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No. 271.

For the Week ending March 12, 1881.

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THE SOUNDS OF VAPORS AND GASES.—THE PHOTOPHONE AS AN INSTRUMENT OF PHYSICAL INVESTIGATION.

Mr. Graham Bell's recent discovery, that musical sounds are produced when an intermittent beam of light falls upon a solid, at once suggested to Prof. Tyndall the idea of testing by the same means the relative capacity of gases and vapors to absorb radiant energy.

The theory is that the sounds observed by Mr. Bell are caused by rapid changes of temperature in the body impinged upon by the light, such variations of temperature producing changes of shape and volume, giving rise to sound waves.

From the superior mobility of gases and vapors, Prof. Tyndall reasoned that the absorption of radiant energy by them would in like manner produce sounds, and louder sounds than are possible with solids. He reasoned further, that the loudness of the sounds would furnish an unmistakable measure of the relative capacity of gases to absorb radiant heat or light; and, if so, the photophonic method of investigating such substances would be likely to afford a satisfactory solution to certain experimental problems hitherto involving such delicate and difficult tests that competent observers have not been able to agree upon the interpretation of the results indicated.

The event justified the hypothesis; and in two recent communications to the Royal Society, which appear in full in the SCIENTIFIC AMERICAN SUPPLEMENT, Prof. Tyndall has described at length several series of investigations, opening up a novel and beautiful method of experimental research, and not only confirming in a remarkable way the correctness of results arrived at by him years ago by less simple methods of investigation, but also clearing up several points of dispute with regard to the relation of vapors and gases to radiant energy.

The gas, vapor, or perfume to be photophonically examined is inclosed in a small bulbous flask, with a narrow neck, from the outside of which a rubber tube with a boxwood or ivory ear piece extends to the ear. Any sounds generated in the flask are thus made minutely audible.

Various sources of radiant energy have been employed. At first an electric light was used, then a lime light, a spirit lamp, a candle, a live coal, a red hot poker, finally bodies at a lower temperature than a red heat. No effects were produced with temperatures lower than the boiling point of water.

The radiations were converged upon the flask on the side opposite to the ear tube, by silvered reflectors, glass lenses proving unsuitable owing to their absorbing the effective radiations. The interruption of the radiant beam of light or heat was accomplished by interposing between the light and the flask a disk of sheet zinc carrying radial slits or teeth with interspaces. When revolved in the beam the disk interrupted the radiations at any rate that might be desired, converting any sound produced into a musical tone.

At first vapors known to be highly absorbent of radiant energy were tested—sulphuric ether, formic ether, acetic ether, etc.—a loud musical tone being obtained. When the flask was filled with the vapor of chloroform, or bisulphide of carbon, and placed in the intermittent beam, the sound produced was barely audible, as was anticipated from the known feebleness of the absorptive power of these vapors. With other vapors, whose behavior toward radiant energy had been previously established, the musical tone produced corresponded in loudness to the ability of the vapor to absorb radiant heat.

The investigation was then carried to gases and vapors whose absorptive power is in dispute. Dry air emitted a note that could be heard only with close attention. Dry oxygen and dry hydrogen behaved like dry air. Carbonic acid gas gave a louder note than was obtained with any elementary gas. A still louder note was produced with nitrous oxide, while under favorable conditions olefiant gas gave a note as loud as that of an ordinary organ pipe. Water vapor, whose deportment toward radiant energy as determined by Prof. Tyndall's earlier experiments had been strenuously disputed, testified in his behalf with a voice distinctly audible.

The next step was to determine beyond question what portion of the intermittent beam—the luminous or the dark rays—produced the sounds. Among the many test experiments was this: a liquid layer of formic ether, sulphuric ether, or acetic ether, one-eighth of an inch thick, was placed in the path of the interrupted beam. The musical sound was stilled. As these liquids are transparent to light it was inferred that the sound-producing rays which they intercepted must have been those of obscure heat. The correctness of this inference was strongly sustained by the result of another test in which the light was cut off and the invisible rays allowed practically free transmission. This was accomplished by interposing a thick layer of bisulphide of carbon rendered opaque by dissolved iodine, under which conditions there was hardly any diminution of the sounds of the more active vapors.

Equally curious and significant were the results obtained when the intermittent beam was converged upon bulbs containing colored gases. The brown vapor of bromine, for instance, gave a somewhat forcible sound, though its capacity to absorb radiant heat is low. Indeed the tones continued when the heat radiations had been entirely cut off, and were stilled when the luminous rays were shut off leaving the obscure radiations an uninterrupted passage to the flask. The explanation of the seeming anomaly is found in the capacity of the brown vapor to arrest the rays of light and convert its motion into that of heat.

