



## ASTERISM AND CONSTELLATION: TERMINOLOGICAL DILEMMAS

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Received: March 14, 2017; Reviewed: March 23, 2017; Accepted: March 31, 2017

**Abstract:** In contemporary astronomical literature, there is no uniform definition of the term asterism. This inconsistency is the consequence of differences between the traditional understanding of the term constellation, from the standpoint of the naked eye astronomy, and its contemporary understanding from the standpoint of the International Astronomical Union. A traditional constellation is a recognizable star configuration with a well-established name, whereas the International Astronomical Union defines a constellation as an exactly defined sector of the cosmic space that belongs to a particular traditional constellation. Asterism is a lower rank term in comparison to constellation, and as such it may not denote a whole traditional constellation, as these terms would become synonymous and parts of constellations would become “asterisms of asterisms“. Similarly, asterism cannot define a macro configuration composed of the brightest stars in more constellations, thus, the Summer Triangle and other sky polygons are not asterisms. Therefore, asterisms are neither constellations nor sky polygons, but the third – easily recognizable parts of traditional constellations with historically well-established names, including separate groups of smaller stars that belong to star clusters (autonomous asterisms). Forms and names of asterisms may or may not be consistent with the parent constellation, and accordingly asterisms can be divided into compatible and incompatible. If asterisms have outlived the exact division of the celestial sphere and remained irreplaceable celestial landmarks in the naked eye astronomy, then it is high time for the International Astronomical Union to agree on the definition of asterism and to compile their official list.

**Key words:** asterism, constellation, star configuration, sky polygon, naked eye astronomy

### Terms asterism and constellation as synonyms

The terms *asterism* and *constellatio* originally marked a constellation. They were used as synonyms until the twentieth century (Barentine, 2016, p. 15) when the term asterism completely disappeared. Today, the term asterism denotes “everything that is not a constellation”, and it is precisely that this careless definition has drawn our attention: How is it possible that what once was a constellation suddenly became everything else but a constellation?

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At the same time, the term asterism has lost its status as a scientific term, so that asterisms, unlike constellations, have never been officially listed. If they were listed today (not including many of the recently composed telescopic asterisms) in accordance with the criterion “everything that is not a constellation”, then the list of asterisms would include two star clusters and a variety of star configurations: parts of constellations, halves of constellations, whole constellations, star couples of the same constellation or a group of the brightest stars of two or more constellations.

Since the term asterism has not been scientifically “codified”, it cannot be found in all astronomy dictionaries: Kleczek’s six-lingual dictionary (Kleczek, 1961, p. 428), for example, in the chapter titled “Constellations” among the ten entries that are not names of constellations, there is not an entry on asterism. Also, there is not specific scientific literature on asterisms. They are mostly studied in the secondary literature, as part of monographs about astronoms (Karpenko, 1985; Bakich, 1995), myths and legends associated with constellations (Bonov, 1978; Sesti & Zolla, 1987; Ruggles, 2005; Falkner, 2011), naked eye astronomy (Talcott, 2009; Upgren, 1998), specific constellations (Barentine, 2016), or in monographs about the history of cartographic presentations of the night sky (Chiravalle, 2006; Kanas, 2007). In these books, and the like, there is no uniform classification of asterisms and therefore no single, uniform definition that would result from it.

In the definition of the term asterism, the basic term is constellation. The term constellation was exactly defined almost a century ago by the International Astronomical Union (IAU), but until now the traditional “naked eye” conception of the term has survived. It is precisely this overlapping of the “cartographic” and “visual” understanding of the term *constellation* that causes inconsistency in defining the term *asterism*.

### **Terms constellation and the IAU-recognized constellation**

In 1930, the IAU officially announced the exact division of the celestial sphere on 88 constellations. On its request, a Belgian astronomer, Eugene Delporte (1930), “parceled out plots” of the celestial sphere, as geodesists do on the ground, and allocated permanent fields of different shapes and surfaces to all constellations, whose sides are defined by lines of right ascension and declination for the epoch 1875. With the exception of the constellations of the Little Bear and the Octant, which include celestial poles, all these fields are either spherical trapezoids (the Greater Dog, the Scutum, the Chamaeleon, the Microscopium, the Telescope) or can be divided into spherical trapezoids. After

Delporte's surveying, the claim that a particular celestial object belongs to a certain constellation means that it is positioned within the boundaries of an exactly defined field of the celestial sphere with the same name.

