# Sirius and the colour enigma

SIR—Some ancient Babylonian, Graeco-Roman, and mediaeval texts[1] have suggested that Sirius might have been red in the past. In particular, Ptolemy (AD 150) classified Sirius as *hipokkiros* (reddish) with stars like Arcturus, Aldebaran, Pollux, Antares and Betelgeuse, all of which have B-V colours higher than 1. But the redness of Sirius is still contentious[2]. We have found a new clue from Chinese records, and suggest a new possible explanation of the hypothetical redness of Sirius about 2,000 years ago — the passage of a small interstellar cloud across our line of sight to Sirius.

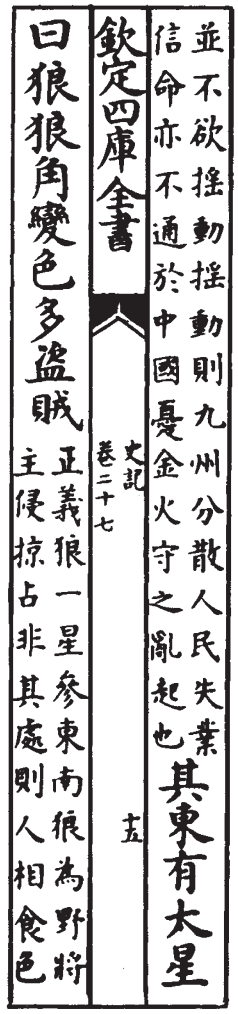
Several Chinese records referring to Sirius as a white star have been quoted to challenge the results of the colour change[3]. But during a recent visit to China, one of us found in the Han dynasty history book (Shiji) of the famous historian and astronomer Sima Qian (145–87 BC) a record, shown and translated in the figure. Following the practice of the time, the astronomical observation is followed by astrological predictions. The astronomical content of Shiji has been generally reliable in these cases (comets' or planets' motions) when direct confirmation can be performed. As for the rest of the compilation work of Sima Qian, no definitive date can be attached to the record, but it does show that a colour change in Sirius may have been noticed by Chinese astronomers more than 2,000 years ago.

It is unquestionable that Sirius was red when Sirius B passed through the red giant phase. But stellar evolution is not rapid enough that this transition could have taken place in human history.

We think that the reddening of Sirius could have been caused by an interstellar cloud travelling between it and the Sun. The Bok globules, discovered by Bok in the 1940s, are the smallest dark nebulae that have been observed[4]. They are between 0.01 and 0.1 parsecs in diameter and between 0.1 and 1.0 solar masses. They are usually seen as dark regions in front of bright emission nebulae, but whether or not they are actually associated with the nebulae is uncertain. About 200 globules are known within 150 parsecs from the Sun, so the presence of a small globule in front of Sirius should have a non-negligible probability.

If we suppose that Sirius used to have a B-V colour of 1, putting it among the stars called *hipokkiros* by Ptolemy, the required reddening must have been $E(B\text{-}V) = 1$. Adopting the standard relation of Spitzer[5], $N(H)/E(B-V) = 5.4 \times 10^{21}$, we find that the absorbing cloud must have a column density of $5.4 \times 10^{21}$ cm$^{-2}$. For a gas-to-dust ratio[5] of $A_J/E(B-V) = 3.0$, we find that the extinction caused by the small cloud is $A = 3$ mag, giving Sirius an apparent magnitude of about +1.5. This is, of course, much fainter than it is now, but still a first magnitude star for the ancients.

If a globule of typical diameter of 0.02 parsecs lies just in front of Sirius, say at a distance of 2.5 parsecs from the Sun, its apparent dimension on the sky would be around 25 arcmin. Its mass then can be calculated as: $M = N$ (cm$^{-2}$) $D^2$ (pc$^2$) 4.2 $10^{21}$ solar masses, $\sim$ 0.01 solar masses. Sirius has a proper motion of 15 km s$^{-1}$ (or 1.3 arcsec yr$^{-1}$). If the globule were motionless, Sirius would have taken about 1,100 years to travel behind it. This time could be shorter depending on the proper motion of the cloud, but the timescale is however compatible with observational reports.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Chinese record from the Han dynasty (second century BC) history book *Shiji*, chapter 27, *Book of Heavenly Bodies* compiled by Sima Qian, referring to a colour change in Sirius. Text from the Qing-ding-si-ku-quan-shu (ed. Zhong Hua Shu Ju, 1959/9) translates literally as: At East/ there is/ big/ star/ called/ Wolf/ Wolf/ horn/ changes / colour/ ,/ many/ thiefs/ robbers/. (Wolf is the Chinese name for Sirius.) The text corresponds to the large heavy characters in the first and third columns, to be read vertically and from right to left.

Note that the colour change would in this case have occurred progressively and would probably not have been noticeable by a human eye in a human lifetime, unlike the proposed violent events[6] affecting Sirius B. This could explain why the colour changes of Sirius were never reported as special events.

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# Sex-ratio biased organisms

SIR—Hurst *et al.* reported in News and Views[1] the work of Stouthamer *et al.*[2] who showed evidence that a microorganism is the probable cause of sex-ratio biasing in the wasp genus *Trichogramma*. Treatment with some antibiotics and temperature above 30 °C caused completely partheno-genetic wasps to adopt permanently bisexual reproduction. Stouthamer *et al.* did not isolate the supposed microorganism, but provided good circumstantial evidence for its existence. Hurst *et al.* did not mention the sex-ratio organism of the fruitfly *Drosophila* or of spiroplasmas. The reader could have been left with the impression that a biased sex ratio in offspring associated with microbial infection is indeed novel.

The novelty of the article by Stouthamer *et al.* stemmed rather from "the idea that the agents (microorganisms) might somehow cause uniparental reproduction", which, if it occurs, may well be novel. The non-mendelian nature of the sex-ratio phenomenon in *Drosophila* is well known[3], and the microorganism responsible for it was first observed in 1961[4]. This organism is now known to belong to the bacterial genus *Spiroplasma* (class Mollicutes). Stouthamer *et al.* mention spiroplasmas indirectly, but failed to appreciate the many similarities their putative organism shared with them[5–8].

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