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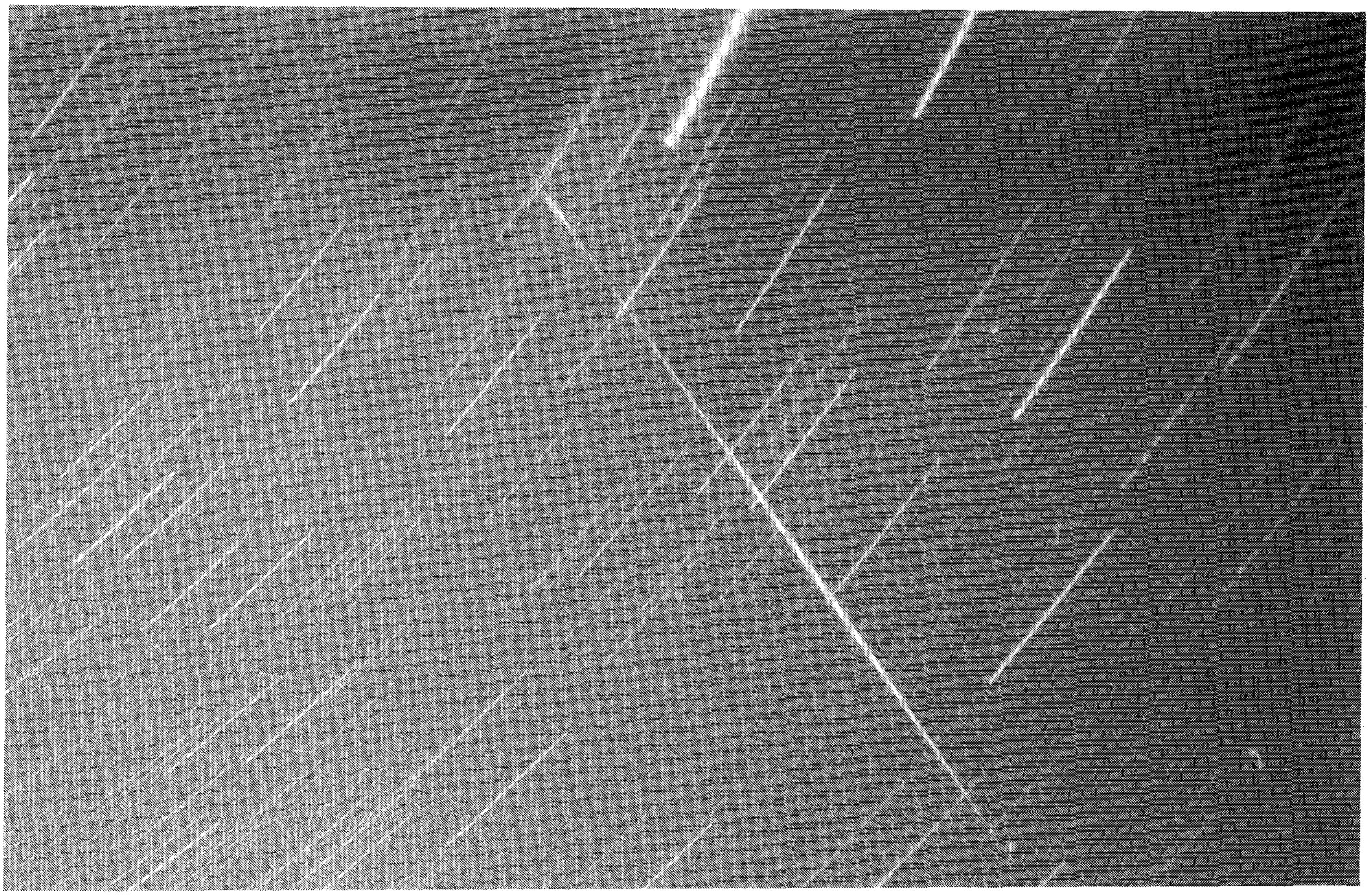

This Aquarid was photographed by Ghislain Plesier (Belgium) on August 8–9, 1988, The photograph was exposed from $23^h54^m05^s$ until $00^h17^m00^s$ UT with a 24 mm $f/2.8$ lens on Kodak TMAX 400.

In case of non-delivery, return postage guaranteed. Please return to:

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Afgiftekantoor: 2800 Mechelen 3

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Useful Information

The August Issue *(WGN 17:4)*

This issue will be mailed earlier than usual, i.e. in the last week of July. Contributions for the *August issue* are therefore due by *June 23* at the latest. 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 1989

The subscription rate for volume 17 is 400 BEF or 12 USD (which includes airmail delivery for subscribers living outside Europe) for six issues. It is anticipated that volume 17 will contain over 220 pages. Subscriptions should be paid to Ann Schroyens or, for the USA and Canada, to Peter Brown. People living in the UK can pay through George Spalding and people living in Japan through 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.

For *IMO* members, renewing subscription automatically entails renewing membership, unless otherwise asked. Non-*IMO* subscribers can ask for membership information by writing to Paul Roggemans (address on inside of back cover).

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 Editor-in-Chief

Marc Gyssens

We were happy to receive several favorable comments on the previous issue of WGN. We are also happy to announce that our publication delay problem is now finally over. The provisional administration continues working on the preparation of IMO's Founding Assembly; meanwhile the Organization keeps growing. Lately, IMO saw a strongly increased interest from Japan.

As far as this issue is concerned, a project for the 1988 Aquarids is proposed. Furthermore, we have a contribution from Mr. Ohtsuka on the December Monocerotids. The radio-amateurs can rejoice in a schema for an inexpensive A/D converter. Thanks to the Visual Meteor Database, we also have comprehensive reports on last year's (northern hemisphere) fall showers.

Happy reading and many clear nights in the months ahead! And do not forget that you too can use WGN to communicate interesting meteor news to your colleagues all over the world!

Letters from Professionals

compiled by Marc Gyssens

Lately, Paul Roggemans received letters from several professional meteor astronomers. Most of them were written in reply to a request from Paul to grant him permission to use some illustrations in the new edition of the Handbook for Visual Meteor Observations. But they all contain encouraging comments for IMO, which we would like to share with you.

I wish you full success in your work within the International Meteor Organization. Some of my colleagues are in close contact with you, which makes me possible to have information on your and *IMO* activities, which I appreciate very much.

Anton Hajduk
Astronomical Institute, Bratislava, Czechoslovakia
April 5, 1989

I've now received the 3 *WGN* issues and Observer's Handbook. I am very impressed by the professionalism of the contributions, and by the rapid development of the *IMO*. I was at IAU in Baltimore, and wholeheartedly agree that greater cooperation between professional and amateur astronomers is needed, and see the development of the IMO as an important step in this direction. I will consider writing something for *WGN* sometime in the future.

Robert Hawkes
Mount Allison University, Sackville, New Brunswick, Canada
March 8, 1989

I think that for the published data [in *WGN*] to be of any practical value it should be in the form of numerical tables. If there is a need for presentation purposes it can also be given in graphical form. I think the *WGN* is doing an excellent job in its present form.

Jim Jones
The University of Western Ontario, London, Ont., Canada
March 6, 1989

I wish you much success in your most valuable efforts to organize closer international coöperation in this area of astronomy, which is more than any other dependent on the input from amateur observers.

Ľubor Kresák
Astronomical Institute, Bratislava, Czechoslovakia
March 8, 1989

I think that *WGN* is a good journal, valuable for the entire meteor community, amateurs and professionals. Congratulations. It seems to me that fast publishing of observational material encourages observers in their activity. Articles such as the "Preliminary Analysis of the 1988 Perseids" (1989, *WGN* 17:1, p. 11) are very valuable for further investigation of the stream behavior. I accept your kind offer to publish some results of my work in *WGN*. I hope to do it in fall this year.

Miloš Šimek
Astronomical Institute, Ondřejov Observatory, Czechoslovakia
March 30, 1989

Turning to the *IMO*, I had of course heard of the developments and wish it luck. Professional astronomers belong to Commission 20 of the IAU and that gives sufficient opportunity for international collaboration. I think that the *IMO* should try and work in close contact with Commission 20 but it is unrealistic for you to hope that many of the professional members of Commission 20 will also join *IMO*. This is not because they have any ill feeling towards amateur astronomers but rather because the number of Societies they can join is enormous and we cannot afford the money even to join all of them. I will however try to put something together for *WGN* in the not too distant future.

I.P. Williams
Queen Mary College, London, England, UK
March 8, 1989

IMO News

Paul Roggemans

- People having registered for the *International Meteor Weekend* in Hungary have to pay their registration fee of 180 DEM to the account of *MACSIT* nr. MNB 218-980550-10564-4. To *IMO* members wanting to register, we propose to centralize the payments. If you want to use this possibility, just transfer 4000 BEF to *Ann Schroyens* in the same way as you did for *WGN*, mentioning *registration IMW 1989*.

- We did not receive reactions on the proposed possibility to have an *exchange subscription with the GDR*. Please read again what we wrote on this subject in *WGN* 17:1. In particular, we can recommend *Die Sterne*!

- Please *do not send registered letters* to Paul Roggemans. Since I am at work during post office business hours, registered letters for me imply unavoidable delays and a loss of time. As a general rule, ordinary letters do not get lost in the Belgian mail.

- At the time of this writing, only 30 voting bulletins were received. *Do not forget to return Voting Bulletin 3* to Paul Roggemans so that it reaches him on June 16 at the latest. Remember, this is a hard deadline!

Observers' Notes: July–August 1989

Jeff Wood

1. Introduction

The months of July and August are the most consistently richest period of the year meteor-wise. Apart from the major showers, the δ-Aquarids and the Perseids, a host of minor streams and a high sporadic rate ensure that overall hourly rates exceed 20 meteors per hour on a regular basis during this time. When it is considered that for northern hemisphere observers July and August occur during the summer holiday season, the warm nights with good rates and no work commitments make for exciting viewing. Table 1 below lists 12 of the more important showers that occur during July and August.

Table 1 – A list of some of the meteor showers to be seen in July–August 1989.

Shower	α	δ	Period	Max
γ-Phoenicids	18°	−43°	Jun 24–Jul 18	Jul 7
o-Draconids	271°	+59°	Jul 7–24	Jul 16
Piscis Austrinids	341°	−30°	Jul 9–Aug 17	Jul 28
δ-Aquarids S	339°	−16°	Jul 8–Aug 17	Jul 29
α-Capricornids	305°	−11°	Jun 18–Aug 22	Jul 30
υ-Phoenicids	20°	−43°	Jul 16–Aug 14	Aug 3
ι-Aquarids S	333°	−15°	Jul 16–Aug 14	Aug 6
δ-Aquarids N	337°	−2°	Jul 15–Aug 29	Aug 12
Perseids	46°	+57°	Jul 23–Aug 23	Aug 12
κ-Cygnids	286°	+59°	Aug 5–30	Aug 18
ι-Aquarids N	327°	−6°	Jul 15–Sep 20	Aug 20
π-Eridanids	52°	−15°	Aug 20–Sep 5	Aug 28

Table 2 – Moonlight and observing conditions in July–August 1989.

