55 YEARS OF COMETS
(1970 – 2024)

PART II
ONE HUNDRED COMET OBSERVATIONS

I have undergone many interesting experiences during my decades of comet observing, and many of the comets, and the observations I have made of them, have been quite remarkable. In that vein, then, I here present 100 of the most interesting, and notable, comet observations I have made over the years. Some of these are first-time additions to my tally while others are notable observations of comets I already had under observation, and meanwhile several of them are observations I associate with goings-on in my personal life, some happy, others sad. It has been difficult to cull the list down to 100, and I have endeavored to have the observations on this list cover the entire spread of the time I have been observing comets.

Many people appear within these short stories. Those who appear numerous times include:

My mother (Ruth Perkins, d. 2013) and father (Nile Hale, d. 2002), and my older brother Barry

My sons Zachary (b. 1987) and Tyler (b. 1992)

My first wife, Eva (met 1980, married 1985, divorced 2010)

My second (and current) wife, Vickie (met 2017, “domestic partner” 2019, married 2024)

A lady (Susanne) with whom I was in a committed relationship from 2010 through 2012, with occasional “get-togethers” into 2016

My best friend when I started observing, Mark Bakke, who was tragically killed in 1984

My friend, colleague, and observing partner when I lived in California during the early- to mid-1980s, Charles Morris, who passed away in January 2025 as I was preparing this analysis

Two additional friends and colleagues from my years in California, Steve Edberg and Rick Shaffer

Dan Green and (the late) Brian Marsden, from the IAU's Central Bureau for Astronomical Telegrams. For many years, Brian was also Director of the IAU's Minor Planet Center.

All dates below are local calendar dates (as opposed to Universal Time dates).

1. FEBRUARY 2, 1970
Comet Tago-Sato-Kosaka 1969g (no. 1)

This is my first comet observation. I had heard of this comet from my father and Barry, and had read accounts in the local newspaper, and then an article in the January 1970 issue of Sky & Telescope mentioned that on the evening of February 2 it would be located near the star Alpha Arietis (Hamal). That evening Mark brought over his 60-mm refractor, and around 7:30 I spotted the comet in 7x35 binoculars – near Hamal, as expected – and then turned my 4.5-inch reflector (which I had had for just over two weeks) to the comet while Mark turned his telescope towards it as well. It appeared as a diffuse glow with a distinct central condensation, and at 5th magnitude I could faintly see it with my naked eye. We showed it everyone in my family, i.e., my father, mother, Barry, and my paternal grandmother who lived with us.

I ended up following the comet every night for the next week, and on the evening of the 6th it appeared distinctly brighter than it had been earlier, being rather easily visible to the naked eye. I would later learn that it had undergone a brief upsurge in brightness right around that time. After February 8th the following nights were cloudy, and I did not look for the comet again.

2. MARCH 25, 1970
Comet Bennett 1969i (no. 2)

Sky & Telescope had mentioned that this bright comet was on its way in, and Mark and I made plans to observe it on the morning of March 25. However, an article in the local newspaper mentioned that someone had seen a comet in the morning sky a couple of mornings earlier, and my father (who was an early riser) woke me up on the morning of the 24th and pointed it out to me. It was an easy naked-eye object, near magnitude 0, with a bright dust tail 10 degrees long or longer.

On the following morning I rose earlier, got the telescope out, and watched the comet as it rose above the Sacramento Mountains to our east. The sight of trees at the top of the mountain ridge silhouetted against the bright dust tail was most remarkable, and after the comet completely rose it was a truly spectacular object, again near magnitude 0 with the dust tail being at least 10 degrees long. That same morning I also tried my hand at comet photography, using a handheld Brownie camera from the doorstep of our house. The results were hardly spectacular, although the comet was clearly "there" in the photographs.

3. JANUARY 10, 1974
Comet Kohoutek 1973f (no. 10)

The much-ballyhooed "Comet of the Century" turned to be a big bust as far as much of general public was concerned, but was still a decently good (if not necessarily "Great") comet for comet-watchers. I had first picked it up in the morning sky in late September 1973 and followed it for the next 2½ months before losing it in the dawn sky. My best view during that time came in early December, when it was about 4th magnitude and I could see it with my naked eye as a faint fuzzy star; in binoculars the tail was three degrees long.

After perihelion the comet appeared in the evening sky, and I first saw it on the evening of January 4, 1974, low in the western sky. My best view came on the evening of the 10th, when it was easily visible to the naked eye, near 4th magnitude, and exhibited a tail several degrees long. With 10x50 binoculars I could trace the tail out to a length of 15 degrees.

The comet faded from that point, dropping below naked-eye visibility by about the end of January, and I followed it for another three weeks thereafter.

4. MARCH 10, 1975
Comet 76P/West-Kohoutek-Ikemura 1975b (no. 15)

In early 1975, thanks to a student one year ahead of me, Darcy McGinn, and a local amateur astronomer, Phil Simpson, I first began to have access to the Alamogordo Public Schools 12.5-inch reflector located on the campus of Buena Vista Elementary School (where I had attended First Grade before a new school, Yucca Elementary, was built, which I would attend from 2nd through 6th Grades). I utilized that telescope to obtain observations of the near-Earth asteroid (433) Eros (which made a close approach to Earth during January) for a Science Fair project, which eventually netted me a First Place in the Earth and Space Science Division at the State Science Fair.

The first comet I observed with that telescope was independently discovered at the end of February 1975 by Lubos Kohoutek in then-Czechoslovakia and amateur astronomer Toshihiko Ikemura in Japan, and later identified with a potential comet that had been noticed by ESO astronomer Richard West on an ESO photographic plate taken in October 1974. It took a while for all this to be straightened out, but once a valid orbit was computed I attempted it on the evening of March 10, and saw it as a vague, diffuse object near magnitude 12½. I did not look for the comet again after that, but the usage of this telescope began a new phase in my observing efforts that continued for some time thereafter.

5. JULY 19, 1975
Comet Kobayashi-Berger-Milon 1975h (no. 16)

During the summer of 1975 – the summer before my Senior year of High School – I attended a 6-week-long National Science Foundation Summer Science Training Program (SSTP) on Optics and Holography that was held at the campus of New Mexico State University in Las Cruces. The program was conducted by the Physics Department, but I

often visited the Astronomy Department to check out the newest IAU Circulars, and learned of this bright new comet discovery. Unfortunately, the summer weather in New Mexico can be "iffy" a lot of the time, and clouds prevented me from making any immediate attempts for the new comet.

On the weekend of the 18th/19th I went home to Alamogordo. The skies that night were overcast, and I actually went out on a date, however when I returned home I noticed a small break in the clouds slowly making its way across the sky. I waited patiently, and shortly after midnight this break reached Cygnus, where the comet was located, and I immediately detected it with binoculars and my telescope, and could also see it with my naked eye. It appeared near 5th magnitude and exhibited a large coma at least 10 arcminutes across. I had about 15 minutes to watch the comet before the cloud break moved away from Cygnus, and that was it for the night.

6. JULY 31, 1975
Comet Kobayashi-Berger-Milon 1975h (no. 16)

On the last weekend of the NSF's SSTP that I attended at the NMSU campus, the NMSU Astronomy Department held a public open night at the campus observatory (named after Clyde Tombaugh, who founded the Department during the 1950s and who was then Professor Emeritus). Comet 1975h was a bright object in the sky then, still near 5th magnitude, and I was given the de facto role as "comet expert" for the many people who came by.

I would maintain my contacts with the NMSU Astronomy Department, the Department Head of which was Herb Beebe, for the next several years, and this played a major role in my deciding to attend Graduate School at NMSU a little over a decade later.

7. FEBRUARY 21, 1976
Comet West 1975n (no. 20)

I knew this potentially bright comet was on its way in, but had little expectation of its becoming "Great." From the published ephemerides I determined that the first night it would become accessible from the northern hemisphere was February 21, 1976, so shortly after sunset that evening I drove to some softball fields close to my house that had a clear view of the western horizon. I didn't really expect to see anything, but was pleasantly surprised when, after a few minutes of searching, I saw a brilliantly white comet, with about a half-degree-long tail, against the bright dusk sky. Once I knew where to look I could see it with my naked eye, and the brightness was probably close to magnitude -1. Later that evening I went bowling with some friends of mine, and mentioned that I had just picked up my 20th comet; one of them remarked that that made me an "ace."

Four nights later I went to observe again from the same location, and right after sunset – when the comet's elongation was only 7 degrees – I immediately picked it up with the binoculars and then with my naked eye. The brightness was difficult to estimate, but was at least magnitude -2 and probably closer to magnitude -3.

That was the day of perihelion passage, and I am aware that there were some daylight sightings that day. I was on the track team (as a discus thrower) and had after-school track practice; had I not had practice and been able to arrive at the site earlier, I might also have glimpsed the comet during daytime.

8. MARCH 3, 1976
Comet West 1975n (no. 20)

After the brilliant comet I had observed in the evening dusk, I had strong expectations for a bright display in the morning sky after perihelion. The

Sacramento Mountains to my east kept me from seeing the show early on, and then I had a couple of days of cloudy weather. Finally, on the morning of March 3, 1976 I drove westward to White Sands National Monument (now White Sands National Park), and while setting up my telescope and camera in the parking lot I noticed what appeared to be a searchlight beam extending upward from the mountains on the eastern horizon. I didn't pay too much attention to this at first, but after completing my setup I turned my attention back to it, and it slowly dawned on me, almost in stupefaction, that I was seeing the comet's tail extending upwards from below the horizon.

Once the comet rose, the sight was nothing less than glorious: a very bright coma, with a brightness near magnitude -0.5, and with the bright dust tail which I measured at a length of 23 degrees. I took several photographs, and one of these was used by the local newspaper as an above-the-fold front page illustration two days later.

The morning-sky show that day presaged a brilliant display that lasted for the next few weeks. Comet West's display that spring, during the final semester of my Senior year of High School, has caused me to rate it as the all-time best comet I have ever seen, and I rank its display on the morning of March 3 as the "best" comet observation I have ever had.

9. JULY 3, 1976
Comet West 1975n (no. 20)
Comet 6P/d'Arrest 1976e (no. 23)

After the early March session I describe in the above entry, I continued to follow Comet West for the next four months as it faded. I might have followed it even longer, but after graduating from High School on May 27, 1976, it was time to move on to the next phase of my life, and for reasons well beyond the scope of this analysis I would end up entering the U.S. Naval Academy in Annapolis, Maryland. I departed on the morning of July 5, and two nights before then – the night before the

Bicentennial July 4 celebrations here in the U.S. – I had one final observing session at the Public Schools' 12.5-inch telescope.

I started the session with an observation of Comet 6P/d'Arrest, which I had just picked up for the first time the previous night. Only 11th magnitude at the time, this comet would pass close to Earth the following month and eventually reach a peak brightness near 5th magnitude, however due to the restrictions on my personal life I would be encountering as a new "plebe" at the Naval Academy I would completely miss this; these first two observations I made of this comet in early July would remain my only ones during that return.

I then turned to Comet West, which was still fairly easily detectable near 10th magnitude. As I observed it I knew this would be the last time I would ever see it, and felt an overwhelming sensation that it was carrying my childhood, and my old life, with it as it receded from the inner solar system. After I completed my observation I closed up the telescope, drove home, and a day and a half later I boarded a plane and my life changed forever.

10. SEPTEMBER 28, 1977
Comet Kohler 1977m (no. 25)

I did not observe any comets from the Naval Academy during my first year. My only comet observation came during a brief trip home during April 1977 when I obtained a single observation of Comet 26P/Grigg-Skjellerup 1977b (no. 24), then near 10th magnitude.

The first comet I observed from the Naval Academy was discovered in early September 1977. On the evening of September 28, despite the fact that the moon was near full, and despite the fact I was "ditching" a required lecture, I headed towards the Naval Academy's 16-inch telescope on top of the Physics Department building with one of my roommates, and grabbed an observation of it. In the bright sky there

wasn't much to see; I would "guesstimate" its brightness as being near 9th magnitude.

I followed Comet Kohler from the Naval Academy for the rest of the fall semester, and it reached a peak brightness near magnitude 6½ during November. I grabbed a final two observations from Alamogordo in late December when I was home for Christmas break.

11. JULY 28, 1979
Comet Meier 1978f (no. 28)

The comet activity remained quite slow throughout my four years at the Naval Academy, and indeed I did not observe any comets at all during the first six months of 1979. After being on one of our summer training cruises, in the western Pacific around Japan (during which, among other things, I was able to climb to the top of Mount Fuji and visit the city of Tachikawa, where I had been born) from mid-June to mid-July, I traveled home to Alamogordo where I stayed for the next three weeks before returning to Annapolis.

I had observed Comet Meier on a handful of occasions between May and July 1978, but it had remained inaccessible from the northern hemisphere for several months after that, and I had no thoughts of observing it again. However, I read a report in Sky & Telescope that suggested it was still bright enough to be visible, and since it was now accessible again from the northern hemisphere I decided to give it a try, and on the morning of July 28, with the 12.5-inch telescope I easily spotted it as a small and fairly "dense" object of 11th magnitude. This observation made Comet Meier the first comet that I had followed for longer than one year, although there was a gap of over a year between successive observations.

I would end up observing Comet Meier one more time from New Mexico, and two additional times from the Naval Academy once I

returned to start my final year. My total observing interval for this comet ended up being 16 months.

12. FEBRUARY 2, 1980
Comet Bradfield 1979l (no. 35)

The best comet that came by during my years at the Naval Academy was discovered by the highly successful Australian comet hunter William Bradfield in late December 1979, although I didn't learn of this until I had returned back to the Naval Academy in mid-January 1980 following Christmas break. At that time the comet was deep in southern skies, and wouldn't become accessible from the northern hemisphere until late that month. Mark, at that time an enlisted man in the U.S. Air Force and stationed at Holloman Air Force Base in New Mexico, reported to me that he had spotted it – as a large, diffuse object – on the evening of the 26th, but because of bad weather I had to wait three more nights. When I did see it on the 29th I had to contend with an almost full moon and couldn't tell much about it, but when I was able to see it again three nights later I could verify Mark's overall description, with the comet's brightness being about 5th magnitude.

The following night, February 2, was the 10-year anniversary of my first comet observation. During the previous year I had founded the U.S. Naval Academy Astronomy Club – which I understand is now a thriving organization – and had been elected President. On that evening I, along with two other Officers of the Club, observed the comet with the Physics Department telescope. It appeared about the same as the previous night, i.e., large, diffuse, and about 5th magnitude. Although it was an easy object in binoculars, due primarily to the light pollution in the area I couldn't quite see it with my naked eye.

I followed Comet Bradfield for another month, and it faded quite rapidly. I did not see any more comets during my time at the Naval Academy.

13. JULY 11, 1980
Comet 37P/Forbes 1980a (no. 36)

After graduating from the U.S. Naval Academy at the end of May 1980 I spent two months at my home in New Mexico prior to leaving to my first duty station, Surface Warfare Officers' School (SWOS) in San Diego, at the end of July. In June I purchased a Meade 8-inch reflector as a graduation present to myself, and on the night of July 11 Mark and I took my new telescope to a site in Karr Canyon, New Mexico (near the town of High Rolls) to test it out. I checked out quite a few deep-sky objects, and overall was very pleased with the telescope's performance, but, meanwhile, one of the first objects we observed was Comet 37P/Forbes, then in the evening sky. I was able to spot it as a very faint and small 13th-magnitude object, and saw a slight motion over a half-hour's watch. This was my first comet observation with that telescope, which I still own and still use on an occasional basis.

I observed Comet Forbes one more time from New Mexico, and once more after I had moved to California; this was the first comet observation (of many more) I made from the State where I would live for the next six years.

14. DECEMBER 18, 1980
Comet 8P/Tuttle 1980h (no. 40)

During the fall months of 1980 when I was attending SWOS I would take the 8-inch telescope into the mountains east of San Diego a couple of times per week, on the average, for observing sessions; this was at least in part an escape, of sorts, from the emotional discomfort I was feeling with my "day job." There were several bright comets I was able to follow that fall, with Comet Tuttle being the brightest of these; I had first picked it up in early October, on the same morning I first picked up Comet 2P/Encke on its 1980 return (no. 39) – my first two-comet-add night, as part of my first three-comet night (along with Comet

38P/Stephan-Oterma 1980g (no. 38), which I had first picked up the previous month). I had met Eva, whom I would marry five years later, that summer, and she accompanied me on some of my observing trips – including on that first three-comet night – although I think for the most part she was underwhelmed by the comets I showed her.

Comet Tuttle passed perihelion in mid-December and was near 7th magnitude at that time. It was heading southward pretty rapidly, and the last morning it would be accessible would be on the 18th, when its declination was -49.7 degrees, just barely above the southern horizon from the observing site near Mount Laguna that I used quite often. I was somewhat surprised to see the comet had brightened further, to near magnitude 6.5, and I could see a rather striking one-degree long tail in binoculars, extending almost due northward. Telescopically the coma appeared more condensed than previously, and I suspected an actual condensation. The comet was so far south that it remained in field with the southern horizon throughout the observation.

15. JANUARY 6, 1981
Comet Bradfield 1980t (no. 42)

In the previous entry I mentioned the emotional discomfort I was feeling with my "day job" as an Officer in the U.S. Navy. That discomfort reached a head during the first few months of 1981, after I reported for duty aboard the Destroyer USS Hewitt at the end of January, and almost resulted in my considering suicide less than two months later. Observing comets (during the few occasions when I had the actual opportunity to do so) provided one source of therapy that got me through that dark period of my life.

During January I was attending a Navigation school at the Naval Station in San Diego, and a bright comet happened to come along at that same time. On the evening of the 6th I went with Eva to a scenic viewpoint along Interstate 8 near the town of Alpine, and immediately picked up

Comet Bradfield in binoculars and then with the 8-inch telescope. It was as striking object, about 4th magnitude with a bright, filmy tail about two degrees long. While Eva had perhaps been underwhelmed by all the previous comets I had shown her, her gasp when she first saw Comet Bradfield indicated that she found this particular object quite impressive. On that same evening I also added Comet 19P/Borrelly 1980i (no. 43) to my tally, the second time (and the second time in three months) that I had had a two-comet-add night.

I observed Comet Bradfield several more times during January, as it faded slightly but remained a rather impressive object. Since these observations took place against the San Diego skyglow from the Alpine viewing site, I never was quite able to see the comet with my naked eye, but it remained easy to detect with binoculars. My final observation came on the evening of the 28th, when I was aboard the Hewitt some 200 miles southwest of the coast of California; through the ship's 5-inch binoculars aboard the signal bridge the comet was about 7th magnitude and displayed about a half-degree-long tail, situated against a rather bright zodiacal light. I suppose one could call this my first comet observation from outside the U.S.

16. MAY 6, 1981
Comet 29P/Schwassmann-Wachmann 1 (no. 47)

In early 1981 I decided to begin monitoring this comet for outbursts, and as happenstance would have it the comet was subsiding from such an outburst slightly before I began searching for it, and I ended up missing this event.

In late April and early May I took some sorely-need two weeks of leave from my Navy assignment aboard the Hewitt, and during the second week of that Eva and I went on a camping trip to Yosemite National Park. On the evening of the 6th we drove to a site just outside the valley entrance, and upon turning the 8-inch telescope to the expected location

for Comet 29P I was rather surprised to see a diffuse 12th-magnitude object about 1 arcminute across at that spot. I excitedly called up Dan Green at the IAU's Central Bureau the following morning to report a possible new outburst, and he informed me that the comet was indeed in outburst and in fact had been for a couple of weeks. Of course, since I had been away from home for several days and had not seen the IAU Circular reporting this, I was completely unaware of that fact. Dan would subsequently publish my observation on another IAU Circular.

I observed the comet again the following night, detecting a slight shift in position from the previous night, and thus completely verifying in my own mind that I had seen this comet. I didn't look for it anymore during that particular outburst, but would detect two more outbursts early the following year (January and April 1982) before it went through aphelion in early May. Although I would continue to monitor Comet 29P for outbursts on a regular basis, more than five years would elapse before I detected another one, in October 1987 (no. 111).

In my mind, this observation of Comet 29P in May 1981 gave me full legitimacy as a comet observer. It is one thing to see a cometary phenomenon after one is already aware of it, but another thing entirely to see something when one is completely unaware of it, as I was at that time. With the emotional difficulties I was having in my "day job," this helped in providing me with some self-confidence to get me through those difficult times.

17. JANUARY 8, 1982
Comet Bowell 1980b (no. 46)

I first picked up this comet in late March 1981, although for the next two months it remained a difficult object to observe, not only due to its faintness but also due to its proximity to Jupiter, which it was in the process of encountering (and undergoing a significant change in orbit due to gravitational perturbations). By late May it had moved far enough

away from Jupiter that it became easier to see, and I followed it for another 2½ months before it sank into evening twilight. I picked it up again, in the morning sky, at the very tail end of 1981.

In early January 1982 Eva and I went to New Mexico to visit with my family. Mark, still stationed at Holloman Air Force Base near Alamogordo, was at that time living in a rented bedroom in a house slightly east of the town of Tularosa, and some time earlier had purchased a 12.5-inch reflector of his own. On the morning of the 8th I visited Mark at his place, and we used his telescope to observe Comet Bowell; with having to contend with bright moonlight – the moon being just a couple of days from full moon – and cirrus clouds, the comet didn't look like much – just a "glow" near magnitude 11½ – but was nevertheless "there."

