tal close to the occiput. It should be traced down to the spine and be divided, or better, ex-sected. This divides the first cervical nerve.

7. An inch lower down than the occipital and under the complexus is the external branch of the posterior division of the third cervical nerve to the splenius capitis. When found, divide or ex-sect close to the bifurcation of the main trunk. This divides the third cervical nerve. Insert a drainage tube and horse hairs; patient lies on back.

Author's operation for the relief of spasmodic torticollis. An incision is made along the anterior border of the sterno-cleido mastoid muscle from the mastoid process to the sternum, joined by a transverse incision three inches in length, following the course of the clavicle. The sterno-cleido mastoid muscle is cut free from its sternal and clavicular attachments.

The cervical fascia is divided and the sterno-cleido mastoid muscle, skin, fascia, etc., are dissected free and retracted backwards, well behind the deep vessels of the neck. By carefully separating the sterno-cleido mastoid muscle from the underlying tissue at its upper extremity, it is quite easy to recognize the spinal accessory nerve as it passes into the sterno-cleido mastoid muscle. Do not look too deep; it is quite superficial when such an extensive incision has been made. It can be found about an inch and a half below the mastoid process. After it has been found, it should be freed to such an extent that at least one or two fingers can be placed beneath it; it should then be thoroughly stretched and its several branches should be cut as close to the muscle as possible. Grasp the proximal end with a strong artery forcep and proceed to wind it on the forceps so as to avulse it from its origin.

By careful blunt disection, posterior to the deep vessels, the transverse processes of the upper cervical vertebrae are soon exposed. The vessels, lymphatics and fatty tissue are retracted forward and the second, third and fourth cervical roots can readily be brought into view. Of these, the second and third roots are divided as close to their origin, and as much of the nerve is destroyed by avulsion and exsection, as is possible. The first cervical root cannot be reached. The phrenic nerve must be located and care taken not to injure it.

The sterno-cleido mastoid muscle is again sutured to its severed sternal and clavicular attachments; the superficial cervical fascia is re-united by fine interrupted sutures, a carefully placed subcuticular silk worm gut, in three pieces, closes the wound most satisfactorily and, when carefully done, leaves a very slight scar. A plaster-of-Paris dressing with the head in the normal position is applied, extending around the upper part of the chest, neck and head. It is trimmed out thoroughly to furnish abundance of arm room, also trimmed about the head and face until only a band about the forehead and a strong support in the back of the neck remains. This can be removed at the end of a week or ten days, the sub-cuticular stitches removed, and the patient allowed to leave the hospital with instructions to avoid excitement, to eat plenty of nourishing food and remain out of doors as much as possible. This is done for the reason that a great deal of blood is lost during the operation and the patients are, as a rule, in a run-down condition. There will probably be some twitching remain, which, however, disappears in from one to three months.

Conclusion. Judging from results obtained from the different methods of treatment, there is no question in my mind but that the most satisfactory treatment is surgical.

The simple division of the spinal accessory nerve gives some good results, yet, in many cases, the cure is not complete and a second operation is frequently refused, leaving the patient in a condition little better than he was before the operation. I, therefore, am of the belief that the greatest amount of satisfaction to both the patient and the surgeon will be derived from making the extensive operation which I recommend whereby the spinal accessory nerve and the second and third cervical roots are resected.

It is true that there are cases which are cured by the simple division of the spinal accessory nerve, and the division of nerve roots would be superfluous, but the amount of atrophy and loss of motion following the resection of these two roots is so small, that the damage done by cutting them unnecessarily, really amounts to nothing.

(*To be continued.*)

SPIRAL ORGANISMS IN RELATION TO SYPHILIS.*

By THEODORE G. DAVIS, M. D., Los Angeles.

So much interest has been manifested in Schaudinn's announcement of the discovery of the organism causing syphilis, and so positive is the evidence accumulating in its favor, that I am led to ask you to consider with me its value as a means of making an early differential diagnosis of syphilis, and in so doing will direct your attention to other spiral organisms present in disease.

With the beginning of last year—1905—the spirochete entered the field as an important factor in the etiology of disease with the discovery by Ross and Milne of the presence of such organisms in the blood of patients suffering from "tick fever" in the Congo Free State. Dutton and Todd later established that they were transmitted by a tick (Ornithodorus moubata) which had become infected by biting patients suffering from "tick fever," and Koch confirmed these observations.

