

THURSDAY, MAY 14, 1891.

PRACTICAL GEOLOGY.

Aids in Practical Geology. By Grenville A. J. Cole, F.G.S., Professor of Geology in the Royal College of Science for Ireland. (London: C. Griffin and Co., 1891.)

An Introduction to the Study of Petrology: the Igneous Rocks. By Frederick H. Hatch, Ph.D., F.G.S. (London: Sonnenschein and Co., 1891.)

HOWEVER prophetic may have been the far-seeing premonitions of men in advance of their age in the dim past, and however invaluable may have been the additions made to the superstructure since, it can scarcely be doubted that the foundation-stones of geology were laid by Scotchmen and Englishmen towards the end of the last, and during the earlier part of the present century. And what a charm is there about the story of these sturdy pioneers, not perhaps quite the men whom one would have picked out as most fitted or most likely to become the fathers of a new science. It has about it the elements of a genuine romance. For the early training of few of these men was such as to give a scientific bent to their mind; they did not have what we are pleased to call "the advantage of a scientific education"; it is probable that they never spoke, perhaps never dreamed of, such a phrase as "the scientific method," which we are so fond of formularizing, and on which we plume ourselves somewhat. But in spite of these seeming drawbacks, rather perhaps because with these men genius was allowed to run its spontaneous untrammelled course, they opened out to mankind a domain of knowledge the very outskirts of which had been barely touched upon before. Of shrewd mother-wit were they; too keen of eye to be wrong about their facts; not a few were ardent sportsmen, and the same instinct which led them to ride straight to hounds or patiently and warily to stalk the deer, led them also, as they brushed away minor details, to go direct to main issues, and carried them on, without rest but without haste, through the toils of many a year's steady field-work. With what awe and reverence do we look up to these giants when we pass their achievements in review!

Nor does it one whit impair this feeling of respectful admiration to turn to the other side, and cast a glance at what were their unavoidable shortcomings. They were too hard-headed to be illogical in the matter of straightforward inferences, but it was hardly to be expected that they would escape going astray sometimes when they ventured on recondite speculation. Rough is not the word for their method; incomplete would be nearer the mark, but even that can scarcely be applied when the means at their disposal are taken into account. No one had yet taught the value of the microscope and balance to the geologist; and, when these and other instruments of precision were introduced, there was just a tendency to gird at appliances that had a finicking look about them to Titans who had so long and so successfully relied on their hammers and their wits.

But by degrees it became clear in Germany, and later on in England, that, though the great main roads of the

newly-discovered territory had been tracked out with such brilliant success, methods more refined than had sufficed for pioneering work must be introduced if all the intricacies of its lanes and by-ways were to be explored. Then the swing of the pendulum rather tended to bring about a disposition to exalt the new means of investigation, and there was just a risk that the sound basis of field-work might come to be undervalued if not neglected; and that Mineralogy and Petrology, instead of being the handmaids of Geology, might be thought to constitute the whole of that science. But the mischief never went far. The mantle which had fallen from the shoulders of the great fathers was not to be lightly cast aside; and, while every new aid was cordially welcomed, the conviction grew stronger and stronger that honest work in the field must for ever be the starting-point of geological inquiry.

How thoroughly this truth has become engrained in the minds of geologists is seen directly we open Prof. Cole's "*Aids in Practical Geology*." A large part of the book is taken up with minute and precise directions for carrying out the various kinds of microscopical, optical, and chemical examination of minerals and rocks. But on the first page we read—

"Such aids in determinative geology as are given in the following pages may be applied in any halting-place, or in cities after the return from an expedition; but, in any case, observations made on specimens are of slight importance if uncoupled with knowledge of their true position in the field."

And again—

"After a study of a number of type specimens, the student is recommended to go out to some well-described district, and to endeavour to recognize the varieties of igneous and sedimentary rocks by careful observation in the field. In this way alone can he appreciate the various modes of weathering, the massive or minuter structures due to jointing, the smooth or rugged outlines that characterize the masses of which his hand-specimens form a part. . . . Nothing short of striking the rock-mass *in situ* with the hammer, and taking in with the eye its position and surroundings, even to the broader features of the landscape, should content the geologist who would follow worthily the founders and masters of the science."

Again and again the author reiterates the lesson—

"Just as no mountain mass can be described by a stranger from a number of hand-specimens, however beautiful, so no rock can be adequately described from isolated microscopic sections. Again and again the observer will pass from his section to the solid specimen, and from this, in memory at any rate, to the great mass of which it formed a part."

And in dealing with the nomenclature of igneous rocks, the chaotic state of which is so largely due to the ignoring of their field-relations, it is insisted that—

"The following out of an igneous rock in the field is a most important lesson, and will soon determine what is valuable and what is valueless in any proposed scheme of classification."

That the author, in these and similar passages, is not speaking from hearsay, not merely re-echoing what is now a truism, is shown by the admirable practical directions which he gives in the first chapter for the outfit and procedure of the field-geologist. Here, and indeed throughout the book, the instructions are detailed and precise.