Date	k	Date	k
Friday June 30	0.13−	Friday August 5	0.11+
Friday July 7	0.15+	Friday August 12	0.72+
Friday July 14	0.77+	Friday August 19	0.95−
Friday July 21	0.94−	Friday August 26	0.26−
Friday July 28	0.24−	Friday September 2	0.03−

New Moon:	July 3, August 1, August 31
First Quarter:	July 11, August 9, September 8
Full Moon:	July 18, August 17, September 15
Last Quarter:	June 26, July 25, August 23

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.

2. The July Phoenicids

This stream consists of two separate branches: the γ-Phoenicids and the υ-Phoenicids. The γ-Phoenicids reach maximum on July 7 and the υ-Phoenicids on August 3 which means they are well placed for viewing moon-wise in 1989. The July Phoenicids are fairly fast faint meteors which probably accounts for them being first detected by radio meteor techniques. Since this stream can only be observed from the southern hemisphere where it is winter, it has not been very well monitored to date. Southern hemisphere observers are therefore encouraged to make this a special project for 1989.

3. Perseids

The Perseids are one of the most active of the regular major showers. They reach maximum on August 12 when rates are of the order of 80 to 100 meteors per hour. The period of maximum activity is fairly narrow lasting less than 24 hours. They are best seen in the northern hemisphere where they attain a high radiant altitude. For southern hemisphere observers watching at latitudes of 20° South or greater, the radiant is very low on the northern horizon from 1^h to 5^h a.m. local time and observed rates will be of the order of 5 to 10 meteors per hour at maximum. Despite their much lower observed rates, the Perseids seen from the southern hemisphere will have extremely long paths which makes for good viewing.

Besides having good rates, the Perseids are noted for their many fast, bright yellow fireballs that leave persistent trains. This feature makes them good for photographing. Moonwise, the Perseids will have some interference from a gibbous Moon at maximum in 1989 meaning that the last few hours before sunrise will provide truly dark skies for the observer.

4. The Aquarid complex

The *δ-Aquarids South* are well known for their fine rates each year. Although the radiant reaches a greater altitude at culmination in the southern hemisphere skies, the shower is still excellent viewing for observers in the northern hemisphere. The δ-Aquarids South reach maximum on July 29 when rates of 15 to 25 meteors per hour can be seen. A special feature of this shower is that almost as high rates can be seen for several days around the maximum. δ-Aquarid South meteors tend to be blue-white in color with only very few leaving a train. They generally do not produce many fireballs. With favorable Moon conditions especially during and after maximum, observers are encouraged to make them a major observing project in 1989.

The *ι-Aquarids South* come from a similar radiant position to the δ-Aquarids South, but they reach maximum about a week later. Even though their radiant positions are very close, δ-Aquarid South and ι-Aquarid South meteors can easily be distinguished from one another since the latter have a slower speed. The ι-Aquarids South are well placed for viewing in 1989 moon-wise. They are typically yellow or white in color. Like the δ-Aquarids South, only a few meteors produce a train.

The *δ-Aquarids North* reach maximum on August 12 and so are often neglected by observers in favor of the much more active Perseids. Since there is a paucity of reliable data on this stream, *IMO* requests that observers monitor the δ-Aquarids North carefully this year. At maximum, there will be some interference from a gibbous Moon though observers should be able to get a few hours of dark skies just before sunrise.

The ι-Aquarids North are a weak ecliptic stream that occur from July to September each year. They reach a broad maximum about August 20 of 1 to 3 meteors per hour. The ι-Aquarids North will be heavily affected by the Moon in 1989.

All these radiants, active in Aquarius, may leave a rather confused impression upon observers. Indeed, it is very difficult to distinguish between the meteors of these radiants. This is possible for meteor trails in the immediate vicinity of the radiant, but at more distant areas in the sky, the observer will only be able to tell that the apparent velocity appears right for *an* Aquarid and that the path direction was right away from the Aquarius quartet. At northern latitudes it is hopeless to try to make separate counts and statistics for the different Aquarid radiant positions. Therefore, our observing project is aimed towards the following goals:

1. We advise all observers to prepare themselves in advance. By carefully locating radiant positions and path directions at the sky, you will be able to identify Aquarids correctly, even at large radiant distances. Everyone is invited to cover the overall Aquarid activity to monitor the hourly rate variation and the magnitude distribution.
2. Observers who are able to make accurate plottings of Aquarid trails as seen from southern latitudes, as well as photographs using standard cameras with sensitive 800 or 1600 ASA

films, may contribute with precise positional data of meteor trails, helpfull in solving the confusing radiant picture.
 - visual observations: send us date, location, time (UT), magnitude, α end δ for beginning and ending point;
 - photographers: send us a paper print, along with exposure time, date and time of appearance and brightness of the meteor. Astrometric results will be registered in *IMO*'s Photographic Meteor Data Base.

3. The world's most experienced observers may attempt to follow the δ-Aquarids North and South and the ι-Aquarids North and South separately in order to follow the four radiants' characteristics in detail. Perfect sky conditions, a favorable elevation of the radiants and much self-criticism are a prerequisite. Most visual observers tend to believe too much in detailed pictures derived from visual radiant determinations. In many cases, the observer is misled by statistical randomness: he will always find a radiant position, a ZHR, etc. However, everybody should remain aware of the relevance of his or her data and question at each stage the reliability of the observational results before jumping to a conclusion.

5. The α-Capricornids

Brilliant multicolored fireballs are the major feature of the α-Capricornid meteor shower. This stream is active for approximately two months from mid June to late August. Although it reaches a broad maximum on July 30, investigations by meteor workers have shown that there are also several sub-maxima occurring throughout its overall period of activity. Since there will be very little interference from the Moon, observers are requested to give the α-Capricornids particular scrutiny in 1989.

6. The κ-Cygnids

Every year in mid August a few meteors per hour are produced by this shower. The κ-Cygnids are relatively slow average brightness type meteors. Only a few produce a train. They will be heavily affected by the Moon in 1989.

7. Other minor showers

The *o-Draconids*, a northern hemisphere stream, will be badly affected by the Moon in 1989. Since it only provides very weak activity at the best of times, watches for this stream under such unfavorable conditions will be most disappointing except for the most avid meteor observer.

The *Piscis Austrinids* are best observed from the southern hemisphere where the radiant is high in the sky for much of the night. The Piscis Austrinids reach maximum on July 28 when rates of 5 to 10 meteors per hour may be recorded. The Piscis Austrinids are medium speed white meteors. In general, only some 10% have a train. They are reasonable well placed moon-wise in 1989 and so are a must for observers this year.

August 28 sees the maximum of the π-Eridanid meteor stream. The π-Eridanids have not been that well observed in the past and *IMO* requests that groups make this a special project in 1989 since there will be virtually no interference from the Moon. The π-Eridanids are active from August 20 through to September 5. Observations have shown that maximum activity varies from year to year. At best, rates can exceed 10 meteors per hour for southern hemisphere observers. The π-Eridanids are fastish yellow meteors. About 20% produce a train.

8. Conclusions

We invite meteor workers to set up well defined observing projects or to propose specific observing efforts. Observing groups are welcome to provide us with a summary report of their observations and these will generally be published in *WGN*. We look forward to seeing the results of your observations. Clear skies and good viewing!

Aquarid Project 1989

Ralf Koschack and Jürgen Rendtel

A complex observing program concerning the showers in Aquarius is introduced. Observers are asked to contribute visual, video, or photographic data gathered between July 25 and August 11, 1989. Goals and methods are described in detail.

1. Introduction

Major showers have been the main objects of meteor observing campaigns until now. Data of minor showers are rather a by-product. A. Terentjeva [1] recommended to pay more attention to minor showers. Of course, there is no experience in such projects within *IMO*. Thus we propose an Aquarid project for 1989 for several reasons. It has to be found out what results are possible combining data of different groups. During the period proposed most observers are active because of the Perseids. The radiants in Capricornus/Aquarius however are well situated for detailed analysis. Table 1 and Figure 1 give information about these five radiants within a relatively small region of the sky.

Table 1 – Radiant positions of the Capricornus/Aquarius complex according to [2].

Shower	Jul 25		Jul 31		Aug 05		Aug 10	
	α	δ	α	δ	α	δ	α	δ
δ-Aquarids N	321°	−09°	327°	−07°	332°	−06°	337°	−05°
ι-Aquarids N	–	–	–	–	–	–	317°	−06°
α-Capricornids	303°	−11°	308°	−10°	312°	−09°	315°	−08°
δ-Aquarids S	337°	−17°	341°	−16°	345°	−15°	349°	−15°
ι-Aquarids S	.321°	−17°	328°	−16°	335°	−15°	338°	−14°

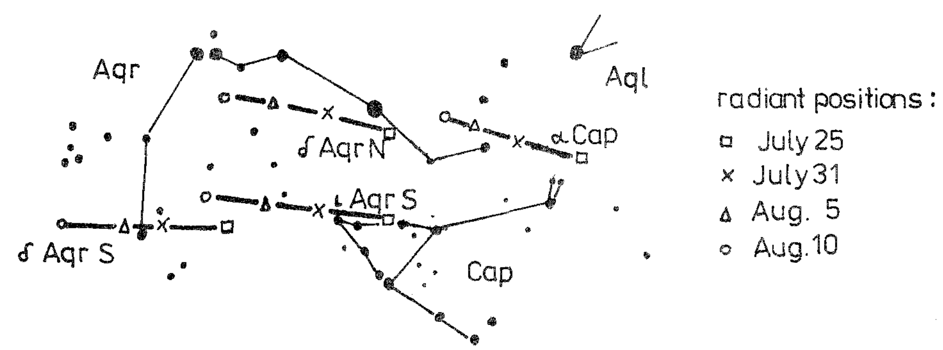

Figure 1 – The radiant complex in the Aquarius/Capricornus region.

These five radiants represent different streams. Thus a total ZHR or a general population index r are of low or even no value. It is necessary to analyze all these radiants separately. The following questions have to be answered:

1. Are these radiants rather sharp or more diffuse (as Virginids and Scorpids)?
2. Is it possible to distinguish meteors from these radiants using visual observations?
3. Are there certain intervals of enhanced activity or neglectable activity for each of the showers?

Therefore we propose this 1989 Aquarid observing program. It should start on July 25 and end on August 11, 1989. The program consists of two parts for visual and photographic/video observations respectively.

2. Visual observations

The visual observing program requires a good observational experience and an observing site south of 45° N. Looking at Figure 1, it is obvious, that the observer has to look at a point between the radiants of the δ-Aquarids N and the ι-Aquarids S in order to distinguish meteors of these southern showers. This will be quite impossible for observers situated north of 45° N. Observations of this program should start only if the radiants have a sufficient altitude. If possible, two observers should look into the same field simultaneously. This could allow estimates of the accuracy of the data.

Only meteors possibly radiating from the Aquarius/Capricornus-region should be plotted. It is necessary to consider the direction, trail length and angular velocity. All other meteors are counted only. Any Aquarids or Capricornids appearing outside the map's field are also counted after careful association to the radiants given in Table 1. In doing so, we are able to calculate ZHR's based on the tabulated radiant positions, and to analyze the radiant position using the plotted meteor trails only. We want to draw the attention to the relationship between the angular velocity of shower meteors, the altitude of their beginning point h_b and the distance between their end point and their radiant D [3]. This criterion is as important as the alignment and the trail length and has to be used carefully in the case of countings.

