

## M102 - Messier's Unknown Journey

*Beset with errors*

"M102. Nebula between the stars  $\omicron$  (Omicron) Boötis and  $\iota$  (Iota) Draconis. It is very faint. Close to it is a sixth-magnitude star." Messier, *Connaissance des Temps* (Knowledge of the Times) for 1784, page 267. Messier states that this was communicated to him "through M. Méchain, which M. Messier has not yet observed."

Thus the journey begins.

Two years after his initial discovery, Pierre Méchain, Messier's colleague and friend, retracted his discovery, "On page 267 of the *Connaissance des Temps* for 1784, M. Messier lists under no. 102 a nebula which I have discovered between Omicron Boötis and Iota Draconis: this is nothing but an error. This nebula is the same as the preceding No. 101. In my list of nebulous stars communicated to him, M. Messier was confused *due to an error in the sky-chart*."

Note that Méchain still refers to *Omicron Boötis* two years after Messier's original announcement of discovery. And also note the statement, "due to an error in the sky-chart."

### Messier Catalogue published by Messier in *Connaissance des Temps*

#### Détails des Nébuleuses & des amas d'Étoiles English: Details of Nebulae & Star Clusters

##### M101

- Nébuleuse sans étoile, très-obscur & fort large, de 6 à 7 minutes de diamètre, entre la main gauche du Bouvier & la queue de la grande Ourse. On a peine à la distinguer en éclairant les fils.
- In English: A starless nebula, very dark and quite large, 6 to 7 arc minutes in diameter, located between the left hand of Boötes and the tail of Ursa Major. It is barely visible even when shining a light on the wires.

##### M102

- Nébuleuse entre les étoiles omicron du Bouvier & iota du Dragon, elle est très-faible; près d'elle est une étoile de la sixième grandeur.
- In English: A nebula between the stars Omicron in Boötes and Iota in Draco, it is very faint; near it is a star of sixth magnitude.

Surely, Méchain and Messier knew that Omicron Boötis lies 42° south of Iota Draconis – and 38° south of M101 – and, therefore, by themselves, these stars would not make suitable guides for locating *any* object. So, the designation of one or both of them must be in error.

### Admiral Smyth's analysis

Admiral Smyth, who observed from Bedford, England (north of London) with a 6 inch refractor in the 1820s and 30s, first suggested that Omicron Boötis was actually meant to be read as Theta Boötis. The Greek Theta (θ) when drawn poorly and without the cross stroke can resemble Omicron (ο).

With that in mind, Smyth wrote regarding a nebula that he thought would be a plausible M102 candidate, "A small but bright nebula on the belly of Draco with four small stars spreading across the field N of it. Doubt as to whether this is the nebula discovered by Méchain in 1781 since Messier describes it as 'very faint,' situated between Omicron Boötis and Iota Draconis. If Omicron Boötis should be Theta Boötis, this is probably the object seen by Méchain and [is also] JH's 1910, being the brightest nebula of five in that vicinity." JH refers to John Herschel's list of nebulae.

Here lies another error: JH 1910, today designated as NGC 5879, is not the brightest in that group. That honor falls to NGC 5866. But in his 1844 work, the *Bedford Catalogue*, Smyth favored NGC 5879 as being the missing M102.

### JLE Dreyer's take

An offshoot from this analysis is JLE Dreyer's belief that it wasn't Omicron Boötis that was in error, but Iota Draconis. (Dreyer was the driving force behind the New General Catalogue of Nebulae and Clusters of Stars.) He posited in 1895 that the correct star was Iota Serpentis and suggested that the missing nebula was between this particular Iota and Omicron Boötis, and that the nebula was the 14th magnitude NGC 5928. With Messier's and Méchain's 4-inch aperture instruments, a 14th magnitude extended object was far out of reach, precluding NGC 5928 as being a viable candidate.

Méchain's description of **M101** in 1784 as given by Messier:

"Nebula without a star, very obscure and pretty large 6' or 7' in diameter between the left hand of Boötes and the tail of the Great Bear." As seen through today's small telescopes, that seems to be a reasonable description of M101. And, indeed, it does lie between the left hand of Boötes (Theta and Kappa Boötis) and the tail of the Great Bear (Zeta and Eta Ursae Majoris). This is not in dispute.

