

study of natural history, and of mountains in the field; (5) by excursions to the plantations and mountains."

With regard to the status of forest officers in different parts of Europe they are described as taking rank with military men and other Government officers of recognised social position, and having in many instances an official uniform and a higher salary than is accorded to military officers, by way of compensation for the monotonous life they are called upon to lead in the forests, which often has a depressing influence—"day after day, month after month—trees, trees, trees everywhere, trees and shade, trees and shade—shade that reminds one of the expression 'the valley of the shadow of death.'"

"Forestry in Norway" is a book of a different character from the preceding. It treats of the general features of the country in its various aspects, with especial regard of course to its arboreal vegetation, and the effects of temperature, rainfall, rivers, lakes, mountains, valleys, &c. The book is for the most part very pleasant reading.

In Chapter IV., under the head of Geographical Distribution of Trees in Norway, Dr. Brown shows that he has made himself acquainted with the modern literature of the subject, especially with the well-known report and maps prepared by Dr. F. C. Schubeler, Professor of Botany in the University of Christiania. From this and from the numerous other works cited the conclusion is drawn that the true forests of Norway are composed almost entirely of the Norway spruce fir (*Picea excelsa*, Link.) and the Scotch fir (*Pinus sylvestris*, L.), though some other trees, as the elder, beech, and oak, are found forming little woods. We must here point out that nearly the whole of this chapter requires careful editing. There is no excuse for the retention of old and exploded names, still less perhaps for absolute mistakes. On p. 39, for instance, it is stated that the Norway spruce is generally known as *Abies communis*, a name under which very few indeed would know it except those well versed in the synonymy of the plant. On the same page *Millaw* is printed for Miller, *Lank* for Link; and a page or two further on, the Norwegian birch is referred to *Betula odorata*, Bechet, when it should be *B. alba*, L. Again on p. 45 we are told that two species of oak "are found growing wild in Norway, the sessile-fruited oak, *Quercus robur*, W., and the common oak, *Q. pedunculata*, W." The fact is that the sessile-fruited oak is *Q. sessiliflora*, Sm., and the pedunculated oak, *Q. pedunculata*, Ehr., both of which are now placed by most modern authorities under the one name of *Quercus robur*, L. Similar instances occur further on, as well as misspellings, all of which could be easily rectified, and the book made more trustworthy.

The general readable nature of the bulk of the book will no doubt cause it to be read by those into whose hands it may fall, whether they are specially interested in forestry or not, and will thus form one means of promoting the extended use of the volume.

LENSES

Lenses and Systems of Lenses. By Chas. Pendlebury, M.A., F.R.A.S., Senior Mathematical Master of St. Paul's. (Cambridge: Deighton, Bell, and Co., 1884.)

WE are glad to welcome at last an English book on this subject, on which up to the present but little has been written in our language. An abstract of

Gauss's paper in Taylor's *Scientific Memoirs*, and a paper by Maxwell in the second volume of the *Quarterly Journal of Mathematics* form, so far as we are aware, the main English literature of the subject. Of course since the time of Gauss foreign writers have used it freely: Listing, Helmholtz, and Carl Neumann in Germany, Verdet and others in France, have introduced it with more or less modification into their works. We would suggest that a list of books and memoirs on the subject would form a valuable addition to Mr. Pendlebury's book. The author gives frequent references in footnotes to books or papers from which he has drawn information, but a complete list would be a great help to others studying the subject. The method itself is very elegant and attractive, though somewhat barren of results; perhaps this is the reason why it has been neglected in England. It enables us to obtain a beautiful solution of the problem to a first approximation when all the rays make but small angles with the axis, but refuses to help us further.

The book before us is clear and well written, though perhaps unnecessarily long. Mr. Pendlebury has three chapters successively on refraction at a single surface, at two surfaces, and at any number of surfaces. This would be very well for a student who was supposed to begin the study of optics with this book, but such a student is hardly likely to exist; and one who has read the ordinary text books on the subject could easily follow at once the reasoning of the most complicated case, and might be left to deduce the others so far as they differ from it as corollaries.

Referring, however, to some points in the book, we think that in Fig. 4 it would have been better to take as the standard case one in which the points X and X' both lie to the same side of A, the case usually considered in text-books on optics. This would have obviated the necessity of having to put a negative sign to the symbol *u* in the algebraical work. Attention also might with advantage be called to the point that one of the two focal distances is negative.

Again, a difficulty occurs when we compare the results of Sections 67 and 74; in the one we have

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f},$$

while, using the same notation, the results of the other may be written

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}.$$

The explanation, of course, is that Fig. 18, from which the last result is deduced, is not drawn for the standard case of a lens forming a virtual image of an object. There is another small point of arrangement which it seems to us might be slightly modified with advantage; we would draw a rather more definite line between the analytical and geometrical methods of treating the subject.

If we assume that a pencil of rays diverging from a point will, after refraction, pass through a point, we can prove geometrically the existence of the principal points, the focal points, and the nodal points. We cannot, however, without analysis, find the position of these points in terms of the curvatures and distances between the various refracting surfaces.

Again, if we assume the position of the focal and

principal points, we can find geometrically the position of the image of any point after refraction through the surface. This we may describe as the geometrical treatment of the subject.

