

A History of the Magellanic Clouds and the European Exploration of the Southern Hemisphere

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The Magellanic Clouds were known before Magellan's voyage exactly 500 years ago, and were not given that name by Magellan himself or his chronicler Antonio Pigafetta. They were, of course, already known by local populations in South America, such as the Mapuche and Tupi-Guaranis. The Portuguese called them Clouds of the Cape, and scientific circles had long used the names of Nubecula Minor and Major. We trace how and when the name Magellanic Clouds came into common usage by following the history of exploration of the southern hemisphere and the southern sky by European explorers — which ultimately led to the founding of ESO.

This year we celebrate the 500th anniversary of the discovery of the navigable sea route that separates mainland South America from Tierra del Fuego — now known as the Strait of Magellan — by Fernão de Magalhães (Ferdinand Magellan in English) and his companions. It therefore seems an appropriate time to examine the “history” of the Magellanic Clouds, not least because the study of the Clouds was one of the main reasons for the foundation of ESO.

Magellan's expedition entered the strait at Cabo de las Virgenes on 21 October 1520 and exited via Cabo Deseado on 28 November. The Clouds are mentioned right after they left the strait, in the best-known narrative of the voyage — that by Antonio Pigafetta, who writes:

Il polo antartico non ha stella alcuna della sorte del polo artico, ma si veggono molte stelle congregate insieme, che sono come due nebulæ [the Clouds], un poco separate l'una dall'altra, e un poco oscure nel mezzo. Tra queste ne sono due, non molto grandi né molto lucenti, che poco si muovono: e quelle due sono il polo antartico. (see Ramusio, 1550).

Obviously neither Pigafetta nor Magellan himself named them the “Magellanic Clouds” — nor indeed did they name the strait after Magellan! The discovery of the passage between the Mar del Oceano (the Atlantic) and the Mar del Sur (the Pacific) quickly became known to sailors and navigators venturing to these remote countries. The race to reach the Spice Islands (the Moluccas) and the competition between Portugal, which controlled the “eastern route” (via the Cape of Good Hope) and Spain which wanted to exploit the “western route” to take possession of new lands, lent great importance to the discovery. Before long this new strait came to be called the “Strait of Magellan” after its discoverer. Of course, the various water channels at the southern end of South America were well known by local fishermen (Alacalufes or Tehuelches), but unfortunately no written reports by locals seem to exist.

As regards the Clouds, history is less clear. Magellan was not the first to reach southern latitudes where the Clouds are visible. On each sea expedition, at least one pilot/astronomer was present to determine the ship's position by astronomical means, so the Clouds could not have escaped their view. However, accounts are few. There are likely two reasons for this. First, the navigators were looking primarily for some star or asterism analogous to Polaris (the North Star) in the south in order to measure the latitude and obviously the Clouds would not serve that purpose. Second, at that time travel documents were kept secret in view of the competition between the various countries. So, to understand the “history” of the Clouds, one needs to follow the history of discoveries and travel in the south, and also the history of the mapping of the southern sky by European explorers and astronomers.

Local populations in South America of course had a knowledge of the southern sky long before Europeans reached that hemisphere. Unfortunately, little is known about their observations as information was transmitted orally and it is only in recent times that efforts have been made to record some of this knowledge before it is lost forever. For instance, the Tupi-Guaranis, in the region of Rio de Janeiro in Brazil, compare the Clouds to foun-

tains (*Hugua*) where a tapir (in the LMC) or a pig (in the SMC) is drinking (Afonso, 2006). Interestingly, the Mapuche in Chile also compare the Clouds to water ponds, called *Rüganko* or *Menoko* in their local language. These water ponds are in the *Wenu Mapu*, the heavens above, and are associated with the *Wenu Leufu*, the river above, i.e., our Milky Way (for example Pozo Menares et al. 2014). The similar nature of the Milky Way and the Clouds was therefore recognised long ago.