C

The author has not forgotten the time when he was a beginner, his early failures, and the disappointments of his student-days, when, from the neglect of some slight precaution, he failed to obtain the results he had been led to expect; and he has used every means in his power, by minute and specific instruction, to shield those who use his book from similar mishaps. As an instance, take what he says about the effect of acids on minerals. How often has the self-taught man turned wearily to one book after another on mineralogy, in the hope of getting some definite information on this point, and all he arrived at was the curt statement, "Soluble in acids," which each apparently had copied from its predecessor, or all had borrowed from some common source. What acid? Concentrated or dilute? Cold or hot? Quickly, or perhaps only after a fortnight's boiling? All these points he was left to make out for himself as best he could. The happier pupil of Prof. Cole is treated far more liberally, and will not have to weary himself by feeling about in the dark if he attend to the cautions and instructions of the book now before us. The directions for blowpipe-work are equally precise. Only one who has been himself an actual worker would have told the observer to wait "till the first red glow has gone off" before noting the colour of a borax-bead. Of course, anyone would, sooner or later, find this out for himself; but, till he had found it out, he would probably blunder not a little; and anything that economizes time nowadays is not to be despised. There is no need to multiply instances; everyone who uses the book will find that it eminently deserves the epithet of "practical," which the author has assigned to it.

But are there no weak points on which the critic may exercise his function? Attention may perhaps be called to the following:—On p. 6, a graphical method, due to Mr. Dalton, is given for determining the full dip of a bed from the dips on two oblique sections. The writer may perhaps be pardoned for preferring a method of his own, given first in the *Geological Magazine* for 1876, p. 377. But, independently of any personal predilection, it may be said that the diagram in the case of this method is simpler than in that of Mr. Dalton. This makes it easier to recollect, and, besides, the fewer lines there are in a graphical construction the less is the chance of error. In dealing with "streak," it would be well to notice that the true streak of some hard minerals, Iron-glance for instance, is not obtained till they have been rubbed down in an agate mortar.

Doubt is thrown on the value of Turner's test for the detection of boron (p. 41): there is an article by Dr. C. Le Neve Foster in the *Mineralogical Magazine* (vol. i. p. 77) which should be consulted in this connection.

It is hardly worth while criticizing the nomenclature and classification of the crystalline rocks. No two petrographers are in agreement here, and probably the existing schemes of arrangement are all of about equal value. There is fortunately no multiplication of species or introduction of new names. It might be possible to take objection to the description of Quartz-felsite as a compact form of Granite, for the part played by the quartz in the two rocks is totally different, and must be correlated with a difference in their mode of consolidating. Quartz-felsites are specially common as dykes, and there may have

been facilities for the escape of water in their case, up the fissures which they fill, that were not present in the case of the more thoroughly buried magma of Granite. It was doubtless the presence of water in the granite-magma which kept the quartz fluid or plastic after the other minerals had crystallized; its escape in the case of Quartz-felsite may have led to the early crystallization of the quartz. In dealing with the foliated rocks, the author touches on the debated point of the "true schists." We are pretty well used to this phrase, and have waited long in the hopes of being told what constitutes a "true schist," but our patience has not yet met with the reward it merits. The author is of opinion that "the alleged distinction between schist-like rocks and schists of pre-Cambrian age requires great delicacy of definition." This is delicately put, and will command the assent of most geologists.

The palæontological section will perhaps be looked upon somewhat derisively by those well versed in biology. But it will serve its end, which is to enable those who cannot pretend to any large amount of biological knowledge to know the commoner fossils when they see them, and determine the genus to which they belong. The method may have a large element of "rule-of-thumb" about it, it may be called empirical, but in a large number of cases it is not practicable to attain to anything better. And it has a certain educational value, for it makes a student use his eyes even if it but slightly disciplines his reason.

That the work deserves its title, that it is full of "aids" and in the highest degree "practical" will be the verdict of all who use it.

Nor will Dr. Hatch's handy volume be any less welcome. Those who wish to have in a compact form the prominent characters of the rock-forming minerals and the igneous rocks, will find all the information needed by a student concisely and lucidly put forth. Some slight acquaintance with crystallography and the optical properties of minerals is assumed. A short section on these subjects would have made the book more self-contained, and need not have increased its size very materially.

The igneous rocks are defined to be "those that have been formed by the consolidation of molten material." There is a spice of danger in the word "molten," for it may lead to the belief that the fluidity of the material was the result of "dry heat." In the case of a Laccolite the view so generally held is taken, that the overlying beds have been bent up by the intrusion of a molten mass. It is, to say the least, quite as likely that earth-movement caused a differential amount of bending in two adjoining beds, and that, as an empty space was thus gradually formed between the two, the molten matter was driven into it.

On the subject of the classification of the igneous rocks we find the following healthy expression of opinion: "The various types are so intimately related, that any attempt at rigid and systematic classification is not likely to meet with any great measure of success." Certainly not till some sounder basis of classification than any yet suggested is hit upon. In the meantime Dr. Hatch's grouping is one that from its clearness and simplicity will be a real boon to the student.

