

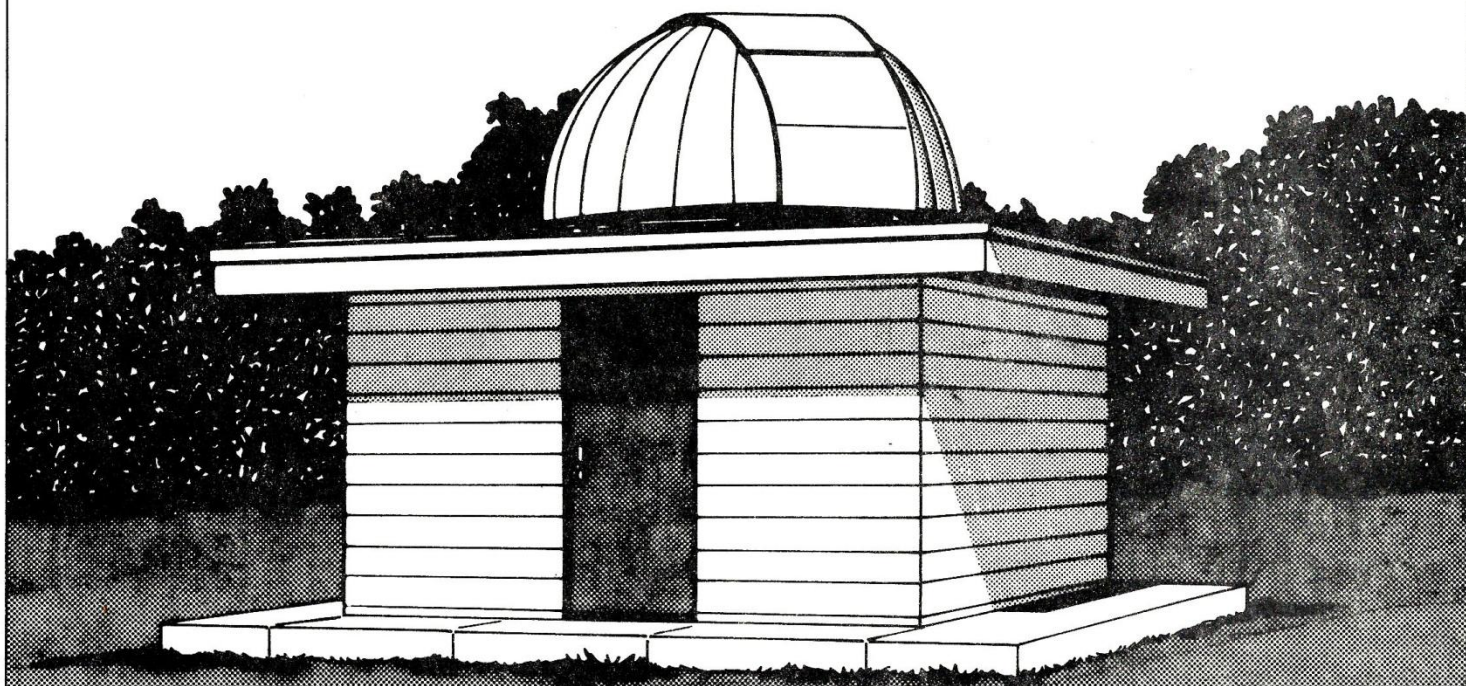
THE WASP

THE JOURNAL OF THE WARREN ASTRONOMICAL SOCIETY



MEMBER

Stargate



The illustration above shows the exterior of the W.A.S. STARGATE observatory, located on Camp Rotary property off North Ave. on 29 mile road. The building contains a 12 $\frac{1}{2}$ " cassagrain telescope of 100" focal length. The use of this observatory is the privilege of all members & guests of members. The equipment within the building will allow observational astronomy to be conducted at all times, weather permitting. A sun filter is also available for use on request.

**May
1973**

THE WARREN ASTRONOMICAL SOCIETY PAPER (W.A.S.P.) IS PUBLISHED BY THE W.A.S., MONTHLY AS A PRIVILEGE OF MEMBERSHIP. THE W.A.S. IS ALSO A CAMPUS CLUB OF MACOMB COMMUNITY COLLEGE - SOUTH CAMPUS, WARREN MICH.



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The Warren Astronomical Society corresponds with the following:

The Detroit Astronomical Society
The Detroit Observational and Astronomical Association
The Kalamazoo Astronomical Society
The Oakland Astronomical Association
The Jackson Astronomical Society (Mississippi)
The Astronomical League
The Miami Valley Astronomical Society
The Oglethorpe Astronomical Society (Savannah, Georgia)
The Royal Astronomical Society of Canada (Toronto)
The Olympic Astronomical Society (Bremerton, Washington)
The Lansing Astronomical Society
The Northern Lights – North Central Region (Minnesota)

(If we forgot anyone, please bring it to our attention)

The Surgeon General says this issue may be hazardous to your health!

The Warren Astronomical Society Paper (W.A.S.P.) is a monthly publication of the Warren Astronomical Society distributed free to all members. Advertisements are free to all W.A.S. members. Non-member subscriptions and advertisements are available upon arrangement with the editors. Contributions, literary or otherwise, are always welcome.

EDITORS: Frank McCullough

Building 9

34136 Clinton Plaza Dr.

Frazer, Michigan, 48026

791-8752

Kenneth Wilson

11157 Granada

Sterling Heights, Michigan, 48077

268-9337

This Month's Cover By: Roger Civic

CLUB NEWS

A campout will be held at Camp Rotary, site of Stargate Observatory, over the Memorial Day Weekend. So, avoid the crowded beaches, go camping and observing with the W.A.S. For further info, call Frank McCullough 791-8752.

Warren Astronomical Society Meetings will continue throughout this summer at Macomb County Community College every third Thursday of the month.

The Messier Group's current project of making a photographic album of the Messier Objects is well under way. If you want to get in on this project, call Frank McCullough at the above number.

The W.A.S. sends its best wishes to Chris Edsall who has just recently left us for England. [Should set Anglo-American relations back a bit] The W.A.S.P. won't be the same without his unique cover artistry.

James Loudon of the University of Michigan will speak at the May general meeting about the early results of the Apollo Program.

The recent Messier Contest, despite the almost perfect seeing conditions, was poorly attended. First Place went to yours truly, Ken Wilson, with the Roger Civic-Tim Skonieczny Team coming in a close second. Dave Harrington placed third.

A petition to get a U.S. stamp commemorating amateur astronomy will be passed around at the April meeting. Please be sure and sign it.

-Kenneth Wilson

P.S. An excellent article on light pollution and its effects on astronomical observation was published in the March 31st issue of "Science" magazine. I strongly encourage you to read it. It is the best published article that I have seen on this subject.

NEWS ITEMS
BY
KENNETH WILSON

ALIEN SHIP IN OUR BACKYARD?

A young Scottish science writer and part-time astronomer believes that an alien space probe has been sent to the earth from another world to circle it and respond to earth based radio communications.

The Scottish astronomer, Duncan Lunan, announced his new idea at a recent meeting of the British Interplanetary Society. Lunan, 27, was inspired by a speculation by Radio Astronomer Ronald Bracewell of Stanford made in 1960. Bracewell suggested that an advanced alien civilization might not use long-range radio for communication with other beings. Instead, they might send a space probe to a nearby star, likely to have a life bearing planet in orbit around it. The probe would wait until it received some radio signals from the planet; then it would relay them back again in order to advertise its presence to the planet.

Lunan believes that he has found evidence that this has in fact happened. When radio was first being experimented with in the 1920's, a Norwegian geophysicist, Carl Storrer and his colleague, Balthasen van der Pol broadcast several short wave messages to each other. Many of them were followed by echoes as late as 15 seconds after the original ones. These echoes cannot be attributed to any as yet known natural phenomenon.

Lunan took these signals and judiciously plotted them on a piece of paper using the time delay as one axis and the sequential position of each echo as the other axis. He was able to obtain a chart of the constellation Boötes with the double star Epsilon moved out of place with respect to the other accurately placed stars. Lunan explains that this is the probe's way of showing us which star in Boötes it came from. Lunan has graphed out other data and supposedly gotten other charts yielding further information about the aliens.

Opinion from the scientific community has been skeptical. Physicist Philip Morrison (M.I.T.) said that "Chances are nine in ten that the whole story is a hoax." British Radio Astronomer Sir Martin Ryle said that "Lunan gave no evidence, only beliefs." When Arthur C. Clarke (famous author and past chairman of the British Interplanetary Society) was in Ann Arbor April 10th, I asked him about Lunan's theory. He told me that Lunan's conclusions were very shaky and extreme, being based on very little evidence "Like standing a pyramid on its tip." Clarke also suggested that he could probably graph the same data to "... show a picture of Brooklyn." if he wanted to.

But, at least one person feels the matter deserves further investigation. Anthony Lawton, a British computer expert, plans to send radio signals into space at 30-second intervals over the next year, in the hope that he will stir the probe into responding again. His operating frequency, however, will be kept secret to prevent any earth-based hoaxes from interfering.

