

Digging Deep in M33

The Triangulum Galaxy is a treasure-trove of subtle beauty. *By Alan Whitman*

CHARLES MESSIER DISCOVERED the 33rd object in his catalog of comet imposters while exploring the constellation Triangulum in 1764. He described it as a “whitish light of almost even brightness . . . seen with difficulty” — a description that many new observers can relate to. Although M33 is the fourth-brightest galaxy in the sky (not counting the Milky Way), its light is spread out over a huge area — three times the size of the full Moon — making it notoriously hard to discern from suburban backyards. But if you explore the Triangulum Galaxy under dark skies, you’ll find a wealth of subtle detail — more than you can see in any other galaxy visible from northern latitudes.

For many years, I was content to admire M33’s spiral arms,

its nucleus, and the bright nebulae that arc across its northern side. But after visiting the Southern Hemisphere and tasting the riches of the Magellanic Clouds, I wondered what a detailed hunt in the Triangulum Galaxy might reveal.

So in October 2002, while administering the Chaco Observatory in Chaco Culture National Historical Park, I decided to explore M33 with the observatory’s 25-inch (635-millimeter) motor-driven Dobsonian reflector. At an altitude of 6,200 feet (1,900 meters) in New Mexico’s high desert, the site had superb transparency. The gegenschein in Pisces was huge — almost the size of the Great Square of Pegasus — and I also glimpsed the fainter zodiacal band extending from the gegenschein toward the Pleiades. (The zodiacal

light consists of sunlight reflected and scattered by dust particles near the ecliptic plane; it includes a bright patch called the gegenschein directly opposite the Sun.) Early one morning I noticed that the brilliant stars of Orion were casting the dome’s diffuse shadow onto the concrete sidewalk. I spent 12 hours observing the Triangulum Galaxy over three consecutive nights, tallying a total of 35 distinct glows — emission areas, stellar associations, or combinations of both.

After seeing a challenge object once, you can often find it with a smaller telescope. Returning home to British Columbia and rinsing the mirror of my 16-inch Newtonian for optimal contrast, I found all but 4 of those 35 objects during eight hours over three more nights, observing mostly at 229×. Steady seeing at my lakeside observatory helped compensate for the smaller aperture. The transparency was good, but it didn’t compare to the high desert: M33 was visible to the unaided eye, but the gegenschein was only the size of the Circlet of Pisces.

Last February I decided to explore M33 with a much smaller telescope. Using an 8-inch Dobsonian at 150× I found seven cataloged objects — far more than I had seen before in decades of casual observing. My mountain site was superbly dark, but M33 was only 35° above the horizon. This suggests that many people could duplicate the observations under less favorable skies.

Overall Impressions

M33’s most prominent features are the two mottled inner spiral arms arranged in a backward S. S&T senior editor Joshua Roth has glimpsed these using an O III filter in a 2.4-inch scope at 11×. The northern arm ends near NGC 604, and



Robert Gendler created this mosaic of M33 from 27 CCD frames shot through 4-inch and 12.5-inch telescopes. The field shown is $3/4^\circ$ tall, with north up.

even an 8-inch scope shows several condensations in the brighter southern arm. An amorphous third inner arm attaches to the southwestern side of the galaxy's core. Large telescopes also show two outer arms that have very low surface brightness.

The 13th-magnitude nucleus lies near the center of the bright core region, just 1 arcminute southwest of a slightly brighter star. And as Christian B. Luginbuhl and Brian A. Skiff note in their classic *Observing Handbook and Catalogue of Deep-Sky Objects* (Cambridge University Press, 1990), "The whole surface of the galaxy is covered with faint stellarings and splotches." Let's tour some of these features, sector by sector.