For the spirochete of relapsing fever—spirochete Obermeieri—similar relations seem to obtain, for it was long since announced by Karlinski that this spirochete could remain alive in the bedbug (cimex or acanthia lectularis) as long as thirty days, and Schaudinn has demonstrated that the spirochete of relapsing fever multiplies in the intestines of the bedbug and is voided with its feces. The contamination by its feces of the organs by which the insect feeds is a method by which relapsing fever is spread from person to person; it is also transmitted

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by the blood of the insect through abrasions of the skin.

Marchoux and Salimbeni found in a disease fatal to fowl in Brazil, a spirochete that was transmitted by the fowl louse or tick (argus miniata), and Sakharoff found in the blood of geese suffering from an epidemic form of septicemia, a spirillum which, when innoculated into healthy birds or transmitted by the biting of the fowl louse or tick, produced the disease —the geese suffering from diarrhoea and dying in about a week. He named this spirillum anserum. It resembles the spirochete Obermeieri and is actively motile. The fact that organisms causing these diseases in fowls are transmitted by the bite of insects, and that relapsing fever can be transmitted by the bedbug as malaria and yellow fever are transmitted by mosquitoes, suggests the possibility of transmitting syphilis in a similar manner, and this is more probable when we consider the relationship which appears to exist between the causative organisms. The flea may be a possible factor in spreading this disease, as it has been shown to transmit a trympanosome, or the bacillus pestis, from rat to rat and from man to man. And it is not beyond credence that man may be inoculated by biting flies with equine syphilis, known as"Dourine," and it is even possible that a vaccine may be obtained from this source.

As early as 1893 Smith and Kilbourne showed that the "Texas fever" affecting cattle was transmitted by a tick (Boophilus bovis), from one animal to another, of the organism Pyroplasma bigeminum, and Wilson and Chowning (1905) have reported the infection of man by a similar if not identical organism in the so-called "Montana spotted fever," which they believe to be transmitted by the tick (Dermacentor) from the gopher to man.

Metchikoff and Roux demonstrated that the virus of syphilis did not pass through a Berkfeld filter, and that it was easily injured and destroyed by low degrees of heat, being rendered inactive after heating for one hour at 51 degrees C., or in half an hour it heated to 60 degrees C. Glycerine does not destroy its pathogenic power.

We have long been acquainted with the fact that various spirochete and spirilla inhabit the body, especially the mouth and about the genitals, and Metchnikoff points out that previous writers had suggested the possibility of a spirochete being the cause of syphilis. Donne, in 1837, and Alvarez and Tanel in 1885, referred to this. The organism they saw was doubtless spirochete refringens, but Bordet and Gengou, early in 1902, observed fine spiral organisms in material from a chancre and from a mucous patch, but, as it was not constantly found by them, they did not venture to ascribe etiologic importance to it. Horand (1902) in blood obtained from the arm veins of a syphilitic child, found actively undulating needle-like bodies darting in various directions. Refringent bodies were seen in and around the red blood corpuscles, and red corpuscles containing granules were observed, as well as sporulating bodies, especially numerous in the mucous patches. He concluded the pathogenic agent of syphilis to be a parasite of evolution, a protozoon.

In March, 1905, Schaudinn recognized in a smear preparation obtained from secondary syphilitic papules, a spiral organism which he called spirochete pallida, and which he described as an extremely delicate spirally twisted organism varying from 4 to 14 microns in length (averaging 7 microns) and from an immeasurable thinness to one half of a micron in thickness, having from three to twelve corkscrew-like turns in its middle and tapering in both directions to pointed ends. He believed it to have an undulating membrane, but this was not satisfactorily shown. Flagella have since been demonstrated by Hexheimer and Loser, whose findings Schaudinn confirms, for he has, by means of Loeffler's mordant stain, been able to make out flagella at both ends, and sometimes, if not always, two flagella are seen at one end. He now doubts the existence of an undulating membrane. The organism is actively motile, moving in the direction of its long axis with a rotary motion, coming to a standstill and resuming its course or going in the opposite direction. It also possesses sinuous and undulating movements affecting the entire body. The character of its curves, its tenuous form, as well as its refractivity to stains, makes its identification relatively easy; yet frequently diligent search is required to find the organism, and the fact that upon the ulcerating surfaces of syphilides other spiral organisms, not limited to specific lesions, may be found, adds to the difficulty and sometimes confuses.