There was, of course, no way to know this at the time, but this would be the last time I would ever see Mark alive. His enlistment in the Air Force ended a month later, and he returned to his family's home in North Dakota. He got married at the end of 1983, and in fact asked me to be his Best Man, but unfortunately I had just started my job at JPL and was flat broke since I had been forced to deplete what little savings I had during my six-weeks period of unemployment after getting out of the Navy, and was unable to attend. Then, in September 1984 he was tragically killed during a firearms accident.

I would continue to follow Comet Bowell for the next nine months, through opposition in late June when it reached a peak brightness near 11th magnitude, and then faded. (My overall duration of observation was 19 months, a record at that time, and it is still in 25th place on the "longest duration" list.) It was the relevant comet for two more notable observations during that time: on June 23 I observed it – barely detecting it – with the old 4½-inch reflector which I had barely used for several years and which I was in the process of selling, and on the night of July 5-6 it became the first comet that I ever observed during a total lunar eclipse.

18. AUGUST 18, 1982
Comet Austin 1982g (no. 52)

During the summer of 1982 I was transferred to the Personnel Support Activity at the Long Beach Naval Station (after having been stationed at another facility at that same Naval base for the previous seven months). That fall I also began taking graduate-level classes in Physics at California State University-Long Beach, and although I would not complete that program, the credits I earned successfully transferred to New Mexico State University when I began the Astronomy program there in 1986.

During the previous months I had also made the acquaintance with Steve Edberg, who worked at JPL and who supervised the Amateur Observations Network portion of the International Halley Watch, for which I had volunteered to assist. When Comet Austin came along he invited me to join him for a trip to the San Gabriel Mountains north of Los Angeles to observe it, and on the evening of August 18th I met him and another JPL employee, Rick Shaffer from the Deep Space Network, at a local restaurant in La Canada for dinner before heading up the Angeles Crest Highway. We pulled into a small turnout several miles up and waited for dark, and once the sky was dark enough we were able to find the comet, near 5th magnitude (and with a distinct bluish tinge) and with a one-degree-long tail. The comet's altitude was still quite low and I was unable to detect it with my naked eye, but it was an easy sight in binoculars.

I followed Comet Austin in the evening sky for another month and although it slowly faded, for a while it climbed higher into the sky, and on one occasion I was able to glimpse it with my naked eye – my first naked-eye comet observation since Comet West in 1976. After conjunction with the sun in October I observed it in the morning sky a couple of times as a distinctly fainter object. Meanwhile, when I got out of the Navy during the fall of 1983 Rick Shaffer was instrumental in putting me in contact with the people who would offer me a job at JPL

(specifically, for the Deep Space Network). Although I have not had much contact with them in recent years, Rick along with Steve Edberg both remain friends of mine to this day.

19. DECEMBER 24, 1982
Comet 67P/Churyumov-Gerasimenko 1982f (no. 53)

I had been somewhat intrigued by this comet ever since I read of its original discovery in the December 1969 issue of Sky & Telescope, one of the first two issues I purchased. In 1982 it had a very favorable return, and I first picked it up in early September. I followed it on a fairly regular basis from that point on, and in early December I could faintly detect it with binoculars near 9th magnitude.

On the evening of December 23, after a heavy winter storm had moved through southern California, I left Orange County (where I lived at the time) for San Diego to spend the Christmas holiday with Eva and her family, but while en route I stopped at an observing site on the road to Palomar Observatory for an observing session. In an exceptionally clear sky, after midnight I observed Comet 67P, and was surprised when I saw the coma encased within an almost-diamond-shaped outer coma, from which sprang a broad, slightly curved 20-arcminute tail; overall, the telescopic appearance was almost that of a miniature "Great Comet." The overall brightness was still about 9th magnitude and I could still detect the comet with binoculars, but this is nevertheless one of the most remarkable appearances I have ever seen of a comet of this brightness.

I observed Comet 67P a couple of more times in December – the latter of these being during the exceptionally dark total lunar eclipse on December 30, the darkness caused by dust blown up into the atmosphere by the eruption of the volcano El Chichon in Mexico earlier that year – and while I could still detect the tail, the overall appearance wasn't anywhere quite as dramatic. I followed the comet into 1983, but once a series of strong El Nino storms started in late January my time with the

comet was all but over. I have observed the comet on several returns since then, including in 2015 (no. 577) when it was the destination of ESA's Rosetta mission, although it has never appeared quite as impressive as it did on that night in 1982. Meanwhile, I had the pleasure of meeting one its discoverers, Klim Churyumov, at the Asteroids Comets Meteors meeting in Flagstaff, Arizona in June 1991.

20. MAY 10-11, 1983
Comet IRAS-Araki-Alcock 1983d (no. 56)

On the evening of May 4, 1983 I received a phone call from Steve Edberg, informing me of the discovery of a bright new comet en route to a very close approach to Earth – 0.031 AU, the closest known approach of a comet to Earth in almost two centuries. After being part of an impromptu "phone tree" wherein I also placed a few phone calls, I headed up to the mountains in southeastern Orange County that same night and quickly spotted the comet, a large diffuse object of 7th magnitude.

I followed the comet, initially on an every-other-night basis, and finally on a nightly basis, over the next week as it approached Earth, and by the end of that time it was an easy naked-eye object of 3rd magnitude. On the night of closest approach, May 10-11, I drove to Chilao Ridge off the Angeles Crest Highway, and saw the comet right away close to the Big Dipper's handle near magnitude 2½, and with a somewhat elongated coma about 2 by 1½ degrees across. The comet's rapid motion – 2 degrees per hour – caused it to travel towards the southwest rather quickly, and I was able to follow it until around 2:00 A.M. The motion was rather obvious even to the naked eye, and through the 8-inch telescope I could detect the central condensation traveling against the background stars in "real time."

I would also observe four other comets during the night, making it my first ever five-comet night. After midnight I observed Comets

9P/Tempel 1 1982j (no. 54) and 22P/Kopff 1982k (no. 55) – both of which I had been following since mid-March – and before dawn I picked up (as new tally additions) Comet 10P/Tempel 2 1982d (no. 57) and the newly-discovered Comet Sugano-Saigusa-Fujikawa 1983e (no. 58). This latter comet would make a very close approach to Earth (0.063 AU) a month later, although this was a significantly less impressive event than the flyby of Comet 1983d. Meanwhile, I would not see 1983d again from the northern hemisphere, although I did successfully observe it once from Australia the following month.

21. JUNE 16, 1983
Comet 7P/Pons-Winnecke 1983b (no. 59)

At the beginning of June 1983 Eva and I departed Los Angeles as part of a tour group chartered by Steve Edberg's "Moonshadow Expeditions" to observe the total solar eclipse from the island of Java on June 11. Along the way we had two-day-long tourist visits to Singapore and the island of Bali. On the evening of the 8th, from a beach outside of our hotel on Bali, I used the Coulter CT-100 4¼-inch reflector (a very portable instrument I had purchased in 1980) to observe Comet 22P/Kopff 1982k (no. 55); this would be my first comet observation from a country outside the U.S., and my first comet observation from the southern hemisphere. After successfully seeing the eclipse on June 11 the tour formally ended, but Eva and I continued on to Australia – my first visit there – arriving in Brisbane on the 13th. That evening I drove to a suburban site near there and successfully observed Comet Sugano-Saigusa-Fujikawa 1983e (no. 58), then having just passed its closest approach to Earth, but it appeared as little more than a faint diffuse glow traveling rapidly against the background sky.

On the following night, from sites in northern New South Wales, I conducted what I called my "Australian Comet Marathon," observing the same five comets that I had seen during the night of Comet IRAS-Araki-Alcock 1983d's (no. 56) flyby of Earth on May 10-11 (previous

entry). Comet 1983d itself had faded to 10th magnitude, and meanwhile Comet 1983e appeared as a very vague, diffuse cloud near magnitude 7½ about 20 arcminutes across. It was while I was engaged in my observations of this comet that I happened to look up and see the center of the Milky Way passing almost directly overhead, the whole scene looking like a photograph of an edge-on spiral galaxy pasted onto the sky; one of the most remarkable sky sights I have ever seen.

When we had arrived in Australia I had called up David Seargent in The Entrance, New South Wales (north of Sydney), whom we would visit before our departure back to the U.S., and he informed me that some Australian observers had successfully spotted Comet Pons-Winnecke – a complete surprise to me, but which was based upon a prediction published in an Australian journal by Dutch amateur astronomer Reinder Bouma. I tried for the comet on both of those first two nights, but never saw anything convincing. On the 15th Eva and I arrived in Coonabarabran, and that evening I drove up to Siding Spring Observatory to visit Tommy Cragg (one of the assistants there), and during the mid-morning hours we used his 12.5-inch reflector to spot the comet. It appeared diffuse and uncondensed, near magnitude 12½ – it was no surprise that I had failed to spot it with the 4¼-inch scope. This was my first – of three so far, all from Australia – addition to my comet tally from outside the U.S.

That would be my final observing session, and final comet observation, on that first trip to Australia. After our return to the U.S. I did manage to observe Comet 7P on one occasion with the 8-inch, but it was very low in the southeastern pre-dawn sky, and with less-than-ideal sky conditions all I could do was tell that the comet was “there.”

22. NOVEMBER 1, 1983
Comet Cernis 1983l (no. 60)

On Thursday, October 20, 1983, at long last I got out of the U.S. Navy. Shortly thereafter I departed for New Mexico, in part to check out potential educational and employment opportunities, but also because earlier that year my father and his wife Frances had sold my childhood home in Alamogordo and were in the process of moving out of it, and moving to Florida. I thus spent a last few days in that childhood home, with the last night being November 1. My father and Frances had departed a couple of days earlier taking a truckload of their belongings to Florida and thus I had the place to myself, and that night I set up the 8-inch telescope in the front yard from where all the things had started all those years earlier. There was only one comet in the sky that I had any real chance of detecting: Comet Cernis 1983l, a distant object which I had first picked up in late July and which was presently around 10th magnitude. After observing that comet and concluding the night's observing session – which included revisiting all the deep-sky objects that I had observed on my first night with the old 4½-inch telescope – I slept one last night in my old bedroom, then the next morning handed the house keys to a friend of my father's before heading west back towards California and to whatever new life might await me there.

23. JANUARY 20, 1984
Comet 27P/Crommelin 1983n (no. 64)

In early December 1983 I began my new job with the Deep Space Network at JPL, and accordingly began moving into an apartment in the foothills community of Montrose. At this same time Charles Morris, whom I had met personally at the Second American Workshop on Cometary Astronomy that Steve Edberg had organized and that had been held at JPL at the beginning of October, was in the area interviewing for a job at the Lab. He informed of a new comet discovery, and shortly thereafter I found a new observing site in Lockwood Valley northwest of

Los Angeles and saw this object, Comet 161P/Hartley-IRAS 1983v (no. 63). Charles ended up being offered the position at JPL, and moved out to the L.A. area from Boston in January. For the next 2½ years we observed together on a fairly regular basis, and he taught me a lot about the proper methods of visually observing comets and making the appropriate measurements. I do not hesitate to say I owe much of my expertise as a comet observer to him.

The first comet we observed together was a Halley-type object with a somewhat checkered observational history that the International Halley Watch had selected as its "trial run" comet in preparation for that object's return two years later, and that had been recovered in August 1983. On the evening of January 20, 1984 Charles and I, along with Steve Edberg and Rick Shaffer, drove to a site in the San Gabriel Mountains near a place called Mount Gleason, and in both my telescope as well as Rick's home-built 19-inch reflector we successfully observed Comet Crommelin as a vague and diffuse object near magnitude 11½. As the four of us were leaving, a passer-by informed us that we had set up not too far from a medium-security prison; needless to say, none of us ever used that site again!

Comet Crommelin reached a peak brightness near 8th magnitude around the time of its perihelion passage in late February, and was still an unexpectedly bright 9th magnitude during the time of the IHW's "trial run" period in late March. It faded quite rapidly thereafter, with my last observation coming in early April. In 2011 I observed it again on a second return (no. 489), although the viewing geometry was quite unfavorable and I obtained only a handful of observations over the course of one week, during which time it remained a faint, vague object of 12th magnitude at a fairly small elongation. As a result of my observations at that return Comet Crommelin became the longest-period periodic comet that I have seen on two returns, a status it would hold for the next seven years. It still remains in second place in this particular category.

24. AUGUST 1, 1984
Comet 98P/Takamizawa 1984j (no. 70)

During the 2½ years Charles and I observed together we jointly confirmed three comet discoveries. The first of these was an object reported by a Japanese amateur astronomer (who would eventually go on to discover three additional comets over the next ten years, and whom I would meet in person two years after that) at the end of July 1984. This was right during the Olympic games that were being held in Los Angeles, and with the opportunity so close at hand Eva and I went to several of the events, including a track-and-field day at the L.A. Coliseum. On the early morning of August 1 Charles and I – with Eva accompanying us – drove to a site called Whitaker Peak northwest of Los Angeles that we utilized quite often, and successfully located the new comet as a small "dense" object just fainter than 9th magnitude; I could faintly detect it in binoculars. Charles subsequently reported our confirmation to Dan Green at the IAU Central Bureau, and we were credited with confirmation on the announcement IAU Circular that was issued that day.

Comet 1984j was found to be a periodic object over two months past perihelion, and since it was near opposition when discovered this seemed to suggest a mystery as to why it had been missed for so long. Pre-discovery photographs that were later identified soon provided the answer: it had been as faint as 13th magnitude in early July, but as bright as magnitude 6.5 four days before its discovery. It had obviously undergone a large outburst not too long before Takamizawa's discovery. Meanwhile, I followed the comet through late September as it faded, but have not seen it since, although I did search for it unsuccessfully on two subsequent returns.

25. AUGUST 25, 1984
Comet Austin 1984i (no. 71)

Following its discovery in early July 1984 this comet remained accessible only from the southern hemisphere, and in early August it was reported as being as bright as 5th magnitude with a 3-degree-long tail. Thereafter it disappeared into sunlight as it passed through perihelion on the 12th, and was due to become accessible from the northern hemisphere towards the end of that month.

On the morning of August 25, during the course of a "mental health" trip to clear my head about things and consider my future, I set up to observe at a site along the Angeles Crest Highway called Dawson Saddle, which at an elevation of 7900 feet offered a clear view towards the northeast over the Mojave Desert several thousand feet lower. Comet Austin's elongation at that time was only 18 degrees, but I had a somewhat unusual ally in locating it: a very thin crescent moon (just 31 hours before new moon). The comet was located only one degree away from the moon, but with the moon to guide me I easily located the comet in the bright sky with both telescopes and even with my 10x50 binoculars. It appeared as a small condensed glow without much coma, and I "guesstimated" a brightness near 7th magnitude. The entire sight of this relatively bright comet very close to the very thin crescent moon (which was exhibiting significant Earthshine) is one of the more remarkable sights I remember from my decades of comet observing.

I would see Comet Austin in a reasonably dark sky on two occasions over the next six days, seeing a slightly curved 1-degree tail in binoculars on the latter occasion; both times I measured a brightness near 6th magnitude, suggesting that my "guesstimate" on the 25th had been a bit of an underestimate. About this same I also began to detect an "anti-tail" with the 8-inch telescope, the first time I had ever seen such a feature on a comet. I ended up following Comet Austin for the next three months as it faded, and the anti-tail remained detectable until almost the end of October.

26. OCTOBER 27, 1984
Comet 24P/Schaumasse 1984m (no. 76)

In late October 1984 I received a letter from Jean Bakke, the woman in North Dakota whom Mark had married at the end of 1983, informing me of the tragic news that Mark had been killed during the course of a firearms accident the previous month. I called her, and also Mark's father (with whom I had been close during their years in Alamogordo, indeed, I had been close with the entire family) to get some details and then, still broken up by the news, a day and a half later I drove to my observing site near Frazier Park to make my first attempt for this particular comet. I successfully spotted it as a diffuse glow near 11th magnitude. In my observing notes for that morning I dedicated the observation (and addition to my tally) to Mark's memory.

Comet Schaumasse reached a peak brightness near magnitude 9.5, and faint visibility in binoculars, around the time it passed through perihelion in early December, and I followed it through mid-February 1985. I have seen it on three returns since then, most recently in 2017 (no. 631), and I think of Mark every time it comes by. Mark's memory also lives on with my older son Zachary who was born in early 1987; his middle name is "Mark."

27. DECEMBER 11-12, 1984
"Comet" (3200) Phaethon (no. 559)

This object, provisionally designated 1983 TB, created quite a bit of excitement after its discovery by the InfraRed Astronomical Satellite (IRAS) mission in October 1983 once orbital calculations showed it had the smallest perihelion distance (0.14 AU) of any asteroid known at that time. The real excitement came when Fred Whipple pointed out that it shared the same orbit as the Geminid meteors, suggesting that the long-lost parent object of that prominent and strong meteor shower had finally been found. I remember my own excitement when I saw the IAU

Circular announcing this, at the U.S. Naval Observatory's station in Flagstaff, Arizona, where I had stopped while en route back to California from New Mexico following my visit there after I had gotten out of the Navy.

It soon became apparent that 1983 TB would be making a moderately close approach to Earth (0.245 AU) in mid-December 1984 while en route to perihelion passage in February 1985. On the night of December 11-12, from my primary observing site along the Angeles Crest Highway (which Steve Edberg had informally named "Morgan's Lookout" after a deceased friend of his) I spotted 1983 TB with the 8-inch telescope, despite fairly bright moonlight and cirrus clouds. I followed it for two hours, during which time it appeared completely stellar and about 13th magnitude.

I observed 1983 TB four more times over the next week and a half, and despite the fact it was still approaching perihelion it had faded a half-magnitude by the end of that time – just as an asteroid would be expected to do with the increasing phase angle. Over the next few months I collected observations from various other observers, including Charles and Steve, and performed a detailed observational analysis of the object, the results of which led me to conclude that its overall behavior was entirely asteroidal. I presented these results at the National Astronomy Convention that was held in Tucson, Arizona in June 1985, and my analysis was published in that Conference's Proceedings – my first published research paper. In the meantime, 1983 TB was assigned the asteroidal number (3200), and later the name "Phaethon," by the IAU's Minor Planet Center.

The entire process of making observations and collecting data, then analyzing all this research and putting it into publishable form along with presenting it to colleagues, re-lit a fire under me that had essentially lain dormant since my High School years. This would play a significant role in my decision to attend Graduate School, and to my eventual return

to New Mexico and my enrollment in the Astronomy Department at New Mexico State University in 1986.

I managed to observe Phaethon one time during a somewhat distant approach to Earth in late 2004, and a handful of times during a relatively close approach to Earth in late 2007. Throughout all the intervening time, despite its association with the Geminid meteors Phaethon never showed any evidence of cometary activity. However, beginning in 2009 researchers analyzing images taken by the STEREO spacecraft noticed that Phaethon exhibited cometary activity, including a coma, tail, and non-asteroidal brightness behavior, when near perihelion. The mechanism that produces this activity is still a matter of investigation, although it is clearly not due to sublimation of volatiles as is the case with actual comets, but in any event Phaethon has sometimes been referred to in the literature as a "rock comet."

A valid question, at least for purposes of my tally, is whether or not a "rock comet" can be considered a "comet." As I was writing my autobiography in 2014 I devoted quite a bit of thought to this issue, and concluded that I could legitimately do so; at the end of that year I accordingly added Phaethon to my tally retroactively, with the 1984 approach being comet no. 559, the 2004 approach being no. 560, and the 2007 approach being no. 561. I've seen Phaethon on two returns since then, and have added it to my tally "in sequence" both times: a somewhat distant post-perihelic approach in 2016 (no. 607) and a very close approach to Earth in late 2017 (no. 633).

28. MAY 26, 1985
Comet 21P/Giacobini-Zinner 1984e (no. 82)

Starting in 1982, and for every year thereafter throughout the remainder of my time in California, I attended the Riverside Telescope Makers' Conference near Big Bear over the Memorial Day holiday weekend. I would, of course, bring the 8-inch telescope with me so I could make

observations, and on the morning of May 26, 1985, I arose early to make an attempt for Comet Giacobini-Zinner, a comet I had a very high interest in observing. (I had missed it in 1972 because Sky & Telescope had never published an ephemeris for it, and meanwhile it was due for a very favorable return in 1985, and was also the target for the re-purposed International Cometary Explorer (ICE) mission. This encounter took place on September 11, and due to my employment with the Deep Space Network I was able to "witness" this encounter from the Space Flight Operations Center at JPL.)

I spotted a very faint 13th-magnitude object near the expected position, and over the course of the next hour verified this suspect as indeed being the comet due to its motion. Charles joined me towards the end of the observation and was also able to verify it. While I observed various comets throughout the years I attended RTMC, this is the only time that I added a comet to my tally while doing so – and a most remarkable comet, at that.

