

different levels of land show clearly that the directions taken by these rivers are the only possible courses for water running downwards to the sea. The course of the Amazon and its tributaries across South America can similarly be understood by a glance at the orographical map. There are thirty maps of this kind in the series, and they are uniform in excellence. They thus bring out prominently the importance of land elevation, and used as they are intended to be—for pupils to fill in the details of physical, political and commercial geography—they will be of real educational value. In the absence of relief or contour maps, the "Diagram" series of orographical maps provide an admirable introduction to the study of geographical science. To convey the idea of comparative size, Great Britain or the British Isles is represented in one corner of each map on the same scale as the map itself. The maps can be supplied as lantern slides, as well as in several forms suitable for school requirements.

Among the noteworthy characteristics of Mr. George Philip's atlas are its remarkable cheapness—the price is only 1s.—and the selection of important geographical features to which prominence is given. There are in the Atlas forty coloured plates, containing ninety maps and plans, and eight pages of introductory letterpress. Physical features are clearly represented, and the scale is stated under each map. The difficulty of distinguishing between political boundaries and lines bordering physical features has been successfully overcome by printing the former in distinct red lines. The maps have not the common defect of being overcrowded, and they are up to date both as regards the spelling of names and political divisions. To ensure that the pupil understands the meaning of a map, several views and plans are given side by side; and there are also maps of the County of London and the Thames Basin. These special supplementary maps can be modified to suit local requirements. There is no excuse for using obsolete maps filled with confusing and unnecessary details now an Atlas such as that by Mr. Philip is available.

The Atlas edited by Mr. Arnold-Forster is constructed upon the same intelligent principles as the preceding one; the maps are well drawn, beautifully coloured, not overcrowded, and the place-names have been carefully selected. Views, plans and sections are shown under one another in the introductory maps to provide lessons in map reading. There are also maps of the same district on different scales, illustrations of methods of showing elevation, as used in Ordnance Survey maps, and a reduced Admiralty chart of the Needles to show the method of sea-mapping. Several good astronomical diagrams show some of the phenomena connected with the rotation and revolution of the earth, but Map 8 is incorrectly designated the Solar System; for all that comes under this head in it are the earth in its orbit at the equinoxes and solstices, and the lines representing the relative lengths of the diameters of the sun, earth and moon. Following these maps are forty others upon which the various continents and countries of the world are represented according to their physical features or political divisions. Several maps are devoted to the representation of the growth of the British Empire. Dr. A. J. Herbertson contributes some notes on the

construction and reading of maps, and teachers will learn from them how the Atlas can best be used and appreciated.

The appearance of these Atlases at about the same time indicates, we hope, that more careful attention is to be paid to instruction in geography in the future than is now given in most schools. The maps represent the best that have yet been prepared at a low price for use by individual pupils, and their adoption can be recommended to all teachers of geography.

OUR BOOK SHELF.

Die Photographie im Hochgebirg. Von Emil Terschak. Pp. xv + 87. (Berlin: Gustav Schmidt, 1900.)

IN this neat little book of some 90 pages, the author gives the reader some practical hints, both in word and illustration, as to the road to success in mountain photography. The hand camera is now so generally used, owing to the rapidity of modern lenses, and there are so many of us who like climbing, and who always carry one of such instruments on our tours, that such a book as this, full of practical hints, will be welcomed. Mountain photography is quite an art in itself, and he who is a good picture-maker near the sea level does not necessarily meet with success when some thousand feet or so up. The effects to be portrayed at that height are of quite a different nature. There we have great contrasts of rock and sky, clouds lying at our feet, mists hanging about different hill-sides, and snow-capped peaks and glaciers adding to the beauty of the landscape.

Each of these cannot be immediately reproduced on the photographic plate without either a great experience in the class of work, or a careful study of the labours of others. In this book the author brings together in an enticing manner the chief points to be borne in mind when making a tour. He commences with useful information relative to the packing up of the camera, plates, &c., and then in turn treats of the several conditions under which the photographer is likely to work—such as photographing mountains from a valley or *vice versa*, mountain groups from a height, clouds, mists, &c. The author accompanies his remarks with numerous excellent reproductions from his own negatives, and in every case gives data, such as the kind of plate used, lens, stop, length of exposure, time of day and year. Every one who is familiar with the German language, and is interested in mountain photography, will be sure to find this a serviceable book.

An Introduction to Vegetable Physiology. By J. Reynolds Green, Sc.D., F.R.S., Professor of Botany to the Pharmaceutical Society of Great Britain. Pp. xx + 459. (London: J. and A. Churchill, 1900.)

ONE of the needs most widely felt in modern botanical literature has been that of a good intermediate book dealing with vegetable physiology. Although several standard works dealing with this branch of botany are already in existence, they are for the most part of too advanced a character to be of much use to a junior student. It is a matter for gratification that the task of providing such a treatise should have fallen into such good hands as those of Prof. Green, by whom, as might have been expected, the subject-matter has been skilfully handled and admirably illustrated. By wisely avoiding excessive detail, and by duly emphasising from different points of view the various matters of special importance, the author has succeeded in producing a really excellent student's book, whilst the general reader will find the principal topics of current physiological interest presented in a lucid and interesting manner.

Of course it is not to be expected that such a work should be altogether perfect, and if we indicate some of the points which strike us as susceptible of improvement, we do so in the hope that the work may gain still further in value when future editions are called for.