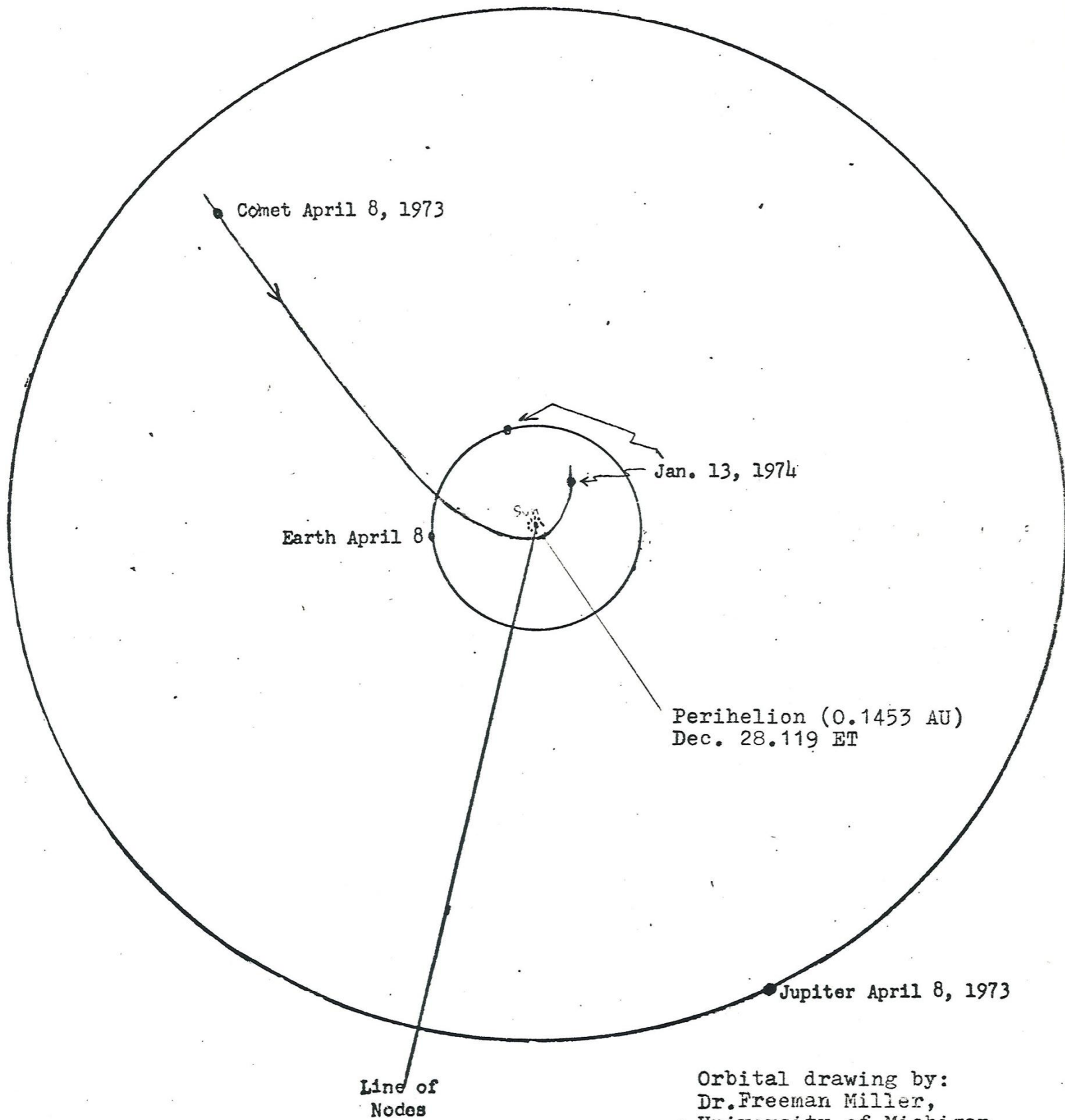
NEW COMET

Another faint comet has been discovered. It has been named Comet Kohoutek (1913f) and is presently of magnitude 15. Orbital parameters are: T=1973 Dec. 28.119 ET; q=0.1455 AU; ω 31°.62 (1950.0); Ω = 257.76 (1950.0); i=14°.30 (1950.0).

Most important however, is the prediction by Dr. Freeman Miller of the Univ. of Mich. that the comet will reach at least 1st magnitude by Dec. or Jan. At this time the comet will probably be too close to the sun to see its head, but a nice long tail maybe visible before sunrise or sunset. See the following page for a drawing the comet's orbit.

COMET KHOUTEK (1973f)

Orbit assumed in ecliptic plane (inclination is 14°3').



APRIL
S M T W T F S
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30

Warren Astronomical Society

MAY

1973
Meeting Guide

JUNE
S M T W T F S
1 2
3 4 5 6 7 8 9
10 11 12 13 14 15 16
17 18 19 20 21 22 23
24 25 26 27 28 29 30

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
		1	2	3 MESSIER CLUB MEETING 791-8752	4 KALAMAZOO MEETING DETROIT MEETING MESSIER	5 GROUP GIRL SCOUTS MAY 4th, 5th, 6th
6 MESSIER CONTEST if MAY 4th CANCELLED OUT	7	8	9	10 ASTRO PHOTO MEETING 771-3283	11 DETROIT MEETING	12
13 Mother's Day	14 SKY LAB LAUNCH	15	16	17 W.A.S. General Meeting 791-8752 South Macomb College	18 DETROIT MEETING GRAND RAPIDS MEETING	19
20	21 Victoria Day (Canada) 1 month TILL ECLIPSE DEPARTURE	22	23	24 OPTICS CLUB CALL FOR APPOINTMENT OR CONSULTATION 751-4115	25 W.A.S. CAMP X	26 OUT X
27 AT CAMP X	28 Memorial Day ROTARY X	29	30	31 RIGHT Ascension Day		

MAY

Messier Contest

PRIZES for 1st, 2nd, & 3rd place
8:00 Starting time

MAY

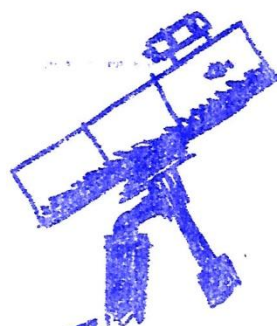
4th Friday or 6th Sunday (WHATEVER DAY IS CLEAR)

OBJECTS WILL BE GIVEN THAT NIGHT

SAME RULES AS BEFORE

FOR INFORMATION CALL 791-8752

AT
STAR GATE
OBSERVATORY



FOR SALE

6" f8 telescope- included are 1) 20mm eyepiece 2) 12 mm 2 to 3 X Barlow a 6X30 finder and pipe-mounting.

Original cost

\$169.75

Selling Price

\$125.00

Extra Equipment

camera & camera holder

\$10.00

Call: 344-1297 after 3:00pm ask for Pete

Address: 1297 West B Ave. Plainwell, Michigan 49080

FOR SALE

12" f7 reflector brand new with mounting will sell promptly

CALL: 751-2649 ask for Tim.

FOR SALE

350mm Lenter telephoto lens, Adaptor to fit Pentax f5.6, Cheap- SUPER CONDITION!

\$50.00

ROGER CIVIC- Call: 775-6634

+++++

FOR SALE

12" f6 Reflector on fork mounting

Includes 12x40 & 6x23.5 Unitron finders

\$425.00

Will deliver free within Great Lakes Region

Write: Mike Potter

3050 Beatrice

Middleville, Michigan

49333

WARREN ASTRONOMICAL SOCIETY
SOLAR ECLIPSE GROUP
To
AFRICA

Compiled by
Dave Harrington

Frank McCullough
34136 Clinton Plaza Dr.
Fraser, Michigan 48026
(791-8752)

Diane McCullough
34136 Clinton Plaza Dr.
Fraser, Michigan 48026
(791-8752)

Pete Kwentus
22107 Melrose Ct.
East Detroit, Michigan
(771-3283)

Tim Skonieczny
28819 Gilbert Dr.
Warren, Michigan 48093
(751- 2649)

Paul Strong
20054 15 Mile Road
Mt. Clemens, Michigan
(791-2323)

Dave Harrington
26612 Karren Dr.
Warren, Michigan 48091
(755-1857)

Gerald Alyea
4479 Sudbury
Warren, Michigan 48092
(751-4115)

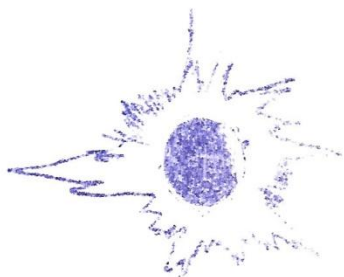
Margaret Alyea
4479 Sudbury
Warren, Michigan 48092
(751-4115)

Ginny McCullough
34136 Clinton Plaza Dr.
Fraser, Michigan 40026
(791-8152)

Roger Civic
26335 Beaconsfield
Roseville, Michigan
(775-6634)

