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Constellations

Throughout the centuries, people have looked to the stars to help them navigate across open oceans or featureless deserts, know when to plant and harvest, and preserve their myths and folklore. Ancient peoples used the appearance or disappearance of certain stars over the course of each year to mark the changing seasons. To make it easier to "read" this celestial calendar, they grouped the brighter stars into readily recognizable shapes, the constellations.

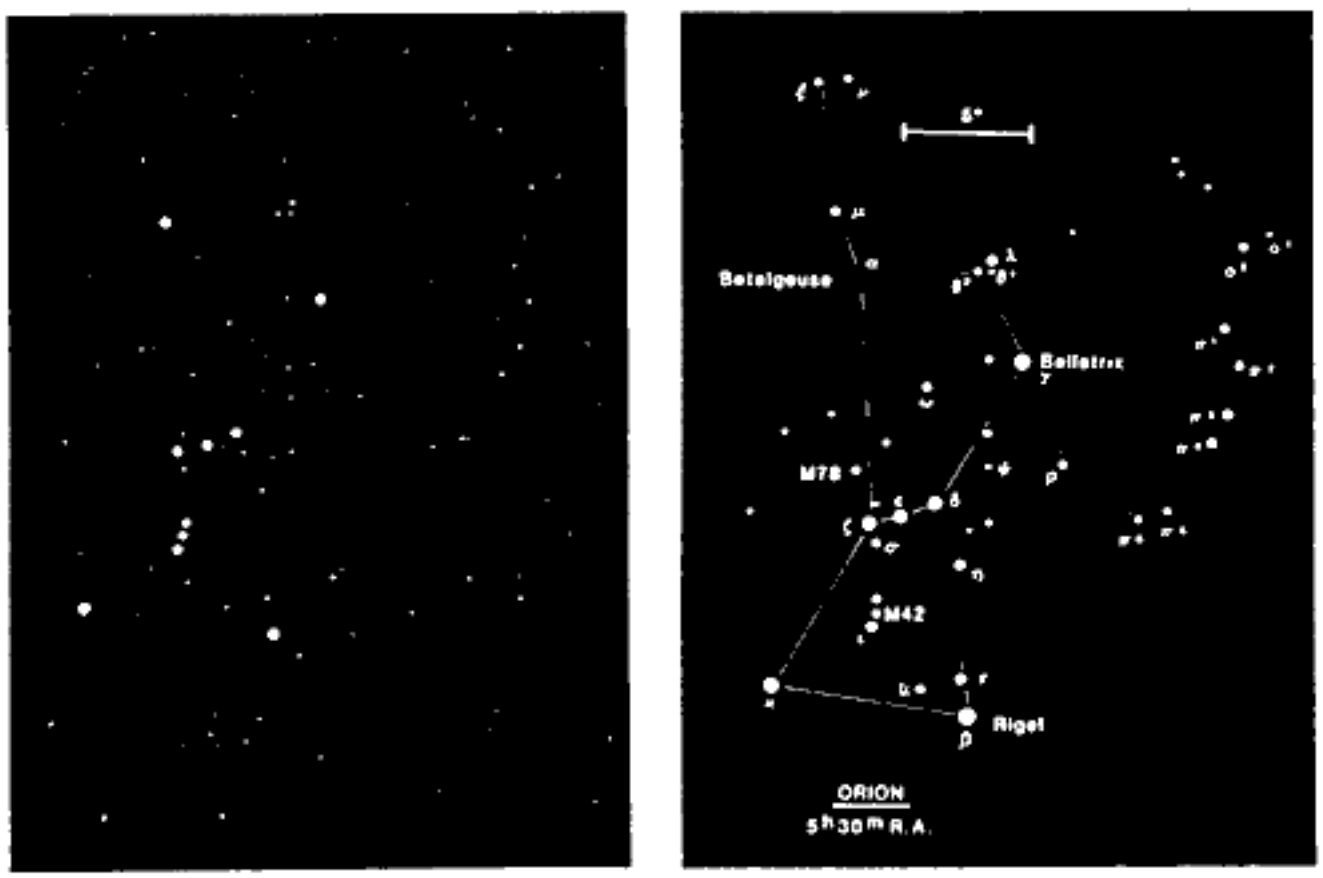
How many constellations are there?

