Herschel 400 Finally Completed

Making a List and Sticking to It

By Alex McConahay

In April's RAS meeting, Catherine Walsh told us how to get organized in our observing. And in May Bob Stephens told us about two of the greats of astronomical history, William and Catherine Herschel, who, among other discoveries, made a list of some 2500 objects of interest.

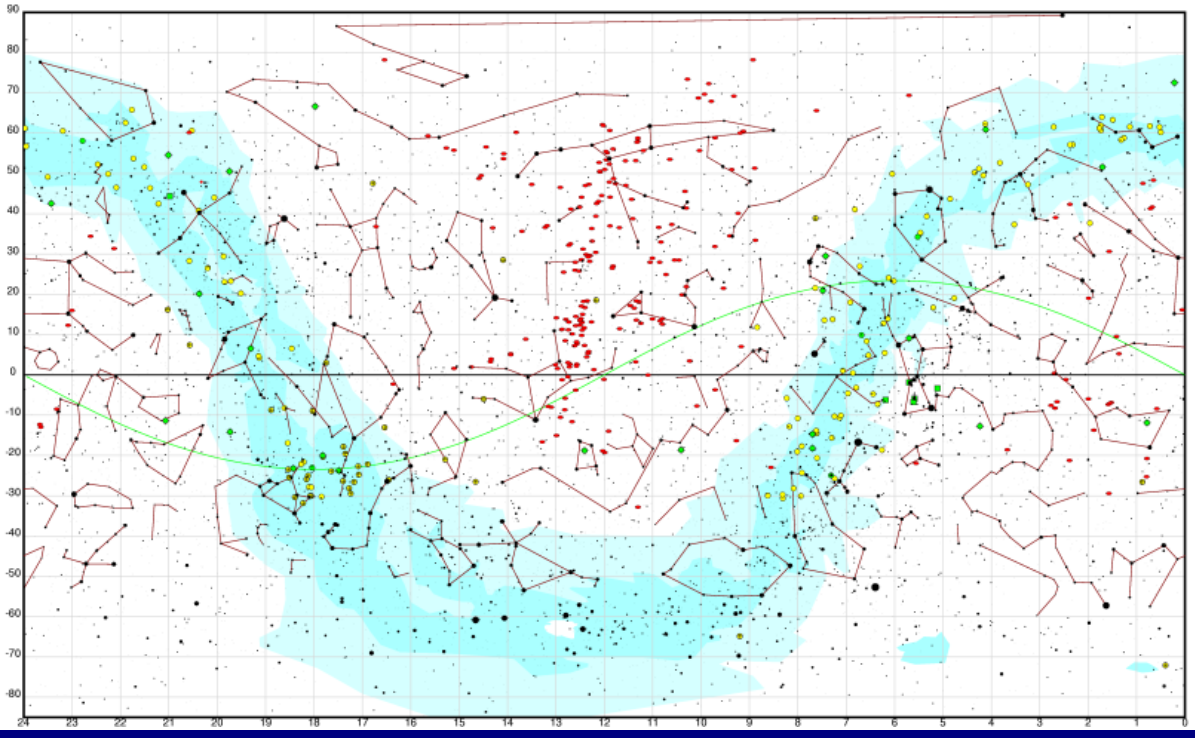
Both of these talks were inspirational for me because after three years I was nearing completion on my Herschel 400. A couple of weeks later at GMARS, on my forty third night of searching, I found my four hundredth target . You work on a long term goal forever it seems, and then it finally happens.