Table 2 – Angular velocity (°/s) for the Aquarids as a function of the altitude of the meteor's beginning point h_b and the distance D between the end point and the radiant.

	ι-Aquarids (N+S), $V_\infty = 33$ km/s					δ-Aquarids (N+S), $V_\infty = 42$ km/s				
	$h_b = 10°$	20°	40°	60°	90°	10°	20°	40°	60°	90°
$D = 5°$	0.3	0.6	1.1	1.4	1.7	0.4	0.7	1.4	1.8	2.1
10°	0.6	1.1	2.1	2.9	3.3	0.7	1.4	2.7	3.6	4.2
20°	1.1	2.2	4.2	5.6	6.5	1.4	2.8	5.3	7.2	8.3
40°	2.1	4.2	7.9	11	12	2.7	5.3	10	14	16
60°	2.9	5.6	11	14	17	3.6	7.2	14	18	21
90°	3.3	6.5	12	17	19	4.2	8.3	16	21	24

Table 3 – Id. for the Capricornids ($V_\infty = 25$ km/s).

	$h_b = 10°$	20°	40°	60°	90°
$D = 5°$	0.2	0.4	0.8	1.1	1.3
10°	0.4	0.9	1.6	2.2	2.5
20°	0.9	1.7	3.2	4.3	4.9
40°	1.6	3.2	5.9	8.0	9.3
60°	2.2	4.3	8.0	11	13
90°	2.5	4.9	9.3	13	14

Table 4 – Relation between angular velocity and step qualifications according to experienced observers [3].

Step qualification	Angular velocity
0 = stationary	0°/s
1 = very slow	$< 10°$/s
2 = slow	10–18°/s
3 = medium	18–25°/s
4 = fast	25–35°/s
5 = very fast	$> 35°$/s

The maps used for regular meteor plottings (scale factor R = 75 mm) are unfavorable for exact plottings of short trails in the vicinity of the radiants. The map of Atlas Brno (R = 160 mm) is suitable for our purposes. Participants of this project may order copies of this map (Aquarius/Capricornus field) from Paul Roggemans. We ask you to use only this map and to send in a list of meteors as shown in Figure 2.

Date : ______ **Observer :** ______ **Place :** λ ° ' φ ° '

N°	TIME (U.T.)	STREAM	MAG.	VELOCITY	NOTES	BEGIN X	BEGIN Y	END X	END Y
1	2342	δ Aqr N	+4	2	o	+183	+156	+220	+175
:									

Figure 2 – Reporting format for visual observations for the Aquarid project 1989. Only the *Atlas Brno* should be used and limiting magnitude as well as cloudiness should be added.

The shower association should be done at the desk using all criteria. Please, add the reliability of the plotted trail in the notes-column ("+" for very certain, "0" for reasonable certain and "–" for uncertain). The x,y-coördinate system is marked on the map. Please, note also basic data as limiting magnitude, cloudiness etc. The observations will allow complex analysis only if all these remarks are taken into consideration. Send your observational data:

1. to the VMDB (as usually; radiants after Table 1), and
2. in the form of a list (Figure 2) to the *Arbeitskreis Meteore, PSF 37, DDR-1561 Potsdam, G.D.R.* mentioning "Aquarid project". Because of the importance of the plottings we would like you to be most careful in this respect.

3. Photographic and video work

As the main goal of our project is the determination of Aquarid radiant positions, we need meteor photographs of good quality. Preferable are, of course, double station photographs.

Video techniques are also suitable, because they allow a certain shower association. Since we are not familiar with video techniques, we would like experienced observers in this field to work out an analyzing procedure. Who wants to take the lead of the "video branch" of this project?

For photographic work, fast lenses ($f/1.4$–$f/1.8$) and high speed films (black and white) are favorable. We have to measure rather short trails in the vicinity of the radiants. Therefore one should prefer focal lengths of 50–100 mm. If possible, guide the camera and use a rotating shutter. Especially in the case of single station work visual and photographic field of view should be identical (for certain identification). Because of the low angular velocity avoid very fast rotating shutters and use about 1:1 shutter blades to get measurable breaks. If your camera is not guided it is necessary to note the time of the appearance of the meteors. Photographs should be sent to *IMO*'s *PMDB* for further analysis.

4. Conclusions

Proposing the Aquarid project for *IMO* we hope to start analysis of so-called minor showers using different methods. The experiences of this program will be helpfull for further projects in similar cases. It will also show how cooperation within *IMO* works in practice, and the amount of data to be expected. We wish all participants good luck!

References

[1] Terentjeva A., "Comments on *IMO*", *WGN* 16:3, 1988, p. 72.
[2] Roggemans P., "Observers Notes: July–August 1988", *WGN* 16:3, 1988, p. 74.
[3] Koschack R., "Angular Velocity of a Meteor", *WGN* 14:1, 1986, p. 13.

The December Monocerotids and P/Mellish

Katsuhito Ohtsuka

Orbital data from photographic meteors are compared with the orbital elements of comet P/Mellish (1917 I). It is concluded that the data confirm the association between the the December Monocerotids and P/Mellish.

The December Monocerotids are active annually in mid-December, at almost the same time as the Geminids. This stream has been supposed to be associated with comet P/Mellish (1917 I) whose period is 145 years. The Earth approaches the comet orbit closely to a distance of 0.062 AU at solar longitude $\lambda_\odot = 262°.6$ (1950.0) on December 14–15. This comet-meteor association was suggested by Whipple [1], and has been studied by Lindblad [2,3], Cook [4] and Kresáková [5].

In the present work, from published photographic meteor catalogues, 15 Monocerotids were selected, as listed in Table 1, and the association of these meteors with P/Mellish was examined. The meteor TN16 was observed by the Tokyo Meteor Network. In order to discriminate whether a meteor belongs to the Monocerotids or not, comparisons with the theoretical radiant points predicted from the comet orbit, the D_{SH}-criterion of Southworth and Hawkins [6] and the D'-criterion of Drummond [7] were applied. As upperbounds for D_{SH} and D', we used 0.2 and 0.1, respectively.

The time of shower maximum inferred from 15 meteors corresponds to $\lambda_\odot = 260°.2 \pm 2.4$ (Dec. 12/13), which is about two days earlier than the predicted maximum. However, the predicted maximum is still within the uncertainty range of our result.

Taking into considerations the weights (wt) given in Table 1, the following radiant motion was reduced from observations by using the least-squares method (Eq. 1950.0):

$$\begin{array}{llll}\alpha = & 101°.95 + & 0°.95\,(\lambda_\odot - 260°.2) & \\ & \pm 0°.29 & \pm 0°.13 & \text{S.D. of unit obs.: } \pm 1°.12 \\ \delta = & +08°.28 - & 0°.03\,(\lambda_\odot - 260°.2) & \\ & \pm 0°.32 & \pm 0°.15 & \text{S.D. of unit obs.: } \pm 1°.22\end{array}$$

Table 1 – Photographic December Monocerotid meteors (Eq. 1950.0). Appropriate references are given after the reference number. Data marked with * were remeasured and recomputed.

Ref. Nr.	Date (UT)	$\lambda_\odot$	α	δ	m	V_g	$\sin Q$	$\cos Z$	V_∞	H_b	H_e
2-9412 [9]	1953 Dec 12 $07^{\mathrm{h}}.38$	255°.0	94°	+12°	0.4	44.2		0.92	45.4	95.7	
5-12564 [8]	1958 Dec 12 $10^{\mathrm{h}}.20$	257°.5	99°.44	+08°.14		42.56	0.704	0.534	44.30	105.8	90.9
3-9475 [10,11]	1953 Dec 12 $10^{\mathrm{h}}.52$	258°.1	101°.60	+07°.67	1.0			0.555	43.9	105.2	94.4
24-62* [10,11]	1977 Dec 12 $10^{\mathrm{h}}.72$	258°.2	100°.23	+07°.93		42.5	0.780	0.852	43.8	101.2	83.5
24-64* [10,11]	1977 Dec 12 $11^{\mathrm{h}}.56$	259°.0	100°.78	+07°.66	0.5	41.2	0.553	0.698	42.9	101.3	86.2
2-9557 [9]	1953 Dec 12 $12^{\mathrm{h}}.40$	260°.1	102°	+09°	−0.7	41.6		0.89	42.9	103.5	
1-2313 [1]	1950 Dec 12 $13^{\mathrm{h}}.20$	260°.6	102°.6	+08°.4	−1.2	42.7	0.120	0.553	44.4	107.9	88.9
17-552 [12]	1972 Dec 12 $12^{\mathrm{h}}.87$	260°.7	102°.63	+08°.22		41.34	0.451	0.662	42.99	103.0	86.3
TN16 [14]	1985 Dec 12 $13^{\mathrm{h}}.64$	261°.1	102°.22	+08°.02	−1.2	41.9	0.943	0.877	43.4	99.6	82.5
24-72 [10,11]	1977 Dec 12 $13^{\mathrm{h}}.71$	261°.2	101°.6	+07°.4	−1.0	39.1			(40.6)	100.0	91.0
24-73 [10,11]	1977 Dec 12 $13^{\mathrm{h}}.71$	261°.2	102°.4	+06°.1		40.5			(42.0)	100.0	77.6
24-75 [10,11]	1977 Dec 12 $13^{\mathrm{h}}.75$	261°.2	103°.8	+07°.9		43.4			(44.8)	100.8	85.1
5-9660 [8]	1956 Dec 12 $13^{\mathrm{h}}.43$	261°.3	105°.35	+08°.97		35.21	0.028	0.833	36.75	95.4	92.9
1-2405 [1]	1950 Dec 12 $15^{\mathrm{h}}.29$	262°.7	103°.5	+08°.1	−1.4	42.1	0.119	0.843	43.7	96.0	80.3
2-6040 [9]	1953 Dec 12 $17^{\mathrm{h}}.37$	265°.4	106°	+11°	−0.7	41.9		0.93	43.3	107.5	
Mean	Dec 12–13	260°.2	102°.0	+08°.3		41.6			43.2	101.9	86.6
S.D.		2°.4	1°.1	1°.2		1.8			1.7	3.8	4.7
1917 I	Dec 14–15	262°.6	103°.4	+08°.6		41.4					

Table 1 – (continued)

