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This month's contributors include...

ALISTER GRAHAM
PROFESSOR OF ASTRONOMY



Alister looks back to the astrological roots of the science of astronomy that we know today. *Page 74*

CAROL LAKOMIAK
SKETCHING EXPERT



Carol writes the last of her monthly sketching columns, ending on a festive note – the Christmas Tree Cluster. *Page 83*

ELIZABETH PEARSON
STAFF WRITER



Elizabeth speaks to Rosetta's project scientist to find out what will happen after the Philae lander is launched. *Page 62*

GOVERT SCHILLING
ASTRONOMY AUTHOR



Govert previews the next generation of giant telescopes being built at observatories around the world. *Page 67*

Welcome

It's beginning to feel a lot like Christmas...



Now that peak firework season has passed and we can revel in dark skies again, we're bringing you a very special observing tour full of Christmas cheer: our Advent calendar challenge, which

highlights one top target for each night from 1-24 December. Of course, many of the sights that Pete Lawrence and Steve Richards have selected are visible on more than just one night, in case of cloud cover. Discover what's behind the first door on page 32.

If the clouds do appear, there's a great project for you to get stuck into on page 80, as we show you how to turn your Newtonian scope into a Dobsonian by making a rocker box base.

Clouds have been the least of worries lately for the Kepler mission. It's been out of action since crucial alignment mechanisms on the craft broke down. But now the plucky probe is embarking on a new mission, as Will Gater reports on page 38.

Enjoy the issue and Happy Christmas!

Chris Bramley Editor

PS Next issue goes on sale 19 December.

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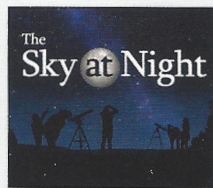
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We look forward to hearing from you soon.



Sky at Night LOTS OF WAYS TO ENJOY THE NIGHT SKY...



TELEVISION

Find out what *The Sky at Night* team will be exploring in this month's episode on page 19



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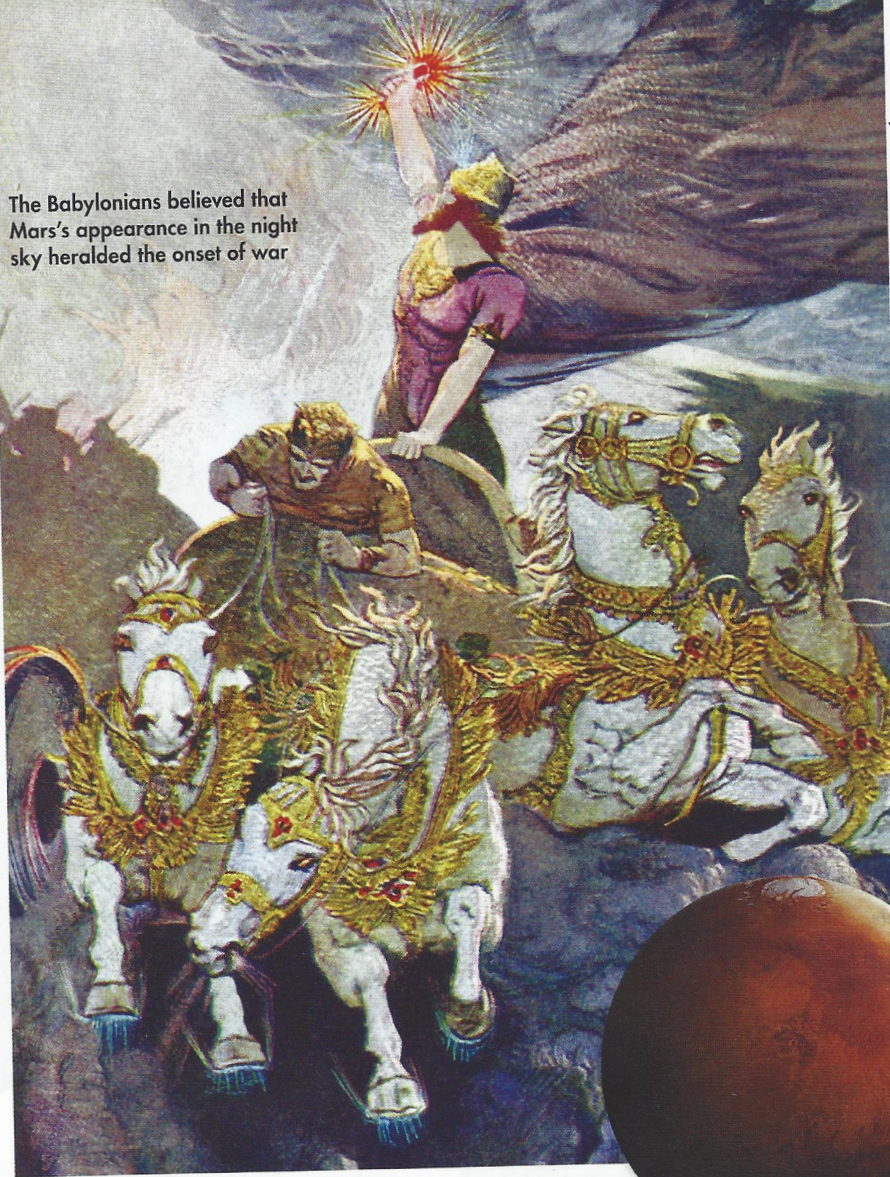
ASTROLOGY