Celestial objects within the boundaries of a certain constellation are located at various depths of cosmic space so that a constellation is not a spherical surface but a sector of cosmic space delineated by rays that emanate from a spectator's eye and go through all the points of the boundary line of this constellation. Therefore, from the standpoint of contemporary astronomy, a constellation is an exactly defined section of the celestial sphere with all celestial objects that can be observed in it with all available tools and methods (Bonov, 1978, p. 13), i.e., an exactly limited sector of cosmic space with all celestial objects that are found in it. An IUA-recognized constellation will be denoted as the IAU constellation in the subsequent sections of this paper.

Before Delporte's surveying of the celestial sphere, from the standpoint of the naked eye astronomy, constellations were considered to be noticeable configurations of the brightest stars for centuries known under their historically-established names. Delporte left 48 classical constellations, made the selection of the constellations introduced by Johann Bayer (1603), Johannes Hevelius (1690/1970) and Nicolas Louis de La Caille (1752), left out 27 of them, drew boundaries for the rest and allocated "areals" to each one, naming them with their traditional names. Traditional constellations of the "pre-Delporte's age" remained in these invisible parenthesis as a kind of trademark.

The relation between a constellation and an IAU constellation can be compared to a relation between a scattered village and its cadastral municipality. An observer who views a scattered village landscape from a nearby knoll does not see the village cadastral municipality and its geodetic boundaries but a village, hamlets and individual households, just as the observer looking at a specific part of the night sky sees a constellation, asterisms and stars, not the arcs of celestial circles which frame them.

From the standpoint of the naked eye astronomy, constellations are groups of bright stars connected by imaginary lines into various figures in accordance with the earthly experience of imaginative observers (laymen, astronomers or cartographers). Each of the classical (pre-telescopic) constellations has a long-established name and identity described in myths that ensure that its shape and location are easily remembered by contemporary generations and learnt by future generations. After constellations, their stars were given the same names: "to name a part after a whole, that is, stars after constellations, was logical and

natural” (Karpenko, 1985, p. 57). Most often, the stars were named by their positions in the star configurations that astronomers vividly portrayed on their star maps: Regul — “a lion’s heart”, Aldebaran — “a bull’s eye”, Megrec — “the beginning of a tail” (the Great Bear), Deneb — “a chicken’s tail” (the Swan), etc. The same logical procedure was used for naming parts of the constellations (the Orion’s Belt, the Dragon’s Head, the Serpent’s Head, the Serpent’s Tail, etc.) that were subsequently named as asterisms.

### Classification of star configurations

Exact division of the celestial sphere into 88 areas by the IAU meant that the names of the constellations were transferred to their allocated spherical surfaces, thus implying a double meaning of the term: 1) in the visual sense, a constellation is a configuration, i.e., a mere conditionality; 2) in the cartographic sense, a constellation (hereinafter an IAU constellation) is a defined field of a cartographic network of an equatorial coordinate system. This division also changed the meaning of the term asterism: first, it became a lower rank term, denoting a part of the entire constellation, not a constellation as a whole, second, it gradually extended to all star configurations that do not correspond to the IAU definition of a constellation. This expansion eventually became too excessive.

When the term asterism started to denote not only a part of a constellation but also other celestial configurations as well, a need for their classification emerged. Not considering classifications without clear criteria, which can be found on the web, apart from the division on the basis of visibility (“naked eye” and telescopic), and according to the origin (ancient, Arabic, contemporary), a classification worthy of attention is the one according to comprehensiveness (Barentine, 2016, p. 18). Within this classification, four types of asterisms are distinguished, with examples — alias, sectional, non-sectional, and cross-border (Table 1).

