

A DECADE OF COMETS

A STUDY OF 33 COMETS DISCOVERED BY
AMATEUR ASTRONOMERS

BETWEEN

1975

1984

BY DON MACHHOLZ

MARK STUBBINS

A
DECADE
OF
COMETS

A STUDY OF THE 33 COMETS
DISCOVERED BY AMATEUR ASTRONOMERS
BETWEEN 1975 AND 1984

BY DON MACHHOLZ

COPYRIGHT 1985 BY DON MACHHOLZ

THIRD EDITION

PRINTED 1995

ISBN 0-9646487-0-9

ACKNOWLEDGEMENTS

This work would not have been possible without the kind assistance of both astronomers and nonastronomers. Allow me to extend my thanks to them.

Dr. Brian Marsden and Daniel Green, both of the Smithsonian Astrophysical Observatory, supplied prediscovery positions of comets, along with orbital elements and magnitude formulae. John Bortle supplied details about some of the foreign comet hunters.

Joe Marcus gave words of encouragement and suggestions. Dr. Edgar Everhart, who wrote a landmark paper on comet discoveries in 1967, was an inspiration for the writing of this smaller scale study. Alan Hale wrote the ephemeris program for the Commodore 64 computer used in this survey. Charles Brannon wrote the word processing program, and John McMullin helped with the printing. Mark Stuefloten did the artwork. Edith Zarcone was the proofreader.

I wish to thank all the comet discoverers who made this study not only possible, but necessary.

And a million thanks to my wife, Laura, whose patience surpasses that of many comet hunters.

PREFACE

This booklet began as a series of features in the regular column entitled "Comet Comments", which I write and send to interested astronomy club newsletters each month. "Comet Comments" began in June 1978, appearing in the San Jose Astronomical Association Newsletter. For nearly one and one half years I ended each article with comet trivia, called "Comet Tails." Then, during 1980 I concentrated on the comet hunters of the past and present, this section was called "Comets In Their Eyes." In 1981 and 1982 I reviewed history's famous comets ("Great Comets").

During 1983 and 1984 I examined each of the comets discovered by amateur astronomers since 1975; this section was called "Past Discoveries." Each month's installment, ranging in length from a paragraph to a page, was placed at the end of the "Comet Comments" articles. This booklet is the result of a full year of reviewing, rewriting, expanding and updating, and is triple the size of the combined "Past Discoveries."

I have written this paper with the comet hunter, observer, writer and enthusiast in mind. Rather than trying to deeply examine every question about discovering comets in this era, I have instead tried to clearly and accurately present the facts. I will leave the data analysis, explaining the "whys" and "hows", to others.

It is hoped that this accumulation of comet discovery details will assist those for whom comets are more than a hobby.

Don Machholz
San Jose, California, USA
February, 1985.

TABLE OF CONTENTS

ACKNOWLEDGMENTS	ii
PREFACE	ii
PART 1: PROFESSIONAL AND AMATEUR DISCOVERIES	
Ten years of comets	1
Labeled additional objects	2
IRAS discoveries	2
Summary of the professional and amateur comets	2
Could amateurs have found some of the professionals' comets?	3
Unconfirmed and unlabeled comets	5
The three missed sungrazers	6
PART 2: THE INDIVIDUAL COMETS	
Introduction	8
The 33 comets found by amateur astronomers	12
PART 3: THE TIME OF DISCOVERY	
Time line for amateur discoveries	55
Comet discoveries for each year	57
Monthly totals of amateur comet discoveries	58
Moon phase at discovery	60
Days of the week	61
Discovery times before and after astronomical twilight	62
Discovery time vs. perihelion time	63
PART 4: MAGNITUDES AND POSITIONS	
Discovery magnitudes	66
Brightness variations in comets	67
Speed and direction of comet at discovery	69
Apparent size and appearance of the comets	71
Elongations	72
Comparing magnitude and elongation	73
The height of the comet in the discoverer's sky	75
"Pointing positions" of comets at discovery	76
Comet altazimuth positions at the time of discovery and at astronomical twilight at various latitudes	79
Celestial coordinates	81
Constellations	83