AN ASTRONOMER'S VIEW



Astrology and astronomy were once the same discipline but, as **Alister Graham** explains, science has since moved on

The Babylonians believed that Mars's appearance in the night sky heralded the onset of war



Ask any astronomer if they believe in the ancient practice of astrology and the answer will likely be a resounding no. And yet the science of astronomy had its origins in this astrological belief system, which goes back a long way.

Perhaps not surprisingly, early civilisations regarded the stars and planets as evidence of supernatural powers that could magically affect their lives. From the writings of Babylonian priests, we know that they would 'interpret' various astronomical events as omens. Using their 'principles of analogy' or 'laws of correspondence', the Babylonian priests would claim to foretell the future state of affairs of their kings based on the positions of celestial bodies. For example, a red-coloured Mars was a sign of blood and imminent war; a stellar constellation resembling two fish referred to water.

By the time of the Egyptian empire, the messages in the heavens weren't just for the rich and powerful – the stars and planets now held advice for everyone. Egyptian astrologers would provide horoscopes founded on the belief that the instant of one's birth established one's character and disposition. With such

an increased customer base and the new personal connection to the heavens and the gods, which was previously only for the elite, it's easy to see why astrology and the production of horoscopes flourished.

The ancient Egyptians also believed that their Sun god Ra was swallowed every night by the sky goddess Nut, then reborn the following day. Night fell when Nut returned to, and embraced, the Earth god Geb, her star-studded body creating a canopy over the Earth. Storms during the day were thought to occur when Nut came close to Geb, and Geb's laughter was thought to be the origin of earthquakes.

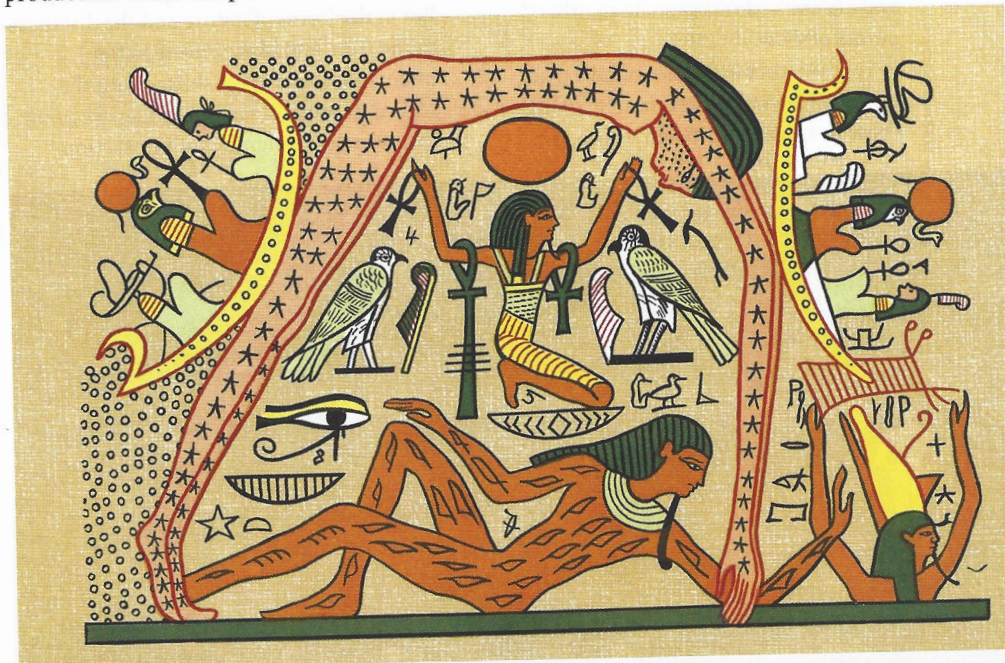
The ancient Greeks further developed the system of correspondences that linked people with the heavens. It was Aristotle's endeavour to mathematically describe this magical world view that led to what we know today as astrology.