Table 1. Types of Asterisms

Type of asterism	Explanation	Examples
Alias	Differently named constellation	Northern Cross (Swan), Kite (Herdsman)
Sectional	“Section” of a constellation	Orion’s Belt, Water Jar (in Aquarius)
Non-sectional	Asterism incompatible with its parent constellation	Keystone (in Hercules), Sickle (in Leo)
Cross-Border	Asterism that includes stars of more than one constellation	The Summer Triangle, False Cross

Source of data: Barentine, 2016, p. 18 (data compiled on the basis of the text)

Barentine's classification is a good starting point in the search for an appropriate definition of asterism. In this regard, it was necessary to discover, in the first place, common points in the definitions of a naked eye asterism that exist in contemporary astronomical literature. These are the three characteristics that appear in the definition of a constellation, too.

- A group of stars seen with a naked eye by an observer from Earth. The group consists of more than two members, thus eliminating all pairs of stars with their own names, for example, there are three such pairs only in the constellation of the Great Bear: the Guards (also known as the Bear Watchers/Bear Keepers), the Pointers, the Horse and Rider.
- A distinctive group of stars. That is why most asterisms have been known since ancient times both by ordinary people and astronomers.
- A group of stars with its own name. Some asterisms have folk names, while others were given names by astronomers, that were later made official in the astronomical literature.

These traits of asterisms are not disputable. The inconsistency in definitions results from the misconceptions of the notion “group of stars” — it is assumed that a group is finite, but that there is no consensus about its size, and what it is a part of. Originally, after Delporte's mapping of the celestial sphere, the term constellation became used in two senses, in a cartographic and visual sense: an IAU constellation and a constellation. All other star configurations, both smaller and larger than a constellation, remained to be named as asterisms: “Asterism is a prominent pattern of stars, usually with a popular name, that is not a complete constellation” (Liu, 2008, p. 90).

The hierarchy was permanently established in 1930, and not a single one of the 88 constellations can be defined as an asterism, no matter whether it may be known under a different name, a “nickname” (alias asterisms from Barentine's classification). This approach would restore the original meaning of the term asterism: asterism = constellation. This should be emphasized, because very often the most famous of all the constellations, the Great Bear, or its synonym the Big Wain/the Big Wagon is provided as an example of an asterism (Roy & Clarke, 2003, p. 36, Crystal, 1990, p. 79). “Examples of asterisms include the seven bright stars in Ursa Major known as ‘the Plough’ in Europe or ‘the Big Dipper’ in America (The Constellations, n.d.;). Originally, this group of bright stars depicted the Great Bear, as they used to delineate the geometrized silhouette of a bear (Karpenko, 1985, p. 31.; Rey, 1976, p. 149). Meanwhile, a bear-like configuration changed, and today a contemporary observer sees another figure (wagon, plough, dipper) even though this figure is formed by the

same group of stars that his ancient ancestor used to watch. As much as he tried, he cannot merge into this configuration the surrounding faint stars, so that he could say meaningfully: “Now I see the constellation of the Great Bear, and then I will focus on the asterism of the Big Dipper”. The reason is — this is the same thing, a constellation, not an asterism. After all, even if the Big Dipper (the Great Wagon) were an asterism, what would then be the Wagon’s Shaft and the Wagon’s Wheels — asterisms of asterisms?

In his *Oxford Dictionary of Astronomy*, Ridpath (1997, p. 31; 2007, p. 37) defines an asterism as “a distinctive pattern of stars that forms part of one or more constellations”. However, it cannot be, since the term asterism is a lower rank term than the term constellation and cannot relate to the macro star configurations that include multiple constellations. Besides, the undisputed property of an asterism is that it is easily recognizable. Observers can view an asterism with a single glance without having to move the glance from one star to another (the angular length of the Orion’s Belt is, for example, only 3°). Thus, the following cross-border asterisms from Barentine’s classification (Table 1) cannot have the right to be observed as asterisms: the Summer Triangle, the Spring Triangle, the Great Square of Pegasus and the Winter Hexagon, which serve as macro seasonal landmarks in the night sky. Since they are triangles, a square and a hexagon whose vertices are the brightest stars, and as the term star polygon is already used in mathematics, it is best to name them as *sky polygons* and treat them as a special group of star configurations (Figure 1).