By the aid of analysis we can show that there is, to the degree of approximation to which we go, a point image of any point, and we can find in terms of known quantities the positions of the cardinal points of the system and the relation between a point and its conjugate focus. Mr. Pendlebury adopts both methods indiscriminately; it seems to us that it would have been better to have kept the two somewhat more distinct.

A short account of the paper of Maxwell to which reference has been made, "On the General Laws of Optical Instruments," would form a valuable addition to the book, and may, perhaps, be included when the author extends it, as he hopes to do, so as to cover a wider area in the field of geometrical optics. At present the field is open to him, and a book on the whole subject as good and interesting as "Lenses and Systems of Lenses" is greatly needed.

R. T. G.

OUR BOOK SHELF

Fuel and Water. Translated from the German of Franz Schwackhöfer, by Walter R. Browne, M.A. (London: Charles Griffin and Co., 1884.)

MR. WALTER R. BROWNE has made a very good translation of a book written for the German students of agriculture in Vienna. He has added a clever sketch of the mechanical theory of heat as an introduction. The English of the translation is remarkably good and clear, and the original treatise has been written by a competent man. The translator in his preface appeals to manufacturers and users of steam on a large scale; but the work is much too scientific for them, dealing not with the various forms of boiler now in the market, but rather with the general principles on which boilers should be constructed. On the other hand I fear that the information given is in many parts not full enough for the engineer, and we frequently find data given such as will be of more value to the German than to the English reader. The chief physical formulæ relating to heat and applicable to practical questions connected with engineering are clearly stated, but the comparison of results deduced from these formulæ with the results derived from actual experience is rather sparingly made. The third chapter, which is headed "Heating Apparatus," treats of the furnace and its management. The author gives the results of some actual experiments as to the loss of heat in the chimney, in the ash-pits, in priming water, and by conduction and radiation. He also gives an experiment with what is called an economiser. This chapter seems to me one of the best in the book. Altogether, I think the work is one which may in many parts be profitably consulted by those engineers who desire to compare theory with practice.

FLEEMING JENKIN

The Elements of Euclid. Books I. to VI. With Deductions, Appendices, and Historical Notes. By J. S. Mackay, M.A. (London: W. and R. Chambers, 1884.)

THIS text-book has been compiled at the request of the publishers, and the event shows that it was by a "happy thought" their choice of an editor fell upon Mr. Mackay, the Mathematical Master of the Edinburgh Academy. Of it we have nothing to say but what is good. This praise is not so much for the text, for others have done well in this direction. Still even here Mr. Mackay has shown great judgment and skill in his selection of proofs. The text is in the main that of R. Simson's well-known

editions, and no change has been made in Euclid's sequence of propositions, and no violent change in his modes of proof.

But what we particularly like are the carefully prepared historical notes, which take the form of footnotes or of fuller paragraphs in the six appendices. Mr. Mackay remarks, "It would perhaps be well if such notes were more frequently to be found in mathematical text books: the names of those who have extended the boundaries, or successfully cultivated any part of the domain, of science, should not be unknown to those who inherit the results of their labour."

We regret that though authors have before expressed themselves to similar effect, yet few have had the inclination or leisure to act as our present author. He has had to curtail his material, but what he gives us shows that he is well qualified by the extent of his reading to satisfy this want.

We note here that recent French mathematicians are in the habit of attributing the first use of the word "orthocentre" (which Mr. Mackay ascribes to Dr. W. H. Besant) to Dr. Booth; in so doing they are certainly in error, as Dr. Booth himself, in the second volume of his "New Geometrical Methods" (p. 261), says "the point has been called by some geometers the *orthocentre*." What he may lay claim to is his calling what is now often called the *pedal triangle* the *orthocentric triangle*.

The figures are admirably drawn and are quite a feature of the book; they deserve the editor's commendation when he thanks Mr. Pairman for the "excellence of the diagrams."

This edition is well suited for the geometrical student, and, at the same time, its cheapness puts it within the reach of all who wish to study "Euclid."

Traité Pratique d'Analyses chimiques et d'Essais industriels. Par Raoul Jagnaux. (Paris: Octave Doin, 1884.)

THE purpose and character of this little book is best indicated by the saying of Berzelius which heads the author's preface: "Le meilleur mode d'analyse est celui qui exige le moins d'habitude chez l'opérateur." The book is mainly intended for the use of the chemical engineer and the metallurgist, and the methods of analysis described are essentially "works-methods," in which rapidity of execution is a very important consideration. Many of these methods are new, and have been devised partly by M. Hautefeuille, and partly by the author. We would especially note those depending upon the precipitation of such metals as zinc, copper, nickel, and bismuth as oxalates, whereby the formation of gelatinous precipitates, difficult to wash, is avoided. The book contains a large number of analytical results as evidence of the validity of the methods employed; many of these analyses, such as those of aventurine glass, garnierite, sylverine, are valuable as illustrating the composition of substances which are not frequently examined.

T.

LETTERS TO THE EDITOR

- [The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]
- [The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

The Relation between the B.A. Unit and the Legal Ohm of the Paris Congress

AT a meeting of the Electrical Standards Committee of the British Association held on Saturday, June 28, the following resolution was carried:—

"That for the purpose of issuing practical standards of elec-