PART 5: THE DISCOVERERS

Introduction	84
List of the discoverers and their comets	84
A profile of the discoverers	86
The number of finds for each discoverer	87
Comets and discoverers by countries	88
The number of hours to find a comet	89
Type of instrument used for each discovery	90

PART 6: ORBITAL PARAMETERS

Orbital data	93
Perihelion distances	95
The argument of perihelion	96
Ascending node	96
Inclinations	97
The "L" values	98
The "B" values	99
Comparing "B" values and discovery declinations	99
"L" and "B" values	100
Ecliptical latitudes at discovery	102
Eccentricity	103
Comet distance from earth and sun at discovery	105
Absolute magnitudes	106
The "N" factor	107
The Holetschek effect and discovery probabilities	108

PREFACE TO THE THIRD EDITION

In the ten years since this book was first published, it has become very popular among comet hunters. Nearly half the copies have been sold to those in foreign countries, and at least parts of it has been translated into Russian, Japanese and German.

I trust that this book will continue to be a help and inspiration to comet hunters, and others. Meanwhile, I am presently working on a comprehensive update of this work. I hope to have it ready in the year 2000 and it will cover a quarter century (1975-1999) of visual comet discoveries.

Don Machholz
P.O. Box 1716
Colfax, CA. 95713
October, 1995

PART 1: PROFESSIONAL AND AMATEUR COMET DISCOVERIES

A total of 162 comets were discovered or recovered during the decade of 1975 through 1984. This breaks down to 33 comets discovered by amateurs and 129 recovered or discovered by professional astronomers.

TABLE 1

TEN YEARS OF COMET DISCOVERIES AND RECOVERIES

YEAR	PRO. L/PER	DISC. S/PER	TOT	PRO. RECOV.	PRO. TOT	AMATEUR L/PER	AMATEUR S/PER	AMAT TOT	GRD TOT
1975	1	5	6	4	10	6	1	7	17
1976	2	1	3	6	9	2	0	2	11
1977	3	4	7	11	18	1	0	1	19
1978	1	3	4	7	11	5	2	7	18
1979	1	3	4	5	9	3	0	3	12
1980	3	3	6	10	16	4	0	4	20
1981	3	2	5	7	12	0	0	0	12
1982	0	2	2	7	9	1	0	1	10
1983	4	5	9	10	19	3	0	3	21
1984	4	4	8	8	16	3	2	5	22
TOTAL	22	32	54	75	129	28	5	33	162

In Table 1 (above) these figures are shown in greater detail. The first column shows the calendar year. Next we see the discoveries by professional astronomers, usually involved in other activities when they accidentally pick up comets on their photographic plates. These figures are displayed for comets later learned to be of both long period (orbital period of more than 200 years), and short period (or periodic).

The total number of professional discoveries is followed by intentional comet recoveries by professional astronomers. This is followed by the total number of comets handled by professionals.

PART 1: PROFESSIONAL AND AMATEUR COMET DISCOVERIES

Looking at the amateur discoveries, we see the number of comets discovered which are long period, those which are short period and the totals for each year. There were no comets intentionally recovered by amateurs; I consider the several comets recovered by E. Everhart and by Tsutomu Seki to be "professional recoveries".

"LABELED" OBJECTS NOT INCLUDED IN TABLE 1

Comet Lovas (1977t): This was declared to be an asteroid (1977YA)

Comet 1980p: This was a ghost image of the star Regulus on a photographic plate.

Comet 1982c: This is part of Comet 1982b.

Comet 1983a: This turned out to be a photographic plate defect.

Comet 1984b: This object could not be confirmed and was never seen after the two "discovery" photos were taken.