Ref. Nr.	ω	Ω	i	e	q	$1/a$	λ	β	D_{SH}	D'	wt
2-9412	126°	75°.0	29°	1.05	0.19	−0.2747	204°.7	+23°.1	0.185	0.073	1
5-12564	128°.4	77°.5	36°.7	1.002	0.186	−0.0086	212°.2	+27°.9	0.128	0.043	2
3-9475	131°.3	78°.1	39°.8	0.992	0.171	+0.0495	216°.9	+28°.7	0.148	0.076	2
24-62	128°.7	78°.2	37°.1	0.998	0.185	+0.0124	213°.3	+28°.0	0.125	0.043	2
24-64	128°.1	79°.0	35°.4	0.983	0.195	+0.0887	212°.9	+27°.1	0.101	0.035	2
2-9557	131°	80°.1	34°	0.99	0.18	+0.0775	216°.5	+25°.0	0.096	0.042	1
1-2313	129°.6	80°.6	36°.1	1.001	0.177	−0.0044	216°.3	+27°.0	0.103	0.049	2
17-552	129°.5	80°.7	34°.7	0.983	0.186	+0.0925	215°.7	+26°.1	0.088	0.031	2
TN16	127°.4	81°.1	34°.9	0.997	0.194	+0.0146	214°.1	+27°.0	0.077	0.027	2
24-72	125°.9	81°.2	31°.8	0.959	0.221	+0.1880	211°.6	+25°.3	0.082	0.081	1
24-73	125°.5	81°.2	36°.8	0.979	0.218	+0.0960	212°.9	+29°.2	0.106	0.076	1
24-75	130°.0	81°.2	37°.5	0.989	0.181	+0.0629	217°.8	+27°.8	0.122	0.047	1
5-9660	134°.9	81°.3	27°.1	0.896	0.191	+0.5459	219°.5	+18°.8	0.197	0.082	1
1-2405	126°.9	82°.7	34°.4	1.004	0.195	−0.0193	215°.0	+26°.9	0.064	0.024	2
2-6040	131°	85°.4	29°	1.00	0.17	+0.0109	220°.2	+21°.5	0.148	0.076	1
Mean	128°.9	80°.1	34°.9	0.991	0.188	+0.0503	21°.6	+26°.4	0.113	0.049	
S.D.	2°.1	2°.2	3°.1	0.026	0.012	+0.1334	3°.1	2°.4	0.034	0.020	
1917 I	121°.3	88°.0	32°.7	0.993	0.190	+0.0362	213°.8	+27°.5			

Table 2 – Theoretical radiant points associated with P/Mellish (Eq. 1950.0).

$\lambda_\odot$	α	δ	Δ	V_g	$\lambda_\odot$	α	δ	Δ	V_g
255°.6	96°.8	+09°.4	0.128	41.6	263°.6	104°.3	+08°.5	0.064	41.4
256°.6	97°.8	+09°.3	0.114	41.5	264°.6	105°.2	+08°.3	0.069	41.4
257°.6	98°.7	+09°.2	0.101	41.5	265°.6	106°.1	+08°.2	0.077	41.4
258°.6	99°.7	+09°.1	0.089	41.5	266°.6	107°.0	+08°.0	0.087	41.3
259°.6	100°.6	+09°.0	0.078	41.5	267°.6	107°.9	+07°.8	0.099	41.3
260°.6	101°.5	+08°.9	0.069	41.5	268°.6	108°.8	+07°.7	0.111	41.3
261°.6	102°.4	+08°.8	0.064	41.5	269°.6	109°.7	+07°.5	0.124	41.2
262°.6	103°.4	+08°.6	0.062	41.4					

The theoretical radiant points predicted from the orbit of P/Mellish are presented in Table 2.

On each date, in order to allow for the orbit of the meteoroid intersecting the orbit of the Earth at the point where the heliocentric distance of the comet should be equal to that of the Earth, Ω, ω and q of the comet were adjusted. However, i and e were regarded as equal to those of the comet orbit.

There are some differences between observations and theory, but, in general, considering our assumptions above, they seem to be in good agreement.

Comparing the mean orbits of 15 meteors with that of P/Mellish, we may say that q, e, λ and β are in good agreement. Differences in three kinds of angular elements are, however, comparatively large.

These differences are assumed to be caused by the ejection velocity of the meteoroid and by the differential planetary perturbations.

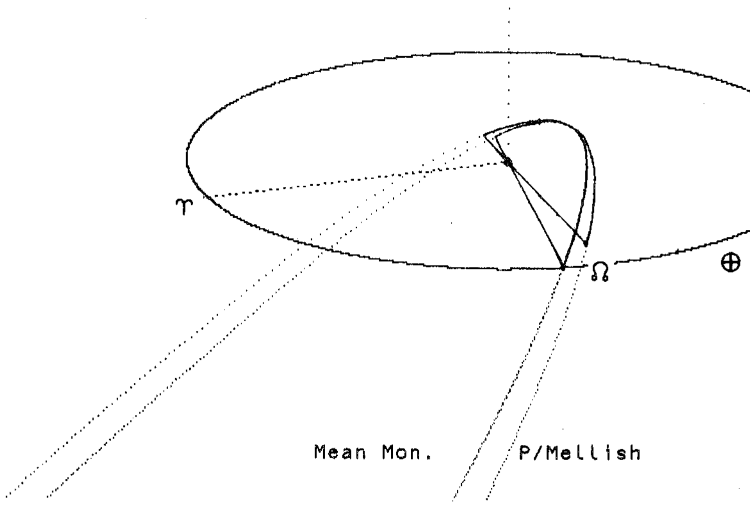

Figure 1 – Orbit of comet 1917 I P/Mellish and mean orbit of the December Monocerotids.

With regard to the mean orbital elements of the December Monocerotids, there are some differences between the data above and those of Kresáková [5]. I think the reason for this is that Dr. Kresáková did not distinguish between the ξ-Orionids and the December Monocerotids in her article.

Table 3 – Photographic ξ-Orionid meteors (Eq. 1950.0).

Ref. Nr.	ω	Ω	i	e	q	a	α	δ	V_G	D_{SH}	D'
5-11290 [8]	144°.7	62°.7	27°.0	1.002	0.090	−42.9	87°.7	+16°.0	44.9	0.260	0.372
5-9503 [8]	139°.4	64°.8	24°.9	0.998	0.120	+63.0	88°.0	+15°.2	43.2	0.248	0.249
5-9521 [8]	141°.1	67°.0	23°.4	0.998	0.110	+45.0	90°.6	+16°.0	43.4	0.248	0.287
5-9564 [8]	126°.9	71°.0	20°.5	1.009	0.193	−20.7	89°.3	+14°.2	40.9	0.301	0.125
5-9568 [8]	138°.2	71°.1	24°.0	1.003	0.124	−42.6	93°.8	+15°.3	43.4	0.218	0.230
5-9580 [8]	136°.0	71°.2	23°.1	1.000	0.138	−318.7	93°.1	+15°.0	42.6	0.221	0.186
1-2239 [1]	136°.6	76°.6	16°.1	1.004	0.133	−31.3	97°.9	+17°.4	42.6	0.315	0.221
1917 I	121°.3	88°.0	32°.7	0.993	0.190	+27.64	103°.4	+08°.6	41.4		

It is concluded that the association of December Monocerotids with P/Mellish is confirmed. More observations and research on December Monocerotids are desirable.

Acknowledgments

The author is very grateful to Dr. Hasegawa for some helpful discussions and suggestions.

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An Inexpensive A/D Converter for VIC 20 or C 64 Built from Readily Available Parts

William H. Black

Construction notes for a very inexpensive A/D converter are presented in conjunction with a simple program allowing to read the output voltage from your radio telescope and post it to screen, printer, tape or disk memory.

1. Introduction

The two programs below, when used with the A/D converter on the following page can permit a VIC 20 or C 64 Commodore computer to read the output voltage from your radio telescope (0–5 V) and post it to CRT screen, printer, tape or disc memory. The converter uses two readily available chips, an ADC 0809 and a 7402 as an external clock oscillator. Both chips are available by picking up a telephone and calling JDR Microdevices, WATS 1-800-538-5000 (charge cards accepted). Total converter cost should not exceed 30 USD.

2. Construction notes

1. Easiest construction is with a small protoboard available from Radio Shack for 6.95 USD.
2. If you experience trouble finding a standard 24 pin connector to the Commodore USER port, buy a 44 pin connector from Radio Shack and cut it off with a hacksaw.
3. To protect both computer and A/D board a series 1/4 amp fuse and 5 V zener diode should be wired to the A/D input as shown.
4. The programs given immediately convert the system to a 0–5 V voltmeter. A little programming knowledge and ingenuity can have the program post the UT time for each sample. Though an 8 bit converter with resolution to 0.02 V on a 5 V scale, the converter can be made to deliver an additional order of magnitude resolution by commanding it to take 10 fast samples and to print the mean.

Wiring of the converter is identical for the C 64 and the VIC 20 except for the two exceptions for the VIC 20. These are noted by asterisks on the schematic. The BASIC program below can be used to turn the VIC-20 into a 0–5 V voltmeter:

```
10 REM A VIC-20 VOLTMETER
15 POKE 37139,255
20 POKE 37137,151
30 POKE 37137,155
40 A=PEEK(37136)
50 B=A*.0196078431
60 C=INT(B*100)/100
70 PRINTCHR$(147):PRINTC;:PRINT" VOLTS DC "
80 GOTO 20
```

The following BASIC program can be used to turn the C-64 into a 0–5 Vn voltmeter:

```
10 REM A C-64 VOLTMETER
20 POKE 56576,155
30 POKE 56576,151
40 A=PEEK(56577)
50 B=A*.0196078431
60 C=INT(B*100)/100
70 PRINTCHR$(147):PRINTC;:PRINT" VOLTS DC "
80 GOTO 20
```