Early explorers

Little is known about travel to the south by the Greeks or the Egyptians, although the latter traveled down the Red Sea to seek gold. The first systematic travel in this direction is by the Arabs, progressing along the east coast of Africa or directly to India. When the Portuguese and Spaniards reached India and the Moluccas, they found a lot of trading posts already established by Arabs in India, Indonesia and Malaysia. From there spices were traded, shipped to the Arabic peninsula by boat and then moved further inland. Several nautical sources are available to us, dating back to the Persians or the Arabs. The best known is the *Kitab al-Fawa'id* (“Book of [nautical] principles”) of 1475 by the *mu'allim* (master of navigation) Ahmad ibn Majid: this knowledge was so precious that Vasco de Gama enrolled a “*Mu'allim Canaca*” to cross the Indian ocean in 1498. It is clear from those treatises that the Arabs navigated by the stars. They used the Pole Star (*Gah*), and also the big chariot (Ursa Major; *Na's*) or the Pleiades (*at-Turayyā*) and then further down *as-Suhayl* (Canopus) or other southern stars — the stars of the Southern Cross were included in Centaurus; for more details, see Ferrand (1928). But the Clouds, although certainly seen, were of no use for navigation owing to their diffuse nature.

The most ancient record we have of sky observations that include a possible mention of the Clouds seems to be the *Suwar al-Kawakib* (Book of Fixed Stars), written around 964 by the Persian astronomer Abd-al-Rahman al-Sufi. Ludwig Ideler, translating it into German from an extract by Kazvini (Ideler, 1809), includes the following statement:

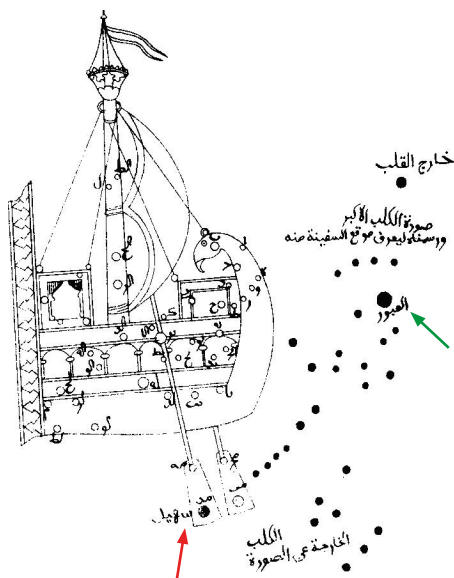


Figure 1. Argo – al Sufi (St. Petersburg manuscript, Schjellerup, 1874). The words at the bottom say “Dog, outside the image”. Red arrow: as-Suhayl (Canopus). Green arrow: Sirius (marked “Transient!”).

Unter den Füßen des Suhel (the classical name for Canopus) steht, wie einige behaupten, ein weisser Fleck, ... den man in Tehama El-bakar, den Ochsen nennt.

This is believed to be the Large Cloud, which could be seen in good weather conditions from the south of Arabia, although no coordinates were given. In 1874, a translation into French was made by the Danish astronomer Hans Schjellerup directly from an original manuscript; this version is slightly different:

Le vulgaire croit qu'il y a au-dessous des pieds du Suhail quelques étoiles luisantes et blanches qui ne se font voir ni dans Irak ni dans Nadschd, et que les habitants du Tihamat nomment ces étoiles al-bakar, les Vaches.

Schjellerup refers to stars and not a cloud; and *al-bakar* does indeed mean cows or a herd, rather than a bull. The accompanying illustration of the constellation Argo-Navis shows a group of stars, with Suhail (Canopus, indicated by the red arrow in Figure 1) at the southern

extremity of the ship's rudder. The illustration on the globe brought back by John Malcolm (Dorn, 1829) shows also a conglomerate of stars south of Canopus rather than a cloud, but the position would be approximately correct.

The Clouds can be seen below about latitude +15 degrees so Chinese voyagers, having long-established contacts with the Arab world, would have seen them when navigating around India. Admiral Zheng He, for example, made seven voyages to Arabia, beginning in 1405. However, these explorations were stopped by the Xuande Emperor (who reigned 1425–1435), and orders were even given to destroy all documents relating to the voyages, so we have no records about their observations today (see Levathes, 1994).