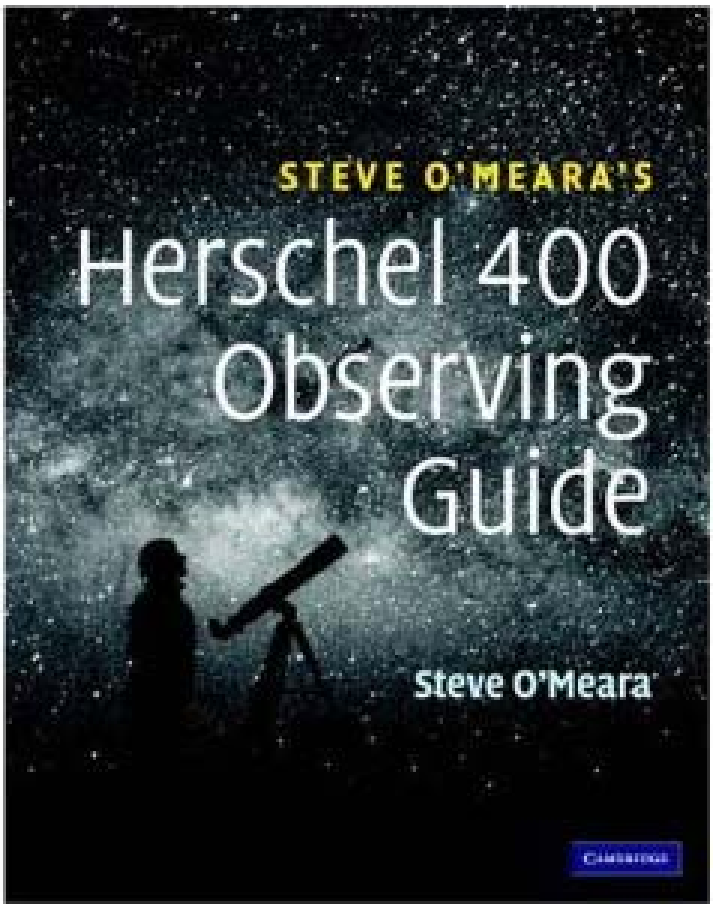
Anybody who has read my previous articles in the Prime Focus, or listened to me talk about observing, has heard my spiel about being a "dedicated observer." I certainly enjoy those evenings when my dob and I just wander around the sky looking at whatever comes up, or whatever the guy at the next scope over is looking at. But I think I get even more out of those nights when I go after the sky more seriously, planning out the evening, star hopping to a new object, and taking notes about what I see. The H400 project made me do that, and I am a better observer for it.

Let me tell you first about the Herschel 400. It is one of those "Clubs" that Catherine talked about from the Astronomical League. Thirty four years ago, members of the Ancient City Astronomy Club of St. Augustine, Florida, were looking for a project to stretch people past the Messier list. They hit on the catalogue that Bob Stephens described as the magnum opus of William Herschel.

The Ancient City Astronomers culled Herschel's list, to find targets representing a variety of deep sky objects to "present a distinct challenge, yet still be in range of amateurs who possessed only modest equipment and were affected by modern light pollution problems." They decided that the object should be observable from a relatively dark suburb (5.5 limiting magnitude) in a six inch or larger scope.

The Herschel 400 objects spread across most of the northern hemisphere and down to about –38 degrees. Galaxies (red), Nebula (green) and star clusters (yellow) are marked below. Although the H400 is a year round activity, note how the heavy concentration of galaxies make springtime (Leo/Virgo) particularly busy.





Steve O'Meara's guide is very helpful to those running the H400 super marathon. It contains history, hints, and data for the search. Quite helpful are the pictures that O'Meara includes for each object. While the objects in the eyepiece generally do not match their photographs, one can see field star patterns, relative brightness, and such that are essential in confirming the identity of the objects. Importantly, the guide organizes the search, leading from one object to the next. Many of the object descriptions end with: "Stop. Do not move the telescope. Your next target is nearby!" If you follow his plan precisely you will finish the 400 in one year, spending seven nights each month. O'Meara told me last fall at PATS that he wrote the book specifically because he could not understand how people spent years on the project and were unable to complete it. Of course not all of us have O'Meara's eyes, or his beautiful Hawaiian skies, or even his seven nights a month to devote to star-hopping. I actually did not use O'Meara's star-hopping directions too often, preferring my own Sky Atlas 2000. However, on some of the harder to find objects, I did rely strictly on his charts and verbal directions, with some success. Where the book came in particularly handy was search sequence and confirmation of the object.

After culling, they came up with:

231 galaxies
107 open clusters
33 globular clusters
20 planetary nebulae
2 halves of a single planetary nebula
7 bright nebulae.

Obviously, the variety was there. And I can tell you after looking at all of them, the challenge certainly was.

They did not pick bright objects. Of the 400, four were naked eye. Sixteen were Messier objects, or parts of Messier objects. About a hundred were magnitude 8 or brighter. At the other extreme, another hundred or so were mag 11 or dimmer, with twenty at mag 12 or 13. But, of course, that is total integrated magnitude which cannot be compared to stellar magnitudes directly because that light is spread out over a larger area, and thus the object had a relatively dim surface brightness.

