therefore of demoralization. Whether the root which the author is so fortunate as to possess is in dipsomaniac captivity to the bottle it hugs, or whether the bottle is captivated by the caressing root, is not quite clear from the context. And how such dire mischief to man wrought by roots — more injurious 'than tempest, fire, and war combined' — is to be reconciled with creative benevolence, we must leave for the Princeton theologians to settle, and pass on to another topic, that of judicious abstinence from technicalities.

Writers of text-books are prone to employ all the technical terms they can find, especially new-fangled ones which have not yet proved their right or reason to exist by continued usage, or which, though convenient in an original treatise or memoir, and harmless or even useful in a glossary, may be advantageously dispensed with in ordinary scientific teaching. We all know of the painter commemorated by *Punch*, who 'rubbed out a good deal,' and who claimed to 'get his best effects that way.' Many scientific books for students' use might be bettered by the same process. Professor Macloskie has so well resisted the ordinary temptation, or restrained in parenthesis needless terms which he did not like to leave out, — such as *xylem*, Greek for wood, most barbarously Germanized (as if, where a Greek said *xylon* and a Roman said *lignum*, we might not say *wood* when we meant it), — that it may be a little ungracious to complain of his making one or two himself, and making them badly. Where he says, "to avoid confusion, we shall call [the seed-coats] *exotest* and *endotest*," the inference is, that these terms are original. Nor, not to insist that confusion is rather made than avoided by the substitution of new names for well-recognized old ones, we might suggest that the coinage is in a small way pedantic, except that a pedant would not violate what our author in another place terms 'the jus connubii' by hybridizing Greek with Latin. Nor, if we must have such Greek-Latin crosses, would he have truncated them into *quasi* English, which is as bad as a third cross, but have written *exotesta* and *endotesta* in full, vile as the terms are. *Gametic* is certainly new coinage; and the author does not clearly say what he means it to pass for. But it may be gathered that 'gametic affinity' means relationship near enough to allow of interbreeding. We are to say, then, that species belonging to different genera have gametic affinity in the rare cases when they can be made to hybridize; and that certain species strictly of the same genus, which we have failed to hybridize, are devoid of gametic affinity: so the term has no explanatory value whatever.

Some of the borrowed woodcuts are very good; most of the original ones are quite the reverse; and the one which is said to represent a 'tip shoot of pea' is a complete puzzle, after all the enlightenment which the letterpress affords.

Turning over the pages, we now and then come upon statements which dampen any enthusiasm of commendation which a reviewer might wish to express. On p. 16 we read that "cymose flowers are always actinomorphic, being equally exposed to light in all directions." The implication that 'actinomorphic,' i.e., regular, flowers are so because equally exposed to light from all directions is a bit of deductive botany of the Grant Allen school. And the assertion that cymose inflorescence and actinomorphic flowers always go together is by no means true, as witness all Labiatae and a large share of other didynamous flowers. The seed "in Lepidium, on being moistened, darts out mucilaginous threads." Is Dr. Macloskie sure of this, or does he infer that there must be such threads because they exist in various other seeds and seed-like fruits which develop mucilage when wetted? The hypocotyledonary stem "in the pea is short because the seed remains underground." Were it not better to say that the seed remains underground because this initial stem does not lengthen? On p. 82 it is asserted, or at least implied, that root-hairs last all summer long, and may be renewed on a surface that has lost them. To Grant Allen, in the year 1882, is attributed the idea that neutral ray-flowers of Compositae are sterilized members set apart and enlarged for purposes of display. Has Dr. Macloskie met with no earlier exposition of that doctrine?

Not to prolong questioning, let us say, that, for those who are most likely to use this book, it was a good idea to devote a few pages at the close to the derivation of common terms, Latin and Greek root-words, and prefixes, and to help those who do not know the Greek alphabet by writing out the words, as nearly as may be, in Roman letters.

THE GEOLOGY OF BELGIUM.

Géologie de la Belgique. Par Michel Mourlon. 2 vols. Bruxelles, *Hayez*, 1880-81. 317; 16+392 p., illustr. 8°.