Portuguese sailors were presumably the first western explorers to see the southern sky. While the report of Ca'da Mosto's voyage (1455) mentions only the Southern Cross, the first reference to the Clouds seems to be that by Amerigo Vespucci during his third voyage in 1501–1502:

E fra le altre viddi tre Canopi: i due erano molto chiari, il terzo era fosco e dissimile dalli altri (Mundus Novus, 1504).

The two “clear” clouds and the third “dark and different from the others” are now interpreted as meaning the two Clouds and the Coalsack, although no precise coordinates are given. But a sketch showing southern stars at various times during the night also shows some accompanying nebulosity.

A fleet of 13 Portuguese ships, led by Pedro Álvares Cabral and bound for the Moluccas (the “Spice Islands” in Indonesia) to exploit the route opened by Gama, made a significant diversion and reached Brazil (called at that time *Terra de la Vera Cruz*) at the latitude of Bahia (~ 14° S) in April 1500. One of the ships was immediately sent back to Portugal to transmit the news of the discovery, carrying with it three letters of report, all dated 1 May. The one by Mestre João (João Faras), physician and navigator, is of most interest to us as it contains a sketch of the southern sky (see Figure 2, left) where the Southern Cross can easily be identified, with the pointers α and β Cen called “guardas”, as well as some other stars like the southern triangle. The term “la bosya”, in the lower left, is the one used in the north to refer to the small chariot, Ursa Minor, in reference to the Pole Star. This clearly shows that, at least at the beginning, the aim was always to find an asterism able to represent the south pole to aid navigation; this was later abandoned in favour of using the altitude of the Sun to derive latitudes. But there is no mention of the Clouds here (the sketch shows that they would fall at the edge of the map), probably because they are low on the horizon in April–May.

So one had to wait until Andrea Corsali travelled to India and wrote two letters from Kochi (Cochin), in 1515 and 1517, describing his voyage and experiences. The first contains a description of the southern sky (Figure 2, right). The various stars are more difficult to recognise than in Faras's letter, but the Southern Cross is there, and the two Clouds are also

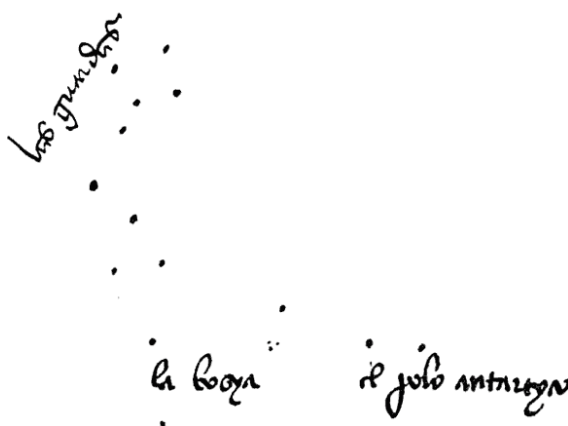
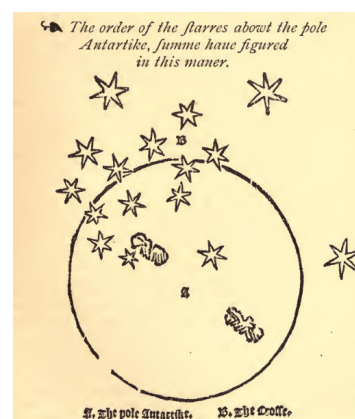


Figure 2. Left: sketch of the southern sky showing Crux (top left) and below it, the Southern Triangle (Mestre Joao, 1500). Right: Sketch from a letter sent by Andrea Corsali in 1515 (translated by Richard Eden).



seen, with a star in the middle which is presumably γ Hyd. He writes:

In che luogo sia il polo antartico, ...ed evidentemente lo manifestano due nugolette di ragionevol grandezza (the Clouds), ch'in-torno ad essa continuamente ora abbas-sandosi e ora alzandosi in moto circolare camminano, con una stella sempre nel mezzo, la qual con esse si volge lontana dal polo circa undici gradi (Ramusio, 1550).

