

NGC 7331

**And Its
Ambiguous
Galaxies**

by Jeffrey Corder and Steven Gottlieb

The field of NGC 7331 is shown here in this photo by K.A. Brownlee. The three galaxies to the east of 7331 are NGC 7335, NGC 7336, and NGC 7337. All other noted objects are stars or close double stars.





The brightest galaxy in Pegasus, NGC 7331, lies high overhead for northern viewers on fall evenings. This spiral was one of William Herschel's earliest discoveries over 200 years ago. Since then, it has been carefully studied by astronomers using progressively more sophisticated instruments and today is considered a galaxy much like our own Milky Way.

Classed as "spiral nebulae" by early observers, galaxies, they noticed, are often accompanied by smaller, fainter neighbors. NGC 7331 is no exception. Following Herschel's discovery, various observers noted the presence of eight suspected companions. Modern observations support the likelihood of a true galaxy cluster in the background, but NGC 7331 is probably not involved.

Chance alignment has the galaxy in the foreground along the same line-of-sight as the small, more distant group.

Discoveries of new galaxy companions were often a pathway to fame and success for late 18th- and early 19th-century astronomers. Monstrous-size telescopes employed by these observers were able to reveal innumerable small "nebulae," but were cumbersome to use, making the note-taking process difficult and drawn-out. Errors were inevitable. Moreover, the telescopes were often situated in locations subject to extended spells of bad weather. Astronomers therefore found it difficult to recheck their notes and observations. The NGC 7331 group fell victim to these errors, some of which have been passed down to more modern times.

Although visible in large finder scopes, NGC 7331 was apparently missed by Messier. In many respects this galaxy resembles the famous Andromeda spiral. Like M31, the Pegasus galaxy is much elongated. This appearance is caused by its nearly edge-on alignment. It has been determined that the western side is nearer to us, hence the galaxy is believed to be rotating with the spiral arms trailing. Lying 23 times more distant than M31, and with an angular size one-twentieth that of the nearer galaxy, it can be seen that NGC 7331 is comparable in size. Also, like M31, 7331 is rich in HII regions; over 125 have been catalogued. These clumps of ionized hydrogen allow 7331's mass, rotation, and distance to be measured with accuracy. The main

Table One

NGC	DISCOVERER	R.A.	DEC.	NOTES	REF.
7325	Schultz 1882	22h 35.7m	+34°15'	"F,vS,7331 foll."	1,3,4
7326	Rosse, 1874	22h 35.7m	+34°18'	"eF,eS,7331 foll."	3,1
7327	Tempel	22h 35.7m	+34°21'	"eF,eS,Np 7331"	5,1
7331	W. Herschel	22h 35.9m	+34°18'	"B,pL,pmE 163°,smBm"	1,3,4
7333	Schultz, 1882	22h 36.1m	+34°19'	"VF,VS,p 7335"	1,3,4
7335	W. Herschel	22h 36.1m	+34°19'	"VF,VS,pos 61°,dist 228""	1,3,4
7336	Rosse, 1849	22h 36.1m	+34°21'	"eF,VS,pos 43°,dist 315""	1,3,4
7337	Rosse, 1849	22h 36.3m	+34°15'	"eF,S,Stell,p119°d328""	1,3,4
7338	Tempel	22h 36.3m	+34°18'	"eF,eS,Sf 7335"	5,1
7340	Rosse, 1849	22h 36.5m	+34°18'	"VF,VS,pos 92°,dist 507""	1,3,4

Bibliography

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difference between M31 and 7331 is the greater abundance of younger, bluer stars in the Pegasus galaxy.

Recently, sources of radio emission have been observed in the region of NGC 7331. The sources also seem to engulf the nearby galaxy cluster, Stephan's Quintet, located about 1.5° to the southwest. This, along with the photographic evidence of a very faint but extensive filament of material stretching between Stephan's Quintet and NGC 7331, argues for a past gravitational interaction that may have once occurred between these galaxies. NGC 7320, the largest member of the Quintet, lies in the foreground of its more distant members, and is the most likely candidate for an ancient association with NGC 7331.

