



Review

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be given as an alternative, and that the close connection between the two should be pointed out. Among the miscellaneous theorems at the end occurs Mr. G. T. Bennett's proof of the existence of the Frégier point,* and the determination of the constant k in the trilinear equation $\alpha\beta = k\gamma\delta$.†

The work does not appear to contain any section on the General Conic, and we have not found any solution of the problem which Boscovich took as his fundamental one, To find where a given straight line cuts a *Conic whose focus, directrix, and eccentricity are given*.‡ This seems quite as worthy of a niche to itself as Stewart's or Maclaurin's Theorem.

Geometrical Conics. By C. SMITH. (Macmillan & Co.). Those who have studied the *Algebra* and the *Conic Sections* (Analytical) by the same author will turn to his new work in the well-grounded expectation of finding a clear and well-arranged treatise, and they will not be disappointed. The arrangement and selection of fundamental propositions is judicious, the proofs neat, the diagrams as a rule well executed, and the type excellent, bold Clarendons calling attention to important phrases and propositions. The Parabola, Ellipse, and Hyperbola have entirely separate sections devoted to them, rightly, in our opinion, in a treatise intended chiefly for beginners. These sections are preceded by one on the General Conic, which, however, need not be taken first if a student prefers to begin with the Parabola. We are glad to see that Mr. Smith, like Messrs. Milne and Davis, has "discarded the usual method of treating a hyperbola as if it were two conics, the curve itself and the conjugate hyperbola." Dr. Taylor has long advocated this reform,§ and it is satisfactory to find the excrescence gradually disappearing from text-books. It is to be hoped that examiners will accelerate the process by ceasing to set questions on the conjugate hyperbola. Probably they will not be sorry to be relieved from the task of looking through reproductions by hurried students of diagrams and demonstrations which are repulsive enough even when correctly executed.

Mr. Smith, in the chapter on the General Conics, follows the method adopted by Leslie and Dr. Taylor (after Boscovich) of using the Eccentric Circle (see Nos. 1 and 3 of the *Mathematical Gazette*) for investigating the ratios of rectangles contained by the segments of chords, but has recourse to the Adams' circle for drawing tangents from an external point, and makes no use of either of them in solving the fundamental problem of Boscovich. It would have given more unity and coherence to the chapter to have used either Adams' or Boscovich's circle throughout, while the connection between the two circles would have afforded good material for exercises, and simple illustrations of some of the methods of Modern Geometry.

The analogies between the properties of the polar of, and the tangent at a point are well presented, and some

excellent addenda draw attention to the properties of Envelopes, Coaxial Parabolas, Confocal Conics, etc. We note two useful properties not often given in works on Conics, viz. gE perpendicular to SP in the Ellipse, p. 108, and $RY = SP$ in the Hyperbola, p. 151. Dr. Taylor was, we believe, the first to point out and utilise these. (See his *Elementary Geometry of Conics* and his *New Treatment of the Hyperbola* in A.I.G.T. Report.) They well deserve to be better known and more used. The diagram for the former is exceptionally faulty. The construction given for finding the axes of an ellipse when a pair of conjugate diameters is given depends on the values of PG and Pg , by which the mid point O of Gg is found; but this is not so neat as the one connected with the "trammel," which we have referred to elsewhere. The least satisfactory portion of the book is that on Anharmonics and Conical Projection. There seems to be no vital connection between the elementary and the advanced sections.

We are of opinion that the space devoted to Conical Projection might have been more usefully given to Plane Perspective and other plane transformations, the previous sections on Orthogonal Projection, Adams' Circle, Similar Conics and the Eccentric Circles being used for illustrations of the general methods described.

Dynamics—Mechanics. By R. T. GLAZEBROOK, M.A., Cambridge University Press. These form part of a series of *Cambridge Natural Science Manuals*, written from the point of view of one who believes that the most satisfactory method of teaching the natural sciences is by experiments which can be performed by the learners themselves, a principle which has our emphatic approval. There is a welcome freshness about the illustrations, which no doubt arises from the fact that the illustrations have been mostly drawn from apparatus used by classes in the Cavendish Laboratory. We join with the author in the hope he expresses that the systematic experimental work described may, through the means of these excellent manuals, be extended in colleges and schools. Some further remarks in the preface are so apt that they deserve quotation *in extenso*: "When questions dealing with momentum, force, and energy come to be considered, two courses at least are open to the teacher. It is possible to make the whole subject purely deductive; we may start with some definitions and axioms—laws of motion, either as Newton gave them, or in some modern dress—and from these laws we may deduce the behaviour of bodies under various circumstances.

"Another and more instructive method, it seems to me, is to attempt to follow the track of the founders of mechanics, to examine the circumstances of the motion of bodies in certain simple cases, in the endeavour to discover the laws to which they are subject. . . . Mechanics is too often taught as a branch of pure mathematics. If the student can be led up to see, in its fundamental principles, a development of the consequences of measurements he has made himself, his interest in his work is at once aroused; he is taught to think about the *physical meaning*

* See 16th General Report of the A.I.G.T.

† See *Mathematical Gazette*, pp. 21, 33.

‡ See *Mathematical Gazette*, Nos. 1 and 3.

