work has special reference to the applications of chemistry to the arts and manufactures, it deals but sparingly with the purely scientific aspects of the science, unless these have some direct and immediate bearing on the business of the technologist. How direct and how immediate such a bearing is at the present day, and how difficult, not to say impossible, it is to separate theory from practice, may be judged of by turning over the pages of this most useful volume.

Take, for example, the article on the azines, written by the most competent authority on that subject, Dr. Otto Witt, of Berlin. The untrained technologist will be completely at sea with the honeycomb of benzene rings with which he clearly explains the constitution of such well-known compounds as the safranenes, the splendid yellow dyes so ably investigated by Dr. Witt himself, whereas the manufacturer who has the theory of the subject at command is complete master of the situation. Or, again, let us turn to the next article, on the azo-colouring matters, communicated by another equally trustworthy authority, Prof. Meldola, covering 28 thickly-printed pages, in which the same necessary connection is seen. And no other example, perhaps, indicates more forcibly the enormous advance which applied chemistry has made in the last ten years, and its entire dependence upon abstract research. In proof of this, it needs only to be pointed out that the article concludes with a list of no less than 95 distinct patents on this one group of colouring matters, from March 12, 1878, to June 30, 1888, all of which are the result of original, chiefly German, research.

An examination of other important articles written by specially-qualified contributors indicates that each subject is brought up to the level of the present state of our knowledge. Let us look for a moment at the article on ammonia, contributed by Prof. Lunge, of Zurich. Here we find detailed reference to the newest forms of apparatus for the manufacture of ammonium salts, illustrated by excellent woodcuts of the Feldmann-still. Again, turning to the article on chlorine, we have to note the same completeness and technical grasp of the questions discussed. Thus, on p. 526, we find the method patented so long ago as 1866 by Mr. Brock, of Widnes, and now for the first time coming into general use, which has for its object the treatment of the exit gases from the bleaching-powder chambers by means of a dry lime-sprinkler, this not only removing a serious nuisance in the manufacture, but also recovering chlorine otherwise wasted.

Prof. Hummel, of Leeds, contributes an excellent article on bleaching; and here again we see that the newest processes are fully described, *e.g.* on p. 323 the Mather-Thompson bleaching process is fully noticed, and the electrical bleaching process of Hermite likewise referred to. As regards this latter, the conclusion arrived at is that now generally admitted by practical authorities, viz. that electrolytic bleaching cannot reasonably be expected to replace bleaching-powder at a price of £7 per ton.

One of the most valuable articles in the book is written by Mr. John Heron on brewing, in which he not only describes the most modern forms of brewing plant and processes, but gives a clear statement of the important researches of Pasteur and Hansen on the alcoholic ferments.

As we all know, it was Pasteur who first directed attention to those other forms of *Saccharomyces* known as "wild" yeasts in fermenting yeasts and beer; but it is not so commonly understood that it was Hansen who taught us how to introduce into the liquid a seed yeast really free from "wild" forms. Since 1883 carefully selected types of yeast from pure cultures, according to Hansen's researches, have been introduced into Denmark, Norway, and Bavaria, with the most satisfactory results, whilst in England nothing of the kind has yet been done, although, at Burton several experiments have been made in this direction. Sufficient has already been done to show that several varieties of *Saccharomyces cerevisiæ* can be separated, which, however, do not differ morphologically, but may be distinguished from each other, inasmuch as they give entirely different results, both as to flavour brightness, attenuation of the beer, and to the mode of separation of the yeast. The proportion of these different varieties in various breweries seems to remain constant, and to give the peculiar flavour and appearance which the various fermented liquors possess.

Another article is that by Prof. Noel Hartley on cements, a subject which though of great importance is not usually considered of great chemical interest, but it has been made so by the writer. He points out the fact, certainly not known to the majority of chemists, that we owe to Lavoisier the first explanation of the phenomena of the baking and hardening of plaster of Paris. At so early an age as 21, he published a short note in the *Comptes rendus* of February 17, 1765, in which he showed that water is removed from the gypsum in two stages, that the first three-quarters of the combined water must be removed in order that the plaster shall afterwards set, but that if the whole of the combined water be removed, the gypsum becomes overburnt and loses its value as plaster.

