The Journal of the American Medical Association

Published under the Auspices of the Board of Trustees

VOL. XLI.

CHICAGO, ILLINOIS, OCTOBER 3, 1903.

No. 14.

Original Articles.

THE BACTERIA CONCERNED IN THE PRODUCTION OF EYE INFLAMMATIONS.*

ROBERT L. RANDOLPH, M.D.
BALTIMORE.

I do not think we are called on to discuss the so-called eye bacteria from a historical point of view, for that would mean a consideration of nearly all these bacteria in their causal relationship to the diseases with which they were first identified. As a matter of fact, we have not found any bacteria which are pathogenic only for the eye, though the possibility of there being such bacteria is suggested when we think of sympathetic ophthalmia and trachoma, two diseases which appear to be peculiar to the human race, and one of which, in all probability, is due to a specific bacterium.

Before speaking of the bacteria which we usually regard as pathogenic for the human eye, I may be pardoned for introducing matter which to many of you may seem very elementary, but which may help to a better understanding of what follows. Bacteria may be divided into two classes, the saprophytes, or those which obtain their nutrition from dead organic material, and the parasites, or those which live at the expense of some other living organic creature. The activities of the saprophytes lead to decomposition, putrefaction and fermentation, while the activities of the parasites result in disease and death. The saprophytes resolve dead animal and vegetable bodies into simpler compounds, carbonic acid, water and ammonia, which serve as food for vegetation, and for this reason this group of bacteria may be regarded as benefactors, while the parasites exist at the expense of some living organic creature, or to put it stronger, at the expense of sight and life. It is to the second class, the parasites, that the group of eye bacteria belongs. In this group we will find two of the grand divisions of bacteria in general micrococci or cocci and bacilli, these names being given them according to their individual outline, the cocci being round or sphere-shaped, the bacilli being rod-shaped. The third grand division of bacteria, the spirilla, finds no representatives in the group of so-called eye bacteria.

In the group of micrococci we find the *Streptococcus pyogenes*, the *Staphylococcus aureus* and *albus*, the pneumococcus and gonococcus. In the group bacilli, we have Weeks' bacillus, the diplobacillus of Morax-Axenfeld, the diphtheria bacillus, xerosis bacillus, tubercle bacillus,

Bacillus pyocyaneus and colon bacillus. Several of these bacteria are often found in the normal conjunctival sac, and the *Micrococcus epidermidis albus* may be regarded as an almost constant inhabitant of this location, and to a somewhat less extent this is the case with the xerosis bacillus. These two bacteria, then, can not be regarded as actually pathogenic for the human conjunctiva, but I have included them in the group of eye bacteria because they are so closely associated with the life history of the eye, and as I have observed elsewhere, both these organisms under certain conditions can become pathogenic and cause inflammation. Very recently I have had occasion to make repeated cultures from the conjunctival sac of an individual with intense monocular conjunctivitis, which, clinically speaking, was indistinguishable from "pink eye," and I was never able to get anything in either culture or cover-slip but the xerosis bacillus. What rendered this micro-organism pathogenic in this particular case I am unable to say. More than once I have been forced to the conclusion that the *Micrococcus epidermidis albus*, which I have found so often in the normal conjunctival sac, was apparently the cause of an intense conjunctivitis which I was treating. The colon bacillus is another organism which is not generally considered pathogenic, but there is sufficient evidence to warrant the belief that it does become very pathogenic under certain circumstances, so that its presence in diseased conditions while possibly accidental, not infrequently means its direct causal relationship to the disease. A number of cases of catarrhal conjunctivitis have been reported where the colon bacillus was found in the conjunctiva in pure culture, and several years ago I reported a case of panophthalmitis in which I obtained this organism from the vitreous in pure culture. These three organisms, then, are the least pathogenic of the group. When we pass to the other members of this family or group the element of pathogenicity comes out stronger, being most marked in the diphtheria bacillus, then in the gonococcus, Weeks' bacillus, pneumococcus, diplobacillus of Morax-Axenfeld, tubercle bacillus, streptococcus and *Staphylococcus aureus*. The latter organism, as it is found so frequently associated with a normal condition of the conjunctiva and lids, may almost be classed with the three organisms which I have indicated as being relatively less pathogenic. The streptococcus is another organism which is most inconstant in its effects. At times it will seem to have little, if any, virulence, no matter how tested, while again, it exhibits very marked pathogenic properties. When found as the active factor in an ophthalmia we usually have a very intense reaction, as seen in the streptococcus diphtheria of the conjunctiva, also in Parinaud's conjunctivitis. Of course, my grading these bacteria as regards their pathogenic value is an

* Read at the Fifty-fourth Annual Session of the American Medical Association, in the Section on Ophthalmology, being Part I (accompanied with lantern slide demonstration) of a symposium on the Bacteriology of the Eye by a committee consisting of Robert L. Randolph (chairman), Brown Pusey and Edgar Thomson. Approved for publication by the Executive Committee: Drs. J. A. Lippincott, Frank Allport and John E. Weeks.