The Ancient City Astronomers also specified that the project was to be completed using only star-hopping, without setting circles (and without digital setting circles once they were invented… Goto??? Well, you could guess!!!!). Furthermore, the observer must keep a record of all the observations in order to be certified as a member of the "Herschel 400 Club."

I took on this project to correct some of my character flaws. I think back to my approach to telescope making. I did that not just to make telescopes (although that was a great by-product) but to help me overcome my innate sloppiness. I am not a precise person. But you cannot get away with sloppiness when polishing a mirror or building a scope. I had to learn and practice precision. Same kind of thing happened with the H400. I had seen many things in my dozen years of amateur astronomy, but I could not really remember them, and I could not keep track of them very well. Getting this long-range goal, and being required to take notes about it was really not what I did well. But I had to learn.

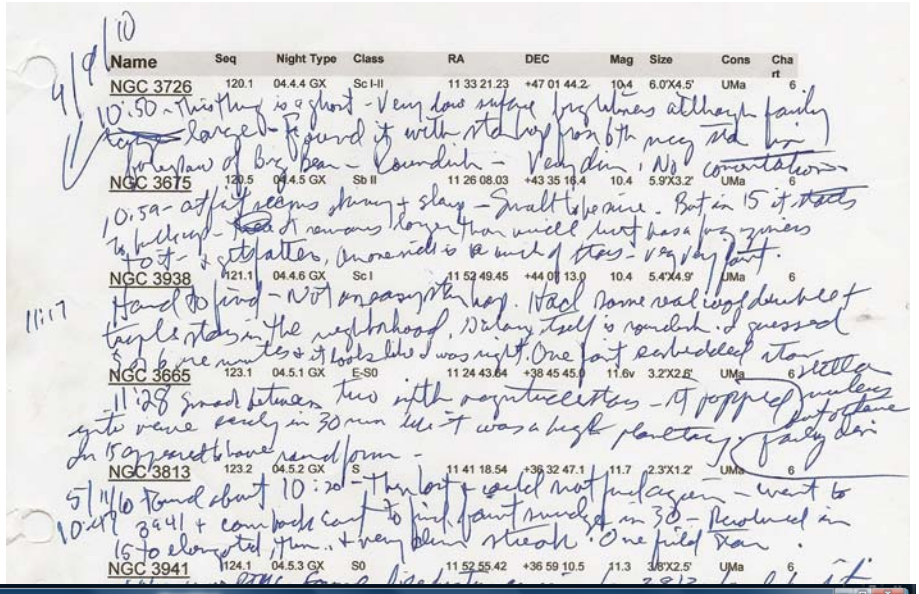
The first thing I had to learn was how to plan an evening of observing. I had several false-starts before I hit on the easy plan.

I downloaded a list of the H400 showing the NGC numbers, RA/Dec, and other identifying information, and in particular, the Sky Atlas 2000 chart number. I converted this list into an Excel spreadsheet. Then I printed out special star charts for the sky showing the zenith for that evening's work. Having sorted the list according to Right Ascension, I could see what would be high in the sky that evening. I found each of them using their coordinates, and circled them on my printed out star charts. This told me what objects were near each other, and suggested my search pattern.

