Professor Tyndall on Haze and Dust.

One of the most remarkable and, perhaps, one of the most prolific discoveries of modern science, says the Pall Mall *Gazette*, was announced and described by Prof. Tyndall in a lecture delivered at the Royal Institution, January 21. The subject of the lecture, which was illustrated by a series of very beautiful experiments or demonstrations, was the very familiar one of "Dust and Disease," and its object was to show the probability of an intimate connection between atmospheric dust and epidemic diseases. Everybody knows that when a direct ray of sunshine crosses a shaded room, its direction is made manifest by a line of apparent vapor. Looking at this vapor, it is seen to consist of innumerable particles of dust which float in the atmosphere and, catching and reflecting the sunshine, are rendered visible.

In the course of some beautiful experiments on the decomposition of vapors by light, Dr. Tyndall found it to be essential that he should get rid of the floating dust. He strained the air through a tube filled with bits of glass wetted with concentrated sulphuric acid, and through another tube filled with bits of marble wetted with caustic potash, he then made it bubble through the liquid acid and the potash solution, but still the dust particles remained in it. He tried various other ways of straining out this dust, but none of them succeeded. At length he passed the air on its way to the tube over the flame of a spirit lamp, and at once every particle of the dust disappeared. It was, therefore, organic matter, and the flame had burned it.

Passing the air a little more quickly over the flame, a fine blue cloud appeared in the tube—the smoke of the dust particles. The organic and combustible nature of these particles was a discovery, for they had hitherto been taken to be inorganic and incombustible. Air was then passed through a tube which contained a roll of platinum gauze, and it was found that when the platinum was cold, the dust particles all passed through with the air, but that when it was made red-hot, the dust particles were all consumed. In this case, too, when the air was forced quickly through, a fine blue cloud of smoke appeared just as in the experiment with the spirit lamp. An attempt was then made to burn the particles by the concentrated rays of a convergent mirror, but it failed; the particles flitted too quickly through the focus of the burning ray to be consumed by it.

The next experiment was to put the flame of a spirit lamp in the ray of light which was revealing the floating dust. At once the flame was seen to be surrounded by wreaths of darkness, resembling intensely black smoke. On lowering the flame beneath the beam of light the same dark masses were seen wreathing upwards. "They were at times," says Dr. Tyndall, "blacker than the blackest smoke that I ever saw issuing from the funnel of a steamer, and their resemblance to smoke was so perfect as to lead the most practised observer to conclude that the apparently pure flame of the alcohol required but a beam of sufficient intensity to reveal its clouds of liberated carbon." But when a red-hot poker was placed under the beam the same black wreaths came floating through. A hydrogen flame was next put under it, and the whirling masses of darkness wreathed upwards more copiously than ever. The blackness was therefore nothing but air from which all dust particles had been burned out, and which consequently, contained nothing to catch the light and reflect it to the eye as the dust particles do.

Here, however, a difficulty came in. The same effect was produced by a copper ball not hot enough to burn the dust, and by a flask filled with hot water. In this case it was found that the air war rarefied with the warmth, and as the dust particles were not heated to the same extent it dropped them and floated upwards without them. Other gases, even common coal gas, carefully prepared so as to exclude the dust particles, have the same black appearance when they cross a ray which the dust-laden air renders visible, and if coal or hydrogen be let into the top part of a glass shade which has been placed in a sunbeam or a ray of the electric light, the line between dust-laden air and the gas is rendered visible—where the air is, the shade will seem full of the illuminated particles, where the gas is it will appear absolutely empty. "The air of our London rooms is filled with this organic dust, nor is the country air free from its pollution. It only needs a sufficiently powerful beam to make the air appear as a semi-solid rather than a gas."

Nobody could in the first instance, without repugnance, place the mouth at the illuminated focus of the electric beam and inhale the dirt revealed there. Yet we are inhaling it every moment, and the wonder is that so small a portion of it should be injurious to health.

What is the portion of this ever-present and all-pervading dust which is injurious to life? Now, it was long believed that epidemic diseases were propagated by malaria, which consisted of organic matter in a state of motor-decay; that when such matter was taken into the body through the lungs or the skin, it had the power of spreading in it a similar decay—yeast was a case in point. Why should not a bit of malarious matter operate in the body as a little leaven, leavening the whole lump?

