

and simplifying calculations involving contingencies depending on several lives. The hypothesis of Gompertz, as formulated by Makeham, is, no doubt, useful for graduating certain tables, and for dealing with some of the more complex problems of life contingencies, but we doubt whether a disproportionate consideration is not given to it and to its application. In so far as it presents itself to us as the most successful effort yet made to fasten down the law of mortality, it has, no doubt, a charm and a fascination for everyone, and especially the mathematician; but, keeping in view the limited use made of it for the ordinary purposes of assurance work, and that even for graduating it is only one of several methods in vogue, we are inclined to think a less elaborate treatment would have been more commensurate with the proper scope of a text-book and book for general reference.

The next, and of course the main, portion of the volume is concerned with the great class of questions involving the consideration of interest when combined with life contingencies; that is to say, with annuities and assurances, whether on single or joint lives, and whether absolute or contingent; with advowsons, next presentations, fines for the renewal of leases on lives; also with life interests and reversions, and the values of life policies. Explanations and demonstrations are given at length, and some of them are exceptionally good. We may note that, in the chapter on annuities and assurances, the author says: "It has been common, in treatises on life annuities, to deal with annuities and assurances separately, but the two classes of benefits are so intimately connected that they ought always to be taken together." We are not quite sure that we have caught exactly the nature of the objection entertained by the author to the common method of dealing with the two kinds of benefit. We take it the intimate connection alluded to implies that both things are built up of the elementary forms of which $v^n l_{x+n}$ is the type, and proceed on parallel lines, and not that the results for the one should be obtained by giving an algebraic twist to the results deduced by a direct process for the other. We do not infer from his words, or gather from his book, that he would not exhibit the present value of an assurance by direct reference to the present value of $\mathcal{L}1$ to be received by each of the persons alive at age $x+n$, rather than obtain it by an indirect process of reasoning, such, for instance, as this:—"If here be an annuity on (x) payable at the end of each year on which he enters, and another annuity payable at the end of each year which he completes, it is evident that the difference between the two is the value of $\mathcal{L}1$ payable at the end of that year on which (x) enters, but which he does not complete; that is, the value of $\mathcal{L}1$ payable at the end of the year of the death of (x) , or, in other words, the value of an assurance on (x) . Now $v(1+a_x)$ is evidently the value of the first-named annuity, and, deducting from this the value of the ordinary annuity, a_x , we have the value of the assurance, $v(1+a_x) - a_x$." The building up of a formula by premising its verbal interpretation is often an admirable example of ingenuity, but this process can never be allowed to displace the established course of mathematical reasoning.

In this, the staple portion of his work, Mr. King manifests his extensive acquaintance with the subject, or, rather,

subjects. With a great quantity of matter at his command, he has used the pruning-knife very sparingly, possibly too sparingly. All the usual formulæ are given for precise calculation, and a number of approximative processes are developed where an exact calculation would be too cumbersome for actual use. It is worth suggesting for consideration whether a collection of questions to be worked out by students might not with advantage be inserted in a future edition of the book. There are many precedents for such a course in connection with text-books, and a goodly supply of questions is already at hand in the examination-papers set at the Institute in past years.

There is a third portion of the work, occupying some seventy pages, in which finite differences, interpolation, and summation are treated with more fullness than branches of pure mathematics would seem to be entitled to in a volume professedly assigned to life contingencies. Indeed, the author admits in his preface that these subjects were not within the scope of the text-book as originally planned. No doubt we have placed before us propositions which are specially applicable to actuarial needs, arranged and demonstrated with Mr. King's usual ability; but it seems to us they would have been more conveniently published in some other connection than the present. A knowledge of these things in a duly regulated course of study would naturally precede the consideration of their application.

The text of the work is supplemented by a collection of interesting tables, commencing with a table of mortality based on a combination of data for young and mature lives, and intended to show the mortality of healthy male life from birth to extreme old age. We must not fail to mention that the collection embraces complete tables for finding the value of joint-life annuities up to four lives inclusive.

Looking at the work as a whole, we find the various subjects are cleverly handled, the propositions appear one after the other in well-ordered succession, the demonstrations are well chosen, and the wording is clear and effective. Altogether Mr. King has done his work diligently and with good judgment, and has placed all future students of the Institute under a debt of obligation to himself and to the Council.