Observers with small telescopes can easily view the prominent features of NGC 7331. It has a well-defined oblong core, and a bright, compact nucleus. The north-south orientation is also quite plain. Spiral structure is evident in 12-inch and larger telescopes. Remarkably, some of the associated HII regions can be seen in larger instruments, especially of the 16-inch class. Careful observers with large telescopes, keen eyesight, and dark skies may catch glimpses of the string of HII knots aligned along the western edge of the galaxy. As with M31, a dust lane is visible.

As noted in the first table, a total of nine NGC entries lie in the vicinity, including NGC 7331. A second table includes five questionable NGC entries,

with their RNGC coordinates and descriptions. Again, although the galaxies listed in the tables seem to be companions of NGC 7331, even a casual inspection of photographs reveals NGC 7331 to be a foreground object.

Observers using 8-inch telescopes can see only a couple of the galaxies listed in the first table, partly due to their dimness, but also because of the many ambiguous galaxies catalogued in this region. Let's explore the entries for the NGC 7331 region in historical detail and find the true members.

A comparison of the two tables reveals a discrepancy in positional data for the first two entries, NGC 7325 and NGC 7326. Both objects were studied by Lord Rosse and other Irish observers at Birr Castle in 1874. Accurate



positions were measured in reference to NGC 7331 and it is clear that the original observers mistook the slightly elongated appearance of close double stars for very small galaxies. The authors of the RNGC evidently used these two ambiguous NGC designations to incorrectly label two nearby anonymous systems, both 10' northwest of the original NGC positions.

In actuality, NGC 7326 is a close pair of magnitude 15 stars just west of the core of NGC 7331, and NGC 7325 is a wider double easily resolvable in a 10-inch scope, 3' south. It is likely that poor resolution of the older telescopes, compared to even the common smaller compound telescopes of today, misled the earlier astronomers into making such false discoveries as these two "galaxies." The newer RNGC 7326 is listed in Fritz Zwicky's *Catalog of Galaxies and Clusters of Galaxies* (CGCG) as 514.066 at photographic magnitude 15.7 and is visible in backyard scopes.

The next object, NGC 7327, was discovered by the German astronomer Ernst W. Tempel with an 11-inch refractor. Although Tempel gave only a vague position in his original paper, Dreyer gave an exact position in the

NGC that closely matches Tempel's description of "preceding the northern end of NGC 7331." This information was undoubtedly conveyed through private correspondence. No double star is noted at the exact position from the NGC, but a single faint star lies very near the expected position. Astronomer Harold Corwin, Jr. of the University of Texas at Austin believes that some of the nebulosity involved with NGC 7331 may have caused the star to appear nonstellar to early observers, but he is guarded in his opinion. A visual inspection of the star in question shows not the slightest hint of nebulosity. It is likely that Tempel was misled during a period of poor seeing. Since Tempel claims to have seen all nine "nebulae" in this region it is also assumed this could not be a duplicate of another of his observations. We may never know exactly which object Tempel actually saw, but it is plain that no galaxy exists at the given NGC position.

Our next object, NGC 7333, was discovered by Dr. Herman Schultz at Uppsala, Sweden and announced in January 1875. Fortunately, Dr. Schultz gave a precise position for his new "nova" to the east of NGC 7331. The

astronomers at Birr Castle, using their tremendous 72-inch reflector did not find the Schultz object, which right away cast doubt on its existence. Modern telescopes show an extremely close double star at that location, which is just elongated on a Hale 5-meter plate. Amazingly, Schultz must have noted this elongation visually in his 13-foot focal length refractor. The exact match in position leaves little doubt as to the certainty of the identification. The RNGC correctly notes this as a double star.