One morning later at that same RTMC, Don Machholz was comet-hunting and managed to discover a comet, 1985e – the only comet ever discovered during the 50-year run of that gathering. I learned of this after I had returned home later that day, and the next morning I met Charles at the "Morgan's Lookout" site on the Angeles Crest Highway, where we jointly confirmed Don's discovery (no. 83) as a 9th-magnitude object. The comet passed through perihelion at the end of June at the extremely small perihelion distance of 0.11 AU – still the 6th-smallest perihelion distance of all the comets on my tally – and apparently disintegrated, although Jim Gibson at Palomar Observatory apparently recorded an extremely faint fragment in early September with that institution's 60-inch reflector.

29. AUGUST 10, 1985
Comet 1P/Halley 1982i (no. 85)

By mid-summer 1985 the comet world was eagerly awaiting the impending appearance of Comet Halley. In early August Steve and Charles invited me to join them the night of August 9-10 at the 24-inch telescope at Table Mountain Observatory near Wrightwood, California, for an attempt to detect Halley. I brought my 8-inch telescope as well, and during the evening we used both telescopes to observe two other comets: 21P/Giacobini-Zinner 1984e (no. 82), at that time a bright 8th magnitude object with a bright and distinct tail, and 47P/Ashbrook-Jackson 1985a (no. 84), at close to 13th magnitude (difficult in the 8-inch, but quite easy in the 24-inch).

In the morning I tried to see if I could spot Halley with the 8-inch, but couldn't see anything. When I went back inside the dome of the 24-inch Steve and Charles informed me they had a suspect, and over the course of the next hour we saw that it was moving – it was the comet! We measured the brightness as being magnitude 14.5, definitely too faint for me to have picked up with the 8-inch scope.

Two mornings later I drove back to Table Mountain, and Charles and I again spotted the comet, which seemed to have brightened a couple of tenths of a magnitude. On the following weekend – the mornings of the 18th and 19th – on two exceptionally clear mornings from the Dawson Saddle site along the Angeles Crest Highway, I fleetingly glimpsed Halley with the 8-inch scope, near 14th magnitude. These were the faintest cometary observations I ever made with that telescope, and all these observations combined marked the beginning of my observations of this most famous of comets over the next year and a half.

30. SEPTEMBER 14, 1985
Comet 21P/Giacobini-Zinner 1984e (no. 82)
Comet 1P/Halley 1982i (no. 85)

The fall months of 1985 were a very busy time for me. Those of us in the Deep Space Network (and many other people at JPL as well) were getting prepared for the Voyager 2 encounter with Uranus the following January, and of course I had a couple of notable comets to keep me occupied. On top of all that, Eva and I were getting married, and had selected September 14 as our wedding date.

It so happened that Comet Giacobini-Zinner and Comet Halley were having a somewhat close conjunction (2 degrees) with each other that morning. By my choice, my "bachelor party," as it were, was an observing session from an overlook over the town of Pine Valley in the mountains east of San Diego, and included Steve, Charles, and San Diego amateur astronomer (and meteor expert) Bob Lunsford, whom I had known for a few years by that point. We observed both comets, with Giacobini-Zinner being near magnitude 8½ (having faded from 7th magnitude in late August) but with a binocular tail still over 20 arcminutes long, and Halley, as a small and faint object near 13th magnitude. I tried to see both comets simultaneously in the same field of view of the CT-100 telescope, but unfortunately Halley was still too faint for that instrument to pick up. This occasion was, incidentally, Bob's first observation of Halley, and he was definitely excited about picking up this object – in his 16-inch telescope – for the first time.

Against the advice of some well-meaning friends, I nevertheless took the 8-inch telescope with me on our honeymoon, and actually went observing a couple of times. One of these occasions was from Yavapai Point near the Grand Canyon in Arizona, where I observed both comets, as well as the gegenschein and the zodiacal band for the first time. Halley had brightened some since my "bachelor party," and was near magnitude 12½, while Giacobini-Zinner appeared about the same that it had been on the earlier occasion.

31. FEBRUARY 25, 1986
Comet 1P/Halley 1982i (no. 85)

Ever since I picked it up in August 1985 I followed Comet Halley on a fairly regular basis, with my first naked-eye sighting coming in mid-November. By the middle of January 1986 it has brightened to close to 4th magnitude, and I could detect a tail over 4 degrees long in binoculars. I obtained my final pre-perihelion observation on the evening of January 27, when its elongation was only 15 degrees and it was buried deep in twilight. (The following day was when the tragic explosion of the Space Shuttle Challenger occurred.)

My first post-perihelion observation came on the morning of February 20, from the "Morgan's Lookout" site along the Angeles Crest Highway; despite fairly bright twilight the comet had obviously brightened during the interim and was near 3rd magnitude. I made two more observations over the next few days, and on the 25th, despite bright moonlight I could see a half-degree-long tail with my naked eye. On that occasion I was joined by Steve, Charles, Rick Shaffer, International Halley Watch scientist Jurgen Rahe – and a television crew from ABC News Nightline, who were filming footage for their coverage of the Soviet Union's Vega 1 encounter with Halley on March 5. A brief view of the front of my car made it onto the coverage that was televised, as was a posed shot from behind of the five of us standing along the ridge, silhouetted against the dawn. As I have explained it ever since, my butt made it onto nationwide TV.

32. APRIL 11, 1986
Comet 1P/Halley 1982i (no. 85)

Comet Halley remained at 3rd magnitude in the morning sky throughout March, and exhibited a bright dust tail 7 degrees long or longer that was easily visible to the naked eye. It was headed southward, meanwhile, for its best appearance that would be best seen from the southern

hemisphere, and like many other comet-watchers Eva and I headed for Australia, leaving on April 1. We spent two weeks traveling around southeastern Australia and an additional couple of days on the North Island of New Zealand, and I obtained quite a few observations of Halley throughout this time. To my eyes, the comet may have undergone a small outburst around the 7th, when from the town of Broken Hill, New South Wales it appeared as bright as 2nd magnitude, with a 4-degree-long tail visible to the naked eye; in the 8-inch telescope (which I had brought with me) I could detect significant jetting structure and other features within the coma.

An especially memorable observing session occurred on the night of April 11-12, when Eva and I stayed at a motel in the ski resort town of Bright in northern Victoria. I set up the telescope right outside our motel room, and the comet, still near 2nd magnitude although having faded slightly from earlier, showed a 1½ degree-long tail to the naked eye; in the binoculars, however, there seemed to be three tails, although I suspect that two of these were the edges of a very broad dust tail and the third was the ion tail. While I was observing, meanwhile, two young men from a nearby room noticed me and after taking a look, spread the word around that there was an "American with a telescope" looking at Halley. For the next three hours I had a non-stop stream of people stopping by, presumably other people staying at the motel but also probably from throughout much of the town. (I remember one elderly gentleman in particular who, after looking at the comet through my telescope, exclaimed "I can die now; I've seen Halley's Comet!") This impromptu star party earned me a special "Thank You!" from the hotel's management when we checked out the following morning (although, unfortunately, not the offer of a discount).

33. JANUARY 18, 1987
Comet Sorrells 1986n (no. 96)

In the summer of 1986 Eva and I moved to Las Cruces, New Mexico, where I entered Graduate School at New Mexico State University at the end of August. Having been away from a rigorous academic environment for a few years I found my first semester quite challenging, although I managed to survive relatively unscathed. My life was to become even more challenging in mid-January 1987, when on the morning of the 16th my older son Zachary was born.

My first comet observation as a new father came just two days later, on the evening of the 18th. The comet in question was Comet Sorrells 1986n, which I had first picked up in early November 1986 shortly after its discovery. On this night it was faintly visible in 10x50 binoculars near 9th magnitude – this actually being the night I recorded my highest brightness measurement for this comet – and telescopically its coma displayed a "stingray" shape with a short, straight tail a few arcminutes long.

At the end of the spring semester I decided to travel to the Riverside Telescope Makers' Conference in California. While there I met an amateur astronomer from California, Dana Patchick, who was trying to sell a Meade DS-16 16-inch reflector for an unusually cheap price. I had been wanting a telescope like this ever since one night in September 1983 when I saw Comet 126P/IRAS 1983j (no. 61) through Bob Lunsford's DS-16 and it exhibited a striking 15-arcminute-long tail which my 8-inch telescope could not detect, but felt like I needed to wait until I could be in a place where I could observe from a home. I purchased it from him on the spot, and transported it back to Las Cruces. My first comet observation with this telescope came on the morning of May 27, and was of Comet Sorrells, now in the morning sky (following conjunction with the sun) and near 10th magnitude. Three mornings later I would make the first addition to my comet tally with this telescope, Comet 68P/Klemola 1987i (no. 101). This has since, of course, become

my primary visual observing telescope, and I have made thousands of comet observations, and hundreds of tally additions, with it during all the intervening years.

34. APRIL 23, 1987
Comet 1P/Halley 1982i (no. 85)

The spring semester of my first year of Graduate School was especially challenging for me, to the point where I almost suffered a nervous breakdown from the stress. (The trip to the Riverside Telescope Makers' Conference that I mention in the previous entry was a "mental health" effort to relieve some of that stress once the semester was over.) In addition to an extremely work-intensive course load plus the work of a Graduate Assistant, I had the responsibilities of raising a newborn child, a completely new experience for me.

The comet activity that spring was about average, but one comet in particular demanded some attention: Comet Halley, which emerged into the morning sky in late 1986 following conjunction with the sun. I picked it up at the end of October and followed it for the first few months of 1987. It appeared as a vague, diffuse, and somewhat difficult object throughout that entire time, never appearing brighter than about magnitude 12 to 12½, and when I was barely able to detect it at 13th magnitude near the beginning of April I figured I was done with it.

On April 22 I received an e-mail from Dan Green informing me that Halley had apparently undergone an outburst. I didn't have especially good sky conditions that night, but did suspect "something" with the 8-inch telescope. On the following night I had to travel to NMSU's Blue Mesa Observatory in the mountains east of Las Cruces to work on an assignment for one of my classes, however since another student also had to work on an assignment I brought the 8-inch telescope along to try for Halley while he worked on his assignment. It turns out I did see Halley as a faint "star" with the 8-inch without quite recognizing it,

however once the other student was done with his work, before starting mine I thought I might try to look at Halley with the Blue Mesa 24-inch reflector. I easily saw it as a small and "dense" object near magnitude 12½, and then quickly located this with the 8-inch scope. I took one final brief view of Halley with the 24-inch scope just before midnight before turning to the star that my assignment involved, which occupied the rest of the night.

It turns out that this somewhat rushed observation from Blue Mesa was my last observation of Comet Halley. I attempted it with the 8-inch scope a handful of times during May, and after acquiring the 16-inch telescope I tried a couple of more times during mid-June, all without success. I even tried for Halley a couple of times late in 1987 after another conjunction with the sun, again without success. If I ever see Comet Halley again, it will have to be during its return in 2061, when I would be 103 years old. I won't hold my breath . . .

35. JANUARY 14, 1989
Comet Yanaka 1989a (no. 123)

Ever since I began observing comets I also wanted to discover one. I searched for new comets somewhat haphazardly during my High School years, and on an occasional basis throughout my years in California. Once I had relocated to Las Cruces and could observe from home I decided to try this more systematically, although my Graduate School workload, the responsibilities of raising a child, and the observation of known comets all took precedence. The comet activity during the fall months of 1988 was relatively weak, however, and since by then my school workload had eased somewhat and Zachary no longer required complete round-the-clock attention, I was able to devote more time to comet-hunting efforts. I was able to log close to 100 hours of searching during those months.

I was somewhat chagrined when an amateur astronomer in Japan, Tetsuo Yanaka, discovered a comet (1988r) on the morning of December 29 – in bright gibbous moonlight. I observed his comet on the morning of New Year's Eve (no. 122); it appeared near magnitude 9½ with a short but distinct tail. Based on the moon's phase, I planned to begin my morning search efforts again on the morning of New Year's Day, and when I went to bed shortly after midnight the sky was clear. However, when I awoke three hours later to begin comet hunting, the sky was completely overcast. The sky would remain overcast for the next four days, and somewhere in the middle of all that it sprinkled rain for about ten minutes.

While I was enduring those cloudy days, I was dismayed when I received an e-mail from Dan Green asking me to confirm another potential comet discovery from Tetsuo Yanaka – which he had found on January 1 precisely in the region of sky that I would have been hunting if the sky had been clear. With the weather conditions being what they were, there was little I could do, except hope that the report was a false alarm – which, of course, it wasn't. When I finally had clear skies on the morning of January 5 I easily detected the comet near 11th magnitude with a diffuse coma three arcminutes across.

I have always believed that, had the clear skies on the night of New Year's Eve held for a few more hours, the first comet of 1989 would have been Comet Hale-Yanaka. I pretty much confirmed this to myself on the morning of January 14 when, during a regular comet-hunting session, I swept up the comet and noticed it right away. Indeed, I was initially slightly confused about where I was looking, and for a few minutes thought I might have genuinely found another comet. It was not to be, of course, but at least I knew that my program had the legitimate potential to discover a comet; my "discovery," as it were, just happened to come 13 days too late.

This newer Comet Yanaka was found to have passed perihelion two months before its discovery, and I followed it for one month before it

faded away. (Despite its "average-ness," I would have nevertheless gladly taken it as a discovery.) I continued fairly systematic comet hunting for another three years – and actually swept up one more, Comet 103P/Hartley 2 1991t (no. 160) in October 1991, although this was three months after I had first picked it up – but my lack of success, combined with increasing work and family responsibilities, convinced me to terminate my efforts in 1992 after amassing a total of 400 hours of searching. Three years later, of course, I actually would discover a comet of my own – accidentally. I'm still not sure whether or not there is a lesson here.

36. SEPTEMBER 25, 1989
Comet 23P/Brorsen-Metcalf 1989o (no. 127)

I've always felt a sort of deep personal attachment to this comet, since Joel Metcalf's re-discovery of it in August 1919 came only four days after my mother's birth. Accordingly, in my mind I somewhat consider it "my mother's comet," and it was nice to have it come around for her 70th birthday. After it was recovered in early July 1989 I first saw it visually three mornings later (on the 7th); as things turned out, I was the first person in the world to see it visually.

The comet reached a peak brightness near magnitude 5½ in early September, at which time it displayed a distinct, straight ion tail about two degrees long in binoculars. Towards the end of that month the comet began to disappear into the dawn, and I obtained my final observation on the 25th, when its elongation was only 18.5 degrees, and it appeared as little more than a central condensation, near 7th magnitude, in the bright sky. Again, as things turned out, there were no further reported observations – visual, astrometric, or otherwise – after that. Thus, not only was I the first person to see "my mother's comet" visually on its 1989 return, I was also the last person to see it – in any way – as well.

37. MAY 27, 1990
Comet Levy 1990c (no. 141)

On May 20, 1990, my good friend, and (significantly more successful) comet-hunting competitor David Levy, telephoned me to tell me had discovered a comet that morning, and asked me to confirm it for him, since he was leaving for an out-of-town engagement and would not be in a position to do so himself. On the following morning I successfully found David's new comet, a small and relatively condensed 10th-magnitude object, and was credited with its confirmation on the IAU Circular announcement issued later that day.

Later that week Eva and I traveled to southern California for, among other things, Barry's graduation from San Diego State University, but we also spent the Memorial Day weekend at the Riverside Telescope Makers' Conference. On the morning of the 27th I observed the new comet along with David, Charles, and a few other active comet observers; it appeared slightly brighter than it had during my first observation. This is the first time that I had the privilege of observing a comet together with its discoverer. Later that morning Eva and I departed RTMC and attended Barry's graduation ceremony that afternoon.

David's comet approached Earth and rapidly brightened, and when near opposition during late August was an easy naked-eye object near magnitude 3.5, with a coma over 20 arcminutes across and a tail that (in binoculars) extended up to three degrees. I was able to follow it through late September, after which it disappeared into dusk, and then after conjunction with the sun I picked it up again in the morning sky in early December. I subsequently followed it until early May 1991, and it reached a peak brightness near magnitude 7½ and displayed a distinct anti-tail when viewed telescopically. Comet Levy has the distinction of being the first comet observed by the Hubble Space Telescope (in late September), and was also observed by the Hopkins Ultraviolet Telescope

(on the Astro-1 observatory) from the Space Shuttle Columbia in early December.

38. JANUARY 6, 1991
Comet 97P/Metcalf-Brewington 1991a (no. 150)

By the fall of 1990 I was working hard on my Ph.D. dissertation, and in the process I applied for observing time using the Coude Feed telescope (adjacent to the 2.1-meter telescope) at Kitt Peak National Observatory in Arizona. I was awarded an observing run of five nights beginning in early January 1991, and on New Year's Day I left New Mexico for Kitt Peak. Unfortunately, that observing run ended up being a total washout; a slow-moving storm system moved in over the area on the first day and thus the first four nights of the run were completely clouded out, and while the fifth (and final) night was clear, there was so much moisture remaining in the air that the relative humidity was too high to open up the telescopes, considering the sensitivity of the electronic instrumentation.

I nevertheless maintained a vigil in the control room of the Coude Feed telescope, in the vain hope that the humidity might drop low enough for me to utilize that instrument. While waiting that evening I was notified that I had received a phone call: it was from Dan Green (who had called my home in New Mexico and spoken to Eva, who informed him where I was), telling me that Howard Brewington (who had relocated to near Cloudcroft, New Mexico the previous year) had reported a comet discovery, and could I confirm it? Since the sky was "clear," and I had nothing else to do, and since I happened to have the 8-inch telescope in the back of my car (as I had planned to remain in the area for a couple of days afterward, and thought it possible I might engage in observing), I decided to give it a try. By that time the comet's location was very low – almost setting in the west – and I had to carry the telescope across the parking lot so I could access that location. The air temperature was well below freezing, and with the very high humidity, and the body heat I had

built up from carrying the telescope, almost as soon as I put my eye to the eyepiece it would fog over. Near the expected location, however, there was a diffuse (but moderately condensed) object close to 9th magnitude that appeared diffuse during the two seconds or so before all the other stars in the field appeared diffuse (each time after which I had to wipe the eyepiece clean and repeat the process). I was able to follow this object for about two minutes before it set, then after measuring an approximate position from star atlases at the Observatory's library I called Dan back and told him "I guess it's real," giving him the approximate position I had measured. Dan issued an IAU Circular announcing the comet's discovery, together with my "confirmation" within the next hour, and I have to admit I was a bit apprehensive about this, since given the difficult conditions I had to deal with I wasn't 100% sure that I had actually seen any comet.

The following night was clear and dry – which, of course, was too late to do me any good as far as my observing run was concerned – and I spent the night at David Levy's home near Vail, Arizona. With his 16-inch telescope we easily saw the new comet, near magnitude 8½ – and in fact I could also detect it with binoculars – and we also observed another just-discovered comet, Comet Arai 1991b (no. 151). As time went by I began to realize, with some embarrassment, that the position I had given Dan (and that had been published on the discovery announcement IAU Circular) was about one degree off; while I had clearly seen the comet, I had misidentified the surrounding star field, indeed, one of the stars I thought I was seeing had already set. I also learned that William Bradfield in Australia and Tsuruhiko Kiuchi in Japan had discovered the same comet that same night, but a few hours after my "confirmation," and since the discovery announcement with that "confirmation" had already been published, they did not receive credit for their discoveries. Also, within short order it became clear that Howard's comet was in fact the long-lost Periodic Comet Metcalf that had been lost since its discovery return in 1906; it had undergone a strong outburst shortly before Howard's discovery.

I have to admit I found it a bit amusing, and also a bit frustrating, that with all the high-tech scientific instrumentation at Kitt Peak, the only useful science I got done during that first observing run was with an 8-inch telescope I had in the back of my car. But all was not lost: I placed myself on a "please call me if there is a cancellation!" list and accordingly was awarded an observing run of three half-nights in late January, and then I had another five-night run in early May, with completely clear skies all night every night. I was able to collect enough data to complete my thesis satisfactorily, and in fact I was able to devote part of the last night to collecting data for another astronomer's project. I was given a "co-author" status when the resulting paper came out, and it wasn't until many years later that I realized, for a most remarkable coincidence, that one of the other co-authors' name was "Bopp" – a Bernard Bopp from the University of Toledo, and no relation to the Bopp with whom my name had since become so closely connected.

39. JUNE 5, 1991
Comet 81P/Wild 2 1989t (no. 145)

My association with Comet 81P/Wild 2 essentially goes back to its very beginning, with its discovery return in 1978, when I was at the U.S. Naval Academy. I followed it for almost three months at that return (no. 26), and I remember showing it to my then-girlfriend Tandy, who was quite underwhelmed. I managed to obtain a couple of observations at the subsequent, and unfavorable, return in 1984 (no. 67). The 1990 return was quite a bit more favorable, and I picked it up in mid-October and followed it until mid-June 1991, with its reaching a peak brightness near 12th magnitude around the time of perihelion passage in mid-December.

One of my last observations during that return came on the morning of June 5, 1991, by which time it had faded to 13th magnitude. I happened to look up from the telescope, and saw a glow of light in the northern sky. At first I thought it was cirrus clouds that had moved in, and then I realized that I was seeing an aurora. Over time I could see changes in

structure of the aurora, and also a faint reddish coloration (which was quite pronounced on the photographs I took.) I even woke up Eva to see it, and although she did not often share my fascination with phenomena in the night sky, she was impressed with this one.

