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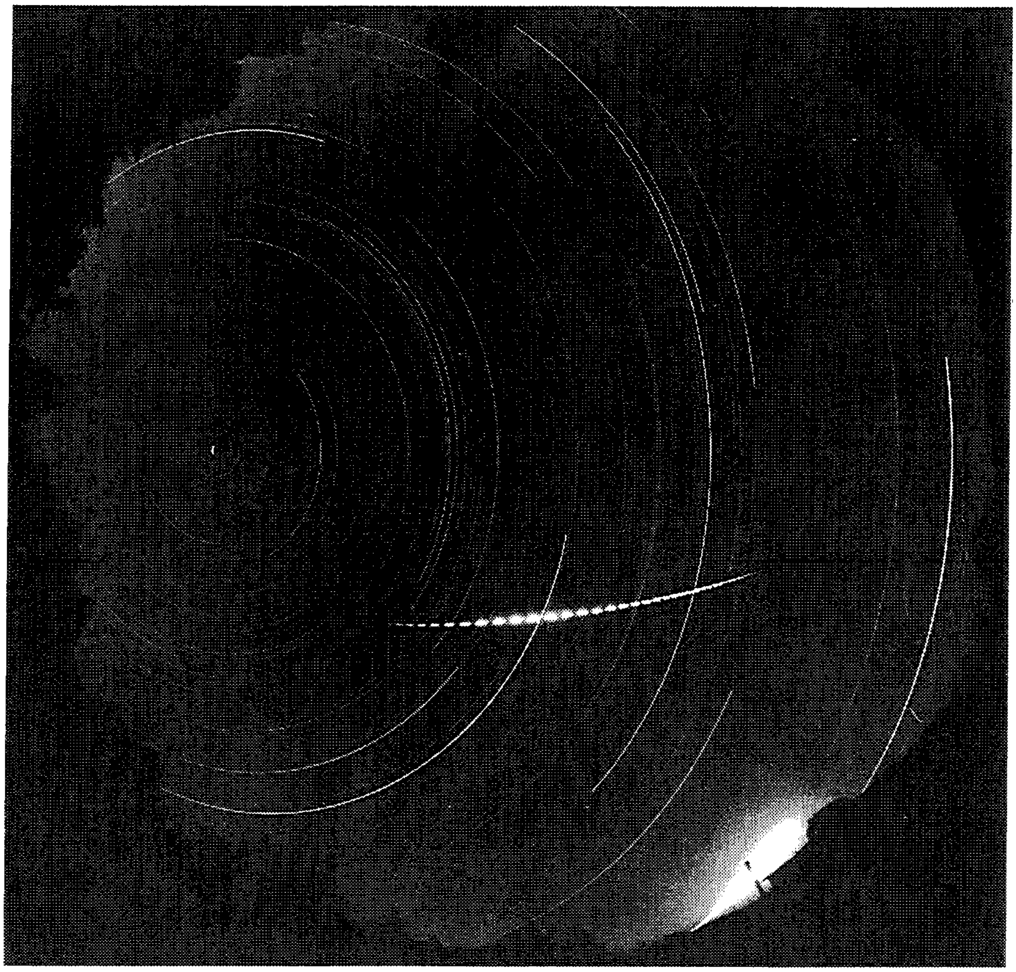

The EN220495 "Kouřim" fireball photographed above the eastern horizon from the closest station Ondřejov by fixed fish-eye camera ($f = 30$ mm, $f/3.5$, shutter 10 breaks/s). The direction of the fireball flight is from south to north.

In this issue:
- Questionnaire for meteor observers
- Practical information for observers
- More on the α-Monocerotids
- History of meteor astronomy
- Meteorite droppings over Japan on January 7
- Observational results

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Useful Information

The August Issue *(WGN 24:4)*

The *August issue* will be mailed around mid-August Contributions are due on *July 11* at the latest. They should be sent to *Marc Gyssens*.

Administrative Correspondence

Ordering *IMO* publications is done in the same way as paying subscription/membership fees. Complaints about not receiving *WGN* or changes of address should be sent to *Paul Roggemans*.

All addresses can be found on the inside of the back cover.

From the Editor-in-Chief

Marc Gyssens

First of all, I wish to apologize to all of you who have been worried at some time or another that either something went wrong with your renewal or something went wrong in the mail. The reality was that the accumulated delay in the production of WGN *had become that large that drastic measures were called for. A double issue, which by the way did not contain fewer pages than would have two separate issues, seemed the most appropriate solution to get back on schedule. Of course, we are firmly committed not to repeat this move. We intend to stay on time now, and as there is now a serious outlook for a reduced professional workload for your editor-in-chief this fall, it is also possible to realize that intention! So, hold on to the previous issue: it may become a collector's item some time from now!*

The June issue is the last issue before summer in the northern hemisphere, a period traditionally well-covered by the observers among our members and subscribers. All general observer information can be found in the previous issue, but some more specific hints are contained in this issue. In particular, we still have to look out for a possible Perseid outburst, as the "new" peak attributed to the proximity of parent comet Swift-Tuttle still showed considerable activity last year.

Enjoy this issue as well as your observing sessions the upcoming months!

Letters to WGN

compiled by Marc Gyssens

How big was the Leonid outburst in 1966?

We received a reaction from Paul Roggemans on Marco Langbroek's letter in the previous issue.

Reading the letter by Marco Langbroek, I took a look at the references quoted. After reading the article by Bruce McIntosh and Peter Millman [1], I was left with a few questions. Nowhere, evidence is given for the radar rates being comparable to any kind of visual rates. It looks to me as if someone tries to compare apples with oranges. Furthermore, radar observations of such an intense display involve specific problems in terms of a saturation of the recording equipment. High-velocity meteors introduce specific problems for radio observations, therefore it looks rather unlikely to me that visually observed meteor stream activity can be straightforwardly compared to echo counts from radar observations. I have read many papers about radar meteor observing, and the complications that occur with high velocity meteors often resulted in a fair warning by the authors as conclusions are uncertain in many of these studies. I would appreciate if any radar meteor worker would comment further on this.

I do not see why an upper limit in visual rates should be installed. It feels dogmatic to me to call rates above a certain level "mythic" or "romantic." For what scientific reason should 40 meteors per second be excluded? Facts must be reported by observers the way they observe them and if these are unbelievably spectacular, well, just bad luck for those who did not see them! Reading the papers of Jenniskens, I get very suspicious about what he writes and I strongly recommend Marco to read some other sources as well than just the papers by Jenniskens he systematically refers to.

Another aspect raised by Marco Langbroek is the use of non-*IMO* data. As I created the *VMDB* in 1988, I experienced that a number of observers preferred not to make their data available. I estimate *IMO* collects some 80% of all available usable visual data from around the world. The remaining 20% is simply not available and unverifiable. The *IMO* is eager to collect as many data as possible; if the *IMO* is missing data, it is because some observers for various reasons do not send their data to the *IMO*. In the other direction, the IMO makes its visual data available worldwide in order to allow different analyses to be undertaken with the data collection of the *IMO*. It is each individual observer's right to choose not to send data to the *IMO*, but then these people must know what they want: unavailable data cannot be used.

[1] B.A. McIntosh, P.M. Millman, "The Leonids by radar—1957 to 1968", *Meteoritics* 5:1, March 31, 1970, pp. 1–18.

Paul Roggemans, March 25, 1996

On a possible radiant from Comet Hyakutake

In the previous issue, Rainer Arlt briefly touched the issue of the possibility, or, rather, the impossibility, of a meteor shower originating from the debris of Comet Hyakutake. We received the following contribution on this matter from Dr. A.K. Terentjeva and Dr. O.A. Bayuk, of the Institute of Astronomy of the Academy of Sciences of Russia in Moscow.

On the basis of the following orbital elements (eq. 2000.0) of Comet 1996 B2 Hyakutake by Marsden [1],

Epoch = 1996 April 27.0 TT
T = 1996 May 1.3965 TT $\omega = 130\overset{\circ}{.}2102$
e = 0.999662 $\Omega = 188\overset{\circ}{.}0430$
q = 0.230035 AU $i = 124\overset{\circ}{.}9098$

the coordinates of the geocentric radiants of a possible meteor shower for the point of the closest approach (appulse) of the Earth's orbit to the orbit of the comet and then in both directions from it (for each degree of the Earth's longitude) were calculated. The calculations were carried out up to a limit determined by the value of the shortest distance ρ between the orbits being equal to 0.250 AU, i.e., the radiants were found for all ρ smaller than 0.250 AU. Thus, the ephemeris of the geocentric radiant (not subject to influence of zenith attraction and diurnal aberration) of the hypothetical meteor shower of Comet 1996 B2 Hyakutake was obtained. The calculations were performed using the algorithm developed in [2].

The Earth approaches the comet orbit twice. First, in March, it passes by the ascending node, the closest approach distance ρ being equal to 0.1010 AU. In September, near the descending node of the comet orbit, the Earth passes the second point of closest approach, but on a larger distance of $\rho = 0.6642$ AU. The ephemeris of the meteor shower radiant is given in Table 1.

Table 1 – Ephemeris of the geocentric radiant of a hypothetical meteor shower caused by Comet 1996 B2 Hyakutake (eq. 2000.0).

1996 March	$\lambda_\odot$	α	δ	V	ρ (AU)
20.603	0°3182	218°8	−32°2	2.006	0.2340
21.610	1°3182	220°3	−32°8	1.9926	0.1935
22.617	2°3182	221°8	−33°3	1.9782	0.1530
23.625	3°3182	223°4	−33°9	1.9631	0.1175
24.634	4°3182	225°1	−34°4	1.9473	0.1010
25.643	5°3182	226°8	−35°0	1.9309	0.1206
26.653	6°3182	228°6	−35°6	1.9140	0.1713
27.663	7°3182	230°4	−36°2	1.8966	0.2404

In Table 1, $\lambda_\odot$ is the solar longitude, α and δ are the coordinates of the radiant, V is the relative velocity of meteor shower (with the Earth's orbital velocity as unit), and ρ is the shortest distance between the orbits of the Earth and the comet. The total duration of the approach of the Earth to the comet's orbit (for $\rho < 0.250$ AU) near the ascending node is equal to 8 days (March 20–27). Over this time interval, the radiant moves from Centaurus into Lupus.