VOYAGE TO DARKNESS

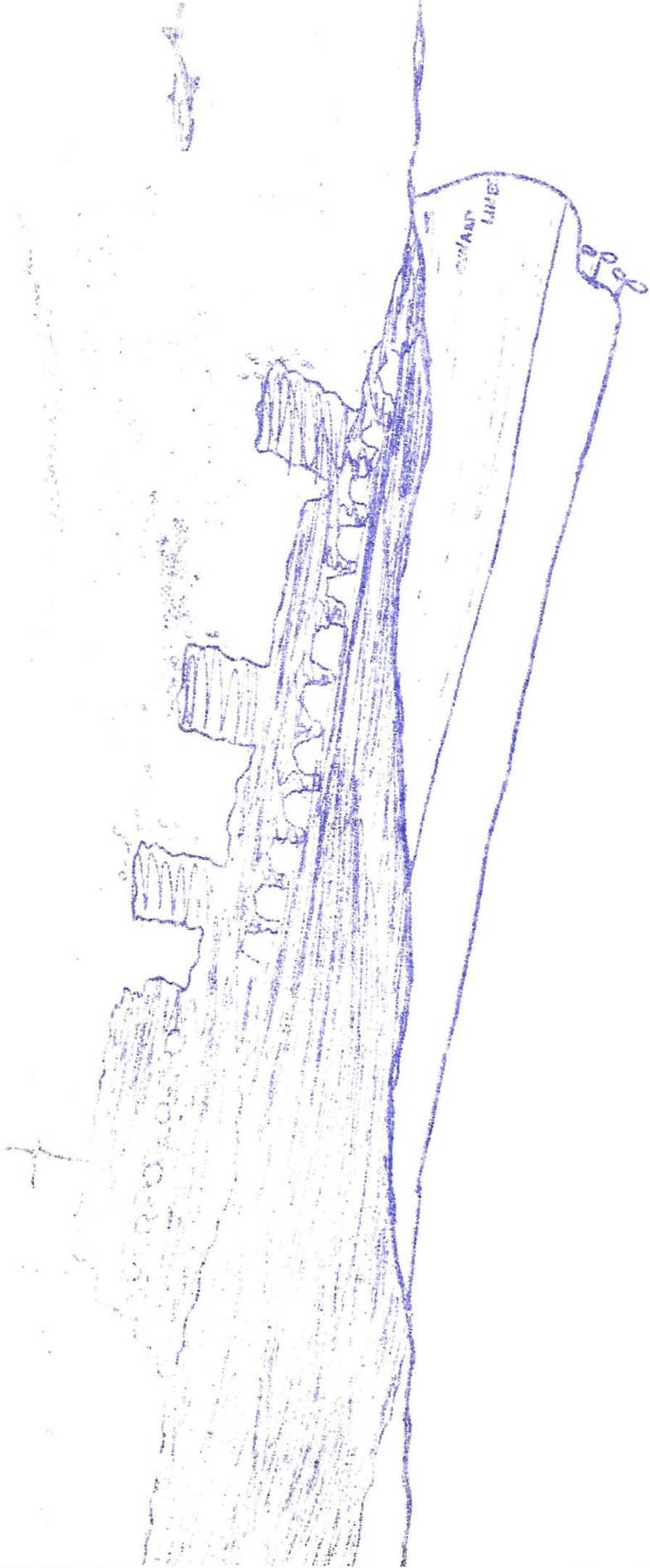
OR
(The Deciden Adventure)



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r

r



GEAR LOAD BALANCING FOR ASTROPHOTOGRAPHY

Louis J. Faix
Warren Astronomical Society
April 19, 1973

The club has undertaken a most ambitious project for an amateur Society; that of creating a photographic catalogue of the Messier Objects. This project can be looked forward to with expectations of great rewards in personal satisfaction for each participant as he acquires a quality photograph of his assigned objects. However, lest we lose our enthusiasm at an early date, we should acknowledge the probability of repeated failures in preliminary efforts. Possibly the greatest reward of this project shall not come from the photographs at all. Indeed, they may be disappointing when we unavoidably mentally compare them with those obtained by professionals or the most advanced and well-equipped amateurs. Rather, the greatest source of personal satisfaction may come from the development and sharpening of skills and knowledge required for the completion of this effort. Indeed, many technical problems may be anticipated along the way.

Most members of the Society are personally equipped with telescopes having apertures of less than eight inches. Limited light gathering power and the higher magnifications required for resolution of the Messier Objects will create the necessity of extremely long photographic exposure times. The long exposures will create problems with sky fogging and film reciprocity. Of equal or perhaps greater difficulty, will be problems of tracking, or guiding, with sufficient accuracy to realize the resolution capability of the telescope, camera and film. The causes of tracking errors which produce "star trails" are almost limitless. It is the intent of this article to discuss only one of the simpler gear drive problems and to propose a possible simple remedy.

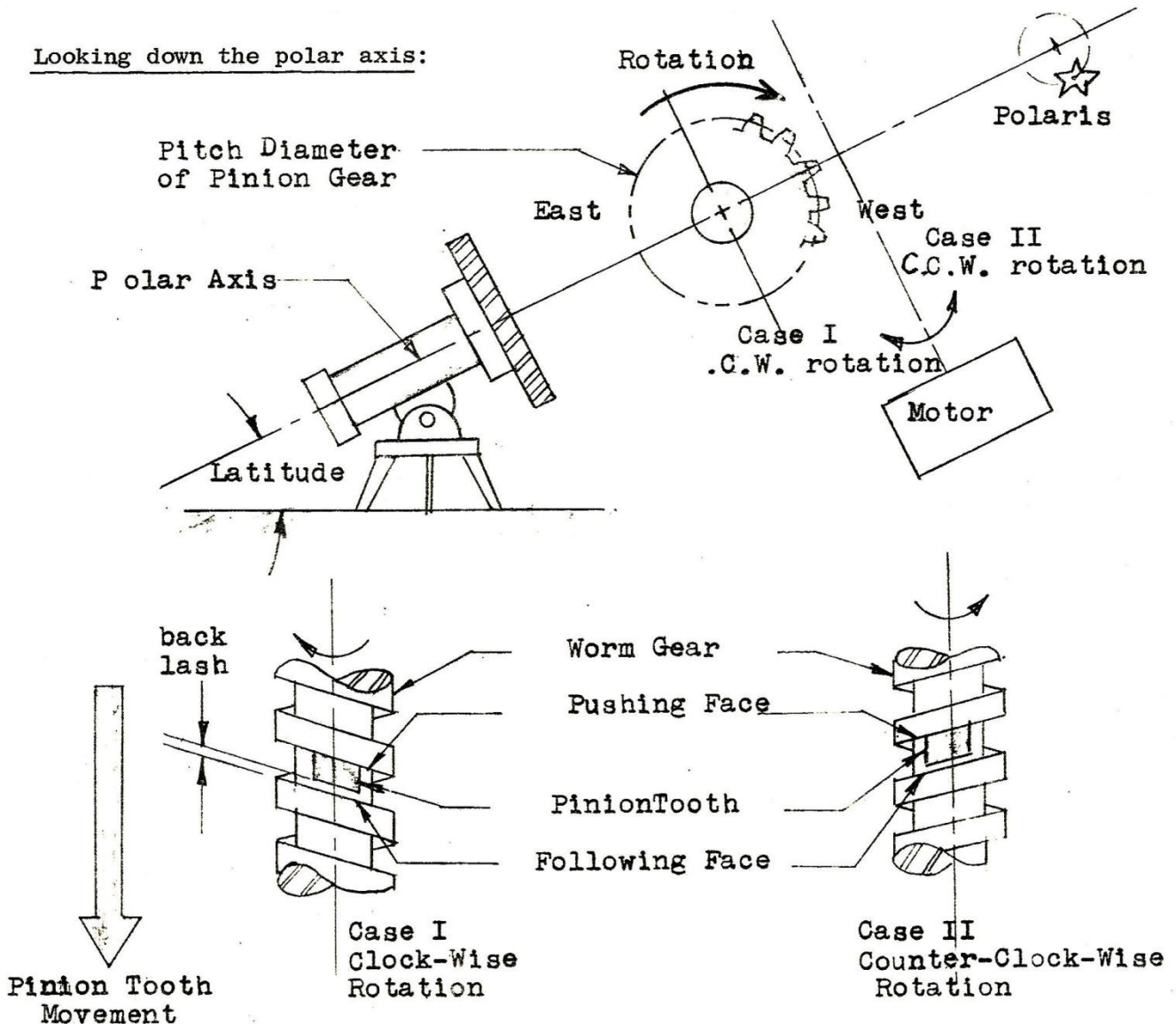
Electronic variable frequency power generators, when coupled with visible guiding and manual corrections, may well be able to compensate for sidereal time, atmospheric refraction and thermal inversions. This equipment can only correct errors which develop slowly and respond to changes in the average rotational speed about the polar axis. It cannot compensate for errors which develop suddenly. Several types of flaws in the gear system can generate small but abrupt changes along the Right Ascension axis. In my own guiding unit, and the one being constructed at Oakland University, I have observed a tendency for unidirectional gear chattering or jerking. Several photographs of long exposure, displayed by various Society members, have revealed systematic irregularities in the star trails. This article proceeds on the assumption that this gear jerking and erratic trails are related. I should hasten to

point out that the explanation and suggested solution of this article is as yet unproven. Mr. Pete Kwentus has generously agreed to collaborate with the writer in conducting the necessary photographic experiments required to substantiate or refute this theoretical analysis. The article is presented in advance of conclusive evidence in the hopes that others may be encouraged to try the same experiments. Through the collective analysis of greater quantities of photographs, a more complete and accurate understanding of gearing problems may be acquired for the advantage of all.

