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Author(s): T. V. Philpott

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The three cognate inequalities involving *sines*, *cosines* and *tangents* respectively, in virtue of the identity $\sin \theta = \tan \theta \cos \theta$, are logically related inasmuch as the *cosine* inequality can at once be deduced from the other two; but as they are harder to prove, this relation is not of much importance.

R. F. MUIRHEAD.

546. [U.] When paying a visit to the Pearl Mosque in the Fort at Agra in December, 1915, I noticed the sundial standing in the S.E. corner of the courtyard. The dial face is as the figure. OA is about $\frac{1}{3}$ of the radius,

OB is about $\frac{1}{2}$ of the radius, ABC is an arc. The diameters are at right angles. The gnomon is not there. Can somebody inform me how this worked?

T. V. PHILPOTT.

547. [L¹. 17.] *Intersections of Curves in Polars.*

An elementary point that is often overlooked is that the intersections of (say) $r=f(\theta)$ and $r=\psi(\theta)$ are not, *in general*, completely given by the equation

$$f(\theta) = \psi(\theta). \quad \dots\dots\dots (1)$$

For example, the conics $\frac{10}{r} = 2 + 5 \cos \theta$ and $\frac{10}{r} = 5 - 4 \cos \theta$ intersect actually in four real points, two only of which are got by equating the values of r .

The root of the matter, of course, lies in the fact that the representation of the position of a point by polar coordinates is not unique, (r, θ) and $(-r, (2\kappa + 1)\pi + \theta)$, (κ integral), being identical.

In tracing polar curves, for some branches r is positive and for others negative. (1) gives only the vectorial angles of points of intersection of branches for which r has the same length. To get those of branches for which r has opposite signs, write one of the equations (say $r=\psi(\theta)$) in its equivalent form,

$$-r = \psi((2\kappa + 1)\pi + \theta).$$

In this form the positive and negative branches exchange rôles, and we can now equate radii vectores again and get for the remaining intersections

$$f(\theta) + \psi((2\kappa + 1)\pi + \theta) = 0. \quad \dots\dots\dots (2)$$

(1) and (2) together give the complete intersections of the curves.

Of course it often happens that the solutions of (2) are included in (1), but this is not true *in general*.

E. H. SMART.