entirely arbitrary arrangement, but judging from the effects produced by their toxins, the arrangement seems to me a reasonable one. All these organisms, however, irrespective of their pathogenicity, require to some extent a helping hand to render them capable of doing harm. While it is impossible to demonstrate always the exact nature of this co-operative agency, it is almost certain in a great number of cases that it consists in an abrasion or injury of the epithelium. Whatever lowers local resistance favors the multiplication of any bacteria which might happen to be in the conjunctival sac, and in overwhelming numbers ordinarily harmless bacteria can become dangerous. The more pathogenic an organism the greater would be the odds against the eye in case of mechanical injury, and I am convinced that the freedom of the eye from suppuration after penetrating wounds from accidents as well as from operations, while due in larger measure to the natural resistance of the eye to the disease, is also to no little extent due to the feeble pathogenic properties of those bacteria which are so often found in the conjunctival sac. No matter how pathogenic the bacteria if they fail to multiply it means that the battle is not to them. The sooner we realize, in dealing with the normal conjunctiva, that the latter is adequately equipped for adversity, the better will be the results of our operative work, and I look forward to no distant day when antiseptic irrigations of the normal conjunctiva in cataract operations will have been generally abandoned, and I am sure that during the past few years there has been a steady growth in the realization of the principle, clean hands, clean instruments, clean cocain, and leave the rest to the tissues of the eye. These rather practical thoughts suggest themselves to me in speaking of the bacteria which are found in the normal conjunctiva. Sometimes I am almost tempted to think that the bacteria which are so often found in this location perform certain important functions in the life of the normal conjunctiva, and that it is not intended we should disturb this relationship. We know that efforts to bring about intestinal and vaginal antiseptics have been followed by worse than failure, and that in the case of one enterprising obstetrician a large crop of puerperal fevers resulted. It is the same story here, bacteria ordinarily harmless are rendered harmful because our mental attitude toward bacteria in general is hostile, but I am convinced that with increasing knowledge we will be compelled to take up another position, even perhaps to regard some of the bacteria which are found in our bodies as benefactors, as blessings in disguise.

BACTERIA IN THE EYE,

AND NOTES ON SOME RECENT WORK IN OPHTHALMOLOGIC BACTERIOLOGY.*

BROWN PUSEY, M.D.

Instructor in Pathology of the Eye in the University of Chicago;
Assistant in Ophthalmology in Rush Medical College.

CHICAGO.

Such an appropriate opening of a subject as that which is forced on me is seldom given to a man. The natural manner in which to consider my subject is to begin with the bacteria that may infect the human conjunctiva, and of these the bacillus of acute, contagious conjunctivitis must first have attention. In the writings of a celebrated German ophthal-

mologist we find the sentence: "For the principal work in the investigation of this microorganism and the real demonstration of it as the cause of a particular form of conjunctivitis, we are indebted to him who in 1886 described the first cases, in which he was able to prove this microorganism to be the cause of this disease." I have the pleasure of showing a specimen containing the organisms spoken of in the above sentence, which bear the name of the investigator referred to—Weeks, the chairman of our Section. My quotation is from the writings of a gentleman who was to have been the guest of this Section—Professor Uhthoff.¹

The specimen is a smear from a conjunctival discharge. This statement reminds me of the fact that in studying bacteria in the conjunctival tissue we are greatly handicapped, because many of the organisms that cause conjunctivitis in man do not lend themselves to experimentation in the conjunctivæ of animals. Such is the case with the bacillus of Weeks, the Morax-Axenfeld diplobacillus, the diphtheria bacillus and the gonococcus. It is a curious and interesting fact that the last-named organism has never been found as a parasite in other animals. These organisms will not grow in the conjunctiva of animals, and, as we can hardly excise human conjunctiva for the purpose of such a demonstration, I can not show them in tissue.

In passing, I may refer to the fact that Weeks² and Morax³ have examined tissue containing the small bacillus, and of the severe forms of conjunctivitis Randolph⁴ has obtained such tissue from rabbits by injecting diphtheria toxin.

Taking up the chronic forms of conjunctivitis, I am fortunate in the possession of a specimen of leprosy of the conjunctiva, stained to show the lepra bacilli.

Of the chronic forms of conjunctivitis, none is so important as trachoma, and it would be most appropriate if I could at this point show the microorganism of this disease. You will all join me in my regret that such a demonstration is still impossible.

Before leaving the subject of the conjunctiva, I wish to refer to the very important recent work of the chairman of our committee—Dr. Randolph.⁴ He has investigated the rôle of the bacterial toxins in inflammations of the eye, and has demonstrated for the first time that, in general, these toxins are incapable of absorption from the intact conjunctival surface, hence such toxins instilled into the healthy conjunctival sac do not produce inflammation; but if they are injected into the conjunctiva or anterior chamber, they invariably set up local inflammation. His conclusions are most interesting, and his experiments, as he says, are in harmony with clinical experience, in that a lesion of continuity is shown to be important, not only in opening a path for invasion by bacteria, but in permitting the entrance of toxins, which constitute the weapons by which the bacterial cells do injury. In this important work Randolph records a study of the bacteriology of the normal conjunctiva of the rabbit, based on an examination of

1. Uhthoff, W.: Ueber die neuen Fortschritte der Bakteriologie auf dem Gebiete der Conjunctivitis und der Keratitis des Menschen Sammlung zwangloser Abhandlungen aus dem Gebiete der Augenheilkunde, II, 5, p. 17, 1898.

2. Weeks, J. E.: The Bacillus of Acute Conjunctival Catarrh or "Pink-eye," Knapp's Arch., xv, p. 441, 1886.

3. Morax, V.: Recherches bactériologiques sur l'étiologie der Conjunctivites algues, etc., Thèse de Paris, 1894.

4. Randolph, R. L.: The Rôle of the Toxins in Inflammations of the Eye, Amer. Jour. Med. Sci., November, 1902; also, Bulletin Johns Hopkins Hosp., March-April, 1903.

* Read, with stereopticon illustration, at the Fifty-fourth Annual Session of the American Medical Association, in the Section on Ophthalmology, and approved for publication by the Executive Committee: Drs. J. A. Lippincott, Frank Allport and John E. Weeks.