THE BACTERIOLOGICAL EXAMINATION OF THE WATER-SUPPLY.*

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THE science of bacteriology being of quite recent date, it is not to be expected that its value as a test of the purity of public water-supplies, although steadily gaining in repute, should yet be generally realized by sanitary authorities and others. Accordingly, in this particular direction, arguments against its employment are still put forward. The following is as fair a statement of certain of these as the writer can make, together with such replies or explanations as suggest themselves to him respecting them :

1. *It is said to be unnecessary.* This view appears to be based on the erroneous idea that, as most of the ordinary bacteria of water are non-pathogenic, they are of no consequence, and need not be studied for the benefit of the public health. . . . Further, the relation of the non-specific bacteria of water to epidemic diarrhoea—a disease which, though never satisfactorily explained hitherto, is invariably prevalent in summer, when these micro-organisms are most plentiful—offers a promising field for investigation. Some urge that the non-pathogenic bacteria are necessary to eat up the pathogenic ones, a theory dangerous to trust to in any case, and, as concerns water organisms, without, it is believed, the slightest basis in fact. The secretary of a large water-works recently wrote his opinion that a bacteriological examination of the water supplied to his town was “absolutely unnecessary,” it being “pure and of good quality”! Curiously enough, the holder of the above notion refers in the next paragraph of his letter to “complaints made about the water some time ago”!

2. *It is charged with being unreliable, and with not coming up to expectation.* The able author of a recent work,† whilst discussing a question in relation to bacteria and water-supply, directs attention to an observation of a certain investigator to the effect that the months of greatest abundance of water-bacteria are those of least prevalence of enteric fever. Although not drawing direct inference from this in the way of cause and effect, any other reason for the author bringing it forward is not obvious, and his statement is calculated to convey to the ordinary reader the impression that some relation had formerly been supposed to exist between ordinary bacteria of water and outbreaks of enteric fever, which had afterwards been proved not to be so. But bacteriologists have never held such views. If others have done so, the mistake is theirs only. So far from having disappointed the expectations of its advocates, bacteriology, although the youngest of the sciences, is constantly making startling advances, and daily throwing new light on the actual causes of disease.

3. As regards the sufficiency of the methods at present available for recognising and estimating the different organisms to be found in drinking-water, no doubt the failure to detect the typhoid bacillus in the

* Extracted from a Report on the Proposed Bacteriological Examination of the Water-Supply of Newcastle-upon-Tyne.

† “Water-Supplies, Chemical and Sanitary,” by Professor W. P. Mason, New York, 1896, p. 23.

water blamed for the Maidstone epidemic came somewhat as a disappointment to the general public. But this is no disproof of the ability of bacteriology to detect it, as Dr. Washbourn has shown.

4. There would appear at first glance to be more weight in favour of chemical as compared with bacteriological examination of water in the argument that the former shows pollutions in solution, and therefore general, whereas the latter indicates only particulate and strictly local matters, and affords no criterion as to the condition of the water as a whole; also that bacilli will develop and multiply in a sample of water after its collection, which is not the case—at least, to an equal extent—with the chemical constituents.

These apparent deficiencies of bacteriological examination do not occur when proper methods of collection and treatment of the samples to be examined are adopted. Moreover, we are by no means certain that a really “average sample” is obtainable even for chemical purposes, or, if it were, that it fully meets all the sanitary requirements of analysis.

5. As regards the alleged “*growing tendency among physicians and civil engineers to belittle the chemist's opinion regarding the potability of a water, and to pin their faith exclusively upon what the bacteriologist may have to say on the subject.*”^{*} This complaint is admittedly based on the classical report (for the year 1881) of Dr. (afterwards Sir George) Buchanan, Medical Officer to the Local Government Board, on the failure of chemical analysis to detect pollutions in drinking-water which had been purposely inoculated by Dr. Cory with the germs of typhoid fever and other contaminations. The report states that “The Medical Department of the Local Government Board has had repeated occasion to observe, on the part of sanitary authorities and their advisers, a tendency to estimate unduly the value of quantitative chemical analysis as demonstrating the wholesomeness of drinking-waters. Some authorities have even regarded evidence of this sort as setting aside presumptions of pollution that had arisen from considerations of dangerous situation of wells and reservoirs.” . . . With regard to the recognition of the germs of enteric fever, Dr. Buchanan observes: “It is found, in the first place, that to the customary methods of chemical examination there is nothing to distinguish this pollution from any other excremental pollutions. Indeed, generally, Dr. Cory's report gives no indication that chemistry can tell whether a healthy or a diseased body has been the source of any foulness observed in water.” Dr. Buchanan proceeds to show how the “albuminoid ammonia” process of analysis failed to show anything remarkable in a water to which enteric fever stools had been purposely added. On this Dr. Buchanan makes the following remark: “In Dr. Cory's experiments, then, with 1 grain of enteric fever stool per gallon we see a water thus largely befouled by a most dangerous material; and the indication of that befoulment when expressed by the chemist, in terms of albuminoid ammonia, is the figure ‘014 part per million parts of the water. Wherefore it is not permissible to accept the doctrines which have been formulated from the amount of albuminoid ammonia present in an otherwise unknown water. Polluting material potent for harm may be present in a water yielding from ‘00 up to ‘05 parts of albuminoid ammonia per million without removing it from the rank of waters of extraordinary organic purity; and we have assuredly no

^{*} Mason, *loc. cit.*, p. 421.

evidence in the case of an unknown water showing from .05 to .10 parts of albuminoid ammonia per million that it is safe organically. The chemist can, in brief, tell us of impurity and hazard, but not of purity and safety."

