

## THE ROENTGEN RAY IN TONSILLAR DISEASE \*

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In response to numerous inquiries as to the efficiency of roentgen-ray therapy in tonsillar disease which have come to this clinic within the last year, we submit a preliminary report as to facts.

The cases which we undertook to treat were those representing every type of tonsillar disease and in patients of varying ages. Each case was treated by the accepted methods of roentgen-ray dosage and technic, controlled by the laryngologist in collaboration with the roentgenologist, and also by bacteriologic, blood and other laboratory methods. It must be remembered that the time element is an important factor, and therefore no case can be reported as a cure or failure unless a certain time has been allowed to elapse. Furthermore, there must be some understanding as to what can be considered a cure, either the loss of the tonsillar struma, or the alleviation of clinical symptoms both subjectively and objectively, or both.

In no case in our series have we observed any very marked changes, and only in children with the typical hypertrophied tonsils have we been able, by the very closest observation, to note even a slight change in size. Patients with infected tonsils with the usual recurrent attacks of tonsillitis were seemingly benefited for a period, only to have a recurrence of the attack. These cryptic tonsils, with the usual infectious material which they harbor, were controlled bacteriologically and found, as is well known, not to have been affected by the roentgen ray. The type of tonsil which has through disease and age undergone a fibrosis is but little affected by this therapy. Those cases which presented any urgent clinical manifestations producing marked systemic reaction were not subjected to the roentgen ray because such conditions as rheumatism, endocarditis and nephritis would gain too firm a foothold in the course of the treatment, and we did not wish to jeopardize the life of the patient. Encouraging results have been obtained not so much objectively as from the alleviation of subjective symptoms, in that type of child whose pharynx is filled with lymphoid hyperplasia.

The roentgenologic work was done entirely by experts, Dr. Benjamin Orndoff and his associates, who have followed the technic well known to men in this line of work, and therefore we omit any technical details. Suffice it to say, however, that every laryngologist should be well versed in the technic so as to give the patient the necessary information as to length of time and possible cost of the treatment. With the cooperation of the roentgenologist, we have made arrangements so that, in the event that the roentgen ray proved finally to be of no benefit, the patient might not be the loser when operation is resorted to; this applies only during the period of our investigation. In other words, the expense of the treatment is about equivalent to the charge for operation in the poorer middle class. This method of procedure has enabled us to obtain material for the proper study of the question. It is our intention to make an exhaustive report when sufficient material is secured and a long enough time has elapsed to warrant a fair statement. This preliminary report is made, as was said before, because we are besieged

by inquiries, and because we hope that all laryngologists will give this method of treatment a fair trial. Thereby the procedure may be given its place according to its efficiency as a type or therapy, and not appear with extravagant claims from some roentgenologist or belittled by a biased laryngologist who condemns the treatment without sufficient proof of its failure. The greatest danger lies in the pretension of treating a serious condition of tonsil or adenoid disease by imperfect roentgen-ray or inefficient clinical control: almost any patient might be immediately subjected to the indiscriminate use of the roentgen ray. We have seen some patients that have been treated by this method in other clinics with resultant extreme dryness of the throat, which has persisted. The procedure, therefore, is not without some danger. Furthermore, there is the negative side, that is, negative results as they compare with the results of a carefully carried out operation when real indications are found for the removal of tonsils.

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## CULTIVATION OF TRICHOMONAS

AND THE QUESTION OF DIFFERENTIATION OF THE FLAGELLATES \*

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Barring a limited number of special workers, the conception of the whole of the medical profession is probably confused no more by any question than that of the intestinal protozoa. That when a physician receives a report of the presence of any of these organisms, all sorts of symptoms and conditions are attached to this fact, and it is made the basis of diagnosis and treatment of the sick, is a point of wide application. The particular importance of this fact lies in the likelihood of such a finding confusing the issue and leading away from some other existing condition.