In constructing my first telescope, I assumed that a perfectly balanced unit, that is, one that would not rotate on its own accord, would be "ideal". That may not be the case. It may be that the smoothest gear driving is achieved with a telescope that is slightly unbalanced in a particular direction. We must be careful not to overdo the unbalancing to the point the motor's torque capability is exceeded.

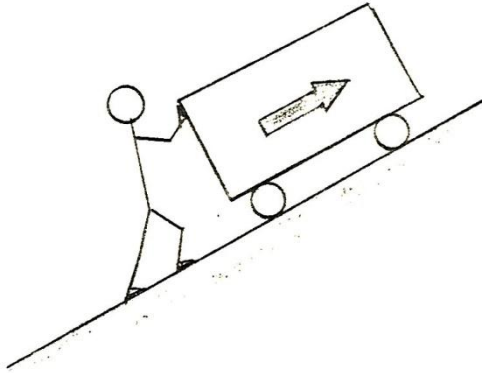
Consider the following illustrations of the gear geometry and motions:

Looking down the polar axis:



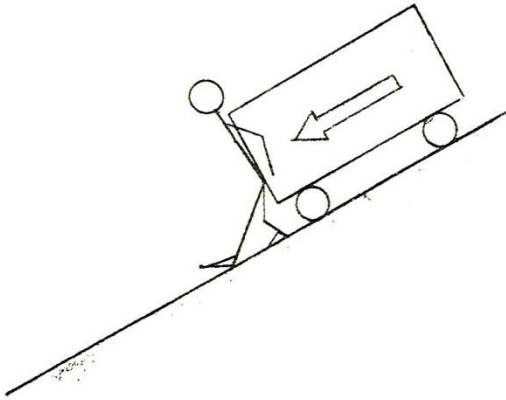
In either case, it is desired to maintain pinion tooth pressure against the “pushing face” of the worm gear. Pressure against the “following face” may result in an intermittent or jerky motion around the polar axis due to restraining friction in the polar axis bushings or bearings. An analogy would be a man pushing a wagon up a hill or letting it down the hill.

Analogy to pressure on “pushing face” of worm gear:



Man can push wagon uphill smoothly

Analogy to pressure on “following face” of the worm gear:



Downhill movement will be jerky with each step

The frequency, or time period of the jerk may vary from a few seconds up to one or two minutes. The variability will depend on such factors as the amount of friction in the polar axis, the reduction ratio of worm and pinion gear set, the gear backlash, and the amplitude of the unbalanced force causing the pressure to be on the following gear face.

If the telescope is to the east side of axis, it must be underbalanced. If it is to the west side, it must be overbalanced. In either case, if the driving clutch is released, the telescope should tend to swing to the east of the target star. That is, the telescope and counterweight should be slightly unbalanced in such a way as to cause the scope to tend to trail the target.

One possible method of testing for this type of drive defect is to take time exposure photographs. The duration of the exposures should be just long enough for the worm gear to complete one revolution. If the classic Edmund Motor (4 revs/hour) and reduction gear set (96:1) is being used, the exposure time will be fifteen minutes. Set the polar axis for your correct latitude (approximately $42^{\circ}30'$ for northern Detroit suburbs). Misalign the polar axis so that it points at a location about 5° west of Polaris. Select a star that is near the celestial equator and will be near the meridian during the exposure. A magnification of 75-100 power is preferred. At the start of the exposure, the target star should be near the top of the field of view. It will drift downwards during the exposure due to the westward misalignment of the polar axis. Exposing near the meridian is necessary for two reasons:

- 1 - Atmospheric refraction, which can cause confusing "star-trails", will be minimized
- 2 - A maximum north-to-south drift of the target star in the field of view will be accomplished. This movement will be necessary in analyzing the photographic plates to detect gear "jerking".

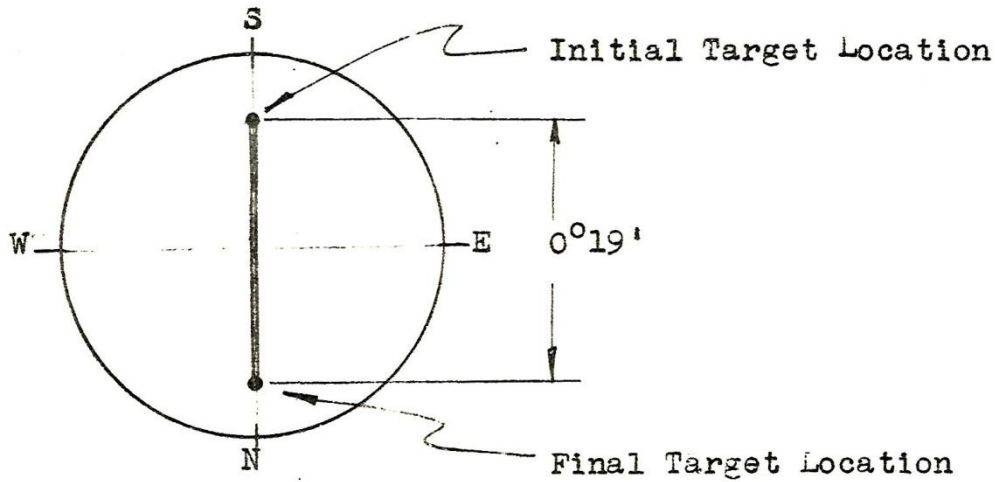
Set up the telescope with the scope on the east side of the polar axis. For the first photograph, adjust the counterweight for overbalance. For the second, adjust it for underbalanced. Balance may be determined by completely releasing the drive clutch and aiming the telescope at the zenith. Overbalancing will cause the scope to swing westward. Underbalancing will cause it to swing eastward. Be sure the camera is attached when balance settings are made.

Prior to photographing, sketch the observed star field and, as accurately as possible, note the north-south axis. An eyepiece with a crossbar reticule, aligned N-S and E-W, is preferred. Also note the exact sidereal time of the start and finish of each photograph and the declination and right ascension of the target star. This

information will be required if an exact mathematical analysis of photographic tracking errors is to be made.

Photo analysis

Let us start with an understanding of what an ideal photograph (i.e., a perfect track) should look like with this set-up. Without using photoelectronic tracking devices, such a photo will never be obtained by an amateur, but nevertheless, it is our goal. The ideal photo would have a south-to-north star trail due to deliberate westward misalignment of the polar axis. The trail for a fifteen minute exposure near the meridian should be about $0^{\circ}19'$. See illustration below:

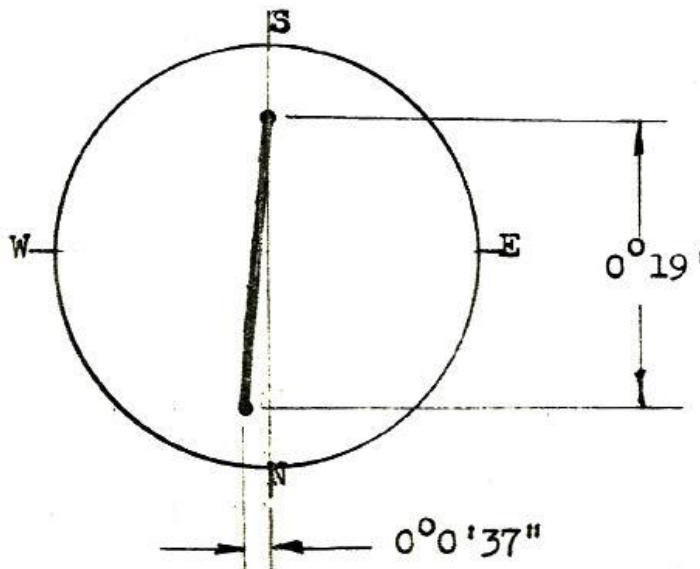


Such a photo would indicate no target drift due to atmospheric thermals, perfect and uniform drive speed with complete compensation for atmospheric refraction.