ROSENBUSCH'S "PETROGRAPHY."

II.

Mikroskopische Physiographie der massigen Gesteine.

Von H. Rosenbusch. II. Abtheilung. Zweite gänzlich umgearbeitete Auflage. (Stuttgart, 1837.)

IN a notice (NATURE, vol. xxxv. p. 482) of the first part of the present work, we showed that the author, adopting a natural system of classification which gives the first place to field-evidence, divides the eruptive rocks into three great groups, viz. (1) the *Plutonic* rocks; (2) the *Dyke* rocks (*Ganggesteine*); and (3) the *Volcanic* or *Effusive* rocks. Unable to free himself entirely from the idea that geological age ought to be an essential factor in rock-classification, he subdivides the third group into a *palæo-volcanic* and a *neo-volcanic* series. It is the treatment of the neo-volcanic series which constitutes the bulk of this, the second and final part of the book.

The neo-volcanic rocks, which are stated to be essentially confined to Tertiary or post-Tertiary times, occur, for the most part, as lava-streams and sheets, and are often accompanied by tuffs. They are classified by Prof. Rosenbusch as follows:—

(a) Family of the Liparites and Pantellerites (equivalents, on the one hand, of the palæo-volcanic quartz-porphyrines, on the other, of the granitic plutonic rocks).

(b) Family of the Trachytes and basic Pantellerites (equivalents of the palæo-volcanic quartzless porphyries, and of the plutonic syenites).

(c) Family of the Phonolites and Leucitophyres (equivalents of the plutonic elæolite-syenites).

(d and e) Family of the Dacites and Andesites (equivalents of the porphyrites and diorites).

(f) Family of the Basalts (equivalents of the melaphyres and certain augite-porphyrines in the palæo-volcanic series; and of the gabbros and diabases among the plutonic rocks).

(g) Family of the Tephrites (equivalents of the theralites, *i.e.* plagioclase-nepheline rocks of the plutonic series).

From this synopsis the merits of the new classification may be appreciated. No classification that taxonomic ingenuity may devise will wholly satisfy the desires of the sanguine petrologist. Rocks, however much they may be characterized by a certain amount of geological uniformity persistent over large areas (which have aptly been termed "petrographical provinces"), are still, it must be remembered, mere mineral aggregates; and the amount of possible variation, dependent on differences in chemical constitution, and varying conditions of consolidation, is enormous. Rock-types, which may be clearly defined and sharply separated on paper, will, in the field, often be found passing over into one another by gradations so imperceptible that the petrographer must regard as hopeless any attempt to draw a hard and fast line between them.

A weak point in Prof. Rosenbusch's classification seems to us his fundamental separation of the "dyke-rocks" (*Ganggesteine*) from the plutonic and volcanic series (*Tiefen- und Ergussgesteine*.) Both plutonic bosses and volcanic sheets must necessarily be accompanied by dykes or pipes through which the eruption took place, and into the rocks composing which they pass by imperceptible gradations. The author, indeed, calls attention himself to this fact (on pp. 6 and 522), and proposes to include under the head of "*Ganggesteine*" only those rocks which occur *solely* in the form of dykes and are unaccompanied by tuffs. Still, rocks so nearly allied as these must necessarily be to the dykes and volcanic pipes and necks in immediate connection with the centre of eruption, should not, we think, be so widely separated from them. On the other hand, we find placed in this group rocks, such as granite-porphyrine, which are known to occur in bosses, as, for instance, at Shap and at Dartmoor.