But in 1836 Cagniard de la Tour discovered the yeast plant, which when placed in a proper medium grows and spreads, and produces what we call fermentation. In the next year Schwann, of Berlin, discovered the plant independently. He also proved that when a docoction of meat is effectually excluded from common air, and supplied solely with air which has been raised to a high temperature, it never putrefies. Putrefaction, therefore, he said, came from the air, and could be destroyed by a sufficiently high temperature. Helmholtz and Ure repeated and confirmed his experiments: but the high authority of Guy-Lussac, who ascribed putrefaction to oxygen, drove chemists back on the old notion. That notion was finally exploded by Pasteur, who proved that the true ferments are organized beings who find in what we call ferments their necessary food.

Side by side with these discoveries grew up the germ theory of epidemic disease. Kircher expressed the idea, and Linnæus favored it, that epidemic diseases are due to germs which, floating in the atmosphere, enter the body and produce disease by the development of parasitic life. Sir Henry Holland, has favored this theory, which derives its strength from the perfect parallelism between the phenomena of contagious disease and those of life. As an acorn planted in the soil gives birth to an oak which produces a whole crop of acorns, each of which has power to produce its parent tree, and thus from a single seed a whole forest may spring, so a germ of disease planted in a human body grows and shakes abroad new germs, which, meeting in other human bodies with their proper food and temperature, finally take possession of whole populations. Thus Asiatic cholera, beginning in a small way in the delta of the Ganges, spread itself in seventeen years over nearly the whole habitable world.

An infinitesimal speck of small-pox virus will develop a crop of pustules, each charged with the original poison. The reappearance of this scourge, as in the case of the Dreadnought at Greenwich, so ably reported on by Dr. Budd and Mr. Busk, is explained by the theory which ascribes it to the lingering of germs about the infected place. Surgeons have long known the danger of admitting air to an abscess, and abscesses are always opened by an instrument which carefully excludes the air from contact with the wound. The instrument should of course, be scrupulously clean; but it can be made perfectly clean in an atmosphere of dust only by being made as hot as its temper will bear. This is not done, and therefore inflammation often sets in after the first operation; rapid putrefaction accompanies it, and the pus, which at first showed no traces of animal life, is now found to be full of active little organisms called vibrios. Professor Lister, from whose letter this fact is derived, contends that this astounding development of animal life is due to the entry of germs into the abscess during the first operation, and their subsequent development by favorable circumstances. Hay fever is another case in point.

The celebrated physiologist Helmholtz suffers from the 29th of May till the end of June from a catarrh of the upper air-passages, and he has found that during this period, and at no other, his nasal secretions are peopled by those vibrios. They nestle in the cavities of the nose, and a sneeze is necessary to dislodge them. These are uncomfortable statements, but if the germ-theory is found to be true, it will give definiteness to our efforts to stamp out disease; and it is only by some definite efforts under its guidance that its truth or falsehood can be established. Hence Dr. Tyndall says he reads with sympathy such papers as those of Dr. Budd, of Bristol, on cholera, scarlet fever and small-pox. Dr. Budd's imagination may occasionally tempt him to a flight beyond his facts, but without this dynamic heat of heart the solid inertia of the Briton can never be overcome. * * *

Returning to the dust, Dr. Tyndall drew certain practical conclusions from the survey of these two classes of facts. The dust cannot be blown away by ordinary bellows, since the air they send out is equally full of the particles. But fill the nozzle with cotton wool, not too tightly pressed, and the air is filtered, and being then blown across the beam of light, forms a clean band of darkness, like the air from the spirit lamp, or from the heated platinum wire. * * *

The most interesting of all illustrations of this filtering process is furnished by the human breast. Fill the lungs with ordinary air and breathe through a warm tube—warmed to prevent the condensation of the watery particles—across the beam of light which is revealing the dust-particles in the air, the particles move with the moving air, but the current from the lungs shows at first as many particles as the ordinary atmosphere. Gradually, however, the particles clear away from the course of the breath, and by the time you have completed your expiration, the expired air cuts a sharp black line