I had seen an aurora once before, in early 1979 while on a plane flight across the northern U.S. (returning from the solar eclipse on February 26), but this was the first one I had ever seen from the ground, and the first one from New Mexico. I have seen three more since then, one from Las Cruces and two from near where I presently reside in 16 Springs Canyon, New Mexico, although the last of these was as long ago as 2001. Unfortunately, a thick band of clouds over the eastern slopes of the Sacramento Mountains prevented me from seeing the strong display that was widely seen from throughout New Mexico (and other parts of the world) on May 10-11, 2024.

40. NOVEMBER 13, 1991
Comet 181P/Shoemaker-Levy 6 1991b1 (no. 164)

One of our responsibilities as Astronomy graduate students at NMSU was to give presentations to schools in the area when teachers requested our services. In early November 1991 the Department received a request from a teacher in Tucumcari, New Mexico – about a six-hours' drive away from Las Cruces – and, not realizing the distance involved, the Department secretary forwarded it to me (as I was at the top of the revolving "list"). I could have refused it, but as I felt a need to "get away," I accepted the request, made arrangements with the teacher involved, then made the drive to Tucumcari where I gave the presentation and spent the night at a local motel. I remember watching MTV that night and seeing, for the first time, the video for the new Rush song "Roll the Bones." I would watch Rush perform this song live when I saw them in concert in Las Cruces the following January.

A new comet had recently been discovered. It had already passed through perihelion and an approach of Earth to 0.22 AU when discovered, and thus was rapidly moving away and fading. After seeing the announcement of its discovery I was hoping to observe it, however there were storms moving through New Mexico and the skies were cloudy for several successive nights. I accordingly brought the 8-inch scope with me to Tucumcari although it was not at all certain I would have clear skies, however after my MTV session I stepped outside my motel room and saw that the sky was clear. In the darkness I drove to an obscure site a few miles outside of Tucumcari, set up the scope, and successfully spotted the coma as a vague, diffuse, fast-moving object near magnitude 11½.

After returning home, I had to wait for clouds and moonlight before observing the comet with the 16-inch scope, and when I was finally able to do so a week and a half later it appeared as an extremely vague and diffuse object of 12th magnitude. I managed one more observation a week and a half after that, when it appeared as little more than a brightening of the background sky.

41. APRIL 1, 1992
Comet Tanaka-Machholz 1992d (no. 168)

On March 4, 1992, I successfully defended my Ph.D. dissertation, and thus earned the right to be called "Dr. Hale." The graduation ceremony was held on May 9, but meanwhile, there was the proverbial "no rest for the weary;" I was in a full-on search for employment, and with Eva now pregnant with our second child, I was in a "beggars can't be choosers" situation. Fortunately, I did receive a job offer from what was then called The Space Center in Alamogordo (now the New Mexico Museum of Space History), and although I was less than thrilled with the three-hour daily commute time, and with cracks starting to develop in the whole situation after a few months, at least I was employed. I started working at the Museum on April 6.

During this time I received an e-mail from Brian Marsden at the IAU's Central Bureau, asking me for confirmation of a comet discovery reported by Don Machholz. On the morning of April 1 I easily spotted the new comet, near magnitude 9½, and on the discovery announcement IAU Circular Brian noted that my observation not only confirmed Don's discovery but also verified its identity with a comet reported by Japanese amateur astronomer Zenichi Tanaka a week earlier. I ended up following Comet Tanaka-Machholz until mid-June, and it reached a peak brightness just fainter than magnitude 7½ in early May.

My second son, Tyler, was born on April 12. Comet Tanaka-Machholz was not the first but rather the second comet I saw after he was born: I observed Comet Shoemaker-Levy 1991d (no. 152) on April 28, one day before I observed Tanaka-Machholz. Nevertheless, especially in view of my confirmation of its discovery a few days before his birth, and its perihelion passage a week and a half after his birth and corresponding reasonably bright performance around that time, it is the comet I most closely associate in my mind with that major event in my personal life.

42. SEPTEMBER 27, 1992
Comet 109P/Swift-Tuttle 1992t (no. 173)

Like I'm sure is true for many comet astronomers, I was long fascinated by Comet Swift-Tuttle, the parent comet of the Perseid meteor shower. The nominal prediction, based upon the observations obtained during its discovery return in 1862, suggested a perihelion passage in 1981, but despite numerous searches – including at least one by me – it did not appear. Attention then switched to a paper Brian Marsden had published back in 1973, wherein he predicted – based upon the assumption that Swift-Tuttle was identical to a comet that had appeared in 1737 – that it would return in late 1992. This attention grew even greater after exceptionally strong displays from the Perseids in 1991 and 1992.

On the evening of September 26, 1992 Dan Green phoned me to inform me that a comet discovery had been reported by Japanese astronomer Tsuruhiko Kiuchi, and that it might be Swift-Tuttle. After making allowances for its difference from Brian Marsden's prediction, on the following morning I successfully located Kiuchi's comet, near 10th magnitude. It soon became clear that this object was indeed Comet Swift-Tuttle, and that it was also identical to the 1737 comet.

The geometry during Swift-Tuttle's 1992 return was not especially favorable, although it did reach naked-eye visibility and a peak brightness of 5th magnitude, with my longest tail measurement being two degrees. After mid-December it began disappearing into evening twilight, and my last sighting was on the 23rd.

While all this was going on, for a variety of reasons things were rapidly becoming intolerable for me at The Space Center. It soon became clear that there would be no resolution that would be acceptable for everyone, so I ended up leaving my position on December 14. Although relations were perhaps a bit acrimonious at first, due both to turnover at the Museum as well as to developments in my personal and professional lives, things have been relatively amicable between the Museum and me for quite a few years, and I have participated in various collaborative educational projects with them from time to time over the years.

43. MARCH 28, 1993
Comet P/Shoemaker-Levy 9 1993e (no. 178)

During my time working with The Space Center I became involved with an effort to establish a commercial spaceport in southern New Mexico, and I continued with that long after I left my employment there. At that time our ad hoc group, which we called the Southwest Regional Space Task Force, would meet once a month at various locations.

On Saturday, March 27, 1993, the Task Force held one of its monthly meetings at the headquarters of White Sands Missile Range. Before departing that morning for the meeting I read a just-issued IAU Circular announcing the discovery of a new comet fairly close to Jupiter, with the appearance being described as "most unusual in that [it] appeared as a dense, linear bar ~1' long and oriented roughly east-west" on the discovery films. When I returned home there was a new IAU Circular giving approximate orbital elements and an ephemeris, and the next morning I successfully located this object with the 16-inch scope. It appeared about 13th magnitude and did indeed look like a linear bar about one arcminute long, with what appeared to be "knots" on both sides of the "bar." I managed to observe the comet on three more occasions over the next three weeks and the appearance was roughly similar each time, although it looked to be slightly fainter and vaguer on the last observation.

Over time it became clear that the comet had been in orbit around Jupiter for several decades, and that it had been ripped apart into over 20 discrete fragments when it had last passed through perijove in mid-1992. The same calculations soon showed that each of the fragments would be impacting Jupiter during the third week of July 1994. Each of the impacts took place on the far side of Jupiter away from Earth, although each site rotated into view after a few minutes. I didn't see any of these, as most of them took place at times when they were not visible from New Mexico (or from El Paso, Texas, where I was living at the time), and the two that were expected to take place at convenient times for me were either "fizzles" or I was clouded out. I was, however, easily able to see some of the impact "scars" in Jupiter's atmosphere, at one time as many as four of them at once. Over time these started to smear out, but even when I first saw Jupiter in early 1995 after being in conjunction with the sun I could detect a dark band where the impacts had occurred. This band faded out over time, although I was able to detect it until the latter part of July, one year after the impacts had taken place.

44. DECEMBER 14, 1993
Comet 2P/Encke (no. 181)
Comet 76P/West-Kohoutek-Ikemura 1993o (no. 182)
Comet 31P/Schwassmann-Wachmann 2 (no. 183)

From August 1993 through March 1995 our family lived in northeastern El Paso, Texas, since Eva was employed at one of the hospitals in that city. However, we were planning an eventual move into the mountains near Cloudcroft, New Mexico, and I was also trying to set up my own independent organization in Alamogordo. I rented an office in downtown Alamogordo during this time, and meanwhile we found a site in 16 Springs Canyon we liked, bought the property, hired a contractor to build a home, and waited for it to be completed so we could make the move there.

My observing activity was quite slow during that time, in part because cometary activity itself was slow (at least, during the latter half of 1993) and also because I had to drive out to sites in the desert between El Paso and Alamogordo, and the responsibilities of parenthood cut down on the amount of time available for this. Furthermore, since to use the 16-inch scope I had to dismantle it, travel to the observing site, then reassemble it, then reverse this procedure to return home, this limited my willingness to use this instrument to no more than about once a month.

This situation partly contributed to the fact that I added three comets to my tally on one night in mid-December 1993, the first of only two times during my decades of observing when this has happened. (The other one was in August 2011.) The three tally additions were: Comet 2P/Encke, then a vague diffuse object near magnitude 11½; Comet 76P/West-Kohoutek-Ikemura 1993o, near magnitude 12½; and – the final comet of the night – Comet 31P/Schwassmann-Wachmann 2, fairly small and condensed and also near magnitude 12½. During the course of the night I also observed Comet Mueller 1993a (no. 176) at 10th magnitude and Comet Mueller 1993p (no. 180) at 12th magnitude.

45. JUNE 9, 1994
Comet McNaught-Russell 1993v (no. 186)
Comet Takamizawa-Levy 1994f (no. 187)

The first occasion (of four so far) when I successfully observed two comets simultaneously in the same telescopic field of view came on the morning of June 9, 1994, during the period of time when I was living in El Paso, Texas, and having to drive into the desert between El Paso and Alamogordo to obtain observations. Comet McNaught-Russell, which had reached a peak brightness near 7th magnitude around the time of its perihelion passage at the end of March, had faded to 11th magnitude and appeared quite vague and diffuse; this was, in fact, my final observation of this comet. Comet Takamizawa-Levy, which had just passed through perihelion three weeks earlier, was near its peak brightness of magnitude 8½ and was visible in binoculars; the 16-inch telescope revealed a short tail about 10 arcminutes long. The two comets were about 20 arcminutes apart at the time of my observation, with Comet McNaught-Russell being located almost due south of the other comet.

46. SEPTEMBER 9, 1994
Comet 141P/Machholz 2 1994o (no. 193)

During the time I lived in El Paso, Texas, because it was not easy to make frequent astronomical observations I wanted the comet activity to remain slow, and for a while, this was indeed the situation. The comet activity began to increase around the middle of 1994, however, and one of the primary instigators of this was my friend, and successful comet hunter, Don Machholz, who discovered three comets between early July and early October. The second of these comets, which he found in mid-August and which I observed the next morning, turned out to be a most interesting periodic object.

Initially about 10th magnitude, the comet brightened suddenly to about 7th magnitude at the end of the month, and meanwhile a secondary

component was discovered at around this same time. Then, within a few more days three more components were discovered, one of these being as bright as the first secondary component and the other two being quite a bit fainter. While I could see the first secondary component with the 8-inch scope, I wanted to try things with the 16-inch scope.

I was able to do so on the morning of September 9. It was a grandstand view: the primary – still bright near magnitude 7½ and easily visible in binoculars – exhibited a distinct, straight tail about 15 arcminutes long. The two bright secondary components – the first-discovered of these being component "D" and the other, closer to the primary, component "B" – were also visible in the 16-inch scope, at magnitudes 11½ and 12, respectively. I couldn't see the other two (components "C" and "E"), which were reported to be quite a bit fainter, although component "C" would have been located near some faint stars that would have made observation difficult in any event.

I did not see component "B" again, but I continued to see component "D" up through the time I stopped following the comet altogether, which was in early October. For a while the primary faded while component "D" brightened, and on the morning of October 2 they appeared almost as a "double comet," with both of them being between magnitude 9 and 9½.

47. JULY 23, 1995
Comet Hale-Bopp C/1995 O1 (no. 199)

In March 1995 our family moved into our new residence in 16 Springs Canyon, New Mexico. I busily worked on getting my independent non-profit science education organization up and running, and earlier that year I had also begun writing a weekly column for our local newspaper, entitled "In Our Skies," that I would write for the next 25 years. For my column for the last week of July I planned to write about Comet 6P/d'Arrest, which I had first picked up the previous month (no. 198)

and which was expected to be putting on a moderately bright display later in the summer.

On Saturday night/Sunday morning, July 22-23, after listening to two songs from the rock band R.E.M. ("Everybody Hurts" and "Man on the Moon") I went outside around 11:30. I first observed Comet 71P/Clark 1994t (no. 197), which at the beginning of April had become the first comet I added from the 16 Springs residence. I finished up with the Clark observation just before midnight, and noted that I had about an hour to wait before Comet d'Arrest rose high enough above the house to be observable. Since it was an exceptionally clear night – something of a rarity during the summer "monsoon" months in New Mexico – I decided to pass the time by observing some deep-sky objects, but when I turned the 16-inch telescope to the globular star cluster M70 in Sagittarius I noticed a dim, fuzzy object – near magnitude 10.5 – in the same field of view. After verifying from various star atlases and deep-sky catalogues that there were no known objects in that location, I tentatively e-mailed Brian Marsden and Dan Green to inform them that I had a possible comet. After doing so, I checked the field again and determined that my object had, over the course of about 45 minutes, moved, slightly westward, against the background stars – it was definitely a comet! I sent another e-mail to Brian and Dan informing them of this fact, then woke up Eva to ask her if she wanted to take a look at "Comet Hale." After dutifully taking the obligatory look, she woke up her sister Alice who was visiting us, who also came to look at it, but when Eva woke up my older son Zachary (then 8 years old) he declined.

I followed the new comet until around 3:00 A.M., when it began disappearing into the trees to our west. (I did take some time to observe Comet d'Arrest during this time.) After e-mailing beginning and ending positions to Brian and Dan, I tried, without much success, to get some sleep, and when I climbed out of bed and checked my e-mail there was a congratulatory message from Brian, asking me if I had asked "Thomas Boppe [sic] in Glendale" to confirm it for me, "he seems to have done so." I replied that I didn't know any such person. Later that day Dan

issued an IAU Circular announcing the discovery of the new comet by me and independently by Thomas Bopp from Glendale, Arizona. (Tom had also been observing M70 and it turns out that our respective discoveries were almost simultaneous.) The rest, as they say, is history . . .

48. FEBRUARY 1, 1996
Comet Hyakutake C/1996 B2 (no. 212)

At the end of January 1996 two Japanese amateur astronomers, Akimasa Nakamura (an experienced CCD imager and astrometrist) and Kesao Takamizawa (who had discovered four comets between the mid-1980s and mid-1990s) traveled to southern New Mexico to visit me and Howard Brewington (who lived nearby at the time). I picked them up at the airport in El Paso, Texas, then delivered them to Howard for their first night and day in the area. They spent their second full day in the area with me, among other things visiting fellow amateur astronomer Warren Offutt who lived near the town of High Rolls, and attending Zachary's intramural basketball practice that evening.

On the 30th I received an e-mail from Dan Green informing me that a comet discovery had been reported by Japanese amateur astronomer Yuji Hyakutake, who just a month earlier had discovered another comet, Comet Hyakutake C/1995 Y1 (no. 209). A winter storm was moving through the area and clouds prevented me from looking for the new comet on the morning of the 31st, and although the sky conditions still were not very good on the following night – the night that Akimasa and Kesao were staying with me – they were nevertheless good enough to make an observation attempt. During clear periods that morning we successfully saw the new comet, a fairly condensed object of 10th magnitude with a coma approximately 2.5 arcminutes across.

49. MARCH 20, 1996
Comet Hyakutake C/1996 B2 (no. 212)

Following its discovery in late January 1996 it became clear that Comet Hyakukate would be making a very close approach to Earth (0.102 AU, the 13th closest approach of all the comets in my tally) in late March. It brightened rapidly during the subsequent weeks and by the beginning of March I could already detect it with my naked eye. By the middle of that month it had brightened to 3rd magnitude and was exhibiting a tail up to 5 degrees long or longer.

During that same time I had obtained funding from a private foundation in Hobbs, New Mexico, to give presentations to students in schools throughout Lea County (in far southeastern New Mexico). On March 20 I was scheduled to give presentations to schools in the town of Lovington, and with officials from that school district I was able to make arrangements to observe the comet that night from a ranch south of Lovington owned by a family named Hicks. Even while driving to the Hicks ranch I could easily see the comet with my naked eye from my car, and the view from the ranch itself was spectacular: the comet was at 2nd magnitude, and the naked-eye tail was 19 degrees long. This was an ion tail, and even in binoculars I could easily detect streamers in this tail.

50. MARCH 27, 1996
Comet Hyakutake C/1996 B2 (no. 212)

As Comet Hyakutake approached Earth in late March 1996 I was observing it almost every night, and indeed its brightness and appearance changed on a night-to-night basis. On the night of closest approach, March 24-25, when it was located near the “handle” of the Big Dipper, its brightness was magnitude 0, the coma well over one degree across, and I measured the naked-eye ion tail as being 54 degrees long.

Two mornings later, the 27th, the comet passed four degrees from the north celestial pole. Although it had faded to 1st magnitude by then, because our view of the tail was more "broadside" it appeared even longer than it had earlier; I measured its length as being 70 degrees, by far the longest cometary tail I have ever observed. Because the diurnal motion was so slow at that high a declination, I was able to take some rather long-exposure photographs that well show the comet, some good internal coma structure, and of course its tail.

In subsequent days the comet moved over into the northwestern evening sky and faded as it receded from Earth (although it was still approaching perihelion). The tail – including a developing dust tail – remained fairly long, and on the evening of April 18 – by which time the comet had faded to magnitude 2½ – 1 formally measured the tail as being 23 degrees long but suspected a length essentially double that. I followed the comet until the evening of April 23, at which time it was deep in twilight at an elongation just under 20 degrees, and perhaps just slightly brighter than 3rd magnitude.

51. MARCH 4, 1997
Comet Hale-Bopp C/1995 O1 (no. 199)

After being in conjunction with the sun at the very end of 1996, Comet Hale-Bopp emerged into the morning sky as a 3rd-magnitude object in early January 1997. From that point it brightened rapidly as it approached the sun and Earth, and by early March was a splendid naked-eye object near magnitude 0 with both distinct ion and dust tails.

On the morning of March 4 I measured an ion tail length of 11 degrees and a somewhat foreshortened dust tail length of 6 degrees. Telescopically I could see, for the first time in this comet, "ripple" structures in the inner coma indicative of the nucleus' rotation – structures I would continue to see until early May. Meanwhile, I was able to follow the central condensation for one minute past sunrise

before losing it in the bright background sky – my first-ever daytime comet observation.

52. APRIL 1, 1997
Comet Hale-Bopp C/1995 O1 (no. 199)

During the third week of March 1997 Comet Hale-Bopp passed through conjunction with the sun, 45 degrees north of it, and for a while around that time could be seen both in the northwestern evening sky and the northeastern morning sky, before becoming a sole evening-sky object. I was traveling quite a bit during this time and observed (and photographed) the comet from several different locations, including from the southern Arizona desert during the partial lunar eclipse on the evening of March 23, and from White Sands Missile Range during the launch of a sounding rocket (to study the comet) on the following night. As Hale-Bopp made its final approach to perihelion at the beginning of April I made my brightest brightness measurements, near magnitude -1, and also my longest tail measurements, 18 degrees for both the ion and dust tails.

On April 1, the date of perihelion, I was being visited and interviewed at home by the crew of CNN's "Science and Technology Week," hosted at that time by Ann Kellan. I took some photographs of the comet that evening from the deck of our house, and the CNN crew actually took video of me in the act of taking those photos. One of the photographs I took is "the" photo that I have utilized in many of my publicity efforts, including posters and the Earthrise Institute web site. I shared this photo with the marketing people of the movie "Deep Impact" that came out the following year, and although apparently not widely distributed, I've since learned that they did use it to some degree in their marketing efforts.

53. APRIL 25, 1997
Comet Hale-Bopp C/1995 O1 (no. 199)

Following its perihelion passage at the beginning of April 1997 Comet Hale-Bopp was a splendid sight in the evening sky throughout the rest of that month, and although it faded slightly, I was still measuring a brightness near magnitude 0 near the end of the month; meanwhile, I was also still measuring a dust tail length near 18 degrees, although the ion tail was becoming shorter and less prominent.

Throughout the time of Hale-Bopp's appearance I was quite the celebrity, and traveled to numerous places to give public talks. During the third week of April my family and I spent over a week in New York City and Washington, D.C., where among other places I spoke at the Hayden Planetarium in New York (hosted by Neil Tyson, who has since become a major media celebrity) and at the National Air & Space Museum in Washington. (During our time in New York I inadvertently came across Tom Bopp – there on his own media tour – at the F.A.O. Schwartz toy store in Manhattan.) While in Washington I also spent a couple of days on Capitol Hill, meeting with U.S. Senators and Representatives as well as some officials of the Presidential Administration, to discuss and share thoughts and ideas on science, scientists, and science education.