The recent war is responsible for exciting interest in, and spreading misinterpreted information about, intestinal protozoa. It stimulated the examination of feces to a much wider practice than existed before, and so intestinal protozoa are much more commonly encountered. One cannot even estimate the number of laboratory technicians who are responsible for all sorts of examinations employed by practicing physicians, very few of whom can differentiate between *Endameba histolytica* and *E. coli*, or between the several flagellates; and yet one has only to visit the offices of practicing physicians to obtain an idea that there are hundreds, if not thousands, of such people, who actually have the whole responsibility of such examinations. It is probably not far wide of the mark to say that the average laboratory worker knows only two terms applied to intestinal protozoa: ameba and trichomonas; and the mere presence of either is considered sufficient evidence of its parasitism.

Of course, there is only one reason for this state of affairs—ignorance and confused information in the medical profession, and among laboratory people in particular. That this exists widely is perfectly evident from the attention given discussions of the subject,

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\* Read before the Section on Pathology and Physiology at the Seventy-Third Annual Session of the American Medical Association, St. Louis, May, 1922.

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particularly before local or regional medical societies. Intestinal protozoa have been and are being blamed for every sort of human ailment. Physicians are energetically treating "amebiasis," when only harmless *Endameba coli* is present, and "flagellate infection," when "*Trichomonas*" is found; and one instance comes to mind in which a considerable number of cases of *Balantidium* infection—the "*Balantidium*" probably being some flagellate—have been reported from his private practice by a physician in a small town.

There is little excuse at the present time for confusing harmless *Endameba coli* with *Endameba histolytica*, or *Balantidium* with any intestinal organism; but, from the reading matter available to the general profession, there is little wonder that the status of the flagellates is confusing.

In order that judgment of the flagellates may be put on a rational basis, we may as well discard the bulk of medical literature of this country on the subject, especially when inaccurate identification of the organism is involved, since one cannot be certain which protozoon was dealt with. Even now, there is no general distinction made between *Trichomonas* and *Chilomastix*, and undoubtedly a large part of our literature concerns the latter instead of *Trichomonas*. It cannot be clear to the average person who is interested in the question whether there are one or more trichomonads in the intestine, or whether the *Trichomonas* of the vagina, mouth and intestine is one or different organisms; and that most common intestinal cell, *Blastocystis*, is not a *Trichomonas* or some other cyst. If we are to settle satisfactorily the clinical significance of *Trichomonas*, we must first be able to know it. Those who would determine the importance of the flagellates as a whole forget the history of the amebas and would not profit by its lessons. The terms "flagellosis" and "flagellate infection" have no meaning at the present time beyond the presence of flagellates.

*Trichomonas* is a common inhabitant of the large intestine, vagina and mouth. It is encountered very often in feces from normal persons. Whenever it is present where there is diarrhea and a liquid stool, it may be prolific and show in enormous numbers in the feces. Particularly is this the case when intestinal exudation occurs, probably because it grows very well in such a medium even under artificial conditions. Consequently, it is but natural that its presence is coupled with intestinal inflammation. That it is concerned with the production of inflammation, there exists only circumstantial evidence. It has been seen within the tissues of the intestine without evidence of exciting a reaction there; and whether it entered before or after death of the host cannot be said. It has been reported from parts of the body which it may have reached through the blood stream. It has been reported to

contain red blood cells, and this has been taken as evidence of its pathogenicity. Clinical reports appear commonly in which "flagellate dysentery" has disappeared under treatment, with the apparent disappearance of the flagellate. On the other hand, although one does not see it often reported, numerous instances are at hand in which *Trichomonas* was present in diarrhea and remained after the diarrhea subsided, with or without treatment. Other instances are at hand in which the intestinal condition ascribed to it remained after *Trichomonas* could no longer be found. Then, again, a number of cases of "cure" of *Trichomonas* infection have been encountered in which the person still harbored *Trichomonas*. I have under observation several hosts of *Trichomonas* as well as *Chilomastix* who have shown the organism on repeated examination for several years, one for as long as nine years, and who have never experienced any disturbance from it; and in routine laboratory work it is very common to find *Trichomonas* in the feces of

people who can give no reference to any ill effects from it. When such a large proportion of people harbor any organism, it is inevitable that it may be associated with some disease condition in a considerable proportion.

