Philip Pugh

Observing the Messier Objects with a Small Telescope



In the Footsteps of a Great Observer

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Springer

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This book is dedicated to the great loves in my life: my wife, Helga and daughter, Marcela. They will be in my heart always and forever.

Preface

It is rather strange that Charles Messier's list of objects to avoid when hunting for comets became the first of many definitive lists of deep sky objects to view. He did, indeed, discover eleven comets, yet it is his "catalogue" that is his main claim to fame. Many would argue that the Messier Catalogue has little relevance today, with many amateur astronomers owning telescopes far larger than he had. Indeed, many advanced amateurs prefer to list objects from the New General Catalogue (NGC), which covers fainter objects and those not visible from Europe. I like the Messier Catalogue because I am familiar with many of its objects, some of which can be enjoyed with modest instruments from less than ideal viewing sites.

In fact, my inspiration for the book came from my own ideas for a comet hunt. One night, I was looking around the Lyra/Hercules/Draco region with binoculars, mostly to look at the area's many double stars. I came across a bright object that looked like a comet. Fortunately, I knew better than to go e-mailing the globe with claims of a new discovery. My "comet" was none other than the globular star cluster M92! I already knew of M92 but, as it was an exceptionally clear night and, as I'd never seen it so bright before, I didn't recognize it immediately. Cursing more that I didn't have any suitable imaging equipment, rather than it wasn't a new discovery, I took the opportunity to have a closer look with my 127 mm Maksutov-Cassegrain, known as a "Maksutov" for short.

This book is a personal voyage of discovery. Although many of the "Usual Suspects" (list of deep sky objects that are easily visible to binoculars) are in the Messier catalogue, some I had never seen before I started researching this book, or had seen a fuzzy patch in the place they were known to exist but not much else.

Indeed, there was a time when I even wondered if I would ever complete this book or find myself outside in the freezing winter trying to map the Virgo Galaxy Cluster before dawn, after two successive springs of missing it! Fortunately, the spring of 2009 was clear enough for me to see it. Not only was it necessary to

complete this book but was also a personal ambition of mine. My family thought I was mad, though, when I spent several nights awake until 3 a.m. in order to see the elusive members of the Messier Catalogue in southern Scorpius and Sagittarius. In fact, I'd already seen some of them from the southern hemisphere but, as I was trying to follow in the footsteps of Charles Messier himself, that would count as cheating! I finally completed observations of all objects in May 2010.

But first, a foreword by Kulvinder Singh Chadha on the man himself. Thanks also to him for researching Charles Messier's own observing notes.

Wiltshire, UK Philip Pugh

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I'd like to thank the following people (in no particular order):

- Kulvinder Singh Chadha for his research into Charles Messier himself. Kulvinder is a named contributor
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Contents

Chapter 1

Charles Messier: His Life, Discoveries, and Legacy

Early Life and Education

Charles Messier was born on the 26th of June, 1730, in Badonviller, France, near Strasbourg, close to the German border, one of the youngest of 12 children. He was the tenth child of Nicolas and Françoise Messier, so he wasn't quite the baby of the family.

The Messiers lived in the (then) kingdom of France, near the Duchy of Lorraine. The bloody upheaval of the French Revolution and the rise of Napoleon Bonaparte were still quite a number of decades away.

There is a commonly held view that Charles had an impoverished background, in the material sense. In such circumstances, Nicolas's efforts to provide for such a large family would have been challenging, to say the least. In actual fact it seems that Charles and his siblings grew up in reasonable affluence, though the idea of an impoverished background could be a reasonable assumption to make in the view of such a large family. Debate still continues on whether this was actually the case, but clearly the notion of a successful astronomer growing up in poverty is a romantic one. Nicolas Messier was likely able to provide adequately for his family, indeed even allow them to live in some level of comfort because of his work as an administrator for the regents of Salm, in the court of Salm-Kyrburg (one of many Holy Roman principalities of Germany, France, and Luxembourg). The Regent Philip Joseph and his brother Johan would eventually become the princes of Salm-Kyrburg, which was a German principality that bordered Lorraine on its northeastern side. But in 1741, Nicolas died.

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Even as recently in the past as the eighteenth century, death was never far away in everyday life, whether you lived a princely, or a more desperate lifestyle. For the young Charles to have already lost six of his brothers and sisters by the time of his father's death was not unusual for the time. Hyacinthe, the eldest child (and male), now became the head of the family, as was the natural and expected thing to do. But with Nicolas's role in the house of Philip Joseph now no more, how was the Messier family to survive, let alone maintain the level of living that its members were accustomed to?

They need not have worried. The 24-year-old Hyacinthe, like his father, took up an administrative role himself in the princes' household, having returned to Badonviller from the town of Nancy in 1740, where he worked as an assistant to a palace curator. Hyacinthe following his father into the prestigious clerical profession was clearly fortunate for the Messiers. And it was around this time that something fateful happened in the history of astronomy. Not for the only time in his life, Charles, who was then 10 years old, was to have an accident. It is said that while playing in a boisterous manner in the family home he fell out of an open window. It must have been quite a considerable fall, because the young Charles had broken his leg at the thigh. Perhaps it was due to this incident and the inevitable length of time it would take to recover from it that Charles was from then on educated at home, under his elder brother's tutelage. This private schooling was to continue for the best part of a decade, with Charles learning the ins and outs of administrative and clerical work. During that time he developed a keen eye for detail, thanks to Hyacinthe's one-on-one tutoring, which was to prove highly advantageous later on.

