

is equal to ten micro-millimetres. Divide three of these into twenty thousand parts. It is practically impossible—except under a microscope—but you may have some idea from this of the almost infinite minuteness of these bodies. But their rate of increase is almost proportionally great. A single bacterium is believed, by good observers, to double itself once or twice in an hour. If, then, only two bacteria are present in a wound at starting, and everything is favourable to their development, in six hours eight thousand one hundred and ninety-two will be present, and at the end of twelve, forty-nine million five hundred and fifty four thousand four hundred and thirty-two. However insignificant, therefore, each may be, and however slight its power for evil, it becomes, by this tremendous power of reproduction, an immensely potent factor, if uncontrolled.

In order to give you some idea of the precautions which bacteriologists think it necessary to take, in order to absolutely free any bottle or other utensils from bacteria and their spores, I will give you the directions of Dr. Klein, the lecturer on Physiology at St. Bartholomew's Hospital. He wishes to cultivate one particular form of bacterium, by sowing it upon some gelatine in a test tube, and in order that this form alone shall grow there, it is, of course, necessary that the tubes, gelatine, &c., shall be, to begin with, perfectly free from anything of the sort. The tube is placed in an oven, heated to 270 deg. F. for several hours on successive days. This is done because the heat which would kill any living microbe would only hatch out the spores. Therefore, the second heating is necessary in order to kill those which have only been started into life by the first. The cotton wool, which is placed in the mouth of the test tube to act as a cork, is also heated several times for several successive days for the same reason, until it is browned. The gelatine is kept in a flask, at a temperature of 90 deg. to 100 deg. F., for several days to several weeks, in order that any germs it may contain may show their presence, and is then poured into the test tubes, the cotton wool being lifted out sufficiently by means of forceps, which have been purified by holding in a flame. The plug is pushed down again, and the tube with the gelatine contained boiled from two to five minutes. They are then placed in the incubator for twenty-four hours, so that any spores which have entered may become developed, and show signs of their presence. They are again boiled in the incubator for two to three weeks; so much is all that it is necessary to know with reference to the form, size, and condition of bacteria. We now come to a far more important and interesting part of our subject, the evidence upon which our belief in the powers for evil of microbes depends.

If you take some blood serum, which must be obtained with the greatest precautions against contamination with germs, or some urine, or indeed any other animal fluid, the first being only selected as the most convenient, and place it in a flask which has been purified as Dr. Klein directs, and plugged by cotton wool also similarly treated, you will find that you can keep that serum, or urine, for months, in a warm place, in a perfectly unchanged condition. At the end of that time there will be no smell, no turbidity, nor the slightest sign of putrefaction, and under the microscope you will find nothing more than you would at first. If you take another quantity and treat it in the same way, placing it this time in several flasks, but exposing each to the open air for a few minutes before plugging, you will find that in some the fluid remains sweet, but that in the majority it will become sour and opaque in two days, and in a week it will be offensive—in fact putrid. Under the microscope you will see an infinite number of small bodies in more or less active movement. If you take yet a third amount, and instead of exposing it to the air, place in it a piece of cloth, linen, blanketing, or carpet, you will find the same result as in the last experiment. The same thing will happen if you add unboiled tap-water.

Notice that these observations prove—

- (1) That there is nothing in the blood or serum *itself* which necessitates its becoming putrid.
- (2) That there exists in the air, in ordinary unboiled water, on articles of clothing, bedding, &c., something which, when it comes in contact with an animal fluid, produces such changes in it as ultimately end in putrescence.
- (3) That this something is not equally distributed through all air.
- (4) That this something cannot pass through cotton-wool, but is, so to speak, filtered out. It cannot, therefore, be a gas. It is evidently not a liquid; it must, therefore, be a solid.

Now carry this a little farther.

If you inject some of the unchanged serum under the skin of any animal, no particular effect is produced upon the creature into whose body you have injected it. But if you inject even a few drops of the putrescent serum, you will produce an abscess around them in the part, whilst if you increase the dose, you will make the creature ill, feverish, hectic, until at last a large dose will kill it as surely, though not as quickly, as though you had given it prussic acid.

There is something then in the putrescent serum which is poisonous to animal life which did not exist in the pure unchanged serum, and which has been formed in consequence of its contact

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