motion is opposed by an internal resistance or friction which is measured by the logarithmic decrement and is distinct from the elastic after-effect. In the new edition six pages are devoted to Boltzmann's theory of internal friction of solid bodies, according to which the damping of oscillations is regarded as due to the elastic after-effect, the result of which is that the force urging the wire towards its position of equilibrium is not proportional to the displacement. In the fourth edition there was little about "Hardness," beyond a list of the substances forming Moh's scale; indeed, the whole article on the different kinds of *Festigkeit* was rather unsatisfactory. Now the researches of Hertz and the experiments of Auerbach have made it possible to measure the hardness of a substance absolutely and without reference to the properties of any other substance.

Instead of being relegated to the volume on heat, as in some text-books, the kinetic theory of gases is here described at considerable length in the section treating of the properties of gases. This section has been overhauled, and Stefan's theory of gaseous diffusion is given in place of O. E. Meyer's. Prof. Wüllner attaches so much importance to recent developments of the electromagnetic theory of light, that he has determined to alter the sequence of the subjects in his treatise, so that light and radiation may come at the end. In the edition now appearing, the second volume will therefore treat of heat, and the third of electricity. *pv.*

Peru. Beobachtungen und Studien über das Land und seine Bewohner während eines 25-jährigen Aufenthalts. Von E. W. Middendorf. (Berlin: Robert Oppenheim, 1893-94.)

DR. MIDDENDORF commences his treatise on Peru by a long preface detailing the circumstances which led him to choose that country for his home. Starting as the surgeon of an Australian emigrant ship from Hamburg in 1854, he narrates the incidents of the voyage, an epidemic of cholera and other irrelevant accidents included, until on the return journey, sick of the sea, he left his vessel in Valparaiso, and after some further wandering took up his residence in Peru, and was led by degrees to pay closer and closer attention to the land and people of his choice.

The work is planned in three parts. The first volume deals nominally with Lima, the capital of the republic, but is really much wider in its scope, commencing with the history of Peru, and after describing the town with its streets and public buildings in somewhat tedious detail, proceeding to discuss the general institutions of the country from the standpoint of the capital. People, church, government, law, education, commerce, transport, and charities are all discussed; and at the end two chapters describe the municipal markets, slaughter-houses, water-works, bull-fighting arenas, theatres, and other places of amusement. The second volume describes the coast lands of Peru northward and southward of the capital, the towns and seaports, the provinces now ceded to Chile, the railway communications, and the antiquities. A third volume is promised dealing with the highlands, but presumably the scheme does not include an account of trans-Andine Peru.

We cannot look on Dr. Middendorf's work as an exhaustive or even a comprehensive work on Peru. It is indeed a book for the general reader rather than the student. Abounding as it does in personal reminiscences, and written in an easy conversational style, it should do much to further the knowledge of the country it describes amongst German-speaking people. But it is, we fear, too diffuse and bulky to serve this purpose with the same degree of satisfaction that a smaller work might have secured, and it lacks firm and wide generalisations which could present a clear picture of the land and people as a whole.

LETTERS TO THE EDITOR.

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The Liquefaction of Gases.

A CAREFUL study of his letter in NATURE of February 14 shows that Prof. Dewar makes four claims.

(1) He claims that in his lecture in 1884 he employed an apparatus "more readily and quickly handled" than that of Messrs. Wroblewski and Olszewski, in the illustrations he gave of the work of these investigators.

(2) He claims that in his lecture in 1884 he used liquid nitrous oxide for the production of liquid oxygen.

(3) He claims that in 1886 he liquefied oxygen by passing the gas through a long copper coil surrounded by liquid ethylene, and that his apparatus made it possible to transfer the liquid oxygen to a glass vessel wherein it could be used as a cooling agent.

(4) He claims that, in conjunction with Prof. Liveing, he determined the refractive index of liquid oxygen before the publication of Prof. Olszewski's first paper on the subject.

I shall consider these claims in order.

(1) The apparatus used by Messrs. Wroblewski and Olszewski in 1883 is fully described and figured in *Wiedemann's Annalen* for that year (xx., 243). The gas to be liquefied was strongly compressed in a glass tube, imbedded in an iron cylinder, and connected by a capillary tube with a glass vessel, which in turn was connected with a store of liquid ethylene, previously cooled by passing through a narrow copper tube two metres long immersed in a bath of solid carbon dioxide; the glass vessel was also connected with a double oscillating Bianchi air-pump. The liquefied gas was collected in the glass vessel, and its properties were examined. A comparison of the apparatus of the Polish Professors with the brief description in the *Proceedings of the Royal Institution* of the apparatus used by Prof. Dewar in 1884 "for the purpose of lecture demonstration" will, I think, show that I stated the matter fairly in my former letter by saying that Prof. Dewar "describes and figures an apparatus which is a slightly modified form of that of the Polish Professors, which in turn was derived from the apparatus of Cailletet."

(2) If anything was gained by using liquid nitrous oxide for the liquefaction of oxygen, why has not Prof. Dewar continued to use this refrigerator?

Prof. Dewar claims to have devised a method for liquefying oxygen which was so much inferior to that brought into practice by Wroblewski and Olszewski that it was abandoned almost as soon as it was devised. I suppose his claim may be admitted here.

(3) Granting that the substitution of a long copper coil for a strong glass tube was an improvement, it must not be forgotten that the apparatus of Messrs. Wroblewski and Olszewski, described in 1883, enabled the liquefied gas to be collected in a vessel wherein its properties not only might be, but were, studied. That this apparatus was an efficient instrument is shown by the facts that before the year (1886) in which the copper coil method was described, Profs. Wroblewski and Olszewski had liquefied oxygen, nitrogen, and carbon monoxide; Prof. Olszewski had liquefied air, nitric oxide, and marsh gas; had determined the boiling points, at atmospheric pressure, and the critical temperatures and pressures, of these six gases; had solidified nitrogen, chlorine, hydrogen chloride, nitric oxide, carbon monoxide, and marsh gas; and had made careful determinations of the behaviour of hydrogen at $-211°$ and $-220°$. But with his copper coil 45 feet long Prof. Dewar did nothing; for, so far as can be judged from his published papers, he did not initiate experiments on the properties of liquefied oxygen, nitrogen, or air, until 1891-92. I think we may conclude that the apparatus of the Polish Professors was better adapted for accurate work than "that made wholly of metal" to which Prof. Dewar refers. If Prof. Dewar's apparatus of 1886 was "safer and better" than "that used in Cracow in 1890"—as he says it was—why was not this safer and better apparatus turned to some scientific use before a description appeared of the apparatus of Prof. Olszewski, in which the gases were liquefied in a steel cylinder and then transferred to