sington Museum, runs some risk of being undone by the unintelligent intermeddling of Government. It would appear from statements recently made in the House of Commons that arrangements were being made for transferring the management of the South Kensington, Bethnal Green, and similar institutions to the trustees of the British Museum. It is difficult for an outsider to see what Government means by contemplating such a step; we believe no better means could be taken to cripple the efficiency of such institutions than by giving them over to the irresponsible management of the unpaid trustees of the British Museum, who have at present much work on their hands, which is the subject of constant Parliamentary inquiry. We cannot conceive that Mr. Cole would approve of any such step, a step which, we repeat, would be sure to mar the great work which, with untiring labour, all-conquering zeal, and advanced intelligence, he has accomplished. Report indeed has reached us that a National Committee is being formed to urge upon Mr. Gladstone's re-constituted Government the necessity of putting the British Museum, the National Gallery, and Institutions supported by Parliamentary funds, and now Trustee-muddled, under the direct control of a responsible Minister.

Sir Joseph Whitworth consulted Mr. Cole upon the establishment of Scholarships for Mechanical Science, to take place after his death. Mr. Cole recommended him to establish them during his life, so that he might have the enjoyment of watching the progress of them. Sir Joseph followed this recommendation, and presented the country with 3,000*l.* a year for these Scholarships.

Mr. Cole is now devoting special attention to the application of Science to Productive Industry in the yearly International Exhibitions, and we trust that he may long be spared to reap the honour which is his due and to help on the work of which he has laid the foundation.

The erection in Exhibition Road of the handsome Science Schools, one of the few buildings devoted to Science of which the country may be justly proud, which Mr. Cole has at length successfully achieved, is due solely to the persistency of his efforts, rendered more and more pertinacious by the obstinacy and penuriousness of the Treasury, which in the most niggardly spirit is still starving the work and preventing its proper development, simply because, we presume, it is a scientific work; and it was the intention of the recent Chancellor, Mr. Lowe, that in this particular England should be distanced by the smallest Continental or American state. It is fair to add that Mr. Cole was supported in this particular direction by the Duke of Buckingham, the Duke of Marlborough, and the Marquis of Ripon, who have successively been Lord Presidents since 1866.

ADVANCED TEXT-BOOK OF PHYSICAL GEOGRAPHY

Advanced Text-Book of Physical Geography. By David Page, LL.D., F.G.S., Professor of Geology in the College of Physical Science, Newcastle. Second and Enlarged Ed. (Edinburgh and London: Blackwood, 1873.)

PHYSICAL Geography is one of those branches of knowledge which, without being a science in itself, makes use of many of the Sciences to explain and illustrate the facts and phenomena with which it deals. So far as it is confined to the mere knowledge of facts and description of natural phenomena, no special acquaintance with any science is required; but when it comes to deal with the causes of phenomena and the deductions from geographical facts, it is essential that the teacher should himself possess a good general knowledge of several branches of modern Science. In particular it is necessary that he should clearly grasp the main principles of Physics, that he should have a good acquaintance with the distribution of animals and plants, and so much familiarity with arithmetic and mathematics as to be able to avoid making statements which are palpably incorrect.

After a careful examination of the present volume, we are forced to conclude that the author is, on all the above-mentioned points, unfitted to teach this particular subject. It is with much regret that we say this, having expected something very different, not only from the popularity of Prof. Page as an author and a teacher, but also from the criticism of one of our first literary periodicals (used as an advertisement), that the work is "a thoroughly good text-book of Physical Geography." In order to justify this difference of opinion from so high an authority, it will be necessary to point out what are the most prominent errors and defects in the volume. Some of these defects may, it is true, be mere oversights; but most persons will be of opinion that, in the second edition of an educational work, the plea of "oversight" can hardly be allowed.

