be effectively dealt with in the limits of an ordinary letter. I propose therefore to deal with the subject in a special article to be written shortly. A. E. H. Love.

St. John's College, Cambridge, December 3.

Gravitation.

May I ask Dr. Joly whether Newton himself did not point out that a graduated tension excited by matter in a continuous inextensible medium, of an intensity proportional to the mass and the inverse distance, would account for gravitation; and whether he did not refrain from further elaborating this idea because there seemed at that time no adequate way of explaining the existence of such a tension? Oliver J. Lodge.

"Outlines of Quaternions."

May I make a short explanation on one or two points on which my reviewer (Nature, November 22) does not appear to have understood me?

(1) I mentioned Prof. Hardy and Dr. Odstrčil's names in one or two places, because I quoted their language verbally. I found it was better than any language I could devise.

(2) The extraordinary oversight on p. 76 would never have seen the light had I had either good health, or the assistance of a friend, in correcting the proofs of a MS. which was written at odds and ends of time, at places as widely separated as Norway, Gibraltar, and India.

(3) My reviewer says eq. 8 of p. 40—$i = \sqrt{-1}$—"plays sad havoc with one's very definitions." Having defined i as a right versor on p. 37, and explained on p. 39 that i^2 means ii, I deduced in the usual manner the eq. $-i^2 = -1$, or—

$$ii = i^2 = -1 = \sqrt{-1}\sqrt{-1}.$$

Hence I concluded that $i = \sqrt{-1}$; and I fail to see how I have played havoc with my definitions in doing so. Had I begun by explaining that Hamilton built up his system by treating $\sqrt{-1}$ as a right versor perpendicular to the line it operates on, I might have been open to criticism; but I did not do so. I took another course, which may not have been the best one; but that is a different thing from violating one's own definitions.

H. W. L. Hime.

24 Haymarket, S.W., November 26.

[A pointed reference to a scientific writer usually implies one of three things—that the writer is an authority on the particular subject under discussion, or has made a noted discovery in connection with it, or has been guilty of a serious blunder. Dr. Odstrcil's corollary hardly comes under the second category, and Prof. Hardy's statement differs in no essential word from Hamilton's own language in the "Lectures" (p. 83).

Equation 8 (p. 40, in "The Outlines of Quaternions") asserts the equality of $i, j, k, -i, -j, -k$, and as these symbols are by definition all different, the said equation is inconsistent with the definitions. To speak of $\sqrt{-1}$ as an indeterminate right versor, that is, an operator which rotates any vector through a right angle about an indeterminate axis—a most difficult operation for the mind even to imagine—may be permitted as a figure of speech; but to equate this backboneless thing to a real unit vector or right versor with all its powers of action, is making a serious demand upon the credulity of the student. After *defining* i, j, k as symbols involving both axis and angle, what right or reason has Colonel Hime thus arbitrarily to annihilate the axis? Is it not playing havoc with the very props of the calculus?—The Reviewer.]

THE WARBLE FLY.[1]

IT is only within comparatively recent years that much attention has been paid to the insect pests of the farm and garden. It is true that when these assume unusually devastating proportions, especially when they make their appearance suddenly, as in the case of locust-swarms, the attention of whole nations is called to them

[1] "Observations on Warble Fly or Ox Bot Fly (*Hypoderma bovis*, De Geer)." By Eleanor A. Ormerod, F.R.Met.Soc., &c. (London: Simpkin, Marshall, Hamilton, Kent, and Co., Ltd., 1894.)

for the moment; but the loss caused by less obtrusive creatures may proceed unchecked and almost unsuspected for years, without attracting the notice even of those who suffer from it most. But there are now many entomologists, among whom Miss Ormerod deserves special notice in England, and Prof. Riley in America, who have been working zealously for years to diminish the loss and injury caused by injurious insects; and the pamphlet before us, with its clear descriptions and statistics, and excellent illustrations, conveys a mass of information, in a very handy form, which certainly deserves the most serious attention of all who are interested in the cattle and leather trades, whether as graziers, butchers, or tanners.

The total loss caused by the warble fly in the United Kingdom alone is estimated at something like £8,000,000 per annum; an enormous amount, but which the facts given in Miss Ormerod's pamphlet fully appear to bear out. When hides are sometimes so deteriorated that the loss on each may be as much as from twenty-five to thirty shillings, to say nothing of hides rendered utterly worthless; cattle killed, or the best parts of the carcase destroyed, and diminished yield of milk, the importance of the matter becomes very apparent. And beyond this, there remains a very serious question which Miss Ormerod has not touched upon at all: how far the milk of badly-infested cows, or the apparently sound portions of a carcase, even when all the obviously diseased part has been conscientiously removed, may be liable to cause disease in man—disease, possibly, of a nature the origin of which is at present absolutely unknown and unsuspected by medical men. And yet we remember once to have met with the statement that the best hides generally contained warbles. This, however, if true in any sense, could only mean that the fly attacks the strongest and healthiest animals in preference to weaker ones, thereby of course increasing the mischief produced by its attacks.

Although the insect is so abundant that as many as 500 maggots have been found in a single hide, yet the fly is rarely seen. When the cattle are attacked by it, they gallop wildly about, with their tails in the air, and seek the shelter of trees or sheds, or rush into the water; and in any of these situations, the fly does not appear to follow them. Cattle will act in the same manner when attacked by true gad-flies, one of the largest British species of which, *Tabanus bovinus*, is likewise noticed and figured by Miss Ormerod in her pamphlet. The gad-flies, however, simply pierce the skin of the cattle, and suck their blood, but inflict no permanent injury; and their larvæ are subterranean, and not epizootic.

According to the observations of Prof. Riley in America, the egg of the warble fly is deposited on, and not under, the skin. In the earliest stage of the maggot, which Miss Ormerod has herself observed, it is a small blood-red worm-like creature, scarcely visible to the naked eye, embedded in a slight swelling, composed of blood-red tissue, through which a fine channel, no wider than a hair, passes up to the surface of the skin (Fig. 1). In the very young stage, the maggot, which always rests with its head at the bottom of the sore, and the breathing apparatus, which is at the opposite extremity of the body, directed towards the opening which communicates with the external air, is provided with two forks or diggers, probably used for piercing through the substance of the hide. In this stage, too, the maggots are capable of inflating themselves with fluid which they have apparently no means of discharging, and become so hard that they can scarcely be compressed with the fingers, thus forming living and growing plugs, which act the part of setons, and which cannot be pressed back out of the wound, more especially as they are furnished with short bands of prickles along a portion of the back. Having penetrated the hide, the