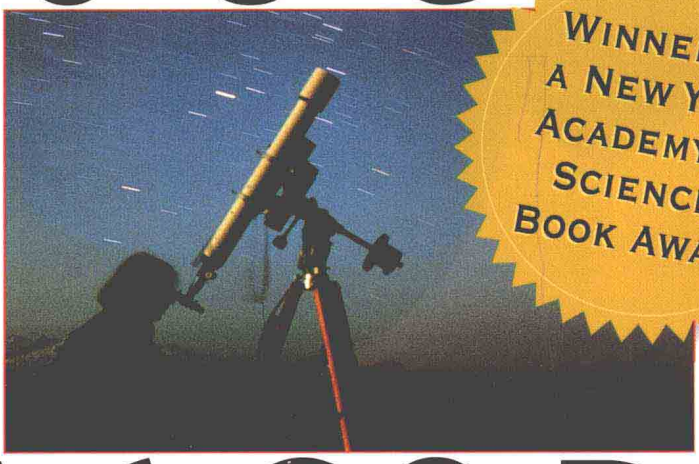
THROUGH THE TELESCOPE



WINNER OF A NEW YORK ACADEMY OF SCIENCES BOOK AWARD

A GUIDE FOR THE AMATEUR ASTRONOMER

LEARN HOW TO:

- use a telescope
- read the sky
- identify stars, planets, and comets
- choose the right telescope

Patricia L. Barnes-Svarney
Michael R. Porcellino

REVISED AND UPDATED

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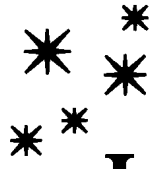


INTRODUCTION

Welcome to the wonderful universe of amateur astronomy. Amateur astronomy is something that anyone can enjoy. All that is needed are clear skies and a dark place to start you on the road to the stars. While no one can supply clear skies, this book can start you on your way.

I wrote this book with two kinds of amateurs in mind. First, it is written for the beginner who is thinking of getting, or has just gotten, a telescope and wants to learn just what it can show them. If you find yourself in this group, you have to take some time and prepare yourself. A big mistake that many people make is to rush out and get a telescope before they are ready to use it.

When is a person ready for a telescope? You must have a working knowledge of the constellations and the star figures that you are going to wander through with your telescope. You wouldn't leave home for a long trip without some idea of where you were going, would you? Well, that's just what you are doing without a knowledge of the constellations. If you don't know where Epsilon Bootes is, then you are never going to be able to find the variable star W Bootes. So take some time and familiarize yourself with the stars. When you know your way around the stars that you can see with your naked eye, then you are ready for a telescope and the stars that you cannot see!

The other group I wrote this book for includes those with a small telescope. They have reached a point where they can easily find their way around the skies, and they have invested in a telescope but they don't know where to point it. This book will serve as a guide to using that instrument. Many of today's observing guides tend to pass over these amateurs, an omission I find unfortunate, and these small scope users feel they have been cheated.

Unfortunately, in this age of 17.5-inch dobsonians, too many of today's amateurs look down on the under 4-inch telescope like a poor relative. But if you ask 100 amateur astronomers how big their first telescope was, I'll wager that 85 percent of them will say it was less than 4 inches. These amateurs and the writers of observation guides have forgotten their "roots." Since that first telescope they have moved up to the huge "light buckets" that have become all the rage, and they now have little use for the small telescope. Everyone in amateur astronomy should remember that they started with some kind of telescope. In many cases it was a small one.

To meet the needs of both these segments of the astronomical community, I wrote this book as a survey of the wide variety of experiences that an amateur with a telescope can enjoy. I've tried to give an overview of the equipment needed by the observer and some thoughts on its selection. I've also tried to show that an amateur

with a small telescope can make a contribution to science. Sure, some activities require a large-aperture instrument, like supernova searches, but other areas just as important to science require only a small instrument.

Whether you are just entering the wonderful universe of amateur astronomy or have been in it for awhile, I want you to remember one thing above all else. Amateur astronomy should be fun! This is not a contest to see who can spot the most features on the planet Mars or estimate 100 variables in one night. It is an immensely enjoyable, relaxing way to spend your time, and if you can make some contribution to science along the way that's great, but it is not a requirement.

So enjoy the stars, enjoy your telescope, and most of all enjoy this book.

