Review

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[10, p. 95.] The example is due to Genese and the explanation to Cayley, see *Messenger*, Vol. VII., pp. 61-63. The rule for finding an envelope does not lead to an envelope unless the two-fold value of the parameter is variable, not constant. Here the values of λ corresponding to the factors x, y, $x/a+y/b-1$ are $0, \infty, a/b$ and are constant, not variable. E. J. NANSON.

[10, p. 95.] *Q.*'s mistake lies in his misinterpretation of the equation $xy\left(\frac{x}{a}+\frac{y}{b}-1\right)=0$. It is true that this may mean the three lines $x=0$, $y=0$, $\frac{x}{a}+\frac{y}{b}-1=0$. But it may also mean, and in this case it certainly does mean, the three points $y=0$, $\frac{x}{a}+\frac{y}{b}-1=0$; $\frac{x}{a}+\frac{y}{b}-1=0$, $x=0$; $x=0$, $y=0$.

As all the parabolas pass through these 3 points, we are not surprised at finding them occur in the envelope; the other factor is $1=0$, the line-infinity, which all parabolas touch. W. D. EVANS.

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[14, p. 95.] Let the graph of $y=a^x$ be drawn and all trace of the y axis, a, and the unit used be removed. Taking an arbitrary position for new y axis, it is readily seen that the graph has for equation $y=b^x$ where b is the value of y when $x=1$, the new unit being the value of y when $x=0$.

The graph manifestly has unit slope at some point. Take the origin below this point and denote the corresponding value of b by e. Measurement of the ordinate where $x=1$ gives $e=2{\cdot}7$, and from the definition of a tangent it follows that

$$\underset{x=0}{Lt}(e^x-1)/x=1.$$

Hence the derivatives of e^x, $\log x$ are found, and by the method given, Vol. III., p. 238, we can readily approximate to e as closely as we please.

E. J. NANSON.

REVIEWS.

Elements of Descriptive Geometry. By O. E. RANDALL, Ph.D. Ginn & Co.

This is a scholarly treatise and on a subject much neglected by English mathematical teachers. The neglect is no doubt mainly due to the examination system, which has not even required the principles of the art to form part of the school course. The compilation of text-books has therefore fallen mainly into the hands of writers who have treated the subject only from the point of the Technical Class or the South Kensington Examinee, and have produced medleys of such snippets of Practical Geometry and other subjects as may be necessary to obtain a pass in the First or Second Stage. It might easily happen that a man "with a good mathematical degree" would be puzzled if called upon to give an account of the methods of Descriptive Geometry. Professor Henrici, in his address as President of Section A (Southport, 1883), attributed this and the neglect of other departments of Pure Geometry to the "grasp of the dead hand" of Euclid: "Most of all, perhaps, solid geometry has suffered, because Euclid's treatment of it is scanty, and it seems almost incredible that a great part of it—the mensuration of areas of simple curved surfaces and of volumes of simple solids—is not included in ordinary school teaching, . . . *and what is almost worse is that the general relation of points, lines, and planes in space is scarcely touched upon, instead of being fully impressed on the student's mind. The methods for doing this have long been developed in the new geometry which originated in France with Monge. But these have never been thoroughly introduced.*" Twenty years later the hold of Euclid was relaxed, and the complaint of Professor Henrici about the non-inclusion of the mensuration of the simpler solids can no longer be made, but Monge's method of investigating relations of points, lines, and planes in spaces has not yet found its way into the ordinary text-book. Without wishing to see Descriptive Geometry introduced formally into the examination syllabus, we would like to see the simple theorems on which his practical constructions depend appear in connection with the fundamental ones of a school course, to which they would form easy exercises. The rotation of one plane into coincidence with another might easily be introduced as a common device for the practical solution *in plano* of simple trigonometrical problems on heights and distances in three dimensions. But while it is not at all desirable that Descriptive Geometry should be formally introduced into the school course, it is highly desirable that teachers of Geometry should familiarise themselves with Monge's methods, and that, if they cannot obtain a copy of his *Géométrie Descriptive*, they should have recourse to some other continuous treatise, such as the one before us, on "that great alphabet of the application of geometry to the arts." If *seri studiorum* find the unwonted diagrams at first rather troublesome to see through, we can strongly recommend T. Jones' set of models (Heywood, 2s.) or J. Schotke's set of 30 stereoscopic slides (L. Friederichsen & Co., Neuerwall 61, Hamburg), if the latter are still to be obtained.

About 70 pages are devoted to the Point, Line, and Plane, 120 to curves and curved surfaces, and the last 19 pages to one-plane methods of projection, of which the isometric is treated most fully. Principles are clearly laid down, and constructions are preceded by the analysis which led to them. Chapter VIII., on the Generation and Classification of Surfaces, does not seem quite satisfactory. It is not pointed out that the same surfaces may be generated in more than one way, and words are used on p. 88 which seem to imply that all surfaces are developable.

Mathematical Drawing. By G. M. MINCHIN, M.A., F.R.S., and J. B. DALE, M.A. (Arnold.)

Graphs. By C. H. FRENCH, M.A., and G. OSBORN, M.A. (W. B. Clive.)

Messrs. Minchin and Dale have supplied a distinct and widely felt want. The contents of their book may be regarded as the higher development of the schemes of practical work now included in school courses of geometry. Its four parts are devoted respectively to: I. Graphic multiplication, Approximate rectification of circular arcs, Amsler's planimeter; II. The constructions for various problems on conic sections by metric methods; III. Various curves other than conics and their connection with the solution of equations; IV. Conical projection. The third and fourth sections are the most interesting, dealing as they do with matters rather out of or beyond the ordinary school text-book, but the other parts contain much that is interesting, especially the clear treatment of the theory of Amsler's planimeter and its applications to finding centres of gravity and radii of gyration of a closed contour. In section III. the curves discussed are mostly those which arise from the graphic representation of the results of physical investigations. The treatment is thorough, and sufficient examples are solved in detail to enable the student to apply the same methods to analogous cases or to develop them further. There is a sub-section on "Dipolar Co-ordinates" which might profitably be read in connection with Professor Genese's "Biangular Co-ordinates" in Milne's *Companion*. Among the curves selected for special treatment are the Catenary (which has about 10 pages to itself), the Magnetic Curve, Bernouilli's Lemniscate, and the Ovals of Descartes and Cassini. Useful as the previous three sections are, we believe the fourth—on the application to practical constructions of the methods of Projective Geometry—to be the most valuable contribution to the improvement of the higher work of schools and to the progress of the right sort of technical mathematics that has been recently made. For the higher parts of the theory the authors naturally refer their readers to the standard treatises on the subject, but we believe that the student could scarcely have a better introduction to the treatises of Russell or Cremona. Few subjects lend themselves more easily to the interweaving of theory and practice than this, and the authors have wisely given a connected view of the theory as far as it applies to the constructions used. The work will be widely welcomed by one important class of students, viz., those who take Mathematics as one of their subjects for the B.A. examination of the University of London, and especially those external students whose isolation makes it difficult or impossible to