This book, a model in its way, will be read with equal profit by the geologist and by the general reader. The geologist will find in it, critically exposed, and in a short and impartial manner, the immense amount of labor

and of detail which is scattered in the numerous papers of the Belgian geologists. Any one of ordinary intellectual culture, and interested in Belgium, will find it a clear and readable account of the past history and chief features of the country. Two causes have contributed to make easier the task of the author: the works on the geology of Belgium by d'Omalius, Dewalque, and especially the celebrated 'Esquisses géologiques' of Gosselet, have already pointed out the way to success; and, moreover, the natural disposition of the country allows a very simple grouping of facts.

Both geologically and geographically, Belgium is formed of two distinct parts. The southern half (the Ardennes) is a hilly region, a continuation of the old paleozoic nucleus of Europe, — the so-called Hercynian mountain-range; the northern half (Flandres, etc.) is a flat land or prairie region, and forms part of the great plain of northern Europe, the basin of the North Sea. The Ardennes is a paleozoic district; Flandres, a tertiary one; the triassic, Jurassic, and cretaceous formations forming but a broken belt around the paleozoic masses. All these formations are, however, studied by the author in a complete manner, and their mineralogical, paleontological, and stratigraphical characters successively described. Both their historical divisions and their local extension are given with care.

Beginning with the older rocks, we first meet the Cambrian shales, forming two principal ranges (massifs de Rocroy and de Stavelot). These rocks can be compared to the Ocoe conglomerates and shales of the Appalachian region; they contain the curious interbedded crystalline porphyroids, so well illustrated by de la Vallée Poussin and Renard, whose papers are here summarized in two good plates. The Silurian beds form two small crests extending east and west, through Brabant and Condros, and have supplied fossils of Barrande's second fauna. These beds, like the underlying Cambrian, have a southerly dip. The upper Silurian fauna is not represented.

The folding of the Silurian rocks was the initial cause of the so-called Dinant and Namur devono-carboniferous depressions, or basins. It was followed by a long-continued depression of the area, in consequence of which the accumulation of an enormous thickness of stratified rocks within the great troughs of Dinant and of Namur took place. This downward bending of the earth's crust did not go on continuously, but submitted to some irregularities related to the breaks and numerous stratigraphical divisions of the Devonian formation. The Devonian formation of Ardennes is the most complete and best studied in Europe, through the labors of Dumont, Gosselet, Dupont, and the author. It shows a thick series of four thousand metres of alternating fossiliferous shales, sandstones, and limestones, marine for the chief part, though some beds have furnished Psilophyton and other plant-remains. After the period of the mountain limestone, littoral, brackish water, and finally lacustrine and terrestrial deposits, came in, and the coal continued forming.

A general movement of elevation succeeded towards the end of the coal-measures, and folded all the paleozoic sediments as if they had been crushed from south to north. This thrust had a more violent effect in the Namur than in the Dinant basin. In the former are comprised the celebrated coal-fields of Mons, Liége, and Charleroy, — the chief causes of Belgian prosperity and wealth.

At the close of the paleozoic period, the mountainous region of southern Belgium was formed; and since then it has always been exposed to denudation. South of this mountainous district, the Jura-triassic beds of eastern France now began to accumulate in the Gulf of Luxemburg (Buntersandstein and Keuper, and the Jurassic from the Avicula contorta beds to the middle oölites). These mesozoic seas did not penetrate north of the Ardennes, where the lower cretaceous are the most ancient mesozoic formations.

The cretaceous formations in this district possess great interest, notwithstanding their small geographical extent. The lower beds have furnished the splendid iguanodons of the Brussels museum, and the upper ones are the well-known Maestricht beds. All are chiefly littoral formations; and the so-called tourtias of the middle cretaceous are famous by the variety and richness of their faunas. In the deep and narrow Gulf of Mons, the cretaceous beds are found in a chalky condition, as in the Anglo-French basins.