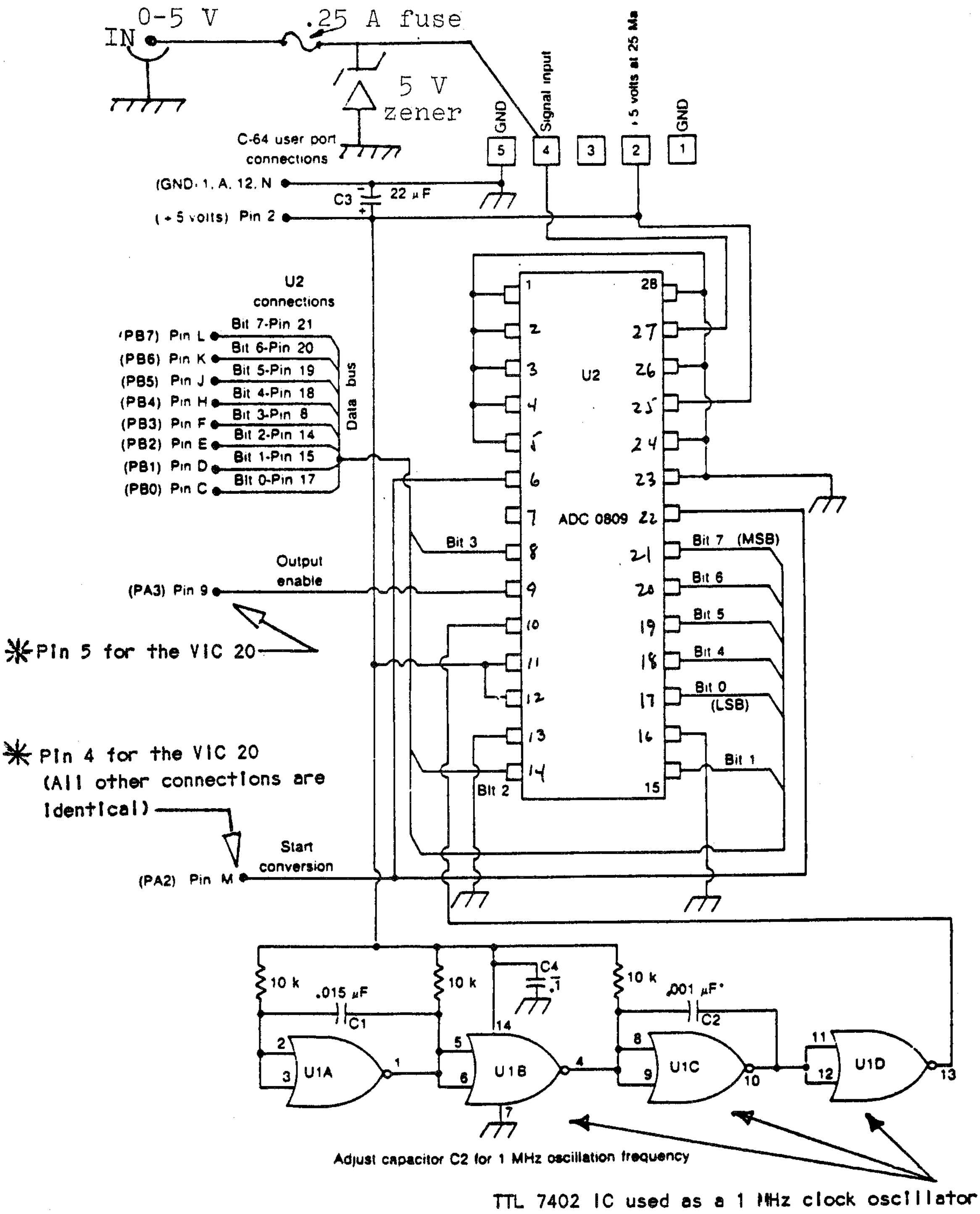

Figure 1 – Schematic shown is for the C 64. Please note the two asterisk exceptions for the VIC 20.

The Telescopic Perseid Radiant

Mark Vints

The author's 1988 observations were used to study the telescopic radiant of the Perseids. It was derived from these data that the radiant has a radius of less than 1°, and that its position agrees excellently with literature values.

During the 1988 Perseid campaign in France an extensive set of telescopic observations was obtained. These results have been reported on in earlier issues of *WGN* [1,2]. The aim of the present study was to see if the telescopic and the photographic radiant agree in position, size and shift.

Of 162 telescopic meteors observed in a fortnight, 20 were classified as Perseids. The trails of these 20 pass within 1°.5 of the predicted radiant; all but two of them even came within 1°. Figure 1 shows a plot of those meteors.

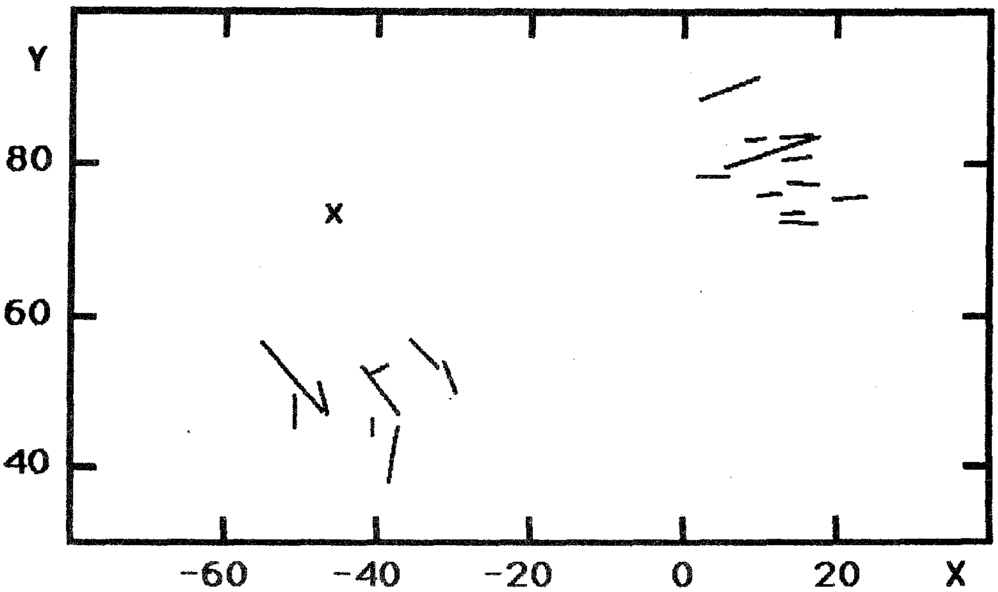

Figure 1 – Plot of all 20 Perseids observed by the author in August 1988. The coördinates refer to a gnomonic plot centered at $\alpha = 30°$ and $\delta = 45°$, with $R = 300$ mm. The cross indicates the radiant position as computed for 1988 August 11-12. The plot shows an area of about 22° by 13°.

Coordinates were measured to the nearest minute of arc using the transparent overlays from my *Uranometria 2000.0* star atlas (the estimated plotting error is about 10′). Because of the low number of Perseids seen per night, the results of all nights were combined. The directions of the meteors in close vicinity of the radiant were computed by making intersections with two hour circles. These two points were then shifted to compensate for the radiant drift relative to a reference date. The radiant motion $\Delta\alpha = +1°.35$/day and $\Delta\delta = +0°.12$/day was taken from [3], and the reference date was 1988 August 11-12. Thus, all meteors observed before the reference date were shifted towards higher right ascension; all meteors observed after this date towards lower right ascension.

In a second stage, I applied the computer program given in [4] to the shifted meteor directions to calculate a mean radiant position and radius for the chosen reference data. The result was that the apparent radiant is situated at $\alpha = 46°$ and $\delta = 57°.7$ with a radius of about 0°.7. The predicted radiant for that day is $\alpha = 47°.15$ and $\delta = 57°.6$, according to [3] and after correcting for precession. So the observed radiant is just 1° off, which is a very nice agreement. There is also a clear indication that the radiant size is significantly smaller than for photographic results.

The meteor directions were plotted, after correction for the radiant shift, and the field was divided in 49 squares of 0°.5 wide, centered on the computed radiant position. I then counted the number of intersections per square, omiting those with an angle of less than about 15–20°. The results are presented as a density distribution plot in Figure 2 (left). The radiant is of course readily detectable, but any substructure must be attributed to the low number of meteors involved. To smooth the image, I replaced each matrix element with the sum of its own value and the nine neighbors. The result is shown in Figure 2 (right). The quasi-circular shape of the radiant allows the conclusion that, over the two-week period, the motion of the telescopic radiant is in full agreement with literature values.

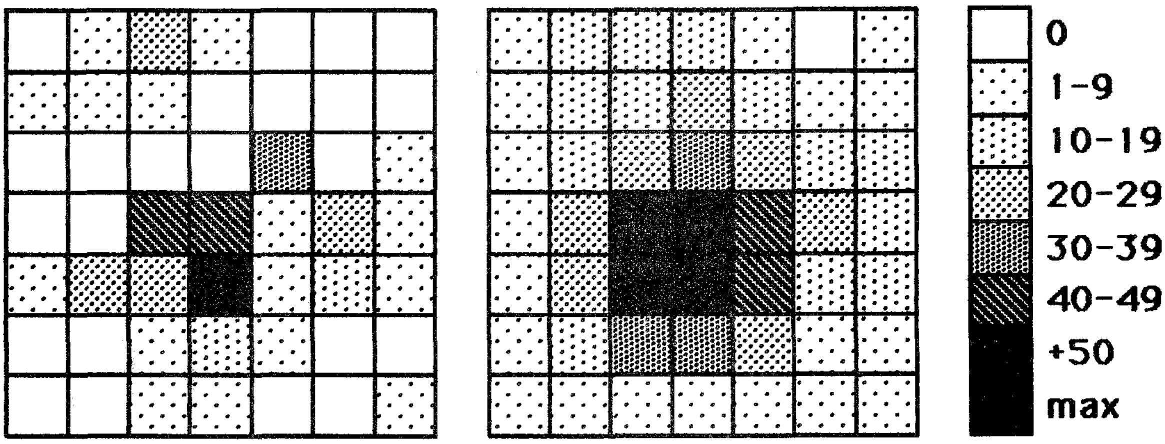

Figure 2 – Density matrix of valid intersections, centered on the calculated radiant. The squares are 0°.5 wide. The results in the left figure (not smoothed) were rescaled to approach those of the smoothed matrix on the right.

Finally, the observed radiant should be corrected for zenith attraction and diurnal aberration—for each individual meteor—to obtain a geocentric radiant. I attempted to make a rough estimate of this correction without going into the calculations. The mean time of appearance of the observed Perseids is about 23^h UT. Looking at data given in [5] for that time, the correction would be something like 50–60′ in right ascension and 10′ in declination. This means that the difference in observed and predicted radiants can almost totally be accounted for.

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Plotting maps for the IMO Aquarid Project: *IMO* recommends the large scale *Atlas Brno* maps by Dr. Znojil. Copies of the map showing Aquarius can be obtained from Paul Roggemans.

The 1988 Leonid Meteor Stream

Paul Roggemans

A global analysis on the activity of the Leonid Meteor Stream in 1988 is presented. The period of activity turned out to be limited from November 12 to 22. A maximum was observed at $\lambda_\odot = 235\overset{\circ}{.}10$ (Eq. 1950.0). This implies that the maximum has been shifted by $0\overset{\circ}{.}638$ in solar longitude over 38 years, indicating a nodal regression of $+1\overset{\circ}{.}68$/century. The width of the observed maximum was 14 hours, from November 17.59 to 18.19 (UT).

1. Introduction

Years have passed since American observers witnessed the great Leonid Meteor Storm in November 1966. Amateurs were successful in monitoring the Leonid stream through its annual appearances since then. A meteor storm is indeed the most spectacular event for all of us. Alas, it happens only at very rare occasions. Years surrounding the occurrence of a meteor storm, such as 1833, 1866 and 1966, produced very high rates (100 and more meteors an hour). Some individual observers came up with remarkable hourly rates for Leonids in years far apart of two Leonid storms. Such reports would indicate that the meteoroids of this stream are very irregularly spread over the orbit. Each year Leonids are present at the morning sky for a few nights around November 18. Most often, rates are very low, except at some years when unexpectedly many fast meteors radiate from the Leonid radiant. Unfortunately few dedicated observers took care to observe Leonids each year.

Therefore more alertness is required from meteor workers worldwide in order to try not to miss such outbursts. In order for amateur observations to be statistically reliable, independent observations are required to obtain a relevant average result. One single observer can say whatever he or she wants, but that is not necessarily representative for an average observer. A group of observers will be able to give a more reliable average value for a short period of the shower activity. The best result that amateurs can achieve is when they work together on a global bases. *IMO*-members may be proud that the cooperation within *IMO* enabled a reasonably good coverage of the 1988 Leonids.