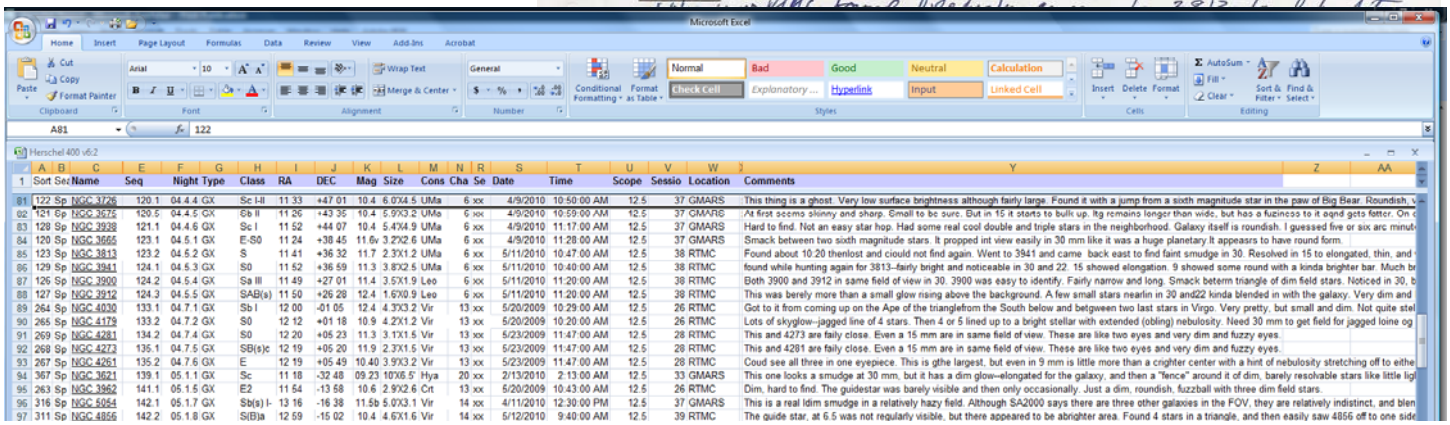
By the end of my journey, however, things had changed. For one thing, I had found several sites where some of this work is already done. See http://www.ngc891.com/index.php for one, or just google Herschel 400. More importantly, I had found Steve O'Meara's Herschel 400 Observing Guide. This 370 page book has an entry for every object, with a photo, star hopping directions, charts and detail charts, and verbal descriptions. One key element in O'Meara's book is that he organized the search sequence by grouping the objects, thus making the search much more efficient.

I added columns on my spreadsheet for O'Meara's search sequence and page reference, and from that point on, substantially speeded up my search. (Of course, part of the speed-up was simply taking the project more seriously.) I printed out my spreadsheet with the object information spread across one line, and then three or four blank lines. This became my "Observer's Log."

The actual night observing log (right) was rather messy (did I mention I was a messy person?) but by the time it was retyped into the spreadsheet, it is readable (bottom). Note the identifying information across the top of the columns. Most of it is obvious. "Seq" and "Night" are references to O'Meara. For instance, for NGC 3665 has a Seq of 123.1, the first object on page 123. Night 4.5.1 says it is best in April, on the fifth night, the first object. Also important is the "Size" reference. This tells the searcher just how big this object might appear as well as its general shape.



Name	Seq	Night	Type	Class	RA	DEC	Mag	Size	Cons	Cha rt
NGC 3726	120.1	04.4.4	GX	Sc I-II	11 33 21.23	+47 01 44.2	10.4	6.0'X4.5'	UMa	6
NGC 3675	120.5	04.4.5	GX	Sb II	11 26 08.03	+43 35 16.4	10.4	5.9'X3.2'	UMa	6
NGC 3938	121.1	04.4.6	GX	Sc I	11 52 49.45	+44 07 13.0	10.4	5.4'X4.9'	UMa	6
NGC 3665	123.1	04.5.1	GX	E-S0	11 24 43.64	+38 45 45.0	11.6v	3.2'X2.6'	UMa	6
NGC 3813	123.2	04.5.2	GX	S	11 41 18.54	+36 32 47.1	11.7	2.3'X1.2'	UMa	6
NGC 3941	124.1	04.5.3	GX	S0	11 52 55.42	+36 59 10.5	11.3	3.6'X2.5'	UMa	6