In the second chapter — on the figure, motion, and dimensions of the earth—we find a series of curious misconceptions, blunders, or obscurities. At page 19 we have the globe "revolving and rotating in obedience to the laws of gravitation and attraction," and in the next page these words are again used as implying distinct "forces." On page 21 occurs the following:—"But day and night are of unequal and varying length according to the *seasons;* and these seasonal successions are caused by the facts—first, that the orbit or path of the earth's revolution round the sun is not a perfect circle, but an ellipse; and second, that in performing this revolution her axis is not perpendicular, but inclined at an angle of 66° 27¼′ to the plane of her orbit." This is simply absurd. The ellipticity of the earth's orbit has nothing whatever to do with the fact of there being seasons, which would occur exactly the same were the orbit a perfect circle. The actual effect of the elliptic orbit in slightly modifying the length and severity of winter in the two hemispheres, and which is of some importance as being an element in explanation of the cause of the glacial epoch, is never so much as alluded to. In a recent public examination some of the competitors gave this very account of the seasons, and received few or no marks in consequence. They had probably got up the subject from Dr. Page's volume. Three pages further we have a table of certain dimensions of the planets. This has no particular bearing on physical geography, but as it is given it should have been correct. It is, however, full of gross blunders, which can be detected by observation alone. We have in three columns—the diameter in miles, the cubic contents in miles, and the volume, earth being taken as 1. Now the "solid contents" and the "volume" being the same

dimension expressed in different ways, must be proportionate in any two planets; yet we have Mercury, volume 0·06, solid contents 10·195; Venus, volume 0·96, solid contents 223·521, so that while the volume of Venus is 16 times that of Mercury, its solid content is 22 times! Again: Earth, volume 1·00, solid content 260·775; Mars, volume 0·14, solid content 48·723, the earth being over 7 times the volume of Mars, but only 5½ times its solid content. Almost any other two planets come out equally wrong. Again, from the diameters given the solid contents can be easily calculated, but here again is frequent error; and to add to the confusion, in at least two cases the diameters are seriously wrong (4,980 miles instead of 4,100 for Mars, for instance), so that it is very difficult to understand where so many mistakes could have come from. On the next page we have a contradiction as to the earth's internal structure. It is first stated positively that "the interior of the earth cannot be composed of the same materials that constitute its outer portion," and lower down, that "either the interior of the earth is composed of materials differing altogether from those known at the surface, or the compression must be counteracted," &c. At page 27 we have the atmosphere described as "mainly composed of two gases, nitrogen and oxygen—79 parts of the former to 21 of the latter—with a small percentage of carbonic acid and other extraneous impurities." Considering the importance of the carbonic acid gas in the atmosphere, it is hardly instructive to class it as an "extraneous impurity."

Passing over the mere description of the earth's surface, parts of which are very well done, we find other objectionable matter as soon as we have to deal with the explanation of phenomena. A mountain range is said at p. 75 to be "not a simple upheaval, the result of one paroxysmal outburst, but the work of innumerable volcanoes and earthquakes operating through ages and subsequently escarped and chiselled by rains, frosts," &c. Here gradual elevation without volcanoes or earthquakes, and possibly from altogether different causes, is ignored. On the next page, speaking of circumdenudation, we have:—"A mountain may thus consist of stratified rocks and be wholly unconnected with any forces of upheaval or ejection from below." Here ignoring that the strata must be upheaved before they can be circumdenuded. These are perhaps slight matters, but we think an introductory work should not adduce the almost exploded theory of Elie de Beaumont on the parallelism of mountain chains of the same age, "even when in opposite hemispheres," as if it were generally admitted, or Prof. Hopkins' explanation of central mountains with diverging spurs as the result of an upheaving force acting on a point, without stating that a very different explanation of the facts is adopted by most modern geologists.

When we come to the subject of the ocean, involving many nice problems in physics, our author is again altogether at fault. It seems hardly credible that he should not know the difference between salt and fresh water as regards the point of maximum density, on which much of the theory of oceanic circulation and temperature depends; yet such seems to be the case. At p. 123 we are told that "at 40° Fahr. water is at its minimum volume and maximum density," and again in the same page—"Its maximum density or minimum volume at 39½, its expansion as ice to one-ninth of its bulk at 32° for fresh water and at 28¼ or less for salt water." Again, at p. 131 we have—"As already mentioned, water acquires its minimum volume or greatest density at a temperature of 40°, and becomes lighter as it rises above or falls below this temperature. Owing to this property a perpetual interchange or circulation is kept up among the waters of the ocean," proving that sea-water also is supposed by the writer to have this property, instead of increasing in density down to about 27½°, as it actually does. Yet the author quotes Maury, who published this correction of the old notion in 1861, and the papers of Dr. Carpenter, who repeatedly refers to this fact as a most important one. Again, at p. 136 we have the obsolete theory of Sir James Ross as to deep-sea temperatures given in full, with a remark that it has recently "been materially interfered with" by the experiment of Drs. Carpenter and Wyville Thomson; but without, apparently, any acquaintance with the whole of the facts established by those gentlemen, as shown by again referring to the temperature of the bottom of the ocean as being 39° Fahr., "that of its maximum density."