Maybe the observation of meteor activity, performed at low latitudes, will clarify the problem of existence of meteoroid particles on the comet's orbit.

[1] B.G. Marsden, *IAU Circular* 6359, Cambridge, Mass., 1996.
[2] A.K. Terentjeva, "On the motion of the Cyclid geocentric radiants", *Problemy kosmicheskoj fiziki* 8, 1973, pp. 140–146.

A.K. Terentjeva and O.A. Bayuk, April 25, 1996

Rainer Arlt, the author of the short note in the previous issues, wrote the following response to the above note by Dr. Terentjeva and Dr. Bayuk.

To my understanding, the above-mentioned radiant of hypothetical meteors from Comet Hyakutake needs some annotations, since this journal does not mainly address professional astronomers in celestial mechanics, but meteor observers who really face the phenomena in the sky.

Several techniques have been developed yielding radiants from asteroids or comets passing the Earth at larger or smaller distance. Most of them do not follow the evolution of the orbits of individual meteoroids neither do they consider the ejection process of meteoroid-sized particles, but apply manipulations to the parent object's orbit which are to some degree reasonable.

The result of these methods is a theoretical radiant which does not tell anything about the number of meteors to be expected. The distance of the orbits of comet and Earth is some 0.1 AU. The method applied above may give indications for shower activity from comet orbits that very closely approach the Earth, but it is hardly applicable to large distances like that of comet Hyakutake. More appropriate techniques would involve the application of secular perturbation theory to the meteoroids over the past 10 000 years [1].

According to my rough estimate in the previous issue of *WGN* [2] we may not expect any meteors from this return of Comet Hyakutake as the meteoroids will not have traveled sufficiently off the comet's orbit to hit the Earth. When we consider the annual component of a hypothetical stream caused by Comet Hyakutake during a large number of revolutions, we find that other orbits of periodic comets have similar distances to the Earth's orbit. However, the long period of comet Hyakutake, and hence the very long trajectory over which the particles spread, causes a much more dilluted annual component, with at best 1/25 of the density of comet Halley's meteoroid stream [3].

Although the above computation cannot give an estimate of the expected meteor activity, it does tell us that the radiant would lie within a radius of about 10° around the given position. Any other positions which have been mentioned on several occasions since March are geometrically impossible. From physical considerations we may further conclude that no visually detectable meteor activity is expected from Comet Hyakutake.

[1] D. Steel, "The association of Earth-crossing asteroids with meteoroid streams", *Earth, Moon, and Planets* 68, 1995, pp. 13–30.

[2] R. Arlt, "No Meteors from 1996 B2 Hyakutake", *WGN* 24:1-2, 1996, p. 19.

[3] P. Jenniskens, *personal communications*, March 17, 1996.

Rainer Arlt, May 14, 1996

New editorial policies

Thusfar, we received only one reaction to the new editorial policies explained in my editorial note last issue.

I do not agree with the removal of the list of potential radiants from comets and asteroids. Romanian observers have no access to Internet, so we cannot consult this list if it is not included in *WGN*. I think that other observers from other countries are in the same situation, too.

Vasile Micu, May 6, 1996

Editor's response: *The editorial policies explained in the previous issue resulted, as do most policies, from weighing sometimes conflicting arguments. Top priority was given to the requirement that the cost of* WGN *should remain under control. For a lot of observers in, e.g., Eastern Europe, I think this is very important. In order to achieve this requirement, the size of* WGN *had to be kept under control. Recently, we regularly received criticism on the number of pages occupied by the observers' notes, especially in regular issues, where they occupied almost half of the issue. Furthermore, these observers' notes were poorly read in general. Therefore, we reduced the size of the observers' notes, while at the same time making them more efficient. In this effort, it was indeed decided to drop the list of potential radiants from comets and asteroids. I must emphasize that this list is not useful for the preparation of an observation, because it contains too many entries. The list is of interest to verify, after observing, whether some unusual meteor activity may match one of the radiants listed. However, I also emphasize that whenever there is a realistic possibility that an Earth-grazing comet or asteroid will produce a meteor display, we will mention this in sufficient detail in the observers' section of* WGN.

Visual Observers' Notes for the 1996 Perseids

Rainer Arlt

Theoretical investigations of the evolution of the new filament in the Perseid meteoroid stream suggest high activity from the meteoroid source of the last century's perihelion passage of 109P/Swift-Tuttle throughout the 1990s [1]. The Perseid outbursts since 1991 confirm this result, and we may expect another activity peak in 1996 as well. We cannot give predictions on the activity level, yet it will definitely be above the ZHR of the annual maximum occurring about half a day later.

The time of the peak varied between $\lambda_\odot = 139.^\circ50 \pm 0.^\circ04$ in 1992 and $\lambda_\odot = 139.^\circ64 \pm 0.^\circ04$ in 1995 (all solar longitudes in eq. 2000.0). These positions correspond to August 11, 21^h UT and August 12, 0^h30^m UT in 1996. The time of the average solar longitude is August 11, 23^h30^m UT, whereas the 1995 peak would correspond to August 12, 0^h30^m UT. These two times which are only 1 hour apart represent the most probable period when the outburst may occur. The time is ideal for European observers; eastern European observers will face the radiant highest in the sky during the peak. Moreover, the maximum is two days before the New Moon, and we can enjoy dark skies.

The traditional maximum was observed between $\lambda_\odot = 140.^\circ0$ and $\lambda_\odot = 140.^\circ3$ in the last years which is between August 12, 10^h UT and 17^h UT in 1996. It can thus be observed from the western parts of Northern America if it is early, from Hawaii, and from Japan.

Let us combine the good circumstances for observing the Perseid maximum with an appropriate way to report the results; otherwise we may lose valuable information due to awkwardly filled-in report forms. The guidelines for observations of high activity were given for the 1994 Perseid maximum in [2]. I will just repeat the items given two years ago here for convenience:

- When the activity is about 50 meteors per hour, report Perseid and non-Perseid numbers for 15-minute periods. Give magnitude distributions per period of about 1 hour.
- When the activity is about 100 meteors per hour, report Perseid and non-Perseid numbers for 10-minute periods. Give magnitude distributions per period of about half an hour.
- When the activity is about 200 meteors per hour or higher, report Perseid and non-Perseid numbers for 5-minute periods. Give magnitude distributions per period of about 15 minutes.
- Enclose a meteor list with the time stamps of the night.

References

[1] Z. Wu, I.P. Williams, "The Perseid Meteor Shower at the Current Time", *MNRAS* 264, 1993, pp. 980–990.
[2] R. Arlt, "Hints for Visual Observations of the Perseids", *WGN* 22:3, 1994, pp. 87–90.

Photographic Observers' Notes for the 1996 Perseids

Marc de Lignie

As announced in the last *WGN*, no photographic observer's notes will be given unless a special event is expected. The 1996 Perseids' maximum is such an event, because it may be one of the last times that the new peak associated with the perihelion passage of P/Swift-Tuttle can be observed.

Photographic observations are of particular importance, because they are more selective than visual observations in discriminating "new Perseids" from "old Perseids." A greater selectivity implies that a smaller increase in activity can still be detected. Photographic observations are more selective because the population index of the new Perseids is lower than that of the old Perseids, so the "new to old" ratio is higher in the photographic magnitude range. Furthermore, the new Perseids are known to originate from just a small area within the radiant area of the old Perseids.

As a result, Lindblad and Porubčan have shown that the new peak has already been visible from photographic observations since 1970 [1], while it did not appear in visual observations until 1988 [2]. Therefore, anyone who knows how to photograph meteors is invited to use his or her camera(s) during the nights around August 12. As announced in the shower calendar, European observers have the best chance of observing the new peak, but observations around the peak are equally valuable in order to determine the background activity of old Perseids.

Reference

[1] B.A. Lindblad, V. Porubčan, "The activity and orbit of the Perseid meteor stream", *Planetary and Space Science* 42 , 1994, pp. 117–122.
[2] P. Roggemans, "The Perseid meteor stream in 1988: a double maximum!", *WGN* 17, 1989, pp. 127–137.

Practical Meteor Photography Part II: Lens Heating

Marc de Lignie

1. Introduction

During windless clear nights, solid objects cool faster than the surrounding air as a result of thermal radiation. In the same way as you can feel the heat of a camp fire through thermal radiation, during a clear night your camera feels the cold of the upper atmosphere. This phenomenon leads to a well-known problem for meteor photographers. If your camera cools below the dew point of the air, dew will form on the lens of the camera and meteor photography becomes nearly impossible. The best way to avoid this problem is to heat your camera. This article provides some practical designs and considerations for building your own lens heating system.

2. The car battery as power supply

Many observers only have their car battery available as a power source for heating cameras. In this case only a few tens of Watts of electrical power are available if you want to observe during a period of 10 hours. This requires that heat is applied selectively to that part of the camera that needs it most, namely the objective.

Two possible designs are drawn in Figures 1 and 2.

The design of Figure 1 applies special cotton straps that are normally used for making curtains (check your local sewing shop). This strap has nice little holes in which you can put small resistors. Use isolated multi-wire electrical wiring, which can be easily bent, and solder all resistors in parallel as indicated in Figure 1. The length of the strap should be a few centimeters longer than the circumference of the camera lens. In this way you can sew some sticking band to the ends of the main strap. With the sticking band it is easy to apply the heating strap to the camera and remove it afterwards.

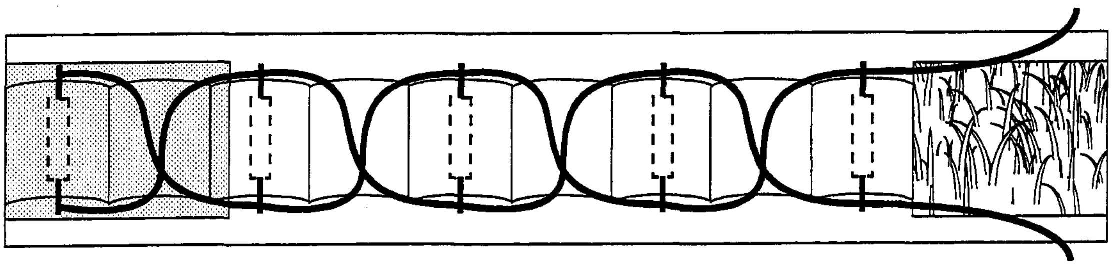

Figure 1 – Lens heating device using a strap of cloth and several small resistors.

