The operative treatment of chalazion by incision and evacuation of the contents with a curette is correctly described.

The treatment of lacrimal abscess by incision, scraping and probing is recommended as preferable to an expectant treatment.

Some of the prescriptions which Al-Ghafiqi gives contain curious ingredients. For loss of pigment of the eyelashes or canities the receipt is as follows:—Burn snail shells and triturate with the fat of wild goat or bear and with the mixture massage the palpebral borders. Many of the other remedies are equally surprising.

Meyerhof's book, which is called "Le Guide d'Oculistique d'Al-Ghafiqi" is tastefully arrayed in vellum with an Arabic inscription. It is beautifully printed at l'Institut graphique Oliva de Vilanova at Barcelona.

FOCAL INFECTION IN DISEASES OF THE EYE*

1.—Report of Certain Laboratory Examinations

BY

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Outline

1. Introduction.
2. Serological methods.
 - a. Complement fixation.
 - b. Agglutination reactions.
 - c. Intradermal tests.
3. Bacteriological methods.
 - a. Rough and smooth differentiation.
 - b. Staphylococci.
 - c. Enterococci.
 - d. Significance of toxicity and other tests.

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4. General considerations of certain foci.
 - a. Examination of teeth.
 - b. Faeces.
 - c. Throat.
 - d. Nose.
 - e. Prostate.
 - f. Distribution of bacteria in various foci.
5. Clinical diagnosis and the results of sero-bacteriological tests.
6. Summary.
7. Conclusions.

Much valuable information has been published concerning the relative importance of focal infections as contributing causes of various diseases of the eye. (See *e.g.*, de Schweinitz¹ and MacNevin and Vaughan².) In most of these contributions, the arguments presented and the diagnoses made were based on clinical and allied procedures. For years we have doubted whether, in a given ocular disturbance, a determination of the aetiological rôle of focal infection could be made by the usual clinical methods, or whether it was "largely a matter of exclusion" as contended by Corley.³

It is not our purpose to discuss the nature of the underlying cause of the eye disease, whether it is a true infection, a toxin or an allergic reaction, or to suggest treatment, but rather to report a critical survey of sero-bacteriological studies undertaken in an effort to evaluate such methods for the determination of the aetiology of certain diseases of the eye.*

Complement fixation.—Complement fixation reactions with the patient's own bacteria performed in 5,000 cases, were found to be unsatisfactory because the titer of the antigens could not be accurately determined by the usual methods.

Agglutination reactions.—The agglutination reaction was of considerable assistance in differentiating pathogenic from non-pathogenic bacteria, particularly streptococci, as the former were usually agglutinated to a high titer by the patient's serum. Many of the very toxic strains gave poor agglutination. While toxic

* It is impossible, in the present state of our knowledge, to prove that the bacteria to which the patient gives positive sero-bacteriological reactions are the direct cause of the disease of the eye, but it is also difficult, if not impossible, to demonstrate that a certain inflammatory disease of the eye is due to tuberculosis or syphilis unless the organism can be recovered from the eye lesion. Meller¹² has recovered tubercle bacilli from the intra-ocular tissues in a case of uveitis.

bacteria were often agglutinated in high titers, the relation between agglutinability and toxicity was only a general one.

Intradermal tests.—Although the reactions to intradermal tests are frequently used for the selection of organisms in the preparation of vaccines, this method has been shown to be subject to error. It may be positive in the absence of infection. It may be negative in the presence of infection. We have used it as a guide to the determination of the initial dose of vaccines and consider it helpful for this purpose.

Rough and smooth differentiation.—It is well-known among bacteriologists that most bacteria exist in several forms, the best known being the "rough" and "smooth" types. There is ample evidence in the literature that the rough type lacks virulence and is not suitable for the preparation of vaccines. On the other hand, organisms of the smooth type are frequently pathogenic, in which case they are most satisfactory for the preparation of vaccines. Consequently, it is important to study bacteria of the smooth type and we have found that the best method of selecting them is to use Rosenow's brain-heart infusion for primary isolation. Rough strains settle to the bottom of this medium. Transplants from the higher levels yield a large proportion of smooth strains not only of streptococci, but also of *M. catarrhalis*, staphylococci, and other bacteria.

Significance of toxicity and other tests.—The work so far indicates that organisms causing focal infection can usually be differentiated from the "normal flora" by the fact that they react more strongly to tests for toxicity and agglutinability. While this is usually true, we have observed instances in which organisms considered to be focal invaders have given none of these reactions.