It is perhaps a small matter that, in describing the Nile valley, Capt. Speke's account is quoted at length (p. 181), and the Victoria Nyanza given as the source, the Albert Nyanza not being once mentioned, or any allusion whatever made to the fact that Sir Samuel Baker claims it to be the true source of the Nile; but it is of great importance that the student should be impressed with clear and accurate ideas as to the cause of winds. Yet we find here the old school-book notion of a vaccum and an inrush to fill it up. "As air is expanded by heat and contracted by cold the warmer and lighter volumes will ascend, and the colder and denser rush in from all sides to supply the vacancy" (p. 205). "The air of the torrid zone becomes rarefied and ascends, while the colder and denser air sets in from either side to supply the deficiency" (p. 213). And the same words are repeated at p. 243. But every physicist knows that there is no "vacancy" and no "deficiency" in the case, but merely a disturbance of equilibrium; and unless this is clearly comprehended the causes and effects of atmospheric currents can never be understood. On the subject of light and heat the ideas of the author appear to be still more confused. At p. 205 he says—"As the atmosphere is the medium through which the sun's heat is conveyed to and disseminated over the earth, so also it is the medium of his light-giving rays." This sentence will certainly convey to the learner the false notion that the atmosphere is in some way essential to the "conveyance" of light and heat from the sun to the earth; and this is further dilated upon in the following vague and unintelligible, if not erroneous sentence:—"Heat and light are alike indispensable to plants and animals, and, from the peculiar constitution of the atmosphere, as regards its varying density, moisture, &c., both are reflected and diffused so as to become most available to vegetable and animal life." The learner must be very acute who can obtain any definite information from such oracular teaching as this. Again (at p. 207) we have a total misconception as to the cause of the decrease of temperature at increasing elevations—"The heat that falls on the land being partly absorbed and partly radiated into the atmo-

sphere, the lowest aërial strata or those nearest the influence of this radiation will be warmer than those at higher elevations." But it is a thoroughly well-established fact that the atmosphere is scarcely at all warmed by radiant heat, except when charged with vapour, but almost wholly by contact with the heated earth, and that the diminution of temperature upwards is due to the cooling by expansion of the air which rises from below, and to its greater diathermacy, owing to the comparatively small amount of vapour at great elevations. In the whole of this part of the book there is no allusion to the effect of atmospheric vapour in checking radiation, so that the learner is left without a clue to the comprehension of some of the most important and interesting facts in climatology.

The latter division of the volume treats of the distribution of life, but it deals chiefly in vague generalities, and shows little acquaintance with the large amount of research which has of late years been bestowed on this subject. The distribution of plants is illustrated by means of the eight zones, from equatorial to polar; and there is no hint to the student that this is not a natural system or that there are any other causes than climate, soil, and altitude that determine the flora of a region. Here, too, we are not free from absurd errors, such as rhododendron and azalea being given as characteristic of the "American Arctic zone," while "box, saxifrage, and gum" (!) are said to grow up to 4,200 ft. on the Pyrenees, and "rice and wheat" in "those provinces subject to the influence of tropical seasons!" (p. 257). Animal life is treated in an equally loose and obsolete fashion. We find such terms as "homoiozoic zones" and "latitudinal distribution" repeated *ad nauseam*, but in illustration of these the student is told that the opossum is peculiar to the north temperate zone, and the kangaroo to the southern, apparently in complete ignorance that opossums abound all through tropical South America, while kangaroos inhabit tropical Australia and equatorial New Guinea, as well as the more temperate regions. "The eagle and falcon" are also given as peculiar to the temperate zone, while "the wolf" is said to be peculiarly arctic (p. 261). We are next informed that—"it has been attempted to arrange the earth's surface into certain zoological kingdoms and provinces, but it must be confessed with much less precision and certainty than in the case of the vegetable world"—which is exactly the reverse of the fact,—and then we have the now obsolete arrangement of Edward Forbes put forth, without a word about the labours of Sclater, Günther, Murray, Blyth, Blandford, Huxley, and others, who have established what all agree are natural zoological divisions of the earth (which has not yet been done in botany), although they may still differ as to the comparative rank of those divisions. We are not therefore much surprised when (at p. 263) we are told that in the Moluccas and Timor "there is a great abundance of carnivora and other orders of animals (!)' or that we have (at p. 269) the entirely novel assertion that "on the introduction of some new exotic, animals hitherto unknown in that locality usually make their appearance." Having perhaps read or heard of Mr. Darwin's celebrated case of the heartsease, bees, mice, and cats ("Origin of Species," 6th ed., p. 57), Dr. Page holds forth as follows:—"Certain birds, for example, feed on certain insects, and these insects again find their chosen food in certain plants; remove the plants and you destroy the insects, and by the destruction of the insects you compel the birds to remove and find othe habitats, or if these supplies cannot be found the birds are extirpated." Mr. Darwin gives a possible and very probable case founded on careful observation, but here we have a very improbable, if not impossible case, founded on imagination; because no birds feed on "certain"—that is definite species of—insects only, and comparatively few insects again are restricted to certain definite species of plants, so that there is no reason to believe that any insectivorous bird could ever be extirpated, or even rendered scarce, by the destruction of a single species of plant with the insects that feed upon it.

