FIG. 1. CHARACTERISTIC LESION OF PARINAUD'S CONJUNCTIVITIS (LEPTOTHRICOSIS CONJUNCTIVAE) VERHOEFF. CENTRAL AREA OF CELL NECROSIS CONTAINS CHIEFLY ENDOTHELIAL PHAGOCYTES LOADED WITH CHROMATIN FRAGMENTS. MANY SHOW NUCLEAR PYCNOSIS, FRAGMENTATION AND OTHER EVIDENCES OF NECROSIS. GRANULATION TISSUE INVADING FROM RIGHT, AND AREA SURROUNDED BY CHRONIC INFLAMMATORY CELLS.

OBSERVATIONS ON PARINAUD'S CONJUNCTIVITIS.

(Leptothricosis Conjunctivae.)

F. H. VERHOEFF, M. D., F. A. C. S.

BOSTON, MASS.

(From the Massachusetts Charitable Eye and Ear Infirmary.)

An account of this disease based upon a study of eighteen cases verified by full microscopic examination; demonstrating the histologic characteristics of the lesion and the presence of the leptothrix. With colored plate and illustration in the text.

Five years ago I reported the finding of minute leptothrices in eleven cases of Parinaud's conjunctivitis and presented reasons for regarding these organisms as the cause of the disease¹. Since other observers have failed to find these organisms, and many have continued to confuse the disease with tuberculosis of the conjunctiva, it seems worth while to record my further observations and to review my entire experience with the disease, which now covers a period of fourteen years.

Since my previous communication on the subject, I have seen and examined six additional cases of Parinaud's conjunctivitis in each of which the characteristic leptothrices were found in large numbers. In all, I have studied eighteen cases, a far greater number than has hitherto been reported by any other single observer, including Parinaud himself, who reported only four cases. This unusual experience has been due largely to the fact that colleagues, especially Drs. F. M. Spalding, F. E. Cheney, and P. S. Smyth, have referred their cases to me. All but one of the eighteen cases were seen by me clinically, and all of them were examined by me microscopically. In almost all of the cases I personally excised the tissues for examination. These cases were without question all authentic, whereas many of the cases in the literature are, to say the least, doubtful, so that the follow-

ing analysis of the more important features of my cases probably gives a more accurate conception of the disease than would a similar analysis of the far larger series of cases that could be collected from the literature.

ANALYSIS OF EIGHTEEN CONSECUTIVE CASES OF PARINAUD'S CONJUNCTIVITIS.

(1) NATIONALITY.—All the patients were natives of the United States. Twelve patients had English names. In two cases the parents were born in Italy. There were no Hebrews.

(2) LOCALITY.—The patients lived in various towns within thirty miles of Boston.

(3) OCCUPATIONS.—The occupations of the patients or of their fathers were as follows: Laborer, 3; carpenter, 2; boilermaker, 1; machinist, 2; grocer, 1; stenographer, 2; factory hand, 1; electrician, 1; painter, 1; not recorded, 4.

(4) SEASON.—January, 6 cases; February, 1; May, 1; July, 1; September, 1; October, 1; November, 3; December, 4. The disease therefore occurred at all seasons, but was far more frequent in winter than in summer.

(5) TRAUMA.—Four cases gave definite histories of trauma within a week of the onset of eye symptoms. One patient was scratched in the eye by a grape vine, another by a cat, and another by his brother's finger. The other patient got twelve steel filings

into his eye which were picked out by means of a match.

(6) ANIMAL CONTACT.—One patient took care of a horse, another a pig, one child played with a guinea pig. In no case was there contact with an animal known to be diseased.

(7) AGE.—The youngest three patients were aged 3, 6, and 7 years; the oldest 35. The average age was 18 years.

(8) SEX.—Males, 14; females, 4.

(9) EYE AFFECTED.—Right eye, 9; left eye, 9; both eyes, 0.

(10) CONSTITUTIONAL SYMPTOMS.—These were insignificant in all cases. The highest temperature noted was 100.2/5°; but the temperature was taken in only a few cases and then not repeatedly.

