of the left ventricle and myocarditis. There was urethritis and suppurative arthritis.

Examination of the cardiac vegetations showed diplococci having the morphology and staining properties of gonococci. Cultures made from the vegetations, the blood, the joint, and the urethra remained sterile.

The cases included in this series are, some at least, of decidedly doubtful character and standing alone, but few of them could be regarded as definitely suggestive. In only one instance (that of Thayer and Blumer) were cultures of the gonococcus obtained, and in this case the subsequent propagation of the organisms failed. Several of the cases seem fairly certain from the discovery of abundant microorganisms and the entire failure of attempts at cultivation. Other cases in which the diagnosis was made from the morphology alone are supported by the clinical history and etiological considerations. The case of Schedler (Leyden's first case) is included on account of the marked similarity with more certain cases and on account of its importance in the history of the disease. A few cases recorded and probably well determined have been omitted as the original papers or satisfactory abstracts could not be consulted. Only fatal cases and those subjected to more or less satisfactory study have been included. No case has as yet been discovered in which the diagnosis has been established by bacteriological examination (of the blood) and which has terminated in recovery.

TABULATED REPORT OF CASES.

No.	Reporter.	Sex.	Age.	Onset and Previous Condition.	Duration.	Important Symptoms.	Fever.	Form of Death.	Pathological Lesions.
1	Schedler (Leyden).	M.	22	Nine or ten months after gonorrhoeal rheumatism.	One month.	Dyspnea, stupor.	.....	.....	Aortic, polypoid; no micro-organisms.
2	Weckerle.	F.	24	Bubo and simple (?) rheumatism one month.	One month.	Symptoms of malignant endocarditis.	.....	.....	Pulmonary; micro-organisms (?).
3	Rothmund.	M.	51	Two and a half months, arthritis, cystitis.	Two weeks.	Cardiac symptoms, collapse.	.....	Collapse.	Aortic.
4	His (1)	M.	19	Five weeks after gonorrhoea.	One month.	Roseolus and petechial eruption, edema, chills and fever, 40.7° C., signs of aortic valve-disease.	Continuous, remittent.	Sudden.	Aortic and myocardial.
5	His (2)	M.	19	Arthritis six weeks after gonorrhoea, cardiac disease about same time.	Eight months.	Chills, pains, arthritis, aortic regurgitation, syncope, edema.	Intermittent and remittent.	Death from edema and hydrothorax.	Aortic valve, aneurism.
6	Leyden.	M.	22	Chronic epididymitis, arthritis.	One month.	Malignant endocarditis, chills, remittent fever, vomiting, infectious nephritis.	Remittent, continuous.	Exhaustion	Aortic, mitral, and myocardial.
7	Wilms.	M.	26	Gonorrhoea six months before; a second attack followed in three weeks by arthritis, endocarditis one week later.	One and a half months after gonorrhoea.	Chills, arthritis, signs of aortic regurgitation.	High.	.....	Aortic and myocardial.
8	Councilman.	M.	..	Polyarthritis.	Five weeks.	Dyspnea, pain in chest, asphyxia.	No fever.	Asphyxia.	Myocardial.
9	Fressel.	F.	26	Inflammation of foot, vaginitis, and abscess under mucosa.	.....	Weakness, emaciation, anemia, orthopnea, râles in lungs.	36.6° C.	.....	Mitral and aortic.
10	Winterberg.	M.	25	Epididymitis, orchitis four to six weeks.	Seven to eight weeks.	Chills, fever, dyspnea, infectious nephritis, edema of lungs.	Remittent.	Exhaustion.	Aortic, mitral, tricuspid, pulmonary myocardial.
11	Thayer and Blumer.	F.	34	General rheumatism three months before.	Nineteen days.	Weakness, chills, fever.	Irregular fever.	.....	Mitral.
12	Dauber and Borst.	M.	20	Ten days enlarged glands; paraurethral abscess.	Three months.	Fever, chills, pain in back and limbs, pneumonia.	High and irregular.	.....	Aortic and myocardial.
13	Zawadski and Bregman	F.	17	Pain in limbs (?).	Eighty days.	Fever, chills, paralysis due to embolism, pleurisy and pneumonia, nephritis.	Irregular and high.	Cerebral symptoms.	Aortic.
14	Finger, <i>et al.</i>	M.	19	One month after gonorrhoea, arthritis (?); fourteen days later murmur.	Four days after murmur.	Arthritis, cardiac failure, edema of lungs.	.....	Pulmonary symptoms.	Aortic and myocardial.
15	Stengel.	F.	20	Chronic gonorrhoea one year.	Thirty-two days.	Diarrhea, abdominal tympany, dyspnea, vomiting, cardiac pain and palpitation, fever, pneumonia, infectious nephritis.	Continuous, 36.7° to 40° C.	Exhaustion.	Mitral.

CLINICAL AND PATHOLOGICAL FEATURES.

