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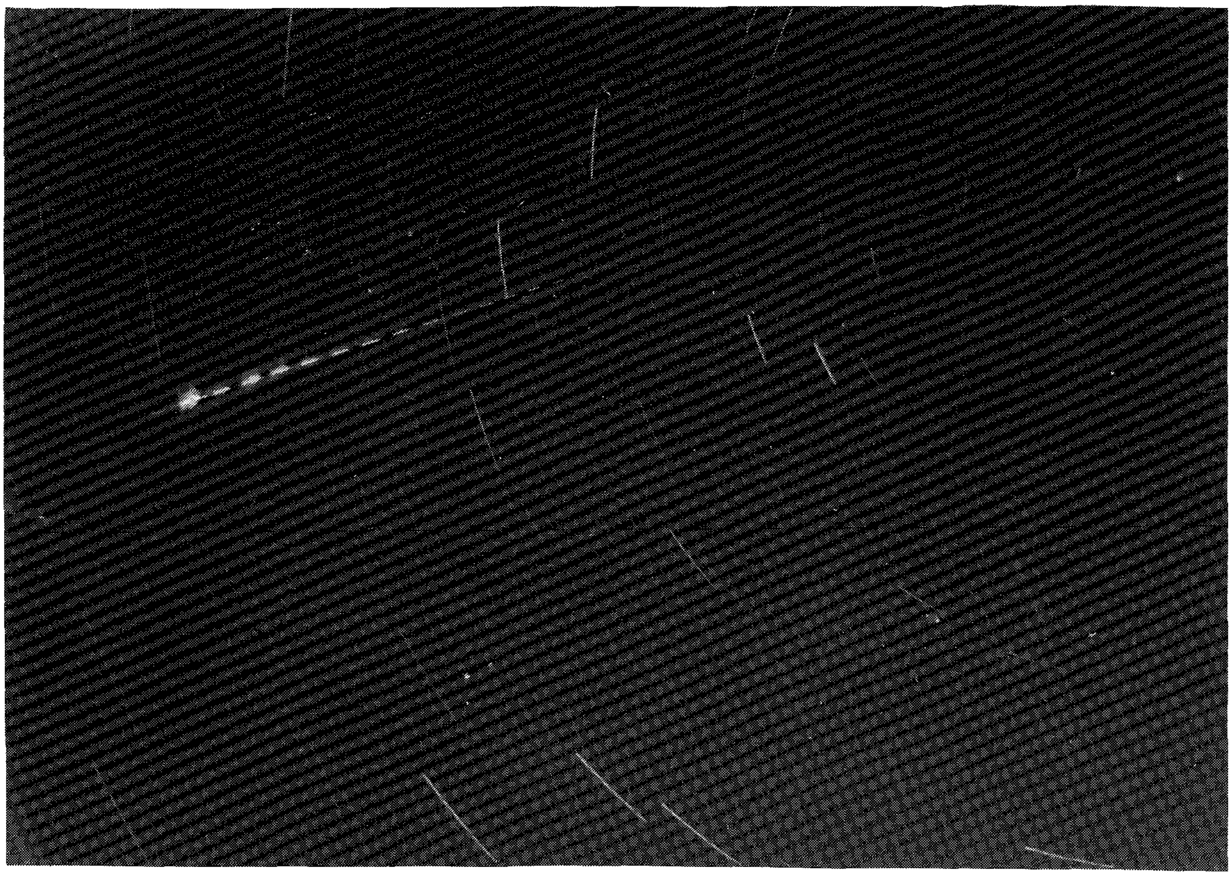

A magnitude −6 Perseid fireball captured by Noel White (England, UK) on August 12, 1989 at $23^h34^m45^s$ UT. The photograph was taken with a 28 mm $f/2.8$ lens and was exposed from $23^h20^m00^s$ till $23^h49^m55^s$ UT on HP5 400 ASA. It was developed in Microphen during 6 minutes at 20° C.

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WGN, volume 18, nr 1, February 1990, pp. 1–28

Contents

Useful Information

The April Issue *(WGN 18:2)*

The *April issue* is expected to be mailed during the first week of April. Contributions are due *March 1*. They should be sent to *Marc Gyssens* or to any member of the editorial board (addresses on the inside of the back cover).

WGN Subscription/IMO Membership 1990

The subscription rate for volume 18 is 400 BEF or 12 USD for six issues. It is anticipated that volume 18 will contain over 240 pages. Subscriptions should be paid to Ann Schroyens or, for the USA and Canada, to Peter Brown, or, for Japan, to Masahiro Koseki (all addresses on the inside of back cover). Please make sure we retain the full amount due after deduction of bank and/or exchange charges. Therefore it is recommended to pay by international postal money order. Additional gifts are of course welcome.

Administrative Correspondence

All payments should be addressed to Ann Schroyens. Complaints about not receiving *WGN* or changes of address should be sent to Paul Roggemans. Their addresses can be found on the inside of the back cover.

From the President

Jürgen Rendtel

First of all, my best wishes for 1990 to all members and friends of the International Meteor Organization. May this year be satisfactory in your personal life as well as successful for all meteor work you intend to do. When IMO was founded, nobody was able to foresee the changes in Europe that are now taking place. Of course, they will influence the practical work in IMO positively. On the other hand, the results of IMO in various fields are only as good as our contributions to them. I regard IMO as an "envelope", not as a goal itself. Therefore I call upon all commission directors to lead their field and not to lag behind the events happening in their fields. Only this way we may reach the objectives of IMO as they are written in article 3 of our constitution.

In 1990 more materials will be published in order to reach experienced observers as well as newcomers. Regional representatives in several language regions will ensure a closer contact to each amateur as well as to the commissions. Since IMO is still new and operated by men, errors may occur and not all ways will follow the optimal route. Therefore I ask all members to write their opinion to me or to any other council member if they feel there are adjustments to be made. Concerning the astronomical conditions, 1990 allows a lot of visual work without bad influence of moonlight. But I also call upon all observers to monitor not only the major showers: look at the programs of the commissions, and send your results to the databases of IMO.

Traditionally, the beginning of a year is a time for making good intentions. IMO makes it possible to realize a lot of these intentions together with other interested and motivated people. Many of these people will meet in Violau at the 1990 International Meteor Weekend to look at the results and to make arrangements for future work.

IMO is our "product"—it is as good as we make it!

Supporting members and subscribers

Marc Gyssens and Paul Roggemans

When 1989 started we foresaw to publish three issues of 28 pages and three issues of 54, making a grand total of 246 pages. Instead, volume 17 turned out to contain 274 pages, an unprecedented record, which barely sufficed to keep pace with the incoming contributions. Of course, this is a good sign, because it means *IMO* is active and productive. Nevertheless, we may not forget that extra pages also cost extra money. On the other hand, it is *IMO*'s policy to keep subscription rates as low as possible, hence there is little margin left for extras. Therefore it is a good thing that a lot of people concerned with meteor work help by paying more than required. In 1989, the following people gave us something on top of their membership/subscription fee:

> Duncan Olsson-Steel, Marc Gyssens, Pekka Parviainen, Manfred Schank, Erwin Van Ballegoy, Detlef Koschny, George Spalding, Teemu Hankamäki, Ann Schroyens, Hiroyuki Tomioka, Ivo Dielen, T. Ueno, Stefano Sposetti, Rick Crook, Lance Benner, Philip Roberts, Mark Davis, Jeff Wood, Hans-Georg Schmidt, Korlevic Korado, Tonny Vanmunster, Louis Bellot, Ichiro Hasegawa, Toshio Kamimura, Kouji Maeda, Yasuo Taguchi, Katsuhito Ohtsuka, Lieven Smits, Kawasaki, Werner Hasubick, Jeroen Van Wassenhove, Alastair McBeath, Glenn Ticket, Christian Steyaert, Paul Roggemans

Our sincere thank to all these people; we hope that we can continue counting on their support and we hope their example will be followed by many others in the future!

Letters to WGN

compiled by Marc Gyssens

Aurora-like displays

The aurora-like rays reported in WGN 17:4, pp. 115–116 still produce reactions. In this issue, comments by two people well placed to discuss phenomena that resemble aurorae: Pekka Parviainen and Trond Erik Hillestad.

Pekka Parviainen, Finland's well known astrophotographer, responded both the article in *WGN* 17:4 and subsequent letters in *WGN* 17:5, p. 170. He sent in following photograph, which is strikingly similar to the ones of Gotfred Kristensen.

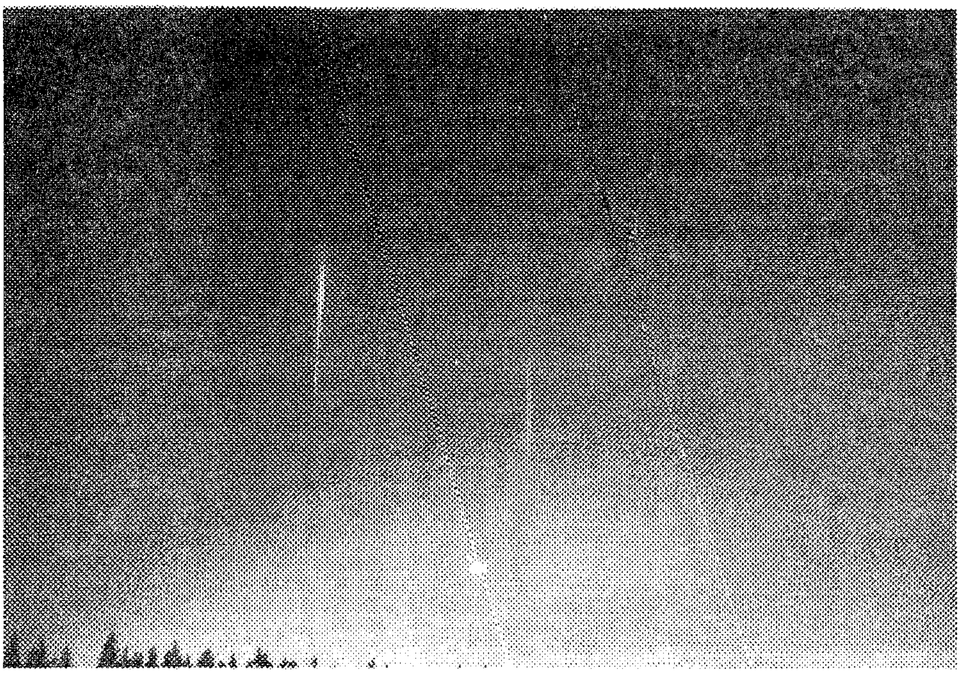

Figure 1 – Aurora-like displays photographed by Pekka Parviainen on February 13, 1985. They were caused by hexagonal crystals in ice-clouds.

Pekka writes: "Confusing these trains to aurora is understandable—so it happened to me. The problem is that the crystal cloud doesn't reach the horizon so that these columns hover in the air like aurora. We here in Finland had a corresponding case a couple of years ago. The observer could later identify the lights causing his observation (behind trees or the horizon)."

communicated by Christian Steyaert

The "train" photos of Gotfred Møbjerg Kristensen in *WGN* 17:4 were fascinating. I do not think that the aurora explanation is the correct answer to the enigma.

My experience is that rays are a very common structure in aurora displays. Rays are usually clustered together to form a larger structure, the so-called arcs or bands ("twisted" arcs). They are vertical, and nearly parallel when close to the horizon, but converge if they are closer to zenith. When the rays are in zenith, they form a beautiful structure called corona, but this is rare. Each ray is perhaps 10–40° high, and some 2° wide. The arc itself may cover an area 20–100° wide, each end touching close to the horizon. Arcs are centered around the magnetic pole, which is "somewhere" in the northern sky. They are never visible in the southern sky. Rays can be seen to the south, but then close to zenith (very seldomly). Unbroken arcs are common, but faint arcs can have only the western or eastern part visible. It is very unusual to see one single ray in the sky. Of the more than 100 displays I have witnessed, only one night had one single ray. A few more nights did also have individual rays, but then never without the presence of an arc or band at another place in the sky.

It should be emphasized that all my aurora observations were made from Norway, either at latitude 59°7 N or at latitude 68°2 N. The auroras seen in southern Norway are usually quite different from those above northern Norway. The tendency of rays to clump themselves into rays or bands, is however common to both places. I believe that the displays of southern Denmark are unlike those in southern Norway, but the difference may be smaller than to northern Norway. It is still possible that single rays are more frequent in Denmark.

I have seen the original photos of Gotfred, and I can tell by intuition they do not look like ordinary aurora rays. They are brighter than normal displays, a bit too wide for their length, and have weird ends. Seeing only one single ray in the sky is a very rare event. Having one ray in Lyra, one in Draco and the third in Bootes is unheard of.