With some help from Geoff Chester at the U.S. Naval Observatory in Washington, I was able to have arranged a private comet-viewing session at the Observatory with U.S. Vice-President Al Gore and his wife Tipper on the evening of April 25. (The Vice-President's residence is on the grounds of the Naval Observatory.) I congratulated the Vice-President on the nice telescope he had in his back yard, presented him a copy of a photograph I had taken of Hale-Bopp from White Sands Missile Range, and discussed various issues of science and education with him. The weather was not especially cooperative, with small thunderstorm cells rapidly moving through the area, but there were enough clear periods that we could grab some decent, albeit somewhat

brief, views of the comet. This is the only astronomical observing session in my life where I have worn a suit-and-tie; my tie, which depicted the cartoon character Winnie the Pooh gazing at a nighttime sky, was one I had worn for the first time especially for this occasion.

On the flight home Hale-Bopp could easily be seen from the airplane, and I pointed out its presence to the flight crew, who had it announced over the intercom. Once back home, I continued to follow the comet, although it was rapidly sinking into the southwestern dusk sky, and continuing to fade; I was measuring a brightness near 1st magnitude during the first half of May, and tail lengths of a few degrees. My final observation during this time came on the evening of the 21st, when I was able to detect it for just a few minutes in bright moonlight through a brief clearing near the horizon in an otherwise overcast sky.

54. NOVEMBER 18, 1997
Comet Hale-Bopp C/1995 O1 (no. 199)

After Comet Hale-Bopp departed from the northern hemisphere's skies in late May 1997 it put on a somewhat brief show in the southern hemisphere's skies. With the assistance of Sky & Space magazine and the Questacon Science Center in Canberra I was able to arrange a three-week-long visit to Australia for my family and me during June, where I gave a series of public talks throughout that country, and also was able to observe the comet on some occasions. It had continued to fade, being about 2nd magnitude throughout that time, with a curved tail about two degrees long; since it remained at a fairly low elongation it was never very high above the horizon. While in Australia I also managed to obtain a handful of observations of Comet 2P/Encke (no. 231), which was around 7th magnitude and which made the closest approach to Earth (0.190 AU) it has made since its original discovery in 1786. This was the first return during which I obtained post-perihelion observations of P/Encke, and I have only accomplished this one other time, in 2020 (no. 683), although this latter occasion was from the northern hemisphere.

Following conjunction with the sun in early July Hale-Bopp was again visible from the northern hemisphere for a few months, but it remained very low above the southern horizon. I first picked it up, in bright twilight, on the morning of July 31, when it was about 5th magnitude. The "best" appearance during this time frame came during early October, when it had faded to 6th magnitude but was somewhat higher in the sky, and I could detect a half-degree-long tail in binoculars. As November started, however, the comet's continued southward motion would soon drop it below our southern horizon permanently.

My final observation of Hale-Bopp from New Mexico came on the morning of November 18, when its declination was -56d 40'. This is already too far south to see from my residence (which has a range of hills in the south), but from the top of a high ridge about a 10-minutes' drive away with a clear shot to the southern horizon I was able to spot it with a 10-inch Schmidt-Cassegrain telescope. The comet, now near magnitude 6½, remained in telescopic field with the horizon for the entire hour that it was visible, and plus I had to contend with fairly bright moonlight; two nearby 6th-magnitude stars helped enormously in finding and seeing it. While I was observing the comet Eva drove by on her way to work and stopped; just like I did on the night that I had discovered it, I asked her if she was interested in "taking a look at Comet Hale." This is, by far, the farthest south I have ever observed a comet from New Mexico.

55. DECEMBER 27, 1997
Comet 55P/Tempel-Tuttle P/1997 E1 (no. 238)

One of my earliest astronomical memories came when I was 8 years old, when on the morning of November 17, 1966, my early-rising father noticed an extremely strong meteor shower taking place, and came and woke me up to see it. Through our eastward-facing living room window we watched a cascade of meteors so intense it almost looked like it was

snowing. What we had witnessed, of course, was the Great Leonid Meteor Storm of that year.

The parent comet of the Leonid meteors, Comet 55P/Tempel-Tuttle, was due to return in early 1998 under relatively favorable viewing circumstances, and had been recovered in March 1997. I began making attempts for it in late October, but for the next two months my attempts were unsuccessful.

In late December a series of winter storms moved through southern New Mexico, each dropping about a foot of snow, with the temperatures between each set of storms never reaching high enough to melt the snow. Thus, by the morning of the 27th there was three feet of snow on the ground, and even though the skies were clear, the recent departure of the most recent storm produced some bitterly cold temperatures, around -5d F. (-21 C). I nevertheless decided to observe, although I first had to shovel the driveway so Eva could drive to work. After that, I successfully located Comet Tempel-Tuttle as a diffuse, slightly condensed object of 11th magnitude with a coma four arcminutes in diameter. While these are not the coldest conditions under which I have made comet observations, this is definitely the coldest temperature under which I have added a comet to my tally.

56. FEBRUARY 25, 1998
Comet Hale-Bopp C/1995 O1 (no. 199)
Comet 55P/Tempel-Tuttle P/1997 E1 (no. 238)

Although Comet Hale-Bopp was no longer accessible from my latitude by early 1998, it could still be observed from latitudes closer to the Equator. Meanwhile, Comet 55P/Tempel-Tuttle, which I had first picked up at the very end of 1997, traveled through northern circumpolar skies and passed 0.36 AU from Earth during January 1998, and reached a peak brightness just brighter than 9th magnitude. By February, meanwhile, although it was still approaching perihelion it was receding from Earth

and consequently fading (albeit slightly), and moreover was sinking lower and lower towards the western evening horizon.

On February 26, 1998 the path of a total solar eclipse crossed parts of the Caribbean Sea. I was able to arrange a cruise aboard a tourist sailing vessel, the S.P.V. Star Clipper, for myself and my family (as well as for Tom Bopp and his father), and we departed from Antigua on February 22. I successfully observed the eclipse (through thin clouds, unfortunately) from the northwest coast of Guadeloupe, but meanwhile I had brought the CT-100 telescope with me for some hopeful comet observations. On the evening of the 25th (the night before the eclipse), from aboard the Star Clipper northwest of the island of Dominica I successfully observed Comet Hale-Bopp near magnitude 8½ (and which was faintly visible in binoculars) and Comet Tempel-Tuttle, about a magnitude fainter.

This would be my last observation of Tempel-Tuttle, but I successfully observed Hale-Bopp again two nights later – briefly, through intermittent clouds – when the Star Clipper was located southeast of Saint Barthelemy.

57. MAY 26, 1998
Comet Hale-Bopp C/1995 O1 (no. 199)
Comet SOHO C/1998 J1 (no. 242)

In early May 1998 I was intrigued with the announcement of a bright new comet in images taken by the LASCO C3 coronagraph aboard the SOlar and Heliospheric Observatory (SOHO) spacecraft. The reports suggested it might actually be bright enough to detect during daylight and I made some unsuccessful search attempts, and then when it became accessible in the evening sky – very low in the west during dusk – I continued to make unsuccessful searches. Since other observers were also reporting unsuccessful searches it began to appear that the comet might have disintegrated, however observers in the southern hemisphere

– where it was becoming almost exclusively placed for observation – began reporting positive detections. It soon became apparent that the comet's brightness from the LASCO images had been distinctly overestimated, and that the orbit based on the LASCO astrometry had been at least two degrees off – in the worst possible direction for northern hemisphere visibility purposes – at the time of my attempts. This incident has since caused a distinct change in how cometary astrometry from LASCO images is performed.

It thus turned out that I never really had a fair chance of detecting Comet SOHO, but after all the effort I had expended in trying to observe it I felt somewhat "cheated" out of it. I had just signed a contract to write a book about comets with a New York publishing house (which ended up never being published, although that's a long story), and I used my advance payment to take a trip to Australia to try to observe it. After arriving in Sydney on May 23 I drove to astronomer Gordon Garradd's residence in the town of Loomberah, New South Wales, and that evening I successfully saw Comet SOHO (dimly visible to the naked eye near magnitude 4½) and also Comet Hale-Bopp, just fainter than 9th magnitude, and apparently having just undergone an outburst in its nuclear regions.

Over the next few nights I traveled throughout northeastern New South Wales and observed both comets during most of the nights. On the evening of the 24th I took a photograph of the sky around Hale-Bopp, not actually expecting to detect it, but upon examination of the photo it turns out that I did, very faintly, record it – the last photograph I ever took of this comet. Two nights later, the evening of the 26th, I was visiting Coonabarabran, and after having dinner with astronomer Rob McNaught I drove to an isolated rural site a few miles north of town. Comet SOHO was still a relatively easy naked-eye object near magnitude 4½, and in both binoculars and the CT-100 telescope I could detect both a straight ion tail about 7 degrees long and a fainter, broad and curving dust tail about 1½ degrees long. I then took a look at Comet Hale-Bopp, which

was still faintly visible in binoculars just fainter than 9th magnitude and moderately condensed when viewed through the CT-100 scope.

This would be the last time I would observe Comet Hale-Bopp, although I did attempt it unsuccessfully from Zimbabwe (with a 20-inch reflector owned by Richard Fleet) three years later when I traveled there to view a total solar eclipse. Two years and ten months after I had accidentally discovered it, my eyes saw for the last time that object that had such a profound impact on my life.

58. MARCH 21, 1999
Comet 37P/Forbes (no. 262)

As the time of this comet's perihelion passage in early May 1999 approached I noticed that there had been no reported astrometric observations (and thus no recovery) of it. While it had been fairly low in the southeastern morning sky and was traversing star-rich Milky Way fields in Sagittarius, by the latter part of March it was clearly accessible, even from the northern hemisphere, and it occurred to me I might be able to make a visual recovery.

On the morning of March 21 I looked for Comet Forbes with the 16-inch reflector, and saw a faint, diffuse object just fainter than 13th magnitude and one arcminute in diameter in the expected location. I only had a brief viewing window before dawn and didn't detect any motion, but on the following morning, after moving the telescope's location slightly to get a better viewing angle, I not only saw the comet again but detected motion over a 20-minute interval. I also contacted my colleague Andrew Pearce in Western Australia – who apparently had been making recovery efforts of his own, but had been unable to detect it as recently as mid-March – and he then successfully observed it after my confirming observation on the 22nd.

The first astrometric observations of Comet Forbes in 1999 weren't made until mid-April, by which time I had already visually observed it four times. Visual recoveries of returning periodic comets have been very rare for the past several decades, with the only recent ones having been Charles' recovery of 4P/Faye 1984h (no. 69) in late June 1984 (although this was almost three weeks after Jim Gibson had photographed it from Palomar, however this hadn't yet been announced), a recovery by three Australian amateur astronomers of 45P/Honda-Mrkos-Pajdusakova 1985c in 1985, and Tsuruhiko Kiuchi's recovery of 109P/Swift-Tuttle 1992t (no. 173) in September 1992. When the IAU instituted its new comet-designation scheme at the beginning of 1995 it no longer officially recognized "routine" recoveries of periodic comets and thus I never received any kind of official recognition for my recovery of P/Forbes, however when I spoke informally to Brian Marsden at a conference later that year he informed me that, had the IAU still recognized such recoveries, I would have been duly credited.

59. AUGUST 11, 1999
Comet Lee C/1999 H1 (no. 263)

While staying overnight in Las Cruces in early January 1998 for a Southwest Regional Space Task Force event, I was reading the local newspaper which contained an editorial about an interview that the recently-elected President of Iran, Mohammad Khatami, had given to CNN, asking for a "dialogue of civilizations" between Iran and the U.S. and for "exchange visits of scholars." While whether or not I might be a "scholar" is perhaps subject to debate, there is no doubt that I was a worldwide-known figure due to the recent appearance of Comet Hale-Bopp, and it accordingly occurred to me that perhaps I could lead such an "exchange visit," especially since a total solar eclipse would be crossing Iran on August 11, 1999 (slightly over a year and a half in the future). I spent that next year and a half putting together such an endeavor – which almost ended up getting derailed at the last minute due to some student unrest in Iran – but on August 1 the group of people I

had recruited left the U.S. and arrived in Iran two days later. We spent the next week and a half traveling to various places around that country, meeting numerous people and speaking at several venues, and overall had a delightful time.

In the meantime, an Australian amateur astronomer, Steve Lee, an assistant at Siding Spring Observatory whom I had met during my visit to Australia in June 1997 and who had arranged a comet-viewing session from Siding Spring, discovered a comet in mid-April 1999 while attending a star party. I first picked up Comet Lee at the beginning of May as a 9th-magnitude object deep in the southern sky, and followed it for the next month and a half before it disappeared into evening twilight; during the first half of June it reached a peak brightness near magnitude 6½, and exhibited a telescopic tail 40 arcminutes long. After that it went into conjunction with the sun, but would be reappearing in the morning sky during August.

For the eclipse (which we successfully observed), our hosts (the Zirakzadeh Science Foundation in Tehran and the Adib Astronomical Society in Esfahan) arranged for our group to stay at a lakeside resort village called Chadegan. On the morning of the eclipse I took the CT-100 scope to a secluded part of the resort, and observed Comet Lee – my first post-conjunction observation of it – after it rose above the Zagros Mountains to the east. It was a relatively easy object in both the scope and in binoculars, at 7th magnitude and with a relatively condensed coma three arcminutes across.

60. JULY 23, 2000
Comet LINEAR C/1999 S4 (no. 272)

In the fall of 1999, after I had returned from what I called my "science diplomacy" visit to Iran during August, I was asked to put together another group for a second visit to Iran during the summer of 2000 for an astronomers' conference. After the discovery by the LINEAR

program of a comet in late September 1999 that showed promise of being a bright object during the summer of 2000, that seemed to provide a good rationale for such a gathering.

While I did successfully recruit some good people to be a part of this trip, including Charles Morris; the SOHO "comet person" Doug Biesecker (who had also been a part of the visit to Iran in 1999); and former astronaut Bruce McCandless and his wife Bernice, the entire endeavor was beset by a series of misfortunes. The comet itself was also turning out to be a disappointment: I first picked it up as a very faint 14th-magnitude object at the beginning of November 1999, and it had brightened by less than a magnitude by the time I obtained my final observation (prior to conjunction with the sun) in early March 2000. It was still only about 11th magnitude when I picked it up again in the morning sky in late May, but had brightened to about 7th magnitude in mid-July shortly before our group left for Iran.

Despite the various misfortunes that had befallen beforehand, the trip itself turned out to be enjoyable and successful. It included the two-day-long conference itself in Esfahan and then a few days traveling to various sites around west-central Iran. On the evening of July 23 we traveled to a site near the town of Alavijeh, some 22 miles north of Esfahan, and with a 12-inch Schmidt-Cassegrain owned by our host organization (the Adib Astronomical Society of Esfahan) we observed Comet LINEAR; in binoculars it appeared close to magnitude 6½ – the brightest at which I ever observed it – with a distinct tail about 1½ degrees long. Two nights later we observed the comet again from the lakeside resort at Chadegan – the same place from which I had observed Comet Lee C/1999 H1 (no. 262) and the total solar eclipse a year earlier (previous entry) – and the overall brightness and appearance were similar.

When I returned home just before the end of July I learned that Comet LINEAR had started to undergo a complete disintegration. I managed to observe it two more times, the last occasion being on the evening of

August 2, and by then it appeared as little more than an extended and amorphous "blur" about seven arcminutes across, with a total brightness near 9th magnitude.

61. NOVEMBER 27, 2000
Comet 41P/Tuttle-Giacobini-Kresak (no. 286)

In March 2000 I received my first significant private grant, from the Foundation for the International Non-governmental Development of Space (FINDS), for the purpose of carrying out research and educational work on near-Earth asteroids and comets. I also received a donated CCD camera from Meade Instruments, to go along with a Schmidt-Cassegrain telescope they had previously donated to me. (They would donate more such equipment to me over the next few years.) I had some equipment compatibility issues I had to work through, but starting in August after my return from Iran I began taking images of comets and asteroids and performing astrometric measurements for submission. In October I received an Observatory Code (921) from the Minor Planet Center.

On the morning of November 27 I decided I would use my system to try to recover Comet 41P – unaware at the time that it had already been recovered three weeks earlier. When I took images of the expected field, and also examined it visually with the 16-inch scope, I was surprised to see a bright 10th-magnitude diffuse object in the field. At first I thought I might be seeing one of the nearby plotted galaxies, but it soon became apparent that I was in fact seeing the comet – in a state of outburst. While I had missed out on the recovery, I was the first observer to report this particular event, and was duly credited in an IAU Circular.

Comet 41P has had a history of outbursts, having undergone them during its returns in 1973 (no. 9) and 1995 (no. 200), so this was not a completely surprising observation. It faded from this one, being about magnitude 11½ in early December, however in the middle of that month it underwent an even stronger outburst, to about magnitude 8½. I was

actually able to see it in 10x50 binoculars on a couple of occasions before it began fading.

62. MARCH 15, 2001
Comet NEAT C/2001 B2 (no. 289)

Although I didn't acquire the telescope/CCD system for this primary purpose, it occurred to me that I could utilize it to help in the visual observations of extremely faint comets. I actually accomplished this in September 2000, when through simultaneous imaging and visual observations with the 16-inch, I successfully detected Comet LINEAR C/2000 K2 (no. 282) at almost 15th magnitude on four different nights. I am quite certain I never would have been able to convince myself I was seeing the comet visually without the near-simultaneous CCD images.

On the evening of March 15, 2001 I tried to make observations of three very faint comets. While I successfully imaged all of them, I succeeded in visually detecting only the middle one of the three: Comet NEAT C/2001 B2, a distant object that I had previously attempted visually on a handful of occasions, all unsuccessfully. It appeared as an extremely faint object right at the threshold of vision, at magnitude 14½. I did not look for it again after that night.

The other two comets that I imaged, but failed to detect visually, were Comet LINEAR C/1999 K5, which had been visually detectable from the southern hemisphere when near perihelion in mid-2000 and which had finally come back north, and Comet 74P/Smirnova-Chernykh, which even though it exhibited a faint tail in the CCD images I could never quite convince myself I was seeing it visually.

63. JUNE 16, 2001
Comet LINEAR C/2001 A2 (no. 290)

I first imaged this comet with my CCD system in mid-March 2001, and then picked it up visually (at 13th magnitude) a week later after reading reports of an apparent outburst (due to apparent splitting of the nucleus). It brightened rapidly from that point, and was close to 6th magnitude when I observed it the beginning of May before losing it below my southwestern horizon.

In early June my family and I left for Zimbabwe, in order to view the total solar eclipse that would take place on June 21. We stayed at a private residence on the outskirts of Harare, and while there I read reports that Comet LINEAR – which had recently become visible in the southern hemisphere's morning sky – had undergone yet another upsurge in brightness. On the morning of the 16th I could easily see the comet with my naked eye near magnitude 3½, and with binoculars measured a coma 12 arcminutes in diameter and could see a straight tail two degrees long. On photographs I took that morning I could trace the tail out to a length of 3½ degrees.

I saw Comet LINEAR two more times while in Zimbabwe, including on the morning of the eclipse from the town of St. Alberts in the northern part of that country. By the time we returned back to the U.S. in late June the comet had become accessible again from the northern hemisphere, and was still a fairly easy naked-eye object near 4th magnitude. It started to fade after that, and I was able to detect it with my naked eye until mid-July and telescopically until early September.

64. AUGUST 19, 2001
Comet 185P/Petriew P/2001 Q2 (no. 294)

Beginning during my California years when I was observing with Charles, and from time to time during the years thereafter, I had been

asked by Brian Marsden and/or Dan Green to confirm reported comet discoveries. My first opportunity to do so once I had my CCD system operational came in August 2001, when on the 18th I received an e-mail from Dan informing me of the latest reported discovery. It had been found that morning by a Canadian amateur astronomer, Vance Petriew, while attending a star party in Saskatchewan.

On the following morning I successfully located the comet in the 16-inch; it was around 11th magnitude and appeared moderately condensed with a coma diameter of 2.5 arcminutes. I also obtained several CCD images of the new comet, and my astrometric measurements from these images were included in the discovery announcement in an IAU Circular issued later that day. I've always felt a bit of pride at this, as I was able to claim that the Southwest Institute for Space Research (which is what I called the Earthrise Institute at that time) was the first institution in the world to obtain precise positional measurements of this new comet.

Petriew's comet was found to be periodic, with an orbital period of slightly under 5½ years. It has returned four times since its initial discovery return in 2001, and I have managed to obtain at least a couple of visual observations of it during each of these returns.

65. MARCH 21, 2002
Comet 153P/Ikeya-Zhang P/2002 C1 (no. 301)

I was thrilled when I saw that Japanese astronomer Kaoru Ikeya, who had discovered several comets in the early- to mid-1960s, had finally discovered a new comet after a lapse of almost 3½ decades. Things became even more exciting when it started to look like the comet was destined to become quite bright, indeed, it was the best comet to appear since Hale-Bopp five years earlier, and when at its best during late March and early April it was an easy and moderately conspicuous naked-eye object of 3rd magnitude, with my longest naked-eye tail measurement being 8 degrees. And finally, it was found to be identical to

a comet that had been observed by the Polish astronomer Johannes Hevelius, among others, in 1661, making it the longest-period periodic comet that has been definitely seen on two returns.