Japanese observations were obtained through the Nippon Meteor Society and another major contribution came from the NAPO Meteor Section of Jeff Wood (Australia). Europeans have never been very strong to study the Leonids; most November nights gave no Leonid activity at all in Europe. Coverage from America was very scarce because of the shortage of meteor workers on that continent. Negotiations with several groups are on the way and we hope that Leonids in future years will be studied by *IMO* using even more reports, including those of the observers not represented in this study. Many thanks are due to all people who were out in November to watch the Leonids and other showers:

> Guy Blackman (BLAGU), Linda Carter (CARLI), Martin Coroneos (CORMA), Tim Daniels (DANTI), Carl De Pooter (DE CA), Jan De Bie (DEBJA), Steve Evans (EVAST), Kai Gaarder (GAAKA), Mark Glossop (GLOMA), Nardia Hickson (HICNA), Daiyu Ito (ITODA), Franko Kattler (KATFR), Chizuyo Kawamura (KAWCH), Junji Kawamura (KAWJU), Norihito Kawamuro (KAWNO), André Knöfel (KNOAN), Ralf Koschack (KOSRA), Ralf Kuschnik (KUSRA), Stefan Lobet (LOBST), Robert Lunsford (LUNRO), Katuhiko Mameta (MAMKA), Naomi Mutou (MUTNA), Yukiko Nagashima (NAGYU), Seiko Nishioka (NISSE), George Platt (PLAGE), Francois Plesier (PLEFO), Francis Plesier (PLEFR), Ghislain Plesier (PLEGH), Leo Rajala (RAJLE), Jürgen Rendtel (RENJU), Toru Sagayama (SAGTO), Kotaro Sakuma (SAKKO), René Scurbecq (SCURE), Holger Seipelt (SEIHO), Yasuo Shiba (SHIYA), David Stevenson (STEDA), Nathan Stewart (STENA), Dominique Suys (SUYDO), Glenn Ticket (TICGL), Hiroyuki Tomioka (TOMHI), Michael Tonkin (TONMI), Nobuhiro Umemura (UMENO), Uyama Yoshiaki (UYAYO), Didier Van Hellemont (VANDI), Mireille Vanheerentals (VANMR), Cis Verbeeck (VERCI), Jean-Marc Wislez (WISJE), Steffen Witsschel (WITST), Jeff Wood (WOOJE), Yasuo Yabu (YABYA).

2. The Hourly rate profile

335 reports were available in the *Visual Meteor Data Base* for the period November 2–22, 1988. Only 245 of them were carried out with the Leonid radiant above the horizon. All the ZHRs were computed according to the *IMO Handbook for Visual Meteor Observations*, referring to the ideal situation where one observer would observe a cloudless, unlimited sky with limiting magnitude +6.5 and the radiant were in the zenith. All the 245 ZHRs were computed with the *IMO*'s *VMDB* as well as the corresponding HRs for the sporadic activity. Next all these individual ZHRs and HRs were averaged using a sliding mean over an interval of 0°.5 in solar longitude advancing with a step of 0°.1 in solar longitude. Results are listed in Table 1. Lines with ZHR = 0 were erased to save space as in general it seems clear that no Leonid activity can be observed before November 10 and after November 22.

The *IMO Handbook for Visual Meteor Observations* mentions $\lambda_\odot = 234°.462$ (Eq. 1950.0) for the time of maximum activity. Corrected for the nodal regression, this would give 235°.07 for 1988. From Table 1 it is clear that the best activity level appeared around that time with a ZHR of about 26. In 1988 this solar longitude occurred most favorably over Australia and Japan. In 1989 European observers should get this Leonid maximum at their morning sky of November 18, unfortunately with a disturbing moon.

ZHRs of about 15 on November 16.6, preceding the maximum by more than a day, are not confirmed in the separated Japanese results. They should not be interpreted as a secondary maximum. The main maximum (on Nov 17.75 UT) was missed by Japanese observers probably due to bad weather conditions. Europeans got the last hours of this maximum in the morning of November 18. After November 20 observing conditions became too bad all over the world.

Table 1 – Averaged ZHR-values for the 1988 Leonids and corresponding HR-values.

Date	$\lambda_\odot$	Nr. Obs.	Leo	ZHR	Spor	HR
Nov 05.46	222°.72	1	1	2.8 ± 2.8	6	6.3 ± 6.3
05.56	222°.82	2	2	2.5 0.4	15	8.2 2.7
05.66	222°.92	2	2	2.5 0.4	15	8.2 2.7
05.76	223°.02	2	2	2.5 0.4	15	8.2 2.7
05.86	223°.12	2	2	2.5 0.4	15	8.2 2.7
05.96	223°.22	3	1	0.7 ± 1.3	36	11.1 2.5
Nov 10.64	227°.92	36	1	0.1 ± 0.4	347	8.7 ± 3.9
10.74	228°.02	36	1	0.1 0.4	347	8.7 3.9
10.84	228°.12	27	1	0.1 0.5	295	9.8 3.7
10.94	228°.22	14	1	0.2 0.6	217	12.4 2.9
Nov 11.04	228°.32	6	1	0.4 ± 1.0	115	13.7 ± 3.6
11.53	228°.82	16	7	1.6 3.5	166	8.6 3.8
11.63	228°.92	23	11	1.9 4.9	252	9.0 3.8
11.73	229°.02	23	11	1.9 4.9	252	9.0 3.8
11.83	229°.12	23	11	1.9 4.9	252	9.0 3.8
11.93	229°.22	23	11	1.9 4.9	252	9.0 3.8
Nov 12.04	229°.32	7	4	2.8 ± 7.4	86	10.0 ± 4.0
12.53	229°.82	38	3	0.3 1.3	343	7.6 4.1
12.63	229°.92	45	14	0.7 1.9	467	8.7 5.0
12.73	230°.02	45	14	0.7 1.9	467	8.7 5.0
12.83	230°.12	32	14	1.0 2.1	389	10.3 5.0
12.93	230°.22	18	14	1.8 2.6	279	13.3 4.2
Nov 13.03	230°.32	7	11	2.9 ± 3.0	124	14.7 ± 5.6
13.63	230°.92	11	5	1.3 1.5	143	10.9 4.8
13.73	231°.02	11	5	1.3 1.5	143	10.9 4.8
13.83	231°.12	13	5	1.1 1.5	152	10.3 4.7
13.92	231°.22	13	5	1.1 1.5	147	10.1 4.9

Table 1 – (continued)

Date	$\lambda_\odot$	Nr. Obs.	Leo	ZHR	Spor	HR
Nov 14.02	231°32	8	5	1.8 ± 1.5	72	8.5 ± 5.6
14.62	231°92	10	6	3.5 3.4	134	11.3 2.5
14.72	232°02	10	6	3.5 3.4	134	11.3 2.5
14.82	232°12	10	6	3.5 ± 3.4	134	11.3 2.5
14.92	232°22	11	9	3.8 ± 3.5	155	13.3 7.0
Nov 15.02	232°32	9	9	4.6 ± 3.2	132	14.2 ± 7.4
15.41	232°72	3	12	11.1 2.2	13	10.4 3.7
15.51	232°82	3	12	11.1 2.2	13	10.4 3.7
15.61	232°92	14	36	9.4 4.0	120	10.1 4.8
15.71	233°02	13	33	9.3 4.2	117	10.4 4.9
15.81	233°12	11	24	8.9 4.4	107	10.1 5.2
15.91	233°22	12	27	8.7 4.2	116	10.4 5.1
Nov 16.01	233°32	14	31	8.1 ± 4.1	132	11.5 ± 5.8
16.11	233°42	3	7	5.4 1.0	25	16.8 5.3
16.21	233°52	3	7	5.4 1.0	25	16.8 5.3
16.31	233°62	3	7	5.4 1.0	25	16.8 5.3
16.40	233°72	2	4	4.9 0.7	16	18.2 6.6
16.60	233°92	5	24	15.0 8.7	46	9.7 2.1
16.70	234°02	5	24	15.0 8.7	46	9.7 2.1
16.80	234°12	6	24	12.5 9.9	54	9.8 1.9
16.90	234°22	11	43	11.2 8.8	94	11.8 6.2
Nov 17.00	234°32	13	51	10.7 ± 8.2	115	13.1 ± 6.5
17.10	234°42	8	27	7.9 7.0	69	15.1 7.5
17.20	234°52	8	27	7.9 7.0	69	15.1 7.5
17.29	234°62	7	27	9.1 6.8	61	15.8 7.8
17.40	234°72	2	8	7.6 3.1	21	20.1 2.1
17.59	234°92	4	29	26.3 10.4	34	10.6 3.6
17.69	235°02	4	29	26.3 10.4	34	10.6 3.6
17.79	235°12	5	41	26.1 9.0	51	11.1 3.3
17.89	235°22	5	41	26.1 9.0	51	11.1 3.3
17.99	235°32	5	41	26.1 9.0	51	11.1 3.3
Nov 18.09	235°42	1	12	25.7 ± 25.7	17	13.1 ± 13.1
18.19	235°52	1	12	25.7 25.7	17	13.1 13.1
18.48	235°82	1	4	9.6 9.6	9	11.8 11.8
18.58	235°92	4	9	8.1 2.4	57	23.8 8.3
18.68	236°02	5	10	7.6 2.4	64	21.4 8.9
18.78	236°12	5	10	7.6 2.4	64	21.4 8.9
18.88	236°22	5	10	7.6 2.4	64	21.4 8.9
18.98	236°32	4	6	7.2 2.4	55	23.8 8.2
Nov 19.08	236°42	1	1	5.6 ± 5.6	7	12.0 ± 12.0
19.57	236°92	9	21	8.3 7.3	63	10.4 5.8
19.67	237°02	12	33	7.7 6.3	97	11.2 5.1
19.77	237°12	13	35	8.0 6.2	103	11.7 5.2
19.87	237°22	13	35	8.0 6.2	103	11.7 5.2
19.97	237°32	13	35	8.0 6.2	103	11.7 5.2
Nov 20.07	237°42	4	14	7.5 ± 3.2	40	14.6 ± 2.1
20.17	237°52	1	2	12.3 12.3	6	17.8 17.8
20.56	237°92	3	6	6.9 4.0	13	5.0 3.0
20.66	238°02	3	6	6.9 4.0	13	5.0 3.0
20.76	238°12	3	6	6.9 4.0	13	5.0 3.0
20.86	238°22	3	6	6.9 4.0	13	5.0 3.0
20.96	238°32	3	6	6.9 4.0	13	5.0 3.0

Table 1 – (continued)

Date	$\lambda_{\odot}$	Nr. Obs.	Leo	ZHR	Spor	HR
Nov 21.26	238°62	1	1	7.2 ± 7.2	0	0
21.36	238°72	2	5	11.2 5.7	4	9.3 ± 13.2
21.46	238°82	2	5	11.2 5.7	4	9.3 13.2
21.56	238°92	2	5	11.2 5.7	4	9.3 13.2
21.66	239°02	2	5	11.2 5.7	4	9.3 13.2
21.76	239°12	1	4	15.2 15.2	4	18.6 18.6

3. Magnitude distributions

As many as 149 magnitude estimates were available to get the magnitude distribution mentioned in Table 2. Unfortunately too few distributions were sent in detailed per night. Therefore it is not yet possible to follow the gradual changes in the mass distribution within the stream, if at all gexisting. The limiting magnitude was 6.11 on average and the lm-corrected r-value for the Leonids was 2.83. There is no excess in bright meteors. The corresponding sporadic magnitude distribution is somewhat biased as it is based on observations during which few or no Leonids were seen. The lm-corrected r-value is rather low: 3.04. This means that the Leonids were rather faint in 1988 when compared to the sporadic background activity.