Astronomers officially recognize 88 constellations covering the entire sky in the northern and southern hemispheres. Currently, 14 men and women, 9 birds, two insects, 19 land animals, 10 water creatures, two centaurs, one head of hair, a serpent, a dragon, a flying horse, a river and 29 inanimate objects are represented in the night sky (the total comes to more than 88 because some constellations include more than one creature.) It is important to realize that the great majority of star patterns bear little, if any, resemblance to the figures they are supposed to represent and whose name they bear. The ancient constellation-makers probably meant for them to be symbolic, not literal, representations of their favorite animals or fabled heroes, a kind of celestial "Hall of Fame."

Who invented them?

Our modern constellation system comes to us from the ancient Greeks. The oldest description of the constellations as we know them comes from a poem, called *Phaenomena*, written

about 270 B.C. by the Greek poet Aratus. However, it is clear from the poem that the constellations mentioned originated long before Aratus' time. No one is sure exactly where, when, or by whom they were invented. And yet a little detective work reveals a plausible origin.



The constellation Orion as it appears in the sky (left) and with the line drawings of the constellation figure added (right). (From *Star Maps*, [AS 289] a constellation slide set, available from the ASP.

The first clue is that Aratus' constellations did not include any near the south celestial pole (the point on the celestial sphere directly above the Earth's south pole) because that area of the sky was always below the horizon of the ancient constellation-makers. From the size of this uncharted area of the sky, we can determine that the people responsible for the original constellations lived near a latitude of 36° north — south of Greece, north of Egypt, but similar to the latitude of the ancient Babylonians and Sumerians.

In addition, the constellation-free zone is not centered exactly on the south celestial pole. Because of a "wobble" of the Earth's axis of rotation, the position of the celestial poles changes slowly with time, a phenomenon known as precession. The uncharted area is centered on the place in the sky where the south celestial pole would have been around the year 2000 B.C. This date matches the time of the Babylonians and Sumerians.

Thus it seems likely the Greek constellations originated with the Sumerians and Babylonians. From there, knowledge of the constellations somehow made its way to Egypt (perhaps through the Minoans on Crete who had contact with the Babylonians and settled in Egypt after an explosive volcanic eruption destroyed their civilization), where early Greek scholars first heard about the constellations and wrote about them.

In 150 A.D., the Greek scientist Ptolemy published a book, known by its Arabic name, *The Almagest*, which contained a summary of Greek astronomical knowledge, including a catalog of 1022 stars, with estimates of their brightness, arranged into 48 constellations. These 48 formed the basis for our modern constellation system.

Over the years, astronomers have added constellations to fill in the gaps between Ptolemy's figures and map the uncharted regions of the sky near the south celestial pole. Major contributors of new constellations included Dutch cartographer Gerardus Mercator in 1551 and Pieter Keyser and Frederick de Hautmann, navigators aboard some of the first trading expeditions to the East Indies in the early 1600s, who mapped the southern sky. Polish astronomer Johannes Hevelius in 1690 and French astronomer Nicolas Louis de Lacaille in the 1750s filled in the remaining gaps in the northern and southern skies.

Are there obsolete constellations?

Over the centuries, some astronomers have attempted to name constellations after themselves or to flatter a patron or king. This reached a peak during the heyday of celestial mapping in the seventeenth and eighteenth centuries. Few of these survived longer than the astronomers who named them, although

they sometimes can be seen in antique star charts. For example, in 1678, Edmond Halley (of Halley's Comet fame) invented a constellation called Robur Carolinum, or Charles' Oak, in honor of King Charles II of England. This constellation did not last long, especially after its rejection by the French astronomer Lacaille in his maps of the southern sky. In 1754, the English naturalist and noted satirist John Hall invented thirteen constellations based on rather unappealing animals such as a toad, a leech, a spider, an earthworm, and a slug. Fortunately, even though they may have been intended as a joke, they never caught on.