It was also during this time that Charles began to demonstrate a nascent interest in astronomy. When he was 14 years old a fantastic comet (discovered by Dutch astronomer Dirk Klinkenberg) appeared in the skies above Lorraine. Designated C/1743 X1, the comet was actually named for the wealthy Swiss mathematician Jean-Philippe Loys de Chéseaux because of his detailed observations of it. It must have been a truly spectacular sight because Comet de Chéseaux was a luminary behemoth, possessing six tails – something that was confirmed by Joseph Nicolas Delisle, France's Astronomer of the Navy. The sight of this celestial gem outshining Jupiter in the night sky probably had a profound impact on the young Charles and quite possibly crystallized his fascination of the heavens (and of comets in particular). Then in 1748, when he was 18, an annular solar eclipse appeared over Badonviller on the 25th of July. An annular eclipse leaves a searing ring of sunlight around the Moon as it passes over the Sun's disk. This meant that Badonviller was not plunged into total darkness, as in the case of a more spectacular total eclipse, but it would still have been a sight to behold. To the young Charles it was as if the heavens were sending him a message as to where his future lay.

And local politics seems to have helped push Charles in that direction, too, albeit in an indirect manner. In 1751 there was a redrawing of political boundaries in the region (much like what occasionally happens with modern English counties) and Badonviller was no longer under the jurisdiction of the House of Salm-Kyrburg.

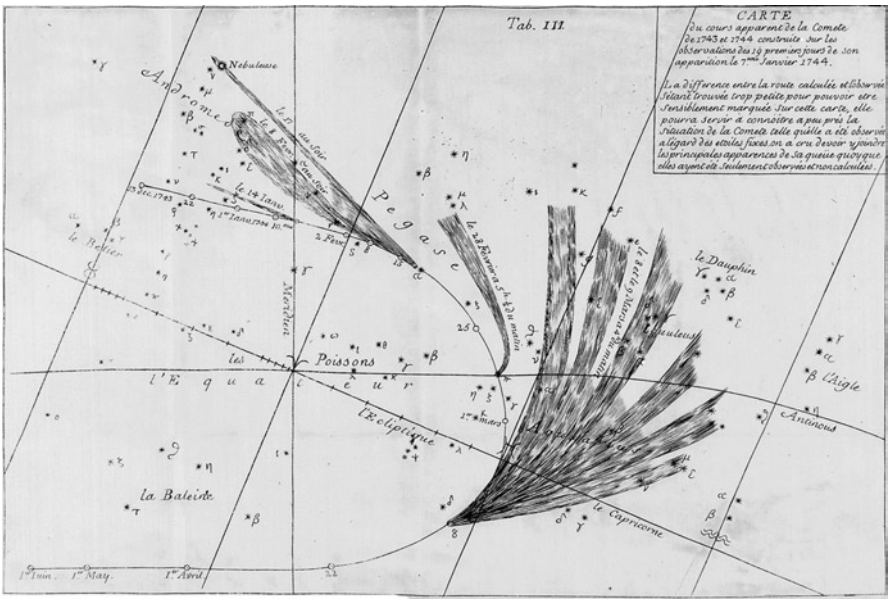

Fig. 1.1 Delisle's depiction of the great comet of 1744 (1 of 3) (Image courtesy of the Paris Observatory)

Being a loyal employee and subject, Hyacinthe left Badonviller again, to follow the Salm-Kyrburgs, and settled in Senones, which today is a small town situated between Nancy and Strasbourg. Charles, now left behind with the remaining members of his family, had to now look for employment. He turned to the trusted Abbot Theolen, who asked around for jobs on Charles's behalf. It was quite common at the time for abbots to act as family mentors and advisers. In fact their role could be considered not too dissimilar from that of modern-day 'agony uncles.' Theolen was clearly effective, finding not one but two potential positions that Charles could have taken up, both of which were in Paris. One was as assistant to a curator, and the other was with the naval astronomer Joseph Delisle, the man who had confirmed Comet de Chéseaux's six-tailed appearance. Charles would have to leave Badonviller for the great city of Paris in either case, but was unsure which of the two job offers he should pursue. Naturally he turned to his older brother for help in making a decision. Did the curator Hyacinthe think that Charles should take on the same role that he and his father had? No. Hyacinthe thought perhaps that Charles should work for Delisle. His wise reasoning for this was that the position would have offered Charles much more in the way of prospects. It was a decision that could not have chimed better with Charles's latent astronomical interests (Figs. 1.1, 1.2 and 1.3).