Table 2 – Global magnitude distributions of the 1988 Leonids and the sporadic background.

Shower	Lm	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	+7	Tot	$\overline{m}$
Leonids	6.11	0	0	0	2	3	7.5	14.5	33.5	42.5	27	17.5	1.5	0	149	2.73
Sporadics	6.08	1.0	2.5	2.5	21.5	43	65.5	157	312.5	488	506	368.5	129.5	10.5	2108	3.25

4. Conclusion

The Leonids are a difficult shower to observe. The time of appearance does not correspond to any holiday period in a season which is not so favorable for astronomical work in many locations. The fact that observations must be carried out in the morning hours and the unpredictable nature of the low activity Leonids, altogether make Leonid watches unpopular. New meteor storms are likely in the period 1996 to 2000. Leonid rates should increase over the next few years. Be out to follow the Leonids for at least 15 years to come!

References

[1] "Apparition of the Leonid Meteor Stream", in *Astronomical Circular of the Nippon Meteor Society* 558, January 1989.

Erratum: In the April issue, Dirk Artoos asked us to mention that he recorded an unusual activity of radio meteors on January 21. Unfortunately, we mistakenly interpreted this as January 21, 1988. In reality, Dirk Artoos recorded high meteor rated on January 21, *1989*. If you noticed anything particular at or around that date, either visually or by radio, please notify Dirk Artoos, either directly (Nattenhofstraat 74, B-2800 Mechelen, Belgium) or through *WGN*.

The 1988 Taurid Meteor Stream

Paul Roggemans

A global analysis on the activity of the Taurid Meteor Stream in 1988 is presented. The Taurids South show a well pronounced maximum at $\lambda_\odot = 219.^\circ 5 \pm 1.^\circ 0$ followed by a vaguer secondary maximum at $\lambda_\odot = 229°$. The Taurids North produced best rates at $\lambda_\odot = 231.^\circ 3$, 6 days after a less pronounced secondary maximum at $\lambda_\odot = 225°$. The secondary maxima may be explained from the structure of the stream.

1. Introduction

A good effort was made by many observers to watch the Taurid activity. In [1], Jeff Wood announced good conditions moonwise in 1988 and reminded the readers to the often reported fireball occurrences from the Taurid complex. I wish to express my sincere gratitude to the observers who altogether gave a very fine coverage of the Taurid activity in 1988. The Japanese observers gave magnitude distributions, but they did not provide hourly rate data.

The contributing observers were as follows:

Rainer Arlt (ARLRA), Petra Baldauf (BALPE), Guy Blackman (BLAGU), Paul Camilleri (CAMPA), Linda Carter (CARLI), Martin Coroneos (CORMA), Kansai Daigaku (DAIKA), Tim Daniëls (DANTI), Carl De Pooter (DE CA), Jan De Bie (DEBJA), Steve Evans (EVAST), Kai Gaarder (GAAKA), Mark Glossop (GLOMA), Teemu Hankamäki (HANTE), Takema Hashimoto (HASTA), Lars Trygve Heen (HEELA), Gunar Hering (HERGU), Nardia Hickson (HICNA), Craig Hinton (HINCR), Franko Kattler (KATFR), Chizuyo Kawamura (KAWCH), Norihito Kawamura (KAWNO), Yasuhiro Kawasaki (KAWYA), Andre Knöfel (KNOAN), Ralf Koschack (KOSRA), Ralf Kuschnik (KUSRA), Stefan Lobet (LOBST), Robert Lunsford (LUNRO), Katuhiko Mameta (MAMKA), Yasuo Matsumoto (MATYO), H. Mizoguchi (MIZHI), Alastair McBeath (MCBAL), Michael Moller (MOLMI), Sabine Moritz (MORSA), Yukiko Nagashima (NAGYU), Seiko Nishioka (NISSE), George Platt (PLAGE), Francois Plesier (PLEFO), Francis Plesier (PLEFR), Ghislain Plesier (PLEGH), Leo Rajala (RAJLE), Ina Rendtel (RENIN), Jürgen Rendtel (RENJU), Paul Roggemans (ROGPA), Hiromi Sato (SATHI), René Scurbecq (SCURE), David Seargent (SEADA), Holger Seipelt (SEIHO), Yasuo Shiba (SHIYA), David Stevenson (STEDA), Nathan Stewart (STENA), Dominique Suys (SUYDO), Richard Taibi (TAIRI), Glenn Ticket (TICGL), Michael Tonkin (TONMI), Hiroyuki Tomioka (TOMHI), Michelle Treasure (TREMI), Jose Trigo Rodriguez (TRIJO), Yoshiaki Uyama (UYAYO), Didier Van Hellemont (VANDI), Jan Vandenbruaene (VANJN), Karin Van Genegen (VANKA), Mireille Vanheerentals (VANMR), Pierre Van Mechelen (VANPI), Cis Verbeeck (VERCI), Noel White (WHINO), J.-M. Wislez (WISJE), Steffen Witsschel (WITST), Jeff Wood (WOOJE), Nikolai Wunsche (WUNNI), Yasuo Yabu (YABYA).

2. The hourly rate profile

All hourly rate reports were entered into the *VMDB*. ZHRs were computed according to the method described in the *IMO* Handbook for Visual Meteor Observations. About 415 individual ZHRs were available. The radiant drifts for the Northern and Southern Taurid radiants were taken into account for the zenith distance correction. A zenith exponent $\gamma = 1$ was used for the computation of the ZHRs.

Many observers did not distinguish between Taurids North or South and reported total Taurid rates instead. The *VMDB*-programs computed the ZHRs including meteors registered as `TAU` (Taurids), as `STA` (Southern Taurids) and as `NTA` (Northern Taurids). It seemed inappropriate to spend a detailed presentation on the separate branches, given the rather small number of observers who really distinguished between both. The Taurid ZHRs and accompanying sporadic hourly rates for each observer were averaged using a sliding mean over 24 hour with a step of 12 hour. The individual ZHRs, covering about 1 hour intervals gave no indications for short duration peaks in the activity. No real sharp peak was notable after the first averaging. The results of these averages are shown in the table below.

Table 1 – Averaged ZHR-values for the 1988 Taurids and corresponding HR-values.

Date	$\lambda_\odot$	Nr. Obs.	Tau	ZHR	Spor	HR
Sep 15.94	172.°75	1	4	0.9 ± 0.9	66	9.5 ± 9.5
16.44	173.°25	2	4	0.5 0.6	91	14.2 6.6
30.75	187.°25	3	8	7.0 7.8	20	10.2 9.5
Oct 01.25	187.°75	3	8	7.0 ± 7.8	20	10.2 ± 9.5
01.77	188.°25	6	16	5.4 4.0	80	8.8 1.5
02.27	188.°75	6	16	5.4 4.0	80	8.8 1.5
02.79	189.°25	4	10	4.4 4.1	40	8.6 2.3
03.29	189.°75	4	10	4.4 4.1	40	8.6 2.3
03.82	190.°25	4	17	5.6 2.1	47	11.5 3.0
04.32	190.°75	6	17	3.7 3.3	55	10.0 3.5
04.81	191.°25	7	15	2.6 2.8	69	8.0 4.0
05.31	191.°75	5	15	3.7 2.7	61	8.4 4.7
06.84	193.°25	2	3	2.9 0.3	16	10.8 4.9
07.34	193.°75	12	12	2.7 3.0	99	10.1 3.2
07.85	194.°25	15	18	2.5 3.1	122	9.6 3.2
08.36	194.°75	13	24	2.3 2.5	156	9.4 3.6
08.87	195.°25	10	25	2.7 2.1	145	9.9 3.6
09.37	195.°75	2	10	4.0 0.4	28	10.9 4.2
09.89	196.°25	1	1	2.0 2.0	6	10.6 10.6
10.39	196.°75	7	17	2.7 3.5	89	9.3 2.2
10.89	197.°25	8	38	4.0 4.0	124	9.4 2.1
11.39	197.°75	2	22	7.7 1.7	41	10.5 0.6
11.90	198.°25	1	7	7.1 7.1	22	14.8 14.8
12.40	198.°75	2	7	3.5 5.0	34	13.3 2.1
12.91	199.°25	5	6	0.5 1.1	93	19.8 8.3
13.41	199.°75	4	6	0.6 1.2	81	21.8 8.1
14.43	200.°75	2	2	2.3 1.1	16	11.3 6.1
14.93	201.°25	2	2	2.3 1.1	16	11.3 6.1
15.43	201.°75	2	4	4.3 2.6	32	21.8 4.7
15.93	202.°25	7	20	3.5 2.9	121	18.8 6.1
16.44	202.°75	6	17	3.0 2.9	100	17.1 6.1
16.95	203.°25	3	2	1.1 1.1	28	9.6 4.1
17.45	203.°75	4	2	0.7 0.8	38	9.1 2.3
17.95	204.°25	4	1	0.4 0.8	45	10.7 0.9
18.46	204.°75	4	1	0.4 0.8	39	9.1 1.8
18.96	205.°25	2	1	0.8 1.1	15	8.0 1.3
19.96	206.°25	3	11	5.3 0.9	37	11.8 2.9
20.46	206.°75	3	11	5.3 0.9	37	11.8 2.9
20.97	207.°25	1	0	0	1	12.2 12.2
21.47	207.°75	4	3	3.2 6.5	11	15.8 9.8
21.98	208.°25	11	11	3.8 5.0	58	19.4 11.6
22.48	208.°75	8	8	3.6 4.5	48	20.4 12.3
22.99	209.°25	2	1	2.5 3.5	6	8.2 11.6
23.49	209.°75	3	2	3.4 3.0	9	9.2 8.4
23.98	210.°25	1	1	5.3 5.3	3	11.2 11.2
24.49	210.°75	2	2	5.8 0.0	12	20.0 4.7
24.99	211.°25	2	2	5.8 0.0	12	20.0 4.7
29.50	215.°75	7	20	8.0 5.7	46	11.7 7.3
30.00	216.°25	7	20	8.0 5.7	46	11.7 7.3
30.50	216.°75	17	38	7.4 5.7	106	12.3 5.0
31.00	217.°25	17	38	7.4 5.7	106	12.3 5.0
31.50	217.°75	13	69	9.2 6.7	107	8.0 2.5

Table 1 – (continued)