When the strap is attached to the camera, the resistors and wiring should be at the outside of the strap. Otherwise, the metal parts of the lens could cause a short circuit. Be also cautious not to burn the strap when soldering the wiring to the resistors so that the strap functions as an insulator between the resistors and the objective. Alternatively, you can sew an additional strap of cloth over the resistors, once you have finished the wiring.

The total heating power required per lens is about 2 Watt. In case of a 12 Volt power supply (car battery) you can use 10 small resistors of 680 Ohm or 12 resistors of 820 Ohm. The small resistors can each dissipate 0.25 Watt of electrical power. Therefore, the lowest resistance value that you can apply at 12 Volt is 560 Ohm (if you do not worry about unloading your car battery).

If you do not have experience with soldering, the design of Figure 2 may be more attractive. In this design it is not attempted to heat the entire objective, but rather a single resistor is placed just below the front of the objective. This causes warm air to ascend in front of the objective, keeping it free from dew.

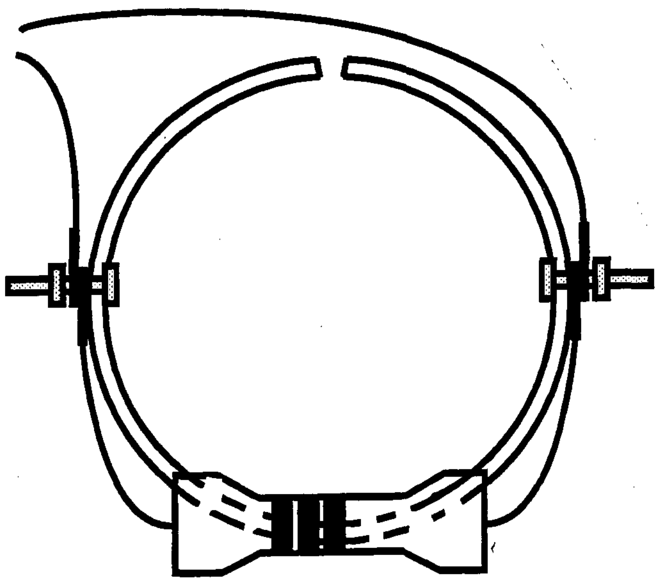

Figure 2 – Lens heating device using a piece of plastic pipe and one large resistor.

The basic materials for this design are a small piece of plastic tube, a single resistor, two 3 mm nuts and bolts, and four small cable sockets. The piece of plastic tube is cut at one spot so that it can be bent to a somewhat larger diameter around the objective. Two holes are drilled at opposite ends of the piece of plastic tube. Now the cable sockets can be attached to the tube with the small bolts. Two of the cable shoes are used for the wires to the power supply. The other cable sockets are used to connect the wires of the resistors to the bolts so that they make electrical contact with the wires of the power supply.

In case of a 12 V power supply the resistor should have a resistance of 100 or 120 Ohm and an allowed electrical power dissipation rate of 1 Watt. In the outside air the resistor can be heated slightly above its ratings. Resistors with a larger power dissipation rate also have larger physical dimensions and are difficult to apply in this design.

If you have the 115/230 Volt mains available at your observing site, you do not have to worry about the power consumption of the lens heating. Nevertheless, you may want to use the designs of the previous section in order to be prepared for future use of car batteries.

Being more generous with applied heat has one big advantage: it is possible to heat not just the lens but rather the entire camera. In many cameras the photographic film has a tendency not to lie flat behind the lens if it is cold or damp. So, heating the entire camera may improve the optical quality of your camera. In addition, transport of the film is easier if it is not allowed to cool strongly or to get damp. This is particularly important for automatic cameras that use a motor winder.

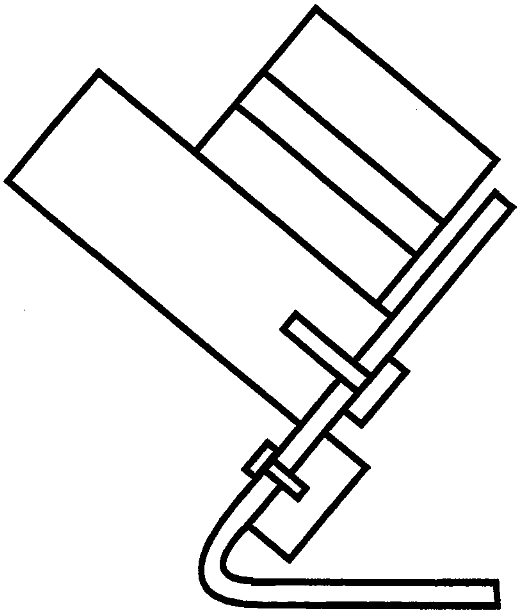

Figure 3 – Heating of the entire camera via a power resistor fixed to a bent aluminum camera mount.

An easy way to heat the entire camera is to mount the camera on a bent aluminum plate (see Figure 3). A heating element can be attached to this plate and the heat will flow from the plate to the camera body. In this design the electrical heat dissipation required is much higher than in the case of lens heating, about 15 Watt per camera. The heating element can be a power resistor in a special heat conducting case. The required resistance value amounts to $V \times V/P$, with V the voltage of the power supply and P the electrical power in Watts. The special resistors may be quite expensive so it may be worthwile to see what you can get at a dump store and adapt the voltage of the power supply to the resistance value that is available. Usable resistance values are between and 1.7 and 60 Ohm. This assumes a power supply voltage between 5 and 30 V and a power dissipation of 15 Watt. A voltage lower than 5 V is not practical. A voltage higher than 30 V is strongly discouraged because of safety reasons, see also below. If the price of power resistors is a problem and you know how to wire a transistor, a power transistor may be a low budget alternative for the power resistor. However, the additional wiring will result in a less reliable setup.

3. Safety

This warning is for people that want to build their own low voltage power supply, which on its turn uses the 115/230 V mains voltage. If you have never made outdoor equipment for 115/230 V, be sure to contact someone that has this experience. Heating your camera is important, but it is not worth electrocution. In particular, all metal parts of the housing of the power supply, as well as the low voltage side of the transformer, should be properly grounded. Further, melt fuses should be applied in both the low and high voltage circuits to prevent fire in case of short circuits. If you are not sure that you understand these general construction procedures, use a commercial power supply with proper grounding.

The use of heating lints or other heating elements that are directly fed by the 115/230 V mains voltage, is strongly discouraged. Although such devices are supposed to be safe, the fact that a meteor photographer works in a dark and often damp environment, makes that any construction faults or damage to these heating lints is much more likely to be fatal.

If you use a car battery as a power source, be sure that the terminals of the battery are insulated so that no accidental short cicuits due to falling tools can occur (many authors claim that car batteries can explode in case of a short circuit). Also in this case, all electrical circuits should have melting fuses to prevent fire in case of short circuits.

Acknowledgments

The lens heating designs described in this article are from Hans Betlem and Klaas Jobse.

An Invitation to Participate in a Survey of Meteor Observers World-Wide

Godfrey Baldacchino

Welcome to the first ever international survey of meteor observers!

This original research initiative by the *IMO* is being undertaken in order to build a profile of the contemporary meteor observer: his/her age, academic, and occupational background; regularity and commitment to observation: objectives from pursuing the hobby; motivators and demotivators towards observations; first experience with meteor watching; type of observation preferred; involvement in groups or associations.

This survey was pre-tested at the September 1995 *International Meteor Conference* in Brandenburg.

The outcome of this pioneering investigation should carry useful implications for an organization like the *IMO*, since this body depends on people willing and able to observe meteors and which need to encourage others to take up this hobby and to derive maximum worth and benefit from this pursuit.

All *WGN* readers who are meteor observers are being invited to complete an anonymous and confidential, two-page questionnaire. You find the questionnaire on the following pages.

Others—who have kindly accepted to act as national coordinators—will organize and supervise the distribution and collection of questionnaires to individuals or groups within a specified country.

You may, if you wish, pass on copies of the survey to meteor observers you know but who do not receive *WGN*; but please take the trouble to collect and forward any completed copies to the national project coordinator. (Remember also: only one questionnaire per meteor observer.) Just a few minutes of your time are important to us!

Various *IMO* members have kindly accepted to act as national coordinators for this study. They have already received a copy of the questionnaire and are photocopying and distributing it to national and regional astronomy associations, meteor observing clubs or individual meteor observers. Some are translating the questionnaire into local languages.

At the time of writing (May 15, *1996*), the following national coordinators are confirmed:

George Zay	(United States)	Cis Verbeeck	(Belgium)
Rainer Arlt	(Germany)	Jeff Wood	(Australia)
Tim Cooper	(South Africa)	Trond Erik Hillestad	(Norway)
Andrey Grishchenyuk	(Ukraine)	Aram Karalic	(Slovenia)
Korado Korlevic	(Croatia)	Ake Lyssell	(Sweden)
Michael Schembri	(Malta)	Carlos Francisco Sosa	(Argentina)
Graham Wolf	(New Zealand)	Daniel Očenáš	(Slovakia)
Vasile Micu	(Romania)	Per Tyberg Aldrich	(Denmark)
Casper ter Kuile	(the Netherlands)	Luis Ramon Bellot	(Spain)
Alastair McBeath	(United Kingdom)	Massimo Dionisi	(Italy)
Ivanka Getsova	(Bulgaria)	Ichiro Hasegawa	(Japan)
Khalil Konsul	(Jordan)	Vladimir Lukic	(Yugoslavia)
Bruno Mancusi	(Switzerland)	Hans Salm	(Bolivia)
Erich Weber	(Austria)	Xu Pin-Xin	(China)
Frederico Ferreira	(Portugal)	Marco Toivonen	(Finland)

For the purpose of this study, a meteor observer is one who (a) has observed meteors at least once over the past 12 months; and (b) is planning to observe meteors again. Any type of meteor observation (visual, photographic, telescopic, etc.) counts.

All completed questionnaires are to reach your national coordinator **by August 15, 1996**. If, for some reason, this is not possible, then send the questionnaires to me at the address given at the inside back cover, but **not later than August 31, 1996**.