Trond Erik Hillestad, November 7, 1989

Calculating error bars for ZHRs

In WGN 17:6, pp. 229–239, Paul Roggemans mentions the problem of finding a suitable formula to calculate error margins on average ZHRs. Marc De Lignie proposes the following solution.

In his article "The Geminid Meteor Stream in 1988"[1], Paul Roggemans argues that it is not clear what error margins should be reported for the average ZHRs calculated by the *VMDB*. He mentions two possibilities:

1. Use $\sigma_{\rm ZHR} = {\rm ZHR}/\sqrt{N}$. This results in very small error margins, "smaller than the thickness of the datapoints in the graph".
2. Use $\sigma^2_{\rm ZHR} = \frac{1}{m-1}\sum_{i=1}^{m}({\rm ZHR}_i - {\rm ZHR}_{\rm avg})^2$. This results in very large error margins, "much larger than the real uncertainty on the ZHR".

Let's see what these quantities really mean. The first quantity is a good estimate of the error, when all observations are done by the standard observer, or, equivalently, when all applied correction factors (limiting magnitude, radiant height and perception) are without error. So it seems reasonable that this quantity results in a too small error margin.

The second quantity merely means that, if there were to be another independent estimate of the same ZHR, it would most probably have a value of ZHR $\pm\, \sigma_{\rm ZHR}$. Indeed, this quantity is much larger than the real uncertainty in the average ZHR. To find this real uncertainty, we must calculate how it depends on errors in the individual estimates ${\rm ZHR}_i$. We have:

$$ {\rm ZHR}_{\rm avg} = \frac{1}{m}\sum_{i=1}^{m} {\rm ZHR}_i \qquad (1) $$

The standard deviation in the individual estimates is:

$$ \sigma^2 = \frac{1}{m-1}\sum_{i=1}^{m}({\rm ZHR}_i - {\rm ZHR}_{\rm avg})^2 \qquad (2) $$

The error in ${\rm ZHR}_{\rm avg}$ due to the error in ${\rm ZHR}_i$ is then $\frac{\partial {\rm ZHR}_{\rm avg}}{\partial {\rm ZHR}_i}\sigma$. As the errors in ${\rm ZHR}_{\rm avg}$ due to each ${\rm ZHR}_i$ are independent, we should add the squares of these errors in order to obtain the total error:

$$ \sigma^2_{\rm ZHR} = \sum_{i=1}^{m}\left(\frac{\partial {\rm ZHR}_{\rm avg}}{\partial {\rm ZHR}_i}\sigma\right)^2 = \frac{\sigma^2}{m} = \frac{\sum_{i=1}^{m}({\rm ZHR}_i - {\rm ZHR}_{\rm avg})^2}{m(m-1)} \qquad (3) $$

In contrast with method 2 in the introduction, we see now that the error in the average decreases for an increasing number of independent estimates. Equation (3) says that *statistical* errors can be averaged away, although it gets harder when the spread in individual estimates is large. In fact, when the standard deviation in equation (2) would obey the Poisson distribution, equation (3) would reduce to that of method 1 in the introduction. Interested readers can find a more elaborate discussion on these topics in reference [2].

Christian Steyaert noticed that it would be better to use weighted averages [3], with weighing factors $1/C_i$ (using the notation of [1]). In that case equations (1–3) change slightly:

$$\mathrm{ZHR_{avg}} = \frac{\sum_{i=1}^{m} \frac{1}{C_i} \mathrm{ZHR}_i}{\sum_{i=1}^{m} \frac{1}{C_i}} = \frac{N_{\mathrm{tot}}}{C_{\mathrm{tot}}} \tag{4}$$

$$\sigma^2 = \frac{\sum_{i=1}^{m} \frac{1}{C_i} \left(\mathrm{ZHR}_i - \mathrm{ZHR_{avg}}\right)^2}{\frac{m-1}{m} C_{\mathrm{tot}}} \tag{5}$$

$$\sigma^2_{\mathrm{ZHR}} = \sum_{i=1}^{m} \left(\frac{\partial \mathrm{ZHR_{avg}}}{\partial \mathrm{ZHR}_i} \sigma \right)^2 = \sum_{i=1}^{m} \left(\frac{\sigma}{C_i C_{\mathrm{tot}}} \right)^2 = \frac{\sigma^2}{C^2_{\mathrm{tot}}} \sum_{i=1}^{m} \left(\frac{1}{C_i} \right)^2 \tag{6}$$

One can easily check that equations (4–6) reduce to (1–3) when all C_i are equal.

As an illustration we will apply equation (3) to the ZHRs of reference [4]. The six-hour points around the maximum in Figure 4 of [4] were calculated from roughly 70 observations per datapoint, with a standard deviation of about 36. According to equation (3), this results in errorbars for the six-hour ZHRs of about 5. This would mean that the dip in the Perseid maximum is statistically significant, i.e. $\mathrm{ZHR_{max}} - \mathrm{ZHR_{min}} > 3\sigma_{\mathrm{ZHR}}$. However, this criterion does not account for *systematic* errors. These could occur if the applied correction factors are systematically wrong in a different way for different datapoints. A possible cause for such a disaster (very small radiant height during the minimum) has already been reported by Ralf Koschack [5].

We can conclude that equations (3) or (6) give a better estimate of the uncertainty in average ZHRs than previously proposed methods. Nevertheless, the results thus obtained should still be used with care.

[1] P. Roggemans, "The Geminid Meteor Stream in 1988", *WGN* 17:6, December 1989, pp. 229–239.

[2] W.H. Press, B.P. Flannery, S.A. Teukolsky, W.T. Vetterling, "Numerical Recipes in C, the art of scientific computing", Cambridge University Press, 1988, pp. 517–532.

[3] C. Steyaert, "Letters to WGN", *WGN* 17:5, October 1989, p. 172.

[4] P. Roggemans, "The Perseid Meteor Stream in 1988: A Double Maximum!", *WGN* 17:4, August 1989, pp. 127–137.

[5] R. Koschak, "Letters to WGN", *WGN* 17:6, December 1989, pp. 198–199.

Marc de Lignie

Important Note for Visual Observers

Ralf Koschack

In order to guarantee a continuous data input into the *VMDB*, and to make sure that shower reports can be compiled within a reasonable time span after the actual event, all visual observers should mail their visual reports monthly, on the 10th of the following month at the latest (e.g. observations from January should be mailed before February 10).

Observers from Western countries should send their observations to Paul Roggemans, observers from Eastern countries to Ralf Koschack (all the addresses figure on the inside of the back cover).

Photographic Coordination within IMO

Casper ter Kuile

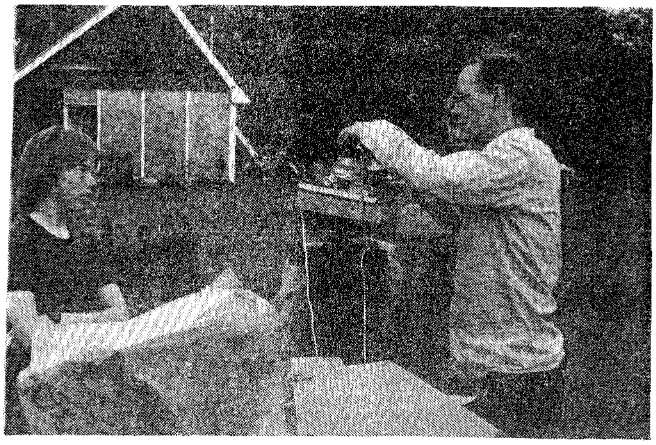

Figure 1 — The author installing an all sky camera.

As most of you know, at the 1989 International Meteor Weekend several workshops were held regarding topics on meteor astronomy. To mention some of them: visual work, computing, radio observing, telescopic observing. Unfortunately, nothing has been established on photographic meteor work so far. This is remarkable, because several countries put much effort in photographic observations. It is the purpose of this article to discuss some matters which have to be done in *IMO* in order to bring to live a photographic commission.

Let us have a closer look to what has to be done. First, there should be calls for action (notably in *WGN*) for the photographic observers. The first article in *WGN* should give an overview of the appearances of primary meteor showers. The other articles have to be published in consecutive issues and should deal with the following items on photographic observing:

- date and time of observations,
- the amount of moonlight, moonrise or moonset,
- when does the radiant appear above the horizon, and
- what about the (Z)HR during the night?

Secondly, people want to be informed about how to photograph meteors. So we have to publish articles dealing with:

- which kind of camera to work with,
- which aperture should be used,
- which film to use,
- what about developing films,
- how to deal with fully automatic camera operation,
- the use of camera shutters,
- keeping objectives free of fog, and
- how to build up a camera battery?

Thirdly, there is all the administrative work before, during and after the campaign. This is of major importance. If one forgets some crucial data, it is very well possible that the results become worthless. So we urgently ask for experienced people discussing their technique of administration in *WGN*.

Forthly, we have to find out how the reduction of the material should be organized. It is best when meteor groups can do this themselves. Let us list which actions have to be carried out for such an observing group:

- collecting the films and administrating them carefully;
- developing the films;
- searching for meteor trails on the negatives;
- recording the camera and negative number for that image;
- recording the position on the negative;
- noting down date and time of opening and closing of the camera shutter;
- noting down the accurate geographical coordinates of the observing site;
- recording all observations in a database; and
- writing articles covering the results in magazines such as *WGN*.

From this point on, the data should be collected by an *IMO* responsible. This person should be able to search for simultaneously photographed meteors. These results have to be recorded in a database. Then it is possible to present overviews of photographic activities world-wide. These overviews should also be published in magazines like *WGN*. The last part is the reduction of the simultaneously photographed meteors. This tricky computational matter should be carried out by qualified persons only.

In this article we did present you a short list of activities which we will come across while photographing meteors. This list is not complete at all and we have to work it out and go into more detail at a later moment. We would like to ask people to send their opinion on these matters to *WGN*. It is very obvious that no single person can do all this work alone. Therefore a team should be established to coordinate the work described in this article. When you are interested in participating, do not hesitate and write to some *IMO* council member!

Philip Bagnall and Christopher Spratt announced the founding of an association for meteorite collectors. For the benefit of our members and subscribers, we gladly pass on this information. For the sake of clarity however, we wish to stress that this association is not *an initiative of IMO, and that, consequently, IMO cannot assume any responsibility for the content of the article below. (Ed.)*

The Society of Meteoritophiles

Philip Bagnall and Christopher Spratt

Meteorite collecting has become increasingly popular in recent years among amateur astronomers and rockhounds and this has led to the publication of a spate of books and articles on meteorites, tektites and cratering. We now feel that the time is right to launch an organization aimed specifically at collectors. The name of this new organization will be the *Society of Meteoritophiles*.

The proposed Society will be non-profit making, international and apolitical. Its objectives will be to promote meteorite and tektite collecting and to create a greater awareness of the subject. To these ends the Society will publish a journal, *IMPACT!*, through which members may trade specimens, exchange views and be kept informed on what is happening in meteoritics. The publication will also carry articles on for example the preservation of specimens, display methods, the history of individual meteorites, details of both public and private collections, planetary geology, etc.

We realize that while many professional meteoriticists encourage amateur interest in meteorites, not all are keen on amateur involvement. They feel, quite rightly, that a rare or unique specimen may fall into the hands of an amateur thus depriving science of a vital part of the "cosmic jigsaw". We appreciate those views and, for that reason, the Society will adopt a policy of encouraging members to make all new falls and finds available for research. We also want to ensure that the few craters that are left on the Earth's surface are protected from damage by over-enthusiastic collectors.

Before the Society can be launched, however, we need to establish whether there is sufficient support to make the venture viable. For the time being, therefore, we are asking all interested parties simply to contact us *(addresses on inside of back cover, ed.)*. Although the Society is aimed mainly at the amateur collector we are particularly keen to attract museum curators and those involved in the teaching of meteoritics and planetary geology.

Visual Observers' Notes : March–April 1990

Jeff Wood

In March and April, only the δ-Pavonids and the April Lyrids are active among the major showers. However, these months are characterized by a whole host of minor streams that makes observing especially after midnight most interesting when rates in dark skies can reach over 20 meteors per hour on occasions. As well, is the unusual number of brilliant fireballs that emanate out of the Scorpius, Libra, Centaurus and Virgo regions. Two of these seen on March 18, 1983, and April 6, 1975 were recorded as −19 and −15 respectively!

Table 1 – A list of some of the meteor showers to be seen in March-April 1990.