This, from 1515, seems to be the first available representation of the Clouds. It is not clear when the mentions of the Cross and the Antarctic Pole were added: Rychard Eden, in his translation of d'Anghiera's *De Orbe Novo* (1555) has this figure with the names — but some earlier manuscripts don't! Several versions of this figure have been published, not always correctly attributed: some even attributed it to Magellan whose travel reports never included any sketch! D'Anghiera in his compilation of travels (d'Anghiera, 1516, in Latin), says “the Portuguese have gone beyond the fifty-fifth degree of the other pole, where... they could see throughout the heavenly vault certain nebulae, similar to the Milky Way, in which rays of light shone” (translation by F. McNutt). There is no mention of where he got this from but the description resembles Vespucci's.

Magellan's voyage and his immediate followers

Turning now to Magellan's voyage itself, the details are known largely thanks to

the lively reporting of Antonio Pigafetta, “Vicentino Cavagliere di Rodi”, who accompanied the expedition to discover the world, and to seek fame (as Pigafetta admits in the introduction to his report). Although the original report, which was written for the Duke of Mantova, has disappeared, several copies or translations quickly appeared, in French, Italian, and Latin.

In an early (shortened) French edition by J. A. Fabre, which is the translation of an original of Pigafetta (circa 1526), one can read, after the passage about the Strait:

Le pôle Antarctique n'est point tant étoilé comme est l'Arctique. Car on y voit plusieurs étoiles petites congrégées (packed) ensemble, qui sont en guise de deux nuées (the two Clouds) un peu séparées l'une de l'autre, et un peu offusquées (obscured), au milieu desquelles sont deux étoiles non trop grandes ni moult reluisantes et qui petitement se meuvent. Et ces deux étoiles sont le pôle Antarctique.

In this description, which has no accompanying sketch, it seems that the pole is represented by two small stars in the middle of the two Clouds (possibly γ and ν Hydri), unlike in Corsali's figure. But Pigafetta was not an astronomer, merely a writer who was sensitive to the beauty of the southern sky. His description of the voyage (and hence the Clouds) has probably survived better because it is livelier than the technical reports by navigators. Yet this was not the case in the years immediately following Magellan's

discovery of the Strait, when the most printed and distributed document/report was a letter by Maximilianus Transylvanus, secretary to Charles V, first printed in 1523. But it contains no mention of observations, the sky or the Clouds. D'Anghiera mentioned the Clouds in an earlier report (1516), but says nothing about the sky when describing Magellan's trip (d'Anghiera, 1524).

But where are the reports of the navigators and astronomers who accompanied Magellan's expedition? The chief pilot was then Andrès de San Martin, but he was killed, along with more than 20 others, on 1 May 1521 by Humabon, Rajah of Cebu; his papers, which are lost today, nevertheless survived for a while, probably confiscated by the Portuguese in Ternate when the Trinidad returned there. A later report of this voyage by Antonio de Herrera (1601) gives much more detail about the astronomical observations, which must come from San Martin's log-book. I also found a mention of this survival in Bibliotheca Hispana Nova by Nicolas Antonio Hispalensis (1773) and Barros (1553) says that he had “in hand” some papers and a book written by San Martin, collected in the Moluccas by Duarte de Resende. San Martin's observations subsequently percolated into reports by several other authors, and other pilot's reports are also available, but in none of them do we find any mention of the Clouds. Once again, this provides proof that the main interest was initially to find stars able to mark the southern celestial pole but not to map the sky, and even this approach was largely abandoned once the solar technique had been mastered^a.



proceeded to Peru, where he settled down. Unfortunately no report from that ship remains. The second ship, whose name and captain have not been recorded, went back to Spain after rounding Tierra del Fuego, discovering the southern strait (now called LeMaire). A fragmented report has been discovered by Torres de Mendoza (1879) in which one finds many observations of the Sun to derive latitudes, but nothing about the sky. There is, however, a clear mention of the Strait of Magellan:

A los 12 del dicho (January 1540), surgimos junto con el cabo de las Vírgines que está en cincuenta i dos grados largos, y de allí vimos la entrada del Estrecho de Magallanes, é tiene por seña, conviene a saber: el cabo bentallado, etc.