Since few amateurs possess drive systems corrected for exact sidereal time (1 rev/23 hrs 56 min 4 sec), and most are mean solar time (1 rev/24 hrs), there will be a slight eastward drift in our fifteen minute time exposure. The error rate for a solar speed drive is nearly one degree/day so the Right Ascension drift would be:

$$\frac{1^{\circ}}{24 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times 15 \text{ min} = \frac{1^{\circ}}{96} \text{ or } 0^{\circ}0'37''$$

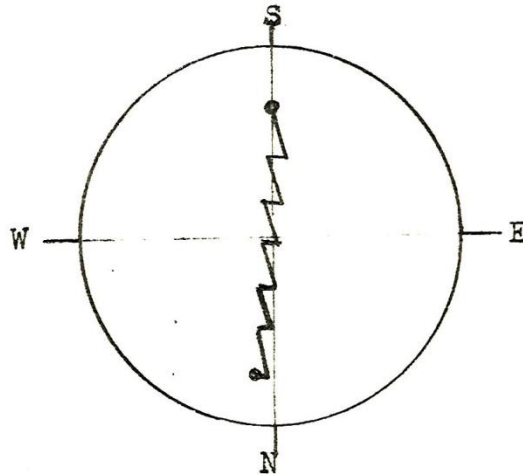
While this drift is small, it should not be ignored. Our "ideal" photo is then slightly modified as noted below:



This "ideal" photo will be further modified by the refraction of the star light through even a stable, uniform temperature atmosphere. Data on this effect is given in Norton's Star Atlas. This effect may be ignored so long as we only photograph stars within ten degrees of the meridian as its maximum value for a fifteen minute exposure should not exceed $0^{\circ}0'3''$ in R.A. drift.

Now, if our gear pressure is bearing against the pushing side of the worm gear, we should get a reasonably smooth transmission of power and motion. A photograph like that shown above should result from a jerk-free drive. Some wiggling of the star trail may result from atmospheric disturbances and gear eccentricities, but this should be slow disturbances causing only gradual demarcations from the ideal straight star trail.

If the telescope is improperly unbalanced and the gear pressure is against the following face of the worm gear, the intermittent jerking of the drive should produce a photograph somewhat like that shown below:



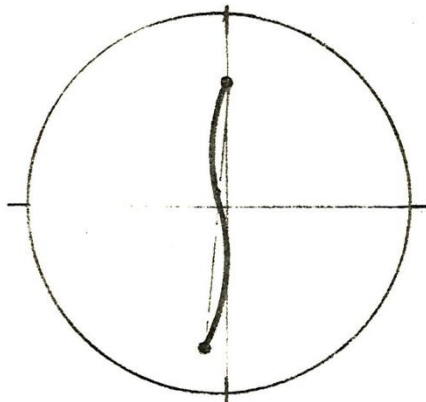
Essentially, a jerking gear drive, due to improper balance and reversed gear tooth pressure, should create a stair-step type of star trail. If the jerks are occurring at short intervals, say a few seconds, the steps will be very small and would not appreciably affect the photo quality. If, however, they occurred at long intervals of even a half minute, the steps would be greater than seven angular minutes. This would be enough to blur and oblate the star image along the east-west axis.

A second adverse effect of a gear jerk, which would be much harder to analyze, would be the vibration effects which could result. In my own instrument, which has a 58 pound mounting system on a $2\frac{1}{2}''$ pipe stand, vibrations take three to four seconds to dampen out.

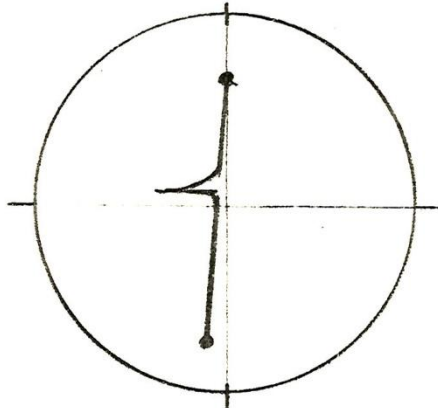
Since vibration can produce oscillations in both axis, the effect would be to generally enlarge and blur the star image.

Comparison of the two photographs will indicate whether the gear system and polar axis friction were sufficiently smooth to be free of any tracking disturbance and whether deliberate unbalancing would benefit the operation of the mechanism.

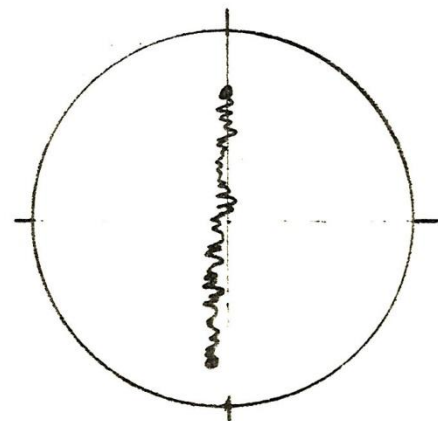
We should point out that there are other types of gear problems which can produce guiding errors. It is not the intent of this article to discuss photo analysis of these other faults at length. Briefly, however, patterns such as are noted below may be produced. Gearing problems are often compounded by the fact that several faults may exist simultaneously.



A smooth wave, once/worm revolution, indicates an eccentric condition of the worm gear about its axis.



A once per worm revolution spike to the east may indicate too great a back lash. Check and tighten gear alignment. Confirm this type of problem by photographing at a lower power for two complete worm gear revolutions.



Short, irregular, choppy disturbances in the star trail may be due to roughness or burrs on the gear faces. It can generally be reduced by polishing in gears with a drill motor and a mixture of light motor oil and fine abrasive. This fault is common on inexpensive nobbed , broached or milled gears

MESSIER CONTEST RESULTS

On March 23rd, the W.A.S. held its 4th annual Messier Contest on a very nice clear night. The objects to be found were M-105, M-95, M-96, M-37, M-1, and M-67. The entries consisted of Ken Wilson, former Messier champ with his 6" f8 reflector. The team of Roger Civic and Tim Skonieczny, who was a former 3rd place finisher, were using the Civic 8" reflector. Sir David Harrington using a 6" f8 reflector, his son with his 4" Newtonian on a fork mount, and Paul Helfenstein was using the 12½" cass. in the observatory.

The contest was finally started at 9:15 after a short delay. The action started with Ken Wilson finding his first object 24 seconds from the start, shortly after he had two objects then a third. Ken had built a three object lead on his rivals. Then the Civic, Skonieczny combination broke loose with a yell finding one of the toughies first, M-1. An early pattern had been started. Ken Wilson had found three of the easiest objects first while Roger and Tim appeared to be going for the most difficult. Roger and Tim had sounded off again by finding one of the easier objects and were now hot on the heels of Ken who was having some problems in Taurus. Roger and Tim struck gold again and now Ken Wilson and the Roger, Tim team deadlocked with the edge so it would appear going to Roger and Tim since they had one hard object under their belt. Then Ken broke the silence by M-1 in Taurus and never looked back as he found 95, 96, and 105 shortly after. The collapse of Tim and Roger came when they got stuck on one of the easy objects M-67. Dave Harrington broke through the ice by finding M-67 for his first object. After Dave found his object Ken finished out with M-105 in Leo and took a total time of 24 minutes. Dave found M-37 and looked possibly like he might be able to catch Roger and Tim who at this time were so disorganized trying to find 67 that Roger wanted to point the telescope east where Tim wanted to go west. Finally Roger and Tim were able to find 67, by asking one of the girl scouts where it was and Tim put the icing on the cake by finding 95 and 96 to take 2nd place in a total time of 50 minutes, finishing 26 minutes behind Ken. Dave Harrington finished in 1 hour 28 minutes for third and last prize position.

So Ken regained his title and is the Messier champ once again.

RESULTS PAST TO PRESENT

1971

- 1) Ken Wilson - Warren Astro. Society
- 2) Walt Roudebush - Warren Astro. Society
- 3) Rick Mouseau - Detroit Astro. Society

1972

- 1) Ken Wilson - Warren Astro. Society
- 2) Walt Roudebush - Warren Astro. Society
- 3) Tim Skonieczny - Warren Astro. Society

1972

- 1) Mike Potter - Kalamazoo Astro. Society
- 2) Bob Ross - Kalamazoo Astro. Society
- 3) Ken Wilson - Warren Astro. Society

1973

- 1) Ken Wilson - Warren Astro. Society
- 2) Roger Civic, Tim Skonieczny - Warren Astro. Society
- 3) Dave Harrington - Warren Astro. Society

PUBLIC NOTICE

The Health Department under section 23.2 of paragraph 6, Article 5, of the Health Code; hereby gives notice and/or warning that the annual convention of the Great Lakes Region of the Astronomical League will be held August 17-19, 1973 at Nazareth College, Kalamazoo, Michigan.

THE MENU INCLUDES: Paper Sessions

Messier Contest

Solar Bowl

Eclipse Results (~~Titanie~~, Canberra, etc.)

Door Prizes (Pine, Oak, etc.)

Telescopes

Shop Talk

Banquet

Exhibits

Observing

An Infamous "Good Time Hour", Friday Night (B.Y.O.B.)

Special Tours of the Mysterious Holes that have opened up in the ground at the site of Pine Mt. Obs ,

And Other Miscellaneous Activities (Local Authorities permitting)

Registration: \$3.50/person, \$5.00/couple, \$7.00/family. Rooms: \$4.00 per person.
More information: Mike Potter- 1-(616)-795-7279.

Special Note: A prize of fifty (50) dollars (\$) cash American [maybe it should be in Japanese Yen?] will be awarded to the club with the best "participation" at the convention (i.e., attendance, papers given, exhibits, slide shows, contest participation, etc.). The KAS has disqualified itself, so it looks like the WAS has a strong chance of winning. So, everybody be there, hear?!