Shower	Radiant			Period	Max	r	V_∞
	α	δ	Diam.				
δ-Leonids	159°	+19°	8°	Feb 05–Mar 19	Feb 26	3.0	23 km
Virginids	Table 5		15° × 10°	Feb 01–May 30	unknown	3.0	30 km
γ-Normids	249°	−51°	5°	Feb 25–Mar 22	Mar 14	2.4	56 km
δ-Pavonids	307°	−63°	10° × 5°	Mar 11–Apr 16	Apr 06	2.6	59 km
α-Scorpids	246°	−25°	5°	Mar 26–Jun 04	early May	2.5	35 km
α-Bootids	218°	+19°	8°	Apr 14–May 12	Apr 28	3.0	20 km
η-Aquarids	336°	−02°	4°	Apr 19–May 28	May 04	2.7	66 km
April Lyrids	271°	+34°	5°	Apr 16–25	Apr 22	2.9	49 km
π-Puppids	109°	−43°	5°	Apr 15–28	Apr 23	2.0	18 km

Table 2 shows moonlight and observing conditions.

Table 2 – Moonlight and observing conditions in March-April 1990.

Date	k	Date	k
Friday March 02	0.27+	Friday April 06	0.84+
Friday March 09	0.94+	Friday April 13	0.93−
Friday March 16	0.82−	Friday April 20	0.33−
Friday March 23	0.18−	Friday April 27	0.05+
Friday March 30	0.14+	Friday May 04	0.52+

New Moon:	Februay 25, March 26, April 25
First Quarter:	March 4, April 2, May 1
Full Moon:	March 11, April 10, May 9
Last Quarter:	February 17, March 19, April 18

The illuminated part of the Moon is always given for 0^h UT on the date indicated. The dates of the phases of the Moon are also given in UT.

The Visual Commission of *IMO* although requiring data on all streams realizes practical considerations like work, study, family, Moon and weather prevent people from observing regularly on a day by day basis throughout most of the year. With this in mind, it has been decided to encourage everyone who has time to observe to concentrate on a couple of showers per month rather than the whole lot. This means we should be able to get a good set of data on these few rather than sparse data on many showers. The showers chosen for special investigation for the months of March and April are the δ-Leonids, Virginids, δ-Pavonids, α-Scorpids and the April Lyrids.

1. The δ-Leonids

The δ-Leonids are thought to possibly be related to the minor planet 1987 SY and so a top priority of *IMO* is to investigate the activity of this shower to see if this is indeed the case. With the Moon in the New Moon phase on the date of maximum, February 26, conditions are very favorable for observing the δ-Leonids in 1990. δ-Leonid meteors are of average brightness, slow in speed ($V_\infty = 23$ km/s) with very few leaving a train. Since there are numerous sporadic meteors as well as the Virginid meteor shower occurring in the vicinity of the δ-Leonid radiant area, great care needs to be taken in identifying fields of view around $\alpha = 180°$ and $\delta = +20°$ or $\alpha = 160°$ and $\delta = 0°$ especially on the date of maximum.

As the δ-Leonids are few in number, all meteors must be plotted. Meteors coming from the radiant area should only be classified as δ-Leonids if their path length and their angular velocity are appropriate.

Table 3 – Radiant positions of the δ-Leonids (diam. = 8°).

Date	α	δ
Feb 06	141°	+25°
Feb 16	150°	+22°
Feb 26	159°	+19°
Mar 08	168°	+16°
Mar 18	177°	+13°

Table 4 – Apparent angular velocity (degrees/second) of the δ-Leonids, depending on the altitude of the beginning point of the meteor h_b and the distance D_e between its end point and the radiant.

	$h_b = 10°$	20°	40°	60°	90°
$D_e = 5°$	0.2	0.5	0.9	1.1	1.3
10°	0.5	0.9	1.6	2.3	2.6
20°	0.9	1.8	3.3	4.5	5.2
40°	1.7	3.3	6.3	8.5	9.8
60°	2.3	4.5	8.5	11	13
90°	2.6	5.2	9.8	13	15

2. The Virginids

As there are a large number of low activity radiants close together, it is very difficult to delineate what branches of the Virginids are active at which time and also to classify each individual meteor seen into its appropriate stream. Consequently, observations over the years have shown a whole myriad of Virginid showers, some real, some fictitious. Also reported rates have varied from nil to over 10 meteors per hour! With this in mind then, *IMO* has for the time being to incorporate all of the Virginids seen into the one "shower". The "Virginids" are active from February 1 to May 30. The have a V_∞ of 30 km/s and are reknown as fireball producers, though their magnitude ratio r of 3.0 indicates there are many fainter members as well.

IMO would appreciate your efforts to monitor this shower in 1990. Intending observers should locate their center of field of view no more than 40° away from the radiant and should plot all meteors seen. Since the "Virginids" have a velocity typical of the sporadic background and also come from a large radiant area, careful attention to path length and angular velocity should be given before classifying a meteor as a "Virginid".

Table 5 – Radiant positions of the Virginids (diameter = 15° × 10°).

Date	α	δ	Date	α	δ
Feb 13	167°	+09°	Apr 09	202°	−07°
Feb 23	174°	+05°	Apr 14	204°	−08°
Mar 05	182°	+01°	Apr 24	208°	−09°
Mar 15	189°	−02°	May 04	211°	−11°
Mar 25	195°	−04°	May 14	214°	−12°
Apr 04	200°	−06°	May 24	217°	−13°

In Table 5, above, radiant positions are given for various dates during the activity period. In Table 6, below, data are presented about the apparent angular velocity of the Virginids.

Table 6 – Apparent angular velocity (degrees/second) of the Virginids, depending on the altitude of the beginning point of the meteor h_b and the distance D_e between its end point and the radiant.

	$h_b = 10°$	20°	40°	60°	90°
$D_e = 5°$	0.3	0.5	1.0	1.4	1.6
10°	0.5	1.1	2.0	2.7	3.1
20°	1.1	2.1	4.0	5.3	6.2
40°	2.0	4.0	7.4	10	12
60°	2.7	5.3	10	14	16
90°	3.1	6.2	12	16	18

3. The δ-Pavonids

The δ-Pavonids are thought to have been formed from the debris of comet P/Grigg-Mellish (1907 II). Observations to date indicate that the shower produces variable activity with rates at maximum varying in the range of 5 to 15 meteors per hour. With the radiant reaching its greatest altitude in southern hemisphere skies in the pre-dawn hours, a gibbous Moon should not greatly interfere with observations before and up to maximum (April 5–6). δ-Pavonid meteors are very fast (V_∞ = 59 km/s), often bright yellow or blue in color and leave a train. Some of these trains are quite persistent with one seen in 1986 lasting for over a minute after the meteor itself had disappeared from view.

Southern hemisphere observers are encouraged to give the δ-Pavonids particular attention in 1990. They should locate their center of field of no more than 40° away from the radiant and ensure all meteors seen are plotted.

Table 7 – Radiant positions of the δ-Pavonids (diameter = 10° × 5°).

Date	α	δ
Mar 11	296°	−65°
Mar 21	301°	−64°
Mar 31	305°	−63°
Apr 05	307°	−63°
Apr 10	309°	−63°
Apr 15	311°	−62°

4. The April Lyrids

The Lyrids are active from April 16 to 25 reaching a maximum of between 10 and 15 meteors per hour on April 22. On a few occasions, the most recent being in 1982, rates have been much higher almost reaching 100 meteors per hour. The Lyrids' parent body is comet P/Thatcher (1861 I).

In 1990, the Lyrid activity period is virtually moon-free and so *IMO* urges all observers to give them special scrutiny. With a V_∞ of 49 km/s care need to be taken when identifying meteors as Lyrids. Observers should ensure that the center of their field of view is no more than 40° from the radiant. Also they should plot all meteors seen unless the ZHR exceeds 10 when countings are permitted. Only on the date of maximum is this likely to be the case.

Table 8 – Radiant positions of the Lyrids (diameter = 5°).

Date	α	δ
Apr 16	265°	+34°
Apr 19	268°	+34°
Apr 22	271°	+34°
Apr 25	274°	+34°

Table 9 – Apparent angular velocity (degrees/second) of the Lyrids, depending on the altitude of the beginning point of the meteor h_b and the distance D_e between its end point and the radiant.

	$h_b = 10°$	20°	40°	60°	90°
$D_e = 5°$	0.5	0.8	1.6	2.1	2.4
10°	0.8	1.6	3.0	4.0	4.7
20°	1.6	3.2	6.0	8.1	9.2
40°	3.2	6.0	12	15	18
60°	4.1	8.1	15	21	24
90°	4.7	9.1	18	24	27

5. The α-Scorpids

The α-Scorpids are one of the major components of what Hoffmeister called the Scorpio-Sagittarius complex of showers. This ecliptic stream is active from March 26 to June 4 with a broad maximum of between 4 and 8 meteors being reached during early May. The α-Scorpids are well known for the many brilliant yellow, orange and green fireballs they produce. Few, however, leave a persistent train.

With a velocity V_∞ of 35 km/s, and several other Scorpio-Sagittarid radiants active in the same region of the sky, especially in May and early June, special care need to be taken when recording and classifying these meteors.

Table 10 – Radiant positions of the α-Scorpids (diameter = 5°).

Date	α	δ	Date	α	δ
Mar 26	236°	−21°	May 05	246°	−24°
Apr 05	238°	−21°	May 15	249°	−25°
Apr 15	241°	−22°	May 25	252°	−25°
Apr 25	244°	−23°	Jun 04	254°	−26°

Telescopic Observers' Notes: February–April 1990

Malcolm Currie

This is the time of year when meteor observers traditionally rest on their laurels. Overall activity is at its lowest of the year, and coupled with the cold for northern-hemisphere observers has meant that knowledge of visual shower activity is skimpy, and at telescopic magnitudes virtually non-existent. So any series of observations lasting a few hours has a high chance of producing something new.

There is only one major shower, the *Lyrids*, which is not in the Geminid or Perseid class, but it is capable of surprises like the peak of about 100 meteors per hour in 1982, when it was also rich in faint meteors. In 1990 the Lyrids will be active during April's dark time, so offer telescopic observers a chance to study the size of the radiant and see if there is any structure. There are already video observations [1] with which to combine telescopic data. Most major showers show a dispersive effect with magnitude, in the sense, the time of maximum is earlier for fainter magnitudes. There is some evidence [2] based on visual and photographic data that for the Lyrids this is not the case. So far this has not been extended to telescopic magnitudes to my knowledge. Though to obtain a reliable time of maximum, observations from many individuals are necessary. An easier goal is to determine the shape of the rate curve. Visually, the activity is brief. If there are dispersive forces acting on the Lyrid meteoroids, there should be a broader activity curve for the telescopic particles. Observations are needed for April 18–26. The visual maximum is expected on April 22 at 8^h. My suggested field centers for mid-northern latitudes are $\alpha = 16^h20^m$, $\delta = +33°$ and $\alpha = 17^h45^m$, $\delta = +56°$ before 1^h local time, and $\alpha = 18^h05^m$, $\delta = +09°$ and $\alpha = 20^h40^m$, $\delta = +31°$ after 1^h local time.

There are a number of known or suspected minor showers active during the period. The best known is the *Virginid complex*, which is believed to be active weakly (less than 3 meteors per hour) from mid-February through April. I think the only way to resolve which radiants are active and when is by telescopic and video observations over many years. Choose pairs of field centers around $\alpha = 175°$–$220°$, $\delta = +10$–$20°$ separated by about 30°. I am deliberately vague as a selection of centers will help resolve occlusions. Being near the galactic pole the normal criteria for field selection (stars well-distributed both spatially and in brightness) may have to be relaxed. It is more important to obtain accurate paths than highly accurate magnitudes. The *α-Aurigids* are slow meteors and its telescopic activity can be up to a third of the sporadic background. The meteors are slow moving and are visible during the first half of February, with peak activity around February 7 from $\alpha = 79°$, $\delta = +42°$. The Moon interferes in 1990. The *δ-Leonids* are also slow moving, and active during February to mid-March peaking around February 22 from an average radiant $\alpha = 159°$, $\delta = +19°$. Visually, the rates are low, but this shower is worth checking telescopically. Kronk [3] suggests there may be a telescopic southern component that peaks around February 3 from $\alpha = 135°$, $\delta = +08°$, which should be looked for. Activity may last until February 24.

There are other showers with equal or lower rates visually that may turn out to be stronger telescopically. Remember that although activity is low, the accurate plotting afforded by telescopic observation makes minor showers stand out more clearly from the sporadic background. So it is important to make watches whenever you have the time and dark skies. Prospective observers should contact me for details of the observing method. I can also provide bespoke charts until the *IMO* set is ready.

References

[1] K. Jobse, "Meteor Observing by Video", *WGN* 16:4, 1987, pp. 119–120.

[2] K.B. Hindley, *J. Brit. Astr. Assoc.*, 1969, pp. 477–480.