Completed questionnaires are already rolling in. Once the completed forms are collected and duly analysed, I will submit a detailed report to be reviewed for publication in *WGN*. It will also be presented to the *IMO* Council where its results and their policy implications will be debated. Hopefully, an interim report may be submitted for the *IMC* at Apeldoorn in mid-September.

Thank you in advance for your cooperation in this project.

Survey of Meteor Watchers World-Wide

Completed today, the _____ of _______________, 1996.

Circle the correct answers or fill in the blanks, as relevant.

1. Your gender: Male/Female
2. Country of residence: _______________
3. Your year of birth: 19__
4. If you are a student, describe your studies: ____
5. If your are working, describe your job: ____
6. Are meteors somehow related to your studies/work? Yes/No
7. How many observing hours have you clocked so far in 1996? (*tick one only*)
   None __
   5 hours or less __
   Between 6 and 20 hours __
   Between 21 and 50 hours __
   51 hours or more __
8. When was your last meteor observation? Date: _______________ (*format dd/mm/yyyy*)
9. Do you prefer to observe alone or in group?
   Alone/Group/No difference
10. What kind of meteor observation do you practise?
    (*Rank in order of importance, with 1 being the most important*)
    visual / photographic / telescopic / TV with video / radio echo / _______________
11. Why are you interested in meteors today? (*Grade your answers in order of priority, assigning 1 to your first choice, 2 to your second, etc. Do not rank items that you consider unimportant.*)
    I can make a contribution to knowledge and science. __
    I am fascinated by the wonders of nature. __
    I consider it a spiritual or emotional experience. __
    The activity builds and strengthens friendships. __
    It is just fun. __
    Any other reason(s)? Please specify!
    __________________________________ __
    __________________________________ __
12. In what year did you carry out your first ever meteor watch? 19__

13. Describe what led you to carry out this first watch:

    ____

14. Did you benefit from a close association with a friend, a teacher, role model, ..., i.e., a person who led you to start observing meteors? Yes/No
15. If yes, describe this person, and, unless you have an objection, give his/her name and capacity:
16. Do you participate today in the activities of any local, national or international astronomy association? Yes/No
17. If yes, specify:
18. What do you usually do with your meteor observations? (*tick all those relevant*)
    - I do not keep records. —
    - I file them away. —
    - I pass the data on for analysis. —
    - I analyze the data and pass on the results. —
19. Finally, your views are important! Can you recommend what can be done to further promote the activity of meteor watching at a local, national, or international level?
20. If you would like to register a comment, a suggestion, or any form of criticism, please do so below:

Renewed thanks. Now, do not forget to return this completed questionnaire to the National Coordinator for your area or country. In case of any difficulty, consult the Survey Coordinator, Godfrey Baldacchino, "Sirius," Triq il-Migbha, Marsascala, Malta, tel.: +356-829 603, fax: +356-340 251, email: `gbal@unimt.mt`.

Ongoing Meteor Work
The 1995 α-Monocerotids from Radar Observation at Ondřejov

Miloš Šimek

An activity outburst of the α-Monocerotids 1995 has been observed by the Ondřejov meteor radar on November 22. A double peak activity occurred between 1^h14^m and 1^h37^m UT with a maximum hourly rate of about 330 meteors per hour, calculated from 1-minute observing intervals. A mass-distribution index $s = 1.33 \pm 0.02$ was found for echo durations $T \geq 0.4$ s corresponding to 1.9 limiting magnitude.

1. Introduction

The α-Monocerotids were known from few, not quite accurate observations in 1925, 1935, and 1985. They were characterized by short-time activity taking less than 10 minutes. Their periodicity of ten years indicated a possible return of the shower in 1995 [1–3]. The predictions of their appearance were uncertain, the radiant coordinates were also not known precisely enough. While the radiant declination $\delta = -6°$ repeated in most predictions, the right ascension, α, varied between $110° - 116°$. For our observation on November 21, 22, and 23, between 23^h and 06^h UT, the radiant coordinates $\alpha = 113°$, $\delta = -6°$ were chosen.

2. Data analysis

Echo rates were determined in one-minute intervals. Only overdense echo durations $T \geq 0.4$ s were used for the analysis. To obtain shower rates, observations from November 21 and 23 were taken as representing the sporadic background, which was subtracted from meteor echoes recorded on November 22. Recorded one-minute mean background rates varied from 0 to 1.5, while the maximum shower rate was 4.5 echoes per minute. Considering the same corrections for the antenna patterns—shower radiant zenith distance $z_R = 58\overset{\circ}{.}6$ geometry for the Perseids, and α-Monocerotids having similar geocentric velocity, we obtained a maximum rate of about 330 per hour. Since one-minute rates show substantial scatter, the shower data were cumulated into three-minutes sliding rates. Results are shown in Figure 1. Shower activity started shortly after 1^h UT at a modest level until 1^h14^m UT, when an apparently continuous rise of meteor echo rates appeared, culminating at 1^h25^m-27^m, followed by a secondary peak at 1^h34^m–35^m. The end of the α-Monocerotid display is characterized by a fast drop of shower activity interrupted by a secondary maximum at 1^h42^m–44^m.

The mass-distribution exponent, s, was determined from the constant slope, $S = -3/4(s-1)$, of the linear part of the cumulative distribution curve of $\log N_c$ versus $\log T$, where diffusion is the dominant destructive process of an ionized overdense meteor trail. In the echo duration range $0.4 \text{ s} \leq T \leq 3.3$ s, corresponding to the magnitude range from +1.9 to +0.3, divided into eight duration classes containing 45% echoes from the entire sample analyzed, the value $s = 1.33 \pm 0.02$ was found. The maximum recorded echo duration of 19.3 s corresponds to magnitude −1.7. The absence of long-duration echoes is evident. The low population index indicates the flow and supply of the meteor stream by fresh meteor particles from the parent source [4]. The population index of the sporadic background flux during the shower period, in the echo duration range $0.4 \text{ s} \leq T \leq 2.6$ s, shows the usual value of $s = 2.22 \pm 0.05$.

3. Conclusions

The activity profile of the 1995 α-Monocerotids is characterized by two distinct peaks, the first one at solar longitude $\lambda_\odot = 239\overset{\circ}{.}325 \pm 0\overset{\circ}{.}001$ (2000.0) followed twelve minutes later by the second one at $\lambda_\odot = 239\overset{\circ}{.}325 \pm 0\overset{\circ}{.}001$. The most intense part of the shower was active for 23 ± 1 minutes. The duration of the event as well as the position of the first activity peak coincides with the results of analyses from visual observations [5–7]. A secondary peak apparent from our observation 8 minutes later almost fits with the secondary maximum resulting from visual observation at the same place [6], and with [7]. The population index from radar observation $s = 1.33$ is quite different from the values $s = 2.00$ and $s = 2.30$ from visual observations [5,7]. This discrepancy can be attributed to different analyzed magnitude intervals, containing mostly fainter meteors in the visual range.

Acknowledgments

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The Makings of Meteor Astronomy: Part XII

Martin Beech

The 1861 review article on cometary astronomy by Daniel Kirkwood (1814–1895) is re-examined. In spite of several recent claims to the contrary, we find that Kirkwood was in no manner responsible for the fundamental advancement that demonstrated a causal relationship between meteoroid streams and comets.

1. Why worry?

This article offers a slight departure from what has gone before and is essentially a commentary, albeit one related to the historical development of meteor astronomy. In some sense, this article is really concerned with the development of myths. In particular, it concerns the idea of urban myths—you know, like the one in which a pet owner supposedly tries to dry a wet cat in a microwave, that sort of thing. Such an event probably never happened, and yet we have all heard variants of it. The problem with urban myths is that they take on a life of their own, and, in some cases, people begin to actually believe them. This article is concerned with a meteoritic urban myth—the myth that Daniel Kirkwood proved the existence of an association between meteoroid streams and comets.

2. In defence of reference

The citation of references within scientific articles is now both time honored and essential. They direct the reader to sources of relevant background authority and allow the authors a means of focus whereby they are freed from lengthy prediscussion. Most importantly, however, references should be relevant. In the introduction to a recent *Icarus* article [1], however, my attention was drawn to one particular historic reference—that by Daniel Kirkwood [2]. It is my contention and the focus of this essay that the authors (who are not unique in their reference, but are merely the latest offenders that I have seen), from an historical perspective, were incorrect in their choice of reference. Incorrect, that is, in the sense that Kirkwood was being accredited with a fundamental discovery and exposition that he did not make.

The reference that I wish to discuss in this essay was presented by Lars et al. as follows: *The identification of groupings of common orbits (meteor streams* [sic, see Beech and Steel [3]]*) and their association with comets (Kirkwood 1861) and asteroids ... have been fundamental to our understanding of the physics of the minor bodies of the solar system.* [1] Firstly, I should state that I have absolutely no qualms with the sentiments expressed by the authors—they are indeed correct. However, I do affirm that Daniel Kirkwood can in no way be considered responsible for the establishment of a physical link between meteoroid streams and comets.

3. The Danville review paper

The Kirkwood reference in question was a review article, simply entitled *Cometary Astronomy*, published in the December 1861 issue of the *Danville Quarterly Review.* The Review was published for the Presbyterian Church of America by R.H. Collins in Danville, Kentucky, and Cincinnati, Ohio. The first issue of the Review appeared in March 1861, and in total four volumes were produced, with the journal folding in December 1864. The distribution of the Review was not large and it became best known as the vehicle through which its chief editor, Robert J. Brechinridge, expressed his political ideas—while Brechinridge embraced the ideas of the Union and the American Constitution, he rejected the idea of emancipation [4]. Obscurity of publication, however, is not my main point—even if Kirkwood had published his article in an "internationally-read" journal, his remarks would still not qualify as those representing a fundamental advancement.