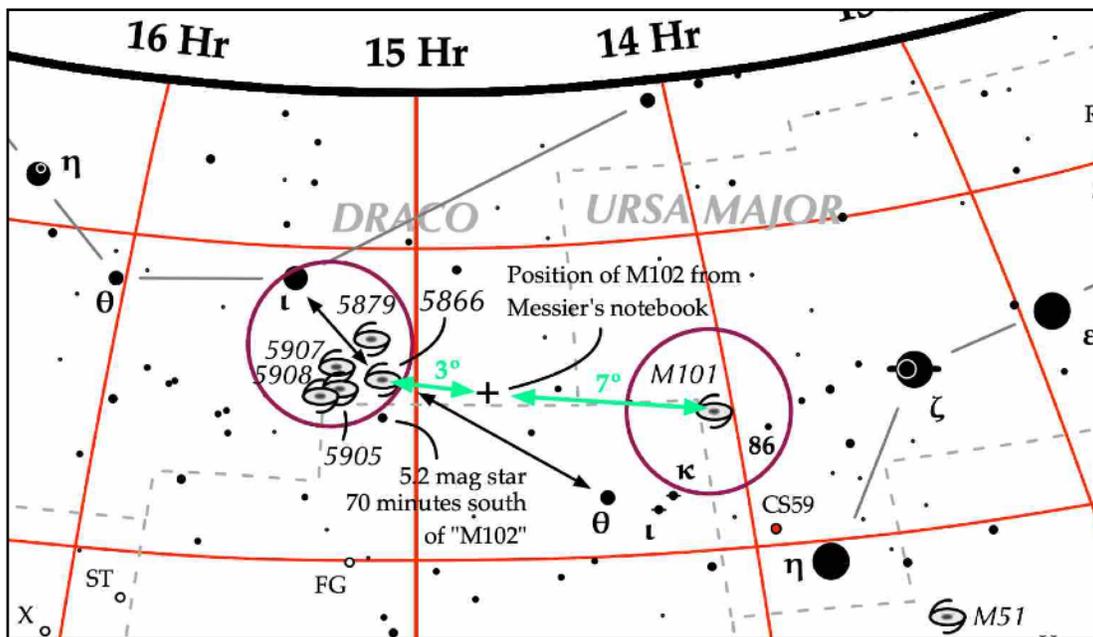
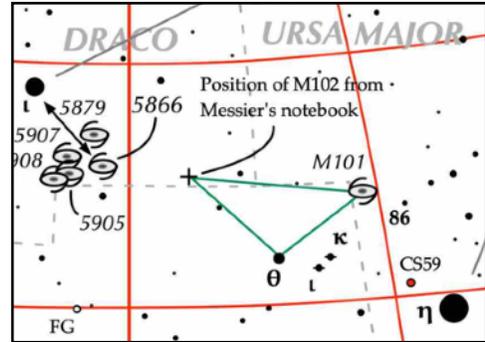
	1790		2000	
	RA	Declination	RA	Declination
<b>M101 (true coordinates)</b>	13h 55m 36s	55.4°	14h 3m 12s	54.3°
<b>M102 (handwritten position for M102 added later to Con des Temps 1784)</b>	14h 40m	56°	14h 46m	55.1°
<b>NGC 5866 (true coordinates)</b>	15h 1m	56.6°	15h 6m 30s	55.7°

Repeating Méchain's description of **M102** in 1784 as given by Messier:  
 "Nebula between the stars  $\theta$  [Omicron] Boötis and  $\iota$  [Iota] Draconis. It is very faint. Close to it is a sixth-magnitude star."

Messier added by hand to his personal copy of *Connaissance des Temps* (1784) the coordinates of Méchain's M102: 14h 46m, +55.1° (2000).

The position for NGC 5866 is 15h 6.5m, +55.7° (2000), and for M101 it is 14h 3.2m, +54.3°. Both NGC 5866 and M101 have about the same declination as the controversial M102.

Strangely, Messier's handwritten coordinates of M102 are about 3° due west of NGC 5866, and 7° east of M101. Was this due to an error on his chart that Méchain was referring to in his retraction, plotting it 3° west of where it should have been? Or an error plotting it 7° east of M101? Also, adding confusion is that Theta Boötis lies midway between Messier's handwritten RA coordinates for M102 and the true coordinates for M101, as pointed out by modern observer Stephen O'Meara. Does that mean anything to the analysis?



### Summary: The case for M102 = M101

- The simplest explanation is the correct one: Méchain really did repeat an observation of M101.
- Méchain's and Messier's note taking and position plotting were sometimes too hastily done. The coordinates added by Messier may have been 7° too far east of M101, as had happened with other coordinates in Messier's map plotting. Stephen O'Meara has asserted that this is the case.