(11) GLANDULAR INVOLVEMENT.—In addition to the preauricular, which was enlarged and tender in all cases, enlargement of the submaxillary glands was noted in 7 cases, and of the cervical glands in 3 cases. In no case did a gland break down, altho in several cases the swelling was very great. In one case the patient applied to a general hospital for treatment of the glandular involvement, before he was aware of the eye condition, but in the other cases the glandular involvement and the eye symptoms were noted at about the same time. In no case have I had opportunity to examine an affected gland histologically, but no doubt it would show the same lesions as the conjunctiva.

(12) SITUATION OF EYE LESIONS.—Above, 8 cases; below, 7; above and below, 2; bulbar conjunctiva, 3; palpebral conjunctiva, 4; fornix, 8; not accurately recorded, 3.

(13) CHARACTER OF THE EYE LESIONS.—Polypoid projections of the conjunctiva of the fornix or lids were recorded in 7 cases. One was recorded as measuring 7 mm. in length and 2.5 mm. in thickness. They were usually single, but there were four small ones in one case. All of the cases showed from one to eight or more greyish or yellowish areas in the affected portions of the conjunctiva. The smallest of these were about 1/2 mm. in size, the

largest three to four mm. The larger were not circular in shape, but generally roughly quadrilateral. In some cases it appeared as if the larger areas were conglomerations of smaller spots. They could be stained with fluorescein. In one case, in which the lower lid was chiefly affected, the upper lid showed one small grey area exactly on the lid margin. In three cases it was recorded that the fornix was thickened to such an extent as to overhang the cornea. In many of the cases there was marked enlargement of the ordinary conjunctival lymph follicles. Ulcers were not observed in any of the cases. The secretion from the eye was never abundant. The cornea was unaffected in all cases.

(14) DURATION.—The duration of the eye symptoms before operation was from four days to five weeks; after operation, from five days to one month. The glands subsided more slowly, usually remaining somewhat enlarged for one to three months.

(15) HISTOLOGY.—Every case in the entire series showed the histologic picture which I have shown to be characteristic of this conjunctival disease alone. The essential lesion is a focal area, .3 mm. in diameter or larger, densely packed with endothelial phagocytes loaded with broken down chromatin granules, which is situated just beneath the epithelium. These areas I have referred to as areas of cell necrosis. This term may have given rise to misconception, since it may have been understood to refer to areas of necrosis similar to those of tuberculosis, altho I have taken pains to explain to the contrary. Perhaps it would be better to term the lesions areas of endothelial phagocytosis. The explanation of these areas became obvious when I finally found within them leptothrices in large numbers. The endothelial phagocytes are evidently attracted by the leptothrices, since they invade the masses of the latter and since they frequently contain many of the organisms, a fact that I have previously neglected to mention. Many of the phagocytes show various stages of necrosis, due, evidently, to the toxic action of the or-

ganisms, the resulting cell detritus being taken up by the newly arrived phagocytes. This process is so extensive that it is difficult to find in the lesions an endothelial leucocyte which is free from chromatin fragments. The endothelial phagocytes seem to be derived chiefly from the endothelium of the conjunctival lymph spaces, for the cells of the latter can be seen in all stages of active proliferation while the spaces themselves are distended with the phagocytes. The endothelial cells never form Langhan's great cells in the areas of necrosis. In hundreds of sections of Parinaud's conjunctivitis examined, I have found only three Langhan's great cells, and each of these occurred away from the areas of cell necrosis. [See Plate XIV, Fig. 1.]

The tissue in all my cases was excised within a few weeks after the onset of the disease; and since recovery promptly followed, I have had no opportunity to study histologically cases that have persisted several months. The chief variations, I found, were in the sizes of the areas of the cell necrosis, and in the amount of granulation tissue that was formed as the result of the reaction around them. In the older cases there was a considerable number of pus cells in addition to the endothelial phagocytes in the lesions. Surrounding the areas, the tissue in all the cases was densely infiltrated with chronic inflammatory cells among which plasma cells largely predominated.