[3] G.W. Kronk, "Meteor Showers: a Descriptive Catalog", Enslow, Hillside, NJ, 1988, pp. 29–31.

The Quadrantids

The 1989 Quadrantid Meteor Stream

Paul Roggemans

A worldwide coverage of the 1989 Quadrantids by visual observers enabled us to reconstruct the activity profile. The maximum occurred at $\lambda_\odot = 282\overset{\circ}{.}64 \pm 0\overset{\circ}{.}03$. This is about 4 hours later than in 1987, when the peak rates were much higher than in 1989. The Quandrantid maximum seems to vary widely from year to year both in time and in strength.

1. Introduction

The Quadrantids, or, as they are also called, the January Bootids, are a classical start of the new year for the experienced meteor observer. It is a very remarkable shower as the activity is very short-lived and often very intense. In the early 19th century, Quadrantids were completely absent. Then, in 1830, they were suddenly reported. Over the years rather contradicting reports confused observers. Bad weather prevented observer groups to watch the Quadrantid maximum on a year to year basis. For some years, very high rates were reported while for subsequent years, rates may have been very low. An additional difficulty is that it is only possible to admire high activity from the sharp Quadrantid peak when at the time of maximum, the radiant is high above the local horizon.

As far as I know, the 1989 return of the Quadrantids is the first one which could be covered in one global analysis based on visual observations. Again, the *VMDB* turned out to be a most powerful help in this kind of work and we are very grateful to the following observers who contributed with observing efforts:

Rainer Arlt (ARLRA), Pierre Bader (BADPI), Peter Brown (BROPE), Koen Clement (CLEKO), Sabine Clement (CLESA), Tim Daniels (DANTI), Raul Fernandez (FERRA), Yasunori Fujiwara (FUJYA), K. Fukui (FUKKE), Kai Gaarder (GAAKA), George W. Gliba (GLIGE), Takema Hashimoto (HASTA), Udo Henning (HENUD), Gunar Hering (HERGU), Daiyu Ito (ITODA), Kiyoshi Izumi (IZUKI), Junji Kawamura (KAWJY), André Knöfel (KNOAN), Bernhard Koch (KOCBE), Y. Komatusaki (KOMKY), Ralf Koschack (KOSRA), Ralf Kuschnik (KUSRA), Robert Lunsford (LUNRO), Kouji Maeda (MAEKO), Katsuhiko Mameta (MAMKA), Mario Lucic (MARLU), John Moody (MOOJO), Sabine Moritz (MORSA), Naomi Muto (MUTNA), Michael Nolle (NOLMI), K. Noze (NOSKU), M. Oka (OKAMA), Ina Rendtel (RENIN), Jürgen Rendtel (RENJU), Janko Richter (RICJA), Paul Roggemans (ROGPA), David Rosenthal (ROSDA), Toru Sagayama (SAGTO), Hiromi Sato (SATHI), T. Sato (SATTA), Holger Seipelt (SEIHO), Takashi Sekiguchi (SEKTA), Y. Sindo (SINYA), Ulrich Sperberg (SPEUL), Y. Suzuki (SUZMA), David Swann (SWADA), Richard Taibi (TAIRI), Yuko Takeuchi (TAKYU), Hiroyuki Tomioka (TOMHI), José Trigo (TRIJO), Toshihiko Ueno (UENTO), Yoshiaki Uyama (UYAYO), Hendrik Vandenbruaene (VANHE), Jan Vandenbruaene (VANJN), Karin Van Genegen (VANKA), Mireille Vanheerentals (VANMR), Cis Verbeeck (VERCI), Nikolai Wunsche (WUNNI).

2. The hourly rate profile

All ZHRs were computed according to the method described in [1]. The available ZHRs were averaged using a method described in the Perseid and Geminid analysis published in several issues of *WGN* in 1989. The final result can be shown on a graph (Figure 1).

Rates were averaged over a 6 hour period. Since quite a lot of observations required a rather strong combined correction for zenith distance and limiting magnitude, the ZHRs were accepted when the correction factor was not larger than 10. At first sight, this is a ridiculously large correction factor and indeed such a ZHR has very little value. It is, however still better than nothing at all. The weighed mean ZHR uses the inverse total correction factor as weighing factor. A ZHR of 100 obtained from an observed rate of only 10 meteors will get a weigth of only 10% and so has little influence on the final result.

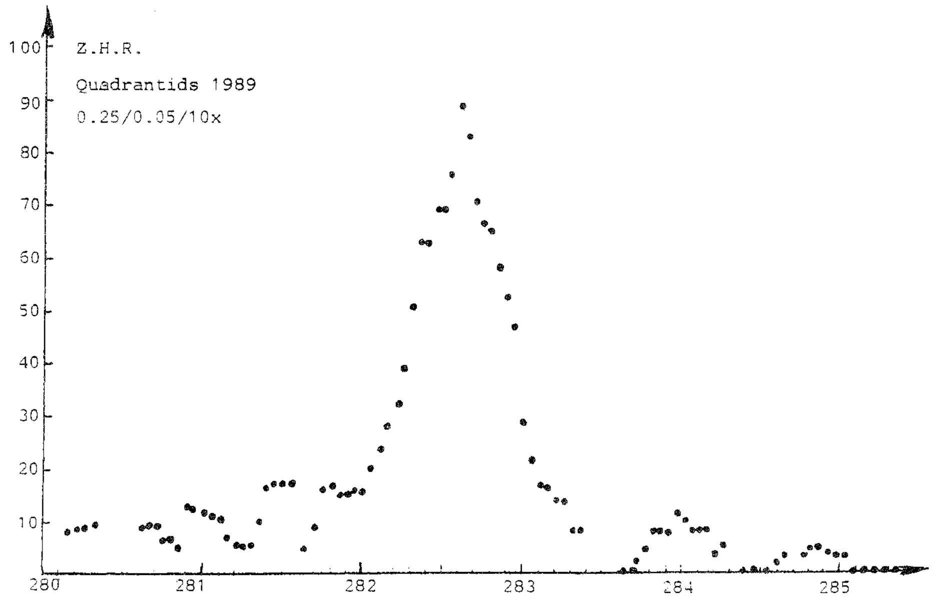

Figure 1 – ZHR profile of th 1989 Quadrantids.

The result shown in Figure 1 is very acceptable. The maximum occurred at $\lambda_\odot = 282\overset{\circ}{.}62$ (Eq. 1950.0) which agrees with previous results. The ZHR of 89 is a bit low compared to the often high Quadrantid peak rates you see in older reports. Also, rates remain very low until $\lambda_\odot = 282°$ when the ZHR starts to increase very steeply. In about 12 hours, a maximum rate is obtained which covers only 1 or 2 hours. Then, the rates decrease very steeply in another 12 hours. The sharp peak is very short-lived and thus can be easily missed.

In 1989, Europe got very disappointing Quadrantid rates as they saw the start of the activity increase in the morning sky of January 3, before daylight. When Americans took over, the radiant was either too low or beneath the horizon. In the local morning hours over the American continent, the radiant was well up in the sky, but very few observers were present to enjoy the good rates. When peak rates occurred at $14^{\text{h}}30^{\text{m}}$ UT, it was too late for Americans and too early for the Japanese, where the zenith distance of the radiant reduced the observed rates a lot. Hawaii would have been the best place to see the Quadrantids in 1989! When Europeans started observing again at 17^{h} UT, the radiant was once more to close to the horizon to produce any significant hourly rates. When the radiant got at a useful elevation, the entire peak was over, leaving rates of only a few up to 10 Quadrantids an hour.

3. Many ZHRs or goods ZHRs?

Despite the results obtained from the *VMDB* have never known their equals in the past, some people questioned their reliability It is good to be critical and it is useful to compare a few activity profiles using different criteria for the quality requirements. There are two factors that influence the final activity profile somehow. When we want to increase the reliability of visual meteor counts, it is obvious that we will limit the correction factor. ZHRs obtained under poor circumstances are very inaccurate.

If *IMO* would have mainly observers who work under perfect transparent sky, their would be plenty of ZHRs with very small correction factors. Unfortunately, even at a global level such as in *IMO*, the number of such observations is very limited. Bringing together all data that is available around the world does not offer us the luxury to work only with perfect sky hourly rates! In a recent circular, the director of *IMO*'s Visual Commission proposed to make shower analysis using ZHRs with a maximum correction factor of 2. The proposal itself is fine, but it frightened me as I know from my work with the *VMDB* that this is a utopia for most meteor stream activity periods. I also tried several conditions for Perseid and Geminid meteor stream analysis and in both cases it turned out that it is far more important to have enough estimates

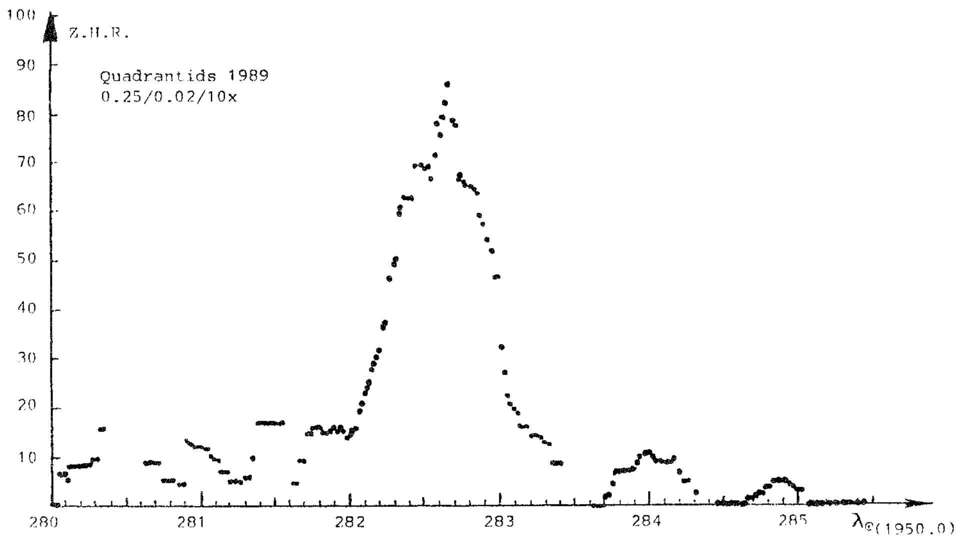

Figure 2 – 1989 Quadrantid activity profile with a sampling period of 6 hours and a maximal correction factor of 10.

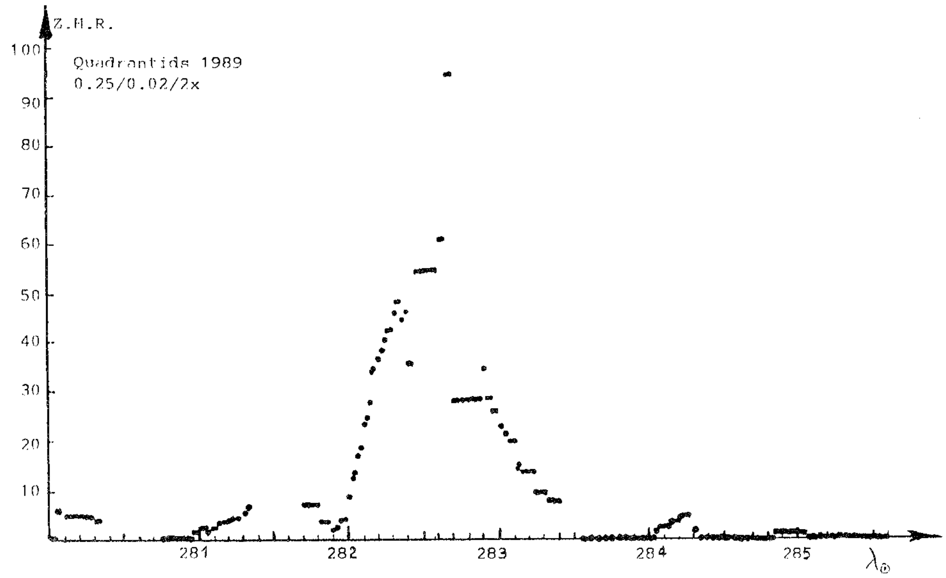

Figure 3 – 1989 Quadrantid activity profile with a sampling period of 6 hours and a maximal correction factor of 5.