In the interior of syphilitic lesions the coarser, more easily staining spirillar forms are less numerous or absent, but usually even here it is associated with the larger, coarser and more readily staining spirochete refringens from which the treponema pallidum can be differentiated by its smallness, delicacy, faint refraction of light and especially in the nature of its coils, which are corkscrew-like, narrow, deeply bent and regular. These characteristics are constant whatever the source of the specimen, whether it be primary lesion, gland, mucous patch, papule, bulla or syphilitic liver, whether the disease be congenital or acquired.

Vuillemin regrets that the probable organism of syphilis should have been called spirochete pallida, a name created by Ehrenberg for the spirochete plicatile. He proposed the name "spironema pallida" for his spiral protozoon with pointed ends which differs from the trypanosomes in the appearance of the undulating membrane and flagelliform prolongations. As the name spironema had been given to another organism with different characteristics Schaudinn suggested that the new organism be called treponema pallidum, which is more expressive and characteristic. Vuillemin approves and I shall hereafter use this as the name of the organism of syphilis.

Vuillemin adds that upon further investigation the organism will doubtless prove to be a protozoon. This gives greater value to the observation by Horand in 1902 "of refringent bodies as well as granules in the red globules and the presence of sporulating forms," and to the finding by Castellani of spiral organisms in four out of eleven cases of Parangi or "Yaws," considered a modified form of

syphilis, one variety being identical with the organism described by Schaudinn. In three of these cases presenting spiral organisms and one that did not, were also found peculiar oval, chromatin containing bodies, regarding which he does not offer any explanation, but which may be a stage in development or possibly an independent organism.

The constant presence of the treponema pallidum in specific lesions, its finding in the blood, in the organs and in the lesions of congenital syphilis, in the experimental leisons produced by human syphilitic virus in monkeys and on the other hand its total ab sence in any other pathologic condition, appears highly suggestive, although the conclusive evidence for its etiologic character is not yet made out.

It is a very fortunate co-incidence that Schaudinn's discovery was preceded by the success of a number of investigators, Roux, Metchnikoff, Neisser, Flexner and others in inoculating syphilis into monkeys, thus establishing the possibility of dealing experimentally with many of the obscure features of the disease. This possibility will be of pre-eminent importance as to etiology, and we may expect with a great deal of confidence, that it will assist in demonstrating the etiologic role of Schaudinn's organism. The inoculation of these and possibly other animals will doubtless play an important part in elucidating many problems in human syphilis. Among such problem are: The immunity of the mother who gives birth to a child infected by the father at the time of conception; (Colle's law) the occasional occurrence of reinfection and the persistence of infectiousness and transmission of the disease into the third generation, of which a number of examples have been reported. Allow me to review briefly the work done in the experimental laboratory that we may appreciate its value:

Klebs, in 1879, was the first to employ monkeys for experimental inoculations with syphilis; Sperk, in 1886 and 1888, first successfully transmitted syphilis from man to monkeys and proved the possibility of successive transmission of the virus from animal to animal.

Metchnikoff and Roux were led to employ the chimpanzee because of its zoological relationship with man, and this choice was particularly fortunate as this animal reacts in a constant and characteristic manner and follows closely the course of inoculation in humans. After the inoculations, the scarifications quickly healed, no visible lesions appearing until the twenty-sixth day, when a small vesicle increasing in size and becoming indurated was noted on the prepuce; the lymphatic glands of the groin began to enlarge and became readily palpable. Eighteen days after the appearance of the primary lesion, small persistent lesions appeared on the tongue and three weeks later other lesions appeared on the lower lip as well. These erosions were regarded as mucous placques. Just fifty-six days after the inoculation, papules were noted upon the thighs, abdomen and back. The peripheral zone of these papules was at first red, later becoming pigmented; the mid-zone was paler and became covered in the center with a scaly crust. On scratching, serum exuded. After a month, these papules healed but markings were visible for some weeks. Later, the animal developed a paraplegia. They also showed that the syphilitic poison was transmissible from ape to ape without undergoing appreciable alteration of quality as evinced by the effects produced.