The attempt to construct a clinical history and course from the above cases must necessarily be somewhat unsatisfactory. It is highly probable that many cases of milder endocarditis arise in the course of gonorrhea and proceed to a favorable termination or end in chronic valvular disease. Some of these may be due to secondary infection; some to the gonococcus itself. It is impossible at the present time to determine the nature of such milder cases, and the clinical study of the disease must be confined to those in which autopsies have been obtained.

Sex and Age.—Of the fifteen cases here recorded, ten were males and five females, a proportion that is easily explained by the frequency of the primary disease in the two sexes and by the number of local complications from which the general infection could occur. The age of the patient is, of course, in similar manner, explained by the age at which the primary disorder commonly occurs.

Source of Infection; Intermediate Complications.—In some cases no intermediary condition is observed between the original gonorrhea and the endocardial disease. This was true of His's first case and of my own. I was careful to examine the uterine appendages, the periurethral strictures, and the bladder with great care, and discovered no macroscopic lesion. It is unfortunate that the specimens were lost and microscopic examinations of these structures could not be obtained. In the case of Zawadski and Bregman the manner of the infection was doubtful. The patient complained of great pains in the limbs, but there was no localized lesion; and it seemed as if a general septicemia occurred at once. In the twelve cases remaining some form of secondary complication intervened between the gonorrhea and the cardiac disease. In ten of the twelve there was a history of arthritis; in six of these arthritis alone is noted; in one bubo and arthritis; in one arthritis and cystitis; in one chronic epididymitis and arthritis; and in one an abscess under the vaginal mucosa. Of the two cases which presented complications without arthritis, one showed a paraurethral abscess with enlarged glands, and one epididymitis and orchitis.

Date of Onset.—The time-relation between the original infection and the occurrence of cardiac symptoms was quite variable. In one case the interval was quite short, something over ten days (Dauber and Borst); but in most of the cases it ranged from four or six weeks to two or three months. In one case it was nine or ten months; in my own it was a year after the gonorrhea began, and in one it is merely stated that the patient suffered with chronic gonorrheal epididymitis and orchitis.

The onset of the disease was frequently abrupt, and marked symptoms were early developed in most instances. Chills and fever marked the beginning in some, while others presented cardiac manifestations at the onset.

Important Symptoms.—The clinical history of these cases does not differ much from that seen in other forms of intense malignant endocarditis. High fever of continuous remitting type or sometimes intermittent was noted in practically all cases. In Councilman's case (which, it may again be recalled, was one of myocarditis and not endocarditis) there was complete absence of fever, and the author is disposed to place considerable significance upon this as a point from ordinary micrococcic infections. The fact that fever occurred in all of the other cases in which this point is noted in my table shows that no great reliance could be placed upon this view. Prostration, sweating, increasing anemia and emaciation, and sometimes pronounced nervous symptoms with the final development of a condition that might properly be spoken of as a typhoid state, were observed in the majority of the cases. In my own, these symptoms with abdominal tympany and diarrhea were sufficiently pronounced to lead to the suspicion at first that the case was one of typhoid fever. Perhaps even more frequently the patient presented the appearances of an intense form of septicemia, having repeated chills with irregular paroxysms of fever and drenching sweats, roseolous or petechial eruption, and sometimes embolic manifestations or albuminuria and casts as an indication of the supervention of infectious nephritis. Edema of the lungs and pneumonia are noted in a number of cases. The cardiac manifestations were prominent in only a minority of the cases, the symptoms, dyspnea, pain at the heart, and palpitations being usually overshadowed by the general systemic disturbance. The duration of the disease was variable. In Finger's case death occurred four days after the murmur was discovered; in the case of Rothmund there is some doubt as to the exact duration, but as nearly as can be determined death seems to have occurred two weeks after the first symptoms developed; in Thayer and Blumer's case the duration was nineteen days, while in several others it was one month. The longest case noted is the second one of His, in which the duration is set down as being eight months. Death usually took place from exhaustion and general intoxication, or from rapid weakening and collapse.

In several of the cases pulmonary symptoms and asphyxia marked the close of the disease.

The seat of the disease was the aortic valve in eleven out of the fourteen cases (Councilman's case is omitted); the aortic valve alone being involved in eight cases, the aortic with the mitral in two cases,

and the aortic with the other three valves in one. The mitral valve was involved alone in two cases and the pulmonary alone in one case. The myocardium was alone involved in one case (Councilman's), and in connection with valvular disease in six cases, four of these being cases of aortic disease and myocardial disease, one aortic, mitral, and myocardial, and one myocardial with involvement of all the valves.

As for the lesions themselves, it was found that these for the most part were considerable in size and in the area of involvement. In most of the cases in which accurate descriptions are given there were large polypoid excrescences of friable character and covering more or less deeply eroded or necrotic areas of the endocardium. Complete destruction of the valve segments was not usual.

