



# VI. On a method of drawing hyperbolas

George J. Burch M.A.

To cite this article: George J. Burch M.A. (1896) VI. On a method of drawing hyperbolas , Philosophical Magazine Series 5, 41:248, 72-75, DOI: [10.1080/14786449608620811](https://doi.org/10.1080/14786449608620811)

To link to this article: <http://dx.doi.org/10.1080/14786449608620811>



Published online: 08 May 2009.



Submit your article to this journal [↗](#)



Article views: 2



View related articles [↗](#)

The resistance of the leads can generally be added as in equation (4). In other cases one of the "dummy-lead" methods of Siemens or Callendar must be adopted.

In conclusion I have to thank Mr. E. H. Griffiths, Mr. W. A. Price, and Prof. W. N. Stocker for their help in preparing this paper; and the Silvertown Telegraph Company, who have kindly allowed me to carry out the experiments and publish the results.

## VI. On a Method of Drawing Hyperbolas.

By GEORGE J. BURCH, M.A. Oxon.\*

THE ordinary methods of drawing hyperbolas fail when the portion of the curve required lies some distance from the vertex, small errors of measurement being then so much magnified as to render the results practically useless. Cunyngame's hyperbolagraph, an admirable instrument for describing the parts near the vertex with a single movement, is also, for the same reason, inapplicable to the cases dealt with in the present communication.

In using graphic methods for the investigation of a problem in Optics, the author had occasion, in 1885, to draw a number of hyperbolas all passing through a fixed point far away from the vertices of most of them, the asymptotes and the vertex of each being given. After vainly endeavouring to draw the curves in the usual way, he devised the following method which proved entirely successful, and which is, so far as he has been able to ascertain, a new one.

*Given the asymptotes  $Ox$  and  $Oy$ , and the vertex  $A$ , to construct an hyperbola.*

The equation of an hyperbola, when referred to its asymptotes as axes of coordinates, is

$$4xy = a^2 + b^2.$$

In the simplest case, that of the rectangular hyperbola,  $a=b$ , and the equation may be conveniently written

$$xy = c^2 = \text{a constant.}$$

To any point  $C$  on  $Ox$  draw  $AC$ , and from  $A$  draw a line parallel to  $Oy$ , cutting  $Ox$  in  $B$ .

Make  $CE$  upon the axis of  $x$  equal to  $BO$ , and from  $E$  draw a line parallel to  $Oy$ , cutting  $AC$  in  $D$ .

Then  $yOx$  being a right angle, and  $\triangle ABC$  and  $\triangle DEC$

\* Communicated by F. J. Smith, F.R.S.

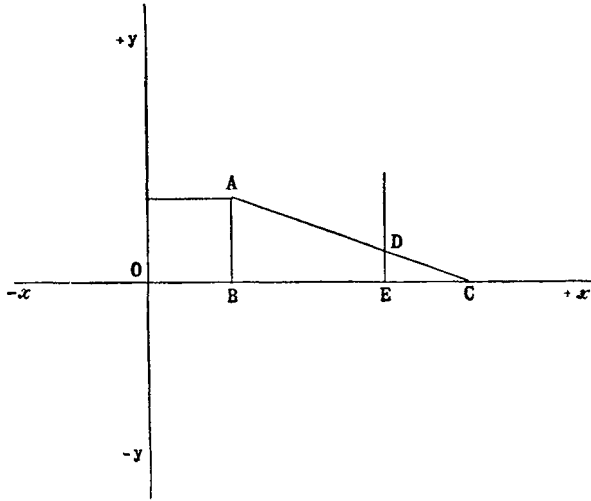
being similar triangles,

$$BC : AB :: EC : DE,$$

or

$$BC \cdot DE = AB \cdot EC.$$

Fig. 1.



But by the construction,  $AB$  and  $EC$  are constant ;

and also  $BC = OE = x$  ;

and  $EC = OB$ .

Therefore if  $ED = y$ ,

$$xy = OB \cdot BA = \text{a constant},$$

and  $D$  is a point on the hyperbola.

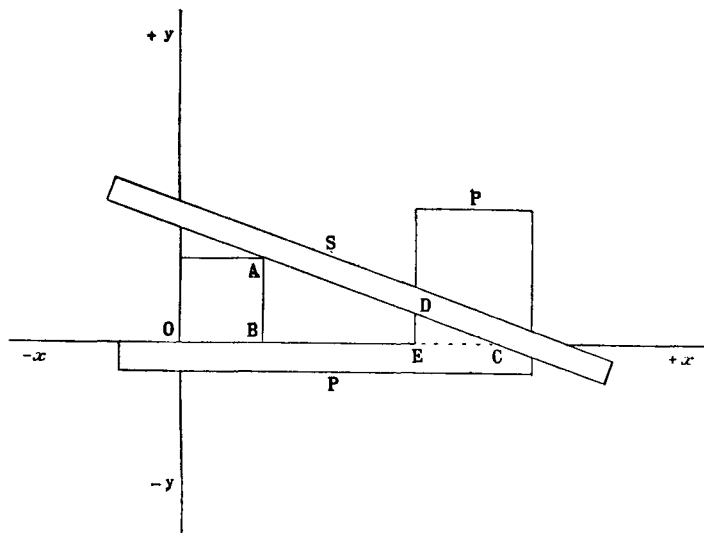
It is scarcely necessary to point out that this construction applies also to hyperbolas other than rectangular, since the lines  $AB$  and  $ED$  are drawn parallel to  $Oy$ , the other asymptote.