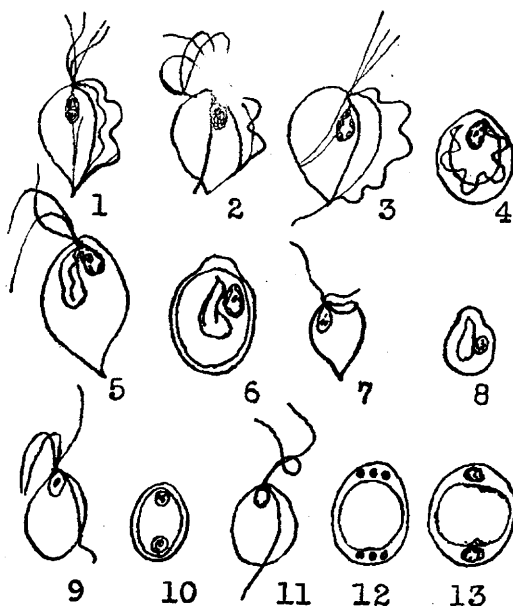
From time to time, experimenters have reported transmission of *Trichomonas*, with apparent infection. None of these experiments can be called conclusive. I realized this after reporting such experiments. It is virtually impossible to select animals not already harboring trichomonads; and, even if it were possible, no reliance can be placed on results obtained from material or cultures containing bacteria.

*Trichomonas* in the vagina is commonly associated with the occurrence of leukorrhea, and in the mouth it grows in the material and exudates around the teeth and gums, in inflammation. In my observation, it

has disappeared with the clearing up of these excellent mediums for its growth, and it may have no further significance.

#### CULTIVATION

*Trichomonas* was first cultivated in beef broth (Lynch<sup>1</sup>). Since that time, Ohira and Noguchi<sup>2</sup> have reported obtaining cultures of *Trichomonas* from the mouth in equal parts of ascitic fluid and Ringer's solution. Boyd<sup>3</sup> obtained a growth of *Trichomonas hominis* in a mixture of feces and physiologic sodium chlorid solution. Pringault<sup>4</sup> cultured *Trichomonas hominis*



1. *Trichomonas hominis*; 2. *Trichomonas vaginalis*; 3. *Trichomonas caviae*; 4. *Trichomonas caviae* cyst; 5. *Chilomastix mesnili*; 6. *Chilomastix* cyst; 7. *Embadomonas intestinalis*, according to Dobell; 8. *Embadomonas* cyst, according to Dobell; 9. *Tricercomonas intestinalis*; 10. *Tricercomonas* cyst with two nuclei, according to Dobell; 11. *Enteromonas caviae* n. sp.; 12 and 13. *Blastocystis*.

1. Lynch, K. M.: Trichomoniasis of the Vagina and Mouth, Am. J. Trop. Dis. 2: 627, 1915; Clinical and Experimental Trichomoniasis of the Intestine, New York M. J., May 1, 1915.  
2. Ohira, T., and Noguchi, H.: The Cultivation of Trichomonas of the Human Mouth (*Trichomonas hominis*), J. Exper. Med., 25: 341 (Feb.) 1917.  
3. Boyd, M. F.: A Note on the Cultivation of Trichomonas Intestinalis, J. Parasitology 4: 168 (June) 1918.  
4. Pringault, E.: Etude biologique die Trichomonas intestinalis, Bull. de la Soc. Path. Exot. 13, 1920.

in Ohira and Noguchi's medium; Reufing<sup>5</sup> *Trichomonas vaginalis* in the same solution, and Hogue<sup>6</sup> *Trichomonas hominis* in a medium of egg albumin and Locke's solution. I have cultivated *Trichomonas* from the feces, vagina, mouth and urine (*Trichomonas* of vaginal origin) in a number of solutions,<sup>7</sup> including liquid blood serum, ascitic fluid, pleural fluid and ovarian cyst fluid, diluted from 1:4 to 1:10 with from 0.5 to 0.9 per cent. sodium chlorid solution, or with Ringer's or Locke's solution. Blood serum diluted with ten volumes of 0.5 per cent. sodium chlorid solution has been found fairly uniformly good. *Trichomonas* grows well at 37 C., at the bottom of a fairly long column of medium, and is best removed with a capillary pipet. Growth is usually progressive, and division of the organism may be followed for about four days, during which time swarms of organisms may be produced. After this period, the number decreases, and the flagellates usually disappear in a few days.