Later in the text, there are several mentions of the Estrecho (with capital E), showing that only about 20 years after its discovery, Magellan's name was clearly associated by sailors with the strait he had discovered.

A bit later, and unbeknownst to the Spaniards (at least at the beginning), another voyage was undertaken through the Strait and up the western coast of Chile, as far north as San Francisco. Francis Drake's voyage left Plymouth on 15 November 1577 and entered the Strait of Magellan (sic) on 20 August 1578. Again, apart from a lunar eclipse observed on 15 September that year, there is no relevant astronomical observation. I mention this here only because Houzeau (1885) claims that the name Magellan, associated with the Clouds, can be found in Hakluyt (1589), about Drake's voyage of 1578. Besides Hakluyt (1589), all the documents relating to that voyage, including a detailed report by the pilot Nuño da Sylva, can be found in Nuttall (1914) — but I could not find any mention of the Clouds!

It therefore seems clear that by then the name of Magellan was being associated by navigators with the Strait, but not necessarily with the Clouds. This is also indicated by the report of one of the most successful expeditions to the Strait, conducted by the brothers Nodal in 1618–1619, who made the journey in less than 10 months and, remarkably, with no

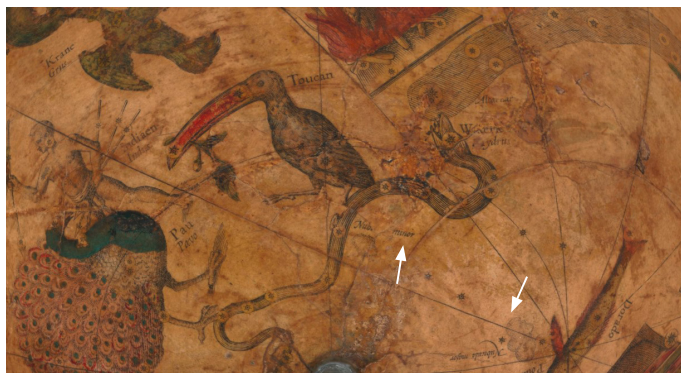


Figure 4. The Toucan (Hondius globe, 1600, BNF Paris). Below Tucana is Nubecula Minor; and Nubecula Major is below Dorado, in the lower right corner (arrows).

losses. It was said to have been organised to recognise the “new strait of São Vicente and the one of Magellan”, because “it had become difficult owing to the number of years during which notice of the navigation had been lost,” as Sir Clements Markham's translation (Markham, 1911) has it. This report mentions some celestial observations (including the sight of the great Comet of 1618) but there is no mention of the Southern Cross or of the Clouds, as if these were already common knowledge. Clearly, by this point the Sun was the preferred way of determining latitude, together with tables in the *Hidrographia Nautica* of Cespedes (1606).

First mappings of the Southern Sky

The Spaniards' interest in the Spice Islands progressively declined, as they were merely active in getting silver and gold back from Peru and had sold their rights on Moluccas to Portugal. The Dutch launched their first expedition, known as the “*eerste Schipvaart*”, under Cornelis de Houtman, who left Holland for the Indies on 2 April 1595. On board were his brother Frederick and Pieter Dirkszoon Keyser (latinised as Petrus Theodori). Keyser had been trained by the cartographer Petrus Plancius, who instructed him to make a record of the southern sky for his celestial globes. This is the first known systematic measurement of the southern sky, probably mostly carried out when the fleet stopped for several months in Madagascar. Unfortunately, Keyser died in Indonesia (reached only in June 1596), but the measurements were probably brought back by Frederick de Houtman in August 1597. During a second voyage with his brother, Frederick complemented those observa-