Greeks and Romans

The Greeks meshed the Egyptian system of attaching significance to the angular distance separating the Moon and planets from the Sun with the Babylonian zodiac. The zodiac shows which constellation the Sun, and thus the powerful Sun god, appears to reside in. It also dictates one's 'star sign'. The Greeks believed that the relative proximity of the Sun god to the other 'gods' (planets) at the time of one's birth influenced one's personality. Similarly, the association of the Sun god with a particular constellation determined our character. Further modifications came from the Romans, notably Ptolemy in the second century AD, perhaps best known for mistakenly believing Earth was the centre of the Solar System.

As astrology developed, each star sign came to have a fictional creature or figure ▶

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▲ In ancient Egyptian lore, Geb the Earth god was blanketed at night by Nut the sky goddess



The 12 constellations that make up the astrological zodiac

► associated with it, whose form was traced out by the brightest stars of a constellation. Those born under the water sign Pisces are supposed to possess a love of the sea and have numerous skills connected with water and rivers, the flowing nature of which is claimed to make Pisceans adaptable to changing situations. They are also said to have a certain degree of dualism due to the presence of two fish in this constellation and are thus compassionate to others' points of view.

To give other examples of how these so-called laws of correspondence work, those born under the sign of Leo are

said to be proud, forceful leaders; those born under Aries are allegedly headstrong and impulsive; Geminis have split personalities, are social and good communicators; Taureans have a plodding, patient, stubborn nature; while Scorpios are self protective.

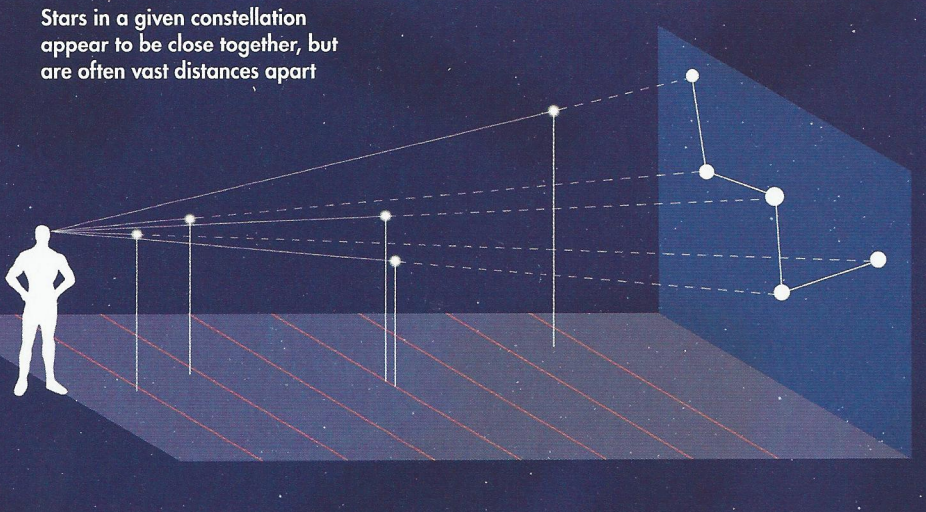
Astronomy and astrology used to be intertwined: Galileo (1564-1642) and Kepler (1571-1630) were expert astrologers. But as the forces of nature and the distances to the stars and planets were better understood, astrology shifted into the realms of pseudo-science. Today we know that there is no significant interaction

between the Sun and the stars that define the constellations – the distances involved are simply too vast. Moreover, even the stars of the constellations themselves often have no physical association with each other, only appearing to do so when viewed from Earth. So the constellation Pisces, once connected with the Babylonian goddesses Anunitum and Simmah, the Syrian goddess Ashtarte, and the Greek goddess Aphrodite and her son Eros, is simply a scattering of self-gravitating nuclear fusion reactors – stars – spread across the Milky Way.