Next we come to the subject of mankind with the inevitable five races of Blumenbach, no notice whatever being taken of more modern classifications. Thus, the hill-tribes of India are left with the Caucasians, and the New Zealanders, Papuans, Australians, and Malays, are all jumbled together as forming one race. In the concluding chapter, which is a kind of summary of the whole work, we find it stated that the new world is characterised by more "uniformity of vegetable and animal life" than Europe, the exact contrary being the case; that "the vegetation of Africa is much less varied than that of Europe or Asia," which is equally untrue as regards Europe; the Cape of Good Hope alone equalling it in the number of families and genera of plants, while the difference between its northern and southern extremities is far greater than any corresponding difference in Europe; and, that the Polynesians are "utterly uncivilised." Having now gone through the book, we find that several classes of earth-knowledge have been totally omitted. The great subjects of terrestrial magnetism and atmospheric electricity are altogether ignored, while such phenomena as the rainbow, the blue sky, and meteoric stones, are never once mentioned.

The great and radical defects which have now been pointed out are not however the only ones, although they are by far the most important. The work is carelessly written, and the author seems not to have thought it worth while, even in a second edition, to correct errors, erase repetitions, or make sentences intelligible. A passage is repeated word for word about the middle and near the bottom of p. 27. "Contour" and "vertical relief" are defined in almost the same words three times over at pp. 62, 66 and 72. The two first lines on p. 21 are unintelligible, owing to some omitted words; and the second line of p. 28 is palpably ungrammatical. These, however, are small matters, and would not have been noticed had the author carried out with any approach to completeness and accuracy his somewhat lofty pretensions. He tells us that it is his object to "present an outline of the science in its higher bearings," to rise above mere external appearances, and seek to explain the causes that produce them, and that "he has endeavoured to embrace all that is important in recent discovery and hypothesis." The numerous quotations and references now given will enable the reader to judge how far the opinion expressed at the commencement of this article is well founded, and, if they agree with that opinion, they will feel some indignation that periodicals of high standing should (through ignorance or something worse), mislead the public so far as to tell them that this is "a thoroughly good text-book of Physical Geography." (!) This is the more to be

regretted, as there are two well-known works to which the epithet is fairly applicable, and which are at least free from such erroneous facts and false or exploded theories as have been pointed out in Dr. Page's volume.

ALFRED R. WALLACE

OUR BOOK SHELF

Half-hours in the Green Lanes: a Book for a Country Stroll. By J. E. Taylor. (Hardwicke.)

THERE are two ways at least in which the first principles of Natural Science may be taught to the youthful mind, as well as to "intelligent people who have not had time to enter into the technicalities of scientific questions." One which, if we may judge from the number of elementary works on Physics in which it is adopted, has many arguments in its favour, consists in the careful and logical working out in detail of a few of the most important principles of the Science, together with the different steps by which they were arrived at; the knowledge of minutiæ being left for future observation and study, on the foundation supplied: and the other is little more than a compilation of disconnected facts, of unequal importance, arranged with an endeavour to make them impressive from their almost endless number, and strung together with teleological argument. The tenants of the "tarns and green lanes being the objects treated of, there is an expanded field for the 300 or so short pages, in which the fishes, molluscs, and reptiles of the former, as well as the birds, insects, and plants of the latter, are rapidly passed in review. Several excellent figures illustrate the work, Mr. Wood and Mr. Keulemans contributing to the ornithological section; however, we are surprised to see so many on subjects of comparatively little importance, as the 14 on the slight variations in the shape and marking of cycloid scales, and the 32 on the different species of snails. Turning to the letterpress, many of the descriptions will be found to be accurate and clear, and a few sufficiently long to enable the uninitiated to form a fair idea of the subject. Many however are so short and incomplete that but little can be made of them without extraneous assistance, and in some the carelessness in the choice of words adds to the difficulty, as where the Vapourer Moth (*Orgyia antiqua*) is said to derive its name "from the habit of the winged males rising and falling simultaneously in their flight." A fact is sometimes stretched to make a *simile*, as when we are inaccurately told that "the generic name of the Kingfisher (*Halcyon*) is derived from the ancient belief that when it was hatching its eggs, the water was always calm and still." The genus *Turdus* is more than once called *Tardus*, and several other mistakes show that the author's knowledge of the subject is not of the deepest, as when the hind wing of the Clifden Nonpareil (*Catocala fraxini*) is said to be black and red, and the wide geographical distribution of the Kingfisher is given as a reason for supposing that it has a comparatively high geological antiquity. Notwithstanding its faults, however, there are many points in this small work which will make it of more than ordinary interest to the general reader.