#### DIFFERENTIATION OF SPECIES AND OTHER ORGANISMS

At present, *Trichomonas hominis* (from the intestine), *Trichomonas vaginalis* (from the vagina) and *Trichomonas buccalis* (from the mouth) are generally considered to be distinct species. At least, they have not been certainly identified as the same. They present in common four anterior flagella arising from the blepharoplast on the anterior end, from which also come the basal rod and free margin of the undulating membrane, which runs diagonally backward, and the axostyle or stiff skeletal support. The nucleus, lying near the anterior end, is ovoid, composed of a compact chromatin mass in the nondividing forms, of loose chromatin network preliminary to mitosis and showing mitosis in division. There is some debate about the constancy of four anterior flagella for the genus, some describing three and some five. In my experience, four is the correct number, although not all may be seen, and more are often encountered in division. Occasionally, one with five is seen, but this fact may not be used as a feature for separating the genus in any thus far encountered in this study. There have been a number of accounts of a five-flagellated trichomonad (*Pentatrachomonas*), which consumes red blood corpuscles. Possibly, this is a distinct organism, and it should be watched for closely on account of its suggested pathogenic significance. I have not encountered a form of *Trichomonas* from man which did not show fairly constantly four flagella, when properly studied.

In direct preparations, there often seems to be differences between the trichomonads of the vagina, mouth and intestine. That of the vagina frequently averages larger in size and is often less active in swimming about. Frequently, the undulating membrane is shorter and more delicate. Yet these features also occur among the organisms from one source. It has been impossible thus far to differentiate with certainty the trichomonads from the intestine, vagina and mouth, in culture in the same material. It appears, therefore, that, under the same conditions, they are identical. At any rate, if they are distinct, the differentiating

feature has yet to be developed and will have to apply to organisms cultivated under the same environment.

As to the relation of human trichomonads to those of other animals, at least some of the latter appear to be distinctly different. *Trichomonas* of the mouse, guinea-pig, and frog all have three flagella. *Trichomonas caviae*, which, following Kofoid<sup>8</sup> is now properly called *Tritrichomonas caviae*, has a distinct encystment, the cyst showing nucleus, blepharoplast, undulating membrane, basal rod and chromatinic margin and axostyle, but no flagella. Its undulating membrane is much heavier; the nucleus is different, and it has not grown with the facility of *Trichomonas* of man in the same culture mediums. Dobell has described a cyst for *Trichomonas* (*Tritrichomonas*) *batrachorum*, and Wenyon a cyst for *Trichomonas* (*Tritrichomonas*) *muris*, while no reported cyst of *Trichomonas* of man has stood the test of critical investigation. There is as yet no proof of a carrier of *Trichomonas* of man among other animals.

A cell frequently called *Trichomonas* cyst is *Blastocystis*, probably related to *Ascomycetes*, a very common cell in the intestine, which has been differentiated for some time by careful observers and recently cultivated by Barret<sup>9</sup> and Lynch.<sup>7</sup>

The organism most commonly confused with active *Trichomonas* is *Chilomastix mesnili*, *Chilomastix davainei* according to Kofoid,<sup>8</sup> and yet it is so distinct that one wonders that the confusion existed even with the best students for so long. *Chilomastix* has three flagella anteriorly directed, a distinct and heavily outlined cytostome or mouth and no undulating membrane save a very delicate flagellar organ within the cytostome. It is frequently spirally twisted, and swims in a distinct spiral without the flexibility of *Trichomonas*. In addition, it has a characteristic lemon-shaped cyst, containing the organism with its distinctive cytostome, first described by Lynch<sup>10</sup> who mistook it for *Trichomonas*.

