

late Mr. Danford and by Dr. Bowdler Sharpe, who read there an important paper on the classification of birds. The presidents on this occasion were Prof. Victor Fatio, of Geneva, and Dr. Otto Herman, of Budapest. The next meeting of the congress was deferred for several years from various causes. But the difficulties were at length surmounted, and the ornithologists of every part of the world were invited to assemble at Paris in June, 1900, under the presidency of the late Dr. Oustalet, the head of the magnificent collection of birds in the Jardin des Plantes. Although ornithologists are not numerous in France, the meeting in Paris was very well attended, and included visitors from all parts of the world. Many excellent communications were made to it. At the close of the *séances* it was resolved that the next (fourth) meeting of the congress should take place in England in 1905, and Dr. R. Bowdler Sharpe, the well-known head of the Bird Department at the Natural History Museum, South Kensington, was selected as its president. The present volume gives us a full account of the proceedings of this meeting, which was held in London in June, 1905, and was attended not only by the English devotees of ornithology, but by representatives of that science from France, Germany, Austria, Hungary, Italy, Holland, Belgium, Russia, Sweden, Switzerland, the United States, Canada, and Australia.

The fourth congress was opened at the Imperial Institute, South Kensington, on June 12 by a few words from the outgoing president, Dr. Oustalet, who then vacated the chair in favour of Dr. Sharpe, the new president. Dr. Sharpe gave a most interesting and instructive address on the origin and progress, from 1753 to the present time, of the national bird-collection in the British Museum, which is now by far the finest and most nearly complete of its kind in the world. This address, which is printed in full in the present volume, gives particulars of the additions made to the great collection year by year since its foundation, together with details on its mode of arrangement and government. By bequest, purchase, and presentation, Dr. Sharpe tells us, nearly every large private collection of birds made in England has ultimately passed into the British Museum, including those of the late Marquess of Tweeddale, Mr. Seebohm, Mr. Crowley, Mr. Allan Hume, Dr. Sclater, Mr. Osbert Salvin, Dr. Godman, and other well-known naturalists.

After the president's address the present volume is mainly occupied with the papers read at the meetings of the congress and at its various sections. These sections were five in number—systematic ornithology and distribution; migration; biology and nidification; economic ornithology; and aviculture. Excellent communications, altogether forty in number, were made on all these subjects. They are mostly of a somewhat technical character, but we may direct attention to Mr. Walter Rothschild's paper on extinct and vanishing birds, which was splendidly illustrated by the large series of specimens and drawings shown to the ornithologists when they made

their excursion to Tring. We may also invite notice to Mr. Pycraft, who writes on the origin of the differences between the various kinds of nestlings, and seeks to justify his ingenious theory that all birds "were originally arboreal."

Those who require information on the eleven Acts for the Protection of Wild Birds passed by our Parliament may refer to Sir Digby Pigott's paper on this difficult subject read before the economic section, while those who keep birds in aviaries should not fail to study Mr. D. Seth-Smith's address on the importance of aviculture as an aid to the study of ornithology. The numerous and interesting facts ascertained by the votaries of this new branch of science are well set out in Mr. Seth Smith's contribution to the present volume.

THERMODYNAMICS.

Thermodynamics: an Introductory Treatise dealing mainly with First Principles and their Direct Applications. By Prof. G. H. Bryan, F.R.S. Pp. xiv + 204. (Leipzig: B. G. Teubner; London: D. Nutt; Williams and Norgate, 1907.)

PROF. BRYAN has not been content in this work to follow closely the beaten track, but has given us the results of much original research. The fundamental conceptions of energy, available or unavailable, of entropy, and of temperature are given in their simplest form (see the general summary at end of the book).

As the conception of temperature is for the most part new, and throws much light on the subject, it is well to set out the author's definition. The absolute temperature of a body M is to be understood, and can be defined, only with reference to another standard body N. It is the ratio between the quantities of heat respectively taken from M and imparted to N, when M is used as reservoir, N as refrigerator in a reversible Carnot cycle. This, of course, is, and is intended to be, a theoretical definition only; and a theoretical definition is needed. Similarly, the entropy of a body cannot be defined as an absolute quantity. We can only say that in certain circumstances it increases or diminishes. In all irreversible transformations it increases by an amount equal to the available energy transformed into unavailable energy. Two definitions of entropy are given at p. 58.

Prof. Bryan encounters the usual difficulty in defining temperature, density, &c., at a point in a molecular medium. Given a continuous medium, we say that (for instance) the density at P is the limiting ratio of quantity to the containing volume when that volume (which contains P) becomes infinitely small. That definition is irreproachable, but, as applied to a medium consisting of discreet molecules, wholly devoid of meaning. It is possible to give a logical definition by proceeding to the limit in the other direction. But in practice—and Bryan follows the practice—it is usual to define density as the number of molecules in an element of volume at P—large compared with molecular dimensions, it being assumed for the purpose of the definition that the density may

be taken without sensible error as constant throughout small distances near P. The same method applies *mutatis mutandis* to temperature.