H&W CONTROL FILM

By
Frank McCullough

For people who develop their own black and white film, here is a film with enlarge-ability hardly any film can compare with.

This film has a listed ASA of 80 and is a high contrast with a very thin emulsion. The film comes in a blue, white and black box and has its own developer which must be purchased separately. The cost of the film is around \$1.15 for a roll of twenty exposures.

I have taken some Saturn shots and have taken my sharpest one at eyepiece projection through my 6" f8 reflector and only had an image of one sixteenth of an inch on the negative and blown it up to three quarters of an inch. I found little to no grain and detail that was not evident on the negative showed up strikingly well on the blown print. This looks like a good lunar film and is worth an article on.

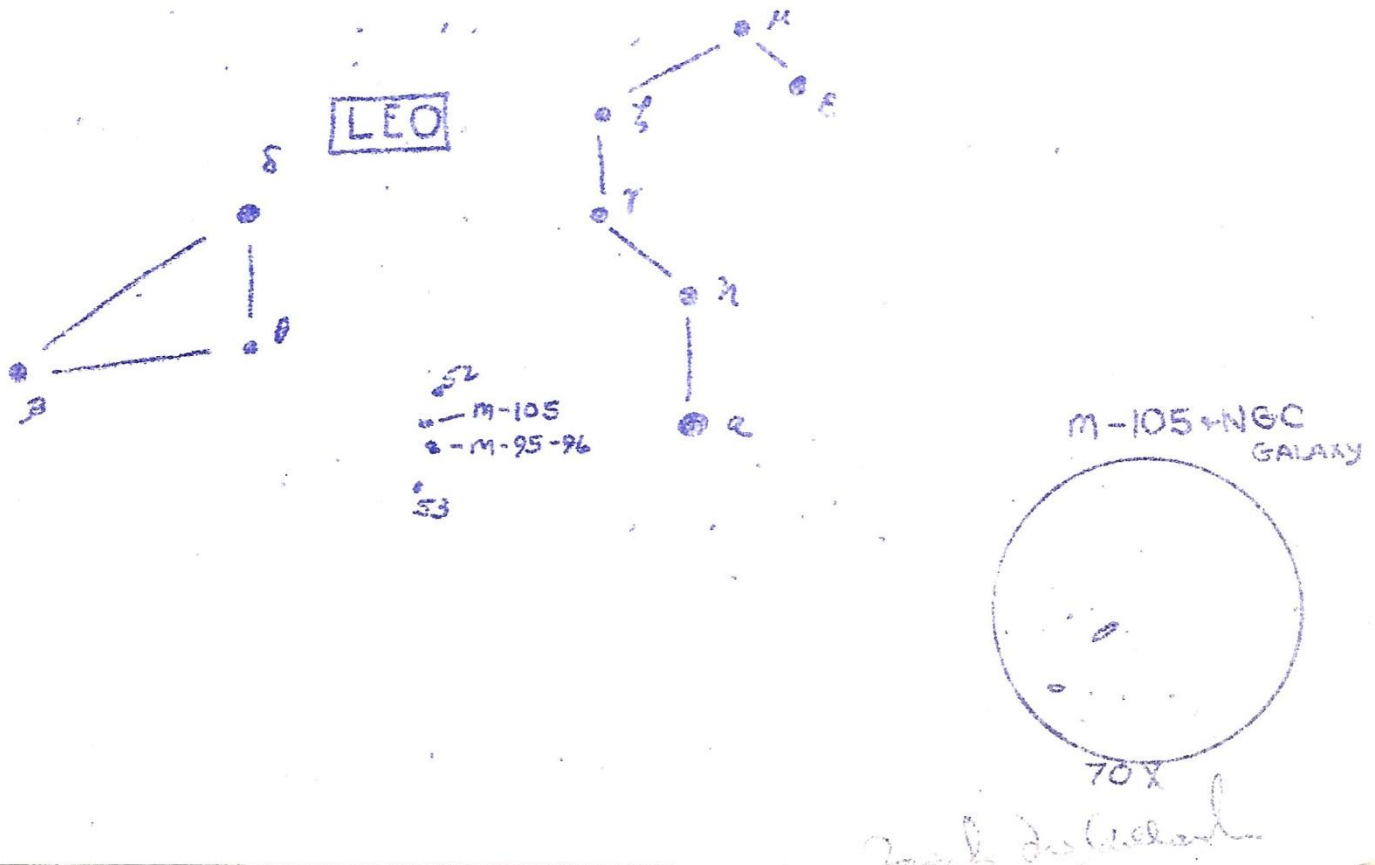
For people who would like to experiment with a roll of it, try mixing 9 oz. of D-76 and 12 ml of H & W Control developer. I did this by mistake and one half of the roll turned out as positives. Yes folks, the ever amazing Frank has done it again!

OBSERVATIONAL ASTRONOMY

In my recent endeavors to finish the Messier Catalogue I have come across my most recent object, M-105 in Leo. This is a very small galaxy but appears slightly bigger than its NGC companion, which can be found very close by to this object. I found 105 in my 6" f8 Newtonian at 70x, on March 22, 1973. This was one of the objects for the most recent Messier Contest and was mistaken by some as 95 & 96, two more galaxies in Leo. These two lie one degree north and a little east of 105.

The coordinates for the 9th magnitude 105 are, R.A. 10hr. 45.2min, DEC. +12°51'.

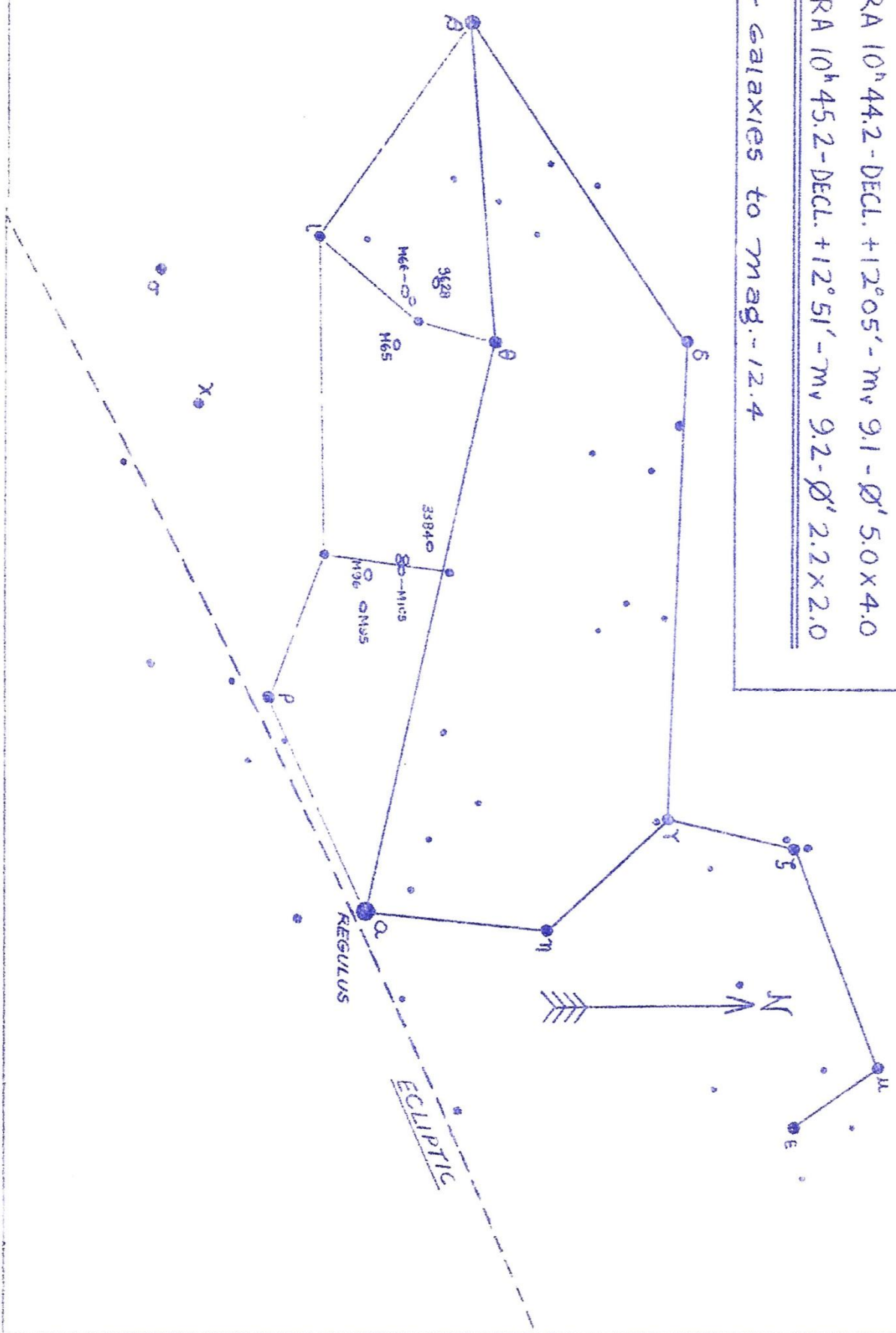
To find, look half way between stars 52 and 53 in Leo.