What did Kirkwood say in his article? His review is 24 pages long and he mentions meteors twice, with the discussion on these bodies consuming less than one page. Firstly Kirkwood mentions sporadic meteors: *If we adopt Laplace's hypothesis of the origin of comets, we may suppose an almost continuous fall of primitive nebular matter toward the center of the system* [the Sun]*—the drops of which penetrating the Earth's atmosphere, produce sporadic meteors; the larger aggregates forming comets.* Kirkwood secondly comments on the phenomenon of periodic meteors. His outline of a theory for the origin of meteoroid streams was inspired by the division of Biela's comet, which split into two components, circa 1842 [5]. *May not*, Kirkwood argued, *this force, whatever it is, that has produced one separation, again divide the parts? And may not this action continue until the fragments become invisible? ... May not our periodic meteors be the debris of ancient but now disintegrated comets, whose matter has become distributed around their orbits?*

Now, it is fair to say that Kirkwood has outlined (in question form only) a theory of meteoroid stream origins that "sounds like" our modern-day understanding. My first point, however, is that he was certainly not the first person to suggest a link between the displays of periodic meteors and comets (see Hughes [6]). Dennison Olmsted [7,8], for example, had expressed the same causal relationship between the November (Leonid) meteors and a cometary body some 25 years before Kirkwood wrote his article. One might also argue, but perhaps less strongly, that Aristotle had expressed the same ideas as Kirkwood, for certainly Aristotle believed that comets and meteors had similar origins [9].

The foregoing discussion is my main reason for believing that Lars et al. (and many others) are incorrect to reference Kirkwood in the way he has been. Kirkwood's 1861 paper is an inappropriate reference for at least three reasons. Firstly, Kirkwood was not the first person to link periodic meteor displays with comets, secondly, Kirkwood merely framed the outline of an hypothesis, which in point of reference was based upon an "unknown" cometary splitting agent, and, thirdly, Kirkwood did not, and indeed could not, offer any proof or verification for the correctness of his statements. So, even beside the fact that very few people would have read Kirkwood's article, his ideas, as far as meteor science is concerned, are hardly those upon which a fundamental advancement can be bestowed.

Lars et al. are not alone in attributing more to Kirkwood's 1861 article than can be justified. Donald Yeomans [5] in his excellent book on the chronological history of comets has argued that *Kirkwood's idea is the currently accepted explanation for the origin of meteor streams.* My comment to this statement is that Kirkwood's idea is not consistent with the currently accepted theory on meteoroid stream origins. Meteoroids are ejected from cometary nuclei by the action of outgassing resulting from surface ice sublimation; meteoroid streams are not formed through the repetitive fragmentation of cometary nuclei—as Kirkwood suggested.

The first definitive observation and indeed proof of argument linking meteoroid streams to comets was delivered by Giovanni Schiaparelli in 1866 (see, for example, Buffoni et al. [10] and Hughes [6]). Schiaparelli deservedly takes the honor for revealing the association between meteoroids and comets, since he demonstrated through observational derivation the clear similarity between the orbital characteristics of Comet 109P/Swift-Tuttle and the August (Perseid) meteor shower (see for example, Adams [11]). Schiaparelli also demonstrated the fact that sporadic meteoroids travel along highly elliptical orbits.

4. Cause for concern?

While it is to be appreciated that the reference given to Kirkwood by Lars et al. is not essential nor detractive to the development of the main theme of their paper, it is vitally important for the development of science that historical advancements are accredited correctly. Kirkwood certainly put forward an interesting idea in his 1861 review that chanced, in retrospect, to be along the right lines. He was not responsible, however, for establishing beyond any reasonable doubt the link between meteoroid streams and comets.

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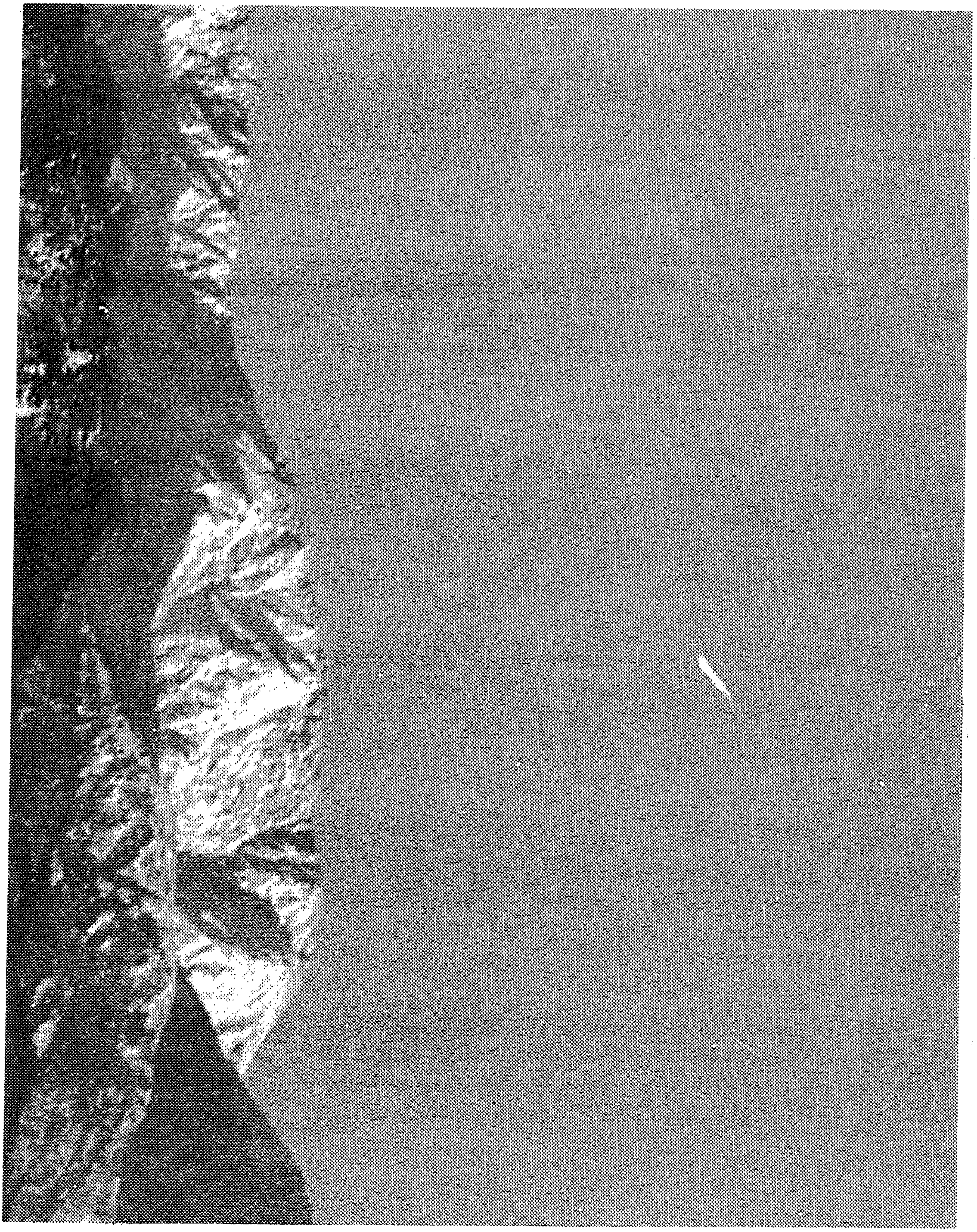

Fireballs and Meteorites

Meteorite Fall in Japan on January 7, 1996

Yasuo Shiba, Daiyu Ito, and Chikara Shimoda

The results of an investigation of a meteorite-dropping daylight fireball over Japan on January 7, 1996, are presented. The fireball was of magnitude between −15 and −20. Up to now, a total of 900 grams of meteorite fragments were found in and around Tsukuba City.

1. Introduction

In the afternoon of January 7, 1996, at $7^{\mathrm{h}}21^{m}$ UT, thousands of people in Eastern Japan, including several members of the *Nippon Meteor Society* (*NMS*) happened to see a very bright fireball flying in the completely cloudless daylight sky. It was about 20 minutes before sunset. This fireball made a big sonic boom, exploded just before it disappeared, and left a meteoritic cloud.

Shortly afterwards, a stone weighing 60 grams that had "attacked" the roof of a garage in Tsukuba City and had been delivered to the police at about $10^{\mathrm{h}}30^{\mathrm{m}}$ UT was recognized as a meteorite by scientists, and was immediately subjected to radio-activity measurement. Short-lived isotopes, such as ^{24}Na, were successfully detected in the stone, for the first time in the world.

Eventually, a total of 900 grams of meteorite fragments were discovered from 23 different sites in and around Tsukuba City. The fragment varied from 1 to 178 grams and were found to be H5-H6 chondrites, although a few were a breccia consisting of different types of stones. They were collectively named the *Tsukuba meteorite*. Research is still going on, mainly at the Geological Survey of Japan and the National Science Museum. In this note, we focus on the work and results of the *NMS* regarding the Tsukuba meteorite.

2. Activities of the Nippon Meteor Society

We received the first news about this daylight fireball from a newspaper company about 30 minutes after the event. We immediately started collecting information through our personal computer network. One hour later, we expected that the fireball had produced a large-scale meteorite shower, and tried to estimate the impact points of meteorites. After meteorites had been discovered one after another, our effort of collecting visual observational data was continued to estimate the geocentric trajectory of the fireball as precisely as possible. We could also obtain some photographs of the fireball itself and the meteoritic cloud. The photograph shown opposite was taken by K. Hongo from Kamiichi, Toyama (137°21′30″ E, 36°40′34″ N). *A fireball photograph by T. Ishida, and a photograph of the meteoritic cloud by S. Kanbara are not reproduced, because too much detail would be lost in this process. (Ed.)*

In order to understand the physiological processes of the meteorite shower fall, simulations were made using the estimated geocentric trajectory and the wind data at high altitude. These wind data were obtained by K. Fukui, one of the *NMS* members, from the Aerological Observatory located in Tsukuba City. The fireball was also caught by seismometers at several locations because of its sonic boom. Dr. Tsukada (Ministry of Meteorology), and Dr. Fukao and Dr. Sakai (Tokyo University) are now analyzing these records. We are exchanging information with them. The *NMS* twice conducted an expedition to find meteorites, with the assistance of the *Tokyo Area Meteor Observer's Network* and a local star-lover's party, the *Tsukuba Star Circle*. The first expedition was conducted on January 13 with 48 participants. The second expedition was conducted on February 11 with 31 participants to survey the area where meteorites over 1 kg would be expected according to the simulation.