(16) BACTERIOLOGY. — Leptothrices in large numbers, were found in all cases except the one noted in my previous paper, in which there was insufficient material saved, and in no case were any other organisms found in the lesions. As regards the morphology of the organisms, I have nothing to add to my previous description, from which, for the sake of completeness, I quote as follows:

"In all cases the microorganisms occur in irregular masses measuring from 10 to 60 micra in diameters, but isolated individuals are also seen. At first the masses may appear to consist of minute dots, but careful examina-

tion with an oil immersion lens shows that they are composed of filaments. The latter seem to have no definite arrangement but are simply intertwined about each other. The individual filament is extremely delicate, stains

Fig. 2.—Showing masses of leptothrices and individual filaments in a large area of cell necrosis. Modified Gram stain. Zeiss comp. oc. 6, obj. 1-12.

faintly, and has single contour. It may be apparently straight or more often irregularly curved. Sometimes it is more than once bent almost at right angles. At almost regular intervals along the filament round dots occur which stain intensely by the modified Gram method. These dots are never exactly centered in the axis of the filament but project noticeably above its surface. The dots are seldom all of the same size on one filament, the largest having a diameter a little greater than that of the filament itself. Usually they are close together, at intervals of about three or four of their diameters, but occasionally they are far apart. In thickness the filaments are usually about $.33\mu$, that is, about the thickness of the influenza bacillus, but individuals half this size are occasionally seen, especially in tissue scrapings. In sections the filaments seldom appear very long, usually 3 to 10 micra, due no doubt to their quickly passing out

of the plane of the section. Some of the long filaments appear either to become thinner or to stain less intensely towards their ends." [See Fig. 2.]

"Except in one case the microorganisms are found only in or within the close vicinity of well marked areas of cell necrosis. In this case, which was evidently an early one, numerous masses can in addition be seen in the superficial lymph spaces, and are especially prominent just beneath the epithelium, where, as I have pointed out, the areas of cell necrosis usually occur. Such masses are undoubtedly the starting points for these areas, for all the stages in the formation of the latter can be made out, beginning with the invasion of a mass of microorganisms by a few endothelial cells. Thus this case is alone sufficient to exclude the possibility of the microorganisms being secondary invaders. The predilection of the microorganisms for the lymph spaces explains the early involvement of the regional lymph glands in this disease."

METHOD OF EXAMINING THE LESIONS.—The best method of demonstrating the microorganisms is by means of sections, but a special staining method is absolutely essential. In two cases in which I endeavored to demonstrate them in spreads made from the areas of phagocytosis I was successful, but the difficulty in staining the organisms was so great that I do not at present recommend this as a routine procedure.

In excising the tissue for examination, care should be taken to include one of the grey areas, for it is only in these that the organisms can be found. To insure good histologic specimens, care should also be taken not to grasp or in any way crush the portion of the tissue containing the area. The best fixative is Zenker's fluid, both for demonstrating the organisms and the histology of the lesions, altho in case of necessity it is possible to stain the organisms after other fixatives. Before placing the specimen in the fixing fluid, it should be placed upon and allowed to adhere to a small bit of paper in such position that later it can be

oriented and sections cut vertical to the epithelial surface. For staining the organisms, I described in my previous paper a modified Gram stain, which was applicable only to paraffin sections. Since then, I have still further modified the method so that it may be used also for celloidin sections. While the results of the newer method are perhaps not superior to the best of those given by my original method, they seem to be more uniform. With this modification the preliminary treatment of the section with balsam is not absolutely necessary, but gives more brilliant results than when it is omitted. I have found this method superior to the Gram-Weigert method for demonstrating any sort of Gram positive organisms in sections.

1. Sections 6μ to 10μ thick. Stain lightly in hematoxylin and eosin, mount in Canada balsam, and examine under microscope. Select only sections which show areas of endothelial phagocytosis. After five minutes or longer (10 years is not too long) remove cover slip by aid of heat and wash off excess of balsam with xylol. Chloroform, 95 per cent. alcohol, water.

2. If celloidin section, place on slide, wipe off excess of water.

3. Stirling's gentian violet, 12 minutes.

4. Water. Remove from slide, if celloidin section.

5. Lugol's solution (1:2:100), 20 seconds.

6. Water.

7. Ninety-five per cent alcohol, in small dish, 20 seconds.

8. Chloroform, in small dish, 15 seconds.

9. Oil of origanum, in dish, 15 seconds.

10. Ninety-five per cent alcohol, 30 seconds. This removes the excess of stain from the celloidin.

11. Oil of origanum. Place on slide and blot.

12. Wash off thoroly with xylol and blot.

13. Xylol-balsam.

In the case of paraffin sections the same procedure is followed, except that

the solutions are dropped upon the slide.