Whilst many of the illustrations are distinctly good, some are very much the reverse, and as an example of the latter class Fig. 40 may be cited, which is excessively bad, and can hardly be said to illustrate the text (which it certainly does not adorn) in any sense whatever. The story of the digestive functions attributed to the leaves of *Lathraea* is now generally discredited, and might as well have been omitted from the text, whilst the somewhat teleological explanation of the red colour in leaves perhaps might at least have been accompanied by suggestions as to the proximate causes of its appearance such as are indicated by Overton's recent experiments. It is, however, against the short chapter on the influence of the environment on plants that we incline to take the greatest exception. The subject is a large one, and can only be adequately, or even usefully, treated by the aid of copious illustrative examples, without which as in the present instance it is apt to degenerate into rather senseless cramming.

Apart, however, from what after all are but minor and easily remedied faults, the book is, as we have already said, a decidedly good one, and its author has displayed such excellent judgment in the selection of his materials in order to meet the special needs of the class of readers for whom it is primarily designed that there will in future be no excuse for that neglect of vegetable physiology which is at present but too common with junior students of botany.

J. B. F.

A Text-book of Important Minerals and Rocks, with Tables for the Determination of Minerals. By S. E. Tillman, Professor of Chemistry, Mineralogy and Geology, U.S. Military Academy, West Point, N.Y. Pp. 176. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1900.)

IN this little manual, Prof. Tillman has brought together such fundamental instructions as are necessary to enable a beginner to determine the most commonly occurring minerals and rocks. Three short chapters on crystallography, the chemical characters, and the physical properties of minerals are followed by a series of tables for the determination of 135 common species. In the choice of these species a considerable amount of judgment is shown, though it is obvious that the opinions of an American mineralogist as to what should be regarded as the most important species differ from those of workers in Europe. The tables are on the familiar plan of those of Weisbach, Persifor Fraser, Brush and Penfield, and other well-known authors, and the arrangement adopted is a very simple one. The twenty pages devoted to rocks at the end of the volume are only sufficient to enable the author to give a very slight sketch of petrographic science. The work is worthy of the attention of teachers organising a system of very elementary instruction in determinative mineralogy.

Laboratory Companion for Use with Shenstone's Inorganic Chemistry. By W. A. Shenstone, F.R.S. Pp. vi + 117. (London: Edward Arnold, 1901.)

MR. SHENSTONE'S course of work in inorganic chemistry was noticed in these columns a few weeks ago (January 10, p. 249). Most of the experiments in that book are reprinted in the present volume, together with a number of exercises, and other experiments have been added. A volume suitable for use as a laboratory manual, that is, containing directions and suggestions, without theoretical considerations, has thus been produced. On p. 117 reference is made to a frontispiece showing Fraunhofer lines, but the picture has been omitted.

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LETTERS TO THE EDITOR.

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A Compact Method of Tabulation.

IN arranging tables of successive values of a variable quantity, it is often difficult to find a middle course between making the entries too numerous and making the intervals too large. I wish to call attention to a mode of tabulation which, although compact, provides facilities for the accurate deduction of intermediate values.

For convenience of description we may regard the tabulated values as equidistant ordinates of a curve. If the common distance is small enough (which implies that the number of ordinates is large), intermediate values can be deduced by the ordinary method of "proportional parts"—in other words by employing first differences only. If the number of ordinates is diminished by largely increasing the common interval, it becomes necessary to take account of differences higher than the first. We shall suppose the interval to be so chosen that the first three orders of differences—and no more—require to be considered.

A table showing the given values accompanied by three columns of differences presents a formidable aspect; and on the other hand, if the user of the table is left to compute these differences for himself, his labour is materially increased. What I wish to point out is that, without any sacrifice of accuracy, the first and third orders of differences can be omitted, the second only being retained; as in the following table of sines, which is suitable for computing the sine of any angle to four places of decimals. The differences entered opposite the sines are the "central" second differences; for example, $\cdot 104$, which stands opposite to $\sin 20^\circ$, is $(\sin 30^\circ - \sin 20^\circ) - (\sin 20^\circ - \sin 10^\circ)$.

Angle	Sine	Second difference	Angle	Sine	Second difference
0	0000	0	50	7660	232
10	1736	52	60	8660	263
20	3420	104	70	9397	286
30	5000	152	80	9848	299
40	6428	196	90	10000	304

Let $u_0 u_1$ be any two consecutive tabulated ordinates (sines) between which it is desired to interpolate a new ordinate u ; $x_0 x_1 x$ being the corresponding abscissas (angles). Putting h for the common interval $x_1 - x_0$, let p stand for $\frac{x - x_0}{h}$, and q

for $\frac{x_1 - x}{h}$, so that $p + q = 1$. Also let $u_0'' u_1''$ denote the central second differences of $u_0 u_1$ respectively. Then it can be shown that the value of u true to third differences is

$$pu_1 + \frac{p(p+1)(p-1)}{1 \cdot 2 \cdot 3} u_1'' + qu_0 + \frac{q(q+1)(q-1)}{1 \cdot 2 \cdot 3} u_0''$$

The sum $pu_1 + qu_0$ of the two terms in u_1 and u_0 , though it does not put first differences in evidence, really includes them, and is the exact value of u when the connecting curve is a straight line. In like manner, though third differences are not in evidence, they are implicitly contained in the sum of the two terms in $u_1'' u_0''$.

The coefficients of $u_1'' u_0''$ are identical in form, and are easily computed. The following list of their values for each tenth of an interval will serve to check mistakes. Their values (neglecting sign) are always less than $\cdot 065$.

p	$\frac{p(p+1)(p-1)}{1 \cdot 2 \cdot 3}$	p	$\frac{p(p+1)(p-1)}{1 \cdot 2 \cdot 3}$	p	$\frac{p(p+1)(p-1)}{1 \cdot 2 \cdot 3}$
1	0165	4	0560	7	0595
2	0320	5	0625	8	0480
3	0455	6	0640	9	0285