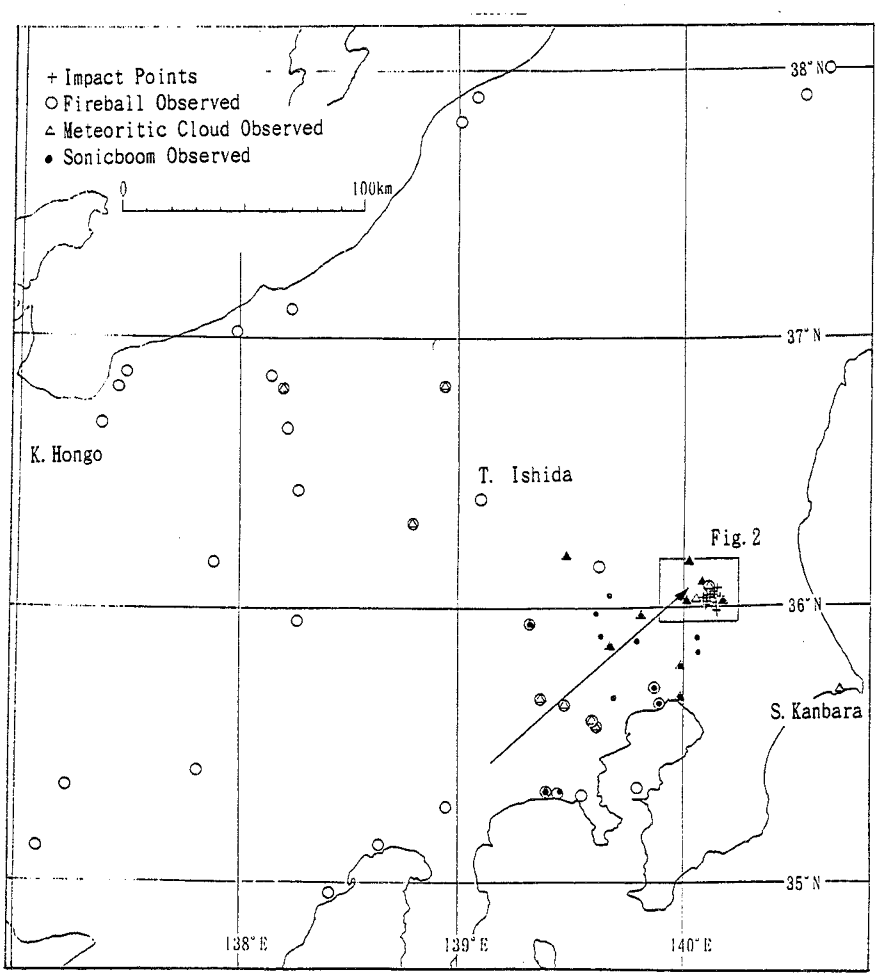

Figure 1 – Observations and trajectory of the fireball

3. Some results obtained

The trajectory of the fireball was estimated by the analysis of visual observation data. An overview is shown in Figures 1 and 2, but we are not yet able to confirm the exact velocity.

The fireball was much brighter than the Full Moon, because many citizens recognized it under the daylight sky, but not comparable to the Sun, because nobody recognized it behind his back nor recognized the shade. Therefore, the brightness was estimated to be between magnitudes −15 and −20. T. Hasegawa estimated it to be −16 or −17, since some person recognized the reflected light of the fireball on a white table.

It was also found that the fireball fragmented in the latter half of its visible flight. According to the visual observations from Tsukuba City, it separated in fragments twice. The fireball shows 6 separate components on the photograph taken by T. Ishida.

Right below the explosion point, the sonic boom was so extreme that it caused vibrations in houses and windows, and scared citizens in their houses who ran outside. The sound was heard within an area of 10 000 km^2.

A white-colored meteoritic cloud was noticed by many people who heard the sonic boom. Our investigation clarified that, at first, a string-shaped cloud of about 1 km length appeared at a height of 22 km, followed by a rapid elevation and deformation. Then, the cloud gradually drifted away with south-easterly winds. The cloud was observed for more than 40 minutes, and then disappeared, probably because of the sunset.

Flight simulations of meteorite fragments with different sizes were made by Y. Shiba based on a simple ablation model, where a velocity of 19 km/s was assumed. Results are shown in Figure 2.

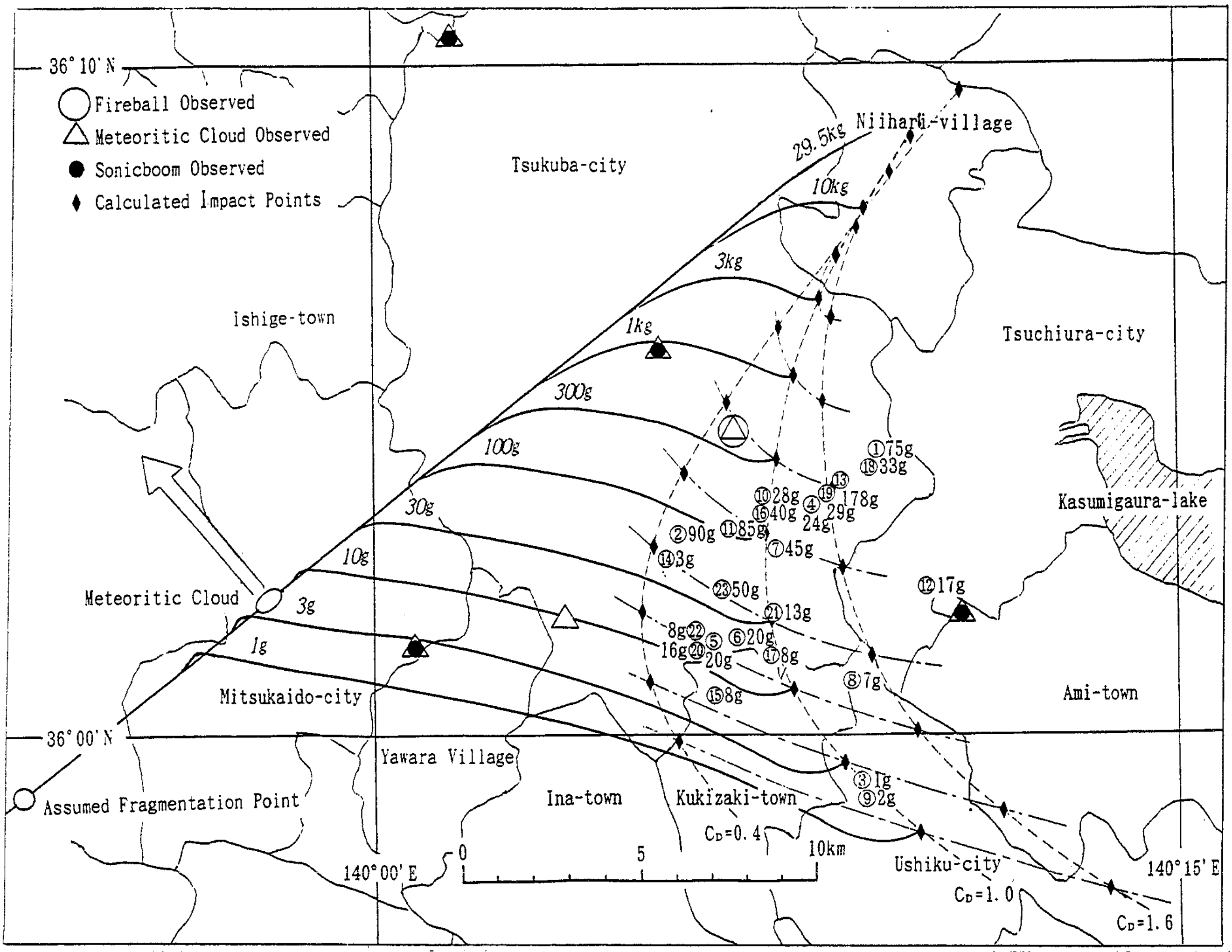

Figure 2 – Detail of Figure 1, showing impact points.

The simulation showed that the smaller-sized fragments deviate much more to the east than the larger ones, and, as a result, the area of meteorite fall is not at all elliptic. This explains the geographical distribution of the discovered fragments well. All fragments could be fit into the model adjusting their drag coefficient (C_D) between 0.4 and 1.6. For fragments Nos. 1, 12, 13, and 18, a correct simulation could also be obtained by assuming a lower fragmentation altitude.

No meteorites were discovered in our expiditions on January 13 and February 11. However, the the first one provided useful clues. On January 14, a participant of our expedition and a person who had watched the event indeed discovered meteorite fragments.

4. Future work

To obtain the origin of the Tsukuba meteorite, we must refine the geocentric trajectory of the fireball. Now we are trying to approach this problem by analyzing photographs of the fireball. Moreover, the precise position of the meteoritic cloud will also help us in refining the trajectory. We have many photographs of the meteoritic cloud to be analyzed. We are planning to determine the brightness of the fireball from the photograph taken by Mr. T. Ishida, although there is no scale for brightness measurement available, except the background blue sky. We are especially interested in the meteoritic cloud. We have many photographs, including the one taken within 1 minute after the cloud had formed. By using them, we want to understand the mechanism of meteoritic cloud formation and deformation. Finally, the total number of meteorites that fell may be much larger than the number of meteorites already discovered. We hope that further simulation studies will indicate where uncollected meteorites may be.

Observational Results

SPA Meteor Section Results: November–December 1995

Alastair McBeath

A review of visual, photographic, and radio data contributed to the *SPA Meteor Section* from November and December is given. November proved to be particularly interesting, with several bright Taurid fireballs, a well-covered, if not especially high, Leonid return, and an impressive, brief, α-Monocerotid outburst on November 21-22. December's weather was generally poor, by contrast, but some Geminids and Ursids were still reported.

1. Introduction

British sky conditions overnight were much as usual during November, which is often one of the worst months of the year for cloudy nights, but even so, the overcast parted to allow at least one British site a view of the α-Monocerotid outburst (albeit that one was my own!). December proved rather worse than normal, however, and consequently, observing totals were well down on what we might have hoped for. The main observing tallies are given in Table 1.

Table 1 – Visual and photographic hours' totals and meteor numbers recorded in each month, including a partial breakdown of meteor types and numbers of photographed meteor trails notified so far.