As to the question of age, it is so far satisfactory that the author has gone a step in what is surely the right direction, in eliminating this factor from the consideration of the plutonic rocks. With regard to the advisability of retaining the separation into an older and a younger series of the volcanic rocks, Prof. Rosenbusch refrains from expressing an opinion (p. xi. of preface.) In con-

nection with this question, we must draw attention to one point. The structure characteristic of the dolerites (diabases of the Germans) in which allotriomorphic masses of augite are penetrated by idiomorphic crystals and microlites of felspar, and which is known as *ophitic structure*, occurs nowhere in more typical development than in the dolerites of the Western Isles of Scotland (described and figured by Judd) and of Iceland (Bréon), a statement that anybody who has seen rock-sections from these localities will support. Yet these rocks, apparently because they are of Tertiary age, are placed by Prof. Rosenbusch (pp. 725 and 733) with the basalts, and are described as possessing "*intersertal structure*," a structure characterized, according to the definition given on p. 504, by the presence of a hypocrySTALLINE interstitial substance (mesostasis) wedged in between the felspars. That some of the rocks in question contain small wedge-shaped portions and films of glassy interstitial substance nobody will deny; but that many of them are perfectly holocrystalline and truly ophitic is equally beyond question.

Besides "*intersertal structure*" we notice two other structural terms used now for the first time, *viz.* "*pilotaxitic*" and "*hyalopilitic*." The former is applied to a holocrystalline structure, especially characteristic of certain porphyrites and basalts, in which the ground mass consists essentially of slender laths and microlites of felspar in felted aggregation, and often exhibits fluxion-phenomena. The addition of films of glass produces "*hyalopilitic*" structure.

New rock-names are *Tholeiite* (p. 504) and *Alnöite* (p. 805). The former is given to a variety of augite-porphyrine with typical "*intersertal structure*." Certain North of England dykes (the Hett dyke, Tynemouth dyke, and Hebburn dyke) described by Teall, are referred to this group. Several of the English, Scotch, and Irish traps, described by Allport and Hull, are, according to the author, olivine-tholeiites (p. 515). The word "*Alnöite*" is applied by Prof. Rosenbusch to a subdivision of the melilite-rocks, hitherto classed with the melilite-basalts, but differing from the latter by their occurrence in the form of dykes and their near relation to the elæolite-syenites.

Interesting to English readers are the remarks contained on pp. 417, 418. In referring to the Cambrian quartz-felsites and felsites of Wales, which have been described by Messrs. Bonney, Cole, and Rutley, Prof. Rosenbusch compliments these authors on not having overlooked the influence of dynamic metamorphism in developing their present character. He then goes on to say that he has been led, partly by Prof. Bonney's descriptions, partly by the examination of sections, to the belief that two distinct classes of rocks are here associated, *viz.* metamorphosed eruptive rocks (schistose porphyries), and metamorphosed slates and tuffs (porphyroides). A comparative study of these rocks in connection with the "*Lenne-porphyrinen*" and the porphyroides of the Thüringer Wald would, the author thinks, be productive of interesting results. Many of these rocks (*e.g.* from between Llanberis and Cwm-y-Glo, north-west of Cwm-y-Glo, Llyn Padarn, near Llanberis; also the nodular felsites from Conway Falls, and the rock from Digoed) ought, judging from the frequent occurrence of striated and micropertitic felspars,

rather to be referred to the quartz-keratophyres than to the quartz-porphyrries (p. 418).

We are glad to see that olivine is no longer regarded by the author as an essential constituent of basalt. This rock-name is thus made to gain considerably in significance, since it now embraces all (neo-)volcanic rocks of *basic* composition which essentially contain plagioclase and augite, whether they occur as lava-sheet or dyke. The *acid* plagioclase-augite rocks, on the other hand, whether with or without olivine, are referred to the andesites.

In connection with the basalts, it may be of interest to point out how considerable an alteration in the minor subdivisions of a rock-group has been produced by modern microscopic research. The old familiar grouping of the basalts, according to their granular texture, as dolerite, anamesite, and basalt, has been superseded. The modern petrographer distinguishes, with Prof. Rosenbusch, between the following structural varieties, which may coexist with any granular dimension: (1) "hypidiomorphic granular," (2) "intersertal," (3) "holocrystalline-porphyrritic," (4) "hypocrystalline-porphyrritic," and (5) "vitrophyric."

Welcome additions to the book are an appendix to the invaluable literature-index of Vol. I., bringing it up to the present date; and a useful index of localities, compiled by Dr. H. B. Patton. The book is well got up, well printed, and remarkably free from typographical errors.

F. H. HATCH.

A TREATISE ON CHEMISTRY.