It is probable that this volume will have even a larger sale than that of the corresponding "Dictionary of Pure Chemistry," and, as with that important work, so with this, the public may well be congratulated on possessing such a valuable book of reference so creditable to all concerned in its production. H. E. ROSCOE.

OATES'S ORNITHOLOGY OF INDIA.

The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India in Council. Edited by W. T. Blanford. *Birds.* Vol. I. By Eugene W. Oates. Pp. i.—xx., 1—556. (London: Taylor and Francis, 1889.)

The Nests and Eggs of Indian Birds. By Allan O. Hume, C.B. Second Edition. Edited by E. W. Oates. Vol. I. Pp. i.—xii., 1—397. (London: R. H. Porter, 1889.)

THE two volumes on the birds of India, which Mr. Oates has recently published, will supply a much needed want. The period of twenty-six years which has elapsed since the publication of Jerdon's "Birds of India" has been prolific in ornithological work, to such an extent that a new adjustment of the scattered details which had accumulated since that time had become an

absolute necessity. Mr. Oates has already won his spurs in the field of Indian ornithology; for his "Hand-book of the Birds of Burma," published in 1883, has always been looked upon as a standard work; and by coming to England, at great personal sacrifice, to write the bird volumes of the "Fauna of British India," he has deserved the gratitude of all zoologists. Those of us who are acquainted with the "Hand-book" before mentioned, will not be surprised to find that in the present volumes Mr. Oates has done his work in a thoroughly conscientious manner. Without commencing, as Jerdon did, with a general outline of ornithology, for which space was not available, Mr. Oates has contrived to give a condensed introduction, which will give the student some small idea of classification of passerine birds, with which this volume deals. We could have wished that the author had followed a more natural arrangement of passerine families, as his scheme of arrangement results in some very incongruous affinities, but these will doubtless be further explained when the author gives a detailed arrangement of the orders and families of birds in his third volume. As the furlough which has been granted to Mr. Oates is quite insufficient for him to finish the work in anything like a reasonable period, we are glad to learn that a representation has been made to the Government of India, by some of our leading men of science, for a further extension of leave, to enable the author to finish the work, which he has begun so creditably. It would be a thousand pities to see the completion of this book intrusted to less capable hands, of which there seems to be some fear expressed in Mr. Blanford's preface.

Since Mr. Seebohm, in the fifth volume of the "Catalogue of Birds in the British Museum," laid stress on the importance of the plumage of the young as distinguishing characters between the Thrushes and the Warblers, this character has been thoughtfully considered by many ornithologists; but Mr. Oates has been the first to apply it in any large measure to the bulk of the passerine birds, and it enables him to divide them into five sections, characterized by the plumage in the nestling. This arrangement brings about some rather startling results, for the Titmice (*Paridae*) become merged in the family *Corvidæ*, and the Dongos (*Dicruridae*) range in close proximity to the Nuthatches (*Sittidae*) and the Creepers (*Certhiidae*). This character of the plumage of the nestlings, like all single characters, carries the author too far, and it is becoming more and more plain every day that the natural classification of birds in the future will be founded on a combination of characters, not on any single one alone. Mr. Oates himself, in his arrangement of the *Crateropodidae*, shows how this can be done.

It is impossible to praise too highly the method in which the present book has been worked out, though it is to be regretted that four volumes were not allowed for the birds, instead of three, for the constriction of the work has compelled the author to treat of 563 species in 544 pages, which is an allowance of less than a page to each species, including the space necessary for family characters and "keys" to genera and species. We notice that the author has been driven to create a good many new genera, but we are not disposed to quarrel with him on this account, though we notice that, like ourselves,