In addition, there are two or more comparatively rare flagellates of the human intestine which may be confused with *Trichomonas* by those uninformed about them. These are *Tricercomonas intestinalis*, *Enteromonas hominis* and *Embadomonas intestinalis*. They are about half the size of *Trichomonas* and have no undulating membrane. *Enteromonas hominis*, according to da Fonseca,<sup>11</sup> possesses three anterior flagella, two directed forward and one back over the body but not adherent. No cyst has been reported for it. *Tricercomonas intestinalis* is described by Wenyon and O'Connor<sup>12</sup> with four anterior flagella, three directed forward, the fourth recurrent and adherent to the surface of the body for a part of its length. Dobell<sup>13</sup> thinks these two flagellates are the same. In my experience, *Tricercomonas* of Wenyon and O'Connor is present in this country, and, although *Enteromonas* of da Fonseca has not been seen, a flagellate conforming to his description found in the guinea-pig confirms the existence of the genus and its possible occurrence

8. Kofoid, C. A.: A Critical Review of the Nomenclature of Human Intestinal Flagellates, *Cercomonas*, *Chilomastix*, *Tetratrachomonas* and *Giardia*, Univ. of California Pub. in Zool. **20**: 145, 1920.

9. Barret, H. P.: A Method for the Cultivation of *Blastocystis*, *Ann. Trop. M. & Parasitol.* **15**: 113 (July) 1921.

10. Lynch, K. M.: Dauerencystformation of *Trichomonas intestinalis*, *J. Parasitology* **3**: 28 (Sept.) 1916.

11. Da Fonseca, O. O. R.: Sobre os flagelados dos mamíferos do Brasil: um novo parasito do homem, *Brazil-Med.* **29**: 281, 1915.

12. Wenyon, C. M., and O'Connor, F. W.: Human Intestinal Protozoa in the Near East, London, 1919.

13. Dobell, Clifford: The Intestinal Protozoa of Man, Dobell and O'Connor, New York, 1921.

5. Reufing, F.: Zur morphologie von *Trichomonas vaginalis* Donne, *Arch. f. Protistenk.* **17**: 347, 1921.

6. Hogue, M. J.: The Cultivation of *Trichomonas Hominis*, *Am. J. Trop. Med.* **1**: 211 (July) 1921.

7. Lynch, K. M.: *Blastocystis* in Culture, *Am. J. Trop. Med.*, to be published; Cultivation of *Trichomonas* from the Human Mouth, Vagina, and from Urine, *Am. J. Trop. Med.*, to be published.

in man. *Embadomonas intestinalis* has two unequal anterior flagella, a comparatively large anterior cytosome and a cyst resembling that of *Chilomastix*, except that it is much smaller. Possibly *Embadomonas* may be confused with *Chilomastix*, although it is less than half the size, its jerky movements differ from the spiral of *Chilomastix* and its flagella differ in number and action.

#### STUDY OF SPECIMENS

A careful study of unstained material will serve to differentiate *Trichomonas* from any other organism. When fresh and active, the flagellar movements and undulating membrane are characteristic. After exposure and cooling, it loses the action of these parts and assumes a peculiar ameboid undulating form in which protoplasmic waves of broad and blunt or long and finger-like proportions progress, with diminishing size from anterior to posterior end. This is also characteristic. When it becomes a question of determining the number of flagella, for the possible dividing of the genus, the most careful staining is necessary. These fine structures may not be counted with certainty on the active cell, and the staining must be sufficient to allow correct observation of a large number of organisms and to differentiate those undergoing division. The usual process depended on for this differentiation is the iron-hematoxylin method. When properly applied, this staining is usually satisfactory, but it has not served so well with spreads from cultures, probably on account of the albumin to be coagulated in the mediums. Excellent results have been obtained in differentiating the flagella and undulating membrane by careful staining of thin films from cultures by Wright's blood stain.