LEO - $9^h-11^h56^m \times -6^\circ \pm 33^\circ$.

M-95 • RA $10^h41.3$ - DECL. $+11^\circ58'$ - m_v 10.4 - δ' 6.1×3.9
M-66 • RA $11^h17.6$ - DECL. $+13^\circ17'$ - m_v 8.4 - δ' 8.0×2.5
M-65 • RA $11^h16.3$ - DECL. $+13^\circ23'$ - m_v 9.3 - δ' 7.8×1.5
M-96 • RA $10^h44.2$ - DECL. $+12^\circ05'$ - m_v 9.1 - δ' 5.0×4.0
M-105 • RA $10^h45.2$ - DECL. $+12^\circ51'$ - m_v 9.2 - δ' 2.2×2.0

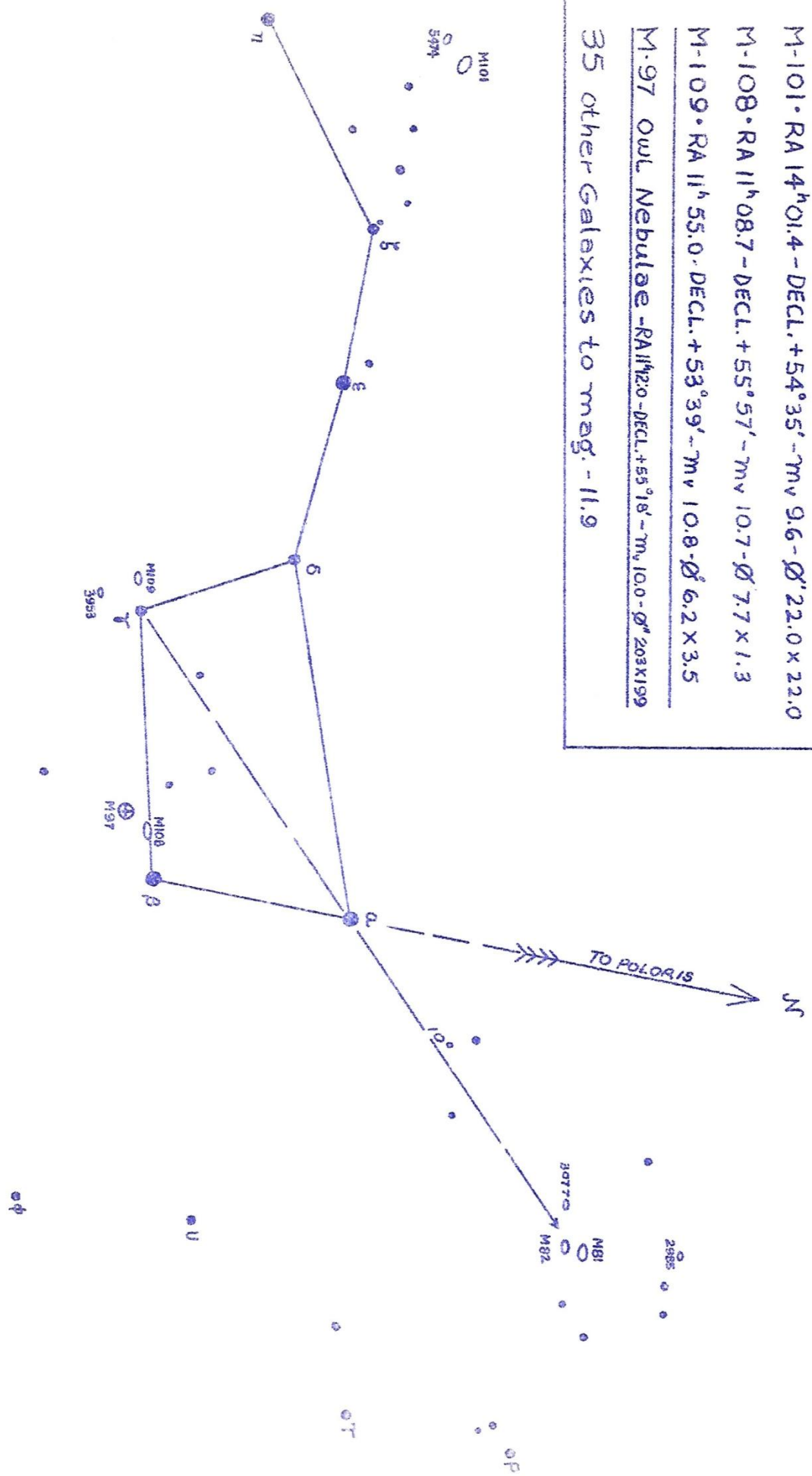
32 other galaxies to mag. -12.4



URSA MAJOR - 8^h-14^h27^m+29°+73°

- M-81 • RA 9^h51.5 - DECL. +69°18' - m_v 7.9 - Ø' 21 x 9.8
- M-82 • RA 9^h51.9 - DECL. +69°56' - m_v 8.8 - Ø' 9.0 x 4.0
- M-101 • RA 14^h01.4 - DECL. +54°35' - m_v 9.6 - Ø' 22.0 x 22.0
- M-108 • RA 11^h08.7 - DECL. +55°57' - m_v 10.7 - Ø' 7.7 x 1.3
- M-109 • RA 11^h55.0 - DECL. +53°39' - m_v 10.8 - Ø' 6.2 x 3.5
- M-97 owl Nebulae - RA 11^h20 - DECL. +55°18' - m_v 10.0 - Ø' 203 x 199

35 other Galaxies to mag. - 11.9



• X

• θ

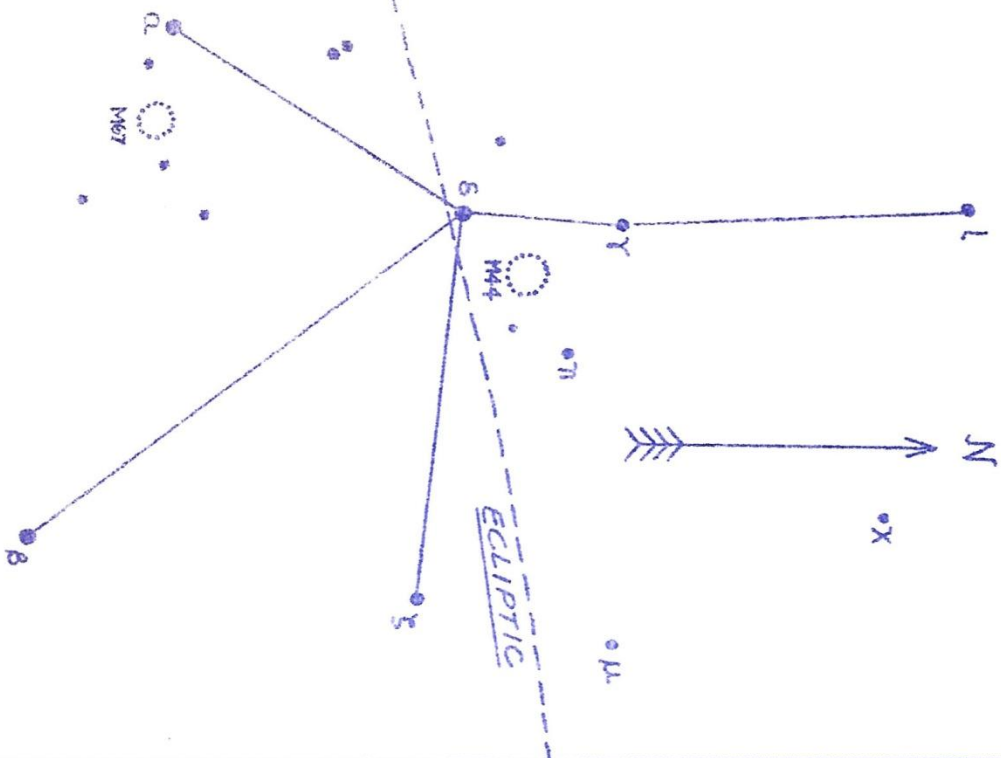
CANCER - $7^h53^m - 9^h19^m \times +7^\circ - +33^\circ$