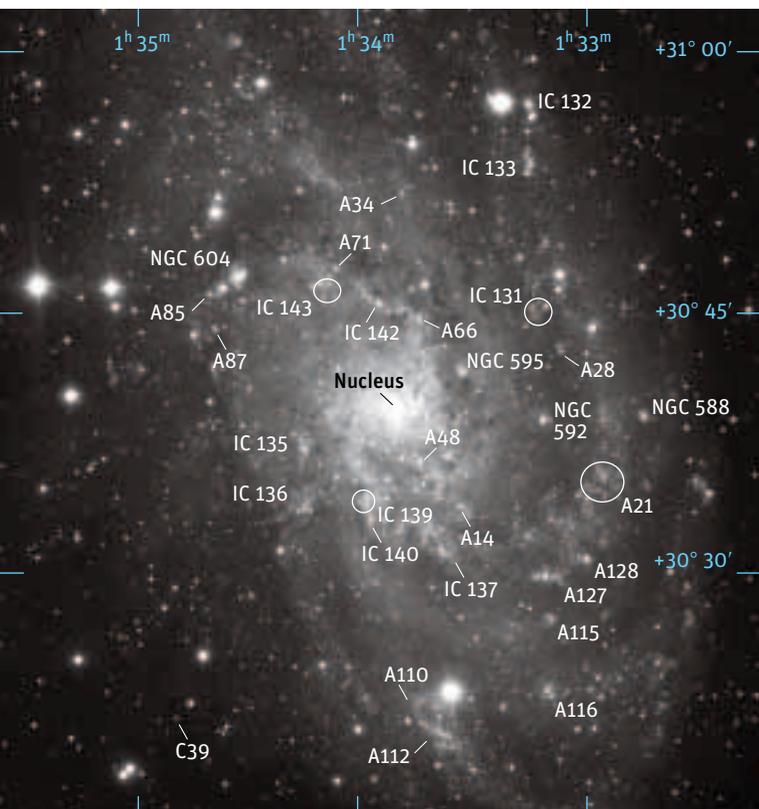
The Northern Arm and the NGC Objects

The brightest splotch in M33 lies 12' northeast of the nucleus, and it's visible even in my 4.1-inch Astroscan. That's **NGC 604**, one of the largest emission nebulae known — more than 1,000 times the size of the Orion Nebula! My 16-inch scope shows two starlike condensations within it and hints at a third.

Five arcminutes west of NGC 604 my 16-inch scope shows an obvious elongated patch stretching diagonally across the main northern spiral arm immediately northwest of a faint star. This consists jointly of an emission nebula around the stellar association **A71** and the larger stellar association **IC 143** to its southeast.

Continuing southwestward along the spiral arm, we reach **IC 142**, which appears stellar at first glance in the 16-inch scope but reveals a fuzzy extension to the southwest on closer inspection. Next comes **A66**, a large obvious knot where the spiral arm bends sharply southward.