The Royal Readers. Nos. 1 to 6. (Nelson and Sons. London and Edinburgh.)

THE excellence of these reading books and their adaptation to the broader culture of the present day demand from us some notice. The editor of the series, who has done his work with unusual ability, tells us in the preface that his aim has been to cultivate the *love* of reading. So far as we are able to judge, this aim he has successfully carried out by presenting interesting subjects in an attractive way. Opening any one of these Readers, we are struck with the air of freshness and interest it possesses. An intelligent child, instead of closing the book with relief, is far more likely to leave it with regret. And added to the happy way in which the lessons have been prepared, the pages abound with capital woodcuts, some of which are of real beauty. There are none of the stereotyped cuts of stale children in old-fashioned dresses and hair in pig-tails, primly grouped at play, and supposed to illustrate the story of the goody-goody girl, or the naughty-naughty boy. Our children are mercifully spared from these haunting ghosts of our childhood and have their Royal Readers instead. But these books have a wider scope than mere reading lessons. In the fifth and sixth books we find a large amount of sound scientific knowledge conveyed in a course of lessons carefully prepared by the editor. Then there are articles on physical geography, the bed of the sea, the various ocean routes, and lessons on useful inventions, besides some other novel features which we have not room to detail. The employment of these reading books will certainly tend to create a love for healthy reading, and at the same time they seem likely to be of the highest service in training and furnishing the minds of children.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Atoms and Ether

I AM not enough of a metaphysician to say whether a substance which can be compressed and expanded *necessarily* contains void spaces.

If so, the idea of air, furnished to a beginner by instruction in "Boyle's Law," is self-contradictory; and any molecular theory afterwards developed in order to account for "Boyle's Law," may claim not only ingenuity but necessity in order to abate a crying grievance to all right-minded persons.

I do not myself believe in Prof. Challis's æther, but at the same time I do not believe in the power of the human mind to pronounce that a continuous medium capable of being compressed is an impossibility.

But, on the other hand, I am sure that a medium consisting of molecules is essentially viscous; that is, any motions on a large scale which exist in it are always being converted into molecular agitation, otherwise called heat, so that every molecular medium is the seat of the dissipation of energy, and is getting hotter at the expense of the motions which it transmits. Hence no perfect fluid can be molecular. So far as I can see, Prof. Challis intends his æther to be a perfect fluid, and therefore continuous (see p. 16 of his Essay), though he does not himself pronounce upon its intimate constitution.

Hansemann* makes his æther molecular, and in fact a gas with the molecules immensely diminished in size.

With regard to Mr. Mott's iron bar, when he pulls one end he diminishes, in some unknown way, the pressure between the particles of the iron, and allows the pressure of the æther on the other end to produce its effect.

N.B. This is only the language of a theory, and that theory not mine; nevertheless, I think it is consistent with itself.

Glenlair, Aug. 13 J. C. M.

Reflected Rainbows

I READ with great interest, in Prof. Tyndall's American lectures, a statement about the rainbow which appeared to me so extraordinary, that I determined to test it on the first opportunity.

The statement (I have not the book with me here, and give merely my recollection of the substance) is that, owing to the want of the necessary condition of parallelism the rays scattered from rain-drops cannot be so reflected as to show a rainbow by reflection from the surface of a lake.

Of course we all know that the same rainbow cannot be seen from two places at the same time, and therefore no one would

* Die Atome und ihre Bewegungen, von Gustav Hansemann. E. H Mayer: Coln, 1871.)