in direction A B due to A. The waves received at B are approximately plane and perpendicular to A B, so that the relation between the velocity and pressure at B is that proper to a plane wave; but it is otherwise in the case of the sound received at A. Accordingly the reciprocal theorem does not lead us to expect an equality between the pressures at A and B, on which quantities the behaviour of the sensitive flames depends. On the contrary, it would appear that the pressure at A corresponding to the given velocity along A B should be much greater than in the case of a plane wave, and then the relative advantage of the position A would be explained.

It will be seen that if the preceding arguments are correct, Prof. Tyndall's experiment does not bear out the conclusions that he has based upon it with respect to the observations of the French Commission at Villejuif and Montlhéry. No acoustic clouds could explain the failure of reciprocity then observed; and the more probable hypothesis that the effect was due to wind is not inconsistent with the observation that the air (at the surface) was moving in the direction against which the sound was best heard.

Further experiments on this subject are very desirable.

VII. "On Phosphorus Pentafluoride." By T. E. Thorpe, F.R.S., Professor of Chemistry in the Yorkshire College of Science. Received June 6, 1876.

Arsenic trifluoride acts violently upon phosphorus pentachloride with the formation of *arsenic trichloride* and the liberation of a heavy fuming gas, which analysis shows to be *phosphorus pentafluoride*.

The production of the new gas may be represented by the equation

$$5\,AsF_3 + 3\,PCl_5 = 5\,AsCl_3 + 3PF_5.$$

Direct experiments have shown that the amount of arsenic trichloride actually produced in the reactions agrees closely with that demanded by this equation.

The accuracy of the formula was further controlled by determinations of the density of the gas. Three experiments made by two independent methods gave the numbers—

I.	.....	62·98
II.	.....	63·33
III.	.....	63·39

The number demanded by the formula PF_5 is

63·0,

hydrogen being the unit.

Phosphorus pentafluoride is a colourless gas: it is incombustible and extinguishes flame; it is absolutely irrespirable even when largely diluted with air; it fumes strongly in moist air, and is rapidly decomposed by water, forming hydrofluoric and phosphoric acids. As it is nearly $4\frac{1}{2}$ times heavier than air, it may be collected by downward displacement, and may be poured from vessel to vessel. It may be preserved in glass vessels over dry mercury for some time without much alteration; but its volume very gradually diminishes, and the glass after prolonged contact with the gas is found to be slightly corroded.

An attempt was made to liquefy the gas by compressing it in an Oersted's apparatus as arranged to show the condensation of the more readily liquefiable gases. Under a pressure of 12 atmospheres (which was the highest pressure the apparatus would safely bear) it showed no signs of change. When compared with the same initial volume of air, no deviation from Boyle's law was observed sufficiently marked to warrant the belief that the gas under this pressure was anywhere near its point of condensation.

Phosphorus pentafluoride experiences no apparent change on the passage of induction-sparks, either when pure or when mixed with oxygen or hydrogen. The character of the light emitted during the discharge is under investigation; the spectrum which it affords is exceedingly complicated.

Phosphorus pentafluoride combines immediately with ammonia-gas, forming a white solid body of the composition $2PF_5.5NH_3$. The gas is readily absorbed by an aqueous solution of ammonia, and the liquid on concentration yields a crystalline deposit consisting of a mixture of ammonium dihydrogen phosphate, $NH_4H_2PO_4$, and acid ammonium fluoride, $NH_4F.HF$.

Wurtz has conclusively shown that phosphorus pentachloride can actually exist in the gaseous state under diminished pressure and between certain narrow limits of temperature. On the other hand, the author has given reasons, derived from considerations of specific volume, for the supposition that phosphorus oxychloride, $POCl_3$, and phosphorus thiochloride, $PSCl_3$ (bodies which are frequently adduced to show its pentadicity), are in reality derivatives of triad phosphorus*.

The existence of the gaseous pentafluoride, taken in conjunction with the fact that it is perfectly stable, even at very high temperatures, is of great interest theoretically, inasmuch as this body unequivocally indicates the pentadicity of phosphorus.

* "Researches upon the Specific Volumes of Liquids.—I. On the Atomic Value of Phosphorus," Proc. Roy. Soc. xxiii. p. 364.