With a very rude photophonic arrangement Prof. Tyndall has been able to hear the sounds of the more active vapors at a distance of one hundred feet from the source of the interrupted rays. He is confident that the vapors of all compound liquids will be found sonorous in the intermittent beam and thinks it probable that even the vapors of elementary bodies, including the elementary gases, when more strictly examined, will be found capable of producing sounds.

It may be that, in connection with the electric sonometer, the photophonic method of investigation will ultimately give us also a new, simple, and efficient method of chemical analysis, as far reaching in its results as spectrum analysis has proved. At any rate it is a valuable addition to the outfit of the physical investigator.

MIDWINTER MALARIA.

From some cause or combination of causes the present winter has been remarkable for a widely extended and marked increase in diphtheria and scarlet fever, which have invaded homes in which the highest attainable skill has been exercised and the most approved appliances have been employed to render them as healthy as possible. In some cases the immediate causes of these disorders are undiscoverable, but in the light of sanitary science the class of agents which either initiate or greatly increase the virulence of these complaints is no longer problematical. Decaying organic matters, more particularly animal excretions, give rise to a subtle blood poison, which, though it yet evades chemical analysis, is now conceded on all hands to be a positive deadly fact. When this poison invades a dwelling, no matter whether from exterior or interior sources, in sufficient quantity, the lives of the inmates are jeopardized as positively as though they were compelled to breathe a mephitic gas. The effect may not be so prompt or fatal, but the danger is a fact no longer disputed by any intelligent physician.

It is, therefore, not sufficient to guard against interior sources of diseases; the peril may be in a neighbor's house or outbuildings, in the emanations of a compost heap or a filthy street or hidden cesspool, which if they find an avenue may enter sleeping apartments, find a *nidus* in clothing, carpets, and drapery, and bring in their train the swift destruction of all that is most cherished.

A case in point has occurred in a neighboring village. Five cases of diphtheria appeared in a household where the utmost care had been taken with the plumbing. The obvious inference was that the causes of the complaint were exterior to the dwelling. It was found that the mouth of the air-box through which exterior air entered to supply the heating furnaces was on a level with the top of a cemented pit on the adjoining premises, in which accumulations of kitchen refuse, animal and vegetable, and barn manure were promiscuously stored and allowed to rot for fertilizing purposes. The foul air from this pit was drawn into the house through this one avenue, and the poisoning of its unfortunate inhabitants, four of whom died in quick succession, was the result. It seems that disease may pervade a house with deadly result where the cause is least suspected; it therefore devolves upon every housekeeper, whether resident of the city, village, or on a farm, to be constantly watchful, not only of his own, but also of his neighbor's premises, that none of the obvious causes of disease be permitted.

RICE CULTURE IN THE SOUTHWEST.

Before the war our rice crop came chiefly from the Carolinas. During the past ten years the rice industry has been extended to Louisiana, where over 50,000 acres are now devoted to it, and the annual crop of the country has been doubled. In the meantime great improvements have been made in the methods of thrashing and cleaning the grain by the introduction of machinery. When the grain is cut it is stacked in the fields to sweat, to facilitate the thrashing, after which the rice is sent to special mills for hulling and polishing. There are seven mills of this sort which have been built in New Orleans during the past decade. Each mill employs from twenty to forty hands, and all are busy. The rough rice is received in large bins, from which it is taken by elevators to the upper floor, where it is winnowed and sifted to remove sticks and rubbish. To remove the beard the rice is passed through a revolving "hoodlum," from which it is carried to the "stones," which crack off the hulls. Then the dark-colored grains are polished for market. The polisher consists of sheepskin, tanned, stretched over sheep wool on revolving cylinders, the space between the sheepskins and wire gauze being just sufficient to allow the rice grains to find their way by degrees to the bottom. The grains are highly polished by the friction against the skins, which rubs off the bran and leaves the grain clean and white. The bran amounts to eight barrels for every hundred barrels of clean rice. It is sometimes used to adulterate spices. The waste in hulling averages about 5 or 6 per cent, but sometimes reaches 20 per cent. The hullers receive from half a cent to three-quarters of a cent per pound for hulling.

Dangers of Aniline Reds.

A number of the aniline colors, especially the red pigments, are, in the course of their manufacture, oxidized by the use of arsenical acid, and some of the arsenic is retained in the finished coloring matter. When such colors are used for dyeing, for wall papers, for artificial flowers, etc., they become carriers of a dangerous poison, whereby sickness and suffering are extensively occasioned. The only real safety is in the use of good cochineal for red colors.

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