of the gases on the enclosing wall. Kirchhoff deduced the consequences of this theory mathematically, and pointed out that the diminution of velocity must vary inversely as the square root of the number of vibrations in the sound propagated; that is to say, that the velocity of sound could not be uniform for different notes. Seebeck shows that the loss is inversely as the cube of the square root of the number of vibrations; so that we can scarcely attribute the result entirely to the loss of heat by friction of the enclosed gas on the walls of the tube. On the other hand, his results completely establish the fact of a difference in the speed with which different notes of music are propagated in tubes.

The magnificent and laborious work of M. Regnault on the velocity of sound in pipes, appeared while Seebeck was occupied in these investigations. He points out, that since the sounds which Regnault studied, such as explosions of gunpowder and so on, are due to violent and complicated disturbances, however important it may be to study them in a practical view, they are not likely to give us accurate and delicately differenced results. Where the sound contains a mass of irregular notes, no effect due to difference of note can be observed. The method of generation compels the air to move at first in all directions in the tube. Such sounds fall into the sea of air like a mass of stone dropped from a great height into the water. The waves which they generate can only reduce themselves to regularity at some distance from the disturbance and their propagation must be irregular till that distance is reached. On the other hand, a regular pulsation, such as would be produced by the timed advance and retrogression of a piston at the end of the cylinder, gives waves which are regular and regularly propagated from the beginning. It is in consequence of this delicacy in the character of his experiments that Seebeck has attained his results.

He makes one of König's tuning-forks sound at the open mouth of a cylindrical pipe, the other end of which is stopped by a moveable piston. A short distance from the mouth of this pipe there is an opening, connected with an indiarubber tube which can be carried to the ear. If, by the motion of the moveable piston, this opening be made to correspond exactly to a "ventre" in the standing wave which is generated in the air of the tube, it is easy to measure, with great accuracy, the length of that standing wave, which corresponds to the precise number of vibrations of the tuning-fork. The extreme difference in fifty experiments for the same note, appears to have been about one five-hundredth of the whole amount.

The results are the following, the velocities being reduced from the experiments to those at 0° C.:

	Diameter of pipe in millimetres.	Velocities reduced to 0°, in metres per second.				Number of vibrations per second in note sounded.
1.	3·4	322·90	318·86	317·26	——	512, 384, 320, 256
2.	9·0	328·44	327·68	327·22	325·63	
3.	17·5	330·92	329·86	329·24	327·82	
4.	29·0	326·10	326·72	325·36	324·54	

If we compare these numbers with that for the speed of propagation in free space, as given by Schröder von der Kolk, which is 332·77, we see (1) that they are *uniformly* and considerably *less*; (2) the divergence *is greatest in narrow tubes*, with the exception of that where the tube was 29 millimetres in diameter, which was in all probability too wide to have the mass of air at its end uniformly affected by the vibrating tuning-fork; (3) the notes which travel slowest are the *low notes*. This difference is by far the greatest in the case of the narrow tube of an eighth of an inch in diameter, amounting to nearly 1 in 60 of the whole amount for the notes *e* and c_2.

The author discusses the further question, whether the nature of the enclosing tube produces any effect. In a tube, the inside of which is sheet copper, which has nearly 17 mm. diameter, the velocity is as low as it is in a glass tube of 9 mm. Where the friction is raised to a maximum by coating the inside wall of the tube with flannel, the velocity is reduced to 293·7 metres per second in a tube of 13 mm. diameter.

The same subject is treated fully by Herr Schneebeli, in a series of experiments published in Poggendorff's *Annalen* in February of last year; but those which we have described appear to us to have conducted their author to more valuable and interesting results.

WILLIAM JACK

An Introduction to the Study of Chymistry. Written for the People by Cuthbert C. Grundy. Pp. 108. (London: Simpkin, Marshall, and Co.)

WE remember when at school being called upon to admire the beauties of Schiller's *Wilhelm Tell.* Our impressions of that play were then by no means complimentary to some of the principal personages: so far as we could see Melcthal, Stauffacher and the rest of the members of the three Cantons apparently did nothing but meet clandestinely (when the weather was favourable) to talk much treason and fine sentiment, generously leaving most of the hard work to be performed by Tell (who being lowly-born was perhaps not so free of speech). All this was doubtless wrong and absurd; but we are reminded of these early impressions by the character of much of what is being said and done in reference to the education of the masses in the present movements. There is a wonderful disparity in the proportion of Tells to our ideal Melcthals and Stauffachers. Possibly, if certain noisy persons would but show their earnestness in the practical manner of Mr. Grundy, the wheels of progress would not drag so heavily.

In a modest little preface, Mr. Grundy informs us that his book is mainly intended for those among the great body of the people who desire knowledge, but have little time and only limited means for acquiring it. Occasionally, for example, when defining and illustrating the phenomena of latent heat, the author lays himself open to the charge of sacrificing precision of knowledge to clearness of statement. This fault is not unfrequently met with in manuals of this character: surely the two are not incompatible. Why does Mr. Grundy prefer the more antiquated form of styling the science? The generally accepted word is undoubtedly more correct: Kopp has satisfactorily shown this in his recently published "Beiträge zur Geschichte der Chemie."

On the whole, however, we can congratulate Mr. Grundy on having succeeded in explaining in clear and simple language the fundamental principles of chemical philosophy.

T. E. T.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

On Professor Tyndall's Exposition of Helmholtz's Theory of Musical Consonance

IN the course of a re-perusal of Helmholtz's "Ton-empfindungen," it occurred to me to compare the theory of consonance and dissonance, there propounded, with the exposition of that theory presented in the Lectures on Sound of Professor Tyndall. The result of the comparison is the present paper, in which I shall endeavour to show that Professor Tyndall's version of the theory is radically different from the original, and erroneous.

Helmholtz determines the consonances of two *simple* tones by reference to their combination-tones. That of the first order suffices for the *octave*; those of the first and second order determine the *fifth* and *fourth*. The remaining consonances—*major and minor sixth* and *major and minor third*, do not, according to him, admit of determination from two simple tones and their combination-tones, but require the addition of a third primary simple tone.

* "Ton-empfindungen," pp. 301-303, 306-307. I shall in the following references use "H." to denote this work, and "T." for Prof. Tyndall's lectures.