#### SUMMARY

1. *Trichomonas* is a widely and highly prevalent inhabitant of the body of man and is being extensively treated as a pathogenic organism.
2. There exists only circumstantial evidence of any harmful effects from it or even of its true parasitism. The ease with which it may be grown artificially, its feeding habits, its high prevalence in the healthy and its long continuance without resulting disturbance in the human body indicate it as a harmless commensal.
3. For a proper judgment of the clinical significance of *Trichomonas*, the organism must first be accurately differentiated from others now confused with it, and, if there are different organisms now included in the genus, they must be separated.
4. *Trichomonas* must be studied under the same conditions before they may be differentiated. This would appear to be best done in culture in the same mediums.
5. In culture in the same material, trichomonads from the human mouth, vagina and intestine have not been certainly differentiated in this study.
6. There exists no proof that trichomonads of other animals are identical with those of man, and at least some of them are certainly distinct.

#### ABSTRACT OF DISCUSSION

DR. JOHN A. KOLMER, Philadelphia: Did the parasites undergo any morphologic changes differing from the appearance as found in the mouth?

DR. KENNETH M. LYNCH, Dallas, Texas: There are no changes in cultures from the characteristic morphology in the direct preparation. Of course, the multiplying forms are much more easily studied.

## CHINA AS A FIELD FOR THE STUDY OF THE NUTRITION OF HUMAN TEETH \*

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According to Pickerill,<sup>1</sup> bad teeth are the curse of civilization. He gives figures to show that dental caries increased in the Britons from the stone age to the bronze age, and from the bronze age to the Roman occupation, and in the Angles and Saxons after they came to England and among the English, so that in modern times about 95 per cent. of them have carious teeth. He also states that the same process took place but far more rapidly among the Maori of New Zealand, and that 95 per cent. of the Maori schoolchildren in the English schools have carious teeth. He places the Chinese among those races with little dental caries. We should remember, however, that while our ancestors led a barbaric life in the forests and swamps of northern Europe and had no agriculture, the Chinese had developed a thickly populated and comparatively civilized community. The central plateau of Asia is considered the "cradle of the human race," and the beginnings of Chinese civilization are lost in antiquity.

We cannot take up the various factors of civilization and their effect on the teeth, but animal experimentation has shown that the chief factor in the well-being of the bones and teeth is diet. I will consider the Chinese civilization from a dietetic standpoint. The origin of domesticated plants is somewhat doubtful, but the emperor Chin-nung, 2800 B. C., ordered a ceremonial in which certain seeds were sown; and by this time and in a few succeeding centuries, but long before our ancestors took up agriculture, the Chinese had domesticated, or obtained from their neighbors chiefly to the south, quite a number of plants. Among these are the radish, Chinese yam, Chinese cabbage, tea, sugar-cane, orange, mandarin orange, jujube, Chinese plums, apricot, peach, kaki (persimmon), date plum (persimmon), Chinese pear, banana, litchi (nut), buckwheat, soy bean, wheat, Italian millet and rice. The Chinese diet is classed by McCollum as a complete vegetarian diet, supplying in sufficient quantity everything needed in nutrition.

As to the special nutrition of the teeth, it has been found that the teeth require all those food elements needed by the body as a whole and in addition the elements giving it its hardness, chiefly calcium, fluorin and the phosphate ion. In other words, as Gautier has shown, the enamel of the teeth has nearly the same composition as crystalline phosphate rock or apatite,  $\text{Ca}_5(\text{PO}_4)_3$ . Magnesium is present to a small extent, and it may be considered to replace calcium as an impurity, or as in the case of the formation of dolomite from limestone. The same elements, with the addition of calcium carbonate and white fibrous connective tissue (collagen), constitute the dentin. When we consider all the articles of diet of a people, the complexity is so great as to prevent any headway with the problem. I<sup>2</sup> have shown that the North American Indians used at least 660 species of plants for food, drink and medicine.

\* From the Laboratory of Physiological Chemistry, University of Minnesota Medical School.

1. Pickerill: The Prevention of Dental Caries and Oral Sepsis, Philadelphia, 1914.

2. McCleendon, J. F.: Some American Plants Considered as Sources of Vitamins and as Parts of a Diet Favorable to the Preservation of the Teeth, J. Dental Res. 3: 279, 1921.