IRAS

In 1983 the Infrared Astronomy Satellite discovered six comets as it swept a ring of sky 90d (d = "degrees") from the sun. Four of them: Comets IRAS 1983f, 1983j, 1983k and 1983o were found only by IRAS. One, Comet Hartley-IRAS (1983v), was co-discovered by a professional astronomer. All five of the above comet finds are rated as "professional discoveries". Comet 1983d (IRAS-Araki-Alcock) was co-discovered by two amateur astronomers. It is classified as an "amateur discovery".

FROM TABLE 1 WE SEE...

Each year yielded an average of 16.2 new or returning comets.

Each year an average of 7.5 returning comets were intentionally recovered.

Each year an average of 5.4 comets were found by professional astronomers.

Each year an average of 3.3 comets were found by amateur astronomers.

PART 1: PROFESSIONAL AND AMATEUR COMET DISCOVERIES

A few words about comet recoveries...

Of the 162 comets, 75, or 46.3% were intentional recoveries.

When a professional astronomer was involved in finding a comet, 58.1% of the time it was a recovery.

For amateur astronomers, none of the comets were recoveries.

...and of the 87 comets discovered...

50, or 57.5% of them were short period (less than 200 years).

37, or 42.5% of them were long period comets.

Professional astronomers found 54, or 62.1% of all comets discovered.

32, or 59.3% of them were periodic comets.

22, or 40.7% of them were long-period comets.

Amateur astronomers found 33, or 37.9% of all comets discovered.

5, or 15.2% of them were periodic comets.

28, or 84.8% of them were long-period comets.

COULD AMATEURS HAVE FOUND SOME OF THE PROFESSIONALS' COMETS?

Of the 54 new comets discovered by professional astronomers, how many of them could have been found by amateurs, if the professionals had missed them? If this is a large number, then the amateurs face competition from the larger telescopes and cameras in the hands of the professional astronomers. If this is a small number, then this is because the professional discoveries are of faint comets that remain faint. We do indeed find that the second case seems to be true, but there are some exceptions. Below are the comets that would have, or could have, been found by amateurs if the professional astronomers had not found them.

Comet West (1975n): Found at mag. 16-17 by Richard West on Aug. 10, 1975, this comet brightened to a fine naked-eye object in early March, 1976. If a professional astronomer had not found it, then amateurs would have had a chance in late Nov. or early Dec. 1975, in the evening sky, at roughly mag. 10.5 and 54 degrees from the Sun at R.A.: 20h 30m, Dec.: -38d. From here, on Dec. 1, the comet brightened to mag. 9.6 in one month and decreased to 35 degrees elongation. If it was not found at this time, the next chance would be in the morning equatorial sky in early March, 1976, as the tail rose before the head.

Chance of amateur discovery: about 100%

PART 1: PROFESSIONAL AND AMATEUR COMET DISCOVERIES

Periodic Comet Wild 2 (1978b): Discovered by Paul Wild on Jan. 6, 1978 at magnitude 14. If left undiscovered, then amateurs would have possibly found it in the evening sky in late May, 1978, near M 44 at magnitude 10.6, at 61 degrees elongation. It did not get much brighter than this as it continued towards the sun at about 0.3d/day.

Chance of amateur discovery: about 70%.

Comet Bowell (1980b): Discovered by Edward Bowell on Feb. 11, 1980 at mag. 16.5, this comet, with a low inclination, came to perihelion more than two years after discovery. It was observed for a few weeks in the summer of 1982 at mag. 10.3-11.5, and might have been discovered at that time. If so, the comet would have been near M 8, in the midst of the Milky Way, in late-June and early-July, 1982. Perhaps someone observing M 8 or M 20 would have found it.

Chance of amateur discovery: about 70%.

Comet IRAS (1983j): Discovered by the satellite IRAS on June 28, 1983 at mag. 15, it was reported to be as bright as mag. 10.6 in early Sept. 1983, but mag. 11.0 and fainter during the weeks before and after. If it would have been found by amateurs, the comet would have been in the morning, northern sky at a large elongation (136d), near M 74.

Chance of amateur discovery: about 50%.

