matter, which might, however, in some cases be fuller and more recent. The volume, as a whole, gives a good idea of the amazing strides which Chile has made during the last century. The great drawback, however, to volumes of this nature, especially when they are anonymous, is the lack of critical spirit. In that respect this volume does not escape. The picture is painted in colours that are often too bright, with the result that it leaves one with the impression of a country so bountifully endowed by Nature as to be almost without drawbacks. For example, the chapter on climate, without ignoring the heavy rainfall, strong winds, and gloomy weather of the far south, contrives to give them considerably less space than the more beneficent Mediterranean climate further north. Apart from this criticism there are few omissions in the book, but some authentic account of the little-known Chilean possessions of Juan Fernandez and Easter Island might have been added.

The English is weak in places; sometimes the meaning must be guessed, and there are misprints on nearly every page. But the most serious charge against the book is the absence of an index and a good map. The only map is a crude, small-scale one of the railways. The numerous illustrations are excellent, but some of the expense they have entailed might profitably have been lavished on sketch maps in the text.

The Journal of the Institute of Metals. Vol. xvii. Edited by G. Shaw Scott. Pp. x+384. (London: The Institute of Metals, 1917.) Price 21*s*.

THE above volume contains the papers presented at the spring meeting of the Institute of Metals, of which an account has already appeared in the columns of NATURE. In addition, it contains the verbal discussion and written communications to which the papers gave rise. It is quite clear from these that the council, in organising a symposium of papers on metal melting, chose a subject which aroused very considerable interest among the members, and that some really valuable information was elicited and has now been placed on record in a form which should be of considerable utility. Equally clear is it that the subject will repay further investigation. The authorities of the Royal Mint are to be commended for having permitted Mr. Hocking to publish so much data based on many years' practice. Mr. Teisen's account of Hermansen's furnace was a very important contribution to the symposium. This producer-gas-fired crucible furnace is the outcome of the fact that owing to the scarcity of fuel and metal in Scandinavia, prices of these commodities are high in those countries as compared with Great Britain. Consequently it was necessary to build a more economical furnace than the type ordinarily used. The latter part of the volume contains the usual abstracts of current papers dealing with non-ferrous metals and alloys, and the present volume of the Journal, taken as a whole, should prove to be one of the most useful published by the Institute.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

On the Alterations of Tone produced by a Violin-"Mute."

EXPERIMENTS on the "wolf-note" of the violin or 'cello (see NATURE, June 29, and September 14, 1916, and *Phil. Mag.*, October, 1916) suggest an explanation of the well-known and striking alterations in the tone of the instrument produced by a "mute," which at first sight seems somewhat difficult of acceptance, viz. that they are due to the lowering of the pitch of the free modes of vibration of the *entire body of the instrument* produced by the added inertia. This view of the action of the mute (which was suggested by way of passing reference in my paper on the "wolf-note") has, I find, excited some incredulity, and its correctness has, in fact, been questioned in a note by Mr. J. W. Giltay in the *Phil. Mag.* for June, 1917. The following brief statement may therefore be of interest as establishing the correctness of my view of this important phenomenon :—

If N_1, N_2, N_3, etc., be the frequencies of the free vibrations of the body (in ascending order), the frequencies as altered by the addition of the "mute" are determined by equating to zero the expression (see Routh's "Advanced Rigid Dynamics," Sec. 76),

$$(N_1^2-n^2)(N_2^2-n^2)\times\text{etc.},-\alpha n^2(n_2^2-n^2)(n_3^2-n^2)\times\text{etc.},$$

where α is a positive quantity proportionate to the added inertia, and n_2, n_3, etc., are the limiting values of N_2, N_3, etc., attained when the load is increased indefinitely [$n_1=0$, and $n_2<N_1$, $n_3<N_2$, etc.]. The forced vibration due to a periodic excitation of frequency n is determined by the same expression, being inversely proportional to it except in the immediate neighbourhood of points of resonance. The sequence of the changes in the forced vibration produced by gradually increasing the load is sufficiently illustrated by considering a case in which n lies between N_1 and N_2. If $n_1<n_2$, the load decreases the forced vibration throughout, but if $n>n_2$, the load at first *increases* the forced vibration until it becomes very large, when n coincides with one of the roots of the equation for free periods, subsequent additions of load decreasing it. The *increase* in the intensity of tone indicated by this theory has actually been observed experimentally by Edwards in the case of the graver tones and harmonics of the violin (*Physical Review*, January, 1911). Edwards's observation that the intensity of tones and harmonics of high pitch is *decreased* by "muting" is also fully explained on this view, as in the case of the higher modes of free vibration of the instrument a very small load would be sufficient to make the frequencies approximate to their limiting values.

Comparison of the effects of loading the bridge of the instrument at various points on the free periods and the tones of the instrument furnishes a further confirmation of the foregoing theory. For instance, on a 'cello tried by me, the lowering of the "wolf-note" pitch produced by a load fixed on *either* of the feet of the bridge was small compared with that obtained by fixing it on top of the bridge, and the observed "mute" effect was correspondingly smaller. In fact, the alterations of free period produced by loading furnish us with quantitative data regarding the relative motion of different parts of the instrument, and of their influence in determining the character of its tones.

C. V. RAMAN.

Calcutta, August 28.