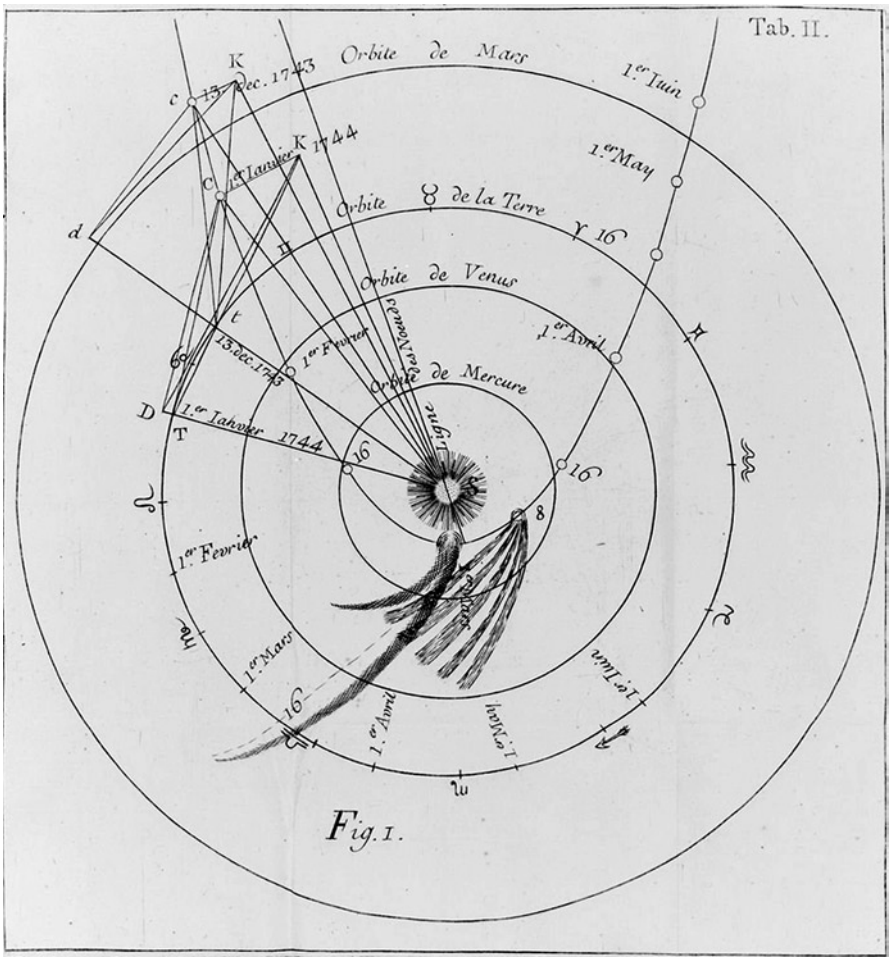

Fig. 1.2 Delisle's depiction of the great comet of 1744 (2 of 3) (Image courtesy of the Paris Observatory)

Charles started work for Delisle on the 2nd of October, 1751, as a clerk-assistant. The building where Delisle was based was called the Hôtel (townhouse) de Cluny; built in 1480 on Roman ruins as a dwelling place for a Parisian order of monks known as the Abbots of Cluny. The building didn't actually belong to the navy, and it was only now in the eighteenth century that it was let to their administration.

When Charles arrived, Delisle was said to have been particularly impressed by his neat handwriting. In fact the astronomer Jean-Baptiste Delambre (known for being a gregarious man) made much of the fact that it was Charles's handwriting

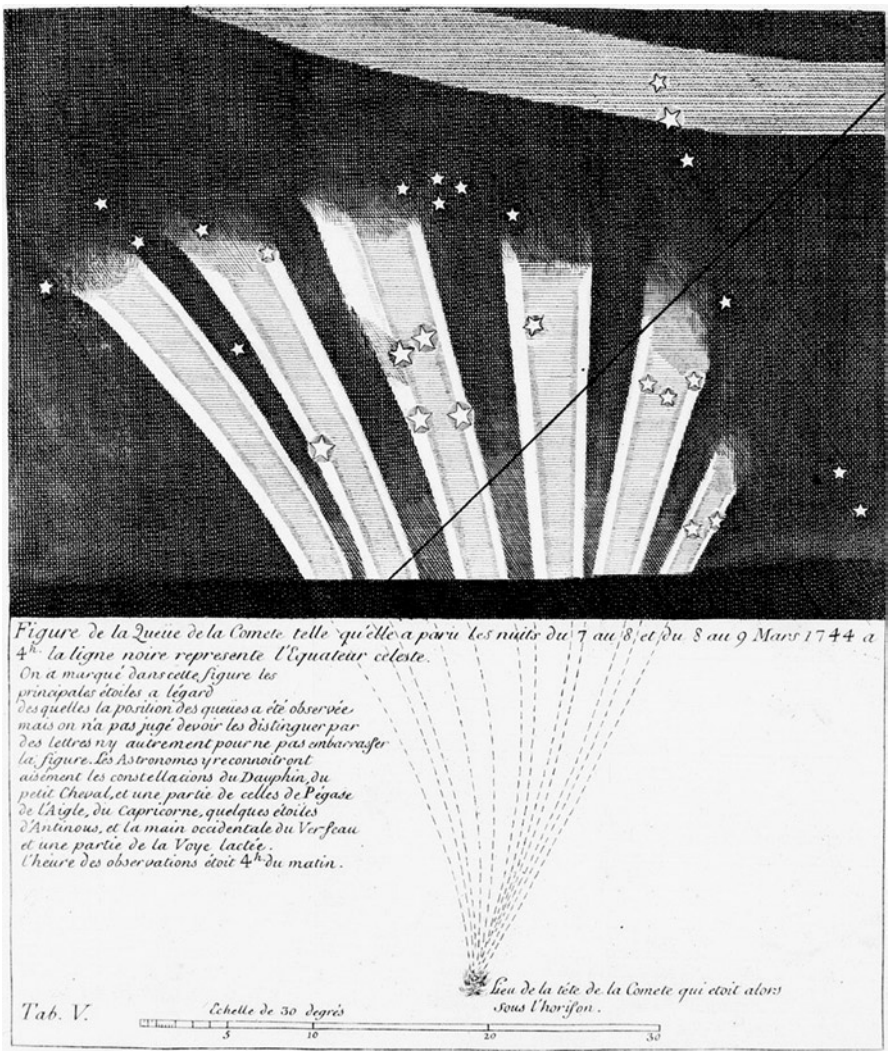

Fig. 1.3 Delisle's depiction of the great comet of 1744 (3 of 3) (Image courtesy of the Paris Observatory)

that secured his position at Cluny. Delambre in later years would write a biography of Charles Messier, and much of what is known about him today comes from this source.