It was while Comet Ikeya-Zhang's main show was starting in early March when my father was admitted to the local hospital with what was initially believed to be a heart attack but later found out to be a disease in the nervous system. The Space and Robotics 2002 conference, which I had helped organize and where I was scheduled to give a couple of talks, was held in Albuquerque during the third week of March, and after much thought and consultation with family members I decided to go ahead and attend, with the understanding I might have to depart at any time. I brought the CT-100 scope with me with the thought I might go travel to a surrounding rural site to view the comet, however my car was broken into one day while I was attending the conference and the telescope, as well as other equipment including my binoculars, was stolen. When the conference ended I stopped at a camera shop in Albuquerque and purchased new binoculars and eyepieces, but as I was on the way home Eva called and told me that my father had just passed away. After arriving home, despite some clouds and a first-quarter moon I observed Comet Ikeya-Zhang – dedicating the observation to his memory – seeing it at 3rd magnitude and exhibiting a 5-degree-long tail.

While I really don't believe in this type of thing, a part of me likes to believe that the comet was escorting my father's essence as it completed its passage through the inner solar system, and might bring his essence back when it returns again around the year 2362.

66. AUGUST 1, 2002
Comet SWAN C/2002 O6 (no. 314)

The Solar Wind ANisotropies (SWAN) ultraviolet telescope aboard the SOHO spacecraft has proven to be especially adept at detecting comets in the inner solar system, as it detects the large Lyman-alpha hydrogen

clouds that are now known to accompany most comets. A couple of previously unknown comets were detected in archived SWAN images and reported during the early 2000s, but in late July 2002 a Japanese researcher, Masayuki Suzuki, detected an apparent comet in "real-time" SWAN images and reported this to the IAU Central Bureau. On the 31st I received an e-mail from Carl Hergenrother, who was apparently "minding the store" at the Central Bureau in the absence of Brian Marsden and Dan Green, informing me about the potential SWAN comet and asking for confirmation.

All Carl had for me were two very approximate positions that were several days old and that indicated a fairly rapid motion. I extrapolated these positions that defined the center of what would likely be a fairly large search area. The next morning I brought out the 8-inch scope to make a search, but in addition to the large search area I had to contend with a 3rd-quarter moon, and typical "monsoon" weather conditions wherein clouds were continuously forming, dissipating, and re-forming throughout the entire search area. I never had more than a handful of minutes of search time before that part of the sky clouded over, and I would have to wait several minutes before it cleared again and I could resume the search.

After about half an hour of unsuccessful searching I was about to give up around the beginning of dawn, when I decided to turn the telescope one last time to the original extrapolated position. I then noticed that one of the stars about 40 arcminutes northeast of that position looked somewhat fuzzy, and over the next several minutes I saw that a hazy patch of light – which I measured as being about magnitude 9½ but which in hindsight was probably a bit brighter – had moved off that star and was traveling in the expected direction at the expected rate. I followed this object for another 25 minutes before dawn and clouds overwhelmed it, and then in addition to reporting back to Carl I also e-mailed my positions to several observers in locations to my west in the hopes that they might be able to pick it up. At least one of them did, and

Carl was able to announce the discovery in an IAU Circular later that day.

I observed Comet SWAN on several additional occasions over the next three weeks, and it reached a peak brightness near 6th magnitude in mid-August before fading about a half-magnitude by about a week later. The images I've seen subsequent to that suggest that it apparently disintegrated as it passed through perihelion in early September.

67. DECEMBER 15, 2002
Comet Kudo-Fujikawa C/2002 X5 (no. 324)

Even though the LINEAR program and other surveys had been operational for a few years by then, 2002 saw still saw a decent share of visual comet discoveries. The last of these came in mid-December, when Japanese observers Tetuo Kudo and Shigehisa Fujikawa independently found this new comet.

I received the IAU Circular announcing Kudo's discovery on the 14th. (Fujikawa had already made his discovery but it hadn't been officially reported yet.) At the dinner table that evening I announced my intention to observe it and take images of it the following morning, and my younger son Tyler, then 10 years old, stated that he would join me. He indeed did so, on a chilly mid-December morning, and after I had located the new comet with the 16-inch telescope (and also detected it with binoculars, since it was readily visible near magnitude 8½) he assisted me in taking several CCD images. When I submitted the astrometric measurements from these images I listed Tyler as an "observer," and he was so credited when a Minor Planet Electronic Circular announcing a reasonably definitive orbit was issued a day later.

That orbit indicated that the comet would be passing close to the sun at the end of the following January – the 25th smallest perihelion distance of all the comets on my tally – and it put on a reasonably good show in

the LASCO C3 and C2 coronagraphs aboard SOHO. A year later there came out press reports (and a research paper) describing how observations of Comet Kudo-Fujikawa with various instruments aboard SOHO had been combined with ground-based observations of both old and young stars to paint a comprehensive picture of how planetary systems, including associated comets, form and evolve over time. The early lead time in the orbital calculations aided in part by the observations that Tyler and I made certainly helped in the early planning of these observations, and from that point on I have relished telling the story of how a 10-year-old student assisted in observations that ultimately helped us understand how our solar system, including Earth, came to be.

68. APRIL 28, 2003
Comet 81P/Wild 2 (no. 332)

The 2003 return of Comet 81P/Wild 2 was a very important one from a scientific perspective, since that was the return when it was encountered by the Stardust spacecraft, which collected material samples as it passed through the coma, for eventual return to Earth. From an observational perspective, however, it was a very unfavorable return, being in conjunction with the sun around the same time as perihelion passage. I first picked it up with my CCD system in early December 2002, and obtained my first visual observation on the evening of March 6, 2003 – the evening before my 45th birthday – by which time it was already starting to get a bit low in the western sky, and was only very faintly visible at 14th magnitude. I followed it until April 28, when its elongation had decreased to 46 degrees, and it was passing by the Crab Nebula M1 in Taurus. The brightness had increased by about half a magnitude, and in addition to my visual observation I also took some CCD images of it located next to the Crab Nebula.

I shared the best of these images with some friends of mine, one of whom passed it along to some members of the Stardust project. Very

shortly thereafter I was contacted by one of those members, who asked me to make sure I passed to them my astrometric measurements of the comet, since it was just about ready to go into conjunction with the sun, and they needed the positional data for spacecraft navigation purposes. I gladly provided them with the data, and for a while my image was featured on the homepage of the Stardust web site.

Comet Wild 2 re-emerged into the morning sky at the very end of 2003 (near 13th magnitude), with the Stardust encounter due to take place on January 4, 2004. The Stardust people again asked me to obtain some astrometry for navigation purposes, but unfortunately my computer froze on the first occasion I tried this, and completely crashed on the second occasion. This wasn't fatal to the mission, fortunately, since Stardust went on to have a successful encounter with the comet, then successfully returned the collected samples to Earth two years later, and then went on to a successful encounter with Comet 9P/Tempel 1 in early 2011.

69. APRIL 29, 2004
Comet LINEAR C/2002 T7 (no. 338)
Comet Bradfield C/2004 F4 (no. 350)

The name of Australian amateur astronomer William Bradfield appeared quite frequently on my tally during my early years of observing, and several of his comets achieved (or at least came close to) naked-eye visibility. I had the privilege of meeting him personally when I was traveling through Australia during 1997 in the wake of Comet Hale-Bopp, and spoke to a gathering in Adelaide.

After a lapse of almost nine years, Bradfield discovered his 18th, and final, comet in late March 2004. There were only a small handful of observations made before it disappeared into evening twilight, but during mid-April it put on a spectacular show as it crossed the field-of-view of the LASCO C3 coronagraph aboard SOHO. A week later I picked it up deep in the dawn sky at 4th magnitude, and over subsequent

days it climbed higher into the morning sky, becoming visible to the naked eye with a long, straight filmy tail.

By the morning of April 29 Comet Bradfield had faded to 5th magnitude, but in binoculars I measured my longest length of its tail, 8½ degrees. On that same morning, Comet LINEAR C/2002 T7 – which I had first picked up in late July 2003, followed until early March 2004 when it began disappearing into dusk, and which had recently re-emerged into the morning sky near 4th magnitude) was also visible, although it was very low; I could see a one-degree-long tail in binoculars. For a few minutes, before dawn began to overwhelm things, I was able to view both comets simultaneously with my naked eye, the first time (of only two occasions thus far) when I have been able to observe two comets in this manner.

70. JULY 4, 2005
Comet 9P/Tempel 1 (no. 367)

This periodic comet, which had been lost for almost a century before being recovered in 1972, has been pretty dependable ever since, and I've observed it on alternate returns since the one in 1983 (no. 54). The 2005 return was special, meanwhile, in that it would be encountered by the Deep Impact mission, which would eject a projectile to impact the comet's nucleus and excavate subsurface material that could then be studied when the main spacecraft passed through it. In a sense, this was true "laboratory comet science."

I first picked up P/Tempel 1 on that return in mid-February 2005, and followed it on a fairly regular basis thereafter; my overall impression is that it remained about a magnitude fainter than it had during the previous returns in 1983 and 1994 (no. 185). It reached a peak brightness near magnitude 10½ in late May and most of June, although it had faded slightly by the time of the Deep Impact encounter, which took place on the night of July 3-4. On that night I followed the comet until

about 20 minutes before the time of the impact, at which time it sank behind trees to my west.

On the following night, 22 hours after the impact, I could clearly see some of the residual effects: the comet appeared about half a magnitude brighter (i.e., just fainter than 10th magnitude) than it had the previous night, and was also quite a bit more condensed in its interior. This didn't last long, however, for when I observed it again the next night it had faded pretty much back to its pre-encounter brightness and appearance.

I followed P/Tempel 1 for another month before it sank below my southwestern horizon, fading to about magnitude 11½ in the process. Meanwhile, the Deep Impact mission, repurposed under the name Extrasolar Planet Observation and Deep Impact eXtended Investigation (EPOXI), went on to encounter Comet 103P/Hartley 2 during its return in 2010 (no. 477), at which time it was passing fairly close to Earth (0.121 AU) and became a naked-eye object near 5th magnitude.

71. SEPTEMBER 13, 2005
Comet 169P/NEAT (no. 378)

At the beginning of August 2005 a just-released IAU Circular announced that the apparent Apollo-type asteroid, 2002 EX12 (discovered 3½ years earlier by the NEAT survey program, and with an orbital period of 4.2 years), exhibited a short, faint tail on CCD images and thus was apparently a small comet. On a couple of occasions over the next few evenings I spotted the object – in the course of making a relatively close approach to Earth (0.147 AU) – as a fast-moving stellar object of 15th magnitude.

2002 EX12 went into conjunction with the sun shortly thereafter, and I thought I was done with it. However, in early September (after it had emerged into the morning sky) I read reports that Michael Jaeger and Gerald Rhemann in Austria had imaged it at a small elongation as a

more-or-less “normal” comet. I was unable to access its location (low in the east at an elongation of 33 degrees) from my home location, so on the morning of September 12 I set up the 8-inch telescope at a nearby site – actually near where my present residence is located – and suspected a faint diffuse object of magnitude 11½ at the comet’s expected location. On the following morning I set up the 16-inch scope at this same location, and clearly saw it as a “normal” comet, at magnitude 11½ and with a diffuse and slightly condensed coma 1½ arcminutes in diameter.

72. JANUARY 11, 2006
Comet 174P/Echeclus P/2000 EC98 (no. 384)

In early January 2006 there came reports that this Centaur object, first discovered by Spacewatch in March 2000, had apparently undergone a cometary outburst late the previous year. Although initially reported as being about 17th magnitude, I soon read a report that it had been visually detected near magnitude 14½, and decided it might be worth giving it a try. On the morning of January 10, under extremely clear sky conditions I did seem to see an extremely faint diffuse object, however it was located right next to a 14th-magnitude star and I couldn’t be sure of what I was seeing. On the following morning, again under excellent conditions the object was in a “clean” location, and I clearly detected it at magnitude 14½ and with a moderately condensed coma slightly less than one arcminute across. At the time of these observations Echeclus was located 13.05 AU and 13.02 AU from the sun and Earth, respectively, the largest heliocentric and geocentric distances at which I’ve ever observed a comet, and was over nine years away from perihelion passage.

I observed Echeclus one more time during that particular outburst, at the beginning of February. It has undergone three additional outbursts since then: in May 2011, to about 15th magnitude and which I did not see; in August 2016, again to 15th magnitude and which I did see on a couple of

occasions; and in December 2017, the brightest outburst thus far, when it almost reached magnitude 13½ and which I managed to observe a handful of times.

73. APRIL 30, 2006
Comet 73P/Schwassmann-Wachmann 3 (no. 385)

The nucleus of this comet fragmented during its 1995 return (no. 202) and it became much brighter than expected, reaching almost 5th magnitude and appearing almost like a telescopic "Great Comet." I managed a handful of observations at the subsequent, and much less favorable, return in 2000-01 (no. 284), and images with large telescopes revealed two smaller fragments (as separate objects); I was unable to detect these visually.

The comet community was eagerly awaiting the 2006 return, since it would be passing only 0.08 AU from Earth in mid-May. I first picked up the primary component (at 14th magnitude) in late January, and then saw one of the main secondary components, Component B, for the first time on my 48th birthday (March 7). Throughout the return this particular component underwent significant outburst activity from time to time; at one point in early May I faintly detected it with my naked eye at 6th magnitude. Meanwhile I first observed another component, Component G, for the first time on April 6, in apparent outburst near magnitude 13½.

On the night of April 29-30 the primary component was an easy binocular object of 7th magnitude, with a tail half a degree long. Component B was also detectable with binoculars at 8th magnitude, and telescopically exhibited a tail 10 arcminutes long; I could also detect a nuclear fragment, which had been designated Component AQ, within B's coma. Component G was faintly visible near magnitude 13½, and I detected yet another separate component, Component R, at a similar brightness. That was my only observation of Component R and my final observation of Component G; meanwhile, I would follow Component B

(which around the time of the closest approach to Earth was located seven degrees from the primary) until the beginning of July, and the primary component until late August.

74. JANUARY 12, 2007
Comet McNaught C/2006 P1 (no. 395)

I first picked up this comet in mid-September 2006, when it appeared as a vague, diffuse object of 14th magnitude, and followed it in the evening sky until mid-November, by which time its elongation had decreased to 24 degrees and it had brightened to magnitude 9½. It went into near-conjunction with the sun after that, but around the end of December I began to read reports that it was being detected from far northern latitudes near 4th magnitude. Thereafter, various reports I read indicated that it brightened rapidly, however at that time the comet was located almost directly north of the sun, and at my latitude of +33 degrees I was at a distinct disadvantage compared to observers farther north. I also had to contend with several cloudy nights that precluded observation attempts. I finally was able to spot it on the evening of January 8, 2007, very deep in bright twilight; it appeared as little more than a central condensation and the beginnings of a short tail, and was probably somewhere between magnitudes 0 and -1.

I had clouds during the next three days, and during this time I began to read of daytime sightings of Comet McNaught. I had clear skies on the 12th, and shortly before noon I used azimuth and altitude offsets from the sun to spot the comet in an 8-inch Schmidt-Cass. It appeared as a very bright central condensation with a wisp of tail, and from comparisons with Venus I measured an approximate brightness of magnitude -3.5. I tried to see it with binoculars and my naked eye, without success – it is possible that the cataracts that I would discover I had later that year were interfering. In any event, I was so mesmerized by seeing this brilliant comet in broad daylight that I followed it for three hours, a time span that encompassed the time of perihelion passage. Later that day a thick

band of clouds covered the area and I drove to a site over an hour's drive to my east, and just after sunset picked up the comet in both binoculars and the 8-inch Schmidt-Cass. Unfortunately, within five minutes clouds had moved up from the western horizon and covered it up, which prevented me from making any observations in a darker sky.

The clouds moved out by the next day, and I ended up seeing Comet McNaught during daytime on both of the next two days. On the 13th I set up the 8-inch Schmidt-Cass in the parking lot of Tyler's school in Cloudcroft, where I had taken him for Science Olympiad practice, and was able to show it to the entire team and to the teacher. The comet appeared even brighter that day, near magnitude -4. By the following day, however, it seemed to have faded somewhat, to about magnitude -3, and in the afternoon I drove to Sacramento Peak Observatory in the town of Sunspot, and while set up underneath the Dunn Tower Telescope I picked it up a few minutes before sunset, and followed it until a few minutes after sunset, at which time its altitude was very low. This would be my last sighting of Comet McNaught as it traveled southward (and became a spectacular object from the southern hemisphere); while the extremities of the tail were visible from the northern hemisphere for a few days afterward, a succession of two major winter storms, and the accompanying cloudy weather, kept skies overcast for a solid week, and thus I never had the opportunity to see this.

75. OCTOBER 24, 2007
Comet 17P/Holmes (no. 414)

I had arisen early on the morning of October 24, 2007, prior to making the two-hours' drive to Las Cruces, New Mexico to attend that year's version of the International Symposium on Personal and Commercial Spaceflight. Before leaving I checked my e-mail, and saw that there were postings on the comets-ml news group about an outburst of this comet; there were several reports from observers in Spain indicating it was about 7th magnitude. Since it was still dark here in New Mexico I

decided to check it out, and saw a star-like object of 4th magnitude – easily visible to the naked eye – in the comet's expected location. After I returned from Las Cruces that evening I looked at it again, and it was even brighter – slightly brighter than 3rd magnitude, easily visible to the naked eye despite an almost full moon – and telescopically it appeared as a bright disk just over an arcminute in diameter. When I observed it again before dawn it had brightened – slightly – still further, and had also slightly grown in size.

It was clear that Comet Holmes was undergoing a huge outburst, similar to what had happened during its discovery in 1892. It reached a peak brightness near 2nd magnitude in early November, and since it had only been about 17th magnitude prior to its outburst, this corresponds to an increase in brightness by a factor of about 600,000, the largest cometary outburst that has ever been recorded.

76. DECEMBER 30, 2007
Comet 17P/Holmes (no. 414)
Comet 8P/Tuttle (no. 415)

After its outburst in late October 2007 Comet 17P/Holmes expanded and diffused outward, and by the latter part of November the coma was over one degree in diameter. It also faded, albeit slowly, and I was able to follow it with my naked eye until late February 2008, in binoculars until early April, and was able to detect faint "wisps" telescopically when I saw it for the last time late that month.

I had a rare view on the evening of December 30, 2007, when Comet Holmes and Comet 8P/Tuttle, then about 20 degrees from each other, were simultaneously visible to my naked eye. Comet Holmes was around 4th magnitude, with a large and oblong diffuse coma about 70 x 65 arcminutes across, while Comet Tuttle – which was located close to the Triangulum Galaxy M33 and which passed 0.25 AU from Earth the following day – was about magnitude 5½ with a diffuse, somewhat

condensed coma 19 arcminutes in diameter. This was the second, and as of this writing the last, time that I have seen two comets simultaneously with my unaided eye.

77. MARCH 21-22, 2009
Various comets

The cometary activity was quite busy during the first few months of 2009, and on the night of March 21-22 I visually observed 15 of them – by far, my record for most comets observed in one night. I began the night with Comet Itagaki C/2009 E1 (no. 452), which I had first picked up a week earlier and which was near magnitude 9½ with a coma 3½ arcminutes across, and before dawn I finished the night with Comet Christensen C/2006 W3 (no. 422) an intrinsically bright but distant object which was emerging from conjunction with the sun; it was about 10th magnitude, with a coma 2 arcminutes in diameter, and would brighten about a magnitude (and become visible with binoculars) when it went through opposition in August.

My brightest comet of the night was the seventh one, Comet Lulin C/2007 N3 (no. 432), which had briefly become a naked-eye object near magnitude 4½ when it passed 0.41 AU from Earth in February; by this night it had faded to 8th magnitude but was still visible with binoculars – the only comet of the night that I so observed – with a coma 7 arcminutes across. Most of the rest of the comets I observed that night were rather dim and nondescript objects, although they do include Comet 29P/Schwassmann-Wachmann 1 (no. 226), coming off one of its outbursts somewhat earlier. My faintest comet of the night was Comet 77P/Longmore (no. 451), at 14th magnitude. I actually attempted three other comets during the night, one of which I had seen earlier during an outburst but was now too faint to detect (Comet 199P/Shoemaker 4 P/2008 G2, no. 437), another one I would pick up the following month (Comet 209P/LINEAR P/2008 X2, no. 455), and one I would never observe (Comet McNaught C/2009 F5). I also ended up taking a forced

two-hour break during the middle of the night, when some cirrus clouds moved through, and then out.

78. MARCH 18-19, 2010
Various comets

Eva and I began our divorce proceedings in 2008, and for the following two years it was a rather slow and sometimes painful process. In early 2010 we were finally able to reach a settlement agreement, and as a part of that I agreed to vacate our residence in 16 Springs Canyon on March 19. On the night prior to that date I conducted my final observing session from the concrete slab in front of our garage from which I had made the comet discovery 15 years earlier that had so dramatically affected my life. That session included five comets, the second of which was a confirming observation of the 14th-magnitude Comet Hill C/2009 U3 (no. 470), which I had suspected two nights earlier. My final comet of the night, which I observed shortly before the onset of dawn, was Comet Siding Spring C/2007 Q3 (no. 441), which appeared as a fairly small and condensed object near 10th magnitude, with a distinct and slightly curved tail several arcminutes long. I concluded the session as dawn was breaking by turning the telescope towards the globular star cluster M70, but there weren't any comets located near it this time.