Leaving that arm, but continuing along the same south-



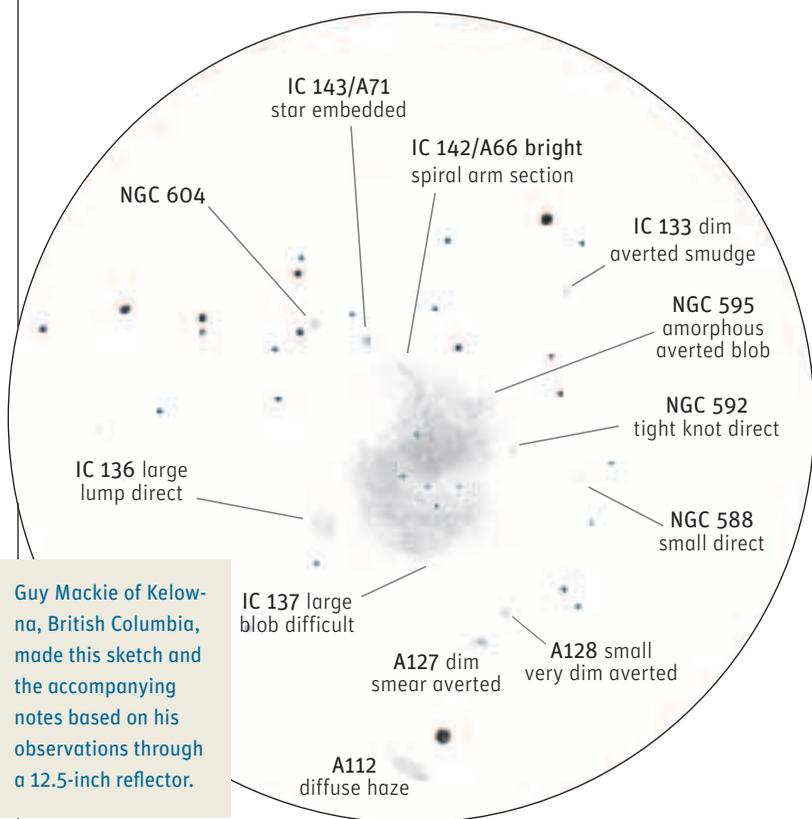
ROBERT GENDLER

Objects Within M33

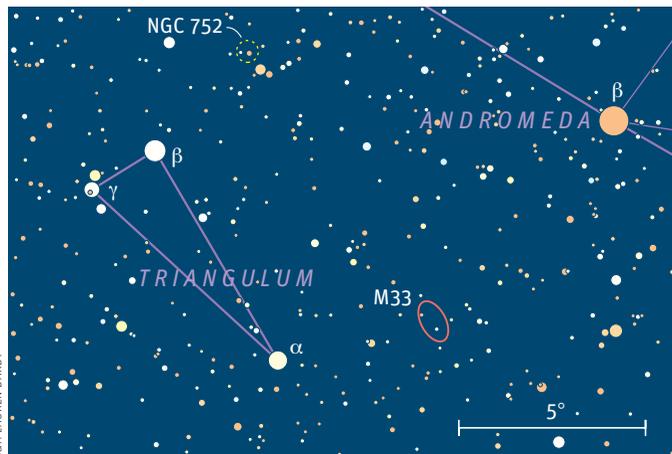
Name	RA	Dec.	Observations (229× in 16-inch scope except as noted)
NGC 588 (A27)	1 ^h 32.8 ^m	+30° 39'	Prominent, round, not seen in 8-inch telescope
NGC 592 (A59)	1 ^h 33.2 ^m	+30° 39'	Smallish, visible in 8-inch, starlike condensations in 25-inch
NGC 595 (A62)	1 ^h 33.6 ^m	+30° 42'	Large and bright but masked by core nearby
NGC 604 (A84)	1 ^h 34.5 ^m	+30° 47'	Very bright, visible in small scopes; see text
IC 131 (A29)	1 ^h 33.2 ^m	+30° 45'	Tiny knot, faintish but not difficult in 25-inch
IC 132	1 ^h 33.3 ^m	+30° 57'	Round H II region with much brighter core, difficult in 8-inch
IC 133 (A137)	1 ^h 33.3 ^m	+30° 53'	Very elongated, starlike cluster near tip
IC 135 (A100)	1 ^h 34.3 ^m	+30° 37'	Large, elongated, knot at S end
IC 136 (A101)	1 ^h 34.3 ^m	+30° 34'	Large, mottled, easy, visible in 8-inch
IC 137 (A12)	1 ^h 33.6 ^m	+30° 31'	Large bright condensation near end of spiral arm
IC 139 (A4)	1 ^h 34.0 ^m	+30° 34'	Bright knot within big bright patch also containing IC 140
IC 140 (A5)	1 ^h 34.0 ^m	+30° 33'	Bright knot within big bright patch also containing IC 139
IC 142 (A67)	1 ^h 33.9 ^m	+30° 45'	Starlike knot with small fuzz to SW
IC 143 (A75)	1 ^h 34.2 ^m	+30° 47'	With A71, elongated patch NW of star
A14	1 ^h 33.6 ^m	+30° 34'	Large and bright, interesting detail in 25-inch scope
A21	1 ^h 32.9 ^m	+30° 35'	Very large faint patch
A28	1 ^h 33.1 ^m	+30° 43'	"Blinking nebula"; see text
A34	1 ^h 33.8 ^m	+30° 52'	Faint, formless patch
A48	1 ^h 33.8 ^m	+30° 36'	Bright, slightly nonstellar
A66	1 ^h 33.8 ^m	+30° 45'	Large bright patch at elbow in arm
A71	1 ^h 34.1 ^m	+30° 48'	Bright knot within glow of IC 143
A85	1 ^h 34.7 ^m	+30° 46'	Bright, barely nonstellar, starlike in 8-inch
A110	1 ^h 33.7 ^m	+30° 22'	Camouflaged between A112 and bright star to the N
A112	1 ^h 33.7 ^m	+30° 21'	Elongated slash, suspected in 8-inch
A115	1 ^h 33.2 ^m	+30° 27'	Amorphous, very faint
A116	1 ^h 33.2 ^m	+30° 23'	Easy round patch, mere ghost in 8-inch
A127	1 ^h 33.2 ^m	+30° 30'	Large, elongated, star at E tip
A128	1 ^h 33.1 ^m	+30° 31'	Round, easy
C39	1 ^h 34.8 ^m	+30° 22'	Brightest globular cluster in M33

Gendler's photograph has been labeled with most of the objects that the author found through 16-inch (400-millimeter) and 25-inch telescopes. A few of his more obscure finds have been omitted to avoid clutter. See Guy Mackie's sketch on the following page for a view through a smaller scope.

west course just north of the core, the three other NGC objects within M33 are all obvious in the 16-inch scope. First comes big, amorphous **NGC 595**, the second-brightest emission nebula in the galaxy. It looks very impressive in photographs, but I need at least a 10-inch scope to separate it from the galaxy's bright, diffuse core. Next is small, bright **NGC 592**, the only one of the three that's visible in my 8-inch scope. It displays two starlike condensations in the 25-inch



Guy Mackie of Kelowna, British Columbia, made this sketch and the accompanying notes based on his observations through a 12.5-inch reflector.



This chart shows stars to magnitude 8.5. The open cluster NGC 752 is occasionally confused with M33.