At its first meeting in 1922, the International Astronomical Union (IAU), astronomy's governing body which is responsible, among other things, for assigning names to celestial objects and features on those objects, officially adopted the list of 88 constellations that we use today. Definitive boundaries between constellations, which extend out beyond the star figures, were set in 1930, so that every star, nebula, or galaxy, no matter how faint, now lies within the limits of one constellation. For today's astronomer, constellations refer not so much to the patterns of stars, but to precisely defined areas of the sky.

Where do individual star names come from?

The ancient Greek tradition was to name stars by their position within a constellation. For example, Ptolemy refers to one star by the description "the reddish one on the southern eye," a star we now know as Aldebaran in the constellation of Taurus the Bull. But these descriptions could get quite involved. Ptolemy refers to another star in the obsolete constellation of Argo the Boat as "the northernmost of two stars close together over the little shield in the poop," a bit cumbersome if you are trying to learn the names of many stars.

When Al-Sufi, one of the greatest Arabic astronomers, published his own version of Ptolemy's *Almagest* in the tenth century, he introduced many individual star names. For centuries, bedouin Arabs had given names to bright stars — for example Aldebaran and Betelgeuse — since they regarded single stars as representing people and animals. Many of the original meanings of the names had been forgotten even in Al-Sufi's time, but some were direct translations of Ptolemy's descriptions. For example, the star name Fomalhaut (in the constellation of Pisces) comes from the Arabic for "mouth of the southern fish," which is how Ptolemy described it in the *Almagest*.

After the tenth century, the works of Ptolemy and others were re-introduced into Europe by the Islamic Arabs, and the Greek books were translated from Arabic into Latin, the scientific language of the day. Thus we know Ptolemy's work from its Arabic translation, *The Almagest*, not by its original Greek title. And it explains why we have a system of Greek constellations with Latin names containing stars with Arabic names.

Did other cultures also see constellations in the sky?

Nearly every culture on Earth has seen patterns in the stars. But, not surprisingly, very few have seen the same patterns. Take, for example, the Big Dipper, perhaps the most recognizable star pattern in the sky. The Big Dipper is not actually a constellation itself, but is part of a larger pattern known to the Greeks as Ursa Major, the Great Bear. The seven stars of the Big Dipper have inspired many stories, perhaps because they are bright and located so near the north celestial pole, around which the stars rotate during the course of the night. But not everyone calls it a Dipper. The British call it a Plough. In Southern France, it is a Saucepan. The Skidi Pawnee Indians saw a stretcher on which a sick man was carried. To the ancient Maya, it was a mythological parrot named Seven Macaw. Hindu sky lore called it the Seven Rishis, or Wise Men. To the early Egyptians, it was the thigh and leg of a bull. The ancient Chinese thought of it as a special chariot for the Emperor of the Heaven or some other celestial bureaucrat. For the Micmac Indians of Canada's Maritime Provinces, along with several other North American Indian tribes, the bowl of the Big Dipper was a bear, and the stars in the handle represented hunters tracking the bear. And in the nineteenth century, the Big Dipper became a symbol of freedom for runaway slaves, who "followed the Drinking Gourd" to the northern states.

Are all the stars in a constellation the same distance away from us?

No. With few exceptions, the stars in a constellation have no connection with one another. They are actually at very different distances from the sun (see Activity Corner). Chance alignments of stars have created the patterns we see in the sky.

Are the constellations permanent?

Ancient astronomers often spoke of the "fixed stars," which maintained permanent positions in the sky. And, indeed, the stars do seem almost fixed in place; the patterns they form look much the same today as they did when the constellations were first named nearly 3000 years ago. But the stars are all moving relative to the Sun, most with speeds of many kilometers per second. Because they are so very far away, it will take thousands of lifetimes to see significant changes in the star patterns. But, over time, they will change. Because of the motions of the stars within it, for example, the handle of the Big Dipper will, in about 50,000 years, appear significantly more bent than it is today (see figure at right). We will, no doubt, keep the same names for the constellations, even if the stars change their positions. Constellations are, after all, products of human imagination, not nature.