Neisser's and Lassar's experiments confirm the preceding. They describe secondary luetic papules on the hands, feet and about the anus of apes, which were studied histologically by Becker and Mayer and shown to agree with corresponding lesions in man and similar conclusions were arrived at by a study of Metchnikoff's specimens by Arnal and Salmon. Flexner, from his own experiments, was able to establish the essential identity of experimental and acquired primary lesions and doubtless the use of the higher apes will aid us in time to solve many disputed points in human syphilis.

The question naturally arises, What is this organism found in the lesions of syphilis and what is its relation to other spiral organisms?

In a recent article Blanchard reviews our knowledge of and classifies these organisms, as follows:

I. Spirobacteria, vegetable in origin.
   Genera—Spirosoma, from the nose and throat.
   Vibrio, as the comma bacillus, etc.
   Spirobacillus.
   Spirillum, from stagnant waters, etc.

II. Trypanosomidæ: protozoa.
   Genera—(a) Spirochete, to which belong those found in stagnant water and in the secretions of the genitals and intestinal tract, their ulcerating surfaces and neoplasms. Those found in animals which associate with man, as the dog, rat, etc., and those which have been recognized as of pathological importance, viz.:
   Spirochete (Obermeiri, 1873) relapsing fever.
   Spirochete, refringens (Schaudinn, 1905).
   Spirochete, pallidula (Castellani, 1905), in parangi or yaws.
   Spirochete, Vincenti—ulcero-membranous angina.
   (b) Treponema (Schaudinn) syn. (Spirochete, Spironema).
   Species: Trep. pallidum.
   (c) Trypanosoma.
   Species: Tryp. Gambiense (Dutton).
   Sleeping sickness and allied diseases; and Trypanosomes found in animals (the horse, rat, etc.).
   (d) Trypanoplasma: found in

fish, frogs, etc. Four species have been described.

Of what value will a comparative study of these spiral organisms be, in making a diagnosis?

When we recall that Blanchard describes nearly two dozen spirillum and twenty-one spirochete, it becomes evident that we must limit the field of our review. The comparative study of these micro-organisms shows the vast differences which exist between the spiro-bacteria and the protozoan trypanosomidæ to which the spirochete or, more properly, treponema of Schaudinn belongs. It also shows how members of both groups are able to adapt themselves to special conditions of life as parasites and the degree of virulence and the varied roles they play in human and comparative pathology as well as pointing the way to new fields of research.

It is beyond the limit of this paper to consider all of these and I shall be content with calling your attention to those that are commonly found or likely to be associated with the treponema pallidum in the various syphilitic lesions of the genitals, anus, mouth and nose, and those found in the blood. It may be well to state briefly the characteristics of the various groupings described by Ehrenberg and amended by Loeffler and others.

Spirillum are *rigid cells* long, spirally bent, somewhat like a corkscrew with usually a polar bunch of flagella of many long principal and several short accessory ones.

Trypanosoma, distinguished by a somewhat long body, are more or less spirally twisted, with an undulating membrane and one to several flagella, together with a "flagellum root" and one nucleus. They are exceedingly motile and vary in size, being two to three microns in breadth by eight to thirty in length. They are transmitted by biting insects.

Spirochete are flexible, long, spirally coiling threads possessing locomotion by means of an undulating membrane as well as by flexion and rotary movements. In some varieties, flagella have recently been shown to exist.

We will first consider the long known spirochete of relapsing fever, the spirochete Obermeieri. Large, flexible, motile, threads, coiled like a corkscrew, with pointed ends, 1 micron in thickness, 10 to 40 microns in length. Flagella not known. It stains readily with anilin dyes. It is not stained by Gram's method. Ganther recommends freeing them of part of their albumen by means of a 1 per cent to 5 per cent acetic acid solution before staining.

Historically of interest, is the spirillum plicatile, occurring in marsh water during the summer months, interesting because it was named by Ehrenberg in 1833, spirochete pallida, but it is easily distinguished from Schaudinn's organism by its size, being 2.25 microns in breadth, 110 to 125 microns in length, and by the fact that the ends appear bluntly cut off and the threads have both primary and secondary windings, the former being of equal size, but the latter being often irregular. They exhibit rapid movements and stain readily with anilin dyes. During cultivation they break into long rods, then short rods and finally cocci, somewhat after the manner of Beggiatoa.