§ See Report of the A.I.G.T. for 1884.

of the various steps he takes, and *not merely to employ certain rules and formulæ* in order to solve a problem." We endorse the view taken by the author, and are of opinion that it cannot be too strongly impressed on teachers. At the same time there is no doubt that the course of experimental study recommended may be very advantageously followed by a purely deductive one, the mind of the student having been prepared by his previous training to form adequate mental concepts of the definitions and axioms on which the fabric of theory is to be founded. It must not be supposed, however, that the author confines himself merely to descriptions of experiments. The laws and theorems are clearly stated and well illustrated by analytical statements and numerical examples.

An Elementary Text-Book on Mechanics. Bk. I. *Dynamics*. Bk. II. *Statics*. By W. BRIGGS, M.A., and G. H. BRYAN, M.A. (University Tutorial Series.) Though not written quite on the same lines as Mr. Glazebrook's, this is an excellent treatise. It is marked by the same clearness of exposition and careful attention to the needs of a beginner which characterise the well-known *Co-ordinate Geometry* by the same authors. It will be found especially useful by students who have to master these subjects with little or no aid from tutors.

Integral Calculus for Beginners. By JOSEPH EDWARDS, M.A. This forms an excellent companion volume to the *Differential Calculus for Beginners* by the same author. It is a clearly written systematic treatise, and can be heartily recommended. The analogies of the *hyperbolic* (or as Mr. Hayward calls them, the *ex-circular*) functions, with the more common trigonometrical functions, are pointed out and used to make some of the forms for integration more easily remembered. Geometrical illustrations are given of the various processes: e.g., of that of *Integration by Parts*, on pp. 47, 48. The value of the work is enhanced by the addition of a section on *Differential Equations*, sufficient for the purposes of those students who wish to read *Analytical Statics*, *Dynamics of a Particle*, and *Elementary Rigid*.

Arithmetic for Schools (new edition), by the Rev. J. B. Lock,—a much improved edition of an already serviceable text-book. The innovations will be familiar enough to members of the A.I.G.T., who will be pleased to see long-advocated reforms in arithmetic gradually urged on teachers by such a well-known writer as Mr. Lock. Among these we notice especially complementary addition (in other words "*shop*" subtraction), the actuaries' rule for decimalising money, Horner's method for evolution. In all these matters Mr. Lock goes as far in the direction of reform as he can well be expected to do. He speaks with no uncertain sound on the claims of the "Italian" method of division to universal adoption, and advocates, rather too mildly in our opinion, the use of the digits of higher order first in multiplication. Periods of transition are always uncomfortable, but it is time now that the difficulty should be met in all schools of repute, and an end put to the inculcation *ab initio* of methods of work which any one

who wishes to carry on serious computation must discard. Experience has shown that the difficulties attending the change advocated are by no means insurmountable.

Euclid's Elements of Geometry. Bks. I-IV. By P. GHOSH. 16th edition, revised and enlarged by A. S. GHOSH, F.R.A.S. (Patrick Press, Calcutta.) An excellent edition, containing numerous exercises, with useful hints for solution, and addenda introducing the student to modern results. Among these is a valuable section on maxima and minima, in which the method of the "Coincidence of Equal Values" is well expounded.

Arithmetic for Schools and Colleges. By P. GHOSH. 19th edition, revised and enlarged by A. S. GHOSH. (Patrick Press, Calcutta.) A serviceable treatise, based on sound principles. It is well furnished with examples, and contains more than 100 pages of Indian University Examination papers. The chapter on Coinage Systems and Exchange seems especially good. We should like, in a future edition, to see the work made still more valuable by alteration in the directions indicated in our notice of Mr. Lock's arithmetic, and treated with some detail in the *Notes on Arithmetic*, published in the Nineteenth A.I.G.T. Report.

Pedal and Antipedal Triangles. By A. S. GHOSH. (Patrick Press, Calcutta.) An interesting little paper. The author has been anticipated on some points, but his mode of presentation is fresh, and the properties in the latter part are new.

Phases of Perigal's Retrogressive Kinematic Parabola. (Bowles and Son, Castle Street, Finsbury.) A collection of six beautifully executed diagrams of the curve $y = a \cos \phi$, $x = a \cos 2\phi$, dedicated by the venerable author to the A.I.G.T. The title-page informs us that "The kinematic curve, of which the retrogressive parabola is a limit, was discovered by Mr. Perigal in 1835, and produced from continuous motion by him in 1840."

Geometry for Grammar Schools. By G. HUNT. (D. G. Heath and Co., Boston.) A book much on the same lines as Spencer's *Inventional Geometry*, and, like it, well adapted, in the hands of an able teacher, to lead on from the methods of the Kindergarten. We hope the time is not far distant when the use of some such course as this will be considered an absolutely necessary introductory training for junior classes before they are confronted with a systematic course of deductive geometry. The English market is supplied by Isbister and Co.

Le Scienze Esatte nell' Antica Grecia (Gino Loria). Lib. II. The book is devoted to "the golden period of Greek Geometry."

The American Mathematical Monthly. Jan., March, April 1895.

The Mathematical Magazine. Jan. 1895.

Journal de Mathématiques Elementaires. March-May 1895.

Periodico di Matematica. Jan.-Feb., Mar.-April 1895.

U.S. Report of the Commissioner of Education. 1891-92.