Clear skies to you all!

—Michael Porcellino, 1989

In the ten years since this book was first written, astronomy has grown by leaps and bounds. There was Shoemaker-Levy-9, the first body (a comet) we ever viewed striking another body (the gas giant Jupiter). The astounding images sent back by the Hubble Space Telescope. The bright comet Hale-Bopp in 1997. The "fleet" of Martian probes, not to mention craft sent to the Moon, Jupiter, Venus, Saturn, and to a near-Earth asteroid.

Amateur astronomy has grown right along with these wonders. The Internet has produced a way for national and worldwide amateur groups to exchange information. The huge network—virtually a giant library—has sparked the interest of more than one future astronomer. And the ability to rapidly report on objects in the nighttime skies also has improved our disposition.

Technology also has enhanced our lives when it comes to watching the heavens. Lenses have improved, along with various new eyepieces with better fields of view. There are CCD telescopes that use technology once the purview of military satellite technology or a few large telescopes. Even small satellite dishes are being modified to allow the amateur to seek out the radio-noise of the skies.

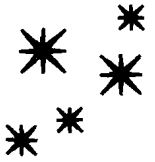
But underneath it all, there are still those of us who want to wander the stars at a slower pace—to know what's out there right now. In other words, to watch, not to get caught up too much in the hype. That's what this book for the amateur astronomer—especially for the beginner and intermediate watches—offers.

In my work and travels as an astronomer (not to mention my many interviews with amateur astronomers), I've met some grand people: long nights with comet hunters as they search the skies for elusive fuzzy spots; sun watchers, counting sunspots before and after solar cycle peaks; an amateur astronomer seeking extrasolar planets in his backyard with a method he developed—and not with the advantage of a huge telescope; the amateur who had an experiment on the Hubble Space Telescope. And even a young woman in her teens who worked out the shape of the first asteroid ever visited (Gaspra) even before the spacecraft arrived.

The list goes on. These amateurs—including myself—have a love of the universe that goes much farther than the naked eye or their telescopes can see. It's a passion—a feeling that you want to discover and uncover something wondrous in the universe. We want to satiate our own curiosity—and to perhaps contribute in some way along our astronomical journey.

It is to these spirited people that this book is written—and all the future amateur astronomers who follow in their footsteps. The universe is yours for the taking.

—Patricia Barnes-Svarney, 1999



ACKNOWLEDGMENTS

A book is never the work of only one person. By meeting and talking to a great number of people, I have been able to garner bits of information that, in one form or another, eventually made their way into this book. Over the course of writing this book, I have had the pleasure and the honor of meeting, talking to, and corresponding with amateurs from around the country. In their way, however small, many people have contributed to the completion of this book.

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Thanks also to Pat Shand and the staff of Lick Observatory for some of the photographs found in this book. Jeff Beish, Don Parker, Jim Phillips, and the other members of the Association of Lunar and Planetary Observers (ALPO) helped, as did Janet Mattei and the American Association of Variable Star Observers (AAVSO). I thank you all.

I want to extend a special thanks to Dave and Marion Bachtell, Barbara Lux, Dan Joyce, Lee Keith, Walter Piorkowski, Dan Troiani, Suresh Sreenivasan, Mark Stauffer, and Linda Warren for the drawings, photographs, and ideas they contributed to this book. Without their help it would never have been completed.

Any errors or omissions found in this work are mine and mine alone.

Finally, I want to thank Roland Phelps, my editor at Tab Books, for putting up with me during the course of this project.

—Michael Porcellino, 1989

As Mike mentioned, no one person writes a book, and I'd like to add my own acknowledgements: I'd also like to thank Thomas Svarney for his help with research; Don Parker and Don Troiani of ALPO; Janet Mattei of AAVSO; Dr. Alan Hale, co-discoverer of comet Hale-Bopp and head of the Southwest Institute for Space Research; Reverend Robert Evans of Australia; Dr. Peter Thomas, Space Science, Cornell University; the Lick Observatory; the Kopernik Observatory in Vestal, New York; and the people I've met along the way—both amateur and professional astronomers who will never give up exploring the universe.

