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619. On Note 597

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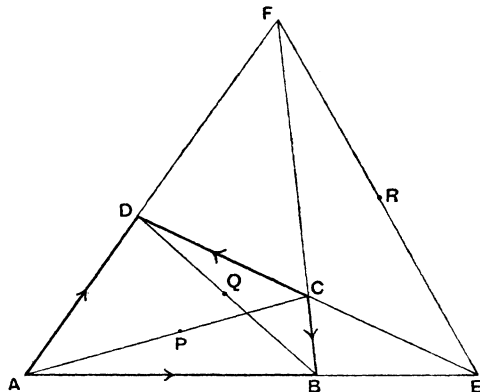


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617. [v. 1. a.  $\mu$ .] *Vector Proof that the Mid-points P, Q, R of the Diagonals AC, BD, EF of a Complete Quadrilateral are collinear.*

Consider the system of four forces  $\overrightarrow{AB}$  along AB,  $\overrightarrow{CB}$  along CB,  $\overrightarrow{CD}$  along CD and  $\overrightarrow{AD}$  along AD.



We have  $\left\{ \begin{array}{l} \overrightarrow{AB} \text{ along } AB + \overrightarrow{AD} \text{ along } AD = 2 \cdot \overrightarrow{AQ} \text{ along } AQ, \\ \overrightarrow{CB} \text{ along } CB + \overrightarrow{CD} \text{ along } CD = 2 \cdot \overrightarrow{CQ} \text{ along } CQ. \end{array} \right\}$

Also,  $2 \cdot \overrightarrow{AQ} \text{ along } AQ + 2 \cdot \overrightarrow{CQ} \text{ along } CQ = 4 \cdot \overrightarrow{PQ} \text{ along } PQ.$

Again,

$\left\{ \begin{array}{l} \overrightarrow{AB} \text{ along } AB + \overrightarrow{CD} \text{ along } CD = (\overrightarrow{AC} + \overrightarrow{CB} + \overrightarrow{CA} + \overrightarrow{AD}) \text{ all through } E \\ \quad \quad \quad = (\overrightarrow{CB} + \overrightarrow{AD}) \text{ through } E. \end{array} \right\}$

Also,  $\overrightarrow{CB} \text{ along } CB + \overrightarrow{AD} \text{ along } AD = (\overrightarrow{CB} + \overrightarrow{AD}) \text{ through } F.$

$\therefore$  the whole = a force through R.

$\therefore$  P, Q, R are collinear.

W. J. DOBBS.

618. [I. 1.] *Note on Note 610.*

The paradox disappears if, after defining a surface as the aggregate of points distributed symmetrically, one proceeds to define the area of a figure as the ratio of the number of points composing it to the number of points composing the figure chosen as the unit of area.

The guile of this "Mathematical Recreation" appears to lurk in the tacit assumption that the elements of area surrounding the  $\frac{1}{2}m(m+1)$  points can be squares, whereas they must be either hexagons or rhombi, each equal to twice the equilateral triangle determined by three neighbouring points.

The Roman formula consequently requires a multiplying factor  $\sqrt{3}/2$  to convert from hexagonal or rhombic units of area to the square units commonly employed. Otherwise there will be a minimum error of approximately 13.4 per cent.

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619. [X. 4.] *On Note 597.*

On a sheet of ruled paper draw a line perpendicular to the ruled lines, and through the point at which it cuts the top line draw two lines equally inclined to it.

Mark these lines 1, 2, 3... where they cut the ruled lines and mark the perpendicular .5, 1, 1.5, 2... where it cuts the ruled lines. Then if a ruler meets the side lines at  $a$  and  $b$  and the central line at  $x$ ,

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{x}.$$

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