the potential function. It contains some valuable suggestions and pertinent remarks on the legitimate use of higher complex number systems. It is shown that the analytic continuation through the bicomplex domain, for instance, cannot yield anything new for the ordinary complex domain which cannot also be obtained by analytic continuation in the latter domain.

On the other hand it is pointed out that certain systems of complex quantities, which do not obey the commutative law of multiplication have been particularly useful for the applications in the theory of groups and in geometry. "Accordingly we must beware of any kind of dogmatism. Science disregards artificial restrictions and acknowledges only its own laws, but no authorities."

In conclusion it is shown that the entire projective geometry in space may be interpreted in the euclidean plane by means of the real point couples or pictures. A number of suggestions are also made, how the methods used by the author may be extended to space.

The little book, on the whole very carefully prepared, thus proves very profitable reading and suggestive for further research.

ARNOLD EMCH.

Vector Analysis. By J. G. COFFIN. Second edition. Wiley and Sons, New York, 1911. 12mo. xxii+262 pages. $2.50.

THE first edition of this book was reviewed in this BULLETIN, volume 17 (1910–11), page 101. The present edition differs little from the first, the important additions occurring in the examples and the appendices. Some few errors have been corrected, and a few statements reworded. Thus, we find the definition of vector now given as follows: "A vector is a directed segment of a straight line on which are distinguished an initial and a terminal point." Exactly what this new definition means, is hard to see. The last clause is superfluous if the main clause means anything, for a segment necessarily has end-points, and if "directed" one end is necessarily initial and the other terminal. Why the end points are specially important is not made clear. Further, the term vector as used in the text does not mean a segment of a straight line, but any one of an infinity of parallel segments of the same currency. It would therefore seem better to define vector* as "the straight segment from an initial point to a terminal point." The assumption of the equivalence of "free vectors" should then be set forth explicitly.

On page 75, line 13, the three *coefficients* of i, j, k are equal to zero,—there are no three *components* of i, j, k. On page 122, line 15, $\nabla \cdot \mathbf{u}$ should be $\nabla \cdot \mathbf{v}$.

On page 107, despite a minor correction, the paragraph on "Total Derivative of a Function" remains badly confused. The statement "This is the same thing as the directional derivative along $\mathbf{r}_1$ multiplied by dr" is not at all correct, unless it be assumed that $\mathbf{r}$ is to vary only along its own direction. Equation (114) holds for any differential vector $d\mathbf{r}$ and gives the total differential (not *derivative*) of V due to the differential variation of $\mathbf{r}$. This may be taken in the direction $\mathbf{r}_1$ or in any other direction. The author has indeed given on page 103 a diagram in which $d\mathbf{r}$ is marked plainly, and is not in the direction of $\mathbf{r}$. Hence a student is certain to be confused in reading this paragraph.

The additional examples have been well-chosen for the purposes of the text. The additions to the appendix begin on page 240. They distinguish between free and sliding vectors; give some differential geometry of curves including Frenet's formulae; a brief study of the motion of an electron in a magnetic field; further proofs of Stokes' theorem, Gauss' theorem, and two theorems in integration analogous to the divergence theorem. The first proof given of Stokes' theorem on page 249 differs in no essential feature from the more general deduction in Joly's Manual of Quaternions, pages 72–73, and the two theorems on pages 252–253 are given substantially by Tait, Treatise on Quaternions, 3rd edition, § 499, page 384. The second proof of Stokes' theorem on pages 249–250 is given by Tait, § 500, page 385. These two references were surely books on vectors, if not on Vector Analysis.

We desire, in supplying these few corrections and comments, to see a third edition of this successful book even better than the first two.

JAMES BYRNIE SHAW.

* Cf. Appell et Dautheville, Précis de Mécanique rationnelle, p. 1.