NGC 7335 is one of the galaxies that does indeed exist. Discovered by William Herschel, this galaxy is the brightest of the group of four on the eastern side of NGC 7331. It lies in Herschel's class III, "very faint nebulae." Because of its great distance only photographs reveal much detail, but observers will note its distinctly elongated shape and large bright core.

The other three galaxies positioned on the eastern side of NGC 7331 can be seen in 10-inch or larger telescopes. One of these is a nearby companion to NGC 7335, the barred spiral NGC 7336 only 2' north-northeast. This system was discovered by Lord Rosse but seems to

Table Two

RNGC	R.A.	DEC.	RNGC DESCRIPTION	CONCLUSION
7325	22h 35.4m	+34°22'	"R,alm stel,HISB	not NGC object,10'NW
7326	22h 35.3m	+34°25'	"EL,sldiff,BM,sstsusp	not NGC object,10'NW
7327	22h 35.7m	+34°21'	"***"-Carlson	star NW 7331
7333	22h 36.1m	+34°19'	"***"-Carlson	close double NNW 7331
7338	22h 36.3m	+34°18'	"***"-Carlson	double star NNE 7337

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- Also: private correspondence with Dr. Harold Corwin, Jr., The University of Texas at Austin, Astronomy Dept. RLM 15.308. Austin, TX 78712, 12 Sept. 1985.

have been missed by Zwicky in the CGCG. Otherwise, all of the early observers seem to have their identifications correct in this case. Visually NGC 7336 is very faint and elongated in a northeast-to-southwest direction. It appears very small and contains a bright core. Although the faintest of four galaxies in this group, it should present no challenge to a 17.5-inch telescope.

The third small galaxy that can be viewed in backyard telescopes is NGC 7337, again discovered by Lord Rosse. This barred-spiral system is located about 7' south of the NGC 7335/36 duo. A 13th-magnitude star appears nearly attached on its southeast side. The galaxy is very faint, very small, and round, and has an even surface brightness. Brighter NGC 7340 is just to the northeast.

The second of Tempel's two "discoveries" in this area has been catalogued as NGC 7338. Only vaguely referred to in Tempel's original paper, it is noted as being "between the four brighter nebulae to the east, a little closer to the two southern ones." We can only assume that he was able to satisfy Dreyer with a more precise location, than which appears in the

NGC. This time the NGC position does not fall on any visible star, double star, or galaxy. Corwin believes the best evidence points to a faint double star 3' southeast of NGC 7335. This position differs with the NGC position by only 0.2' of right ascension. The NGC position may be off by this much, as it seems then to fit Tempel's original notes more accurately. At any rate, a visual inspection of the star in question shows it to be double, which could be mistaken for a nearly stellar galaxy.

The final galaxy for consideration in the NGC 7331 area is NGC 7340, a faint elongated system 8' to the east of NGC 7331. The galaxy was the third and final discovery by Lord Rosse at Birr Castle, Ireland, in 1849. This galaxy is considerably faint, at only photographic magnitude 14.9, which places it as second brightest among its three faint companions. It appears round with a small bright core. This galaxy is at the very limits of an 8-inch telescope under a dark sky.

From our considerations of the field surrounding NGC 7331, it is obvious that early astronomers realized that these "nebulae" often appear in groups. Observers evidently searched the area

around the brighter galaxies quite carefully, hoping to make a discovery of their own. A good example of this method is illustrated in the catalogue of the astronomers using the 72-inch telescope at Birr Castle. Even Dreyer noted that the Birr Castle "discoveries" were usually found clustered together around brighter galaxies. In our case, in the vicinity of NGC 7331, early observers correctly identified four neighbors (NGC 7335, 7336, 7337, and 7340), but mistakenly observed five others.

It is also evident from this one case that many errors still exist in the catalogues used regularly by amateurs. It is important to spend some time to research observations so that we can be certain of what we are seeing and recording. This requires some effort but it can make the difference between accurate and inaccurate observations.

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