*M-67 RA $8^h48.3$ - DECL. $+12^\circ00'$ - m_v 3.7 - δ' 95.0

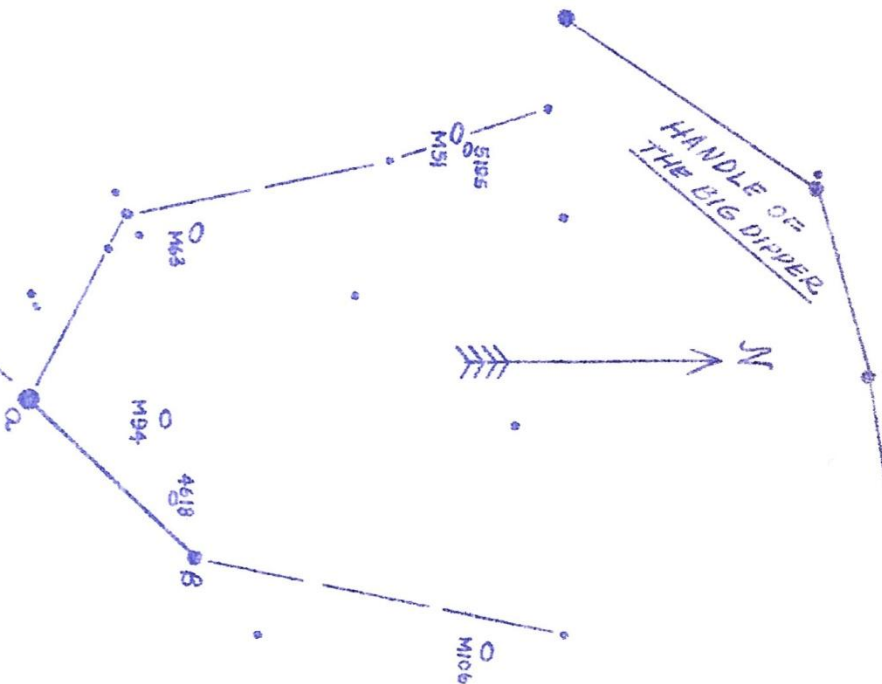
*M-44 RA $8^h37.5$ - DECL. $+19^\circ52'$ - m_v 6.1 - δ' 15.0

CLUSTERS * 

1 Galaxy mag. 10.7



HANDLE OF THE BIG DIPPER



CANES VENATICI -

$12^h04^m - 14^h05^m \times +28^\circ - +53^\circ$

M-51 - RA $13^h27.8$ - DECL. $+47^\circ27'$ - m_v 8.1 - δ' 10.0 x 5.5

M-63 - RA $13^h13.5$ - DECL. $+42^\circ17'$ - m_v 9.4 - δ' 10.0 x 5.0

M-94 - RA $12^h48.6$ - DECL. $+41^\circ23'$ - m_v 7.9 - δ' 5.0 x 3.5

M-106 - RA $12^h16.5$ - DECL. $+47^\circ35'$ - m_v 8.9 - δ' 19.5 x 7.0

27 other galaxies to 12.5 mag.

*M-3 - RA $13^h39.9$ - DECL. $+28^\circ38'$ - m_v 6.4 - δ' 9.6

*GLOBULARS 

ASTRO-ALMANAC

By

Ken Wilson

<u>May /</u>	<u>EVENT</u>
1	Moon 8° N. of Mercury at 12:00, Twilight-begins: 5:02, ends: 19:25 L.M.T.
2	New Moon at 15:55
3	
4	Lunar perigee (223,800mi.) at 1:00
5	Moon 3°N. of Saturn at 3:00, maximum of η Aquarid meteor shower (1 st -6 th) at 4:00 (radiant: 221602; V. fast w. long trails)
6	
7	
8	
9	First Quarter Moon at 7:07
10	
11	Beginning of ζ Herculid Meteor Shower, thru 24 th , (radiant: 162828) Fast; white
12	
13	
14	Moon 6°S. of Uranus at 5:00
15	Venus at ascending node, Mercury at 030113 30, Venus at 040520 48 (mag. -3.4), Mars at 222911 32 (mag. +0.5), Jupiter at 205717 44 (mag. -2.0), Saturn at 051721 56 (mag. +0.3), Uranus at 131407 07, Neptune at 161919 44
16	Full Moon at 23:58
17	Warren Astronomical Society General Meeting at 8:00 p.m. Moon 4° S. of Neptune at 22:00
18	Mercury at ascending node
19	Lunar apogee (252,300mi.) at 9:00
20	Mercury in superior conjunction at 3:00, Venus 6°N. of Aldebaran 1200
21	
22	
23	Mercury at perihelion, Moon 4°N. of Jupiter at 11:00
24	
25	Last Quarter Moon at 3:40
26	Moon 8° N. of Mars at 1:00
27	Neptune at opposition at 8:00, WAS campout over Mem. Weekend at Camp Rotary, call Frank at 791-8752
28	
29	
30	Venus 1.7°N. of Saturn at 5:00, maximum of η Pegasid meteor shower (radiant: 220028) V. fast w. persistent trails.
31	Mercury 3°N. of Saturn at 9:00, Jupiter stationary at 1:00, New Moon at 23:34 NOTE: All times are in 24-hour E.S.T., unless otherwise noted. Configurations for Jupiter's satellites are on the next page.

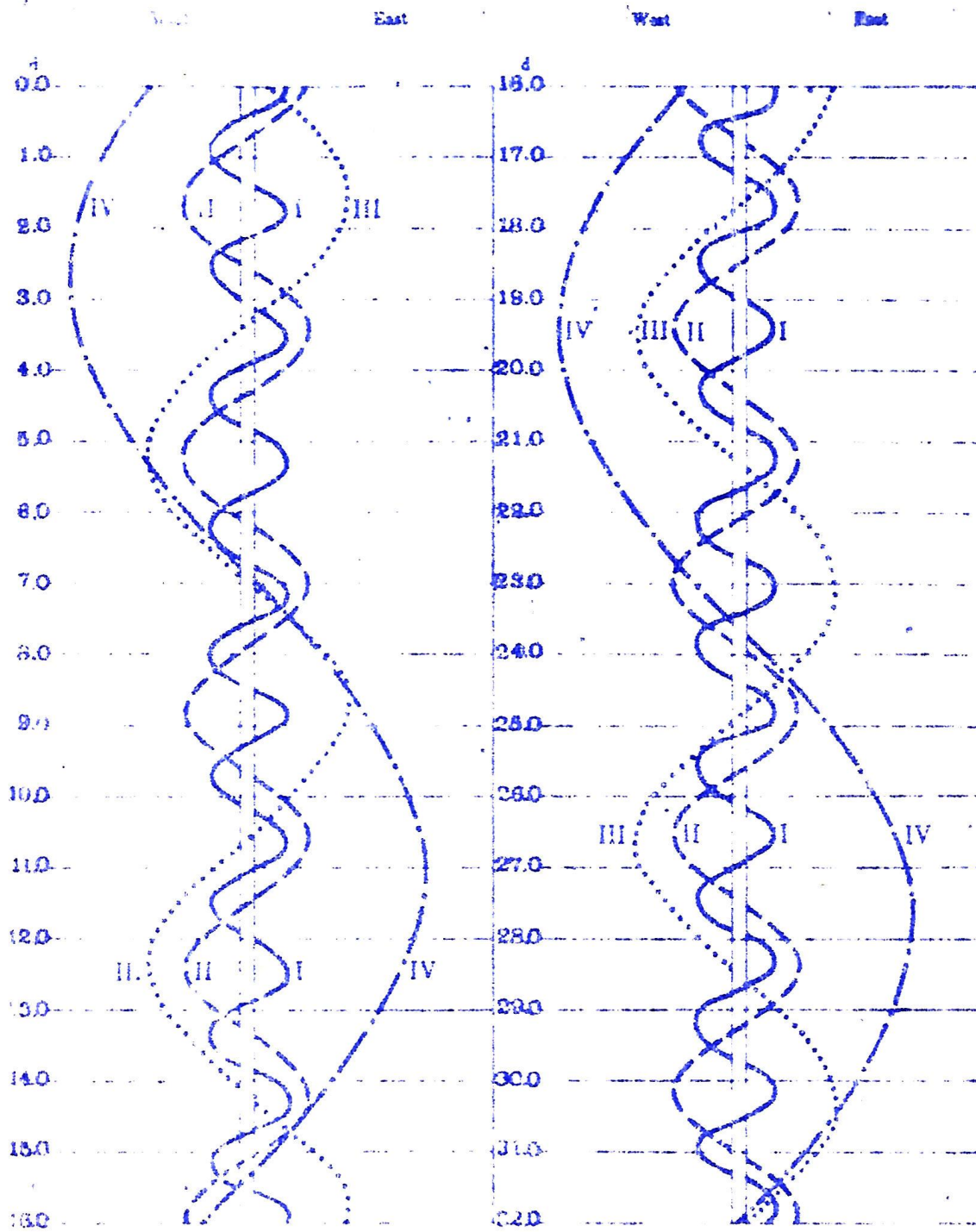
ASTROPHOTOGRAPHERS

Save time and film. Twenty-page booklet (8½ by 11 in.) contains exposure data for the sun, moon, planets, satellites of Jupiter and has a recently expanded eclipse section for the sun and moon. Seventeen exposure guides list shutter speeds for all films (4 to 2000 ASA) and f ratios (1.4 to 256.0). Includes instructions for first focus, afocal, negative and positive projection telescope photography. Send \$2.00 to Larry F. Kalinowski, 15674 Flanagan Ave., Roseville, Mich. 48066. Phone (313)-776-9720. SPECIAL OFFER: \$1.00 off regular price of \$2.00 for all Warren Astronomical Society Members.

SATELLITES OF JUPITER, 1973

CONFIGURATIONS OF SATELLITES I-IV FOR MAY

UNIVERSAL TIME



PHASES OF THE ECLIPSES

I	W		III	E	W		E
II	W		IV	E	W		E