

may be very accurately compared with the number of alternations marked, in the same time, by the vibrating body". Notwithstanding the clearness of this description, the graphical method remained for a long time unknown, and when it was developed later in 1864 the original discovery was incorrectly attributed to Wilhelm Weber (1830). Between these dates slight applications of the method had been made by Savart, Duhamel, Lissajous and Desains, Wertheim and others; the most important of such applications being that of Scott, who in 1858 applied it to his Phonautograph. Finally, from 1858 to 1862, Rudolph Kœnig devoted himself specially to the perfection of this method, and exhibited the results of his labours at the Exhibition in London in 1862, in the form of a large collection of phonograms. This collection in its seven sections comprises all the applications of the method which have so far been made in acoustics. Whilst the progress of this method was thus slow before 1862, its use from that time onward became general, especially in physiological researches, in connection with which it received its widest development in the publication by M. Marey of his splendid work, "*La Méthode graphique*" in 1878. Parenthetically I might remark that Edison's Phonograph (1877) was doubtless suggested by Scott's Phonautograph.

*Optical Methods.*—As with the graphical methods, the earliest suggestion of an optical method of studying vibratory movements came from Dr. Thomas Young, who in 1807 described the construction of curves resulting from the composition of two rectangular vibratory movements. The practical realization of these curves was effected in 1827 by Wheatstone in his Kaleidophone. The most important advance, however, in the development of this method was made by Lissajous who, after some preliminary work in 1855, published in 1857 his great paper entitled "*Mémoire sur l'étude optique des mouvements vibratoires*". The optical effects produced by Lissajous' method, especially when the curves were projected on the screen, were so beautiful that the method obtained general recognition, and became immediately popularized. The chief merit of the method, however, does not lie in the beauty of the effects thus obtained, but rather in the fact that by this means we are enabled to determine with facility and with the utmost accuracy both the interval and the difference of phase between two vibratory movements. It is this fact which renders the Optical Comparator one of the most important instruments at the disposal of the acoustician.

A second optical method we owe to Biot who, in 1820, showed that the changes in density at the nodes of a transparent body vibrating longitudinally could be exhibited when the nodal line of the body is placed between the crossed mirrors of a polarization apparatus. During