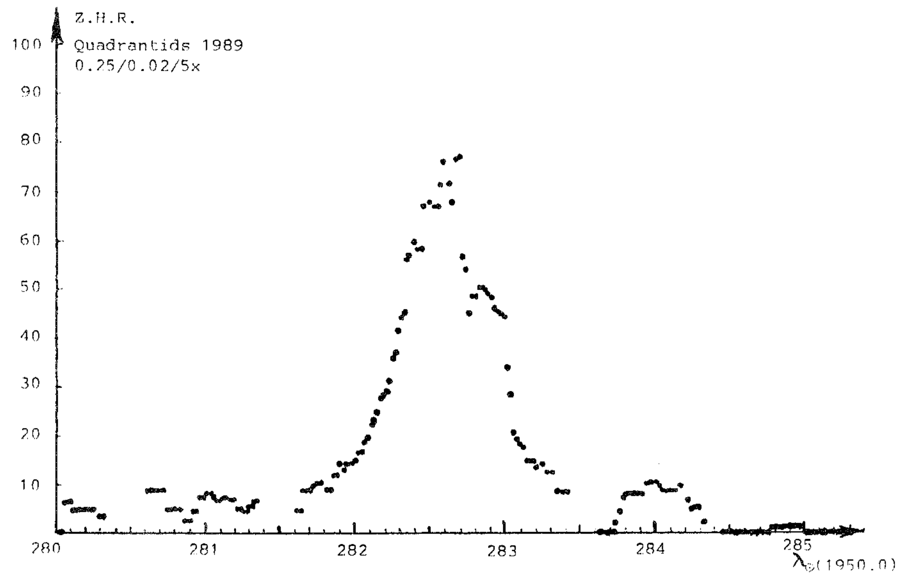

Figure 4 – 1989 Quadrantid activity profile with a sampling period of 6 hours and a maximal correction factor of 2.

per time period than only a few which have a very small correction factor. This is not so much of a surprise due to introduction of a weighing factor, being the inverse of the total correcting factor. So, a poorly determined ZHR has very little influence.

The more relaxed the quality criteria, the more ZHRs are available to average the activity level. Therefore, we compare activity profiles all based on the same database of Quadrantid ZHRs, obtained with different quality selections. We compare the profiles as obtained from data with a maximum correction factor of 10, 5 and 2. In order to resolve short duration activity variations, the duration of the sampling period can be varied. Experiments before learned 6 hours, or 0°25 in solar longitude, turned out to be reasonable. The shorter the sampling period, the fewer the ZHRs available in them, the less certain the average ZHR is. Just to compare how activity profiles would vary, the curves were constructed for a sampling period of 6 hours and for 4 hours, maximum correction allowed being 10×, 5× and 2×. The resulting curves are shown in Figures 2–7.

Looking at these graphs, Figure 2 gives a fine result already. The central peak shows up very well. When the maximum correction factor is reduced from 10 to 5 in Figure 3, the essential characteristics remain unchanged. ZHRs become a bit lower and the pre-and post maximum activity shows more stable low ZHRs. If the correction factor is limited to 2, as proposed for future analysis, Figure 4 shows a rather poor result. Gaps appear due to a lack of data that match the quality requirements. The maximum is based only on one single ZHR value! This case indicates at least that the number of ZHRs we need to get a reliable ZHR average is of more importance than the correction factor used.

The characteristics of the different profiles are reproduced in Table 1. The sampling period, the step length at which an average was taken and the maximum correction factor identify the profile. The differences are very unsignificant Table 2 lists the number of ZHRs available for each profile per time interval of one degree in solar longitude.

Table 1 – Some activity profile characteristics.

Profile	Period	Step	Corr.	Max ($\lambda_\odot$)	Max (UT)	ZHR_{max}
Figure 1	0.25	0.05	10	282°62	13^h45^m	89
Figure 2	0.25	0.02	10	282°67	15^h00^m	86
Figure 3	0.25	0.02	5	282°65	14^h30^m	77
Figure 4	0.25	0.02	2	282°65	14^h30^m	94
Figure 5	0.15	0.02	10	282°67	15^h00^m	95
Figure 6	0.15	0.02	5	282°61	13^h30^m	84
Figure 7	0.15	0.02	2	282°62	13^h45^m	94
1987	0.25	0.02	5	282°43		140

Table 2 – The number of ZHRs used per degree of solar longitude, used in Figures 1–7.

Profile	279°–280°	280°–281°	281°–282°	282°–283°	283°–284°	284°–285°
Figure 1		38	157	522	155	102
Figure 2		104	405	1315	384	248
Figure 3		73	306	805	305	213
Figure 4		42	129	258	153	146
Figure 5	71	58	234	786	224	163
Figure 6	71	40	177	480	198	140
Figure 7	55	24	73	155	95	95
1987		95	438	1710	435	259

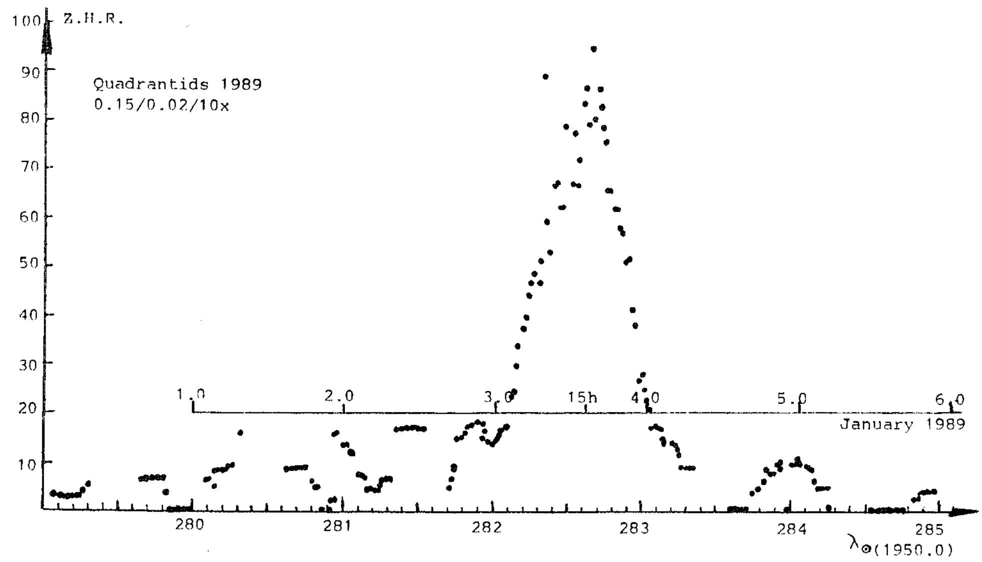

Figure 5 – 1989 Quadrantid activity profile with a sampling period of 4 hours and a maximal correction factor of 10.

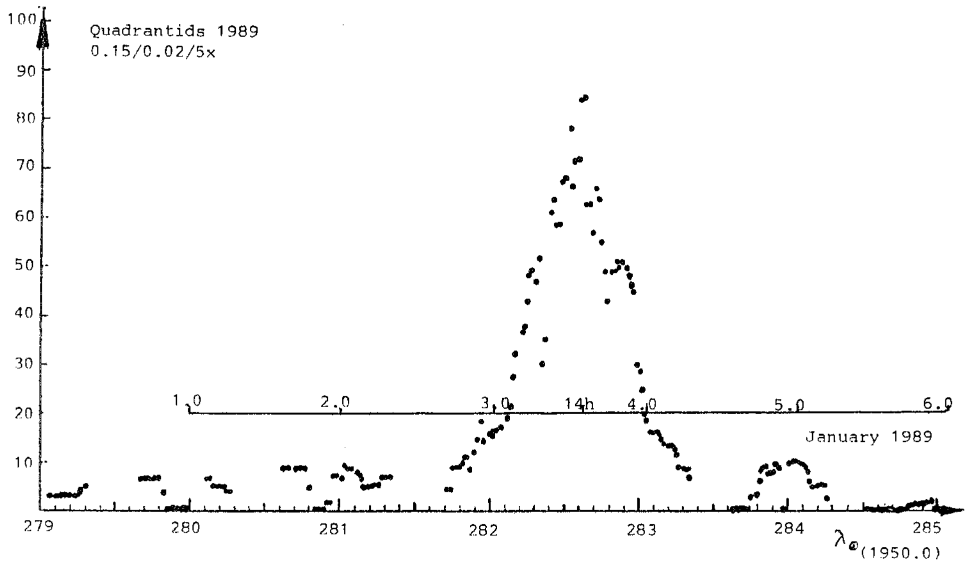

Figure 6 – 1989 Quadrantid activity profile with a sampling period of 4 hours and a maximal correction factor of 5.

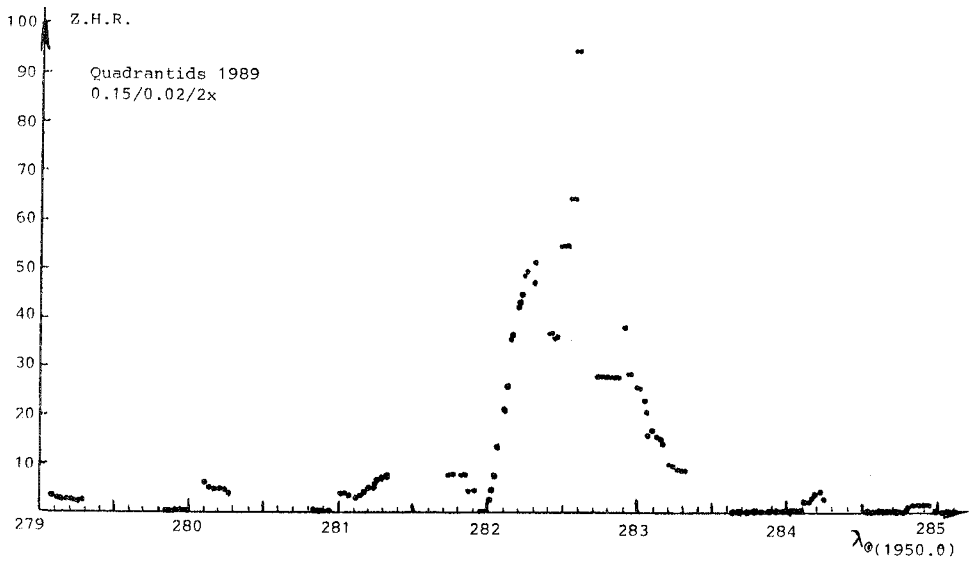

Figure 7 – 1989 Quadrantid activity profile with a sampling period of 4 hours and a maximal correction factor of 2.

Repeating the analyses for a sampling period of 4 hours leads to Figures 5–7. As the number of ZHRs decreases, the scatter becomes somewhat larger, but, essentially, parameters do not change.

An attempt to reconstruct overall activity counts for 1 hour intervals comparable to radio observation histograms, but based on visual rates led to no results at all, or better to as many results as there are cases, unfortunately all different. No reliable time of maximum or level of maximum activity could be derived from such histograms. This could be a warning towards radio observers to be careful with such histograms. Radio rates must be reduced to a measurable unit to be compared and to be used for similar goals comparable to these visual results.

4. Comparison with previous years

Since the *VMDB* contains already a good collection of pre-1989 data, all Quadrantid rates for the period 1984 to 1990 were combined in one "long term activity profile". The result is shown in Figure 8.

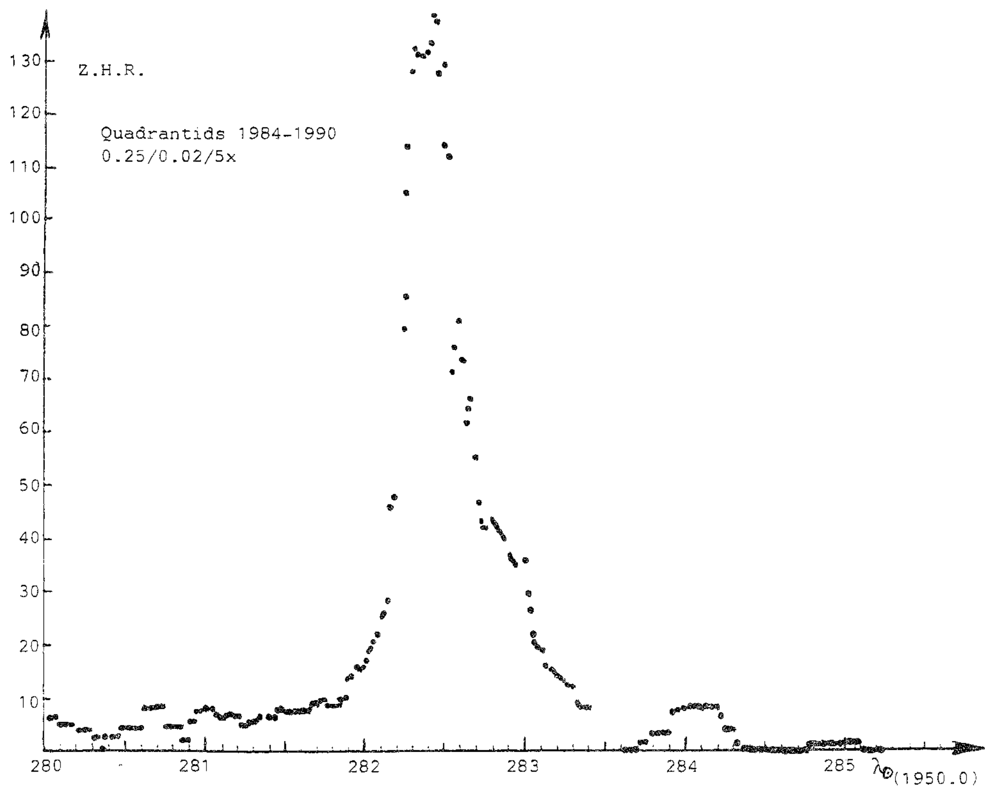

Figure 8 – Quadrantid activity profile for the period 1984–1990.

