

## No. III.

## Report on the Microscopical Examination of certain Atmospheres, during the Epidemic of Cholera. By Mr. Rainey.

THE observations which will form the first part of this Report have an especial reference to the condition of the atmosphere in a Cholera district, both when Cholera was present, and after it had entirely left the neighbourhood. In the prosecution of these inquiries I have had the advantage of a series of very careful experiments, instituted and carried on at St. Thomas's Hospital, upon a very large scale, by Dr. Dundas Thomson, the Professor of Chemistry at this Hospital.

As Dr. Thomson's report will contain the details of these experiments, it will only be necessary for me to make such allusions to them as will be required to render my own observations intelligible. The immediate object of these experiments was to transmit the air of one of the Cholera wards at different periods through a small quantity of distilled water, in order that it might be determined by microscopic examinations whether the water thus treated contained any organic or inorganic bodies when Cholera prevailed which could not be found in it when the disease was absent. First, some of the distilled water through which the air of the Cholera ward had been transmitted, when the disease was at its height, was examined by the microscope with the best lenses, under the best illumination. This water contained a great variety of substances, some of which were alive, and evidently in an active state of growth: these were so apparent as to be visible to the naked eye. The other substances were not possessed of life, but were from the dust which had floated in the atmosphere of the ward. These latter consisted of minute hairs, of vegetable fibres of different kinds and colours, of starch granules, amorphous black carbonaceous matter, which were particles of smoke, and lastly of epithelial cells. With respect to the origin and presence of these substances in this water, little need be said, since it is at once obvious that, in the act of making the beds, and in that of dressing and undressing, numerous vegetable and animal fibres would be detached from the bed clothes, with particles of starch which had been employed for stiffening the patients' linen, and be wafted into the upper part of the air of the ward, and from thence be carried by the tubes connected with the apparatus into the distilled water, in which they would be detained. With these substances the epidermic scales in progress of desquamation from the surface of the body, when detached from it by the slightest friction, would, from their extreme lightness, readily ascend, and mingling with them in the atmosphere, form also a part of this heterogeneous compound. These contaminations being diffused through the whole of the air in the ward, would not only gain access to the parts of the apparatus destined to convey them into the fluid in the reservoirs, but they must with equal facility

find their way into the lungs of all who are obliged to breathe the same contaminated atmosphere. But it must be remarked that such impurities are not confined to the atmosphere of the wards of hospitals; they exist of course in the air of all apartments where persons sleep; their proportion to the quantity of pure air depending upon the number of persons in any one apartment, its size, the time they spend there, and also upon their general habits of personal cleanliness, or the neglect of it. These impurities are present also in the open air, especially in densely populated districts, where they will be mixed with gaseous contaminations of different kinds. As it respects the origin and presence of the living organic bodies before alluded to in the distilled water, some further observations are necessary. These bodies had the appearance of small flocculent masses in the fluid at the bottom of the vessel, visible to the naked eye. These were examined at the same time by Dr. Thomson and myself, and were found to consist of the mycelia of fungi, apparently in an active state of vegetation, mixed with the fibrous portion of the impurities before mentioned. By a most careful examination with the microscope, I could not discover any appreciable difference between these growths and the mycelia of fungi, which had formed in solutions of vegetable substance after exposure to the air where no Cholera was present. In this instance these fungi were associated with more or less extraneous vegetable fibres; but these I believe to be altogether unnecessary for the production of these bodies, as the mycelia of fungi are capable of developing themselves in fluids where no such extraneous matter is present. Besides the fungi, there were extremely minute, colourless, indistinctly beaded fibres, resembling in their general characters that form of vibrionia called "bacterium." These were so abundant as to cover some of the larger branching fibres of the mycelium to which they seemed to be attached. These bodies are so extremely minute that, under a magnifying power of 900 diameters, and good illumination, they do not present very definite structural characters. I do not recollect to have seen them on mycelia growing in astringent vegetable solutions prepared for the purpose of producing fungi.

After this another portion of distilled water, through which the atmospheric air of the same ward had been transmitted precisely in the same manner as before, though when the disease was very much on the decline, was submitted to microscopic examination. This water contained impurities attributable to dust, similar to those already particularized in the other water, also the same two living organic bodies, although the vibrio-like fibres were much less numerous than in the first experiment; however they were in sufficient quantity to remove all doubt as to their actual existence. These fibres, as also the mycelia found in this water, presented the same characters as those found in the first quantity.