Thus, if an asterism is neither a constellation, nor a sky polygon, what is it? It is what remains — a section of a constellation. Most constellations can be divided into their component parts and this possibility was used by astronomers once to help them indicate the positions of the stars, especially in spacious constellations such as, for example, the Orion’s (Belt, Shield, Sword), the Hercules’s (Club, Branch), the Fishes (North Fish, South Fish), the Scorpion’s (Tail, Pincers), etc. With the application of coordinate geometry to the celestial sphere, the need for such orientation ceased, which made some asterisms lose their significance. Only asterism in the strictest sense of the word remained, those known since ancient times, the ones that observers of the night sky cannot help but notice. Such are, for example, the Orion’s Belt, the Keystone of Hercules (Hercules’s Bust), the Scorpion’s Tail, the Gorgon’s Head (in Perseus), the Dragon, and in particular the Pleiades and the Hyades.

The Pleiades and the Hyades are star clusters, that is, celestial objects in the physical sense of the word, and that is what makes them essentially different, but does not eliminate them from the group of asterisms. An observer with a keen

eye looking at the Pleiades or the Hyades does not see open star clusters with thousands of stars, but only some very faint stars. This is another unique feature of the Pleiades and the Hyades in relation to other asterisms. The third would be the conditional autonomy of these miniature asterisms (“pictograms”) in relation to their parent constellation (Taurus) in which they are positioned (conditional autonomy, because both asterisms are connected though the Greek myths).

The Gorgon’s Head in Perseus, the Water Jar in Aquarius, the Ear of Wheat in Virgin, the Capella and Reins in Charioteer, the Tail in Scorpion, the Chain in Andromeda, the Wagon’s Shaft, etc., are all examples of asterisms that were named in Barentine’s classification as sectional asterisms (Table 1). They fit meaningfully into their parent constellations, i.e. into the visual pattern that was created by astronomers-cartographers. Apart from these, there are also recently composed asterisms, which are identified in Barentine’s classification as non-sectional asterisms (Table 1), whose names correspond to their configurations, but are not in conformity with whole constellations. Thus, the Sickle is not in accordance with Leo, the Keystone with Hercules (why not the Bust?), the Teapot with Archer, the Butterfly with Hercules or Orion, and especially not the Ice Cream with the Herdsman. The names of the constellations have been determined and cannot be changed. Also, the rules for naming celestial bodies have been established, and it is only asterisms that can be freely named.

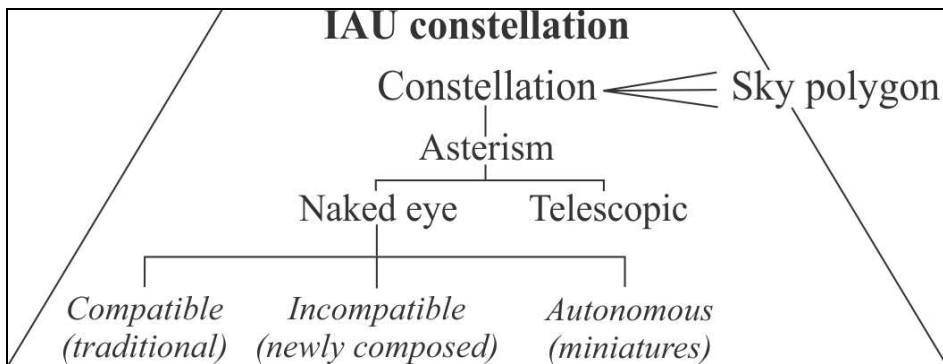


Figure 1. The hierarchical scheme of star configurations

The hierarchy of star configurations based on the previous analysis of the difference between the terms constellation and asterism is presented in the following scheme (Figure 1) and in the map of a part of the night sky dominated by Orion (Figure 2).

