When using quaternions we have to be very careful to distinguish results which are intrinsically geometric from results which are relative to the direction of reals. This may be illustrated from the theory of complex numbers. The transformation $z' = az + b$, where a, b, z, z' are vectors in a plane (which become complex numbers after the choice of a real axis), is a transformation of similitude, no matter what direction be chosen as the axis of reals, but the transformation is not independent of that choice.

In relativity the time axis is accidental to a particular observer or group of observers and should be chosen *after* the fundamental work is done, not before. The analysis which is really appropriate to the theory of relativity as conceived by Minkowski is Grassmann's. Even a vector analysis (such as that used by Lewis and me, loc. cit.) assumes an origin, which is theoretically "de trop," though practically not much in the way. Is it not unfortunate that Minkowski should have followed the English Cayley, referred to the Scot-Irish Hamilton, and ignored the German Grassmann? Should not some Geheimer Regierungsrat among his colleagues have given him secret directions to avoid such an unpatriotic scientific mésalliance?

E. B. WILSON.

SHORTER NOTICES.

Histoire des Mathématiques. Par CH. BIOCHE. Paris, Belin Frères, 1914. vi+93 pp. Price, 1 fr. 75 c.

IT is one of the strange anomalies in the making of books that France, where the best work in the history of mathematics was done in the eighteenth and early nineteenth centuries, should have done so little in this line in recent years. Montucla, who wrote the first interesting general history of the subject; Delambre and De la Lande who were his worthy successors; Bossut, whose style maintained well the earlier traditions; Libri, writing in France although Italian by birth, and writing with the style of a novelist; Chasles, putting more mathematics into his work than his predecessors,—all these men contributed very notably to the appreciation of the historical development of the science, and set a high standard of style if not always of scholarship. But of late France has produced no general histories of mathematics worthy the name.

To be sure Paul Tannery was a remarkable scholar in his field, and there are few men now living who can rank with Duhem, but the former never attempted a general history and the latter has not done so as yet.

It is for such reasons as these that one looks with special interest to even the simplest efforts to revive the splendid traditions of France in a field that was one time peculiarly her own. And so, while the work of M. Bioche is modest in size and humble in purpose, it is none the less welcome as an evidence of growing interest in the subject. Urged as he says by his " excellents camarades d'Ecole normale, Henri Bergson et Gaston Milhaud," M. Bioche has set about to write a history of ideas rather than one of literature, a record of the stream of progress of mathematics rather than a biography of mathematics.

As a result he has produced a manual somewhat like Mr. Rouse Ball's little Primer of Mathematics in size, although quite different in general treatment. The work consists of eleven chapters, devoted successively to the following topics: Mathematics before the time of the Alexandrian school; the school of Alexandria; the middle ages; the geometry of the Renaissance; the origin of algebra; analytic geometry; the infinitesimal calculus; geometry in the seventeenth and eighteenth centuries; the nineteenth century; ancient astronomy; modern astronomy.

It is not to be expected that new contributions should appear in such a handbook, and there is nothing of this nature to record. A few assertions may be found, however, which are not usually seen in elementary treatises, as that Archytas of Tarentum was probably the first to consider a curve of double curvature, that Aristarchus was the first to make a tentative evaluation of the elements of the solar system, that Apastamba stated the pythagorean theorem before the conquest of Alexander, that Oresmus had the true idea of function in his De latitudinibus formarum, and that the early Greeks used the idea of the climate (the parallel of equal maximum day lengths) instead of the notion of latitude with respect to the equator.

The style of the author maintains the high reputation of the French school and leaves little to be desired. The statements are, however, not altogether free from error, and the omission of a name like that of Mahavir is difficult to explain. The

dates are generally stated as if they were known with certainty, as that Euclid was born in 330 B.C., and Fibonacci in 1175 A.D., while in reality many of these statements are very doubtful and are liable to be put to unfortunate use by the novice. Among the probable errors of statement are the assertion that Heron was a contemporary of Hipparchus, and that Jordanus Nemorarius was the Jordanus who was general of the Dominicans. Among the certain errors are the assertions that Alcuin was abbot of Canterbury, and that Omar Khayyám was of Arab rather than Persian stock; and among the typographical errors are the printing of Gunther for Günther (page 26), Muller for Müller (page 30), Harriott for the preferred form of Harriot (page 34), and Plucker for Plücker in the index (with a wrong reference). But in spite of these little blemishes the book will serve a good purpose, particularly among the students of the secondary schools of the French-speaking countries. DAVID EUGENE SMITH.

Solid Geometry. By SOPHIA FOSTER RICHARDSON. Boston, Ginn and Company, 1914. iv + 209 pp.

As the author states in the preface, she gives in this book the "usual course in solid geometry more complete in logical structure than that of the text-books commonly used." Definitions and axioms are quite numerous and prominent and it is by carefully stating these that many difficulties are avoided. For instance there is no difficulty nor incompleteness in the proofs of the theorems about the intersection of a cylinder or cone with a plane through an element and another point of the surface because the theorems are explicitly limited to convex surfaces. We find here also the practice, too rare in American texts, of establishing the existence of a geometric object before defining it. Thus the theorem that a straight line perpendicular to each of two intersecting straight lines at their point of intersection is perpendicular to every straight line in their plane passing through their point of intersection, is given before the definition of a perpendicular to a plane. Similarly the theorem "Any tangent line to a convex cylindrical surface and the element through its point of contact determine a plane which contains no other point of the surface" leads to the definition of a tangent plane to a convex cylindrical surface. As in most texts, geometric locus is defined and the two parts of a locus problem are pointed out,