Gravitational force

But are there any known forces exerted by the stars and planets that might affect us? Gravity and electromagnetism are the only possible candidates, yet they are so weak as to be negligible. At the time of our birth, the obstetrician exerts a greater gravitational force on us than the planets and constellations, and a fridge magnet has a stronger electromagnetic influence. Moreover, variations in solar flares result in the Sun's magnetic influence on Earth changing randomly from day to day, and at a level greater than that coming from the planets and stars. And the lights of a hospital operating theatre, or even local TV and radio stations, produce more radiation than that which arrives from space.

Stars in a given constellation appear to be close together, but are often vast distances apart





▲ If astrology is to be believed, then more married couples should have purportedly 'compatible' star signs – but this is not the case

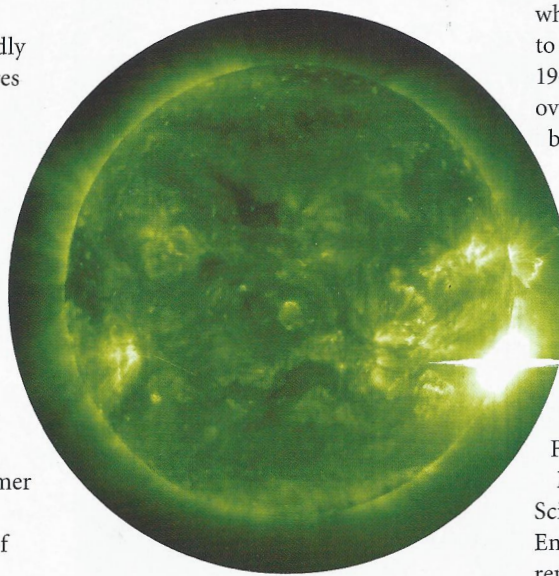


▲ Joan Quigley, who passed away in October 2014, acted as astrologer for US President Ronald Reagan following an assassination attempt

It therefore comes as little surprise, especially given that traits are supposedly based on those of mythological creatures in the heavens, that modern statistical studies using large numbers of people have shown no evidence that constellations or planets provide any insight into individual personalities. Marriage and divorce rates show no correlation with allegedly compatible and incompatible 'signs'. Scientists of every sign exist in equal numbers, as do entertainers and military personnel; there is no tendency for any of them to be of a particular star sign.

In 2003, Australian scientist and former astrologer Geoffrey Dean, and Ivan Kelly, a psychologist at the University of Saskatchewan in Canada, presented a study of over 2,000 'time twins' born in London. People born at the same time should, according to astrology, have very similar personalities. However, the study found no evidence of any more similarities between 'time twins' than between any randomly selected pair of people.

In another study, Dean asked 22 people to rate the accuracy of their astrological readings, but switched the phrases in half of these with their exact opposite meaning. Those who received the reversed readings rated them just as highly as those who received the unmodified horoscopes. And in 2007 David Voas examined the birth dates of 10 million married couples in England and Wales. If people of a certain zodiac sign are indeed particularly compatible, then one would have expected to see this reflected in the star sign of their partner – yet the results revealed no such pairing.



▲ Variations in solar flare activity have a greater influence on Earth than planetary motions

“At the time of our birth, the obstetrician exerts a greater gravitational force on us than the planets and constellations”

So is there a plausible explanation for belief in horoscopes? One might be that, in general, they are often vague. This might explain how they succeed in making some people believers: when readings give specific predictions, subjects tend to forget those that didn't come true, but concentrate on those which seem accurate.

Popular appeal

Vast numbers of individuals and businesses base important professional and personal decisions on advice received from astrologers and daily horoscopes,

which claim to help us find solutions. Who to date? Who to employ? Spend or save? In 1966 the number of births in Japan fell by over 25 per cent as couples avoided giving birth in the year of the 'Fire Horse', which comes around every 60 years and is said to result in daughters with such monstrous egos and lack of family loyalty that they bring bad luck to the father and future husband. It was heavily publicised in 1988 that former US President Ronald Reagan would plan his schedule around the writings of Joan Quigley, a San Francisco astrologer.

More recently, the US National Science Foundation (NSF) Science and Engineering Indicators study from 2014 reported that a whopping 45 per cent of Americans think that astrology is either 'somewhat' or 'very' scientific. It's a similar story in India, where many

people, including top politicians, are reported to still consult with astrologers, in particular for the optimal timing of key private and public events. In contrast, the

NSF report noted that only eight per cent of Chinese people believe in horoscopes.

Astrology's enduring appeal, despite its lack of any scientific foundation, says more about human psychology than it does about the power of the stars. ☉



ABOUT THE WRITER

Prof Alister Graham researches the structure and dynamics of galaxies, and teaches through Swinburne Astronomy Online.