So it seemed that the years of private education by his munificent older brother were beginning to pay off for Charles. Being a childless man in his sixties, Delisle developed a paternalistic bond with the young Charles, who was 21 at the time.

Delisle and his wife offered Charles accommodation in the Royal College of France, where the couple lived. In the space of a few days Charles Messier had made it to Paris, impressed his employer, and now had a place to stay, too. Not bad!

However, when he got down to work Charles's first task wasn't astronomical at all but involved copying out a map of China. Specifically, Charles copied out depictions of the Great Wall, built in 200 BC by the Emperor Huang to protect China and the Old City of Peking – settled since the Iron Age – from Mongolian invaders. Joseph Delisle was a widely traveled man who recently returned from a 21-year stay in Russia where he taught astronomy and even helped to build an observatory in St Petersburg. The old man reputedly had a love of old charts and documents and must have come across the maps of the Great Wall and the Old City during his travels.

As fascinating as this was, Charles wouldn't be kept away from astronomy for long, for he now had a new job: to keep a record of all the observations undertaken at Delisle's observatory, which sat at the top of the Hôtel de Cluny. It was a marvel to see. Built by Delisle with his own hands, it consisted of a wooden structure with glass panels and must have been quite a sight. The Cluny building is now a museum of medieval arts with displays that include many fine tapestries, though tragically, the observatory itself was completely dismantled in the nineteenth century.

Although he was working with astronomical records, Charles wasn't actually doing any astronomy himself, and this is what he really yearned to do. Being in the employee of the Naval Astronomer and working so close to the observatory, how could he not? As it turned out he could not have wished to be in a better place for it and didn't have to wait much longer. Delisle had a personal assistant at Cluny called Libour who showed Charles all the ropes, including how to use the instruments in the observatory. The telescopes housed in the observatory, though large in aperture, were actually not the most efficient instruments around even for their day. This probably didn't matter a great deal to Charles when he finally started observing heavens, for he must in some way have felt overwhelmed with the notion that his time had now come.

The first recorded observation that Charles made at the observatory was the transit of the planet Mercury across the Sun's disc on the 6th of May, 1753. Planetary transits at that time were of great importance in determining the accuracy of orbital calculations, as well as for predicting future transits. It was only since the work of Johannes Kepler in the 1600s that planetary positions could be calculated with any accuracy at all. In his time Delisle was to organize expeditions to various parts of the world for planetary transit observations. These kinds of expeditions were a little-known concept in astronomy in the 1700s, but became much more commonplace in the centuries that followed.

By 1755 Charles was promoted to depot clerk of the navy. Delisle had sold his large collection of books, maps, and documents to the government in order to get an annuity for himself, and Charles didn't miss out either. He got board and lodgings at the observatory for Delisle's efforts, as well as an annual salary of 500 francs (Fig. 1.4).

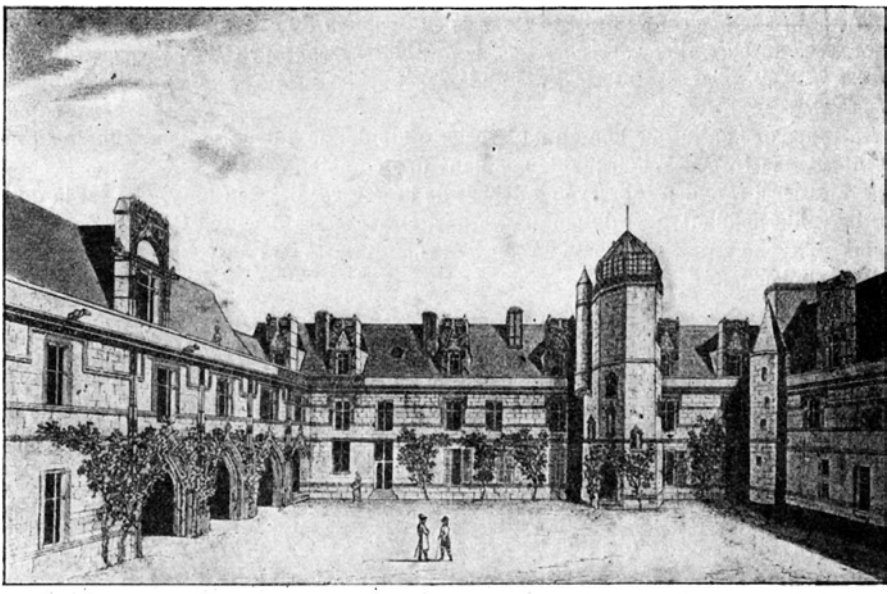

Fig. 193. — Hôtel de Cluny au XVIIIe siècle. Tour de l'Observatoire de la Marine.
(D'après Saint-Victor, Tableau de Paris.)