The greatest care is required in the differentiation in alcohol and chloroform. A variation of a few seconds here makes a great difference in the results. It is therefore well to carry a number of sections at one time up to step (6) and then differentiate each separately, varying the time a few seconds from that stated. If the differentiation is perfect, the leptothrix filaments as well as the dots on them will be stained, otherwise the dots alone may be stained so that the organisms will appear as rows of dots. If the differentiation is carried too far, especially in the alcohol (7) the organisms may be completely decolorized.

INOCULATIONS AND CULTURES.—Animal inoculations were made in six cases, with negative results in all instances. A guinea pig was inoculated subcutaneously in the groin in one case, and another in the anterior chamber. A rabbit was inoculated in the anterior chamber in one case, and beneath the conjunctiva in two cases. Pieces of tissue were introduced beneath the conjunctiva of monkeys (*macacus rhesus*) in two cases, and beneath the conjunctiva of a kitten in one case. A white mouse was inoculated in the abdominal wall in one case. An anthropoid ape, unfortunately, was never available.

Cultures were attempted in five cases. Coagulated blood serum, hydrocele agar, blood agar, glycerin agar, glucose agar, potato, under both aerobic and anaerobic conditions, were all used, but with negative results except for contamination with the usual bacteria. Owing to the organisms being so near the surface of the tissue it is of course difficult to avoid contaminations with the surface flora. Another difficulty in making cultural examinations, is that the cases are so infrequent that it is not possible to have special culture media ready when they occur. For this reason I have not had opportunity to employ the media used by Noguchi for cultivating the *spirocheta pallida*.

From the foregoing it will be seen that in Parinaud's conjunctivitis we have a disease that presents focal lesions differing in character from those of any other conditions of the conjunctiva, that within these foci and nowhere else, there invariably occur minute leptothrices, differing from any other known organisms, that no organisms of any other kind can be demonstrated in these foci, that the lesions are covered with epithelium which protects them from contamination with surface microorganisms, that endothelial phagocytes are attracted by the leptothrices, taken up by them, and are thereby destroyed, thus explaining the character of the lesion, and, finally, that all these conditions occur in every case. From these facts the conclusion is inevitable that the leptothrices are the cause of the disease. It would, of course, be desirable, if possible, to cultivate the organisms, and to reproduce the disease in animals, but this additional evidence is certainly unnecessary here, and while artificial cultivation of the organisms will no doubt finally be accomplished, it is doubtful if reproduction of the disease in animals other than man will ever be successful. [Since this was written, Wherry and Ray² have reported the cultivation of a leptothrix from the preauricular gland in a case of Parinaud's conjunctivitis. They employed Dorset's egg medium incubated under partial tension and anaerobic conditions. They state: "It seems probable tho not certain that the organism grown by us is identical with that found in sections by Verhoeff."]

CONFUSION WITH TUBERCULOSIS.—Owing to the frequency with which cases of conjunctival tuberculosis have been described as cases of Parinaud's conjunctivitis, some observers have maintained that the latter is not in fact an entity. The above observations, however, prove conclusively that there is a disease of the conjunctiva, due to infection with a specific microorganism, and presenting histologically characteristic lesions, that possesses the clinical features described by Parinaud. Since these clinical features are in

themselves so characteristic as to exclude, except possibly in isolated instances, all other diseases of the conjunctiva, there should be no doubt that the disease investigated by me is identical with that described by Parinaud. Parinaud, however, knew nothing of its histology or etiology, so that to this extent his identification of the disease was incomplete. For this reason it would be preferable now to employ the designation *Leptothricosis Conjunctivae*.

Altho it has now been fourteen years since I described the characteristic histologic picture of Parinaud's conjunctivitis, and many observers have subsequently made microscopic examinations of the tissues in the disease, yet only one observer, Bernheimer,³ has given a sufficiently accurate description to show that he has recognized the essential lesions. The descriptions of other observers seem to indicate that they have given their attention to the diffuse infiltration around the essential lesions, which presents no especially characteristic features. In some instances no doubt the lesions have simply been overlooked, in others insufficient sections have been made, or care has not been taken to see that the tissue removed contained one of the greyish areas referred to above. In this connection, it may be well to point out, that enlarged lymph follicles which are often present in this disease, should not be mistaken for the essential lesions. Since most of the observers have thus failed to find the essential lesion of the disease, it is not surprising that they also failed to find the infecting organisms which occur only in these lesions.

