principle of the parallelogram of forces was, so to speak, in the air. In one and the same year, 1687, we have enunciations of the principle from Newton, Varignon, and Lami. For long it has been the tradition of British text-books to take the parallelogram of forces as the basis on which is erected the mechanical edifice. From this tradition Messrs. Tuckey and Nayler have cut themselves adrift. Their "First Course" boldly opens with the law of the lever, from which it is the easiest of steps to moments about a point, and to the notion of the centre of gravity. The parallelogram of forces is hinted at on p. 74, stated on p. 113, and "proved" and discussed on pp. 266→. So marked a departure from the usual course on the part of two chartered libertines should arrest the attention of teachers, and prepare them for yet further surprises. Chapter II. shows how forces are resolved, and the principles of the first two chapters are then applied to the simpler forms of machines. So far, the work has run *pari passu* with experiment. Geometry is now introduced. Graphical methods are carefully explained. The notation of R. H. Bow, who in the early seventies familiarised British readers with the product of the genius of Culmann, is rightly retained. It is strange that such a chapter as that entitled "The connection between the Principles" should have for so long been missing from our elementary text-books. To this we must refer the reader, with the suggestion that he cannot afford to give Messrs. Tuckey and Nayler's little book a merely casual glance. For their constant reference to fundamental principles is, if we are not mistaken, the great *raison d'être* of their little book.

CORRESPONDENCE.

To the Editor of the *Mathematical Gazette.*

Dear Sir,

The death of my friend C. S. Jackson makes it impossible for me to reply in detail to the note signed by him and Mr. A. Lodge on p. 311 of the October *Gazette.* I can reply only generally by saying that I do not admit that the note correctly represents either what I actually wrote (July *Gazette*, p. 296) or the necessary deductions from what I wrote.

The quotation in the first paragraph touches a question on which I should like to make some observations later on.

The last paragraph introduces a new point, which I heartily welcome. If this discussion results in a greater use of arithmetical quantity in elementary teaching, in the place of mere number, it will have done some good. But, even so, I should hope that arithmetical quantities which are shown as the result of multiplications or divisions, and which have to be added or subtracted, would be enclosed in brackets, unless precautions as to spacing, etc., make this unnecessary.

As there are a great many people who object to the rule laid down by teachers of arithmetic with regard to this use of brackets, could not the matter be considered by a small committee? There is more to be said on the subject than has yet been said in the *Gazette.*

W. F. Sheppard.

I have to thank Mr. Sheppard for most courteously sending me the above letter to read before passing it on to the Editor. I much appreciate this tribute of respect to our friend, whose loss we mutually deplore.

Alfred Lodge.

Sir,

The following argument seems to have been overlooked by those who consider it unnecessary to insist on the convention of priority of multiplication and division over addition and subtraction.

The ordinary boy, when learning the rudiments of Algebra, is greatly helped by frequent references to what he has done in Arithmetic. He is encouraged to check his algebraical work by simple numerical substitutions, both for the sake of accuracy, and for the sake of a general appeal to his commonsense reasoning in the concrete.

One of the most frequent sources of error is the confusion between $a+bc$ and $(a+b)c$, and this is especially noticeable when numerical values are substituted for letters.

A few weeks' practical experience in dealing with this error in boys who are not particularly brilliant will convince the most sceptical mathematician that, however needless the priority convention may be in ordinary Arithmetic, he must insist on it at all times, whether he wishes to or not. He will find it impossible to get on without it.

It is useless to argue that $a+bc$ ought to convey its real meaning to the average boy, when he substitutes numerical values. The boy will write $8{\cdot}2+1{\cdot}8\times 14{\cdot}5$, and unless he has had this apparently unnecessary rule drilled into him, the chances are about even that he will write the result as 145.

It is from the psychological point of view a curious fact that this is especially noticeable, when the numbers are so heavy as to require a conscious effort for the working out of their product.

This type of mistake is continually cropping up in the practical application of mathematics to formulae and to physical problems. Such a mistake as $1{\cdot}7+8{\cdot}3(t-4)=10(t-4)$ is all too common, and we shall not improve matters by deliberately stating that $1{\cdot}7+8{\cdot}3\times 9$ may be taken to mean either $(1{\cdot}7+8{\cdot}3)\times 9$ or $1{\cdot}7+(8{\cdot}3\times 9)$.

Royal Naval College, Osborne. R. Nettell.

Dear Sir,

I would have much preferred that others should have replied to Prof. Hill's letter on p. 15 of the present volume of the *Gazette*, for, alas, it cannot now be a joint reply; but as he specially calls on me to controvert, if I can, his argument on p. 281 of the last volume that the application of Rule 1 to such an expression as

$$9-6\div 3\times 2+4$$

is illegitimate because $6\div 3\times 2$ is of doubtful meaning, I feel bound to say a few words.

Putting aside for a moment the meaning to be attached to $6\div 3\times 2$, there is no doubt in my mind, and I believe the great majority of your readers will agree with me, that it is a number which has to be subtracted from the sum of 9 and 4. It constitutes a 'term.' If arithmetical and algebraic conventions are to be as nearly as possible identical, there is no alternative.

Rule 1 accepts the existence of terms, and indeed may be said to define them; terms being those quantities which are separated from each other by + or − signs. That completes my answer to Prof. Hill's specific question.

With regard to the term quoted by Prof. Hill, viz. $6\div 3\times 2$, my own feeling is that it ought not to be written without brackets for the reason I gave before, viz. that, if it means $(6\div 3)\times 2$, which is in accordance with Rule 2, it ought to have been written in the unambiguous form—$6\times 2\div 3$; consequently, if it is written with $\div 3$ in the middle, the inference is almost irresistible that it must be intended for $6\div(3\times 2)$, especially if it is read as "6 *divided by* 3 *times* 2," which is a perfectly fair reading. It is no longer a mere beginner's difficulty; experts also would be in doubt.

But that is no reason for discarding Rule 1: this particular difficulty has nothing whatever to do with that Rule! That is why we called it a red herring. Alfred Lodge.

Charterhouse, Godalming, 30th January, 1917.