Fig. 1.4 The grounds of the Hôtel de Cluny, rented to the naval administration of France. The observatory where Charles Messier worked can clearly be seen on top of the column (Image courtesy of the Paris Observatory)

The Race for Halley's Comet

One of the big questions in astronomy at the time was whether comets were random visitors to the Solar System or were they somehow traveling in periodic orbits, much like the planets did. The British astronomer (and later second Astronomer Royal after John Flamsteed) Edmund Halley posed this question in 1701. The Oxford-educated Halley charted sunspots and went on expeditions (much in the same way as Delisle). In this case it was to the southern hemisphere to map the positions of the stars there. But clearly he is best associated with the comet that now bears his name.

Indeed, why would Halley's name be most associated with periodic comets? The reason was simple. When calculating the orbital dynamics of a comet that had appeared in 1681–1682, Halley noticed something curious about his figures. The calculations seemed to match that of a comet seen in 1531 by the German mathematician and astronomer Petrus Apianus, and also to one seen by Johannes Kepler in 1607. The period between these previous two sightings caught Halley's eye too, at 76 years apiece. This was also the same period between Halley's own sighting

and that of Kepler's. Coincidence? Halley took an intellectual step and predicted that these sightings were all of the same comet, and that it should return in another 76-odd years – though he knew he wouldn't be around to see it. Up until that time it was commonly accepted that the appearance of comets was a haphazard affair, and now Halley put forward an alternative theory that got comet hunters excited.

So in 1758 Europe's astronomical world was eagerly awaiting the supposed return of the comet predicted by Edmund Halley. It's not clear at the time of writing if other parts of the world had heard of Halley's theory, or indeed discovered it independently. If the comet were to be spotted it would for the first time in history be proof that comets had periodic orbits. And that meant that they had to somehow be part of the Solar System and not chance visitors from beyond.

Halley predicted that the comet would return in late '58 or early '59. Astronomers such as Jérôme Joseph Lalande, who worked at the Hôtel de Cluny, calculated the date of the comet's perihelion as 13th of April, 1759. But this date, like any when calculating positions for comets, was subject to revision. As the exact date of the comet's initial visibility was unknown, astronomers around Europe had started scanning the skies in early 1758. For Charles, this was a great opportunity to make a name for himself, and he started his own search as early as 1757. After all, using Delisle's own orbital calculations he would surely spot it first. So three years into his role as depot clerk, Charles Messier spent his nights looking out for arguably the most important comet in history. In the back of his mind Charles was no doubt thinking about the spectacular sight of Comet de Chéseaux that he had witnessed in his youth.

Messier created charts (exquisitely decorated with the mythical figures of the constellations) using Delisle's calculations of the comet's path and scanned the area that Delisle had asked him to (and had marked on the map, which took into account the gravitational effects of large planets such as Saturn and Jupiter). Not being mathematically proficient, unlike Delisle and other colleagues, Charles likely didn't attempt such calculations himself. In return Delisle was probably glad to have his enthusiastic young depot clerk search in his stead.

Methodical, accurate, enthusiastic – Charles was all of these things, and the work must have been painstaking. Astronomy wasn't actually one of his employed duties, but he observed every clear night using a wide-field Newtonian reflector with a hefty 53-in. focal length. But one of Charles's favorite telescopes was a 6-in. aperture Gregorian reflector. Reflecting telescope mirrors of the time weren't made from precision, diffraction-limited glass, as they are today, but instead they were formed from the very reflective (but brittle) copper-tin alloy of speculum. Speculum was poor compared to modern aluminized glass mirrors and also had an annoying habit of tarnishing easily. But even considering this, the Cluny telescopes weren't of the greatest quality for their age. They must have given anyone using them (including Charles) quite a headache, not to mention eyestrain! Another curious fact about the Cluny instruments was that they had fixed magnifications. Thus they didn't have interchangeable eyepieces, and this necessitated a cumbersome array of instruments. But even with all of these telescopes at his disposal, try as he might, Charles just couldn't find the comet. Were the instruments just too plain awful to use…or was Halley's prediction wrong? (Fig. 1.5).

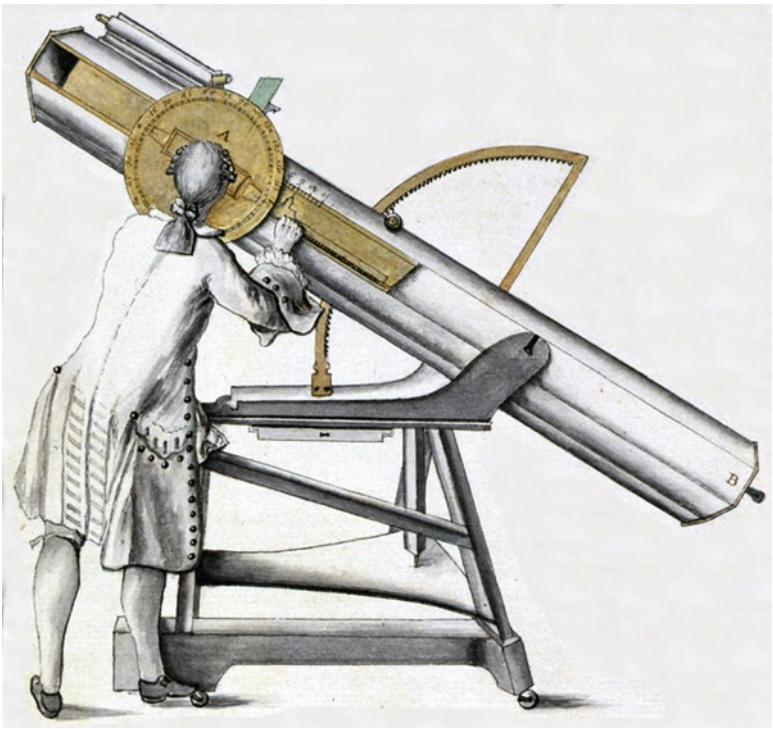

Fig. 1.5 Charles Messier using one of the Cluny telescopes, probably the 53-in. focal length reflector (Image courtesy of the Paris Observatory)