In the neighborhood of Mons and Landen are found the most ancient representatives known in Europe of the tertiary epoch (systêmes montien, heersien), so well illustrated by Cornet and Briart. The Landenian system has a wider extension, forming, with the other terms of the eocene series, nearly all of lower Belgium. Thus it is to the wide-spread mass of the London clay, which covers the Landenian sands, that Belgium owes its meadows and well-cultivated fields, which extend in an immense plain from the Brabant to the coast,

and from Dunkirk to Ostend. The Bruxellian and Laekenian systems form superficial hills in the neighborhood of Brussels, Gand, etc. The oligocene system shows two principal divisions (tongrian, rupelian), which stretch across the lower part of the river Escaut, where it leaves the eocene districts, through which it flows in the western part of the country. The pliocene formations overlap irregularly the underlying tertiary beds, and extend from Antwerp to Louvain. Many fine fossils have been found in these beds, where Mourlon admits several divisions, — Diestien (in part), Anversien, and Scaldisien. The last chapters of the work treat of the quaternary (diluvien, hesbayen, and campinien) and recent periods.

Though special attention has here been given to the stratigraphical extent and disposition of the beds, the author has treated with equal care of their lithological and paleontological characters, their minerals and fossils, and the useful products they furnish to Belgian industry. It will be enough, to indicate what amount of documents are included in the book, to state that the lists of fossils occupy 240, and the bibliographical lists 144 pages.

DU MONCEL'S ELECTRO-MAGNETS.

Electro-magnets. The determination of the elements of their construction. By Th. Du Moncel. From the second French edition. New York, *Van Nostrand*, 1883.

The same. Translated from the French by C. J. Wharton. London, *Spon*, 1883.

The great interest in the practical applications of electricity demands simple treatises on the most economical methods of making electro-magnets. Count Th. Du Moncel has endeavored to supply this want, and has added another treatise to the long list he has already published upon electricity. He disclaims any endeavor to make a treatise on electro-magnets which shall embody scientific theories upon that most difficult of subjects, theoretical magnetism. His desire is to give the mechanician a *vade mecum* by means of which he can construct electro-magnets for operations outside the laboratory. Indeed, this treatise is intended to stand in the same relation to the maker of dynamo-electric machines as a treatise on the practical construction of boilers, minus theories of elasticity, would stand to the constructor of steam-engines. There is need for such a treatise, undoubtedly; for much expense can be saved by a little knowledge where to put the material to the best advantage. Most of the dynamo machines which are before the world at the present time are defective in the arrangement of the wire of the field electro-magnets. Does the treatise of Du Moncel supply this want? The author follows the antiquated French fashion of expressing the resistance of a wire in terms of the length and diameter, without specifying, in many cases, the specific resistance. Thus, instead of ohms, we read so many metres of telegraph-wire; and one must enter into a troublesome arithmetical drudgery to ascertain what is meant. The English edition, published by Spon, states in the preface the relation between Du Moncel's units and the commonly received units of resistance and electro-motive force; but the American edition, published by Van Nostrand, leaves the reader to find out this relation after he has plodded some distance through the treatise.

The two imprints, one by Spon and the other by Van Nostrand, are carelessly edited. Thus, on p. 43 in Van Nostrand, we find an inconsistency between the values of t^2 and A.

On p. 47, Van Nostrand gives

$$ab = \frac{\rho}{e^2}\, 0.000506 \sqrt[3]{\sqrt[3]{P^4 f^8}}$$
$$= \frac{\rho}{e^2}\left(0.0225 \sqrt[3]{\sqrt[3]{P^2 f^4}}\right)^2,$$

while Spon gives, on p. 34,

$$ab = \frac{\rho}{e^2}\left(.0225 \sqrt[3]{\sqrt[3]{P^2 f^4}}\right)^2$$
$$= \frac{\rho}{e^2}\, .000506 \sqrt[3]{\sqrt[3]{P^4 f^8}}.$$

We give this as an example of similar mistakes which meet the eye. The question arises whether a more carefully prepared treatise, which would start with the fundamental system of electrical measurements, is not still needed. It is useless for any one to endeavor to become a practical electrician to-day, without a sound training in mathematics as far as the principles of the differential and integral calculus. A genius may arise, but he will know enough to employ a steady plodder who has been steeped in the principles of the calculus. Most constructors who desire to build electro-magnets will find that the exigences of space and material will demand a certain form. Unless they understand the theory of magnetic measurements, they will find the treatise of Du Moncel of little value; for so many and so large approximations must be made, that the final result would not differ much from those obtained by a thumb-rule. We commend to the practical