Sort Seq	Name	Seq	Night	Type	Class	RA	DEC	Mag	Size	Cons	Cha	Se	Date	Time	Scope	Sessio	Location	Comments
122 Sp	NGC 3726	120.1	04.4.4	GX	Sc I-II	11 33	+47 01	10.4	6.0'X4.5'	UMa	6	xx	4/9/2010	10:50:00 AM	12.5		37 GMARS	This thing is a ghost. Very low surface brightness although fairly large. Found it with a jump from a sixth magnitude star in the paw of Big Bear. Roundish, v
121 Sp	NGC 3675	120.5	04.4.5	GX	Sb II	11 26	+43 35	10.4	5.9'X3.2'	UMa	6	xx	4/9/2010	10:59:00 AM	12.5		37 GMARS	At first seems skinny and sharp. Small to be sure. But in 15 it starts to bulk up. Itg remains longer than wide, but has a fuziness to it agnd gets fatter. On c
128 Sp	NGC 3938	121.1	04.4.6	GX	Sc I	11 52	+44 07	10.4	5.4'X4.9'	UMa	6	xx	4/9/2010	11:17:00 AM	12.5		37 GMARS	Hard to find. Not an easy star hop. Had some real cool double and triple stars in the neighborhood. Galaxy itself is roundish. I guessed five or six arc minut
120 Sp	NGC 3665	123.1	04.5.1	GX	E-S0	11 24	+38 45	11.6v	3.2'X2.6'	UMa	6	xx	4/9/2010	11:28:00 AM	12.5		37 GMARS	Smack between two sixth magnitude stars. It propped int view easily in 30 mm like it was a huge planetary It appeasrs to have round form.
123 Sp	NGC 3813	123.2	04.5.2	GX	S	11 41	+36 32	11.7	2.3'X1.2'	UMa	6	xx	5/11/2010	10:47:00 AM	12.5		38 RTMC	Found about 10:20 thenlost and ciould not find again. Went to 3941 and came back east to find faint smudge in 30. Resolved in 15 to elongated, thin, and
129 Sp	NGC 3941	124.1	04.5.3	GX	S0	11 52	+36 59	11.3	3.8'X2.5'	UMa	6	xx	5/11/2010	10:40:00 AM	12.5		38 RTMC	found while hunting again for 3813–fairly bright and noticeable in 30 and 22. 15 showed elongation. 9 showed some round with a kinda brighter bar. Much br
126 Sp	NGC 3900	124.2	04.5.4	GX	Sa III	11 49	+27 01	11.4	3.5'X1.9'	Leo	6	xx	5/11/2010	11:20:00 AM	12.5		38 RTMC	Both 3900 and 3912 in same field of view in 30. 3900 was easy to identify. Fairly narrow and long. Smack beterm triangle of dim field stars. Noticed in 30, b
127 Sp	NGC 3912	124.3	04.5.5	GX	SAB(s)	11 50	+26 28	12.4	1.6'X0.9'	Leo	6	xx	5/11/2010	11:20:00 AM	12.5		38 RTMC	This was berely more than a small glow rising above the background. A few small stars nearlin in 30 and22 kinda blended in with the galaxy. Very dim and
264 Sp	NGC 4030	133.1	04.7.1	GX	Sb I	12 00	-01 05	12.4	4.3'X3.2'	Vir	13	xx	5/20/2009	10:29:00 AM	12.5		26 RTMC	Got to it from coming up on the Ape of the triangleffrom the South below and betgween two last stars in Virgo. Very pretty, but small and dim. Not quite stel
265 Sp	NGC 4179	133.2	04.7.2	GX	S0	12 12	+01 18	10.9	4.2'X1.2'	Vir	13	xx	5/20/2009	10:20:00 AM	12.5		26 RTMC	Lots of skyglow–jagged line of 4 stars. Then 4 or 5 lined up to a bright stellar with extended (obling) nebulosity. Need 30 mm to get field for jagged loine og
269 Sp	NGC 4281	134.2	04.7.4	GX	S0	12 20	+05 23	11.3	3.1'X1.5'	Vir	13	xx	5/23/2009	11:47:00 AM	12.5		28 RTMC	This and 4273 are faily close. Even a 15 mm are in same field of view. These are like two eyes and very dim and fuzzy eyes.
268 Sp	NGC 4273	135.1	04.7.5	GX	SB(s)c	12 19	+05 20	11.9	2.3'X1.5'	Vir	13	xx	5/23/2009	11:47:00 AM	12.5		28 RTMC	This and 4281 are faily close. Even a 15 mm are in same field of view. These are like two eyes and very dim and fuzzy eyes.
267 Sp	NGC 4261	135.2	04.7.6	GX	E	12 19	+05 49	10.40	3.9'X3.2'	Vir	13	xx	5/23/2009	11:47:00 AM	12.5		28 RTMC	Coud see all three in one eyepiece. This is gthe largest, but even in 9 mm is little more than a crighter center with a hint of nebulosity stretching off to eithe
367 Sp	NGC 3621	139.1	05.1.1	GX	Sc	11 18	-32 48	09.23	10'X6.5'	Hya	20	xx	2/13/2010	2:13:00 AM	12.5		33 GMARS	This one looks a smudge at 30 mm, but it has a dim glow–elongated for the galaxy, and then a "fence" around it of dim, barely resolvable stars like little lig
263 Sp	NGC 3962	141.1	05.1.5	GX	E2	11 54	-13 58	10.6	2.9'X2.6'	Crt	13	xx	5/20/2009	10:43:00 AM	12.5		26 RTMC	Dim, hard to find. The guidestar was barely visible and then only occasionally. Just a dim, roundish, fuzzball with three dim field stars.
316 Sp	NGC 5054	142.1	05.1.7	GX	Sb(s) I-	13 16	-16 38	11.5b	5.0'X3.1'	Vir	14	xx	4/11/2010	12:30:00 PM	12.5		37 GMARS	This is a real ldim smudge in a relatively hazy field. Although SA2000 says there are three other galaxies in the FOV, they are relatively indistinct, and blen
311 Sp	NGC 4856	142.2	05.1.8	GX	S(B)a	12 59	-15 02	10.4	4.6'X1.6'	Vir	14	xx	5/12/2010	9:40:00 AM	12.5		39 RTMC	The guide star, at 6.5 was not regularly visible, but there appeared to be abrighter area. Found 4 stars in a triangle, and then easily saw 4856 off to one side

