

IV. "Further Experiments on the Transmission of Sound."

By JOHN TYNDALL, D.C.L., LL.D., Professor of Natural Philosophy in the Royal Institution. Received May 21, 1874.

The author describes a number of experiments made with heterogeneous atmospheres obtained by saturating alternate layers of air with the vapours of various volatile liquids. Starting from his observation on the transmission of sound through a snow-storm on the Mer de Glace, in the winter of 1859, he shows the extraordinary power of sound to pass through the interstices of solid bodies as long as the continuity of the air is preserved. Sound, for example, penetrates through twelve layers of a silk handkerchief, while a single layer of the same handkerchief dipped into water, so as to fill the interstices, cuts off the sound.

He also describes numerous experiments with artificial fogs of a density so great that a depth of three feet sufficed to intercept the concentrated beam of the electric light; the effect of such fogs on sound was sensibly *nil*. Experiments were also executed on the illumination of such fogs by sudden flashes, obtained by the combustion of gun-powder or gun-cotton, or by the alternate extinction and revival of the electric and other lights. Such flashes promise to be extremely useful as fog-signals.

The author corrects the mistake of supposing that, in the experiments at the South Foreland, the lower trumpets were not compared with the higher ones. This, in fact, was the first step of the inquiry.

He also communicated an extraordinary instance of the interception of sound during one of the battles of the late American war.

In these experiments the author has been ably aided by his assistant, Mr. John Cottrell. An account of the experiments will be found in a paper now printing for the Philosophical Transactions.

V. "On some recent Experiments with a Fireman's Respirator."

By JOHN TYNDALL, D.C.L., LL.D., Professor of Natural Philosophy in the Royal Institution. Received May 21, 1874.

In vol. clx. of the 'Philosophical Transactions,' 1870, p. 337, I refer to certain experiments on the "floating matter of the air," which were afterwards considerably expanded and in part described in my 'Fragments of Science.' These experiments, in which my object was to obtain optically pure air by filtration through cotton-wool, suggested to me the notion of a fireman's respirator. Cotton-wool had been previously employed by Schroeder and Pasteur in their experiments on spontaneous generation.

I had heard that smoke was a formidable obstacle to the fireman, and that cases of suffocation were not rare; hence the desire to construct a

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respirator. My first trials were made with cotton-wool alone. Associated with the respirator was a mouthpiece with two valves: through one the inhaled air reached the lungs, having first passed through the cotton-wool, while through the other the exhaled air was discharged directly into the atmosphere. The smoke was generated in small rooms, and in some experiments in a cupboard; but though the irritation of the smoke was greatly mitigated by the cotton-wool, it was unbearable for any considerable time.

The cotton-wool was next carefully moistened with glycerine, no clots which could intercept the air being permitted. The respirator was distinctly improved by the stickiness of the fibres of the wool: still, when the smoke was very dense, an amount of irritation continued, which materially interfered with the usefulness of the respirator. Thinking it certain that the mechanically suspended matter would be intercepted by the moistened wool, I concluded that this residual irritation was due to the vaporous hydrocarbons generated during combustion: hence the thought of associating with the cotton-wool Dr. Stenhouse's excellent device of a charcoal respirator. The experiment was successful. With this combination it was possible to remain with comparative comfort for half an hour, or even an hour, in atmospheres a single inhalation of which without the respirator would be intolerably painful.

Captain Shaw, of the Metropolitan Fire Brigade, has worked energetically towards the completion of the respirator by associating with it a smoke-cap. Mr. Sinclair has done the same, and he informs me that the respirator is now in considerable demand.

Having heard from Captain Shaw that, in some recent very trying experiments, he had obtained the best effects from dry cotton-wool, and thinking that I could not have been mistaken in my first results, which proved the dry so much inferior to the moistened wool and its associated charcoal, I proposed to Captain Shaw to bring the matter to a test at his workshops in the city. He was good enough to accept my proposal, and thither I went on the 7th of May. The smoke was generated in a confined space from wet straw, and it was certainly very diabolical. At this season of the year I am usually somewhat shorn of vigour, and therefore not in the best condition for severe experiments; still I wished to test the matter in my own person. With a respirator which had been in use some days previously, and which was not carefully packed, I followed a fireman into the smoke, he being provided with a dry-wool respirator. I was compelled to quit the place in about three minutes, while the fireman remained there for six or seven minutes.

I then tried his respirator upon myself, and found that with it I could not remain more than a minute in the smoke; in fact the first inhalation provoked coughing.

Thinking that Captain Shaw himself might have lungs more like mine than those of his fireman, I proposed that he and I should try the

respirators; but he informed me that his lungs were very strong. He was, however, good enough to accede to my request. Packing the respirator with greater care, I entered the den with Captain Shaw. I could hear him breathe long, slow inhalations; and after the lapse of seven minutes I heard him cough. In seven and a half minutes he had to quit the place, thus proving that his lungs were able to endure the irritation seven times as long as mine could bear it. I continued in the smoke with hardly any discomfort for sixteen minutes, and certainly could have remained in it much longer.

During this time I was in a condition to render very material assistance to a person in danger of suffocation.

The smoke-cap I wore was one made by Mr. Sinclair, which has a mouthpiece similar to that used in the inhalation of nitrous oxide. But, to show the care necessary in packing the respirator, it is only necessary to remark that, with the packing furnished to me by Mr. Sinclair, it was not possible for either myself or Mr. Cottrell to continue in a dense smoke for more than three minutes; and even these were minutes of laborious breathing. Flannel disks are employed in these respirators, but I cannot recommend them. Cotton-wool carefully moistened and teased is, in my opinion, much better.

It is always possible to associate fragments of lime with the respirator, thus, if necessary, intercepting a portion of the carbonic acid. But in most fires we have a more or less free circulation of air; and I venture to think that not in one case in a thousand of actual fires would the combination of smoke and carbonic acid be so noisome as it was in the experiments here described.

The Society then adjourned over the Whitsuntide Recess, to Thursday, June 11.

June 4, 1874.

The Annual Meeting for the election of Fellows was held this day.

JOSEPH DALTON HOOKER, C.B., President, in the Chair.

The Statutes relating to the election of Fellows having been read, Sir James Alderson and General Boileau were, with the consent of the Society, nominated Scrutators to assist the Secretaries in examining the Lists.

The votes of the Fellows present having been collected, the following candidates were declared duly elected into the Society:—