tions further, returning in July 1602. None of Keyser's notes survived, but de Houtman brought back measurements which were long hidden as an appendix to his dictionary and grammar of the Malayan and Malagasy languages (Houtman, 1603), later reprinted as a catalogue of southern circumpolar stars in a French translation by Aristide Marre (1881). They have clearly been used on various celestial globes by Hondius (1598; 1601), Willem Blaeu (1602) and ultimately by Bayer in his *Uranometria* (1603) where he explicitly mentions Petrus Theodori as the originator of his 12 new constellations (although it is actually Plancius, not Theodori, who is behind these twelve constellations of the southern sky, still in use today with small modifications). Interestingly, no mention of the Clouds is made in Houtman's catalogue but they do appear on Hondius's earlier globes. For instance, of Dorado (where the LMC would be) Houtman (1603) says only: “*Den Dorado heft 4. Sterren*,” and in “*Den Indiaenschen Exster, op Indies Lang ghenaeft*” (our Tucana, close to the SMC), he mentions only six stars. But Bayer's map of the southern pole (his plate 49) indicates both Nubecula Minor and Nubecula Major (without mention of Magellan), Latin being the usual working language at the time.

A detailed analysis of these early mapping attempts can be found in Dekker (1987). Houzeau (1885) claims that Theodori returned in 1597, bringing back “*une énumération des Constellations du Sud en douze astérismes antarctiques...*,” one of which was “*le Nuage*” (the Cloud). Houzeau initially counted 12 new constellations including the Cloud, but then ends up with 21, eight of which were already listed by Ptolemy: his total now

amounted to 13 (21 – 8), including two new ones (Crux and Musca) but excluding the Cloud! While it is clear that Houzeau was misled about Theodori by the comment in Bayer's *Uranometria*, it is less clear where his idea of the constellation *le Nuage* comes from. Maybe he was influenced by the presentation of the Clouds in the earlier globes of Hondius (see Figure 4) or Blaeu. There are unfortunately many approximate statements in this paper. As for globes, see a detailed description of some of them in van der Krogt (1993) or at the National Maritime Museum in Greenwich, but these are all references to the Nubeculae, not to the name Magellan.

It is clear from these early records that neither the Clouds nor the Southern Cross were of any real interest to the sailors anymore, rather they were merely a curiosity in the sky. The Portuguese, of course, knew them and occasionally mentioned them as the Clouds of the Cape. The development of celestial cartography proceeded and usually included the Clouds, but with their Latin names, Nubecula Minor and Nubecula Major (see, for example, the maps in Bayer's third edition of 1661; or in the atlases of Cellarius, 1660; Pardies, 1675; Flamsteed, 1725; Ottens, 1729). Schiller (1627), in his curious biblical map, includes Tucana, Hydrus and Nubecula Minor in his idiosyncratic constellation of St Raphaël. In his *Uranographia*, where the names of 30 Dor or 47 Tuc come from, Bode (1801) uses both German and French, but does not mention Magellan.

Two major efforts to get better celestial cartography in the south were undertaken after Plancius. The first was by Edmond Halley from the island of St Helena, where he had been sent by John Flamsteed the first English Astronomer Royal; he observed during 1677 and published the *Catalogus Stellarum Australium* (Halley, 1679). His work is known because of the inclusion of a new (fleeting) constellation, Robur Carolinum, to please King Charles II. He mentions in an appendix that:

Proxima, ex iis quas observavi, est in Cauda Apodis, in distancia paulo ultra 8 graduum, Duæ Nubeculae, quæ a Nautis Nebulae Magellanicae appellantur, exacte referent Galaxiae albedinem &

Telescopio inspectae, hinc inde Nebulas Parvas & exiguas Stellas ostendunt...

It appears it was clear to him that the name Magellanic Clouds was used only by sailors, and that those Clouds resemble the Milky Way. The only other mention in the catalogue itself comes in the final list of bright stars "*in Usu Navigantium*", useful for navigation, where the first in the list is "*quæ adjacent Nubeculae minori*", close to the Small Cloud. The Clouds also appear as Nubeculae in his *Planisphère* of 1678.

The second effort was by Nicolas de La Caille who observed at the Cape of Good Hope between August 1751 and July 1752. He published a catalogue of southern nebulae (or, more precisely, of nebulous stars) in 1755, in which the Clouds are not listed, probably because they were too large for his purpose (47 Tuc and 30 Dor are mentioned). In the introduction he says that he observed the brightest regions of the Milky Way several times with a 14-foot (4.25-m) focal length telescope, and compared them to the two Clouds:

"qu'on appelle communément les nuées de Magellan et que les Hollandais et les Danois appellent les nuées du Cap (his underlining). On voit évidemment que ces parties blanches du ciel se ressemblent si parfaitement, qu'on peut croire, sans trop donner aux conjectures, qu'elles sont de même nature,..."