Figure 8 shows a very sharp peak at $\lambda_\odot = 282^\circ\!.42$. The right wing of the profile corresponds most with the 1989 data. 1986 values compare very well to 1989, but the peak is only due to 1987 observations when both in Europe and Japan, a very rich Quandrantid return was witnessed by all observers. This sharp peak with intense high rates has not reoccurred in 1989! Similar findings were reported by Simek et al. [2].

5. Magnitude distributions

It is disappointing to see how much this aspect is still neglected by the observers who report to the *VMDB*. For the case of the Quadrantids, we got so few magnitude distributions that there is no much point in discussing them in detail. The only reason why we mention them is to avoid the impression that magnitude distributions are unnecessary. They are essential information and must be given per night, per shower, and per observer. If these are missing in your report, it is simply incomplete. I also stress the need to detail magnitude data into distributions per observer per night. Totalized magnitude distribution are of no value in the *VMDB*.

Table 3 – Global magnitude distributions of the 1989 Quadrantids.

Date	−6	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	+7	Tot	$\overline{m}$
Jan 01	0	0	0	0	0	0	0	0	2.5	2.5	2	1	0	0	8	3.19
02	0	0	0	0	0	0	1	3	3.5	11	21.5	6.5	0.5	0	47	3.50
03	0	0	0	1	3	12.5	19.5	33.5	88	101	86.5	35	2	0	382	2.68
04	0	0	0	0	1	3	6	10.5	22	31	39	19	2.5	0	134	3.05
05	0	0	0	1	1	1	1	1.5	2.5	6.5	4	3.5	1	0	23	2.59

6. Conclusion

With a joint effort, the amateur community can reconstruct an activity profile of a meteor stream from a single year collection of visual observations. In order to increase the ability to produce reports such as this one, we need more reports especially from the USSR, America and Hawaii. The longitudes in these countries are insufficiently covered compared to Japan and Europe.

Most encouraging is that the correcting factors seem to work very well as the filtering of data from different degrees of observing conditions does not change essential characteristics. If one has to choose between many observations obtained under poor circumstances (limiting magnitude of 5.5 ± 0.5 for instance) and a much smaller number of perfect sky data it seem better to take the first possibility.

References

[1] Roggemans P. (ed.), "*IMO* Handbook for Visual Meteor Observations", Sky Publishing Corporation, 1989.

[2] McIntosh B.A., Simek M., "Quadrantid Meteor Shower: a Quarter Century of Radar Observations", *Bull. Astr. Inst. Czech.* 35, 1984, pp. 14–28.

The 1990 Quadrantids from Maryland

Richard Taibi

Moderate weather conditions and low rates are reported for the 1990 Quadrantids, as seen from Maryland, USA.

Clear weather is very uncertain in Maryland in the winter. I suppose another Maryland observer, George Gliba, and I were fortunate to get some good weather for 1990's Quadrantids. However, clouds did cut short my observing sessions on January 3 and 4. Anyhow, no observer saw more than 2 Quadrantids per hour under limiting magnitudes of 5.4–5.8 and F-values of 1.00–1.21.

I suspect that the shower maximum occurred for longitudes on the other side of the planet. The low rates for the sessions of January 3 (7^h42^m–8^h20^m UT) and January 4 (3^h44^m–6^h18^m UT) suggests that the peak may have occurred between them, for luckier observers in the eastern hemisphere. This interpretation is based on *Sky and Telescope*'s prediction of the maximum (Calendar Notes, January 1990, p. 79).

Telescopic Meteor Showers of the Summer Season

Vladimír Znojil

The detection and identification of telescopic meteor showers during the summers of 1966–1973, using both statistical methods and simultaneous observations, is discussed. A list of showers is presented.

1. Introduction

The observation of telescopic meteors has a long tradition in Czechoslovakia dating back as far as to the 40ties when extensive observational material has been gained from Skalnaté Pleso [1,2]. In the beginning of the 50ties telescopic meteor observation has also been attempted, not very successfully though with rare exceptions such as e.g. the observation of the α-Lyrids [3]. The cause was partially the value of r as a consequence of which the ratio of the number of sporadic and shower meteors was rather disadvantageous for telescopic observation. Only a suitable organization of observations, the huge gathering of observation material in the mid 60ties, and more sensible statistical analysis, have allowed detection and often even a more detailed study of showers [4,5].

Meteor plotting has considerably improved the value of telescopic observations, especially in connection with multiple station observations. Rather extensive actions of this type have been realized, especially between 1966 and 1973, and between 1982 and 1984. The Nicholas Copernicus Observatory and Planetarium in Brno keeps the data files of more than 40 000 telescopically observed meteors. At present, only a small part of this material has been analyzed; the methods used for statistical evaluation of showers and the processing of multi-station meteors are very elaborate, even with the use of computers.

2. Observational material and detected showers

From older observational results, a catalogue of 887 multi-station telescopic meteors has been composed and will be published. Most of them (840 meteors) have been observed in the summmer season. In this catalogue, some meteor showers and associations have been identified; the identified showers and association and the comparison of our results with those of the statistical elaboration of the material of the period 1966–1968 will be treated later.

Table 1 – List of observing seasons.

Year	λ_b	λ_e	Meteors	Records
1966	133°9	147°6	298	1955
1967	124°1	134°9	56	194
1968	120°0	129°9	62	206
1970	125°3	135°0	137	431
1972	134°4	142°4	162	686
1973	122°7	131°6	125	546

Table 1 shows a brief review of the observations enclosed in the summer par of the catalogue; the table encloses the year of the observation, the ecliptic longitude of the Sun during the observation period, the number of stations the meteor was observed from, and the number of recordings of different observers at respective stations.

Table 2 is a list of meteor showers and associations detected from these meteor data. It contains the name of the shower or the association, the range of the ecliptic longitude of the Sun from the beginning till the end of the activity period, a mid value of this longitude, a preliminary mid position of the radiant and the number of radiants of individual meteors which were used. At the end of the table there is an identification of the shower or association with associations or showers from older catalogues: C is the catalogue of Cook [6], T up to the number 154 refers to the Terentjeva catalogue [7], T from the number 155 onwards refers to its continuation in [8], and TD to the supplements [9], K is the catalogue of radio location data in [10]. The addition "*" means that the shower is listed in the catalogue under the same name as in Table 2.

Table 2 – List of meteor showers and associations

Designation	λ_b	λ_e	λ_m	α	δ	N	Identification
02 o-Dra	120°1	127°5	122°6	263°	+69°	3	C*, T220*
03 β-Lac	120°2	129°5	125°2	335°	+53°	12	
04 α-Cas	120°2	128°9	126°0	6°	+56°	3	K97
05 ζ-Cyg	126°6	128°6	127°9	318°	+33°	3	
06 γ-And	126°6	131°5	128°2	27°	+44°	8	T104*, K104
07 ω-Aqr	127°6	129°6	129°0	352°	−20°	4	K111?
08 β-Per	127°7	131°5	129°3	39°	+42°	5	T105 (α-Per)?, K120
09 13-Lyr	127°2	134°0	129°7	286°	+44°	4	T102
10 19-Cam	129°4	131°5	130°0	83°	+76°	4	
11 β-Cas	120°1	142°1	130°5	358°	+60°	10	T100 (Cas)
12 ι-Cep	120°2	138°3	130°8	328°	+66°	7	
13 Equ	127°3	134°0	131°8	321°	+14°	6	T103 (γ-Del)?, K94?
14 δ-Aqr	120°2	145°4	133°9	345°	−11°	34	15+16
15 δ-Aqr S	122°9	134°1	128°5	340°	−15°	11	C*, K93+95
16 δ-Aqr N	126°7	134°9	130°4	341°	+02°	20	C*, K87+89
17 α-Cap	122°9	140°8	132°0	309°	−15°	19	C*
18 κ-Cas	129°4	138°4	133°8	11°	+66°	7	K86
19 ω-Oph	133°9	137°8	136°3	250°	−21°	5	
20 ι-Aqr	126°6	144°6	138°0	323°	−09°	30	21+C (ι-Aqr S)
21 ι-Aqr N	128°2	134°9	131°6	330°	−02°	10	C*, K91
22 Per	125°5	144°7	137°6	46°	+56°	76	C*, K115
23 η-Aql	126°9	141°3	137°9	293°	+09°	9	T117*
24 κ-Cep	134°6	141°7	138°9	308°	+79°	11	T233 (73-Dra)
25 ι-Cas	134°0	142°2	139°1	38°	+68°	12	
26 47-Cep	134°4	144°5	139°2	36°	+79°	11	T232 (α-UMi), K88?
27 γ-Cyg	134°5	142°1	139°7	324°	+38°	4	
28 δ-Sgr	134°6	142°2	140°0	275°	−30°	7	T114 (γ-Sct)?
29 κ-Cyg	139°4	141°2	140°3	287°	+59°	2	C*, T116*
30 4-Cas	135°4	144°7	140°4	346°	+61°	9	TD96?
31 30-Cam	137°8	141°7	140°5	143°	+84°	5	
32 α-Tau	140°8	140°8	140°8	74°	+17°	3	
33 ζ-Dra	135°4	145°4	141°7	270°	+69°	8	T110+112 (b-Dra)
34 σ-Cet	141°6	144°6	143°4	35°	−17°	5	

The δ- and ι-Aquarid showers are listed twice for technical reasons. During observations near the pole, it was impossible to differentiate the North and South branches (that is why observing far from the radiant results in the determination of a radiant area with the shape of a highly elongated ellipse). For some other observations, a differentiation was possible. In the first case the different meteors are included in a summary radiant, in the second case the radiants of the different branches are distinguished.

3. Notes on different radiants

The following notes make the data in Table 1 data more precise and contain a comparison of results obtained from statistical evaluation of radiants from 1966–1968 materials [11]. Part of the data tabulated here has been published in [12].

- *o-Draconids and φ-Draconids:* in statistical evaluation, they have not been fully differentiated; the suspicion that meteors registered telescopically and visually refer to the different showers has proved to be justified. The activity of the φ-Draconids in 1966 was nevertheless apparently low. Both radiants are rather diffuse, particularly the radiant of the o-Draconids. The tabulated declination of the radiant is rather uncertain.