A most useful feature in the book is the list of localities

where each rock occurs. The illustrations are very well executed. Though the book has appeared only recently, one teacher at least can already bear testimony, founded on actual experience, as to its value to students.

A. H. GREEN.

BACTERIOLOGY.

Les Virus. Par Dr. S. Arloing. (Paris : Ancienne Librairie, Germer, Baillière, et Cie., 1891.)

THE name of Dr. S. Arloing as the author of a work on bacteriology is a sufficient guarantee that the book is worth reading, nor are we disappointed. "*Les Virus*" is one of the best volumes on this science yet produced. It is not a mere compilation of other men's work, giving a categorical account of the numerous pathogenic and non-pathogenic bacteria now recognized, but is a thorough scientific investigation into the principles of one of the most important branches of medical science, and might perhaps be better called a manual of "microbiology."

The work is divided into six parts, under the following heads :—

(1) General considerations as to the nature of the bacterial poison.

(2) Form and mode of life of the microbes (biology).

(3) The part taken by the microbes in the propagation and spread of infectious diseases.

(4) Struggle of the host against the poison. Natural extinction and artificial destruction of its effects.

(5) Immunity enjoyed by the body against certain microbes.

(6) Attenuation and reproduction of the bacterial poison.

It will be seen by the above list that this work covers a large field, and one not exactly dealt with by any previous author.

In the first part, which is subdivided into six chapters, Dr. Arloing commences with an historical survey of the science of bacteriology, pointing out the gradual extension of ideas from the time of Rhazes, who, in the ninth century, attributed small-pox to a process of fermentation "comparable to that which takes place in the juice of the grape when made into wine"; touching then on the works of Rayer, Davaine, Chaveau, and others, the author traces the development of the science until present times and the discoveries of Koch and Pasteur. An interesting comparison of the "virulent" parasites with simple parasites, such as *Trichina spiralis*, then follows; and, next, the formulation of two statements which form the basis of the modern science: (1) the active agents of the virulent process are organisms; (2) these organisms are living, and possess specific properties.

The second part of the work deals with the biology of bacteria. The methods of cultivating them are fully described, and, what we do not remember to have seen in any other work on bacteriology, there is a full account of the effect on micro-organisms of nourishment, temperature, light, atmospheric conditions, and electricity. In this part, also, are two most important chapters—namely, the effects on the microbes of the nature of the cultivating medium. This is only just beginning to be properly un-

derstood, and its investigation has already been productive of valuable results.

The chapter on the products of the growth of micro-organisms is hardly up to the general excellence of the work. It has not been sufficiently brought up to date, so that the researches of Dr. Hankin, and the more complete investigations of Dr. Sidney Martin in reference to the albuminoses and alkaloids, do not appear in it. The diastases and ptomaines are, however, fully discussed, and much may be learnt from a perusal of this chapter.

The third division of the book is devoted to the rôle which the microbes play in the propagation and causation of disease. The chapter on contagion is one of the best in the book, and would alone form a most valuable *brochure*. After a consideration of the general modes in which contagion is carried, a most exhaustive account is given of air, water, soil, food, and artificial inoculation (vaccination) as carriers of disease. As a natural sequence, the modes of entry of the germs into the body are then described, auto-infection being included; and next we have a consideration of what may become of the organisms after their entry, and the changes which take place in the host. The descriptions here given are exceedingly precise, and, although rather condensed, convey all that can be desired.

Passing now to the fourth part, we find four chapters devoted to the strife between the host and the microbes, and the natural extinction and artificial destruction of the poison. In the third chapter the subject of disinfection is noticed, both by heat and antiseptics, special attention being drawn to the necessity of the careful disinfection of sputum, linen, bedding, &c.,—points which cannot be too strongly insisted upon in all hospitals, and not merely in those devoted to fevers or diseases of the chest.

The fifth part deals with the very difficult, and, at present, vague subject of "immunity." Dr. Arloing divides immunity into two classes—"acquired" and "natural." On this subject no one is more qualified to speak than the author of this work, for he has made it almost a special study for years, and it is treated of in his usual masterly way.

The sixth and last part contains some of the more recent researches (especially those of Pasteur) on the attenuation of the virus.

Taking the work as a whole, we cannot speak too highly of it. We heartily congratulate the author on the success of his labours. The book is well illustrated, and we cordially recommend it to all those who wish to study a subject so replete with interest and of such vital importance to mankind.

F. J. W.

OUR BOOK SHELF.

Anleitung zur Bearbeitung meteorologischer Beobachtungen für die Klimatologie. Von Dr. Hugo Meyer. (Berlin : Julius Springer, 1891.)

WERE this little book less severely technical in form, it might be commended to the notice of that large class of observers whose sole aim and object in meteorological registration is to ascertain the characteristics of the local climate and to compare them in detail with those shown by the similar records of other places. It teaches how the results of observation may be tabulated or graphically