In particular, I'd like to thank my editor, Griffin Hansbury, for his fine editing and good humor. And also, of course, I'd like to thank my parents, William and Helen Barnes, who for years have nurtured and encouraged me in my writing and astronomical adventures. I couldn't have done it without them.

—Patricia Barnes-Svarney, 1999
e-mail: *svarney@ibm.net*
home page: *http://www.sff.net/people/P.Barnes-Svarney*

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THE AMATEUR IN ASTRONOMY

Astronomy offers a pleasure that follows the law of increasing rather than diminishing returns. The more you develop a thirst for it, the greater your return.

WILLIAM T. OLCOTT

There is something almost mystical about sitting under a crystal clear night sky while the strains of Bach or the Beatles or Spyro Gyra play on your portable stereo- or as nighttime silence surrounds you. Sitting and studying the shapes of the constellations as they wheel across the black velvet dome of the sky is both exciting and relaxing. This is the realm of the amateur astronomer.

There are many definitions of the word *amateur*. A few listed by Webster's Dictionary include "dilettante," "nonprofessional," and a personal favorite, "one who is unskilled." These definitions might be adequate for an entry in Webster's, but they hardly describe the "amateur" in amateur astronomer. These definitions forget that *amateur* comes from the Latin word *amator*, meaning "one who loves." That describes the amateur astronomer; it describes one who loves astronomy (Fig. 1-1).

THE AMATEUR TRADITION IN ASTRONOMY

During most of the eighteenth century, astronomy was a practical science. The job of the astronomer was simple: to produce information that would be useful in the exploration of the world. So the astronomer tried to determine the positions of stars as accurately as possible. This kind of information was just the thing a sailor or surveyor needed to know to figure out his position on the Earth.

Until the late eighteenth century, positional astronomy was the order of the day at the observatory. In many observatories it was forbidden for the staff to use the