At the telescope, I would open my log to the appropriate page (determined by RA of the sky at zenith that evening), get out the Sky Atlas 2000, and start my hunt. After star-hopping to the object, I would write down the date and time of finding the object and any notes. I tried to note how I found the object, identifying characteristics, shape, brightness, field stars, and any other reactions. On arriving home, I would enter the evening's observations back into the spreadsheet, thus making a more legible copy of my log.

I did not feel the need to repeat the observing conditions on each observation (since they did not change much throughout the night). Instead I noted the weather, seeing conditions, and such in a separate log for each evening of viewing. Furthermore, I did not note the eyepiece magnification power under each object. I relied instead on noting the size of the eyepiece (and since the scope was always the same 12.5 inch F5 home made dob this could be used to calculate the magnification). All the objects (unless noted) were found with a Quickfinder reflex finder and a 30 mm 82 degree Apparent Field of View eyepeice , which was at 52 power. Then they were studied as noted with a 22 or 15 mm, 68 d FOV eyepiece (71, 104 power respectively), or a 9 mm 82 d AFOV (173 power). The main scope had no separate finder scope.

In retrospect, it would probably have been easier to find some of the objects with a smaller scope. The open clusters in the Milky Way were particularly hard to distinguish from the generally starry background with the large light grabbing power of the 12.5.

I won't go into the observing hints and techniques (dark adaptation, how to star hop, use of adverted vision, jiggling the scope, calculating FOV for star-hopping, etc.), and I won't cover again the questions one should ask when observing different classes of objects (size, shape, orientation, field stars, concentration, change in brightness across surface, etc.) because I have covered that already in the series of articles I wrote for observing the RAS 100 last year.

I often spent the night running between my imaging setup and my dob, and my eyes probably never reached maximum dark adaptation those nights.

Although the process took me a little less than three years, there is no reason I could not have finished in half that time. After finding three objects in July 07, and 14 that November, I did not log another observation until the next April. I had a further six month hiatus from July 09 through January 10 because I had observed all the objects that were available in the evening sky and had to wait for the objects to rotate into view.

My most productive night was November 18 (my wife Judy's birthday!!!—how did I get away with that???) when I logged 17 objects. However, a dozen or so was a more typical good evening, and the average was about 9.

If you are interested in certificates and pins, the Astronomical League awards both to those who properly submit a completed log to their organization. Some 436 people have completed the project according to their latest report. See http://www.astroleague.org/al/obsclubs/herschel/hers400.html for more information, rules, and resources.

Sometimes as many as three objects were in the same field of view, but usually it took ten or more minutes to find the next target.

It was incredibly easy to star hop at the Texas Star party. Things just showed up in the eyepiece. The only "light pollution" came from the glow of the Milky Way. Guide stars were quite obvious. Even at GMARS on a dark night, the Sky Atlas 2000 shows more stars than can be seen in the sky. This was generally not true in Texas.

NGC 253, the Sculptor Galaxy (as imaged here by Alson Wong) is one of the H400, and was a surprise to me when I first found it on a cold November night at GMARS. One of the reasons to do the H400 is that you go looking for things you did not realize were out there.