The answer to that question appeared to come just in time, for in 1757 Charles saw a fuzzy object in the sky (cometary halos often have a fuzzy appearance) in the constellation Andromeda. But as he looked more closely Charles could see that something was wrong. This object wasn't in the right place. Could it have been another comet? Charles observed for a few nights and found that it didn't move. Something that didn't move couldn't be a comet. It was in fact a tiresome impostor: a nebula. This object would eventually become M32 (or Messier 32) when Charles would later note it down in a list. Then on the 14th of August, Charles noticed what seemed to be a genuine comet in the sky. Had he finally found it? He checked the orbital path on his star chart with haste. His heart must have sunk a little when he quickly realized that the two didn't match. It was indeed a comet this time, but not the one predicted by Halley. And as a further blow, Charles couldn't even claim it as a brand new discovery.

The comet that Charles saw that evening was C/1758 K1 de la Nux, discovered on May 6 of that year, which, coincidentally, was the fifth anniversary of Charles's first observation at the observatory: that of the transit of Mercury across the Sun's face.

Despite the fact that it wasn't the comet he was after, Charles was nonetheless intrigued, and continued observing de la Nux for many nights. And then he spotted something else in the constellation Taurus on the 28th of August. Was it another comet? It would have to wait for the time being, as Charles continued observing de la Nux right up until 2nd of November, all the while keeping careful and accurate records in the way that Delisle and Libour had showed him. It was only after de la Nux disappeared from view that Charles returned to that curious fuzzy patch in Taurus. Had it moved? He saw that it hadn't, so it couldn't have been a comet. Charles noted the position of this nebula and labeled it Messier 1 (M1). It was this object that was to be the start of Charles's now-famous list.

Messier 1's position was at the exact same point in the sky that a bright new 'star' appeared seven centuries earlier. So bright was it at the time that it outshone Venus and was even visible in the daytime. What's more, Chinese astronomers of the time noted how you could read by the 'star's' light on moonless nights! But then the 'guest star' eventually faded over the weeks. Messier 1 is the remnant of an old, dead star that blew up in a supernova explosion, briefly outshining all the other stars in the galaxy put together. This is what gave it the appearance of a 'guest star' to the Chinese and others.

The fuzzy patch that Charles observed (first spotted by the English astronomer John Bevis in 1731) had now taken the place of the once-spectacular 'star.' In his time Charles wouldn't have known its true nature, but the third Earl of Rosse would name this patch the Crab Nebula in 1844 using his 36-in. reflector at Birr Castle in Ireland.

For Charles, however, the patch was just another frustrating 'non-comet,' much like the other fuzzy patch in the constellation Andromeda. Although he had noted it down using his own classification system he was really interested only in comets and saw these nebulae as a potential source of confusion and frustration. He would have to deal with these troublesome objects in a more systematic way at some point in the future. And in any case, the great comet hadn't yet returned (if it was going to at all), and that was the most pressing matter (Fig. 1.6).

Charles had now widened his search area beyond Delisle's remit and continued his systematic and relentless hunt. One can imagine that only daylight and cloud cover stopped him from watching the skies every waking moment. Then on the 21st of January 1759, two years after he started his search, Charles Messier saw something out of the corner of his eye with his wide-field Newtonian reflector. What was this new object? Could it be another dead end? After all, Charles had been searching for so long. Charles investigated the object further, comparing its movements closely against his charts. He checked and checked again, looking for some error that he may have made, or some divergence from the numbers. There was none. Charles saw excitedly that it matched Halley's criterion. And this object clearly wasn't a nebula, as it moved across the sky. It could only be a comet. It had to be *the* comet. Just 52 days before its perihelion (where it would have become entirely lost in the Sun's glare) the great comet had indeed appeared in the eyepiece of the wide-field Cluny reflector.

Finally Charles had found Edmund Halley's comet! But why did it take him so long? Charles quickly realized that Delisle's charts contained an error – an

Fig. 1.6 Halley's comet, the most famous comet in history, was the first to be shown to be periodic. Charles Messier, however, would have a difficult time with this comet (Image courtesy of NASA)

underestimation of the perturbing effect of Jupiter on the comet. This meant that Charles couldn't have hoped to be looking in the right place for the comet had he not used some initiative. But it had at last been found, right where Halley predicted. That surely was a cause for celebration regardless?

Actually, it seemed not. Delisle behaved strangely from that point on. He told Charles to continue observing, but would not accept that he had made a mistake. In addition Delisle also refused to make a public announcement about the return of the comet. Not wishing to upset his mentor and benefactor, Charles agreed to Delisle's somewhat odd request and continued as before, although it must have been an anguishing experience for him. The whole of the astronomical world had been waiting for the predicted return of the comet, and now after two years of sleepless nights and unrelenting persistence, Charles had been asked by Delisle (probably out of his own shame for the error) to keep it a secret.