In practice, when it is required to plot several curves, the simplest plan is to draw the asymptotes on a piece of stout paper and then cut it into the shape of a modified T-square, as shown in P, fig. 2, where the edge  $OBE$  forms part of the asymptote  $Ox$ , the continuation of which is ruled on the paper and represented by the dotted line, and the edge  $DE$  is parallel to the asymptote  $Oy$ .

A distance  $EC$  equal to  $OP$  is measured along the line  $Ex$ , and a fine pin-hole made at  $C$ .

Drawing-pins are fixed in the board at  $O$  the origin and  $A$  the vertex of the proposed hyperbola, and the asymptotes

Fig. 2.



drawn. Then the paper square,  $P$ , is laid against one asymptote and a third pin inserted at  $C$ . This can be done with greater accuracy if the line  $EC$  is continued to the end of the paper. It remains to place a straight-edge  $S$  against the pins  $A$  and  $C$ , and to mark the intersection of it with the line  $ED$  at  $D$ . Then  $D$  is a point on the hyperbola, and by shifting the pin  $C$  together with the paper square  $P$  to a fresh position on the line  $Ox$ , another point can be determined in like manner. One great advantage of the method is that the value of  $y$  can be found directly for any given value of  $x$ . To do so, it is only necessary to place the paper  $P$  so that  $OE=x$ , and proceed as before.

Obviously, too, the instrument might be constructed in metal and arranged so as to slide along the asymptote  $Ox$ , drawing a continuous curve. It might consist of two brass bars hinged at  $C$ , with a cross-bar clamped to one of them in such a way that its distance from  $C$  and the angle between it and the bar  $P$  could be adjusted. This cross-bar might carry a pencil or writing-point free to slide along it, and pressed by a light spring against the edge of  $S$ . A rough model of such an instrument was made at the time by the author, and

was found to work very well. It should be noted that all the long lines being given by the straight edge, great accuracy is easily obtainable, whether with the simple paper square or the more complex instrument.

21 Norham Road, Oxford,  
September 28, 1895.

## VII. *Notices respecting New Books.*

*Elements of the Mathematical Theory of Electricity and Magnetism.*  
By J. J. THOMSON, M.A., F.R.S. Cambridge University Press, 1895.

STUDENTS of Electricity who desire to read the more mathematical portions of the subject, and particularly those who wish to follow the development of the æther theory of electricity and the electromagnetic theory of light, usually find some difficulty in the choice of a text-book. From a first-year experimental course to Maxwell's treatise is too great a step, in mathematics as well as in physics; some text-book of an intermediate character is therefore required. Maxwell appears to have realized this, and he attempted to remove the difficulty by his *Elementary Treatise*, which, unfortunately, he did not live to complete. In the present volume Prof. Thomson has a similar aim: he retains nearly the same order of subject-matter as in Maxwell's treatise, but (with few exceptions) only such problems are considered as can be solved by the aid of the differential calculus. By this treatment the mathematical difficulties are greatly diminished, while the physics of the subject is satisfactorily developed and illustrated by a sufficiently large number of examples.

The author has made frequent use of Faraday tubes of force in explanations of phenomena occurring in the electric field: he shows very simply that such tubes will be in equilibrium if the tension along their axes is accompanied by an equal pressure at right angles to them. In discussing the case of an insulated sphere in a uniform field, the idea of an electric doublet is introduced, and an expression is found for the moment of a doublet representing the external effect of the charge on the sphere. Among other new modes of treatment we may mention the use of the dissipation function in determining the distribution of currents in any network of conductors. Kirchhoff's laws are shown to be equivalent to the statement that the currents distribute themselves so as to make the total rate of development of heat-energy a minimum; by writing down the expression for this heat-energy and making it a minimum, the values of the currents in each branch may be obtained. Prof. Thomson has found a companion for  $\kappa$ , the specific inductive capacity, and  $\mu$ , the magnetic permeability, in dimensional formulae. The work done by a unit magnetic pole in threading a closed circuit is  $4\pi/p$  times the current flowing in the circuit; as the