Comet Shoemaker (1983p): Discovered by Carolyn Shoemaker on Sept. 7, 1983 at photographic mag. 16, this comet was observed visually at mag. 11.5 in mid-Sept., 1983. At that time it was in the morning sky, about 150 degrees from the sun, in the Square of Pegasus. Considering the faint magnitude and position, it probably would not have been discovered by amateurs.

Chance of amateur discovery: about 30%.

Comet Hartley-IRAS (1983v): Discovered Nov. 4 by Malcolm Hartley and Nov. 10 by IRAS at mag. 15, this comet quickly brightened (possibly a flare) and was independently discovered by amateur David Levy on Nov. 30 at about mag. 11. John Bortle observed it at mag. 10.6 on Dec. 2, and Daniel Green observed it at mag. 10.9 on Dec. 9. When David Levy first saw it, the comet was in the evening sky, 70 degrees from the sun, and at R.A.: 21h 00m, Dec.: -4d. The comet dimmed slightly, but, after the beginning of 1984, it began to slowly brighten, then it flared to mag. 7.8 in late Feb.

Chance of amateur discovery: about 100%.

Comet Shoemaker (1984f): Discovered by Carolyn and Eugene Shoemaker on May 27, 1984 at mag. 14, this comet reaches perihelion some 17 months after being found. It is expected to brighten to mag. 10.6 in May, 1985. If it was not discovered by the professional astronomers, it probably would be found in the southern sky, opposite the sun, in the constellation Centaurus, in March or April 1985.

Chance of amateur discovery: about 60%.

PART 1: PROFESSIONAL AND AMATEUR COMET DISCOVERIES

Comet Shoemaker (1984q): Discovered by the Shoemakers on Sept. 27, 1984 at mag. 13, this comet attained visual mag. (approx.) 11.4 in mid-Oct. Some estimates place it at mag. 11.5-12.0. At that time, however, the comet was far from the sun, near opposition, in the Square of Pegasus. It is unlikely, therefore, that the comet would have been found by amateurs.

Chance of amateur discovery: about 20%.

Comet Shoemaker (1984s): This comet was discovered by the Shoemakers on Oct. 25, 1984 at photographic mag. 12. The comet brightened to mag. 9.6, it would have been easily discoverable by amateurs in Dec., 1984, near M 77 at mag. 10.0. Most amateur comet hunters do not sweep this far from the sun (135d) in the evening sky and discovery might have waited until early Jan., 1985, when the comet crept to within 120 degrees of the sun, before moving away from the sun and dimming.

Chance of amateur discovery: about 85%.

So we see that amateur astronomers would have found perhaps five more comets if the professional astronomers stopped discovering all comets. Close examination of these listed comets shows a significant increase in their numbers in recent years. Why is this?

Several reasons come to mind. First, amateurs have only recently begun observing professionally discovered comets rated in the mag. 12-15 range. And they have learned that the actual visual brightness is about two magnitudes brighter. This means that this class of comets, once thought to be out of reach of the amateur, is now being regularly observed. And because of this the brighter visual magnitude places more of these comets into the "discoverable" range.

Secondly, amateurs are now using larger instruments for comet seeking, this places some of the fainter comets within reach. Third, professional astronomers have changed their comet detection habits during the past few years. In years past, plates were often not examined (if examined at all) until several weeks after they were taken. Comets went unconfirmed (see next section) or missed completely. Now, it's become a habit to examine plates soon after exposure.

UNCONFIRMED AND UNLABELED COMETS

During these ten years twelve comets were reported on the IAU Circulars as "possible" or "probable", but were not labeled with a letter designation or confirmed to be a comet. Most often these were photographic "finds" and the comet was mag. 13-18. Sometimes the comet was reported months after the plate was taken and followup was difficult.

On IAU Circular No. 3876, dated Oct. 5, 1983, Dr. Brian Marsden of the Smithsonian Astrophysical Observatory noted the large number of unconfirmed "discoveries" and asked that observers try to confirm their own finds. In the 15 months since that request there have been no further "possible" or "probable" comets reported in the IAU Circulars, although some are still reported to the SAO.