79. APRIL 16, 2010
Comet Vales P/2010 H2 (no. 473)
Comet McNaught C/2009 R1 (no. 474)

While my divorce from Eva was going on, I purchased some property in 16 Springs Canyon, not too far from the place I had lived for the previous 15 years, and a mobile home to be placed on that property. (This has been my residence ever since.) Due to an excessively strong "El Nino" winter, which involved almost record amounts of snowfall, the process of getting the mobile home to the property and ready for

residency took quite a bit longer than expected, and thus for two months after moving out of my previous residence I found it necessary to live in a motel room in Alamogordo (an hour's drive away) for the next two months before I could move in during the third week of May. Due to the distance involved and the weather, observing sessions were relatively few and far between during this period.

On the morning of April 16, 2010 I rose early to make the drive to the 16 Springs property for an observing session, but before leaving my motel room I checked the Minor Planet Center's Near Earth Object Confirmation Page, and noticed a new 13th-magnitude object listed there, close to opposition. When I arrived at the site I turned the 16-inch scope towards this object's location, expecting to see something cometary, but instead I saw just a stellar object, indeed at 13th magnitude. As things turned out, this object had just undergone a large outburst within the previous 24 hours, and over the subsequent days it expanded outward and developed a cometary coma. To my eyes, it reached a peak brightness near magnitude 11½ (with a two-arcminute coma) at the beginning of May, and I followed it until the end of that month before it faded away. Comet Vales turned out to be a periodic object with an orbital period of 7.5 years, and an orbit resembling that of the Hilda-type asteroids; it has not been seen since, and I suspect the outburst it underwent in 2010 may have been its death throes.

After finishing with my observation of Comet Vales on April 16, I turned towards my primary reason for that morning's observing session: Comet McNaught C/2009 R1, which was just becoming accessible from the northern hemisphere. I successfully located it just before dawn as it was clearing the trees on my eastern horizon; it appeared as a diffuse, somewhat condensed object slightly brighter than magnitude 11½. Comet McNaught brightened fairly rapidly after that, reaching a peak brightness near magnitude 5½ in mid-June when I was able to glimpse it with my naked eye on a couple of occasions. One of my observations of it came in bright moonlight on May 29 (when it was near magnitude

7½); this was more-or-less a symbolic observation, on the morning of the day that Tyler graduated from Cloudcroft High School.

While I wasn't aware of it at the time – it would be a few days later before I found out – my divorce decree had been signed on April 15. Thus, Comets Vales and McNaught were the first comets I added to my tally after my divorce had become final.

80. DECEMBER 12, 2010
"Comet" (596) Scheila (no. 623)

On December 11, 2010 I read an announcement that Steve Larson with the Catalina Sky Survey had reported that the main-belt asteroid (596) Scheila was about a magnitude brighter than expected and was accompanied by a cometary coma. On the following morning I observed it with the 16-inch scope, and as it was slightly brighter than 14th magnitude it was indeed about a magnitude brighter than the ephemeris prediction; meanwhile, although I couldn't really see a "coma," there did seem to be a hint of "fuzziness" around the asteroid. I never saw this "fuzziness" again, but Scheila itself continued to run somewhat brighter than the ephemeris prediction for a while, being slightly brighter than magnitude 13½ in mid-January 2011. By the end of that month, however, the brightness I measured for Scheila was consistent with the ephemeris predictions, and it remained that way thereafter.

Detailed studies have strongly suggested that Scheila's cometary outburst was almost certainly due to the impact by a much smaller asteroid, perhaps 35 meters in diameter. While there has never been any real reason to suspect a repeat of its cometary activity, I have nevertheless continued to monitor Scheila on a somewhat continuous basis ever since, at least around the times it has been at opposition, although I finally concluded this activity in late 2023. As expected, it has remained completely asteroidal in appearance throughout all this time,

and its brightness has always remained quite close to the ephemeris predictions.

Even though Scheila can be considered an "active asteroid," the fact that its burst of cometary activity was clearly not due to sublimation of volatiles suggests it may not be appropriate to include it as a "comet" for purposes of my tally. However, by mid-2017 the IAU had assigned periodic comet numbers to a couple of other objects that – at least in one distinct case – had also experienced cometary activity due to impacts, and I came to the conclusion that I could accordingly count any "active asteroid" that I observed as a "comet," provided that the evidence for that activity was clear and compelling. I thus added Scheila to my tally retroactively. Since during the course of my observations of it Scheila has gone through three different perihelion passages (in 2012, 2017, and 2022) it has accordingly had three "returns" and thus appears on my tally three times. The first two "returns" are retroactive additions (no. 623 for the 2012 "return" and no. 624 for the 2017 "return"), while I added the 2022 "return" (no. 669) "in sequence." My first observations for the 2017 and 2022 "returns" came just after Scheila had passed through aphelion (and when it was close to opposition), and as it turns out on both of these "returns" my observations were the first anywhere to be reported post-aphelion; thus, for whatever it's worth these initial observations can be considered as "recoveries."

81. OCTOBER 24, 2011
Comet Elenin C/2010 X1 (no. 487)

For a while it looked like this comet had the potential to be a fairly bright one, with a moderately small perihelion distance (0.483 AU) and a moderately close approach to Earth (0.23 AU) taking place five weeks after perihelion. Almost from the outset, however, it ran fainter than expected, being no brighter than about magnitude 15½ to 16 when I imaged it with my old CCD system in late March 2011 (when, after lying dormant for several years, I brought it out for that special

occasion), and appearing as a very vague and diffuse object slightly fainter than 14th magnitude when I first picked it up visually during late May. It remained faint for another month, but finally in July it started to pick up some steam and began brightening, and when I obtained my final pre-perihelion sighting at the beginning of August it was near 10th magnitude with a somewhat condensed coma 3½ arcminutes across.

After that Comet Elenin was no longer accessible from the northern hemisphere, but according to observers in the southern hemisphere, it continued to brighten somewhat rapidly, and was close to 8th magnitude by mid-August. It began to fade after that, however, and moreover grew more and more diffuse, and by the second week of September it was nothing more than a diffuse, uncondensed "blur," suggesting that it had disintegrated. This conclusion was reinforced in late September when it passed two degrees north of the sun, and despite favorable geometry for forward scattering nothing was visible in the LASCO coronagraphs aboard SOHO. While I didn't really expect to see anything, I nevertheless made a couple of attempts for the comet after it appeared in the morning sky in early October, and just as I expected I was unable to find anything. Other observers, including a CCD attached to the 2-meter Faulkes North Telescope in Hawaii, also failed to detect anything.

After mid-October, however, after the moon had cleared from the morning sky, I began to see CCD images that showed a faint wisp of tail – detached several arcminutes from the coma's expected location – showing that at least that part of the comet still survived. On the morning of the 24th I suspected an extremely faint "presence" in about the right location for this tail, and that seemed to move with the comet's expected motion; I could best detect it by noting very slight differences in the background sky brightness from where it "was" vs. where it "wasn't." After seeing this same feature on two subsequent mornings, and comparing my observations with CCD images that were taken at almost the exact same times, I was able to convince myself that I was indeed seeing this tail fragment. All told, these are among the most difficult and challenging visual comet observations I have ever made.

82. JANUARY 22, 2012
Comet Lovejoy C/2011 W3 (no. 500)

In early 2007, as I was approaching my 400th comet, to inaugurate a repurposed Earthrise Institute I inaugurated a new educational program, "Countdown to 500 Comets," wherein I encouraged students and comet observers around the world to observe comets with me as I made my way towards my 500th comet. Each time I added a new comet to my tally I posted a write-up about it to a special web page at the Earthrise web site, posted information to various forums, and gave special recognition to those individuals who observed ten or more of those comets.

My 500th comet turned out to be a very interesting object with a lot of scientific importance, but also turned out to be an extremely difficult and challenging object for me to observe. It was discovered (near 13th magnitude) on November 27, 2011 by an Australian amateur astronomer (whom I know personally and consider a friend), Terry Lovejoy, and it soon became apparent that his newest comet was a Kreutz Sungrazer. The last ground-based discovery of such an object had taken place back in 1970, although numerous sungrazers had been detected in more recent years by space-based coronagraphs (especially the LASCO coronagraphs aboard SOHO). It was subsequently followed for another two weeks, during which it brightened some and developed a distinct tail before disappearing into the dawn. As it passed through perihelion on December 16 it appeared as a very bright sungrazer in the LASCO coronagraphs, but unlike every other sungrazer that had been detected in LASCO, it survived perihelion, even shedding its old tail and growing a new one in the process. Its appearance in the LASCO images was bright enough that I attempted daytime searches utilizing the 8-inch Schmidt-Cass and the same setup and procedure by which I had observed Comet McNaught C/2006 P1 (no. 395) during daytime in January 2007. Unfortunately, I never saw anything, which suggested that Comet Lovejoy wasn't quite bright enough for me to detect.

A few days after perihelion Comet Lovejoy appeared in the southern hemisphere's morning sky. According to observers there, it was a spectacular object, pretty much a "Great Comet," initially as bright as magnitude 0 (although it faded fairly rapidly), and with a tail in excess of 30 degrees in length. Unfortunately for those of us in the northern hemisphere, the comet was inaccessible, and it continued traveling almost due southward; when it was nearest Earth (0.50 AU) in early January 2012 it was in southern circumpolar skies, and it came to within 1½ degrees of the south celestial pole shortly thereafter, although it did begin heading back north after that. Ominously, meanwhile, observers in the southern hemisphere began reporting that there was no coma, i.e., that it appeared as a "headless wonder" meaning that the nucleus had disintegrated. Whether or not there would be anything left of the comet to see by the time it became accessible for me in late January remained to be seen.

On the evening of January 22 I had very good sky conditions, and even though the comet's location was fairly deep in my southern sky, when I examined the expected field with the 16-inch scope I seemed to see an extremely pale and vague brightening of the background sky – about the same surface brightness as the gegenschein – that traveled in the comet's expected direction at the expected rate during the hour and a half that I followed it. After two days of cloudy weather I saw the same object again on the evening of the 25th, and followed it for two hours. (While I "measured" a "brightness" near 12th magnitude, since there was no coma to speak of I'm not sure this has much physical meaning.) I had finally achieved my 500th comet – and a Kreutz sungrazer, at that – but the observations were so difficult and challenging that it all almost seemed anti-climactic.

83. MARCH 12, 2013
Comet PANSTARRS C/2011 L4 (no. 504)

During the last few months as my divorce was becoming finalized I met a woman named Susanne, who lived in Albuquerque, via an on-line dating site. We had our first date at the beginning of 2010, and things took off quickly from there. We were together for 2½ years and were talking at least semi-seriously of getting married, however for reasons that have never been entirely clear to me she broke up with me at the end of June 2012. We did get together from time to time during the months and years afterward, but could never quite recapture what we had during the time we were together. I sometimes think of these times as the "lost years," as I struggled to get over all this, but one thing that helped me get through this time emotionally was my comet observing.

The last comet I added to my tally before Susanne broke up with me had been discovered in June 2011, by the at-that-time new Pan-STARRS survey program, almost two years before perihelion passage. I first picked it up at the end of March 2012, as a very faint and tiny object a bit fainter than 14th magnitude, and followed it under early September, after which time it disappeared into western evening twilight; it had brightened about a magnitude and a half during those months. Observers in the southern hemisphere picked it up in late December, near 9th magnitude, after conjunction with the sun, and although its elongation remained somewhat small, they were able to follow it until early March 2013, by which time it had brightened to 2nd magnitude.

Comet PANSTARRS was heading almost due northward at that time, and I first picked it up again on the evening of March 10, from an overlook on the Sunspot Highway south of Cloudcroft overlooking the Tularosa Basin. It was buried deep in twilight, at an elongation of only 15 degrees, and although it was near magnitude 1½ and exhibited a short tail in binoculars, due to the bright sky and low elevation I couldn't see it with my naked eye. Two nights later, from the same site the one-day-old crescent moon formed a spectacular sight with the comet; the

comet's brightness was still magnitude 1½, and I could see it, although not especially easily, with my naked eye, and could see a bright dust tail 20 arcminutes long with binoculars. Several friends and other amateur astronomers joined me at the site, and since I had written about the comet (and moon) in my weekly newspaper column it's possible that inspired a few people to travel there as well.

The comet's elongation increased somewhat over subsequent days, although it remained quite close to the horizon, and it also began fading; I did succeed in making one additional naked-eye sighting (the following night). Shortly thereafter it went through conjunction with the sun and began emerging into the morning sky, and it faded to below 6th magnitude by mid-April. Meanwhile it began to develop a distinct anti-tail, which I would measure as being four degrees long at the end of May (the comet's brightness itself being 8th magnitude at the time, and the main tail being only about half a degree long).

84. NOVEMBER 21, 2013
Comet ISON C/2012 S1 (no. 529)

For a time, it looked like we might have a very bright, "Great Comet" to observe in late 2013. Comet ISON's very small perihelion distance of 0.012 AU – still the 2nd smallest perihelion distance of all the comets on my tally – combined with favorable post-perihelion viewing geometry from the northern hemisphere (which included an approach to Earth of 0.43 AU) all seemed to indicate a very good-case scenario. The reality, however, ended up being quite different, with the first bit of bad news being that Comet ISON was found to be a first-time visitor from the Oort Cloud.

I made several attempts for the comet during the first five months of 2013, but never saw anything convincing. After conjunction with the sun it began to emerge into the morning sky, and I first picked it up, at 13th magnitude, on September 1. From that point it brightened somewhat

steadily, albeit somewhat slowly, and even by early November – just three weeks before perihelion passage – it was only about 9th magnitude, although telescopically it exhibited a distinct tail 15 to 20 arcminutes long. However, the comet then began to undergo outbursts, and on the 15th it appeared in binoculars at 5th magnitude with a straight, filmy tail 1½ degrees long. It subsequently faded a bit from this, but then underwent another outburst; on the morning of the 21st it appeared in binoculars as a condensed, near-stellar object of 4th magnitude, again with a filmy tail 1½ degrees long, and in the 8-inch telescope it exhibited a distinct bluish-green color. The comet's elongation at that time was 24 degrees, and I couldn't quite convince myself I could see it with my naked eye.

This would be my last sighting of Comet ISON, as clouds prevented attempts on the immediately subsequent days, and it then quickly disappeared into the dawn. On the day of perihelion, the 28th, I followed it in real-time images from the LASCO coronagraphs, and although it initially was quite bright in the images, it very clearly disintegrated as it passed through perihelion, and nothing was left of it but a cloud of debris as it exited the LASCO field. I made a couple of attempts in early and mid-December to see if I could detect this debris cloud, but never saw anything convincing.

85. DECEMBER 8, 2013
Comet Lovejoy C/2013 R1 (no. 532)

I wrote in one of the previous entries that there was a naked-eye comet (Comet 153P/Ikeya-Zhang P/2002 C1, no. 301) in the sky when my father passed away in March 2002. It turns out that the same thing was true when my mother passed away. The comet in question was discovered in early September 2013 by Australian amateur astronomer (and friend) Terry Lovejoy, and I first picked it up (at 14th magnitude) two days later, less than a week before a massive flood set up by an enormously heavy rainstorm swept through 16 Springs Canyon. (My

property only suffered relatively minor damage, but some of my neighbors weren't so fortunate.) The comet brightened rapidly, and reached a peak brightness of 5th magnitude during the latter part of November. In some respects, it provided some consolation from the major disappointment by Comet ISON (previous entry).

My mother, age 94 at the time, had taken ill in mid-November, and my brother Barry and his wife Cindy had moved her to a treatment center in Albuquerque. She initially seemed to be recovering nicely, and was doing well when I visited her on the 30th. However, a few days later she took a turn for the worse, and Barry called me on the afternoon of December 7 to tell me that she had passed away earlier that day. On the following morning I observed Comet Lovejoy in her memory; it was still faintly visible to the naked eye at magnitude 5½, and in binoculars exhibited a tail two degrees long.

Like the comet that escorted my father's essence out of the solar system, the comet performing the same task for my mother will also come back someday, although it will take a little longer. According to the most recent calculations, Comet Lovejoy will return in approximately 8200 years.

86. JULY 18, 2015
Comet 67P/Churyumov-Gerasimenko (no. 577)

I wrote in an earlier entry of the emotional "lost years" I went through during the mid-2010s following the breakup of my relationship with Susanne. In 2014 I concluded that it might be therapeutic to write a "comet memoirs" describing my lifetime of comet observing, and by the end of the year I had completed this. In the process of doing so, however, I had included so many personal life events that I had essentially written a sort of auto-biography, and I decided I wanted to extend the work into a full auto-biography – which I entitled "the comet man" – and commenced re-writing the manuscript. My intent was to

have this ready to release to the world as an e-book on July 23, 2015, the 20th anniversary of my discovery of Comet Hale-Bopp.

The final comet I wanted to write about in this auto-biography was Comet 67P/Churyumov-Gerasimenko, which as I hinted at in an earlier entry is a comet I tend to associate with the beginning of my comet observing "career," and which moreover at that time was being studied by ESA's Rosetta spacecraft. Rosetta had arrived at the comet in August 2014 and had been in orbit around it ever since – including the deployment of a surface lander, Philae, in November – and the comet itself would soon be arriving at perihelion. I wasn't at all sure I would be able to include it, however, since initially the comet was fairly faint and not favorably placed for observation from my latitude, and plus I had to contend with moonlight and the summer monsoon. Fortunately, after one unsuccessful attempt in late June, although it was at a low altitude and there were some occasional clouds moving through, I finally was able to see the comet on the morning of July 18 – just five days before my book went "live." It appeared as a faint and somewhat condensed object near magnitude 13½, with a coma slightly over half an arcminute across.

I ended up following Comet 67P until mid-January 2016, and it reached a peak brightness near magnitude 12½ in September 2015. Rosetta would continue orbiting the comet until the end of September 2016, at which time it performed a planned landing on the nucleus.

87. FEBRUARY 26, 2016
Comet 252P/LINEAR (no. 592)

I would have one final date with Susanne on February 26, 2016, when she drove down from Albuquerque and we had lunch together at a restaurant in Tularosa. While it was a pleasant get-together and we agreed in principle that we would see each other again, I could tell from her overall demeanor that that wasn't a high priority for her. Indeed,

within a few months I would learn that she was in a new relationship, and less than two years after that she was married.

That night I obtained my first observation of a comet I had been eagerly awaiting. It was an intrinsically faint object that had originally been discovered by the LINEAR program in April 2000, one month after a pretty close approach to Earth (0.097 AU), and I had looked for it a couple of times without success after its discovery. It was due for an even closer approach to Earth in March 2016 – 0.036 AU, the fourth-closest approach of any comet in my tally – although when it was closest it would be deep in southern circumpolar skies and furthermore would be close to the time of full moon. When I first saw it on the evening of the 26th it was already at a declination of -30 degrees, and appeared as a very faint object of 14th magnitude slightly less than an arcminute across.

Despite its forthcoming close approach I didn't expect the comet to become bright, however by the second week of March it had already brightened to about magnitude 10½ with a coma over 10 arcminutes across. It then dropped below my southern horizon, but according to observers in the southern hemisphere it became a naked-eye object near 5th magnitude around the time of its closest approach on the 21st. I was actually able to pick it up very low in my south a couple of mornings later, and while I couldn't tell much in the bright moonlight, it appeared large and diffuse and perhaps around 6th magnitude. Once the moon cleared from the morning sky and the comet had climbed higher above the southern horizon, on April 3 I could faintly detect it with my naked eye near magnitude 5½, with a large diffuse coma almost 45 arcminutes in diameter. It faded slowly from that point, although I could detect it with binoculars until early May and I followed it telescopically until early June.

For what it's worth, Comet 252P will pass 0.07 AU from Earth in March 2032. If I'm still observing comets at some level at that time, perhaps I will be able to see it again.

88. NOVEMBER 10, 2018
Comet Machholz-Fujikawa-Iwamoto C/2018 V1 (no. 655)

As time went by the emotional "lost years" started to recede a little bit, and I did date from time to time. In late 2016 I "met" a woman, Vickie, who lived in Rio Rancho, New Mexico, via an on-line dating site, and we had our first date in February 2017. She moved in with me in February 2019 and we were "domestic partners" for the next 5½ years, and we eventually married in August 2024.

In late May 2018 Vickie and I traveled to southern California to attend the penultimate Riverside Telescope Makers' Conference, which my long-time friend Charles Morris had organized and had invited me to speak. One of the other speakers was my long-time friend, and successful comet hunter, Don Machholz, who told me that he was still comet-hunting. I wished him good luck, but with all the comprehensive survey programs going on I honestly didn't think he stood much chance of success.

Less than six months later Don – much to my surprised delight – proved me wrong when on November 7 he visually discovered his 12th comet (which was independently discovered a few hours later by two Japanese amateur astronomers utilizing CCDs). Three mornings later Vickie was visiting me, and she joined me when I observed Don's comet for the first time. I could faintly detect it with binoculars near magnitude 9½, and through the 16-inch telescope I could just barely detect the beginnings of a faint westward-pointing tail.

I followed the comet in the morning sky for another week and a half as it reached magnitude 8½, and then after conjunction with the sun I picked it up once low in the evening sky in early December. Don, meanwhile, moved not too long thereafter from California to rural northwestern Arizona and continued his comet-hunting, and I had hopes that someday I might see another "Comet Machholz." This was not to be, however,

for, sadly, Don passed away due to COVID-19 in August 2022 at the age of 69.