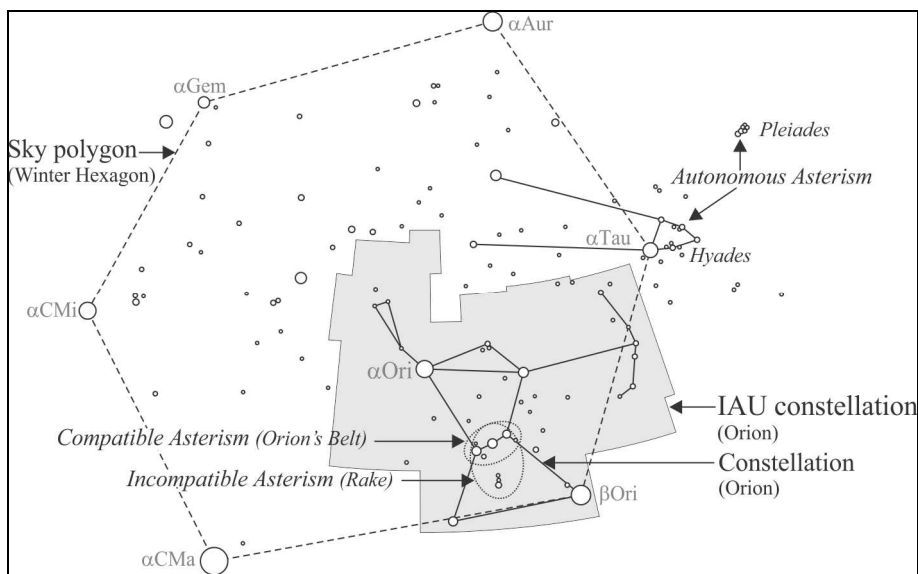


Figure 2. Star configurations in the constellation of Orion

The presented classification is the basis for harmonization of definitions of star configurations.

### Conclusion

In the definition of the term asterism, the basic term is constellation. According to the IAU definition, a constellation is an exactly defined part of the celestial sphere with all celestial objects that can be observed in it with all available tools and methods. The number, names and boundaries of the IAU constellations are unchangeable. Within the boundaries of the IAU constellations, there are traditional constellations with the same names. They are clearly visible (naked eye visible) and easily identifiable star configurations that have served from the ancient times as specific identification patterns: it is precisely them that an observer of the night sky sees, and not the boundaries of the IAU constellations.

The biggest star-identification patterns in the night sky are the sky polygons (the Summer Triangle, the Great Square of Pegasus, the Winter Hexagon and the Spring Triangle), whose vertices constitute the brightest stars from several constellations. The sky polygons are named according to the season during which they dominate in the night sky in the role of reliable celestial landmarks.

Spherical fields of the IAU constellations are of different shapes and surfaces, depending on the size and extension of the traditional constellations, whose



“cadastral municipality” they present. Some traditional constellations are simple, clustered configurations that can be viewed at a single glance, unlike the complex constellations within which star configurations of a lower rank — asterisms — can be identified. Asterisms are easily visible parts of the traditional constellations whose shapes and names may or may not be consistent with the parent constellations (compatible and incompatible asterisms), or they can be separate groups of faint stars that belong to star clusters (autonomous asterism).

The definition of the term asterism implies a star configuration with a historically well-established name, visible with a naked eye and easily recognizable.

By introducing geometrically defined and astronomically and geodetically delineated boundaries of the constellations, the IAU has given new meaning to the term constellation, compiled and determined their official list, but has left the issue of asterisms to historians of astronomy and onomasiologists. However, this has not made asterisms lose their names or functions, which are much older than the IAU: the IAU constellation has its depth, and it is examined by a telescope, whereas the traditional constellation is a mere conditionality and neither telescope nor coordinate geometry are needed for its observation, but the naked eye and asterisms. Therefore, the IAU should not leave the naming and renaming of asterisms to imaginative individuals. First, it needs to agree on a definition of the term asterism, after which it will not be difficult to compile their official list. This list is necessary because asterisms, as it has been shown, are still indispensable celestial landmarks in the naked eye astronomy.

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