in writing the "Catalogue of Birds," he has found it hard to be consistent, and he certainly varies somewhat in his estimate of characters in different families. Thus he divides the Bulbuls into a number of slenderly defined genera, yet he places the Rook and the Jackdaw in the same genus, *Corvus*, as the Raven. What was sauce for a Bulbul ought to have been sauce for a Rook! It is very interesting to notice the immense strides which our knowledge of Indian ornithology has made in the last twenty years. This is mostly due to the energy of Mr. Allan Hume, whose marvellous collection of Oriental birds was given by him to the British Museum in 1885. Since that date the registration and arrangement of the Hume Collection, has occupied the bulk of our own time and that of our colleagues in the Bird Room, so that the whole of the Indian Passeres have been placed conveniently at Mr. Oates's disposal for the present work. It may, indeed, be said that Mr. Hume sowed, the officers of the British Museum watered, and Mr. Oates came over from India in time to gather the increase. It must be a great pleasure to Mr. Hume, and to Major Wardlaw Ramsay, who gave the Tweeddale Collection and Library to the Museum two years ago, to see that already their magnificent donations have been turned to such good account.

The number of new species described by Mr. Oates is, as might be expected, small; but ornithology has now reached a stage when the description of new species will be surpassed in interest by the study of greater facts, of which the geographical distribution of birds is likely to prove the most absorbing. For this purpose the splendid Collection of skins amassed by Mr. Hume will be invaluable, for in most instances the specimens in the Hume collection trace out definitely the range of each species, and Mr. Oates has shown great talent in condensing into his limited space the large amount of material which was at his command. It is, in fact, impossible to speak too highly of the way in which he has performed his task.

The volume before us is profusely illustrated with woodcuts, which will undoubtedly be of great service to the student in enabling him to identify the species of birds which are to be met with in India. These woodcuts are, almost without exception, well executed, and are the best specimens of ornithological work which we have seen from the pencil of Mr. Peter Smit. We are not quite able to grasp the plan on which the names of Indian localities have been altered in the present book to bring them into a recognized system of correct orthography, but we suppose that there is some sound reason for the changes. If, however, our old friend "Mooleyit" is to become "Muleyit," and "Malewoon" to become "Malawun," why does not "Masuri" take the place of "Mussoorie"? Surely it is pedantic to alter the specific name of "nipalensis" to "nepalensis," because it suits modern notions to speak of "Nepal" instead of "Nipal." As this mode of orthography does not appear in any of Mr. Oates's previous writings, we suppose that the editor is responsible for the changes in the spelling of the names of places. We would gladly adopt a complete method of spelling the names of Indian localities, but that adopted in the present work seems neither one thing or the other.

It was a happy idea of Mr. Oates's to issue the new edition of Mr. Hume's "Nests and Eggs of Indian

Birds" in volumes of simultaneous issue with his volumes of birds. This egg-book of Mr. Hume's is one of the best oological works ever published, and has long been out of print. A good deal of the additional matter which Mr. Hume had accumulated for a second edition, was stolen by a dishonest servant, and sold for waste paper in the Simla Bazaar, but enough has remained to enable Mr. Oates to put before us a very interesting record of the breeding habits of Indian birds; and if any tribute be wanted to Mr. Hume's energy and ability, the reader has but to refer to the present work, to study the oological records of the best circle of field-ornithologists which ever rallied round the central figure of any zoologist. The portraits of naturalists who have contributed to the development of our knowledge of Indian birds lend an additional interest to Mr. Oates's volume on the "Nests and Eggs of Indian Birds."

R. BOWDLER SHARPE.

EPHEDRA.

Die Arten der Gattung Ephedra. Von Dr. Otto Stapf. Pp. 112, 1 Map and 5 Plates. (Vienna: R. Tempsky, 1889.)

EPHEDRA is one of the three genera of the small Gymnospermous order Gnetaceæ, the two others being Gnetum and Welwitschia, that most curious of all gymnospermous plants. Ephedra is a type of remarkable habit, specially modified, though in a different way from Welwitschia, to inhabit the dry and sandy regions of the world. It has shrubby stems, with copious slender, whip-like, straight or turning branches, foliar organs and flower-wrapper reduced to a minimum, unisexual mostly dioicous flowers in small catkins with dry imbricated scales, the female catkins containing one or two flowers only, and the males several, with from two to eight stamens with the filaments usually joined in a column. The species are numerous and difficult of determination, partly because the leaves are nearly suppressed, partly because the stems of all the species are very similar, and that it is needful to have both staminate and pistillate flowers to study before any given plant can be determined confidently.