In lesions about the genitals we must distinguish Schaudinn's organism from the spirillum balanitidis, but these stain readily, are larger, coarser, with wave-like curves and blunt rounded ends.

In specific disease of the nose we may find the treponema associated with the spirillum nasalis (of Weibel) which are non-motile curved rods and spirilliform filaments.

Associated in lesions of the mouth may be the spirillum dentium (Miller), which, though pointed, are ten to twelve microns in length, and the spirillum linguae (Weibel), which occur as spirilla, spirillar filaments, curved rods and involution forms, and are distinguished from the other forms described by Weibel by being stained by Gram's method.

Occurring in saliva and about diseased teeth are curved rods very similar in appearance to the comma bacillus, the spirillum sputigenum (Miller), which has flagella on its sides and not on the ends.

In lesions about the soft palate and pharnyx or tonsils, we may also find the spirillum of Vincent's angina associated with the fusiform bacillus. The fusiform bacillus are non-motile, long slender rods slightly bent, 6 to 12 microns in length, somewhat larger in the middle and usually with pointed ends. They do not stain by Gram's method, but stain fairly well with Loeffler's methylene blue and anilin water gentian violet, but best with carbol-fluchsin. The spirillum, also spoken of as spirochete, which is associated with the fusiform bacillus in a symbiotic relation, is long and delicate with 3 or 4 turns and usually actively motile. They stain uniformly but much less intensely than the bacilli and may be easily overlooked. They do not stain by Gram's method and are much more easily decolored than the bacilli.

I have previously pointed out the differential characteristics of the spirochete refringens, so frequently found associated with the treponema pallidum that the relation of symbiosis has been suggested. The difficulty of satisfactorily and quickly staining this organism of syphilis will doubtless soon be removed. Giemsa's stain has been used by most of the investigators, and, so far, is the base of all satisfactory stains. The modification of this stain for tissues, by Levaditi, by the previous use of silver nitrate has also been applied to smears, and recently Goldhorn's blood stain, intensified by Gram's iodine solution, has given rapid and excellent results.

In the primary sore as well as in the enlarged glands and mucous patches, the treponema is found associated with the spirochete refringens. In the lesion, especially if the chancre assumes a phagedenic character, a fusiform bacillus has been found. This bacillus resembles the fusiform bacillus associated with a spirillum in ulcero-membraneous angina (or Vincent's angina) and probably has a similar symbiotic relation. Delamer and Tanasesco state "at times the bacilli assumed the form of spirals and suggests possible developmental relation."

Hirxheimer and Hubner first demonstrated the

treponema in the tissues, and Burnet and Vincent made sections of a chancre of five days' duration, the tissue being stained by Levaditi's method, and found the parasite. Few, in the central portion, but numerous in the papilla and connective tissue, as well as in the zone of infiltration. That the treponema is found in limited areas principally about the blood vessels, explains its absence from many smears obtained from primary sores and mucous patches, and this should be borne in mind when collecting material for examination.

So far as we know the treponema pallidum is the only spiral organism which penetrates the deep tissues affected by primary and secondary syphilis. They invade the tissues and lymph spaces, and in this manner cause adenitis and enter the vascular circulation. The presence of the organism in the walls of the vessels and about them in the perivascular spaces, explains the occurrence of arteritis and periarteritis. The absence of the organism from the indurated areas suggests that the sclerosis resulting from perivascular infiltration by round cells is a factor in the local destruction of the parasite.

Veillon and Girard found the organism in sections of a syphilitic roseola of four days' duration. The section showed intense congestion of the capillaries and beginning perivascular infiltration. The organism being found in the sub-capillary vessels and in the terminal capillaries of the papilla, only few being found in the perivascular nodules. From this it would appear as if the roseola was due to a true parasitic embolus lodged in the terminal capillaries of the skin followed by a perivascular infiltration. It is because of the depth of the tissue invaded that it is necessary to use a long acting blister to obtain serum for examination from the secondary skin lesions of syphilis.

