

gratulated on the fair and temperate manner in which they have brought their case before the court of public opinion. Pain and suffering are unfortunately inseparable from the lot of many kinds of domesticated animals, as well as of those wild species which are hunted for sport or for their spoils; but it is the bounden and paramount duty of all civilised nations to see that these are reduced to the smallest possible minimum. Those who read this book—and it is, for the most part, at any rate, very painful reading—will, however, be convinced that even in our own country matters too often are by no means as they should be in this respect. In fact the authors have, unhappily, in many instances, a very strong, and in almost every instance a very sad, case; and it is sincerely to be hoped that their book may be the means of bringing to pass a better state of affairs in regard to our treatment of the lower animals in such cases as amendment and amelioration are most urgent and at the same time practicable. Apart from the ruthless slaughter of birds for their plumage—accompanied too frequently by the lingering starvation of their helpless young—one of the worst and most pitiable cases in the whole sad story is the treatment meted out to worn-out horses; and it must indeed be a hardened heart which is not rent by the illustrations depicting these wretched animals on their last journeys. Fortunately, several European Governments are already awake to the need of stringent measures to remedy this crying evil, and we trust the present volume may give a further stimulus to their efforts.

R. L.

Les Moteurs Thermiques dans leurs Rapports avec la Thermodynamique. Moteurs à explosion et à Combustion. Machines Alternatives à Vapeur. Turbines à Vapeur. By F. Moritz. Pp. vi+297. (Paris: Gauthier-Villars, 1913.) Price 13 francs.

In writing this book on heat engines the author has divided very unequally the space given to engines operating with external combustion and those in which combustion takes place inside the cylinder. By far the larger part is given up to the steam engine, and particularly the steam turbine. As is usual in French books, mathematical analysis is the natural line of approach to any difficult problem, however obscure the relationship of theory and practice. The book is divided into six chapters, of which the first two relate to the laws of thermodynamics—and a very careful and complete statement of them is given—to gaseous cycles and to a concise explanation of what is meant by entropy.

The twenty-five pages of chapter iii. are made to suffice for the application of preceding theory to the gas engine, and as a natural consequence of such compression the conclusions reached are incomplete. The gaseous mixture used in the gas engine is throughout assumed to have a specific heat quite independent of all temperature changes—an assumption which naturally removes almost all practical value from any conclusions which may be arrived at on theoretical

grounds. The chapter concludes with the following quaint suggestion:—"On peut en tirer des conclusions pratiques intéressantes, par exemple, sur l'influence de la circulation d'eau autour des cylindres. Nous laissons au lecteur le soin de faire cette comparaison pour tous les cas qui peuvent se présenter à lui."

Chapters iv., v., and vi. (some two hundred pages) are given up to piston steam engines and steam turbines. The author shows much skill in his analysis of the theory of jets and of turbine flow; he treats very fully also of turbine leakage, and uses freely the entropy diagram to illustrate his meaning. Students of the steam turbine will find M. Moritz' book both interesting and stimulating.

LETTERS TO THE EDITOR.

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The Spectra of Helium and Hydrogen.

WITH regard to Mr. Evans's communication to NATURE, September 4, p. 5, I should like to remark that while I have for some time recognised that the experimental evidence, on the whole, seems to be in favour of helium as the origin of the new lines 4686, &c., it should not be too hastily concluded that they are not due to hydrogen. Mr. Evans appears to have succeeded in eliminating the ordinary spectroscopic indications of hydrogen from his helium tubes, but is it not possible that, under the special conditions of the strongly disruptive discharge, with helium also present, residual hydrogen may be represented only by the new lines? This would not be the only known case in which the presence of helium aids the development of the spectrum of another gas with which it is mixed. I have observed this effect in the case of the series of bands of carbonic oxide which are characteristic of the tails of comets; these bands are of very feeble intensity at the low pressures necessary for their approximate isolation in the spectrum of the pure gas, but I have seen them greatly intensified when carbonic oxide was present as an impurity in helium. Also, the Ritz series of infra-red hydrogen lines was found by Paschen to be brighter in a mixture of hydrogen and helium than in hydrogen alone. Apart from this, I find it difficult to believe that the close agreement of one set of lines with the principal series calculated for hydrogen by Rydberg is merely accidental.

Dr. Bohr's theory (*Phil. Mag.*, July, 1913) does not at present seem to me to give much evidence for helium, in preference to hydrogen, as the origin of the lines in question. The formula derived from the theory gives no better agreement with the observations than that of Rydberg, so far as the two are comparable, and apparently requires that the seven observed lines, beginning with 4686, should be capable of arrangement in a single series. I think, however, that the lines cannot be so united within the limits of error of observation, though very nearly so, and I believe that my separation into two series converging to the same limit is correct. The necessity for two series is rather more clearly indicated in the case of the analogous series of magnesium spark lines