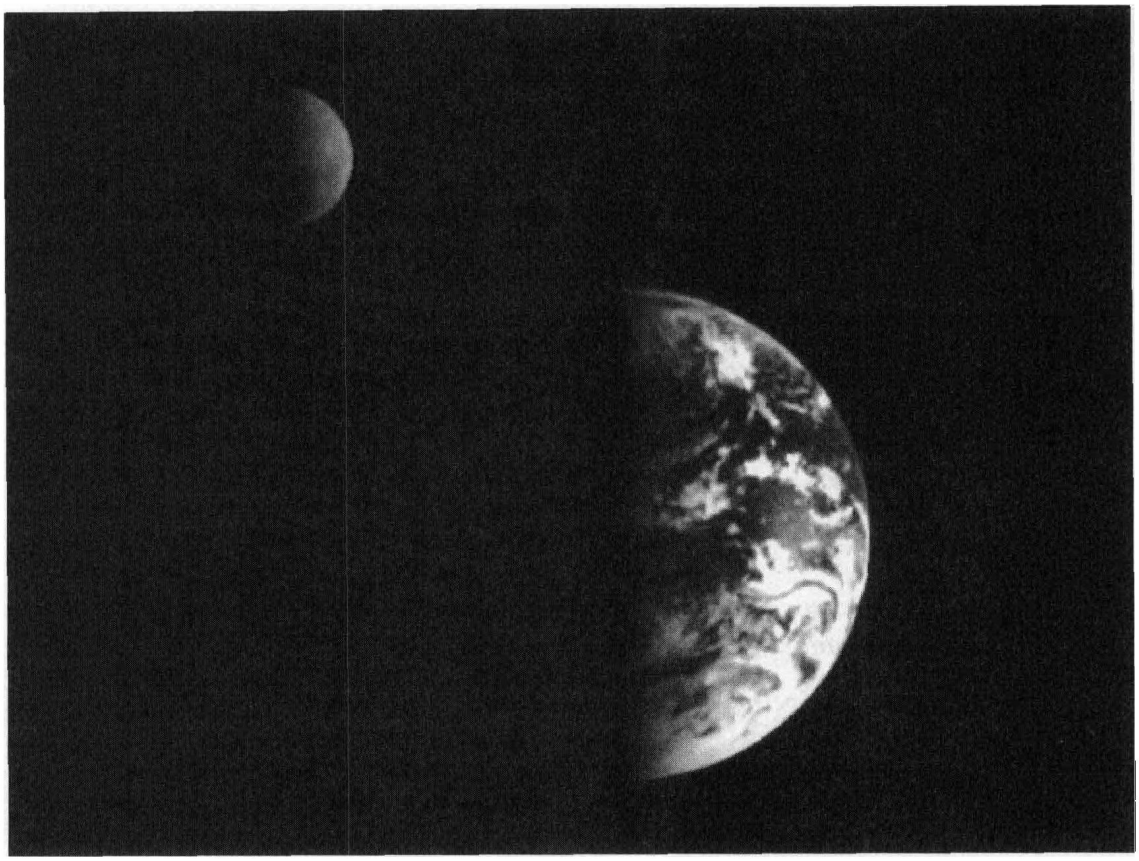

FIGURE 1-1 *The Earth and Moon from the Galileo spacecraft—something only viewed from space, but it shows our place in the solar system. (NASA)*

telescopes for anything but the measurement of star positions. It was also a time when many who held the title of astronomer worked their way up the ladder through the boring jobs of calculating ephemerides and copying charts.

This situation began to change in the mid-1700s with the invention of the achromatic lens system for refracting telescopes by John Dolland. Apprentice astronomers, taken with the images of the stars during their stints at the transit telescope, began to get curious. What would the Moon look like with this instrument? They would risk the wrath of their employers and sneak a peek. Soon, even their employers were peeking into the universe. Others began experimenting by casting metal mirrors and constructing instruments along the lines suggested by scientist Sir Isaac Newton. Overall, these telescopes were required to do nothing more than show their owners the universe.

The man credited with the invention of observational astronomy, Sir William Herschel, was by trade a musician (although the first person to use a telescope for astronomical observation was Galileo Galilei in 1609). Each night, Herschel would retire with a glass of milk and two books: one on harmonics, the study of musical sounds, and the other on astronomy. As his interest in astronomy was piqued, he

began constructing simple telescopes from spectacle lenses. In 1774, he began constructing large reflecting telescopes and using them for a systematic study of the sky—for no other purpose than to see what was out there. Observational astronomy was born.

In the United States, no one exemplified the amateur tradition in astronomy better than Sherburne Wesley Burnham. Born in Vermont in 1838, Burnham was trained as a shorthand writer. He served in the Civil War as a court reporter with the Union forces occupying New Orleans, and later as the Chief Clerk of the Circuit Court in Chicago. He would work 8 hours at his job and then stay up far into the night studying double stars from the backyard of his home in Chicago. Using a 6-inch refractor built for him by the Massachusetts firm of Alvan Clark & Sons, Burnham discovered and studied hundreds of double stars. His publication of his observations lead to recognition by scientific societies around the world and entry into some of the world's most prestigious observatories. With the exception of a two-year stint on the staff of Lick Observatory, all of Burnham's work, until his death in 1921, was done as an amateur.

In the twentieth century, the amateur tradition has been represented by a number of observers. Probably best known among them was Leslie Peltier of Delphos, Ohio. Peltier began his love of the heavens as a boy and carried the torch until his death in 1980. Called the "world's best nonprofessional astronomer" by Harvard College Observatory director Harlow Shapley, Pettier's career spanned almost 70 years. During this time he discovered 12 comets, contributed over 100,000 brightness estimates of variable stars, and made numerous other accomplishments in the field of astronomy.

Today, the tradition continues. A doctor in South Carolina spends his time away from the hospital studying features on the Moon known as domes in an attempt to understand lunar volcanic action. A postal worker in Chicago rises well before dawn to study Mars and contribute to our growing knowledge of that planet's weather. A housewife in Virginia watches the Sun with her special telescope, keeping track of sunspot activity every sunny day. A chemist in Baton Rouge meticulously measures the distance between double stars in an attempt to refine the knowledge gained about them over the past 200 years.

WHY AMATEUR ASTRONOMY?

People become interested in astronomy for a variety of reasons. Ask a hundred amateur astronomers how they became interested and you will probably get a hundred different answers. Many will admit that using a small telescope they received as a child began a lifelong love affair with the stars. For others it was a trip to a planetarium or an event sponsored by a local astronomy club that sparked their interest.