In a time when discovering comets conferred the same celebrity status that reality television does today, this was indeed odd behavior on Delisle's part. It is all the more strange when you consider that back then, the exact masses for Jupiter and the other distant planets weren't known anyway, which is why the exact date of any

comet's appearance couldn't have been predicted even to within months. Even skilled astronomical calculators like Lalande couldn't do that. In light of this, Delisle's apparent worry over his error seemed quite unnecessary (though the charts did indeed contain an error on Delisle's part, as well as this general uncertainty).

Then for Charles came the shocking hammer blow. It turned out that all his efforts were in vain anyway. Sometime in late March to April, news reached the Hôtel de Cluny that the comet had already been spotted by Johann Palitzch, an amateur astronomer in Saxony, Germany, on the night of December 25–26, 1758. The single-minded tenacity of a man who had spent Christmas night looking for the comet had paid off. Bitterly, Delisle's error had cost Charles the main prize. Palitzch had become an overnight sensation, and his achievement was a cause for celebration. It proved Halley's theory was true; comets were periodic after all. It was another resounding victory for science, and the comet of Christmas 1758 was officially named 'Halley's Comet' in the late Englishman's honor. Along with Palitzch, Halley's name was now renowned throughout Europe. Rather surprisingly, though, the comet's return was a somewhat tepid affair in Britain, Edmund Halley's own country.

Tepid must have also described the atmosphere in the Hôtel de Cluny. Delisle did eventually announce the return of Halley's Comet soon after the announcement from Saxony. But other astronomers in France were skeptical. Why, if the comet was discovered on the 21st of January, had the information been held for over three months? It was perhaps unfortunate that Delisle chose to make his announcement on the 1st of April.

If Charles was upset with Delisle over the whole affair there is no record that he ever said so at the time, though much later in his life, when writing his memoirs, he did express his regret and frustration that the great comet of 1759 had slipped away from him. But Charles, ever-tenacious, continued to work. In late January 1760 he discovered C/1760 A1, the great comet of that year (though it had also been spotted by many others) with a fantastic 5-degree long tail – 10 times the diameter of the full Moon in the sky. Delisle by this point had now become quite irrational and briefly also refused to publish this new discovery by Charles. In the end, though, the aging Delisle eventually changed his mind and allowed Charles to continue. The old man withdrew from astronomical work from then on, leaving Charles to dance to his own tune. One of his first observations after emancipation from Delisle's influence was his second Messier object (M2), a globular star cluster in Aquarius that the French-Italian astronomer Jean-Dominique Maraldi had discovered in 1731.

Clock Watching Beyond the Sea

Charles Messier had by now become France's human version of the Hubble Space Telescope, consistently finding new objects or observing others in detail. Mirroring his first-ever observation at the Hôtel de Cluny, Charles tracked a planetary transit across the Sun's disc. This time it was Venus, on the 6th of June, 1761. Saturn's rings were another observing target for Charles.

It wasn't long before he observed another comet: Klinkenberg (C/1762 K1 in 1762). Charles discovered Comet C/1763 S1 on the 28th of September, 1763, and C/1764 A1 on the 3rd of January, 1764. These objects didn't conform to any known cometary bodies, so they were totally new, and Charles Messier had been the first person on Earth to spot them. Probably buoyed by these, his first genuine discoveries (all the other objects having been discovered by others – not that it mattered as much in those times as it does today), Charles tried to become a fellow of the French Royal Academy of Sciences, the Académie des Sciences. The academy was founded by King Louis XIV in 1666 in order to procure the best intellectual talent from Renaissance Europe. One of the founder members was none other than the Dutch scientist Christiaan Huygens, known for his discoveries of the Martian polar ice caps and the rocky composition of the rings of Saturn, as well as the discovery of its largest moon, Titan. The probe that landed on Titan in January 2005, Huygens (part of the European Cassini-Huygens mission to Saturn), is named in his honor. Charles would have been proud to be counted among such hallowed figures, but he was to be disappointed when the academy rejected his application. Likely this was due to the fact that Charles wasn't an academic astronomer, not knowing astronomical theory, nor indeed being particularly skilled in mathematics. Charles himself knew that a lack of knowledge and experience in these fields held him back somewhat, but a rejection by the academy must have been a blow all the same. There must have been some part of him that felt the whole affair over Halley's Comet had its part to play as well.

Ever passionate though, Charles continued observing the skies, and curiously it was after his rejection by the academy that the number of discoveries he made really took off. By 1765 he had discovered a further 20 Messier objects. Many of these were star clusters; others were nebulae, galaxies, and stellar remnants. Though through a telescope some structure can be seen in a star cluster, there isn't much, visually speaking, to tell the other types of objects apart. The nature of galaxies as vast groupings of star systems was unknown until the early twentieth century. For this reason, all non-moving fuzzy celestial objects were called nebulae in Charles's time. The important thing about them as far as he was concerned was that they looked like, but were not, comets.

With the nebular objects Charles had decided (probably with his observation of M1) that he would finally catalogue as many of them as he could. He wasn't interested in them per se, but because their faint fuzzy appearance was so similar to that of comets he didn't want to confuse the two sets of objects any more – this source of irritation had to be dealt with once and for all, and the list of nebulae would become the world-famous Messier Catalogue.

Although at first it seems strange that a comet hunter would put so much effort into actively finding nebulae, you quickly realize that it is in fact a sensible thing to do. If Charles found and catalogued as many nebulae as possible, he would know exactly where they were in the sky because their positions would never change compared to the background stars. If Charles revisited a patch of sky and saw a new 'nebula,' then the chances were that it would be a comet (though watching the position of the comet changing from night to night would be the only way to be sure).