- *β-Lacertids:* a very mighty stream in 1968 when it had many multi-station meteors. They have not been identified in 1967. The activity in 1973 was rather low. The radiant of the stream is well defined and the stream contains many weak meteors.
- *α-Cassiopeids*: a weak association was found statistically in 1967 as well as in 1968. Double-station meteors have been registered in 1968 only. They are enormously rich in weak meteors (population index r about 4!).
- *φ-Cygnids and γ-Cygnids:* weak association was noted 1972 and 1973. In 1966, visual meteors with radiant in the proximity of these associations have been identified. It is not guaranteed that these telescopic streams really exist.
- *γ-Andromedids:* observed solely in 1973. They occupy in number of meteors the first place among the showers registered that year. Several meteors with imprecisely determined radiants belonging to it have not been included in the table.
- *ω-Aquarids:* registered only in 1973. It is not clear whether this is a real shower.
- β-Perseids: relatively weak stream registered only in 1973, when conditions for its identification were optimal.
- 13-*Lyrids:* registered only in 1973, although the conditions for its registration were more favorable in other years. In spite of the identification with a shower in the catalogue of Terentjeva one cannot guarantee the reality of the registered.
- *19-Camelopardalids:* a radiant that had (except for 1970) a very favorable position in the sky w.r.t. possible detection. Yet it was identified in 1973 only.
- *β-Cassiopeids:* a known shower predominantly containing rather bright meteors. The telescopic activity is rather low and fluctuates in different years.
- *ι-Cepheids:* a very weak stream registered more frequently visually than telescopically.
- *Equleids:* registered in 1970 only. Only that year geometric conditions were favorable for detection.
- *δ-Aquarids and ι-Aquarids:* well-known ecliptical showers with a relatively great number of telescopic meteors (population index r about 2.5).
- *α-Capricornids:* very well-known shower. Its telescopic activity is relatively low, though, but very constant without significant fluctuations over the years.
- *α-Cassiopeids:* a weak meteor shower, statistically identified between 1967 and 1968. The meteors in the table were observed in 1968, 1972 and 1973. The radar shower catalogue published by Kascheev et al. [10] describes it as a very mighty stream.
- *ω-Ophiuchids:* registered solely in 1966. The only other year favorable to their registration was 1972. In spite of a small number of meteors, this shower is striking because there are very few other radiants in that region of the sky.
- *η-Aquilids, perhaps "mixed" with η-Sagittids:* a very weak, but known shower.
- *Perseids:* the main shower of the summer season. A considerable part of the meteors registered are in fact visual meteors observed telescopically. The population index r is low, about 1.85, and in the range of the weakest meteors, it tends to decrease.
- *κ-Cepheids and 30-Camelopardalids:* streams with radiants in the proximity of the pole and with a relatively high number of weak meteors. In statistical evaluations of the data, a shower ε-Ursae Minorids ($\alpha = 228° \pm 7°$, $\delta = +84° \pm 1°$, $\lambda_\odot = 136\overset{\circ}{.}5$) that is probably the superposition of these two streams, not differentiated by the methods used (the radiant having been described as diffuse).
- *ι-Cassiopeids:* a very weak but probably real shower of relatively bright (pseudo-visual) meteors with a high percentage of trains. In statistical evaluation, it is only distinguishable from the Perseids with great difficulties.
- *47-Cepheids:* weak but real shower with a relatively great fraction of weak meteors. Its radiant too is considerably superimposed by the Perseids.

- *δ-Sagittarids:* a striking association of preponderantly weak meteors, practically without trains. It has been registered in 1972 only when it has given the greatest number of simultaneous meteors after the Perseids and the δ-Aquarids.
- *κ-Cygnids:* in spite of the fact that it is a known shower, the real existence of a telescopic radiant is by far not guaranteed.
- *4-Cassiopeids:* another minor stream with radiants in the proximity of those of the Perseids and the β-Cassiopeids. Taking into account a relatively high concentration of sporadic radiants in this region, the reality of their existence is not fully guaranteed.
- *α-Taurids:* three bright meteors registered (the weakest of magnitude 4) with trains in a 40 minutes interval. There are only very few sporadic radiants in that region of sky. The radiant's declination is very uncertain.
- *σ-Cetids:* rather weak meteors. The radiants position is in the proximity of radiants of the south toroidal bunch. Registered solely in 1966, but the activity period touches only marginally the period of the observations in 1972.

4. Registration and differentiation of minor shower radiants

The first efficient method for observing minor streams was proposed by Kresák [1]. However, this method could be used only when the shower's radiant position was known. Without using plotting of meteors which allows a rather subtile differentiation of orientations, only rather active showers can be studied in this way. For such showers, the big advantage of the method is its simplicity. It has been used e.g. in [13].

However this method is not appropriate to detect and study minor showers in more detail. Therefore, it is neccesary to use either observations from several fields or multi-station observations. Showers are then being evaluated either statistically on the basis of plottings or derived from the individual radiants obtained from multi-station observations.

The principle used in the rather simple statistical map is that of making a map of the sky showing the density of backward prolongations of observed meteor trails. Radiants then manifest themselves as concentrations on this map. In practice, the evaluation is not simple: the densities are greater in the proximity of the observed fields, around the zenith and near ecliptical sources of meteors: strong radiants may cause fictitious concentrations. These problems may be partially eliminated by also taking into account parameters such as velocity, brightness, etc., but even then, the use of this method requires considerable experience.

Deriving showers from known individual meteor radiants is much more simple, but the number of such radiants are low, the probability of seeing a weak meteor from several stations being very small. As a consequence, only seldomly quite detailed quantitative data on different showers can be obtained.

In practice, the best thing to do is to combine both methods. It is quite clear that the statistical method makes more sense for showers predominantly producing very weak meteors, but individual radiants better all to differentiate showers with radiants that are close to each other. Also, the effect of "superposition" of minor showers by a nearby, very active radiant does not occur with this methods. For both methods, though, accuracy and differentiating ability drop with growing distances between the radiant and the observing field (for instance, the error range of individual radiants takes the shape of very elongated ellipses, with the axes' ratio being 10:1 or even more).

The observation's effectivity (as to the ability to detect and identify a minor shower) is generally determined by the distance between the radiant and the observing fields.[1] Indeed, the meteor's angular length increases with increasing distance from the radiant. This results in either a greater probability to see it or a great effective field of vision. On the other hand, however, a

[1] This is, not taking into account the zenith effect, influence from ecliptical showers and superposition effects from major showers.

greater angular length also implies a greater angular velocity, whence a decrease in brightness. This decrease in brightness can amount up to 1 magnitude, even at a tenfold magnification.

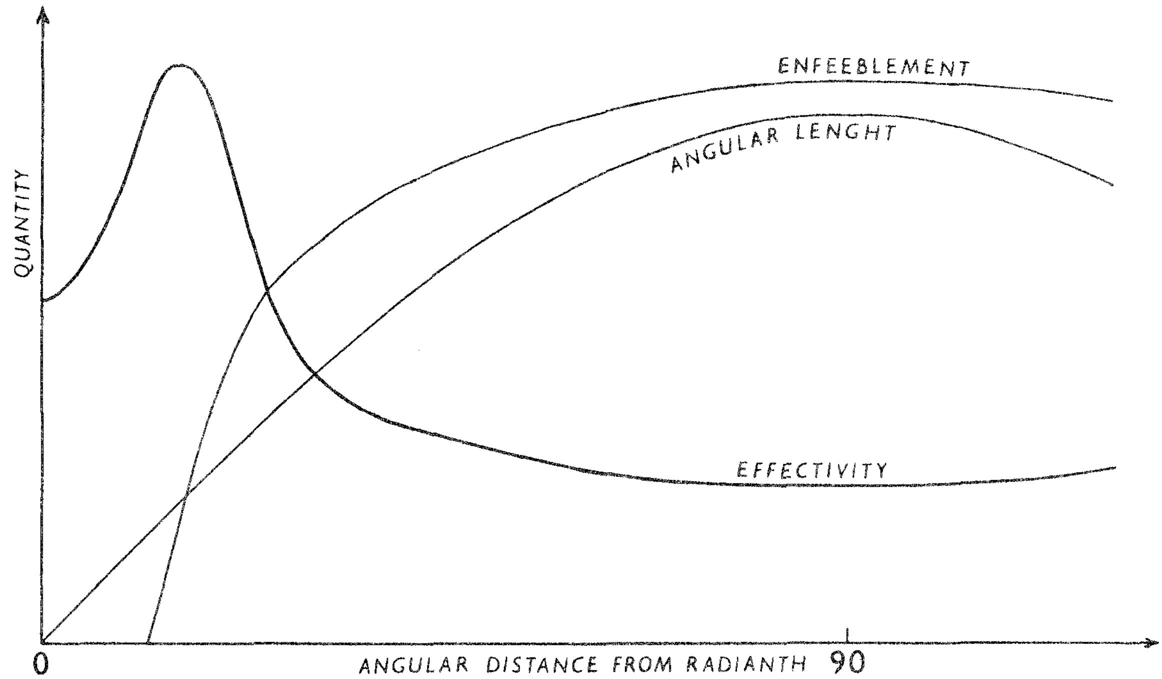

Figure 1 – The observation's effectivity as a function of the distance between the observing field and the radiant.

Figure 1 shows approximate curves of the two factors involved, and their combined effect on the observation's effectivity, the quantitative calibration depending upon the shower's geocentric velocity and the elevations of the observing field and of the radiant above the horizon. Considering that observations in fields less than 40° above the horizon are unwanted (due to great distance to the meteor, one observers in fact visual meteors), one can say that the optimal observing fields are located at a distance of about 20° from the radiant for showers with medium velocity, and at about 12° for fast streams, for 10×80 or 12×60 binoculars. With greater distances to the radiant, the effectivity drops, but usually not dramatically. A sufficiently strong shower can be detected at any distance from the radiant. (The δ-Aquarids, for instance, can be easily detected in observing fields near the pole.)

Among the showers detected by the statistical method during the years mentioned, only the η-Pegasids could not be registered using individual radiants [11]. Their activity index has been relatively low, though (about 8% of the sporadic background after zenith reduction). On the other hand, we were able to identify other showers (some of which were already registered earlier in the visual control data in [11].)

References

[1] Kresák L., "The direction distribution of telescopic meteors", *Centr. Astr. Observ. Skalnaté Pleso* I, 1955, p. 9–39.

[2] Kresáková M., Kresák L., "On the activity of telescopic meteors and some related problems", *Centr. Astr. Observ. Skalnaté Pleso* I, 1955, p. 40–81.

[3] Grygar J., Kohoutek L., Kvíz Z., Mikušec J., "Observation of the α-Lyrid meteor stream", *Bull. Astr. Inst. Czechosl.* 11, 1960, pp. 84–86.

[4] Znojil V., "Frequency occurence of small particles in meteor showers I: Aurigids, Lyrids, Scorpio-Sagittarids, Taurids", *Bull. Astr. Inst. Czechosl.* 19, 1968, pp. 301–306.

[5] Znojil V., "Frequency occurrence of small particles in meteor showers I: Orionids, ε-Geminids", *Bull. Astr. Inst. Czechosl.* 19, 1968, pp. 306–315.

[6] Cook A.F., "A Working List of Meteor Streams", *Evolutionary and Physical Properties of Meteoroids*, C.L. Hemenway, P.M. Millman, A.F. Cook (eds.), NASA, Washington D.C., 1973, pp. 183–191..

[7] Terentjeva A.K., "Malye meteornye rei", *Issledovaniya meteorov*, Nauka, Moscow, 1965, pp. 62–132.

[8] Terentjeva A.K., "Investigation of minor meteor stream", *Physics and Dynamics of meteors*, L. Kresák, P. Millman (eds.), Reidel, Dordrecht, 1968, pp. 408–427.

[9] Terentjeva A.K., "Orbity malykh meteornykh roev", *Astronomiczeskiy cirkulyar* 423, maya 25, 1967, pp. 1–7.

[10] Kaskheev B.L., Lebedinec V.N., Lagutin M.F., "Meteornye yavleniya v atmosfere Zemli", Nauka, Moscow, 1967.

[11] Znojil V., "Occurrence of minor particles in summer meteor streams of the northern hemisphere", *Bull. Astr. Inst. Czechosl.* 33, 1982, pp. 201–210.

[12] Znojil V., Hollan J., Šimek M., "The relation between optical brightness and properties of the ionized trail III. Double station observations (Result of the Ondřejov meteor expeditions in 1972 and 1973", *Bull. Astr. Inst. Czechosl.* 36, pp. 44–56.

[13] Znojil V., Hollan J., Hajduk A., "Concentration of small particles in Orionids", *Bull. Astr. Inst. Czechosl.* 38, 1987, pp. 372–375.

Observational Results

Spain: Heyday of Meteor Investigation

José Trigo Rodríguez and Miguel Camarasa Yuste

This article analyzes the developments made in meteor study during the last decade. At its heyday the *S.O.M.Y.C.E.* was formed.

1. The first investigators

In the late seventies there existed a growing interest in scientifically founded meteor observing—in contrast to former years. Several observer groups originated in those years, which adhered to the *FEMA* methodology (Federation of European Meteor Astronomers) and obtained relevant results. In Spain the meteor sections of A.A. Madrid and A.A. Albireo were the most representative. This was mostly due to the work of their coordinators, Guillermo Castilla Alcalá and Eduardo Martínez Moya respectively. They became real promoters of the meteor work in these days. Both meteor sections worked closely together, and this soon resulted in some important publications. Two of those publications emphasize the extent of cooperation. They were from the hand of Eduardo Martínez: "Meteor Observations of July–August 1982" and "Perseids 1983". These were published by A.A. Albireo. "Perseids 1983" won a third prize in Holland with its 16th edition. One effect of all this was that Eduardo Martínez became *FEMA* coordinator for Spain—a task which he fulfilled several years, during which he reorganized the section and its observing methods.

2. The new generation

The activities of both abovementioned sections diminished gradually, because of internal problems and because the people in charge had less and less time to spend on meteor work. After this crisis, which could have stagnated all further investigations in years to come, the lead was fortunately taken up again by José Trigo who organized the meteor section of the Astronomical

Association of Valencia. Several members of that society found an outlet for their observing urges in this meteor section. From this initial group emerged José Luís Martín. He and José Trigo laid firm foundations for their meteor section, and it was able to survive throughout the years until the arrival of fresh observers in the summer of 1986: Antonio Francisco Marín and Vicente Soldevila Perez, who both became editor of the A.V.V. circular "Meteors".

