

## Astronomy

## Draughtsmen of the constellations

from David W. Hughes

TO THE astronomically-initiated stargazer, six hundred or so of the brightest stars are dragooned into an array of constellations. For anyone who has wondered why, when and by whom this cartographic system was drafted, Archie Roy of Glasgow University provides some answers in *Vistas in Astronomy* 27, 171; 1984.

First, bear in mind that an observer living at latitude  $0^{\circ}\text{N}$  not only never sees the south celestial pole but also finds that stars with declinations between  $-90^{\circ}$  and  $-0^{\circ}$  never rise above the horizon. Moreover, the celestial poles are not fixed but precess about a circle of radius  $23.5^{\circ}$  every 26,000 years. It is, then, not difficult to establish the era and the domicile of the original draughtsmen. There is a patch of sky in the southern celestial hemisphere which has no ancient constellations, even though it is spattered with bright stars, and whose angular radius of avoidance is about  $36^{\circ}$ . This means that the originators of the constellations must have lived somewhere on the longitude line  $36^{\circ}\text{N}$ . And, allowing for precession, the centre of the zone corresponds to the south celestial pole of around 2,500 BC.

Why was the constellation system devised? The clues come from the work of Hipparchus (125 BC), Eudoxus (409–356 BC) and Aratus (315–250 BC). Aratus was a poet who, at the instigation of King Gonatus of Macedonia, wrote the *Phaenomena*, a poem embodying the work of Eudoxus. According to M.W. Ovenden (*Philosophical Journal* 3, 1; 1966) the daily and seasonal behaviour of the constellations discussed in this work are commensurate with a date of 2,600  $\pm$  800 BC and a latitude of  $36^{\circ} \pm 1.5^{\circ}\text{N}$ . But Roy's re-analysis of the poem, concentrating on its description of the positions of the celestial equator and the celestial tropics of Cancer and Capricorn, leads him to date the description to 2,000  $\pm$  200 BC; Eudoxus seems to have been writing not about the sky that he could see but about the sky as it was 1,600 years earlier. Neither Eudoxus nor Aratus bothered to check that their poetic picture agreed with the Greek sky of 400–250 BC: they simply reproduced previous work. Hipparchus did check, and the discrepancies probably led him to discover polar precession.

Eudoxus was writing about people who had a sophisticated astronomical outlook which encompassed an Earth poised in space with the heavens revolving about it on a bipolar axis, although one pole was not visible. The constellation system seems to have been designed primarily as a navigational aid for sailors. Non-circumpolar constellations (those with declinations between  $+0^{\circ}$  and  $-0^{\circ}$ ) always rise and set

at a specific compass point on the eastern and western horizon. A ring of constellations with the same angular distance from the celestial equator can be used to indicate a specific compass setting throughout the night and would have been a great navigational aid at a time when there was no acceptable pole star.

So who were the original draughtsmen? Four groups have been suspected – the Phoenicians, the Egyptians, the Babylonians and the Minoans. The Phoenicians can be ruled out because they prospered too late, from about 1500–500 BC. The Egyptians, despite their sophistication and their role as tutors to early Greek science, simply lived too far south. The Babylonians are stronger contenders: the Sumero-Akkadian people of the Euphrates region were great believers in astrology, and the movement of planets through the Zodiac was used for calendrical and religious purposes. The records left on their clay tablets leave us in no doubt that as far back as 2,100 BC they were using a system of constellations essentially similar to that given in Aratus's poem. Moreover, navigation was important to the Babylonians for their links with India and South Arabia, centred on Bahrein (ancient Dilmun). On the other hand, their sea traffic, was closer to the equator than the 'observer's latitude' derived from Eudoxus.

This leaves the Minoans, who lived on Crete and the Cyclades, and traded from there with Egypt, Greece, Cyprus,

Andromeda (top) and Perseus by Giovanni Paolo Gallucci (1588). From George S. Snyder *Maps of the Heavens* (Andre Deutsch 1984), to be reviewed in *Nature*.

Syria and Mesopotamia throughout the third millenia BC. Roy considers that it was the Minoans who borrowed and developed early Babylonian ideas and transformed them into a complete celestial sphere of constellations for navigational purposes.

But why was the Eudoxian sky 1,600 years out of date? A simple solution is proposed. With the complete destruction of the Minoan civilization around 1,450 BC by the volcanic explosion of Thera (Santorini), their astronomical ideas and constellations were frozen in time. □

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