After all the observing, I learned a lot:

- There are lots of interesting objects out there that never made Messier's list. They are not as large, bright, or generally spectacular as Messier's Greatest Hits. But they really can hold their own. They range from the absolutely grand and glorious NGC 253, down in the southern skies (an object I had not heard much about, and was totally surprised when I first saw it in my eyepiece) to the exquisite NGC 2362, a rather dim (naked eye) star that absolutely enchants when caught in a scope as the luminescent center of a cluster of 60 or more sparkling jewels.

- I really hate open clusters in Monoceros and Puppis, and otherwise spread out across the Milky Way. I mean, just how is a guy supposed to decide which is the open cluster and what is just the mass of background stars? There are thousands of them, and they really don't distinguish themselves all that well. Picking out patterns, and noticing magnitudes helps, but enough is enough after a while.

- And globulars come in lots of shapes and sizes besides the standards found in the Messier list. Some of them were so dim, or small, or thinly populated, they were hardly recognizable as globulars. Some had cute little field stars that added to their mystique. One has a companion galaxy.

- One learns to trust one's body, muscle memory, eyeballs, and all that when one practices star hopping. I learned just how far one had to move the scope (by the way it felt moving it) to match a move on the star chart. One also learns how separation between guide stars on a star chart looks in the sky. It is not always necessary to hop from star to star, but one can look a third or so of the way between two relatively bright star, and find the quarry.

- Things that you cannot see at first can pop up eventually when you know what you are looking for. A couple of objects were simply not there when I looked, sometimes for an hour or two at a time. I was sure I had star-hopped to the right place, and had re-tried many times. Some-

times increasing the magnification made the object emerge. On one, I found it initially by going next door to Gordon Tyler's Gemini-Goto driven C -11. On another I tried Robert Nyman's 18 inch NGT to find the object. My scope had been pointed in the right place, but I just could not see the object until I knew what I was looking for. Sure enough, when I got back to my own scope later I was able to see both these mystery objects. They were dim and small, but not so difficult now that I knew what to expect.

- The experts do not agree. I'm referring to the sources I used in my search. The most extreme example is NGC 6540. My spreadsheet lists it as a globular cluster. But Sky Atlas 2000 uses an open cluster symbol for it. (My observation sides with open, but a small and dense open.) Variations in size and magnitude (and even for RA and Dec) for a given target are plentiful throughout the various sources.

- And what they agree on is not necessarily useful. Using the size and magnitudes listed on my spreadsheet is a rough guide to what an object might look like, but the seeing conditions, darkness of skies, and the tapering of the concentration of light can dramatically alter the shape and size of any object. If, for instance, two objects are both 8 x 2 arc minutes, and one has a bright central core, and very faint spiral arms, it will look small and circular. The other, with fairly even brightening throughout, would look extended. It is also dangerous to trust photographs, which can emphasize faint light and be unrealistic.

- Sometimes it is easier to regroup and start anew. With only a couple of dozen objects left, I was struggling through the Coma/Virgo cluster. I was looking hard for my objects, but just getting lost again and again. O'Meara wasn't helping. I stopped. I took out the big map and looked at it. And then I remembered Bill Patton's advice about star hopping in Virgo-Coma. "Don't." Instead, Bill advises, "Galaxy-hop." When I took out my green magic marker, and started circling the last few objects I had to find, I realized they were clustered around M84-86, two big beacons in the sky. Within a couple of hours I had knocked off nine objects. Just use galaxies instead of stars for the signposts. Easy pie. (Or, to continue with Bill's advice—"Bob's your uncle!")

I've told a few people I've finished the H400, and all of them seemed to want to know what I will be doing next. I decided that I will go after the Messier List for real this time. I have run the Messier Marathon three or four times, and have gotten as many as 104 or so in a night. In one Marathon I got all 110. That particular marathon started in March like all the others, but did not finish until I stumbled across the finish line with number 110 the next July. This time I will record more than just the time of finding the object, and see if I can get even more out of the adventure.

I wasn't looking forward to an evening chasing dim fuzzies in the Coma/Virgo cluster. There are so few guide stars, and so many dim galaxies confusing the issue. Then I noticed that I could use M84/86 and Markarian's chain (which I had imaged just a month ago) as my markers. At the left of the group are NGC 4435 and 4438, two of the last evening's objects. They and the rest of the galaxies were relatively easy to locate once I hit on using M 84 and M86 as the guideposts.