From the PHILOSOPHICAL MAGAZINE for March 1884

21364-44

On the Phenomena exhibited by Dusty Air in the neighbourhood of strongly Illuminated Bodies. By OLIVER J. LODGE *and* J. W. CLARK *.

PART I.

[Plate VII.]

IN the course of a lecture on Dust and Disease given at the Royal Institution in 1870, Dr. Tyndall calls attention to, and fully illustrates by experiment, a dark or dust-free region which he had observed in the convection-currents rising from hot solids placed in the path of a powerful beam of light (see Proc. Roy. Inst. vol. vi. p. 1, also 'The Floating Matter of the Air'). He describes this dark stream as of surprising sharpness and definiteness, especially when it is seen above an ignited platinum wire, the line of sight being parallel to the wire but at right angles to the beam. Dr. Tyndall also gave

* An abstract was read before the Physical Society on February 9, 1884.

two explanations of the phenomena—one of which he considered to be applicable when the solid is at a red or white heat; the other applicable when the body is at some more moderate temperature, such as that of boiling or even warm water. The first explanation is that the dust is absolutely burnt and consumed by the heat; the second is that the hot body warms the air in contact with it, which air therefore rises, dragging the dust after it but getting a slight start in advance of the dust, so that a thin stratum of the advance air from either side of the body is free from dust, and the mingling of the two strata constitutes the dark plane. This goes on continually as long as the convection-currents are produced by the body; and so the dark plane is permanent while the body is hot.

Prof. Frankland, in another paper on Dust and Disease, gives a still simpler account of the matter, and considers (Proc. Roy. Soc. vol. xxv. p. 542) that the observation proves that "a very large proportion of the suspended particles in the London atmosphere consists of water and other volatile liquid or solid matter." In other words, Prof. Frankland considers that the dust is simply dried up by the heat.

These three explanations seem to have been sufficiently plausible to satisfy those who may have examined or exhibited the phenomena discovered by Dr. Tyndall, until in 1881 Lord Rayleigh repeated and extended the original observation, "not feeling satisfied with the explanation of the dark plane given by the discoverer" (Roy. Soc. Dec. 21, 1882; 'Nature,' vol. xxviii. p. 139). He used a glass box to prevent draughts, and his hot body was usually a small copper spade which could be warmed from the outside of the box with a spirit-lamp. He called attention to the fact that the stream-lines round the obstacle follow the electrical law of flow, because the warm obstacle is itself the origin of the motion. He showed that smoke was not evaporated by being blown through a hot glass tube into sunshine, and he conclusively disproved any evaporation hypothesis by reversing the whole phenomenon: cooling the rod instead of heating it, and causing the dark plane to stream downwards.

Lord Rayleigh further suggested an hypothesis of his own to account for the dark plane in a simple mechanical manner, viz. that the curvature of the stream-lines near the surface of the obstacle was such as to cause the heavier dust-particles to be thrown outwards away from the body, and thus to leave a thin layer of air free from dust. To test this hypothesis he made a special centrifugal experiment with a whirling table, the direct result of which was negative; but it led to the

observation of an apparent purification of air by contact with a solid, which if followed up might have led a good deal further. It was not followed up, however, though the remark is made that "it would seem as if this kind of contact was sufficient to purify the air without the aid of centrifugal force;" and the paper concludes with another test of the centrifugal force hypothesis, concerning which, finally, "no absolute conclusion can be drawn."

In the autumn of 1883 our attention was called to the matter by Lord Rayleigh's article in 'Nature;' and being struck with the apparent total collapse of all explanations hitherto offered, we proceeded to repeat the experiments with some care. The first result of any importance which we obtained was the fact that the dark plane hitherto observed to rise from a warm body, or to sink from a cold one, is only a continuation of a dark or dust-free *coat* of uniform thickness and sharp outline which completely invests the body; and we were led to the conclusion that this coat is the most important part of the phenomenon, because the up or down streaming-planes seem only to be that portion of the coat which is being continuously wiped off by convection-currents, the coat on the body being as continually renewed by some action not by us then understood. This fact, together with a few other results having reference mainly to the effect of electrifying the solid body, was communicated in a letter to 'Nature' (26th July, 1883, vol. xxviii. p. 297).

Since then we have continued the observations. We shall first describe generally the methods of experiment and the phenomena observed.

General Methods of Experiment.—In all cases the electric light has been employed to illuminate the bodies under examination in dusty media. For the examination in air and gases two principal forms of apparatus have been employed. Fig. 5 shows the glass box which has been used for ordinary air. The sides and one end are of glass, the other end is of wood and perforated with a hole for a cork; the top is also of wood, but provided with a wide slot, which can be closed by a glass plate, so as to allow the substance under examination to be illuminated from above, or by perforated wooden covers through which tubes, wires, &c. could be introduced when it was desired to test the electrical or other condition of the body under examination. The box is closed at the bottom by standing it upon a blotting-paper pad on one of Quincke's adjustable glass-plated supports. A fragment of magnesium wire burnt beneath the box served to introduce air laden with magnesic-oxide particles; and by removing the cover from the top of