The map shows clearly at a glance the geographical range of the genus. It surrounds the basin of the Mediterranean, climbs the lower levels of the Central European Alps, attains its highest development in Central Asia, reaching southward to the north of India and all through Arabia, northward to Lake Baikal and the Ural Mountains, and eastward to the western provinces of China; and reappears in the New World—in North America in California and Mexico, and in South America in the Andes and over a wide area south of the tropic from Chili across to Buenos Ayres. Though spread so widely over extra-tropical South America, it does not reach either the Cape or Australia, where the climate and soil seem so suitable for it. None of the single species have a very wide range, but it is one of the instances where a well-marked, sharply isolated generic type is represented in many different geographical areas by distinct specific types.

The present monograph is one of the best and most complete works of the kind that have lately appeared.

It is extracted from the second part of the sixteenth volume of the *Denkschriften der Mathematisch-Naturwissenschaftlichen* class of the Kaiserlichen Akademie der Wissenschaften in Vienna. Dr. Stapf is one of the officials of the Botanic Garden of the University of Vienna, and has had the advantage of full command of material, both in the way of specimens and books. Two of the plates and a large proportion of the letterpress are devoted to the anatomy and morphology of the vegetative and reproductive organs of Ephedra. In the structure of the woody bundles Gnetaceæ establish some links of transition between Coniferæ and the typical Dicotyledons. Ephedra approximates in some points towards Casuarina. In the veining of its well-developed leaves Gnetum recedes from the ordinary Gymnospermous type. In Ephedra there is an unmistakable perianth to the male flower, but the homology of the outer wrapper of the seed is not so clear. Then follows the systematic portion of the monograph. Dr. Stapf admits twenty-eight certain and three imperfectly-known species, and for each of these he gives a diagnosis, a figure showing its essential characters, an extended description, and a full account of its synonymy and geographical distribution. He makes three sections, Alata, Asarea, and Pseudo-baccata, dependent mainly upon whether the seed is fleshy in a mature state, or dry and furnished with a wing. Then follows a list of local names, and a very full list of the books in which the genus is noticed, extending from Gerarde and Ray down to the present time. The monograph is one that deserves to be studied carefully, both by structural and systematic botanists.

J. G. B.

OUR BOOK SHELF.

Geological Mechanism; or, An Epitome of the History of the Earth. By J. Spottiswoode Wilson, C.E. (London and Manchester: John Heywood, 1890.)

THE nature of this little work of 135 pages will be best indicated by a brief statement of its contents. The book is divided into three portions of not very unequal length.

The first of these is "autobiographical," and relates, with much circumstance, the author's adventures at the Geological Society and Club, where, on the invitation of the late Sir Roderick Murchison, he read a paper in the year 1854. This is followed by an account (his own) of the causes which led to a disagreement between himself and the leaders of an exploring expedition of which he had been appointed a member. This part of the book is relieved from the charge of being prosaic, however, by the introduction of some very remarkable, and undoubtedly original verses.

Having devoted more than forty pages to himself, the author has left for the earth little more than fifty pages more; and in this space he contrives to dispose of a great number of highly important problems, beginning with "intelligence supreme; the nebular theory of Laplace; hypothesis of incandescence; theory of the crystalline rocks; hypothesis of metamorphism," &c.; and finishing up with "the lunar, magnetic, and solar tides; the progressive desiccation of the atmosphere and earth; the change of time; and the theory of creation."

Comprehensive as is this portion of the book, however, the author still finds much to put into his third part, or appendix—such as, "tails or atmospheres of planets and comets; the magnetic pole and change of climate; the magnetic tide of the atmosphere, &c." As in the first part he rose into poetry, here, in the appendix, he