Levaditi, working with Salmon, found the organisms in sweat glands and suprarenals as well as in the hepatic tissue and in the bronchial epithelial cells and pulmonic endothelial cells of a baby dying of hereditary syphilis (sixteen hours after birth). In the lungs many treponema were found along the pulmonary capillaries, and in the perivascular lymph spaces, as well as in the epithelial cells lining the alveoli and bronchial tubes. Hence Levaditi suggests they may be present in the sputum of certain syphilitics and a means of infection.

In the liver, the treponema are abundant around the intralobular venules, from which they appear to radiate into the intercellular spaces between the hepatic cells. They are also abundant in the perivascular tissue and the endothelial walls of the vessels, but none were found in the lumen of the vessel. Yet their perivascular distribution points to their dissemination by the vascular system, primarily from the lymph spaces by the lymphatics.

In the section of the liver of a child who died four hours after birth of syphilis and which had been stained by Levaditi's method I found the treponema about the liver cells in the intercellular spaces more delicate and lighter staining than those in the spaces between the connective tissue cells of the portal tracts or even about the blood vessels. This variation in the appearance of the organism is supported by the observations of Richards and Hunt, who state that it appears in three forms, possibly developmental, evolution or involution forms, differing in thickness, length, and the number of spirals; one form being thick and straight or but slightly curved, a second of the same thickness but with the well defined spirals, and the third exceedingly thin, distinctly spiral, with a large number of turns and very long, the latter being found in the deeper tissue. Most of the observers believe these to be distinct forms. Besides this, I found globular cells with granular bodies deeply staining such as are described by Horand in the blood from an arm vein of a syphilitic child and by Castelleni as occurring in "yaws." These cells contain six to eight or more distinct granular masses regularly arranged, some of them globular in form, others more nearly oval, larger and roughened, apparently approaching the periphery of the cell. In one instance it appeared as if the cell wall had ruptured and they were about to be extruded. These granular masses, arranged in regular form, recall the state of complete segmentation observed in the malarial infection and similar to that described and figured by Mallory as occurring in measles and scarlet fever, and to the primary sporoblasts occurring in the nuclear stage of the development of cytoryctes variola s. vaccinae.

We should not forget in this connection the possibility of these bodies being the Cytoryctes luis, discovered and described by Siegel, and which can usually be found in the circulating blood of syphilitics, the cycle of development of which has been followed through monkeys after inoculation, and the findings of Siegel confirmed. It is quite possible that this flagellate has some bearing upon the cause of syphilis, and it is not beyond reason to think there may be some connection between the two organisms, and Schutz calls attention to the way in which both are always found together and close to or inside the red corpuscles.

One must of course be cautious, but, from the overwhelming array of evidence presented in literature, I feel we must conclude that the treponema pallidum does not occur in the healthy tissue of man or monkeys nor in tissues affected with other than syphilitic lesions. From its constant occurrence in syphilitic lesions and its absence in healthy or otherwise diseased tissues, one may assume with probability bordering on certainty, that this organism is the cause of syphilis.

I feel that we may conclude with Metchnikoff that taking everything into consideration the evidence points toward syphilis being a chronic spirillosis.

Levaditi considers congenital syphilis as being, usually, *an acute form of the disease,* although it may assume a subacute or chronic form. Neisser found the blood of children with inherited syphilis swarming with the organisms, and inoculation of apes was always positive, an observation confirmed by Hoffman. A monkey inoculated with mucous from the nose of such a child gave positive results. Two children, apparently healthy until several

weeks of age, and in whose history no suspicion of syphilis existed, developed the disease. Neisser suggests that an examination of the blood or secretions might have shown the organism and an early diagnosis have been made.

The methods in laboratory diagnosis will vary with the stage of the disease. We may examine the blood or secretions. We may examine scrapings from the primary sore or excise it and make sections. We may aspirate and examine fluid from an infected gland or excise and prepare sections; we may examine the deep scrapings from a mucous patch or the serum obtained by a slow and deeply acting blister over a secondary skin lesion or we may excise and section the same and, lastly, confirmatory inoculation of apes or monkeys may be made.

My object in bringing this subject before you is to point the way to the early recognition and differential diagnosis of syphilis, a matter of the greatest importance to the physician, the individual and the community.

