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Review

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REVIEWS.

A. S. Gomes de Carvalho. A Teoria das Tangentes antes da Invenção do Cálculo Diferencial. 1919. (Coimbra: imprensa da Universidade.)

An interesting dissertation in three chapters. I. and II. deal respectively with the treatment of tangency in the golden period of Greek Geometry and in the middle of the seventeenth century A.D. Fully worked examples are given, the author, like Prof. Heath, using modern notation where the prolixity of the ancient investigations might deter readers with little time to spare. These examples seem well chosen, those in particular of the work of Apollonius illustrating at once the originality and beauty of his results and the tedious methods by which he produces them. A sketch is added of the famous treatment of the "four normals from a point" and the determination of points on the evolute of a conic. Among the moderns Fermat, Descartes, Roberval, and Barrow have the most space allotted to them, the disputes between the first two and between Roberval and Torricelli being discussed. Hudde, Huygens, De Sluze, Wallis, Tschirnausen, Fatio de Duillier, De l'Hôpital have honourable mention. Chapter III. treats briefly of the inverse problem of tangents, that is the investigation of curves arising from known properties of their tangents in some of the few cases solved before the invention of the Integral Calculus reduced it to the solution of differential equations.

E. M. LANGLEY.

Physics. The Elements. By N. R. CAMPBELL, Sc.D. Pp. x + 566. Price 40s. net. 1920. (Cambridge University Press.)

As a fair sample of the quality of this work we may take the chapter on probability. The author properly points out what mathematicians have not always remembered; namely, that everything ultimately depends upon the assumption of "equally probable" cases: he also makes some very sensible remarks about such terms as "random," "independent," and so on. But in discussing a particular example on p. 166 he comes sadly to grief, and it is difficult not to accuse him of quibbling. A piquet pack and a whist pack are placed side by side on a table, and a card is drawn at random; what is the chance of drawing an ace of spades? The orthodox answer is $21/832$; Dr. Campbell does not dispute the correctness of this, but asks what are the 832 equally favourable cases corresponding to this fraction—the possible number of events being 84, the total number of cards. It seems as if the author required every probability p/q to be explainable in relation to some q equally probable cases; thus ignoring, or cavilling at, the whole theory of compound events. An extreme case may be given. A person is allowed to choose either of two purses, and draw one coin from it. One purse contains m shillings, and the other n sovereigns; what is the chance of drawing a sovereign? Clearly $\frac{1}{2}$; but the number of events is $(m+n)$. There is no contradiction, because the events are not equally probable: the probability of drawing a particular shilling is $1/2m$, and that of drawing a particular sovereign is $1/2n$.

Another characteristic chapter is that on units and dimensions. It is a strange mixture of pertinent criticisms and diffuse rambling arguments which are almost, if not quite, paradoxical. The criticism (p. 406) of the theory of dimensions applied to the formula for the period of a simple pendulum is perverse and irrelevant; it would be waste of space to justify this statement here.

It is distressing to be obliged to make these unfavourable criticisms. Dr. Campbell has been impressed by, and to some extent has comprehended, the critical work of Peano and his school in the domain of pure mathematics; with the idea of performing a similar task for physics, he has spent a vast amount of labour, too honest and independent to be wholly wasted, but often misapplied and ineffective. Applied mathematics may ultimately, perhaps, be reduced to a purely logical system, but the prospect, at present, seems very remote. Even in geometry there are things like the connectivity of surfaces, which are only with great difficulty made amenable to analytical treatment; and even when this is successful, most people, I fancy, will feel