PART 1: PROFESSIONAL AND AMATEUR COMET DISCOVERIES

During the same decade, five comets were found on the Palomar Observatory Sky Survey plates, taken between 1950 and 1956. One of them was later identified to be Comet Gunn.

THE THREE MISSED SUNGRAZERS

During this decade three comets were observed by the Solwind P78-1 satellite to crash into the sun. None of the comets were observed from the earth and the Solwind photos seem to be the only evidence of their existence. Also, each one disappeared after reaching (or hitting) the sun. These comets are not included in the tables or discussions above. The orbits seem to indicate that these were of the Kreutz sungrazing family. Lets look at each comet and see the possibilities for discovery from earth.

Comet Howard-Koomen-Michels (1979 XI): This comet apparently hit the sun on Aug. 30, 1979, it was reported two full years later. The comet was observed by the satellite for only a few hours. At a solar distance of less than 6 solar radii the head was "somewhat brighter than Venus" and the tail pointed away from the sun. If the absolute magnitude of the comet was 10.0 (this is relatively faint for comets from this group) and the "n" factor was 4.0, then the comet was difficult to find before perihelion and would also have been difficult if it had survived perihelion.

In early August the comet was mag. 11.7 and 23.6 degrees from the sun, in the morning sky and south of the sun. From here it brightened, but slowly decreased in elongation. It was not found for those reasons.

If the comet had survived perihelion passage, it would have whipped into the morning sky again. Perhaps the best chance for discovery would have been in late Sept., when the comet was mag. 9.9 and 31 degrees from the sun. From here it would have traveled in five days to 37 degrees, but by then the magnitude would be 10.7. Five days later it would have been 42 degrees from the sun but mag. 11.3.

So it is not a surprise that this comet was not found by ground-based observers. And if it had survived perihelion it still would have not been found.

Comet SOLWIND 2 (1981 I): This comet reached perihelion on Jan. 27, 1981, and possibly hit the sun. It was reported six months later. At 8 solar radii it was estimated to be mag. 0.0, it faded to mag. +1.0 at 5.5 solar radii, and then brightened to mag. -2.5 at 3 solar radii. Such a change in brightness makes it hard to estimate the absolute magnitude and "N" factor, but we will use $A/M = 15$ and $N = 4$.

Prior to perihelion the comet approached the sun from the evening side. On Jan. 12 it was at mag. 12.3 when 42 degrees from the sun. Five days later it was mag. 11.4 and at 30 degrees elongation. In another five days it brightened to mag. 9.6, but it was 18 degrees from the sun. Five days later it grazed the sun.

PART 1: PROFESSIONAL AND AMATEUR COMET DISCOVERIES

If the comet had survived perihelion, it would have whipped into the evening sky again. In five days it would have been mag. 9.3 and 13 degrees from the sun, five days later its mag. would have been 11.1 when it was 28 degrees from the sun.

So both before the comet reached the sun it was a difficult object, and if it had survived it would have been equally difficult.

Comet SOLWIND 3 (1981 XIII): This comet apparently hit the sun on July 20, 1981, it was reported one full year later. The comet was tracked for a day, becoming mag. -0.8 at 8 solar radii. For these calculations we assume an A/M of 12 and an "N" of 4.

Prior to perihelion the comet was in the morning sky, mag. 11.3 when 15 degrees from the sun on July 5. Five days later it was mag. 9.9 and 13 degrees from the sun. In another five days it brightened to mag. 7.7 but it was at only 10 degrees elongation. Five days later it hit the sun.

If the comet survived perihelion it would have been mag. 7.4 and at 7 degrees elongation in the evening sky on July 25. Ten days later it would have moved to the morning sky, been mag. 11.2 and 14 degrees from the sun. From this point elongations increased by less than 1d/day and it continued to dim.

So we see that of the three sungrazing comets just studied, this was the least likely to have been discovered. All three, however, were very difficult to discover and we would not normally expect them to be found by amateur astronomers.