The cataloguing of nebulae then would be an invaluable method of avoiding false targets. There were other such catalogues available to Charles at the time, including those of Halley, Nicolas Lacaille, Giovanni Maraldi, and Johannes Hevelius. He incorporated the information from these into his own catalogue, but Charles wanted to expand on them to create a list as comprehensive as possible. He also wanted to check the previous observations for himself.

During this time Charles was also busy building up contacts with his contemporaries in Britain, Russia, and Germany. Clearly it seemed he felt recognition was deserved for his work, and joining an academy would be a great way of opening doors. Despite being shunned by his own academy in France, Charles was accepted as a member of the Academy of Sciences of the Netherlands (known as Harlem). On the 6th of December of that same year he was also accepted as a foreign member of Britain's prestigious Royal Society. The society was much more relaxed about admitting new members at the time than it eventually became.

A year later, in 1765, the 77-year-old Joseph Delisle, having taken a backseat for a few years, had now decided to retire from his post altogether. Though it took at least another six years for the depot clerk Charles to be appointed Astronomer of the Navy, he was now even freer to pursue his own observing program – and his unquenchable enthusiasm saw to it that he did exactly that. And 1765 was significant also because Charles discovered his 41st Messier object, an open star cluster in Canis Major. Like most of Charles's other discoveries this one had been discovered before. In this case the Sicilian Giovanni Hodierna saw it at least 112 years previously, and the ancient Greeks probably knew about it too. Nevertheless, being the first to the post wasn't really the point of Charles's catalogue of nebulae; he simply wanted to avoid confusing these objects with comets.

It was on the 8th March in 1766 That Charles Messier, who was becoming renowned in Europe as a prodigious comet hunter, discovered another one of these much sought-after celestial visitors (C/1766 E1). This time he spotted it with the naked eye, which is how he also discovered the great comet of 1760. This was probably just as well, considering the quality of the instruments he had to work with. In April he independently co-discovered Comet D/1766 G1 along with Johann Helfenzreider.

It was in 1767 that Charles, who after Delisle's retirement was at this stage still only a naval clerk, undertook his first (and only) ever-recorded naval voyage. Along with a colleague Charles was to test marine chronometers made by Julian and Pierre Le Roy, who were the French equivalents of John and William Harrison. John Harrison was the Yorkshire-born carpenter's son famed for creating a series of increasingly accurate marine chronometers to aid naval vessels in their calculation of longitude. Despite Nevil Maskelyne, Sir Isaac Newton, and other scientific heavyweights championing the lunar table method, longitude calculations at sea could only really be done in any practical way with the aid of an accurate timepiece. Though pendulum clocks existed, rough sea voyages jostled ships up, down, left, and right by just the right frequency and amplitude to play havoc with the mechanisms. Three years before Charles's own voyage, Harrison's H4 model was successfully tested on a return voyage to Barbados. Harrison's tale is recounted in Dava Sobel's *Longitude.*

Le Roy, like Harrison, was also working on the problem of longitude and had invented a bimetallic strip to compensate for the changes in temperature during a voyage (particularly when traveling from cold, northern European waters to the tropics, and vice versa). Normally, differences in temperature would make the metal in any chronometer expand and contract enough to alter its timekeeping abilities, but the bimetallic strip would overcome this. Harrison had also arrived at the same solution independently. The question of accurate timekeeping was arguably the most pressing technological problem in the age of the European trading empires – the 'golden age' of maritime voyages. Whoever accurately knew the time would effectively have mastery of the sea, and hence the world's naval trading routes. Prophetically, the British had gotten there first.

But France wasn't going to give up so easily. Le Roy's latest chronometer was considered to be equivalent in prowess to the H4. A ship known as L'Aurore (the Dawn) was built in La Havre docks on the Normandy coast specifically for the purpose. Both the ship and the voyage were funded by the Marquis de Courtanvaux. L'Aurore is not to be confused with another vessel of the same name that served as a slave ship, transporting people from Angola to the West Indies between 1784 – when that ship was built – and 1789 when the slave trade was abolished in France (albeit briefly).

Charles's colleague on his 3–4 month voyage was Alexandre-Guy Pingré. Unlike the H4 on its voyage, the Le Roy chronometers and the two accompanying astronomers would not be traveling to the warm paradise islands of the tropics. Charles and Pingré's journey would instead take them to the colder waters of the Baltic Sea in Scandinavia. In order to show that the marine watches were accurate it was necessary to test them against the tried and trusted sextant (used since 1731), despite the formidable difficulties of using one at sea. But if anyone could do it, the exacting Charles Messier could. Charles and Pingré formed a two-man team, with Charles doing the astronomical observational work and Pingré doing the calculations. During Charles's absence from the Cluny observatory, Lalande continued with the observation program.

Charles it seems didn't really enjoy his excursion (important as it was), and was probably glad of returning to France four months later.

Recognition, Tragedy and a Big Egg

In April 1769, Charles was elected member of the Stockholm Royal Academy of Sciences. Then on the 8th of August, Charles discovered the great comet of that year, which, like his previous discoveries was named after him. This latest one was called 1769 Messier. The modern-day designation is C/1769 P1. Being shrewd, and no doubt remembering the debacle of Halley's Comet (as well as the snub by his own academy), Charles sent a letter and a diagram of the comet's position to Frederick II, King of Prussia (a now defunct kingdom of the German Empire). Reputedly it is said that Frederick was so impressed with Charles that he pulled a