The evidence of those observers who maintain that Parinaud's conjunctivitis is a form of tuberculosis seems to be about as follows in all cases: A patient presents himself with one or more granulations springing from the conjunctiva and an enlarged preauricular gland. The condition being a novelty to the observer, he makes a diagnosis of Parinaud's conjunctivitis. He then removes some of the tissue and inoculates with it a guinea pig or rabbit. The animal develops tubercu-

losis, hence Parinaud's conjunctivitis is a form of tuberculosis! As a matter of fact all that he has proved is that his original diagnosis was erroneous. If he had made a microscopic examination of the tissue he would have found the typical histologic picture of tuberculosis, which as I have conclusively shown does not bear the slightest resemblance to that of Parinaud's conjunctivitis. These observers seem to ignore the fact that guinea pigs have frequently been inoculated with tissue from cases of Parinaud's conjunctivitis, with negative results.

In the clinical differentiation of Parinaud's conjunctivitis from conjunctival tuberculosis there are three facts to be taken into account, the importance of which seems to have been generally overlooked, namely, that the onset of Parinaud's conjunctivitis is relatively acute, that the glandular involvement is practically synchronous with the onset of the eye symptoms, and that the affected conjunctiva always shows one or more greyish areas, the essential lesions of the disease. These facts, it seems to me if positively established in any case are alone sufficient to exclude tuberculosis. As regards the relative frequency of these two conditions this would of course be expected to vary in different regions, but as concerns Boston and its vicinity some idea of it may be inferred from the fact that I have examined only five cases of conjunctival tuberculosis within the period within which I examined the eighteen cases of Parinaud's conjunctivitis.

COMMENTS.

According to my observations, both clinical and histologic, the terms, granulations, polypoid vegetations, ulcers, and erosions, are not strictly applicable to any of the lesions of Parinaud's conjunctivitis. I have never seen actual loss of substance occur so that no doubt the terms erosions, and ulcers, described in the literature usually refer to the greyish areas of endothelial phagocytosis, which are still covered by epithelium. It seems possible, however, that in more advanced cases loss of substance might occur.

The so called granulations and polypoid vegetations do not usually arise, as these terms would suggest, from an exuberant growth of granulation tissue thru breaks in the surface of the conjunctiva, but are due to the extreme infiltration about the essential lesions, and an interstitial formation of granulation tissue, which together cause the affected conjunctiva to project more or less abruptly above the surrounding surface. For this reason they never occur on the bulbar conjunctiva but almost exclusively on the retrotarsal folds where the subepithelial tissue is most abundant.

As regards the source of the infection, my cases seem to throw no light of a positive nature. It is clear, however, that the infection is not transmitted from man to man since cases of the disease occur at long intervals; and no instance is known of an individual affected with the disease having been associated in any way with another individual similarly affected. My cases also do not lend support to the theory of animal origin, for while in four cases there was close contact with some animal, it was a different kind of animal in each case, and there was no case in which there was contact with an animal known to be diseased in any way. Moreover, inoculations of various animals all gave negative results. It is conceivable, however, that the organisms may exist as saprophytes on animals.

The fact that the incidence of the disease was greatest by far in the winter must be of great significance; but just what the meaning of this may be it is impossible at present to say. This is probably true also of the fact that males were much more frequently affected than females. The great rarity of the disease does not necessarily indicate that the leptothrices are not abundant in Nature; but may mean that only exceptional individuals are susceptible; and that slight injury to the conjunctiva is required to give the organisms entrance to the tissues. That the affected individuals have a certain degree of immunity to the disease is shown by the fact that it never be-

comes generalized and recovery always takes place in a relatively short time. Incidentally, this high natural immunity on the part of man suggests that animals also may be immune, and that transference of the disease to animals may never be accomplished.

The histories of slight but definite abrasive injuries to the conjunctiva obtained in four of my cases suggest nothing in regard to the source of the infection, but are of great importance in showing the incubation period of the disease. In two cases, the eye symptoms began three days after the injury, in one case one week, and in the other case, two weeks. The latter case was that of a child three years of age who had been scratched in the eye by a cat, and since the condition was well marked when first noticed by the father, it is probable that symptoms had been present for at least a week. These cases would seem to set the incubation period at three days to one week.