89. FEBRUARY 1-2, 2019
Comet PANSTARRS C/2016 M1 (no. 629)
Comet Iwamoto C/2018 Y1 (no. 658)

In early 2019 I had the opportunity to teach some guest classes for the International Space University's Southern Hemisphere's Space Studies Program in Adelaide, South Australia. From late January through early February Vickie and I spent three weeks in and around Adelaide, and among other things we were able visit with my son Zachary and his then-partner Karina, who lived there at the time (and still live there, with their son Santiago).

I was able to make arrangements with the Astronomical Society of South Australia to spend a night at their Stockport Observatory in rural South Australia. On the night of February 1-2 a couple of members of the Society drove me out to the Observatory, and among other objects I took a look at Comet PANSTARRS C/2016 M1, which I had not seen since it had dropped below my southern horizon the previous July. It appeared as a moderately condensed object of 11th magnitude five arcminutes across, and at a declination of -75d06' this is the farthest south I have ever observed a comet. Right around midnight I began an observation of Comet Iwamoto, which would be passing 0.30 AU from Earth a week later; it was visible in binoculars at magnitude 7½, and exhibited a large, diffuse coma 14 arcminutes in diameter. My fellow comet observer, Michael Mattiazzo, who lives in Victoria, happened to be visiting the area at the time, and he stopped by at Stockport that night to observe with me for a while.

Eight nights later I would go out again to Stockport Observatory, as part of a scheduled star party with the ISU faculty and students. Unfortunately we had to contend with quite a few clouds, but – after

most of the group had left – there was some clearing, and I was able to observe Comet Iwamoto again. It had brightened slightly, to about 7th magnitude, with a coma almost half a degree across when viewed with binoculars.

90. SEPTEMBER 7, 2019
Comet ASASSN C/2018 N2 (no. 657)
Comet 260P/McNaught (no. 666)

The third occasion (of four, so far) when I have been able to observe two comets simultaneously in the same telescopic field of view came on the early morning of September 7, 2019, and involved the above listed two comets. Comet ASASSN was the slightly brighter of the two, at 12th magnitude, while Comet P/McNaught was about half a magnitude fainter. Both comets appeared as small and moderately condensed objects, and at higher magnification – when, unfortunately, they were just outside the same field of view – they exhibited distinct tails a few arcminutes long, oriented in slightly different directions about 40 degrees with respect to each other.

In late 2017 I began a collaboration with the Las Cumbres Observatory via their Global Sky Partners educators' forum. I assist the various educators with observations of comets and asteroids, and meanwhile I have access to the LCO telescopes – based at some of the top Observatory sites in the world – for remote imaging. (This work has involved confirmation and follow-up observations of numerous discoveries, and – as of now – three recoveries of expected incoming periodic comets.) I managed to take some images of the two comets on September 7 near the time of closest approach, and the scene of two distinct comets – with their respective tails oriented in different directions – is perhaps one of the most dramatic images I have taken via LCO.

91. DECEMBER 21, 2019
Comet 2I/Borisov I/2019 Q4 (no. 670)

One of the most scientifically important comets ever discovered was found on August 30, 2019, by amateur astronomer Gennady Borisov in Ukraine. Calculations soon showed that its orbit had an eccentricity of 3.4, meaning that it was an interstellar comet arriving from outside the solar system, and after passing through perihelion would depart the solar system back into interstellar space.

I began imaging Comet Borisov with the LCO telescopes in late September, and began visual attempts – initially unsuccessful – a month later. On the morning of December 21, right around the time the comet was expected to be at its brightest, under exceptionally clear sky conditions I successfully spotted it as a tiny object at the very threshold of vision, near magnitude 14½; it exhibited the expected motion over the course of the next hour. Again under exceptionally clear sky conditions I saw the comet again the following morning; the brightness and appearance were similar, and I followed it for an hour and a half. After that, I did not look for it again, and it soon dropped below my southern horizon.

92. JULY 3, 2020
Comet NEOWISE C/2020 F3 (no. 676)

We comet-watchers in the northern hemisphere had not had a “Great Comet” to observe since Comet Hale-Bopp in 1997. The two “Great Comets” that had appeared during the interim – Comet McNaught C/2006 P1 (no. 395) and Comet Lovejoy C/2011 W3 (no. 500) – had been “Great” only from the southern hemisphere, and the one comet that had shown promise of being a “Great Comet” for the northern hemisphere, Comet ISON C/2012 S1 (no. 529), had disintegrated as it passed through perihelion.

That string would finally come to an end, of sorts, during the summer of 2020. After its discovery in March I had managed a couple of observations of Comet NEOWISE in late April as a faint object of 13th magnitude, but after that it was only visible from the southern hemisphere. According to the observers there it had brightened to about 7th magnitude by the time it entered evening twilight in early June, and it was a relatively nice object late that month when it crossed the field-of-view of the LASCO C3 coronagraph aboard SOHO, where it exhibited two tails and was perhaps close to 2nd magnitude when it exited the field.

In early July I began to read reports that Comet NEOWISE was detectable as a bright object very low in the dawn sky. On the morning of the 3rd Vickie and I drove to a site near Dunken, New Mexico – about an hour's drive from our residence – at which time the comet's elongation was just over 13 degrees. In the bright sky I was easily able to see the comet with binoculars – although not with my naked eye – with its exhibiting a faint wisp of tail. In the 8-inch telescope it exhibited a bright central condensation with some wisps of diffuseness around it. With no suitable comparison stars around it was difficult to make a good brightness measurement, but I was eventually able to conclude that it was likely a bit brighter than 1st magnitude.

93. JULY 21, 2020
Comet NEOWISE C/2020 F3 (no. 676)

Following our observation of Comet NEOWISE on the morning of July 3, 2020 (previous entry), Vickie and I drove out to the site near Dunken two more times during the following week. The morning of the 10th was quite cloudy and I was only able to make some brief observations through clouds, but the sky conditions were good on the 11th, when despite moderately bright moonlight I could easily see the comet with my naked eye near 2nd magnitude, with a tail 2½ degrees long; in binoculars the tail appeared 10 degrees long. A week later the comet went through conjunction with the sun (25 degrees north of it) and

became an evening-sky object; I first saw it on the evening of the 16th, when it was a lovely naked-eye object near magnitude 2½ with 9 degrees of tail visible. Based on its appearance on this and later nights I consider Comet NEOWISE a borderline "Great Comet."

The comet would be closest to Earth (0.69 AU) on July 23. That happened to coincide with the 25th anniversary of my discovery of Comet Hale-Bopp, and I wanted to make a special "anniversary" observation of Comet NEOWISE on the evening of the 22nd. Knowing the monsoon weather conditions in these parts that time of year, I accordingly made an observation of the comet the previous evening, and it was a good thing I did, since I was clouded out on the 22nd. On the evening of the 21st the comet was a spectacular object, and although it had faded slightly, to 3rd magnitude, I could easily detect 12 degrees of tail with my naked eye. I was able to take several good photographs of the comet as well, and these helped cement the "anniversary" observation.

94. DECEMBER 19, 2021
Comet Leonard C/2021 A1 (no. 707)

I first picked up this comet (at 13th magnitude) in early October 2021 after it had emerged into the morning sky, and followed it for the next two months. By the time I obtained my final observation in early December before conjunction with the sun, it had brightened to 6th magnitude and I could detect a half-degree-long tail with binoculars.

After passing through inferior conjunction Comet Leonard began appearing in the evening sky. I had read reports that it might be undergoing an outburst, and when I saw it on the evening of December 19, despite low altitude, twilight, and bright moonlight I could easily see it in binoculars near 4th magnitude, with a distinct bright tail about 45 arcminutes long. Given the conditions I didn't attempt to see it with my naked eye, but I did succeed in taking some decent photographs of it.

This would be my final observation of Comet Leonard. I had poor weather on subsequent nights, and with the comet's southward motion it soon became inaccessible from the northern hemisphere. According to reports from observers in the southern hemisphere it continued to undergo outbursts, and reached a peak brightness near 3rd magnitude.

95. SEPTEMBER 30, 2022
"Comet" (65803) Didymos (no. 725)

I realize that this object stretches the definition of "comet" for purposes of my tally, since the activity that produced its cometary appearance was artificially induced. However, with my previous decision to include all "active asteroids" as "comets" regardless of the mechanism that produced the "activity," I feel justified in including it.

In early October 2022 the near-Earth asteroid (65803) Didymos passed 0.071 AU from Earth – the 9th-closest approach to Earth of all the "comets" on my tally – and on September 26 the Double Asteroid Redirection Test (DART) mission impacted Didymos' moon Dimorphos, with the debris from this creating a comet's tail-like plume extending from it. I successfully imaged this comet-like appearance with the LCO telescopes, and on the morning of September 30 I also observed Didymos visually with the 16-inch telescope. It appeared just fainter than magnitude 13½ – a full magnitude brighter than the ephemeris prediction – and, although I could never be entirely sure of this, there did seem to be a vague, amorphous "coma," of sorts, around it.

I never looked for Didymos visually again, although even on October 17 – almost three weeks after the DART impact – I could easily record the "tail" in LCO images. Meanwhile, on the morning of the 30th, after I had finished with the observation of Didymos I turned the 16-inch scope to the northeast, and although I was now having to contend with clouds that were moving in I suspected a very faint (14th magnitude) object in the

expected location of Comet ATLAS C/2022 R2. Unfortunately, I only had a handful of minutes to see it before clouds covered it back up, and it wasn't until I was able to obtain some LCO images of it shortly thereafter that I was able to convince myself that I had in fact detected it (no. 726). While, as I reported in Part I, there have been 39 occasions when I have added two comets to my tally during a single night, this is the only time when both comets have been "one-time wonders."

96. JULY 20, 2023
Comet 12P/Pons-Brooks (no. 740)

I have long been intrigued with the Halley-type periodic comets 12P/Pons-Brooks and 13P/Olbers, both of which had returned just a few years before I was born and both of which – as I discovered in the 1999-2000 timeframe when I was working on a (never-published) book about comets that had appeared during the 20th Century—would be returning within a few months of each other in 2024. Comet Pons-Brooks was recovered by the Lowell Discovery Telescope in Arizona as a very faint object as early as June 2020, and I obtained my first images with one of the 1-meter LCO telescopes in October 2022. After its conjunction with the sun I began imaging it on a fairly regular basis beginning in early April 2023.

Comet Pons-Brooks had undergone well-documented outbursts on its way to perihelion during previous returns, and there was every reason to suspect it would do so again this time around. Sure enough, on July 20, 2023 an amateur astronomer in Hungary, Elek Tamas, reported that it was undergoing an outburst, and that evening I first saw it visually as a stellar object of magnitude 11½, and also imaged it via the LCO network.

Over the subsequent days and weeks the coma dispersed out from this outburst, although the brightness remained more-or-less constant. Meanwhile, as it had during the previous returns, the comet would

continue to undergo additional outbursts as it approached perihelion, and through fortuitous timing on one set of LCO images I had taken I received "co-author" credit on an Astronomer's Telegram about one of these events.

97. AUGUST 24, 2024
Comet 13P/Olbers (no. 752)

In the previous entry I discussed Comet 12P/Pons-Brooks, one of the two Halley-type periodic comets whose returns in 2024 I was eagerly awaiting. I followed Pons-Brooks until early April, and it reached a peak brightness near 5th magnitude, but due to its relatively low placement in the sky I only saw it with my naked eye once, just barely, in early March. I had hoped to view it during the total solar eclipse on April 8, but unfortunately was clouded out from Kerrville, Texas, where Vickie and I had traveled to view that event.

The other comet, 13P/Olbers, turned out to be even more special for me. It occurred to me that I might be able to make the recovery, and I began attempting this as early as October 2022. After the comet emerged into the morning sky after conjunction with the sun in mid-2023 I began making recovery attempts with LCO telescopes on roughly a bi-weekly basis, and on August 24 I successfully recorded two images of it on exposures taken with one of LCO's 1-meter telescopes. I was subsequently able to identify the comet on a pair of images I had taken on August 13 and then on images I took on several nights after the 24th, and I was officially credited with the recovery.

I continued to image Comet Olbers on a fairly regular basis, and first picked it up visually, at magnitude 13½, at the beginning of February. It brightened steadily from that point, although for a good part of that time it remained at a fairly small elongation, and reached a peak brightness near 6th magnitude, and easy binocular visibility, with a tail 20 to 30

arcminutes long, in late June and early July. I followed it until early September, by which time it had faded to 8th magnitude.

At the end of January Vickie and I made the decision to get married. We did so on August 24 – coincidentally, on the one-year anniversary of my recovery of Comet Olbers – and held an informal ceremony outdoors at our residence. Both of my sons – who acted as my "Best Men" – and their respective families attended, as did several of Vickie's extended family and friends. To help me mark the special occasion, on that evening I made an observation of Comet Olbers, although I only utilized 10x50 binoculars (since I would have had to transport a telescope away from my prime observing location in order to use one). The comet appeared slightly brighter than magnitude 7½, with an 8-arcminute coma and a 20-arcminute tail. The spiral galaxy M64, which was very faintly visible in the binoculars, was in the same field.

98. OCTOBER 14, 2024
Comet Tsuchinshan-ATLAS C/2023 A3 (no. 749)

I began imaging this comet via the LCO network in late February 2023, shortly after it was posted to the Minor Planet Center's Near-Earth Object Confirmation Page following its discovery by the ATLAS survey. I continued to image it on a fairly regular basis until early September, after which it entered evening twilight en route to conjunction with the sun. After it emerged into the morning sky late in the year I first picked it up visually on December 18, as a small condensed object of 14th magnitude. From that point I continued to make regular visual observations of it, until early July 2024 after which time it sank below my western horizon. By then it had reached 10th magnitude – a brightness it had maintained for over two months – and telescopically was exhibiting a distinct tail almost 15 arcminutes long, almost giving it an appearance of a miniature "Great Comet."

After conjunction with the sun, Comet Tsuchinshan-ATLAS was due to make an appearance low in the southeastern morning sky in late September and early October, and according to various reports and images I've seen it put on a rather spectacular show, but life had other plans for me. In early September I somehow contracted a bacterial lung infection and collapsed lung which resulted in my being hospitalized (in El Paso) for three weeks, two of those weeks in the Intensive Care Unit; I thus missed the entire morning apparition of the comet. After I was discharged from the hospital I was sent to a rehab facility on the northeast side of Las Cruces, where I would stay for a little over a week.

It was at that time that Comet Tsuchinshan-ATLAS began making its grand appearance in the evening sky. I was able to prevail upon the staff at the rehab facility to wheel me out to the parking lot during dusk for comet observing. I first spotted the comet on the evening of October 12 as a bright object, perhaps around 1st magnitude, but although I could see it with my naked eye, at an elongation of only 17 degrees it was an easier binocular object. On the following night it was distinctly higher in the sky and I could easily see 10 degrees of tail with my naked eye. In gratitude to the staff at the rehab facility, I made arrangements with the Astronomical Society of Las Cruces for a comet viewing party for employees and residents on the following evening (October 14); the comet seemed to have faded slightly, being perhaps near magnitude 1½, but on the other hand I could easily see a naked-eye tail 18 degrees long, and in binoculars I could detect the "sheath" of an anti-tail. A friend of mine, Jeff Steinborn, who is a New Mexico State Senator who represents one of the districts in the Las Cruces area – and who had attended Vickie's and my wedding back in August – also came by, and took a nice photograph that includes the gathering of the people as well as the comet. There was some light pollution, although this wasn't too bad, and also bright moonlight, but the comet was still a spectacular sight despite all this.

On the following night I again observed the comet from the parking lot of the rehab facility, and then on the 18th I was discharged and, after over

a month away, was finally able to return home. On the evening of the 21st I was finally able to view the comet from a dark rural site and without moonlight; it had faded further, to magnitude 3½, but was still a spectacular naked-eye sight with a 13-degree tail. I followed it on a fairly regular basis after that, although it faded fairly rapidly; I was able to detect it with my naked eye until almost the end of October, with binoculars until the end of November, and then telescopically as it sank lower into the western evening sky.

99. DECEMBER 24, 2024
Comet 29P/Schwassmann-Wachmann 1 (no. 498)
Comet Tsuchinshan-ATLAS C/2023 A3 (no. 749)

I have known for some time that there would come a time when I would no longer be able to maintain the systematic comet observing program I have conducted ever since I was 11 years old. Especially after a period of hospitalization in mid-2018 that has required me to be on oxygen therapy ever since, that rather vague thought started to become more of a reality. With the expected returns of Comets 12P/Pons-Brooks (no. 740) and 13P/Olbers (no. 752) in 2024 I decided I would likely "retire" from the systematic visual observing once these comets had left, but then the discovery of Comet Tsuchinshan-ATLAS C/2023 A3, and its potential very bright display during the autumn of 2024, caused me to push back that "retirement" to the end of 2024. The period of hospitalization I underwent in September and October of 2024 put a rather emphatic note on the idea, and in the meantime it has clearly become more and more physically "challenging" over recent years to push the 16-inch telescope outside and then back inside my observing building, and (especially during winter months) deal with the cold nighttime air. I accordingly decided that I would indeed "retire" at the end of 2024.

My "final" night of visual observations was the evening of December 24. As soon as it was dark I made one final observation of Comet Tsuchinshan-ATLAS, now very low in the southwestern sky at an

elongation of 35 degrees. It had faded to almost 11th magnitude, but still exhibited a distinctly condensed fan-shaped coma and a tail a few arcminutes long. I then went inside my house, but went out again five hours later for my final comet, Comet P/Schwassmann-Wachmann 1 (which, curiously, was less than three degrees from the position it had occupied when I made my very first observation of it back in 1981). The comet had undergone a pair of strong outbursts the previous month, and was diffusing out from these; it appeared as a large diffuse cloud over 5 arcminutes in diameter, with a total brightness slightly fainter than magnitude 11½. After finishing up with the comet, I pushed the 16-inch telescope back inside its building, wrote "It's a wrap . . ." in my observing notes, then returned to my house.

While I have now "retired" from systematic visual comet observing, I have not necessarily walked away from it altogether, and – on an occasional basis – may continue to make observations of bright and/or interesting comets that might come along. Such a comet indeed came by the following month, and is the subject of the next (and concluding) entry. Meanwhile, on the evening of February 2, 2025 I decided to mark the 55th anniversary of my first comet observation by taking another look at P/Schwassmann-Wachmann 1 which, somewhat coincidentally, had just undergone another outburst. It appeared as a near-stellar condensation distinctly off-center within a vague and diffuse coma, with an overall brightness near 12th magnitude.

100. JANUARY 14, 2025
Comet ATLAS C/2024 G3 (no. 761)

My first "post-retirement" comet was certainly a bright and interesting one. It was discovered in April 2024 by the ATLAS survey, and from then up until near the end of August I imaged it via the LCO network on a somewhat regular basis. It has the fourth-smallest perihelion distance of any comet on my tally, and its orbit is such that it both approached and receded from perihelion from almost due south of the sun. The only

opportunities for observation from the northern hemisphere would be very low in the southeastern morning sky for a few days before perihelion and very low in the southwestern evening sky for a few days after perihelion, and – if it became bright enough – in daylight right around perihelion passage.

The comet underwent an outburst at the very beginning of 2025, and theoretically I might have been able to observe it, however I would have had to travel quite a distance to get a clear enough horizon to have done so, and I declined to do that. I had to contend with cloudy skies for the first couple of days of daylight visibility, but January 14 – the day after perihelion – the sky was clear, and by using the 8-inch Schmidt-Cass and the same setup and procedure that allowed me to make daytime observations of Comet McNaught C/2006 P1 (no. 395) back in 2007, I was able to find and see Comet ATLAS, first for a few minutes during the late morning, and then in the early afternoon for about half an hour. It appeared as a bright central condensation with a slightly curved tail a couple of arcminutes long. It wasn't really practical to make a formal brightness measurement, but it appeared somewhat fainter than I remember Comet McNaught as appearing, and I made an approximate "guesstimate" of magnitude -2. At the time of my first sighting in the late morning the comet's heliocentric distance was 0.119 AU, the smallest heliocentric distance at which I've ever observed a comet, and meanwhile it became only the third comet that I've ever seen during the daytime (and the only comet I have added to my tally during daytime).

I had made arrangements with the New Mexico Museum of Space History in Alamogordo to try to observe Comet ATLAS from their parking lot (above and overlooking the city) on the evening of January 15, and Vickie and I made the drive down with my 4-inch Schmidt-Cass. Unfortunately, a band of cirrus clouds moved into the southwestern sky late in the day and thwarted any serious observation attempts, although I was able to grab a very brief (30 seconds) view of the comet through a gap in the clouds 20 minutes after sunset. It again appeared as a bright

central condensation with the beginnings of a slightly curved tail, and I would “guesstimate” the brightness as being near magnitude -1.

Theoretically Comet ATLAS might have been accessible for two or three more nights, but since the prospects for clear skies were not especially promising and the comet would likely be fading, I declined to make any more trips to try to observe it. Within a few days the comet had become a spectacular object from the southern hemisphere, and there were some reports of the tail’s extremities being visible from the northern hemisphere, but I never made any attempt to observe these.

16 Springs Canyon, New Mexico, USA
February 23, 2025