Answering queries and closing, Dr. Davis said: I believe the presence of the organism in such great numbers in the walls of the blood vessels explains the arteritis and periarteritis which occur in syphilis.

As to the methods of transmission to the offspring by the father or the mother, there is no doubt but that the ovum is affected directly from the mother and through the spermatozoa from the father, but the form in which the organism exists has not been determined. Neither has the form in which the organism is present in tertiary lesions been demonstrated. It may be in a developmental or "resting stage"; but from the histological analogy of the gumma to a tubercle, it is possible that the organism exists in a condition very difficult to stain, similar to the bacillus tuberculosis in tubercle.

This I believe is probable, for contrary to what has usually been taught, Neisser states "that positive results are obtained in all inoculations from tertiary lesions, if these lesions have not undergone necrosis or suppuration; but if specific gummatous degeneration or suppuration has occurred, then the inoculations are never successful."

Patients from whom some of these inoculations were made had acquired syphilis ten or fifteen years before. It appears immaterial whether the tertiary manifestations occur at an early or a very late stage of the syphilitic infection.

Neisser therefore warns that every tertiary manifestation should be regarded as *contagious,* although the danger is much less than in primary or secondary manifestations.

TECHNIC AND STAINING OF TREPONEMA PALLIDUM.

By E. L. LEONARD, M. D., Los Angeles.

The treponema pallidum has been demonstrated by many independent observers in chancres and mucous patches, but as yet no one has found the organism in tertiary lesions. Levaditi demonstrated the treponema in the liver, suprarenal gland, lung and other organs of an infant having congenital syphilis, sixteen hours after death. He also found large numbers in the sweat glands.

In obtaining material from chancres, Burnet and Vincent report the parasites rare in the center, but very numerous in the papillæ and connective tissues in the zone of infiltration. Specimens should be made from deep curettings. The organism may be seen without staining, but this is very difficult on account of its delicate contour. It is motile, with a rotary motion forward and backward.

Closely associated with treponema pallidum in syphilis is another distinct organism, spirochete refringens, which has been found in other diseases besides lues, such as carcinoma, tuberculosis, acute gonorrhea, acne vulgaris, impetigo, etc.

The treponema pallidum is difficult to demonstrate where pus is present. Very few are found superficially in primary and secondary lesions, but they are more abundant in the deeper tissues. In centrifuged specimens of blood organisms have been found, but they are not present in large numbers in the peripheral circulation.

So far as reported, treponema pallidum has been found in the following locations:

1. Juices of glands. 2. Chancres. 3. Flat condylomata (deep and superficial). 4. Inguinal glands. 5. Splenic blood. 6. Roseola. 7. Congenital syphilis. 8. Centrifugalized peripheral blood. 9. Excised papules. 10. Veins of syphilitic child. 11. Mucous patches.

In gumma and other tertiary lesions, none have ever been demonstrated.

Methods of examinations from fresh tissue fluids are as follows: Wash the surface with normal salt solution, use cocaine if necessary and curette the lesion rather deeply below the surface. Smear on a clean slide or cover glass. Hypodermic needles may be used for aspirating glandular fluids. The smears should be made very thin. The most satisfactory method of staining is Giemsa's method.

Fix smears in the air or in osmic acid fumes. Harden in absolute alcohol from 25 to 60 minutes.

Stain should be diluted ten times and smears covered for ten to twenty minutes. Better results are obtained if a one per cent carbonated potassium solution be added to the diluting water. Wash in distilled water, dry and mount.

The treponema pallidum will be found after diligent search, stained a faint pink. The spirochete refringens is usually present in large numbers, and is to be distinguished by its larger size and prominent outline and deeper staining. Many modifications of the Giemsa method have been employed by Marino, Wright, Leischman, Zabolotny and Loefler with varying results, but Giemsa's method seems to have been most widely used. Dr. L. B. Goldhorn has prepared a special modification of his polychrome methylene-blue blood stain suitable for demonstrating the treponema pallidum. Staining is complete in from two to five seconds. By the use of this stain distinct flagella may be demonstrated on spirochete refringens, but none have been found on the treponema pallidum.

Fresh specimens have been examined, and although the treponema is highly refractile and ac-