In the meantime a growing friendship developed between observers from Catalonia and Valencia; the opportunity of forming one large organization was at hand. It would add more weight to the significance of joint operational results.

An important period for the coordinator was when he received considerable support from Dr. Ignacio Ferrín, president of the Ibero-American astronomical league who spent some time in Spain. He also drew moral support from the joint discovery with other European observers on December 21, 1986, of a peculiar condensation in the Ursid stream—an important stepping stone in the field of orbital dynamics.

In 1987 new observers joined the association, among which Oscar Cervera García, José Vicente Díaz, Raúl Fernández and Miguel Camarasa; They made it possible to conduct more ambitious campaigns. There was hope of forming an organization in which all observers interested in interplanetary matter would find a place to end the till then existing division.

3. Formation of S.O.M.Y.C.E.

As a result of good work and several discussion with observers during the 1987 "National Week of Astronomy" in Barcelona, José Trigo, Carles Royo, Xavier Bayona, David Martínez, Juan Antonio Alduncin and Sebastiá Torell agreed that the overall association which had been formed in 1987 should become legalized in 1988. That organization soon became second in place in the world's list of observing hours, after MMTÉH (Magyar Meteor- és Tüzgömbészlelö Hálózat), with results never before achieved in Spain: 1700 hours and 7000 registered meteors, spread over 250 different nights. In 1988, through the work done in the previous year on methodology, the criteria for meteor study used in Spain were ameliorated and standardized. Several campaigns gave interesting results and in the end served as basis on which the *S.O.M.Y.C.E.* was legalized. *S.O.M.Y.C.E. (Sociedad Observadores de Meteores y Cometas Españoles)* is also known in English as *S.M.S. (Spanish Meteor Society)*.

In the same period there was a growing interest in joint activities with Latin-American observers. As a result of talks between Ignacio Ferrín (president of LIADA), Hans Salm (coordinator of a meteor section of the Asociación Boliviana de Astronomía) and José Trigo, a new coordination team was established in the persons of Hans Salm and José Trigo. Undoubtly meteor science has progressed significantly in the last decade, mostly due the disinterested but decisive efforts of the observers who remain in anonymity. Their efforts did not only make the creation of *S.O.M.Y.C.E.* possible, but also that of *IMO*. *IMO* which is not just a uniting of several observers around the world, provides the basis and methods on which to perform all further investigations.

The existence of a collective organization dedicated to the study of interplanetary matter in all its aspects, fills a large gap which existed in Spain and South America. It is evident that various seperate groups with scarce cooperation cannot live up to the standards of high precision and world level investigation required by a science like ours. Our objective is to fully cooperate insofar as lies in our means, on all levels. We think the basis for good cooperation is to be found in a series of observing groups that work together on the same projects, and who are well interrelated.

The organizational and methodological levels still have not progressed enough. In Spain this is reflected by the existence of isolated projects, the principal problem to be solved by *S.O.M.Y.C.E.* We therefore intend to include positive criticism on certain articles published in popular journal which do not live up to scientific standards and make the work of years of observers who aim scientifically founded results, lose prestige, instead of promoting their efforts. We always advise such journals, as well as our own writers to get the necessary information from us or from *IMO*.

4. Activities since 1986

Our association has always been characterized by dedicated activity during whole the year. We always covered minor as well as major showers. Therefore it is extremely difficult to summerize all the *S.O.M.Y.C.E.* activities. Between 1986 and 1988 we recorded 20 000 meteors visually, and tens of meteors photographically. Certainly worthwhile were the campaigns of the Perseids, Geminids, Quadrantids, Lyrids, η-Virginids, Orionids, η-Aquarids, Leonids, δ-Aquarids, κ-Cygnids, ...

We hope that the energy put in this kind of investigation will become continuous and that the level of the work in *IMO* will keep increasing.

The α-Capricornids in 1989

Luis Ramón Bellot Rubio

The present study intends to be an analysis of the α-Capricornid activity during July–August 1989. All the observations were carried out by some members of the Spanish Meteor Society, as well as *IMO* members.

1. Introduction

In July–August, there are a high number of radiants which remain active in the sky. This makes the observer watch a lot of meteors belonging to several streams. In particular, the α-Capricornid stream starts its activity in the middle of July, anf finishes it on August 25. During this period, the Aquarids are also active, and the correct association of the α-Capricornids and Aquarids to their radiant might be difficult.

2. Radiant characteristics

The rates of activity of the α-Capricornids remain steady in the whole period of visibility. Distinct maxima are not seen, but a higher activity level in $\lambda_\odot = 126°$ being the main maximum [1], is possible. Another secondary maximum is expected to occur on July 25–26, although it is almost unexistent [2], and in 1987 another submaximum could be registered on July 20–21 [3].

3. Analysis of the observations

In order to get correct classification of the α-Capricornids, we dealt with a maximum radiant diameter of 5°. In this diameter, we leave 2°–3° as a margin for the plotting errors that could have been made. Any meteor deviating more than 5° from the theoretical radiant position was discarted. Another criterion used was the apparent angular velocity of the meteors, as well as the length of their trails [4]. From photographical observations the geocentric velocity of the α-Capricornids has been determined as $V_\infty = 25.6 \pm 0.4$ km [1]. Consequently their angular velocity is low or medium. As the angular velocity of the Aquarids is higher, the α-Capricornids can be easily recognized by this criterion.

Brightness was used as an additional criterion when the association was not very clear. Bright meteors were classified as α-Capricornids because this shower has a large portion of bright meteors.

4. Observational results

The following data are based on 102 α-Capricornids registered by six observers during 169 hours of effective observing time. We registered 3878 meteors in total, especially Perseids and Aquarids. This action was undertaken to study the Aquarid complex, and it is possible we missed some α-Capricornids by special concentration to the region in or near Aquarius.

We started looking for α-Capricornids on July 8–9. This is before the visibility period had started. The first shower member was seen on the July 25–26, but this is probably due to bad observing conditions until this date. The last α-Capricornid registered appeared on the night August 11–12. From August 14 onwards we could not continue the observations because of the Moon. Anyway, the activity of the α-Capricornids on these dates is known to be very poor.

The six observers who participated were:

Luis R. Bellot (BELLU), Miguel Camarasa Yuste (CAMMI), Rosario Moyano Aguirre (MOROS), Francisco Reyes Andres (Pacos), Paul Roggemans (ROGPA), José M. Trigo (TRIJO).

Table 1 shows the results of our observations *(nights without α-Capricornids omitted, ed.)*. Over 58 individual ZHR values were obtained. All of them were taken into account, except those not showing any activity at all, when the activity was evident from observations by others.

Table 1 – Hourly rate observations of the 1989.

Date	Nr. Obs.	T_{eff}	Lm	α-Cap	ZHR
Jul 25–26	2	5.42	6.44	8	2.7 ± 0.9
26–27	2	2.95	6.67	8	4.4 ± 1.5
27–28	3	7.46	6.45	10	2.5 ± 0.8
28–29	4	5.85	6.00	5	2.0 ± 0.9
29–30	2	2.40	6.16	1	1.0 ± 1.0
30–31	4	6.10	6.29	9	5.3 ± 1.8
31–32	4	16.92	6.29	17	1.8 ± 0.4
Aug 01–02	5	17.66	6.41	16	1.6 ± 0.4
02–03	1	6.25	6.41	9	2.6 ± 0.9
03–04	3	7.18	6.30	7	1.6 ± 0.6
04–05	3	4.00	6.34	7	3.5 ± 1.3
06–07	2	9.34	6.32	4	0.7 ± 0.4
11–12	3	7.59	6.30	1	1.2 ± 1.2

A maximum is clear on the night of July 30–31, at $\lambda_\odot = 127^\circ\!.7$. On July 26, the α-Capricornids reached another submaximum, at $\lambda_\odot = 123^\circ\!.88$. Finally we could see an increase of the activity on August 4–5. The regularity of the stream from July 25–26 until August 6–7 is very evident, and no great maximum can be found.

Table 2 shows magnitude distribution per observer. After averaging all the magnitudes, we arrive to a mean magnitude of 2.83 (not corrected for the limiting magnitude. The r-value computed using meteors between magnitude -3 and 4 was 2.09 ± 0.33. This value has been used to calculate the ZHR values.

Table 2 – Magnitude distributions of the 1989 α-Capricornids.

Obs	Lm	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	$\overline{m}$	Tot
MOROS	6.3	1	0	1	0	0	0	0	1	0	0	0.00	3
CAMMI	6.3	0	1	1	0	0	1	0	3	3	0	2.88	9
BELLU	6.2	0	0	0	0	2	3	2	4	0	0	2.72	11
TRIJO	6.3	0	2	0	0	0	0.5	10.5	10.5	10	5.5	3.93	39
ROGPA	6.3	0	1	0	5	6.5	11.5	11.5	4.5	0	0	2.00	40
Tot	6.3	1	4	2	5	8.5	16	24	23	13	5.5	2.83	102

The most remakable features of the α-Capricornids are their slow velocity and the brightness of some of them. In general, the α-Capricornids do not leave any train.

References

[1] P. Roggemans, "*IMO* Handbook for Visual Meteor Observations", Sky Publishing Corporation, 1989.

[2] J. Wood, "The 1987 Aquarids in Australia", *WGN* 16:5, October 1988, pp. 158–159.

[3] G. Ticket, "An Analysis of the 1987 Aquarids", *WGN* 16:5, October 1988, pp. 160–170.

[4] L.R. Bellot, "Relación entre longitud aparente de los meteoros y su distancia al radiante", *Halley* 13, November 1989, pp. 3–7.

Spring and Summer 1989 Observations from Maryland

Richard Taibi

An overview is given of meteor observations conducted in Maryland during the Spring and Summer of 1989.

Maryland suffered through worse than usual observation conditions due to heavy rains and clouds this spring and summer. The clouds parted long enough to permit mediocre conditions on July 29 and 30 so that the maxima of the Aquarid and α-Capricornid stream could be monitored. The Perseid maximum was lost due to bad weather but fine conditions did prevail on August 9. Considering the prevailing poor weather I was fortunate to see any of the major and minor streams. I felt even more fortunate to see α-Capricornid and Perseid fireballs.

The late July results reveal that the South δ-Aquarid and α-Capricornid stream were most productive. The Perseid stream was poorly monitored during July because I was facing the Aquarid radiants to monitor those streams for *IMO*'s Aquarid Project. I was pleasantly surprised to see eleven Perseids during the second half of my watch on August 9, the only time I looked specifically for Perseids. Even better, I saw three Perseid fireballs within a twenty minute period!

From the Meteor Library

compiled by Paul Roggemans

- *V. Porubčan, M. Šimek, B.A. McIntosh, "Lyrid Meteor Stream: Long-term Activity Profile", Bull. Astr. Inst. Czechosl. 40:5, 1989, pp. 298–302.*

The Springhill and Ondřejov radar observations provide the longest known series of systematic observations of the Lyrid meteor shower—18 returns over a total interval of thirty years. The data over all years have been combined to produce a mean profile of relative shower activity with a resolution of one hour (0°.04 in solar longitude). The maximum activity occurs at $\lambda_{\odot} = 31^{\circ}.50 \pm 0^{\circ}.05$ (Eq. 1950.0) and the width of the rate profile at half-amplitude is 1.5 days. The results are in good agreement with values determined from visual observations.

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Please do not forget to renew promptly your

Subscription/Membership for 1990

if you have not yet done so!!!

Last year, many *WGN* subscribers renewed late. As a consequence, we had to run to the post office almost daily to mail back-issues. Please save us such a loss of time this year and make sure your subscription will not be discontinued! All subscription/membership information can be found on pp. 169–170 of the 1989 October issue of *WGN*!

IMO International Meteor Weekend 1990

Be sure to participate in the next meteor weekend in 1990, plan your holidays and make your reservation right now:

Dates:

Begins: Thursday evenening September 6, 1990
Ends: Sunday noon September 9, 1990.

Place:

Bruder-Klaus-Heim, in D-8901 Violau, FRG
(near the city of Augsburg)

Program:

Introduction of observing groups, lectures on meteors and related fields, poster presentations, excursion to the Augsburg planetarium (optional), 2nd General Assembly of *IMO*. The official language is English.

Accomodation:

Accomodation will be in 4-bed rooms. Make your reservations early, since the number of rooms is limited! The estimated price for accomodation, full board and participation at the conference is around 140,- DEM,

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