Month	Visual	STA	NTA	LEO	AMO	GEM	URS	Met	Photo	Trails
November	$152^{h}_{.}23$	90	61	716	330			2107	$330^{h}_{.}16$	4
December	$140^{h}_{.}4$					295	65	905	$177^{h}_{.}75$	1

Apart from these details, three radio observers also contributed data: Robert White in West Sussex, England (662 hours of almost-continuous operation—his recording program crashed between $08^{h}30^{m}$ to $18^{h}00^{m}$ UT on November 23, thankfully not sooner—from November 1–27 for 31 410 echoes), K. Jonas in Budapest, Hungary (data covering the α-Monocerotid maximum only, forwarded by Jeff Lashley of *Sunderland Astronomical Society*) and Ilkka Yrjölä in Finland (data supplied by Norman Fitch of the Radio Society of Great Britain; 96 hours of continuous operation between November 16-19, and a similar amount from December 12-15). The radio data which was noted as coming from Norman Fitch in the previous article in this series [1], was actually from Ilkka as well, incidentally; I apologize for the mistake to Ilkka, Norman, and all who read the article.

All the photographic work was conducted by *Arbeitskreis Meteore* (*AKM*) members as part of the all-sky coverage of the European Fireball Patrol Network. Visual observations were received from (UK sites unless stated):

> *AKM* members (Germany, data summaries provided by Jürgen Rendtel), members of *Astroclub Canopus* (Bulgaria, data submitted by Eva Bojurova), *Ayr Astronomical Society* (data from Tom McEwan), Eva Bojurova (Bulgaria), Walter Bradford, Peter Craven (Finland), *Exeter Astronomical Society* members (observations sent by Lawrence Beck), Shelagh Godwin, Valentin Grigore (Romania), members of the *Hungarian Astronomical Society*'s Meteor Section (results forwarded by Jeff Lashley of *Sunderland AS*), Brian Kelly, Trevor Law, Richard Livingstone, Nick Martin, Tony Markham, Alastair McBeath, Tom McEwan, Vasile Micu (Romania), Martin Plater, Graham Pointer, Ian Rigney, George Spalding, Josep Trigo (Spain), Peter Ward, Graham Winstanley, Graham Wolf (New Zealand, including data from the NZ Fireball Network), and David Woodward.

2. November

The apparent fireball spate begun with the brilliant event of October 30-31 mentioned last time continued through until mid-month and beyond, although after November 15, most such events were Leonids, whereas most before then had been Taurids.

One of the brightest during November occurred at $20^h25^m33^s$ UT on November 5 over Germany, recorded by at least 18 observers [1], including Sirko Molau at Chemnitz, who was indoors working at the time, glanced up and saw the object through partly closed curtains! This has to be one of the luckiest fireball sightings for some time. The object was estimated to be at least magnitude −10, but it is still not clear whether this was a Taurid. Perhaps the last of these possible bright Taurid fireballs, this time "only"about magnitude −5, was seen from two sites in southern England at 21^h13^m UT on November 15. This object fragmented into at least three pieces before fading away.

Other than the fireballs, the Taurids produced low activity, with ZHRs of about 5–6 from either branch up to mid-month, when clouds and the Moon allowed any rates to be calculated, at least. The Taurid peak too seems to have enhanced the radio data Robert White amassed in the early stages of his run, notably from November 5–10, as shown in Figure 1.

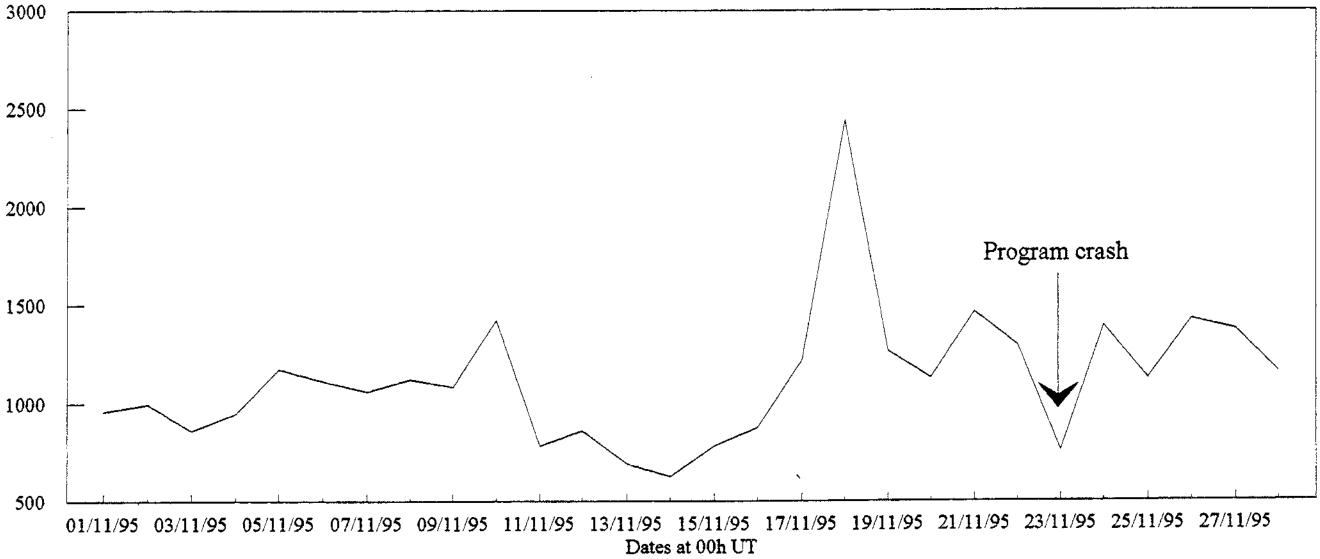

Figure 1 – Daily totals of raw forward-scatter radio meteor counts produced by Robert White during 1995 November. Activity from the Taurids seems to be most noticeable from November 5–10, with the Leonids producing a large "spike" around November 17–19. Part of the enhancement on November 21-22 was due to the α-Monocerotid outburst.

The Leonids were always liable to generate more than normal interest in 1995, after the first enhancement of their rates since the 1966 storm was detected in 1994 November, despite moonlight problems then [2]. Unfortunately, in Britain at least, and encouraged by some rather incautious "predictions" being made in certain quarters, the media were apparently expecting something approaching an actual storm of Leonids to arrive in 1995. While this seems to have persuaded more people to go out and look for meteors than otherwise might, quite a few people were rather disappointed by what actually occurred. To be fair, those observers with more meteor watching experience were reasonably pleased to see the Leonids produce better activity than most have seen in a long time, but as activity was lower than best estimates suggest for 1994, it was hardly the display the "hype" had led people to expect.

Most visual observations for November concentrated around November 17–20, and some good vigils were conducted, including spells of around 3 hours or more on November 17-18 coming from S. Godwin, R. Livingstone, T. Markham, T. McEwan, G. Spalding, G. Wolf, and several *AKM* members, notably R. Arlt, R. Koschack, J. Rendtel, and U. Sperberg. Observed Leonid activity was generally around 10–15 an hour.

Clear-sky data sets (where the limiting magnitude was +5.5 or better, and cloud cover less than 20%) showed mean Leonid ZHRs of about 19 ± 5 on November 16–18, rising to 30 ± 6 on November 17-18. Around 3^h–4^h UT on November 17-18, highest Leonid ZHRs were about 35–40 ± 11–12, but went no higher, even so, representing a two- to threefold increase on shower rates in recent years. They were still around 10–20 up to November 19-20, but had fallen away to about 3 ± 2 by November 21-22. These figures were computed using an r-value of 2.25, indicated by the magnitude distribution, where a lot of bright Leonids were apparent. Something of this can be seen in Table 2, which shows global magnitude distributions for the better-sky Leonids, α-Monocerotids and November sporadics extracted from reports featuring such information.

Table 2 – Global magnitude distributions, including mean limiting magnitude, for the Leonid, α-Monocerotid, and sporadic meteors seen during November 1995, under better sky conditions.

Shower	-3^-	-2	-1	0	+1	+2	+3	+4	$+5^+$	Tot	Lm
LEO	5	4	10	16.5	44.5	42.5	34.5	10.5	6.5	174	5.91
AMO	1	1.5	12.5	35.5	31	36.5	24.5	14	9.5	166	6.18
SPO	1	0	5.5	12.5	36.5	56	69.5	50.5	54.5	286	5.91

Radio results from Robert White and Ilkka Yrjulle both suggested the possibility of two peaks due to the Leonids on November 18, the first around 3^h or 5^h UT, the second about 7^h or 9^h UT. There is a slight discrepancy in these times, with Ilkka's both being earlier, but it is difficult to tell if this is a real feature or an artifact of the systems in use. Both observers detected enhancements due to the Leonids on November 17 and 19 as well.

In all, some 36 fireballs were reported to the Section for November, 19 on November 17 and 18, the majority of which were Leonids. Three of the four successful photographic trail captures came from *AKM* cameras on November 17-18, and all four trails were Leonid fireballs, the brightest of which was magnitude -8 and left a 7-minute train, at $2^h17^m10^s$ UT. Other particularly impressive visual specimens came at curiously coincidental times (1995 was a year for such strange timing coincidences, apparently!) on November 17 ($4^h46^m10^s$ UT, a green, flaring magnitude -4 Leonid that left a 4-minute persistent train, as seen by Nick Martin), November 18 (04^h40^m UT, a superb -10 Leonid that left an 8-minute train, reported by *Exeter AS* observers) and November 19 (4^h40^m UT, a blue Leonid of magnitude -5 that produced a 5-minute train; the observer was Trevor Law). The Leonids have long held a reputation for producing fine long-lasting trains, and just over 53% produced them in 1995. Some further details have been derived from these trained shower meteors, and the trained sporadics too, given in Table 3. Further news on the 1995 Leonids was given in Bulletin 7 of the *ILW* [3].

Table 3 – Total numbers of trained meteors (N_{XXX}) and mean train durations in seconds (D_{XXX}) by magnitude class for the Leonids and sporadics. The overall trained meteor numbers (Tot) and percentages (%) are also given. As not all observers who contributed magnitude distribution data also reported train results in full, the total number of sampled meteors is reduced, to 165 Leonids and 164 sporadics.

