that we must have uniform and consistent law, as has been stated by a recent contributor to the discussion, if we desire a stable system of nomenclature; in fact it goes without saying that this is quite essential.

But sundry knotty problems arise. For example when we observe in a recent catalogue that the word *Sunius,* for a well-known genus of beetles, which we have known hitherto only by that name, which our fathers and grandfathers knew only by that name, which in fact is the only name by which the genus has been known in virtually the entire domain of literature, must be changed and replaced by *Astenus,* we pause to ask why. It may be admitted that some one connected with the catalogue has gone back and at least thought he understood that the original diagnosis—these old descriptions being almost meaningless nine times out of ten—of *Astenus,* applied better to what we have known as *Sunius* than to anything else; but we are given no visible evidence whatever. Are we blindly to change the lifelong conception of several generations and reverse all published literature of the genus, on the authority of a guess and without presentation of any sort of proof? The language of the original description must alone afford this proof, for there is no way of knowing that the original type label may not have been shifted in some way, if the type chance to be in existence.

The pity of the interminable tangle may be reduced to this: If these over-zealous advocates of strict priority had only refrained from such publication until some system could be formulated, it would have been possible to adopt a uniform and consistent law which need not be necessarily that of rigid priority. One that might, for example, be analogous to the legal rule of exemption after a certain time limit. That is: If a genus name has not been challenged or corrected during a continuous period of say sixty or seventy years after its introduction in the commonly accepted sense, then it is to be considered permanent. This is absolute and consistent law and nothing else.

But the enthusiastic explorers of antiquity have spoiled this otherwise available recourse and I am free to confess that, as matters now stand, there seems to be no rational way out of the trouble but definitely to adopt the law of absolute priority. I would, however, only accept the identifications made by a competent commission, which should be compelled to publish its results in the fullest and broadest possible manner and in such a convincing way, by adducing the necessary proofs, that there could be no just ground for dissent. I feel that the enthusiasts aforesaid have compelled this course, because if we now use the old genus name *Ips,* for example, without further qualification, one would not know whether we refer to a Nitidulid or a Rhynchophorid beetle (*Tomicus* Latr.), to give only one instance among many.

So the very chaos which has come about through premature efforts to adhere to the law of strict priority now forces the adoption of that law, but only in the rigid way suggested above. In other words, incontrovertible evidence must be clearly and widely published, proving that the change is necessary. This opens up another vexing field of dispute. The subject is really serious and should be given the attention of the ablest natural historians now and without further delay, so that a secure foundation may be laid for future generations. Other work should be laid aside until this foundation is secure.

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SCIENTIFIC BOOKS

Geometrical Optics. By ARCHIBALD STANLEY PERCIVAL. London, Longmans, Green, and Company. 1913. Pp. vi + 132.

This volume, issued recently, is intended for medical students as a text-book introducing them to so much of optical theory as may be necessary for the ophthalmic surgeon. The mathematics of the subject is hence free from applications of calculus, but the algebra involved is enough to cause most American medical students to quail. The author assumes thorough knowledge of algebra, geometry and trigonometry, including particularly the vectorial significance of linear direction.

Physical optics is avoided entirely, since "no thorough elementary knowledge of that intricate subject can be obtained in the short time allotted to the student for studying optics." It is questionable whether this truth warrants the pedagogic loss involved in ignoring the wave theory of light. Elementary knowledge may be correct so far as it goes, but without involving intricacies. Children are taught in the grammar-school some of the conclusions resulting from the Newtonian theory of gravitation, but without any reference to the difficulties overcome in its establishment. The wave theory of light is now about as well established as the theory of gravitation. To assume it at the outset of a course in elementary optics is common enough to-day. For the college student this assumption is probably accompanied quite generally with the promise that he who perseveres will in time be provided with adequate foundation for the faith which is accepted without question at the outset. In deducing and applying the elementary formulas of optics the use of wave fronts is found to simplify demonstrations that are equally possible without them. Wave fronts and rays are quite inseparable instead of being mutually exclusive. The judicious teacher will be apt to guide himself by convenience and economy in reaching a decision as to a choice of methods of demonstration.

