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BHASKARA'S CALCULATIONS OF THE GNOMON'S SHADOW

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The following problems, proposed and solved by Bhaskara in his *Siddhantasiromani*, are characteristic of his work.

(i) To find the gnomon's shadow in a given direction on any day in a place of known latitude.

Bhaskara's formula runs as follows:

पलप्रभा व्यासदळेन निघ्नी दिग्ज्योद्धृता तां पलभां प्रकल्प्य
साध्याक्षजीवाथ तया विनिघ्नी स्वाक्षज्ययाप्तापमशिञ्जिनी च ॥
ताभ्यां दिनार्धद्युतिवद्धिदध्यादभीष्टदिक्स्थे द्युमणौ द्युतिं वा ।

that is, assuming $Rs/\sin a$ to be the equinoctial shadow where s is the original equinoctial shadow, R the radian measured in minutes and equal to 3438 and a the azimuth of the moment, compute the sine of the corresponding latitude, say sin L; then compute sin D from the formula $\sin D = \sin d \sin L/\sin \varphi$ where d is the sun's declination and φ the latitude of the place. Then $L \pm D$ gives us the zenith-distance wherefrom the shadow can be derived.

The equinoctial shadow is that cast by the gnomon on an equinoctial day at noon. Thus $s/12 = \tan \varphi$, the gnomon's length being 12 units. Hence the Hindu sine of the latitude of the place, in terms of the equinoctial shadow would be $\dfrac{Rs}{\sqrt{12^2 + s^2}}$ where the Hindu sine is the modern sine multiplied by R.

The formula may be proved as follows according to modern methods.

Let TRQ be the equator, Z the zenith, P the pole and S the Sun's position. ZS, the zenith-distance of the Sun is equal to $ZT \pm ST$ according as the Sun is in the South or North of the Equator. ZT

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