Next a third portion of distilled water was treated precisely in the same manner as the other two, though after the Cholera had entirely left the district. This water, like the last, contained some foreign particles, attributable to dust, also the mycelia of fungi in considerable abundance, and apparently in an active state of vege-

tation, but I could not find any of the vibrio-like growths, although I examined this water with great care.

The next microscopic examinations which were instituted were made with the view of determining whether any organic bodies were present on the lining membrane of the air passages of those who had died from Cholera which were not to be found in the same situations in those who had died from other causes. The membrane covering the inferior vocal chords was considered to be the part most suitable for this examination, as it is difficult to imagine how organic bodies floating in the air, sufficient in quantity to destroy life on reaching the interior of the lungs, could all pass through so small an aperture as the rima glottides without leaving some trace behind on that membrane. This portion of the mucous membrane is also well adapted for such an examination, in consequence of its epithelium being squamous, and not ciliated, as in other parts of the air passages, and so transparent and simple in its character, that in case any extraneous bodies had been there arrested, they would be placed under circumstances the most favourable for their detection and minute inspection by the microscope. I accordingly examined the larynges of eleven persons who had died in the Cholera ward of this (St. Thomas's) Hospital. They were all well marked cases, and the examination of each was made as soon after death as circumstances would permit. The appearances were in all these cases moderately uniform. I could detect nothing like spores, or the mycelia of fungi, or the vibrio-like fibres in any one of them. Had these been present in the larynges of these individuals it would have enhanced the importance of the first experiments, but still their absence does not detract much from them, for it is far from certain that physiologists are yet able to recognise all the various forms in which these bodies do exist. The appearance which the mucous membrane presented in all these larynges when examined immediately after death were as follows:—The squamous epithelium in some parts was studded with patches, generally inclining to an oval form, of extremely minute dark points, producing an appearance resembling that which is frequently seen in animal matter just beginning to produce vibriones, in other parts the molecules composing these patches had a decided tendency to coalesce and form larger particles, presenting all the microscopic characters of minute masses of oil. The same part, when examined at a later period, that is, after two or three days, had undergone a considerable change; vibriones had formed in it in great abundance. They were in vigorous motion; at this time well-defined crystals of triple phosphate were deposited in considerable quantities, but still the patches of molecules were present, and had undergone no appreciable alteration. In order to determine how far the appearances just described might be considered as normal or abnormal, or whether they were confined to Cholera subjects or not, I examined the same part of the mucous membrane in an individual who had not had Cholera, but who died from the effects of an accident; and in making a careful comparison of the appearances in these cases, I could discover no difference by which I was enabled to distinguish one from another. The patches of molecules in the two states, as above noticed, were present in the latter case, differing in no

appreciable degree from those in the Cholera subjects. These appearances seem, therefore, to be natural, and due to a normal process of molecular disintegration which the epithelial scales are undergoing prior to their complete decay. This epithelium also, when examined after two days, was beset with vibrios, and deposited triple phosphate as in the Cholera cases. I have since examined other larynges of persons not affected with Cholera, which confirm the conclusion I had before arrived at, namely, that there is no appreciable difference in the mucous membrane covering the inferior vocal chords in persons who have died of Cholera from those who have died of other complaints.

I have examined the blood of several Cholera patients, in which there was nothing remarkable, unless it be the large quantity of triple phosphate which it deposited after standing a day or two. I have made also some examinations of the rice-water motions, but without being able to detect in them anything which had not been before noticed. The very early appearance of vibriones in these motions, even directly after they had been voided, seemed at first to be a remarkable circumstance; however, on examining the contents of the different divisions of the intestinal canal, as short a time as possible after death, before any signs of putrefaction were apparent, I also found them in the contents of all these parts in considerable abundance, and in active motion, even as high up in the intestine as the duodenum. Being desirous to ascertain whether these organisms existed only in the contents of the intestines of persons who had died of Cholera, I examined the contents of the intestinal canal of individuals, also as soon after death as practicable, who had died of other complaints, and I still found vibriones; so that it appears these bodies, existing in the secretions of the intestinal canal, do not form one of the peculiarities of Cholera.

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