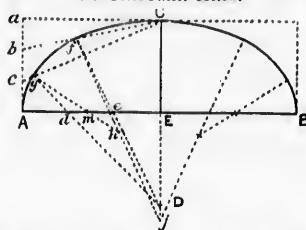
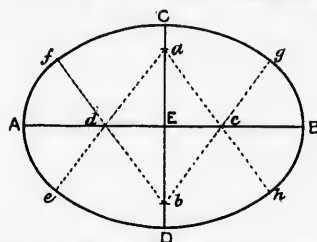


PROBLEM 65 (c).—TO CONSTRUCT AN ELLIPSE APPROXIMATELY BY CIRCULAR ARCS.



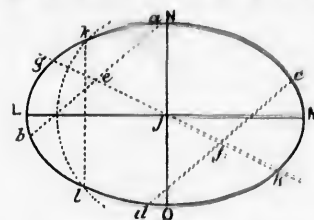
Draw the axes AB , CD , and on AB construct the rectangle BAa . Divide EA into three equal parts in e and d , and also AA into three equal parts in b and c . Join C' to b and c and draw lines from D through d and e , cutting Cb , $C'e$ in g and f . Find the centre j in the line $C'D$ of the arc passing through C' and f , and describe the arc. Next find the centre h , on the line fj , of the arc passing through f and g . The point m where gh cuts AB will be the centre of the remaining arc gA . Draw the other quadrants similarly. A closer approximation may be obtained by dividing the lines AA , AE into four or more parts, and obtaining the centres of the arcs in a similar manner.

PROBLEM 65 (d).—TO CONSTRUCT AN ELLIPSE APPROXIMATELY BY MEANS OF CIRCULAR ARCS UPON GIVEN AXES AB , CD .



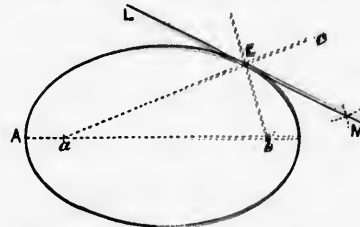
Make EA and EB equal to the difference between the axes AB and CD . Make also Ed and Ec equal to three-fourths of this difference. ($EA = AB - CD$ and $Ed = \frac{3}{4}EA$.) Join a and b to d and e and produce the lines. From d and e with radii equal to da or eb describe the arcs eAf , gBh and from b and a with radii equal to bd or ae describe the arcs fCg , hDe . These arcs will meet in f , g , h and e and form the required approximate ellipse. This method is described by Mr. B. F. LaRue in *Engineering News*, vol. xxxiv., No. 17.

PROBLEM 66.—AN ELLIPSE BEING GIVEN, TO FIND THE AXES.



Draw any two straight lines ab , cd , across the ellipse and parallel to each other. Bisect these lines in e and f . Join ef and produce it both ways to meet the curve in m and n . Bisect gm in j , and from j as centre describe any arc cutting the curve in k and l . Join kl and through j draw lines NQ , LM , parallel and perpendicular to it. NQ and LM will be the required axes.

PROBLEM 67.—AT A GIVEN POINT E IN THE CIRCUMFERENCE OF AN ELLIPSE TO DRAW A TANGENT TO THE CURVE.



Find the axes and foci a , b , of the ellipse (*Probs. 66 and 65*). Join E to a and b , and produce aE to e . Bisect the angle CEb by the line EM . LEM will be the required tangent.