

gestion of Laplace, by members of the Bureau des Longitudes, to determine the velocity in air and other media. These experiments, which were the beginning of truly scientific work in this subject, were performed by Prony, Arago, Mathieu, A. de Humboldt, Gay-Lussac and Bouvard, between Montlhéry and Villejuif, cannon being fired at both stations. The result obtained was 331 m. at zero temperature, with an increase of 0.6 m. for each degree above zero. In the course of these experiments it was observed that the cannon fired at Villejuif were all distinctly heard at Montlhéry, whilst the reciprocal reports were so faint that only a small number were heard. Tyndall long afterwards, in 1875, explained this curious phenomenon, attributing it to the existence at Villejuif of a heterogeneous atmosphere, caused by the heated air which came from Paris.

Since the memorable experiments of the Bureau des Longitudes of Paris, various individuals have from time to time undertaken to solve the same problem. Among these may be mentioned Moll and van Beck (at Utrecht), Gregory Woolwich, Stone and Captain Perry in voyages to the polar regions in 1822, 1824, and Kendall in the Franklin expedition in 1825. In some of these experiments the temperatures ranged from 2° to -40° , the results obtained according with the theoretical values. In 1823 Stampfer and Myrback conducted experiments between two stations in the Tyrol at a difference of level of 1364 m.; a similar experiment being undertaken in 1844 in Switzerland by Bravais and Martin with a difference of level of 2079 m. Both experiments confirmed the law that the velocity of sound in air is independent of the pressure.

In all these experiments the exactness of the results was affected by the difficulty of estimating accurately the time between the perception of the flash and that of the report. Different observers of course gave different estimates. This source of error was first eliminated by Victor Regnault, who in his long series of researches between 1860 and 1870 made use of the graphical method, electric signals being employed to measure time intervals. Regnault's experiments were conducted in 7 tubes (part of the Paris sewers) varying in length from 70 m. to 4900 m., and of diameters from 0.11 m. to 1.10 m. Experiments were also conducted in the open air by means of reciprocal shots fired from two stations at a distance of 2445 metres. The number of the shots fired was 334. These researches of Regnault represent such an enormous amount of work that I shall attempt to give only the principal conclusions deducible from them:

1. In a cylindrical tube the intensity of the wave varies, diminishing with the distance. The narrower the tube, the more rapid is the diminution.