The fact that the disease is rarely, if ever bilateral, may possibly be explained on the assumption that for infection to occur slight injury to the conjunctiva is essential, or more probably by the fact that the organisms, so far as I can determine, occur exclusively in the areas of endothelial phagocytosis beneath the intact epithelium, and hence do not get into the conjunctival secretion. In either or both of these ways also may be explained the fact that the disease is never transmitted from one individual to another, altho here again the question of natural immunity may enter.

It is noteworthy that all of my cases were unilateral and that in none of them was the cornea affected. In the literature, however, there are a few cases recorded in which both eyes were affected and a few also in which the cornea was involved. Such unusual cases, it seems to me, should not be accepted as authentic unless they are shown to possess the characteristic histologic changes described by me, and leptothrices are demonstrated in the lesions. Most of the cases in the literature are single cases reported by ob-

servers who have had no previous experience with the disease and who are therefore not in position to make an accurate clinical diagnosis. It would, therefore, seem best, in fact, to accept no diagnosis of the disease based on clinical findings alone.

DESCRIPTION.

In conclusion, it seems to me, I can best summarize my observations on Parinaud's conjunctivitis by giving the following brief description in which I have attempted to correlate the clinical, histologic, and bacteriologic features of the disease:

Parinaud's conjunctivitis, or leptothricosis conjunctivae, is a subacute inflammatory condition of the conjunctiva due to infection with a minute leptothrix, and is always associated with inflammatory enlargement of the preauricular or other regional lymph glands. The source of the infection is unknown. In some cases there is a history of slight trauma to the conjunctiva preceding the infection. The incubation period is from three to seven days. The glandular enlargement is synchronous with the onset of the ocular symptoms. The essential conjunctival lesions consist of focal areas situated immediately beneath the epithelium, infiltrated with endothelial phagocytes in various stages of necrosis. Clinically these foci appear as opaque greyish areas from about $\frac{1}{2}$ mm. to 4 mm. in diameter. In individual cases they may be single or multiple, and may occur in any part of the conjunc-

tiva including the bulbar portion. They contain the leptothrices in great numbers. Beneath these areas more or less granulation tissue is produced which may cause the conjunctiva to project in the form of polypoid nodules. The latter occur chiefly on the fornices. Ulceration seldom if ever occurs. In the affected regions, the conjunctival tissue is congested, edematous, and densely infiltrated with chronic inflammatory cells, among which plasma cells largely predominate. In marked cases this causes the fornix to become everted and to project like a curtain over the cornea. Frequently the normal conjunctival lymph follicles are greatly enlarged. The congestion and edema extend through the whole of the lids so that in severe cases ptosis may result. The conjunctival secretion is slight in amount and mucopurulent in character. The cornea is unaffected. The local subjective symptoms are not severe, and constitutional symptoms are slight or entirely wanting. The affected glands seldom break down.

The disease is almost if not always unilateral, attacks almost exclusively children and young adults, and males more frequently than females. It is most prevalent in winter, and, so far as known, is never transmitted from one individual to another. The most efficient treatment is excision of the grey areas and nodules. The duration of the eye symptoms after this treatment is from one to five weeks. The glandular enlargement may persist for a considerably longer period.

REFERENCES.

1. Verhoeff. Parinaud's Conjunctivitis, a mycotic disease due to a hitherto undescribed filamentous organism. *Arch. of Ophth.*, 1913, v. 43, p. 345.
2. Wherry and Ray. *Journal Infectious Diseases*, 1918, v. 22, p. 554.
3. Bernheimer, S. Ein beitrag zur Parinaud's Konjunktivitis. *Klin. Monatsbl. f. Augenh.*, 1906, v. 44, p. 323.

EXPLANATION OF PLATE.

Plate XIV.—Showing characteristic lesion of Parinaud's conjunctivitis. The entire lesion, which is unusually small, is included in the field. The central area beneath the epithelium—area of cell necrosis—contains chiefly endothelial phagocytes, loaded with chromatin fragments. Many of the phagocytes show nuclear pycnosis or fragmentation and other evidences of necrosis. The area is being invaded by granulation tissue from below, and is surrounded by chronic inflammatory cells which here consist almost exclusively of lymphocytes. Just beyond the limits of the illustration plasma cells greatly predominated. Other sections of this lesion, specially stained for the purpose, showed it to contain relatively few leptothrices, owing evidently to its small size. Zenker's fixation. Celloidin section. Hematoxylin and eosin. Zeiss oc. 18, obj. AA.