Examination of teeth.—Using *bacteriological caution* teeth are extracted, broken open, and the various sections cultured separately. In this way we are able to avoid extensive contamination which would occur if, as is usually done, the whole tooth is dropped into a liquid medium. With these precautions we have been able to obtain a high proportion of relatively pure cultures of streptococcus viridans. Excluding peri-apical abscesses, the finding of other bacteria suggests contamination.

Faeces.—The most significant finding in our faecal examinations was that the total number of *B. coli* seemed to bear a direct relationship to streptococcal infection or intoxication. We have observed many cases where the relative absence of *B. coli* was probably associated with a streptococcal focus.

Distribution of bacteria in different foci.—Streptococci of the viridans type were found more frequently in the throat than in any other focus. They were also fairly common in the faeces, but the faecal strains usually gave poor agglutination. Staphylococci were found as often in the nose as in the throat and only rarely in faeces.

Summary

We have attempted to make a brief survey of the correlative value of some of the reactions available for the study of the bacteriology and immunology of focal infection. It is of paramount importance to appreciate that a given pathogenic micro-organism may not, in every instance, produce pathogenic effects. There are factors other than toxicity and immunity which enter into the host-parasite relationship. Sometimes the mere release of pent up necrotic material will give rise to relief from symptoms. This is the important underlying principle of surgical drainage. It is also the basis for relief of stasis of the colon and, no doubt, explains the beneficial effects of agents which increase peristalsis. Mucous membrane integrity and the length of time the toxin is in contact with the mucous membrane are as important in the production of an infection as is the power of a given micro-organism to produce disease. Therefore, in any given instance it is not alone necessary to demonstrate that certain bacteria are pathogenic; one should also attempt to discover specific antibodies or by other means ascertain that the bacteria or their toxins have penetrated the defensive mechanism.

In our survey of the reactions selected for determining any of the above factors, we have attempted to point out both the limitations and the value of each and have given a critical appraisal of their value for the study of focal infection. By a critical correlation of all these reactions one should be better able to evaluate the rôle played by each organism in the production of the pathological processes affecting the patient. In many instances, evidence may be discovered of foci which were not revealed by the history and the physical examination. Sometimes the patient is not aware of certain symptoms until they have been suggested from the results of these tests.

These studies emphasize the futility of relying on only one test, so far described, as a measure of the importance of any organism either in diagnosis or as a basis for the preparation of vaccines. Tests of toxicity of one organism have not always been found suitable for others. Serological tests may be of great value in the study of certain groups and of limited value in others. Among

the tests which we have found of decided value *when used in conjunction are*:—Agglutination; rough and smooth differentiation; bactericidal tests; electrophoresis; coagulase and haemolysis reactions for staphylococci; animal inoculation—either of the live or killed culture.

One thought which has been constantly in mind is that the inclusion of every available test would increase the cost of each examination to a prohibitive amount. While we feel that the question of cost should be secondary to the value of the work to the patient, we have hesitated to use such reactions as elective localization which would require the use of a considerable number of rabbits to test all the strains isolated from each patient. The method has excellent possibilities and is worthy of further study. Some reactions require standardization before they are available for routine use, and interested ophthalmologists may consider it worth while to include other methods which we have not yet had an opportunity to study.

Conclusions

1. We believe that the presence of a high agglutinin titer to an autogenous strain of streptococci is strong presumptive evidence that the strain is related to a focus of infection, but the converse is not necessarily true as we have observed a number of instances where inagglutinable or weakly agglutinable organisms were undoubtedly of focal origin.

2. Many of these low titer strains give positive toxicity tests.

3. Using the term "pathogenic" in its broader sense, we have not found a bacteriological or serological reaction which is generally applicable to the differentiation of "normal" from pathogenic bacteria of all the species studied.

4. Our results indicate that errors of certain tests can often be detected by the simultaneous use of other tests. For example, many strains of staphylococcus aureus and B. coli gave poor agglutination but strong toxicity tests. Subsequent experience indicated that these strains were probably related to the patient's foci of infection and were, therefore, as important as those which gave strong agglutination.

5. Correlation of a number of different methods should assist in the evaluation of the rôle of any micro-organism as a focal invader.

6. The simultaneous use of a number of different sero-bacteriological reactions has given us information as to the identity and probable location of organisms thought to be responsible for certain lesions of the eye, and has often suggested a hitherto unsuspected focus.

7. We believe that these reactions are of decided value to the ophthalmologist in studying diseases of the eye which are possibly due to focal infection. These tests are also of value in determining the progress of treatment.

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