In text-books on optics there is unfortunately no definite consensus thus far in regard to the conventional assumptions to be applied in the development of theory. From the standpoint of the teacher and the manufacturer certain conventions may be useful which are unsatisfactory to the advanced student of theory. In every case they should be as simple as possible, so as to be really helpful. For the elementary student, and even the advanced student, probably the most troublesome snare is the minus sign. Mr. Percival says (p. 22): "We have adopted the usual conventions that directions from left to right are considered positive, and those from right to left negative." Similarly, upward is positive; downward, negative; counter-clockwise angular rotation is positive, clockwise, negative. This seems like simplicity itself; but in its application the elementary student of optics finds himself soon confused. In many cases mere magnitude is all that needs consideration, and to introduce additionally the element of direction, especially rotational direction, merely increases the chances of misinterpretation. For example, the deviation, D, which a prism of refracting angle A imposes on a beam of homogeneous light sent through it is commonly expressed in terms of A and the angles of incidence, ϕ, and emergence ψ, by the formula,

$$D = \phi + \psi - A.$$

Mr. Percival expresses this in words by saying (p. 43): "The total deviation is equal to the difference between the angles of emergence and incidence less the apical angle of the prism." A glance at the diagram is enough to satisfy any student of geometry that the former expression is correct. The author requests the reader to note that ϕ is measured clockwise and ψ counter-clockwise; but the introduction of this convention is here wholly unnecessary and misleading.

The formula for a thin lens in air is one of the most important in optics. Let us assume, as standard form, a bi-convex lens, with refractive index, n, radius of curvature r_1 on the side of incidence, and r_2 on that of emergence. Let this lens receive light from a radiant at distance u, and converge it to a conjugate focus at distance v. The relation existing is expressed by the equation,

$$\frac{1}{u} + \frac{1}{v} = (n - 1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right). \qquad (1)$$

The conventional assumptions involved are:

1. Irrespective of direction, the radius of curvature is positive for a convex lens surface, and negative for a concave lens surface.

2. Irrespective of direction, the curvature

is considered positive for a wave front propagated toward or from a real focus; and negative if from a virtual focus.

Another form commonly seen is,

$$\frac{1}{u} - \frac{1}{v} = (n-1)\left(\frac{1}{r_2} - \frac{1}{r_1}\right). \qquad (2)$$

The assumptions now involved are:

1. The direction from lens toward radiant is positive; its opposite is negative.

2. Curvature concave toward the radiant is positive; its opposite is negative.

If it is assumed additionally that the radiant is at the right of the lens, Mr. Percival's convention is expressed in Eq. (2).

The conventions connected with Eq. (1) have long been in common use. A converging lens is commonly called positive; a diverging lens, negative. Of late years Eq. (2) has been increasingly coming into use, for analytical reasons. The teacher of optics is free to take his choice; and this is apt to be influenced, in part at least, by ease of application. In a text-book published about twenty-five years ago by a pair of highly respected American college teachers of physics the deduction and discussion of Eq. (2) is given; but at its close they add the remark: "The equation is more simple in application if, instead of making the algebraic signs of the quantities depend on the direction of measurement they are made to depend on the form of the surfaces and the character of the foci." The conventions given in connection with Eq. (1) are then expressed. The present writer has tried both sets of conventions with his students; and with the result that pedagogically Eq. (1) is found much preferable. On examining thirty text-books in his library he finds Eq. (1) used in sixteen of them; Eq. (2) in thirteen; and both in one of them.

Mr. Percival seems to select the position of the radiant as origin, for in his diagrams he places this at the left, or negative, side of the lens or mirror; but this is not always done by him. He makes a distinction (p. 49) between the convention applied in *finding* a general formula and that applied in *using* a formula, saying, "when using the formulæ it will generally be found convenient to regard the direction of the incident light as the positive direction." The ordinary student, expecting uniformity and consistency, will be apt to stumble here, especially if he consults Edser's excellent book "Light for Students," and finds (p. 28), that "when the direction of measurement is opposite to that in which the incident light travels, the distance is positive." In this connection it should be noted that both Edser and Percival use the same form, expressed in Eq. (2). The positive direction for this equation may thus be either rightward, or leftward, or in the direction of propagation, or opposite to this direction, according to preference. The student probably has no preference, but wants definite information. After reversing his minus sign, and then re-reversing it a sufficient number of times, his mental condition becomes undesirable, to say the least.

Taking the equations as they are found in Mr. Percival's volume, he illustrates them by the solution of numerical problems, and in a number of cases additionally by graphic methods. The discussion of Gauss's cardinal points for a thick lens, or system of lenses, is perhaps scarcely full enough to enable the student to acquire very satisfactory working knowledge of the subject. Its application to the optics of the human eye is well illustrated both numerically and graphically.

An appendix is added in which a number of topics of practical importance are treated mathematically, without any attempt to avoid or disguise the notation of calculus. Medical students, for the most part, may naturally be disposed to accept the results without mastering the details of demonstration.

There are a few obvious typographical errors that will probably be corrected in a future edition. Despite the uncertainties about linear and angular direction, the book is clearly written, and by one who has evidently had good experience in dealing with students. It is worthy of commendation to those for whom it was intended.

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