changes of elasticity in the air, as dependent on its compression, cannot be applied to those rapid vibrations in which sound consists, since the sudden compression produces a degree of heat which additionally increases the elasticity. The ratio of this increase depended on the experiments by which the relation of heat and air is established. Laplace, in 1816, published[8] the theorem on which the correction depends. On applying it, the calculated velocity of sound agreed very closely with the best antecedent experiments, and was confirmed by more exact ones instituted for that purpose.

This step completes the solution of the problem of the propagation of sound, as a mathematical induction, obtained from, and verified by, facts. Most of the discussions concerning points of analysis to which the investigations on this subject gave rise, as, for instance, the admissibility of *discontinuous functions* into the solutions of partial differential equations, belong to the history of pure mathematics. Those which really concern the physical theory of sound may be referred to the problem of the motion of air in tubes, to which we shall soon have to proceed; but we must first speak of another form which the problem of vibrating strings assumed.

It deserves to be noticed that the ultimate result of the study of the undulations of fluids seems to show that the comparison of the motion of air in the diffusion of sound with the motion of circular waves from a centre in water, which is mentioned at the beginning of this chapter, though pertinent in a certain way, is not exact. It appears by Mr. Scott's recent investigations concerning waves,[9] that the circular waves are oscillating waves of the Second order, and are *gregarious*. The sound-wave seems rather to resemble the great solitary Wave of Translation of the First order, of which we have already spoken in Book vi. chapter vi.

CHAPTER IV.

Problem of different Sounds of the same String.

IT had been observed at an early period of acoustical knowledge, that one string might give several sounds. Mersenne and others

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[8] *Ann. Phys. et Chim.* t. iii. p. 288. [9] *Brit. Ass. Reports for* 1844, p. 361.