He adds that these Clouds seem to be detached parts of the Milky Way, and that it is not clear that their whiteness would be caused, as is usually believed (sic), by clusters of small stars more tied together than in other parts of the sky, as he could not resolve them with his telescope. About the names, he also says:

D'ailleurs, la plupart des Navigateurs appellent nuages du Cap, ce que nous appelons nuées de Magellan, ou le grand & le petit nuage.

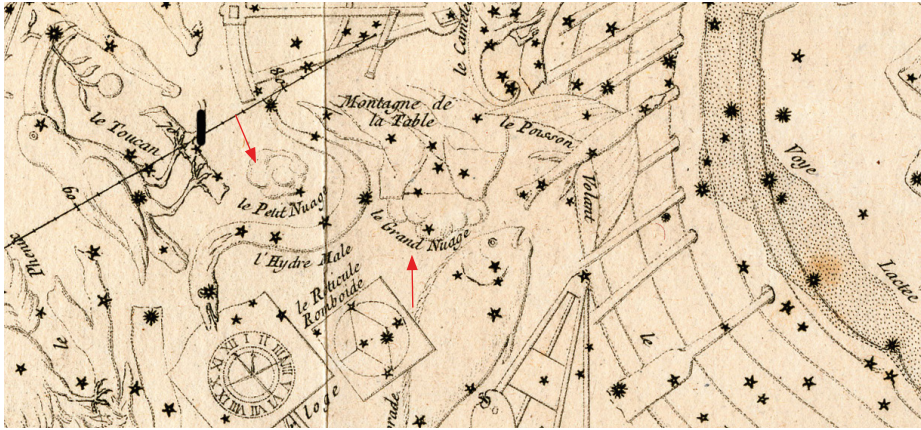
In the celestial map completing his publication (see Figure 5) the two Clouds do indeed appear under the names "*le Petit, et le Grand Nuage*". But his words, "*que nous appelons nuées de Magellan*", seem to indicate that around that time the

association of the Clouds with Magellan was already spreading beyond the nautical community, even if the scientific term was still simply Nubeculae or les Nuages.

When James Dunlop described his observations of the southern sky (Dunlop, 1828) "*made at my house*" in Paramatta, near the Brisbane Observatory in Australia, he reported that he made: "*very correct drawings of the Nebulae major and minor... with an excellent 9-feet reflecting telescope*" but there is not a single mention of Magellan. He gives detailed sketches of both nebulae, with the positions of many stars and smaller nebulae within.

When Rümker later published his catalogue (Rümker, 1832) based on observations from the Observatory of Paramatta, Australia, he states that "*the Nubeculae major and minor of LaCaille are two fragments of the via lactea and distinguish themselves by nothing from any other parts of it requiring, with the exception of two nebulae, no powerfull telescope to be dissolved in well-defined Star's*" — again, no mention of Magellan.

John Herschel (1847), in a section entitled "On the two nubeculae or Magellanic Clouds", talks only about Nubeculae. Only in the accompanying figure, where he gives his visual observations, does he mention, "*The two Magellanic Clouds as seen with the naked Eye*". So he uses both the scientific denomination and the more public name, and Herschel seems to have been the first to use the name Magellanic Clouds in scientific publications. Later, in the first edition (1910) of the well-known Norton's Star Atlas, it is stated that, "the Magellanic Clouds or Nubecula Major and Nubecula Minor appear to the naked eye like detached portions of the Milky Way, and are a marvelous sight in the telescope" as if their names were obvious, but without any further note on Magellan (nor on their nature). So, although no precise date can be given, it seems that by the late 19th century, the term Nubecula was still being used in scientific exchanges, but the term Magellanic Clouds was progressively passing from nautical circles to the public and scientific spheres, finally replacing Nubeculae once scientists abandoned Latin.



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