The chapter on the diffusion of gases from the point of view of thermodynamics requires more explanation than the author has directly given. He says (p. 125):—

“When two gases at equal temperature and pressure mix by diffusion, the gain of entropy is the same as would occur if each were to expand by escaping into vacuum till it occupied the volume of the mixture.”

To this *Advocatus Diaboli* would say, If instead of two gases you have two quantities of the same gas, oxygen, *caeteris paribus*, the whole system remains throughout in the same physical state, and, therefore (art. 86 [2]), there is no gain of entropy. What difference can it make that one volume of oxygen is replaced by nitrogen?

I think Prof. Bryan would justify his statements thus:—He asserts, art. 124 (a), “as two gases at equal pressure and temperature in general tend to mix by diffusion and not to separate, the process of diffusion is irreversible.” And he implies (b) that every irreversible process necessarily involves increase of entropy. If these principles (a) and (b) be granted, 125 is probably justified. But they are both very questionable.

It is not possible within the limits of this notice adequately to discuss either (a) or (b). I would, however, point out that in diffusion, as in all motions of gases, if at any instant the velocities of all the molecules were reversed the system, if isolated, would retrace its course. Does not this fact make a broad distinction between diffusion of gases and irreversible processes usually admitted as such?

S. H. BURBURY.

VOLCANOES.

I Vulcani Attivi della Terra. Morfologia—Dinamismo—Prodotti Distribuzione Geografica—Cause. By G. Mercalli. Pp. viii+421; illustrated. (Milano: Ulrico Hoepli, 1907.) Price 10 Ls.

THIS history of the study of volcanoes may be divided into three periods; the earliest is covered by the fragmentary remains of the writings of classical philosophers and the sporadic records of great eruptions of Vesuvius and Etna during the Middle Ages; the second commenced with the eruption of Vesuvius in 1631, which gave rise to over 200 publications, and from this date on we have a fairly complete record of the activity of Vesuvius and Etna; in the third period, observation became systematised, and vulcanology, as a science, may be said to date from Spallanzani's study of Stromboli in 1788. In the nineteenth century the science expanded its boundaries, volcanoes in other parts of the world besides Italy began to be studied, experimental methods were applied to elucidating the mechanism of eruptions and the formation of volcanic rocks, and the microscope to the investigation of their composition and structure.

As a consequence of this expansion of the science it has come to pass that we have had to look, not

to Italy, but to other countries, and especially to England, for a general handbook; Prof. Mercalli has rectified this, and the country where the study of volcanoes, and the science of vulcanology, took their birth has produced the best and most complete guide to their pursuit. In the compass of a moderate sized book, we have a remarkably complete, well-balanced review of the subject, which commences with the final result of volcanic activity, in an account of the rocks produced, and works back through the forms of volcanoes, their dynamics, and distribution, to the cause of volcanic activity.

The longest and most generally interesting chapter in the book is doubtless that dealing with the dynamics of volcanoes. Fissure eruptions and the outflow of lava without the formation of a volcanic cone are recognised, and in the classification of volcanic explosions we come across a third type—in addition to the familiar vulcanian and strombolian types—in what are termed plinian eruptions. This name is applied to the violent explosive eruptions, like that of Vesuvius in 79 A.D., of Bandaisan and of Krakatoa, which follow prolonged periods of repose, are of extraordinary violence, are accompanied by comparatively little or no outpouring of lava, while causing the ejection of large volumes of previously solidified material, and are succeeded by another period of repose. The eruptions of Pelée and St. Vincent in 1902 are regarded as differing in degree only, not in kind, from other known eruptions; the celebrated spine of Pelée, which was thrust up to 1000 feet above the crater, was an extreme case of extrusion of solidified lava, and the “black cloud” an extreme case of the avalanches of incandescent ashes which are a not uncommon accompaniment of great eruptions.

In dealing with the cause of volcanic activity, Prof. Mercalli favours the view, first propounded by Seneca, that it is produced by the access of sea water to highly-heated material in the interior of the earth, resulting in the production of high-pressure steam; but here, as elsewhere throughout the book, the theory is not pressed, and alternative explanations are fairly stated. A word, too, may be said for the illustrations, which are numerous and excellent.

OUR BOOK SHELF.

Shaft Sinking in Difficult Cases. By J. Riemer; translated from the German by J. W. Brough. Pp. xii+122; with 18 illustrations and 19 folding plates. (London: Charles Griffin and Co., Ltd., 1907.) Price 10s. 6d. net.

MR. RIEMER is one of the leading German authorities on sinking, and a translation of his valuable treatise forms an addition to English technical literature that is specially welcome in view of the fact that shaft sinking, the most complicated of all mining problems, is necessarily dealt with in a brief manner in the standard works on coal-mining. The volume is confined to a description of means that have to be resorted to when ordinary methods of sinking cannot be applied on account of excessive influx of water, the means described being shaft sinking by hand, boring shafts, the freezing method of sinking, and the sinking-drum method.

The particulars given relate exclusively to recent