Dob. That matches the photographic evidence, which shows this object to contain two tight knots of hot, blue, newly formed stars surrounded by moderately faint nebulosity. Finally, **NGC 588** lies near the galaxy's western outskirts. It's just the opposite of NGC 592: a modest stellar association surrounded by an extremely bright nebula.

Other Objects

There are two big, bright condensations within M33's southern arm. The westernmost is **IC 137**, near the arm's end, and the other contains two distinct knots: **IC 139** and **IC 140**, each of which has a brighter core. East of those lie two large stellar associations: elongated **IC 135** and bright, mottled **IC 136**, which is easily visible in my 8-inch scope.

On M33's southern edge, just beyond an 8th-magnitude star, lies the star cloud **A112**, merging imperceptibly with **A110** to its northeast. And two of my favorites lie west of the 9th-magnitude star on the galaxy's far northern out-

What's in a Name?

By Tony Flanders In the course of labeling Robert Gendler's photograph, I noticed that sources disagreed about the identities of the Index Catalogue (IC) objects within M33. My attempts to resolve these conflicts led me down some fascinating historical byways.

My first thought was to bypass the problem by following the example set by Christian B. Luginbuhl and Brian A. Skiff in their seminal *Observing Handbook and Catalogue of Deep-Sky Objects* (Cambridge University Press, 1990). They avoided both New General Catalogue (NGC) and IC designations. Instead, they used names beginning with the letter A to refer to the list of M33's stellar associations published by Roberta M. Humphreys (University of Minnesota) and Allan R. Sandage (Carnegie Observatories) in the November 1980 *Astrophysical Journal Supplement Series*. But I soon realized

that IC 132 did not correspond to any of Humphreys and Sandage's associations.

Next I turned for help to the Web site of the NGC/IC Project (S&T: November 2003, page 113). I found that Steve Gottlieb, one of the key contributors, had already provided Humphreys-Sandage numbers for some of the IC objects, but I suspected that his list was incomplete. So I sent e-mail asking him and project leader Harold Corwin for help. Their responses were quick, comprehensive, and extremely helpful — especially Corwin's translations of the notes that Guillaume Bigourdan took when he discovered these IC objects on October 28, 1889, using Paris Observatory's 12-inch refractor at 159x.

Bigourdan's life ambition was to measure the positions of all known nebulae, so that future astronomers would be able to determine

their proper motions — the change in those positions over years, decades, or centuries. In the course of this he discovered about 500 new objects, an achievement that he considered less important than his primary goal. In retrospect, it's just the opposite; we now know that almost all nebulae are too distant for us to detect their proper motions — especially ones in other galaxies!

Bigourdan was looking for nebulae, while Humphreys and Sandage were looking for associations of stars, so it's a little surprising that the correspondence between their lists is so close. But the colors of Gendler's photograph help explain that. Almost all the clusters of bright blue stars are surrounded by red emission nebulae, indicating that the stars are so young that their radiation pressure has not yet dispersed the gas from which they were formed.

skirts. **IC 133** is very elongated north to south with a starlike point at the southern tip that is actually an open cluster. **IC 132** is one of the few bright emission areas in M33 that do not contain a stellar association. I hadn't expected to find such a distant IC nebula in my 8-inch scope, but 240× revealed it as a difficult blur.

The obscure stellar association and nebula **A28**, some 10' west-northwest of the nucleus, was quite difficult even in the 25-inch scope at Chaco. First I would suspect something fuzzy, then I would see something stellar in a slightly different position. I finally realized that this was a "blinking nebula." As my eye moved around, I would see either A28 or the faint star immediately to its north — but never both at once.

C39, M33's brightest globular cluster at magnitude 15.9, lies in a prominent triangle of stars on the southeastern side of the galaxy, and well outside the visible glow. It is intermittently visible in my 16-inch scope.

I found many other objects within M33, but there isn't space to discuss them all. Most are labeled on the chart on page 93 and described in the accompanying table. But I'm sure that I have not exhausted M33's possibilities; it holds many challenging objects that I have not yet seen. *

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The colors are too faint to see through a telescope's eyepiece, but a nebula filter can reveal them indirectly; if such a filter dims an object greatly, then a high proportion of the light probably comes from stars rather than from nebulosity. In fact, a number of Bigourdan's discoveries, such as IC 140 and IC 143, stand out mostly because of starlight. But Bigourdan didn't have modern filters, and his 12-inch telescope was too small to resolve individual stars 3 million light-years from Earth, so he had no reliable way to distinguish star clusters from true nebulosity.

Comparing Bigourdan's list against the concentrations that Guy Mackie sketched with a telescope of similar size, it's interesting to note that Mackie "rediscovered" most of the IC objects. Furthermore, all the conspicuous objects that Bigourdan did not list are quite far from the main mass of the galaxy.