Shower	-3^-	-2	-1	0	+1	+2	+3	+4	$+5^+$	Tot	%
N_{ORI}	4	3	9	13.5	23	25	8.5	2	0	88	53.3
D_{ORI}	2.4	2	2.6	1.5	1.5	1.2	1	0.5			
N_{SPO}	0	0	1	1.5	5.5	3	1	0	0	12	7.3
D_{SPO}			4	0.5	1.9	1	1				

Next came the much more exciting α-Monocerotid outburst on November 21-22, first details of which can be found in [4,5]. Despite published notes elsewhere to the contrary, the outburst was observed visually, and by radio, from the UK, as well as from sites across Europe. Reports of the outburst have now been received by the Section from Spain, Germany , Hungary (including radio) and Romania as well, indicating the short-lived nature of the outburst, which peaked at around 1^h30^m UT on November 22. The mean ZHR for the shower for November 21-22 was about 60 ± 10, but the ZHR for the peak activity was of the order of $300–400 \pm 50$. Table 2 has the magnitude details for the better-seen shower members whose details were submitted to the Section, and despite the overall brightness of the mean magnitude, only one fireball has so far been reported, a magnitude −5 event at $1^h37^m30^s$, which produced two or three flares and a 20-second train, as seen by Vasile Micu. Overall, 31% of the α-Monocerotids left persistent trains, but the small actual number of train data reported has prevented any further examination of this facet of the shower.

The α-Monocerotid ZHRs were around 6–7 from November 19-20 to 25-26 apart from the peak night, with some slight indication that there may have been a drop in rates on November 24-25. Curiously, although the timing meant he missed the main maximum, Graham Wolf detected a minor enhancement of the α-Monocerotids between about 10^h18^m to 10^h30^m UT on November 25. During this time, 6 α-Monocerotids were seen in clear, +6.3 skies, with 18 shower members noted from 09^h35^m to 11^h46^m UT, the corrected mean magnitude for which was +2.72, significantly fainter than for the main outburst.

Two sets of radio data were received covering the α-Monocerotid main burst, from Robert White (his data between November 21 and 24 is illustrated in more detail as Figure 2) and K. Janos. Both data sets show highest radio rates slightly after the visual maximum, peaking at about 1^h40^m–1^h50^m UT (Robert's 10-minute raw counts are given in Table 4 for near this time). This may possibly indicate a degree of mass-sorting of the meteoroids across the very narrow maximal stream, with smaller particles on the outer edge as the Earth encounters it. Clearly, the α-Monocerotids are a shower to watch in the future.

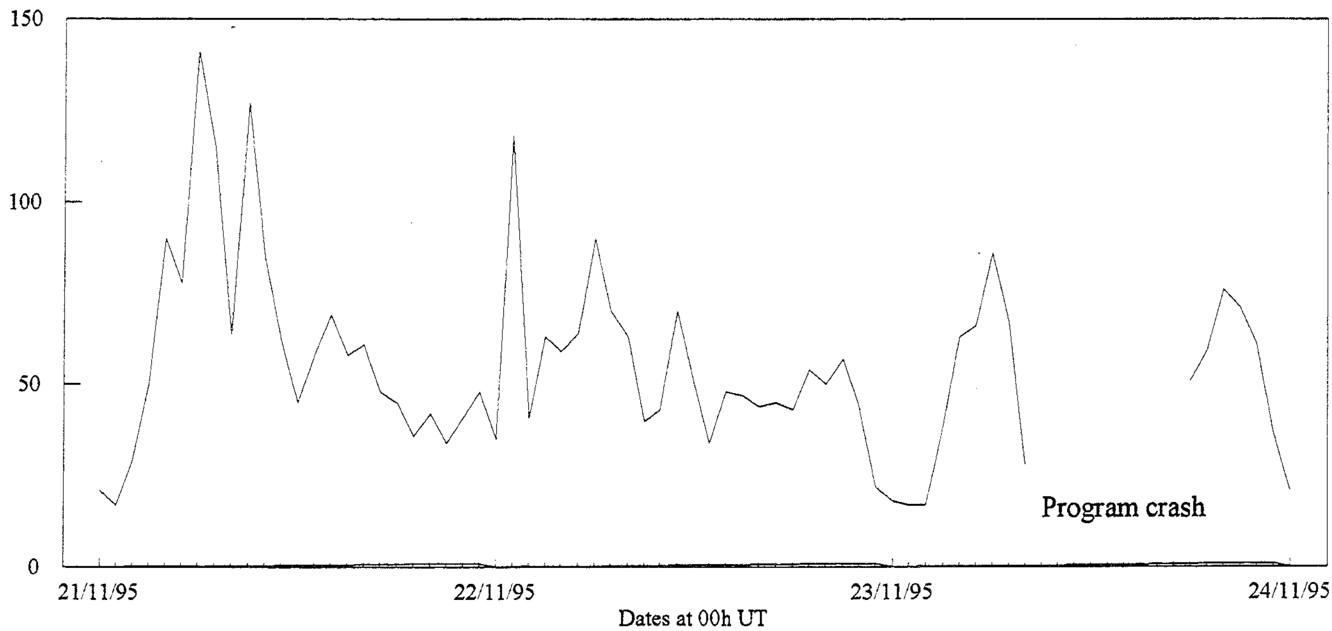

Figure 2 – Raw hourly counts of forward-scatter radio echoes detected by Robert White between November 21–24, over the α-Monocerotid visual outburst time. Leonid activity is still apparent on November 21, and weakly on November 22 as well, but the α-Monocerotids produced a very sharp spike in the hour commencing at 01^h UT.

3. December

After such an interesting year generally, December was rather disappointing. The Geminids were always going to be a visual challenge, with a waning gibbous Moon, and in the end most observations were concentrated in the final third of the month. Indeed, every night from December 17-18 to year's end saw at least one observer active.

Table 4 – Raw 10-minute forward-scatter radio echoes from data collected by Robert White, showing the α-Monocerotid outburst counts on November 22.

Time	Echoes	Time	Echoes	Time	Echoes
00^h00^m–00^h10^m	5	01^h00^m–01^h10^m	4	02^h00^m–02^h10^m	11
00^h10^m-00^h20^m	7	01^h10^m–01^h20^m	2	02^h10^m–02^h20^m	5
00^h20^m–00^h30^m	8	01^h20^m–01^h30^m	13	02^h20^m–02^h30^m	4
00^h30^m–00^h40^m	4	01^h30^m–01^h40^m	42	02^h30^m–02^h40^m	5
00^h40^m–00^h50^m	2	01^h40^m–01^h50^m	41	02^h40^m–02^h50^m	11
00^h50^m–01^h00^m	9	01^h50^m–02^h00^m	16	02^h50^m–03^h00^m	5

Watchers out to try to cover the Geminid maximum around December 13–15 included P. Craven, N. Martin, T. McEwan, V. Micu, J. Rendtel, J. Trigo, and G. Wolf, with mostly short, pre-moonrise observations possible. Peter Craven did well to manage a 40-minute watch on December 13-14, since the air temperature was −12° C. Even that was warm by contrast to his conditions on his next clear night, December 23-24, when the thermometer registered −24° C. Peter's comment was that at least it was warmer than in a neighboring village 10 km away, where the same night, a "cool −35.8° C" was recorded!

Ilkka Yrjulle provided another four-day run of radio results over the Geminid peak, with best activity registered on December 13-14, and a comparable, if shorter, peak on December 14-15 before midnight UT. The apparent twin maximum on consecutive nights is a result of the radiant's rising and setting. Visual ZHRs confirmed that best activity, about 80–100, occurred on December 13-14 (there is an element of uncertainty in the actual numbers due to higher than desirable correction factors, a result of post-moonrise observations having to be used), but that rates were still good by the following night, when ZHRs of 40–60 were obtained before midnight UT. Too few Geminids were seen in better skies to allow a full magnitude analysis, but from 72 meteors, a corrected mean magnitude of +1.85 has been derived (mean limiting magnitude of +6.14). Around 7% of these events were trained. By contrast, 87 December sporadics produced a corrected mean magnitude of +3.6, with again 7% trained (mean limiting magnitude of +5.95).

Coverage of the Ursids was patchy, due to poor weather conditions over many northern hemisphere sites. The best set of results came from three observers at Avren in Bulgaria, where several *Astroclub Canopus* members had gone to observe the shower. Data from Eva Bojurova, Ivan Truchev, and Valentin Velkov confirms a mean ZHR level of about 10–15 for December 22-23. Some predictions of possibly enhanced Ursid activity had been issued in advance for 1995 December, but these seem not to have come true for European observers at least. Other results are awaited.

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[5] J. Rendtel, "Activity burst of α-Monocerotids on November 22, 1995", *WGN* 23, 1995, pp. 200–203.

Meteor observing in Southern France.

Some of you may already have heard that the *Association Newton 406* is dissolved. Nevertheless, it is still possible for meteor observers and users of personal telescopes to stay in "La Remise" with full board. (Telescopes are no longer available, however.) For information and reservations, contact Arlette Steenmans, La Remise Puimichel, F-04700 Oraison, France, tel. +33-92 79 95 00, fax +33-92 79 62 41. (*Paul Roggemans*)

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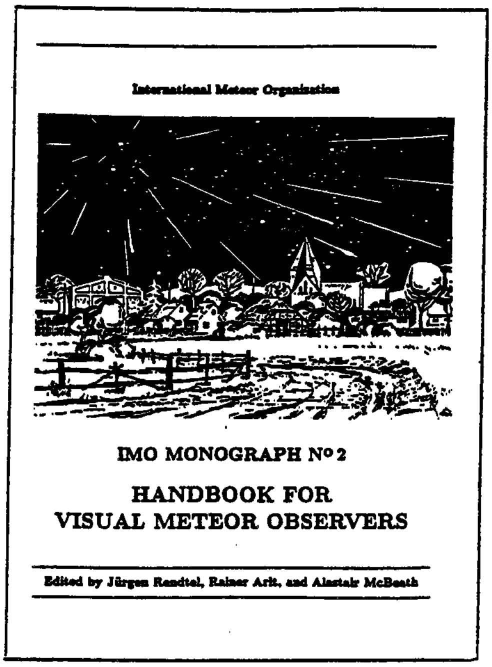

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