Some were simply fascinated by the patterns the stars created in the night sky. After spending some time in the local library reading up on stars, constellations, and astronomy, they soon found themselves able to identify such star groups as Orion, Lyra, and Leo. Still others owe their interest in astronomy to their children. Helping with a science project has given many a parent a taste for science in general and astronomy in particular.

Regardless of how your interest in astronomy was sparked, there are a number of ways you can get more involved with astronomy. First, you can simply experience the sky, which has fascinated people for hundreds of centuries. If a pair of binoculars is around the house, you can use them to turn toward the stars. Once you have a taste of what lies beyond the grasp of the naked eye, you will realize your appetite has only been whetted. Finally, you might buy or make a telescope. Each of these stages is a learning experience and if progressed through properly, you may eventually make significant contributions to science.

You could soon find yourself rising at 3:00 A.M. to get a good view of Mars or Jupiter. You might find yourself thrilled by the changing brightness of a distant star and record those changes at every opportunity. The rolling line of sunrise on the Moon may catch your fancy, and you might find yourself watching it night after night—until you realize the distant surface of the Moon is as familiar to you as your own backyard.

CONTRIBUTIONS FROM THE AMATEUR

Amateur astronomers fill a void in today's science. Unfortunately, budget restrictions at many of the major observatories make some types of astronomical work uneconomical. The amateur is relied upon to fill the void. A prime example is the study of the planets. With such missions to Mars as the Viking, Pathfinder, and Mars Global Surveyor, the Voyager missions to the outer planets, Galileo to Jupiter, and Cassini to Saturn, many astronomers felt the days of Earth-based planetary observation were over.

However, despite their mind-boggling results, these missions last only a finite time. If we are going to launch and carry out a manned mission to Mars, for example, we have to have a better understanding of Martian weather. It doesn't do any good to mount an expensive manned mission that will last two or more years and travel over 120 million miles only to have the spacecraft orbit the red planet, unable to land due to a massive dust storm. Much of our knowledge of Martian weather, including the growth and predictions of major dust storms, has come from the work of amateur astronomers such as executive director Donald Parker, Daniel Troiani, and other members of the Association of Lunar and Planetary Observers (ALPO).

Another example is the internal constitution of the stars, long the purview of professional astronomers: Such studies have also felt the impact of the amateur astronomer. Now that observational time on large telescopes is severely limited, amateurs are contributing observations of the fluctuations in brightness of stars. This information helps scientists determine what makes a star shine. Since its foundation in 1911, the members of the American Association of Variable Star Observers (AAVSO) have contributed over 5 million observations of stellar brightness. The role played by the members of AAVSO has also grown in importance with the introduction of sophisticated satellites studying stars from Earth's orbit. Often amateur observations provided by AAVSO enable scientists to correlate an event observed by their satellites with actual visual observations.

There is nothing that says you must, as an amateur astronomer, make such observations. The beauty of amateur astronomy is that you can make contributions like these if you want to—not because you must.

ONE AMATEUR'S EXPERIENCE

Just what kind of contribution can a single amateur make to the world of astronomy? At first glance it would seem hopeless to try to compete with the huge telescopes and complex instruments of the professional, but have faith, it is possible.

Dan Troiani first became interested in astronomy in 1971 when he visited Chicago's Adler Planetarium with his future wife, Kathy. He was fascinated with the sky show and the wide variety of astronomical exhibits at Adler. He bean to read about astronomy and became more deeply interested. He also became an avid *Star Trek* fan, but found he was more interested in the "science" than the fiction. "I realized after a short time," he said, "that the science of astronomy was stranger and weirder than fiction could ever be."

In his wide readings, Dan was taken by the amount of detail visible on the planetary drawings he saw. "Could I do that?" he asked himself. The skies over a large city like Chicago are not conducive to many types of astronomical work. It became apparent to Dan during the course of his research that the Moon and planets were the perfect objects for a city astronomer to study.

In the 1970s, before the revolution in telescope design brought about by lightweight mirrors and the dobsonian mount, a 10- or 12.5-inch newtonian reflector was considered a large telescope. Dan decided that a 10-inch reflector would be the perfect tool for a serious program of planetary study. So in March 1977, he ordered a 10-inch mirror from Cave Optical Company and constructed a telescope. He also joined the Chicago Astronomical Society and learned how to use his telescope. After a short construction period, Dan began an observational program that concentrated on the bright planets. He joined ALPO in late 1978 and began to contribute his observations to that group. In 1979 he widened his astronomical program, joined the American Association of Variable Star Observers (AAVSO), and began to study variable stars. Everything went smoothly for Dan until December 17, 1979.