The *Lancet*,* commenting on the chemical and bacteriological reports of the recent outbreak of enteric fever at Maidstone, makes the following observation: "Two points will strike even the most superficial observer: (1) That bacteriological examination often serves to bring to light faults in the water that are not discriminated by the chemist—the converse also holding good; and (2) that bacteriological examination may often serve to clinch suspicious features in the chemical analysis."

The truth is, that the chemical and bacteriological methods of analysis are each the complement and confirmation of the other, and that no examination of a water-supply is complete without the employment of both.

6. Some superiority may perhaps be attributed to chemical methods of water analysis on the ground that, dealing, as they do, with matters in solution, they are available for the purpose of tracing certain outbreaks of disease, where earth-filtration has removed all or most of the micro-organisms, but not the dissolved chlorides, nitrates, nitrites, and ammonia which indicate pollution. An instance somewhat of this kind is undoubtedly on record, viz., that of the outbreak of enteric fever in the village of Lausen, near Basel, in Switzerland, due to the polluted water from an isolated farmhouse on the far side of a mountain, through which it filtered to a spring used by the villagers who contracted fever. Here an attempt to trace the water through the mountain by mixing it with flour failed, from the flour being filtered out by the earth through which the water passed; whereas the addition of a large quantity of common salt to the stream near the infected farm soon made itself apparent to chemical analysis in the water of the village spring. In this case what happened to the flour might perhaps have happened to the majority of the non-pathogenic bacteria in the water (although we have no information that any bacteriological test was applied), viz., they might be filtered out. Such occurrences must of necessity be extremely rare, and even were the bacteriological examination to fail in a case of the kind, it would only go to prove the validity of the foregoing proposition, that no water analysis is complete without both methods of examination.

7. Chemical analysis has been said to give warning of general organic pollution of water, and thereby to anticipate and lead to the possible prevention of outbreaks of specific disease.† But the same must be admitted for bacteriological analysis, which not only does this, but in one respect does so with greater precision, since it differentiates between three forms of polluting organisms, viz., (a) general non-pathogenic, (b) intestinal non-pathogenic, and (c) pathogenic. The first of these indications serves as a valuable measure of pollution liable to vary from time to time, and which, though innocent to-day, may not be so to-morrow; the second is a note of danger, as clear and unmistakable as any chemistry can sound; and the third, when met with, is a proof of the actual presence of deadly poison beyond chemical recognition.

8. It has been said that too much reliance is placed on bacterial inquiry, and that to publish regular returns of the organisms found in a

* January 8th, 1898.

† Mason, p. 423.

water-supply would tend to create unnecessary alarm, etc. To which it may be replied, that if the public, in their hopefulness respecting the benefits to be gained from bacteriology as applied to water examinations, have expected from it more than is yet justifiable or has ever been promised, that is no reason why the undoubted services of the new science in this respect should be lost to mankind. The publication of the results of chemical analysis has not been found to give rise to undue excitement, neither have the statistics of bacilli in the waters of the eight London companies reported monthly by the Registrar-General. If, however, any exception be taken to the systematic publication of biological details, the reports may be confined to a comment or criticism of the returns, without giving the actual figures.

9. The last objection likely to be raised against the proposal in question is that of *expense*, an argument which, other things being equal, it is confidently felt will not have undue weight with the Sanitary Authority of Newcastle.

CONGENITAL TUBERCULOSIS.

It has been so frequently stated within past years that tuberculosis as a disease is not inherited, that cases of manifestly congenital disease demand some notice. At the meeting of the Pathological Society of London, of 2nd May last, Professor J. Macfadyen exhibited part of a tuberculous calf, making the third instance of congenital disease observed by him since 1897, prior to which date he had seen only one example. In the first case since 1897 there was advanced tubercular disease of the maternal uterus; nothing was known of the condition of the mother in the second; and in the third the lungs were tuberculous, but the uterus was not examined. In the second calf the disease was present in the liver, spleen, lungs, and myocardium, and in the third in the liver, spleen, kidney (to a slight extent), lungs, and the lymphatic glands, hepatic, mesenteric, etc. Calcification was noticed in the second calf. In the adult bovine the lungs, pleura and peritoneum are usually infected, the spleen rarely.

In the Proceedings of the Pathological Society of Philadelphia, U.S.A. (Vol. II., N.S., No. 6), is reported a case of a cow in an advanced stage of tuberculosis which aborted. To the naked eye the embryo presented no appearance of infection except two small doubtful nodules in the liver. These were crushed with proper precautions and emulsified, three guinea-pigs being inoculated with the emulsion. Two of the guinea-pigs died some two months later, and were found to be suffering from general abdominal tuberculosis. The third was killed shortly after the deaths of the others, and found to be tubercular; the bacillus and tuberculosis was demonstrated in all three guinea-pigs. The mother was tuberculous in the lungs and mesenteric glands.

ROYAL STATISTICAL SOCIETY.—At the meeting of May 16th Dr. Hayward, Medical Officer of Health of Haydock, Lancs., read a paper on "Life Tables: their Construction and Practical Uses." The paper was a long but interesting communication, but not one which can be abstracted without spoiling the object for which it was written. Moreover, a very considerable part of the subject was dealt with by Dr. Hayward in a communication to the North-western Branch in May, 1898 (see PUBLIC HEALTH, x., p. 329, July, 1898).