A Treatise on Chemistry. By Sir H. E. Roscoe, F.R.S., and C. Schorlemmer, F.R.S. Vol. III. The Chemistry of the Hydrocarbons and their Derivatives; or, Organic Chemistry. Part IV. (London: Macmillan and Co., 1888.)

THE present instalment of this well-known work deals with those benzenoid compounds containing respectively seven and eight atoms of carbon.

The excellent features referred to in our notices of the previous parts are preserved in this new section. The historical portions are especially valuable. Most text-books of organic chemistry restrict themselves to giving an account of the existing state of the science; but in the present work the description of every important compound, or group of compounds, is prefaced by an historical review of the various investigations which have led up, step by step, to the views now held. To students of organic chemistry, who, in ninety-nine cases out of a hundred, never see the older memoirs (and, if they did, would probably only be bewildered by the obsolete nomenclature and formulæ), these historical introductions are a great boon. As instances of this interesting mode of treatment, we may cite the historical introductions to the subjects of *toluene*, of the *nitrotoluenes*, and of *creosote*—with the account, in the latter case, of the confusion between creosote and phenol, and of the way in which this confusion was eventually cleared up. In this connection we may call the attention of our spelling reformers among English chemists to the passage (p. 33) quoted from Reichenbach's original memoir in which he first coins the word "creosote." The etymological

knowledge of the average English chemist (when it exists at all) is little—and dangerous. He has learned that there is such a word as *κρέας*, and rashly opining that he is at liberty to derive an English word from a Greek nominative, he changes Reichenbach's spelling to "creasote"—a corrupt form which, as "creasotum," has passed into the Pharmacopœia, embalmed in the choicest apothecaries' Latin. One regrets that the zeal of the reformer was not tempered by the knowledge that Reichenbach derives the word from the contracted genitive, *κρέως*.¹

The descriptive portion of the work is full and accurate. The only case that we have noticed in which the information is not up to date is in the account of the *benzaldehydines* (pp. 141 and 142), which are represented as ordinary condensation-compounds of ortho-diamines with benzaldehyde; whereas Hinsberg showed, about a year and a half ago, that they are in reality benzylated anhydro-bases. The name "Nevile" is also throughout erroneously given as "Neville."

OUR BOOK SHELF.

A Text-book of Organic Materia Medica. By Robert Bentley, M.R.C.S., F.L.S. Cr. 8vo. pp. 415. (London: Longmans, Green, and Co., 1887.)

It is a difficult matter to produce a text-book of materia medica which shall answer the requirements of the student in these days. No subject is less clearly defined either by teachers or by the authorities at Examining Boards. Prof. Bentley indicates this difficulty in his introduction, where he first defines "materia medica" and the allied words "pharmacology" and "therapeutics," and then confesses that our first English authority in this department of science, Dr. Lauder Brunton, has used some of the terms in a different sense. There is one advantage, however, in this difference of view—namely, a variety in the treatment of the subject; and we have to thank Prof. Bentley for having produced a work which departs in many directions from the somewhat stereotyped arrangement of English works on materia medica.

As might have been expected from the accomplished Professor of Botany in King's College, the work is mainly devoted to a careful description of the characters of medicinal plants and their products. The arrangement of the plants is founded, so far as the Phanerogamia are concerned, upon that adopted by Bentham and Hooker in their "Genera Plantarum." The descriptions are given very fully, so as to enable the student to recognize the drugs with facility and certainty, and thus at the same time readily to detect any adulteration. The author is right when he expresses his belief that in the latter respect the book will be especially valuable to the pharmacist. To the medical student and to the medical practitioner adulteration is no longer a subject of direct interest. The day has gone by when crude drugs came into the dispensary of the doctor, who now buys all the preparations ready made; and the Examining Bodies, aware of this, have relieved medical students of the laborious subject of drug adulteration, and now require of them the recognition of but a few of the most important specimens. No doubt the book will find its largest circle of readers amongst young men preparing for the examinations of the Pharmaceutical Society.

In our opinion it would have been better to give the strength as well as the dose of the more important preparations, such as those of opium.

The sections on the chemical composition of drugs have

¹ "Of course the reformer may write "creasote" if he chooses; but "creasote" is inadmissible.