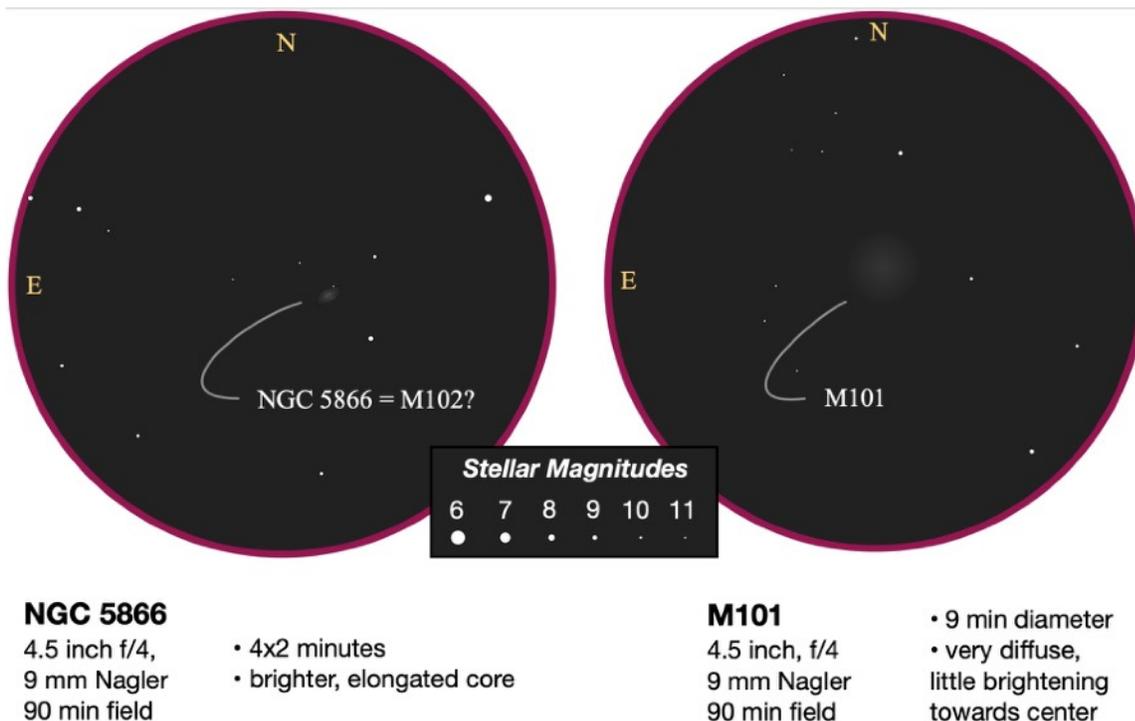
- 86 Ursae Majoris is a 5.7 magnitude star 90 minutes southwest of M101. This would account for the 6th magnitude star mentioned in Méchain's description,
- The visual appearance of M101 and NGC 5866 look nothing alike. Their size, brightness, and diffuseness are quite different. If Méchain truly had observed NGC 5866, he would have noticed that it looks nothing like M101. NGC 5866 is faint, but it does have a brighter center. And it is noticeably elongated and not round, like M101, with its length about half of M101's apparent diameter.

### Summary: The case for M102 = NGC 5866

- Méchain's original descriptive location of M102 lying between Omicron (i.e., really Theta) Boötis and Iota Draconis better fits NGC 5866's true location than M101's.
- Méchain's visual description of M102 through a 4-inch telescope resembles more NGC 5866 than M101.
- The nearby sixth magnitude star is 5.2 magnitude HIP 73909 and lies 70' south of NGC 5866.
- Many observers today would not use Iota Draconis and Theta Boötis as reference stars to locate M101. They would more likely use Mizar and Alkaid. However, they would use Iota and Theta to triangulate to NGC 5866.

### Concluding remarks

We have two real possibilities for the identity of M102. After reading this story and after observing M101 and NGC 5866, what do you think? Or is there yet another possibility?



## Your observing tasks

1. **Identify** the stars Iota Draconis, Theta Serpentis, Theta Boötis, and Omicron Boötis.
2. **Concentrate on locating, then observing NGC 5866.** Do you also see NGC 5879? Any other galaxies?
  - What guide stars did you use?
  - Note telescope aperture, and field of view.
  - Give a description of the the galaxies you see: include size, shape, brightness, and appearance of a noticeable core. Any other galaxies in the area?
  - Attempt a sketch of what you observe.

Modern estimates of size and brightness:  
NGC 5866 - 9.9 magnitude, 4.7' x 1.9' in size  
NGC 5879 - 12.4 magnitude, 3.7' x 1.0' in size

### 3. Locate and Observe M101.

What guide stars did you use?  
Give a description: include size, shape, brightness, presence and appearance of a noticeable core.  
Attempt a sketch of what you observe.

Modern estimates of size and brightness:  
M101 - 7.9 magnitude, 28.8' x 26.9' in size

While the use of all sizes of telescope apertures is permitted for this challenge, it would be more instructive to use one of around 4 inches. (Yes, the galaxies will be exceedingly faint!) This would help simulate how these galaxies would have appeared to Méchain and Messier. (For those of you who are familiar with the "Library Telescope Program," this instrument of 4.5 inches aperture would be nearly ideal.)

### 4. Outreach component. Do any one of these three activities:

- Hold a public session to observe M101 and NGC 5866.
- Give a presentation at a club meeting about this topic
- Write an article for your club newsletter describing this Observing Challenge and what you did to complete it.

## References

John H. Mallas and Evered Kreimer, 1978. The Messier Album. 1st edition. Sky Publishing Corporation, 1978. Second revised printing 1979.

O'Meara, Stephen, 2005. M102: Mystery Solved. Sky and Telescope, March, p 78-79.

<http://www.messier.seds.org/xtra/supp/m102art.txt>

Jones, Kenneth Glyn, Messier's Nebulae & Star Clusters. Cambridge University Press, 1991.

Frommert, Hartmut, M102 Controversy, *SACNews* of the Saguaro Astronomy Club, March 1998, no. 254, p1.

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