We have to stop here and drop back in time almost a hundred years. During the 1880s, the famous Mars observer Giovanni Schiaparelli, director of the Brera Observatory in Milan, Italy, noted that the north polar cap of Mars seemed to be divided into two parts. He determined that the cause of the division was a dark rift in the polar cap. He called this rift Rima Tenuis.

The rift was repeatedly observed during the next close approaches of Mars until the approach of 1918. The Rima Tenuis had disappeared. It was searched for repeatedly during following years but could not be seen. During the 1960s, Rima Tenuis was searched for using telescopes from 24 to 82 inches in diameter but these large instruments found nothing. When the Mariner—and later Viking—spacecraft arrived at the planet, their photography showed nothing at the north polar cap but layers of white. Rima Tenuis had indeed vanished.

On December 17, 1979, Dan was at his 10-inch telescope making drawings of Mars to forward to ALPO for study. He noted a dark rift that seemed to cut across the north polar cap and recorded it in his drawing. At the time Dan did not think much about the significance of what he was seeing. "I just tried to get it down accurately in the drawing," he said.

When Dan's drawing was received by ALPO's Mars director a few days later, it was looked at critically and with some disbelief. "I guess they didn't trust my eye-

sight," Dan said with a shrug. Astronomers around the world in ALPO's network of Mars observers rushed to their telescopes to see if Dan had really seen something that had not been visible on the red planet for almost 60 years. But for six weeks they had to wait. Because of the way Mars rotates, features visible near the edge of the planet pass behind Mars and are out of sight for that long. Finally, in February 1980, confirmations began to arrive: Rima Tenuis was back. Dan Troiani had succeeded with a 10-inch telescope where instruments two to eight times larger had failed. He had seen more from his backyard in Chicago than advanced spacecraft had seen from an orbit a few hundred miles above the planet. The credit for the rediscovery of Rima Tenuis on the north polar cap belongs to Dan Troiani, amateur astronomer, and no one else.

ANOTHER EXPERIENCE

Some professionals started out as amateurs, too—or just people interested in recording data on such objects as variable stars or comets. Take for example, Alan Hale, the co-discoverer with amateur astronomer Thomas Bopp of the famous 1997 comet Hale-Bopp. Hale didn't start out as a professional—he started as an amateur astronomer.

Hale started in astronomy like many of us—when he was young. "When I was in first grade by father checked out some books on astronomy from the local library and handed them to me to look at," Hale said. "I've never really looked back since, although my interests fluctuated a bit while in elementary school. I settled on astronomy 'for good' when I was in sixth grade. For a while I used my father's spotting scope, but shortly before I turned twelve, I managed to convince him to purchase a four-and-a-half-inch reflector from Sears (on sale, of course). And I never looked back."

There were other influences, too: (1) he was raised in a fairly small town in New Mexico, with lots of clear nights and no streetlights to speak of; (2) he watched the early space efforts (he vividly remembers watching some of the Gemini flights and the subsequent Apollo missions); and (3) he liked the television program *Star Trek*, with its premise of "exploring strange new worlds. . . ." And he kept reading every book on astronomy he could get his hands on. After a while, he decided he wanted to have a look at some of these objects he kept reading about.

His "evolution" from amateur to professional wasn't overnight. "I was involved in a science fair while in high school—and won first prize statewide in my division my junior year (the project was on the near-Earth asteroid Eros) and alternate to International Science Fair my senior year (the project was on Comet West)." Then he majored in physics at the Naval Academy and started the United States Naval Academy (USNA) astronomy club; spent 2 1/2 years working with the Deep Space Network at the Jet Propulsion Laboratory, and was involved with the VEGA Venus Balloon project and the Voyager 2 encounter with Uranus. He was also southwestern U.S. visual observations recorder for the International Halley Watch during this time.

He eventually returned to New Mexico and entered grad school at New Mexico State University (NMSU). "Although my dissertation work was on the subject of planets around other stars, and I've managed to publish a few papers on this subject," said Hale, "I continued 'backyard observing' after my return to New Mexico