Date	$\lambda_\odot$	Nr. Obs.	Tau	ZHR	Spor	HR
Nov 01.00	218°25	13	69	9.2 ± 6.7	107	8.0 ± 2.5
01.50	218°75	6	33	13.2 6.6	23	5.2 3.3
02.00	219°25	6	33	13.2 6.6	23	5.2 3.3
02.50	219°75	16	94	11.9 11.8	84	11.8 11.2
03.00	220°25	23	147	16.4 13.5	120	12.9 10.4
03.49	220°75	33	193	13.8 9.7	220	11.1 7.2
04.00	221°25	36	198	9.4 4.8	303	10.4 6.5
04.50	221°75	27	162	9.5 6.3	248	10.9 6.2
04.99	222°25	20	132	10.8 6.7	193	10.7 5.8
05.49	222°75	16	126	9.5 3.1	185	8.2 4.0
05.99	223°25	15	115	9.8 4.0	148	7.8 3.9
06.49	223°75	8	48	9.5 5.2	72	10.8 4.0
06.99	224°25	8	47	9.5 3.5	67	11.0 4.3
07.49	224°75	4	30	12.1 2.4	38	11.2 4.5
07.98	225°25	3	16	9.2 6.2	20	8.4 4.2
08.49	225°75	2	3	3.3 0.7	9	6.3 0.9
08.97	226°25	1	1	3.8 3.8	5	7.0 7.0
09.47	226°75	21	61	4.3 1.9	255	8.9 3.4
09.97	227°25	25	89	4.5 2.4	324	9.8 4.2
10.47	227°75	33	98	4.6 2.5	351	9.7 4.7
10.97	228°25	30	86	4.6 2.3	320	9.2 4.2
11.47	228°75	17	74	5.9 1.9	252	10.8 1.9
11.96	229°25	17	66	6.0 2.1	231	11.5 3.5
12.46	229°75	32	147	6.9 4.0	325	8.5 5.9
12.96	230°25	31	139	6.8 4.0	308	8.0 5.3
13.46	230°75	12	42	6.5 5.7	161	11.9 3.6
13.96	231°25	16	60	6.6 5.3	188	10.9 4.0
14.44	231°75	15	67	5.7 3.5	179	9.2 3.1
14.95	232°25	13	53	5.2 3.6	176	11.3 7.0
15.44	232°75	7	11	3.8 3.7	78	15.5 8.3
15.94	233°25	8	10	3.0 2.2	79	14.8 3.7
16.44	233°75	6	7	3.0 1.8	58	13.9 4.7
16.93	234°25	11	14	3.3 2.8	102	14.0 6.6
17.42	234°75	13	18	3.5 2.9	117	13.9 6.3
17.92	235°25	6	12	3.8 2.3	65	12.1 3.3
18.42	235°75	3	6	4.1 0.1	50	23.4 9.3
18.91	236°25	2	2	4.1 0.0	33	28.6 3.7
19.40	236°75	2	2	5.5 0.0	14	16.9 3.5
19.90	237°25	3	5	7.1 2.7	20	17.2 2.5
20.40	237°75	1	3	10.2 10.2	6	17.8 17.8
21.39	238°75	3	0	0.0 0.0	5	9.2 9.3
21.89	239°25	3	0	0.0 0.0	5	9.2 9.3
27.31	244°75	2	3	3.3 0.5	21	9.6 0.1
27.81	245°25	2	3	3.3 0.5	21	9.6 0.1
29.29	246°75	1	4	8.4 8.4	10	8.9 8.9
29.79	247°25	5	25	4.1 3.2	130	10.6 1.6
30.29	247°75	4	21	3.0 2.5	120	11.0 1.5

Most nights in September yielded no Taurid activity. The lines with ZHR value 0 were omitted from the table to save space. Throughout October, the Taurids remain present though their activity is only about 2 to 3 meteors an hour on average. From approximately October 25 onwards, the Taurids become much stronger. The best rates were reported during a 48 hour period centered around $\lambda_\odot = 219°5$, about the time given in the *Handbook* for the Taurids South maximum!

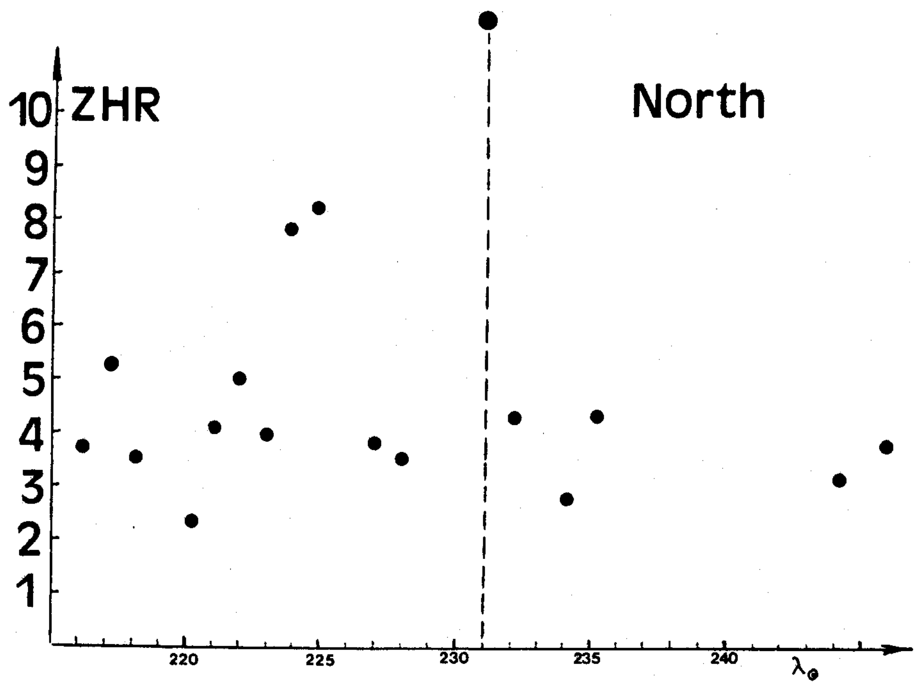

Figure 1 – ZHR-profile of the 1988 Northern Taurids.

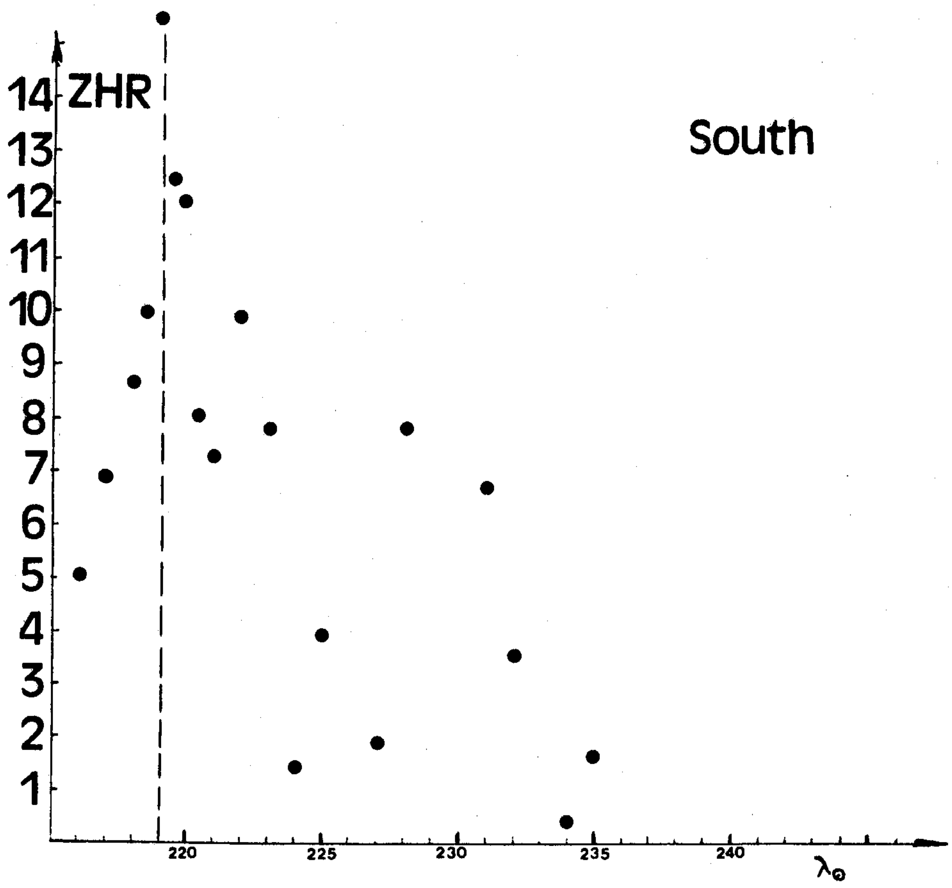

Figure 2 – ZHR-profile of the 1988 Southern Taurids.

After November 4, the rates remain stable around one half of the number of meteors recorded at the maximum on November 3. Rich Taurid nights occur around November 7–8. The second maximum, predicted for November 12–13, does not show up from the observations. Fewer observers were active at that time, but the numbers available yield much lower rates than on November 3. After November 13, Taurids are still present, but hourly rates are low. Almost no

Taurids were seen in the nights after November 20, because of the Full Moon. However, Taurid activity remained detectable until the end of November.

The average Taurid rates are based upon all observations, i.e. both on reports that did and that did not distinguish between the northern and the southern branch. About 66 reports were available consistently giving detailed hourly rates for both substreams. These were used to compute Southern and Northern Taurid ZHRs separately. Both series of ZHRs were averaged independently using a sliding mean over a 24 hour period. The results are shown in Figures 1 and 2.

These detailed reports include almost no zero activity counts, and seem to be of superior quality. They show that the Taurids North are reported all the time with on average 4 meteors per hour. The activity doubled around $\lambda_\odot = 225°$ (November 7–8). A few observers report rates

Table 2 – Global magnitude distributions of the 1988 Taurids and the sporadic background.

Date	Shower	−6	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	+7	Tot	$\overline{m}$
Sep 16	Tau N															0	
	Tau S	0	0	0	0	0	0	0	0	1	0.5	1.5	1	0	0	4	3.63
	Tau	0	0	0	0	0	0	0	0	1	0.5	1.5	1	0	0	4	3.63
	Spor	0	0	1	0	0	0	1.5	5.5	6.5	6	9	11.5	16.5	8.5	66	4.31
Oct 01	Tau N	0	0	0	0	0	0	0	0	1.5	0.5	1.5	0.5	0	0	4	3.25
	Tau S	0	0	0	0	0	0	0	1	0	1	0	0	0	0	2	2.00
	Tau	0	0	0	0	0	0	0	1	1.5	1.5	1.5	0.5	0	0	6	2.83
	Spor	0	0	0	0	0	0	0	1.5	2.5	3	2.5	6	1.5	0	17	3.79
02	Tau N	0	0	0	0	0	0	0.5	0.5	1.5	1.5	1.5	1.5	1	0	8	3.44
	Tau S	0	0	0	0	0	0	0	0	2	0	3	2	0.5	0.5	8	4.06
	Tau	0	0	0	0	0	0	0.5	0.5	3.5	1.5	4.5	3.5	1.5	0.5	16	3.75
	Spor	0	0	0	0	1	2	1.5	2.5	8	14	14.5	25.0	11.5	0	80	3.86
03	Tau N	0	0	0	0	0	0	0.5	2.5	1.5	1.5	2	1	0	0	9	2.56
	Tau S	0	0	0	0	0	0	0	1	1	1.5	2	1.5	0	0	7	3.29
	Tau	0	0	0	0	0	0	0.5	3.5	2.5	3	4	2.5	0	0	16	2.88
	Spor	0	0	0	0	0	0.5	2	2	6	10.5	10.5	19.0	5.5	0	56	3.84
04	Tau N	0	0	0	0	0	0	0	0	0	1	3	1	0	0	5	4.00
	Tau S	0	0	0	0	0	0	0	0	4	3	3	2	0	0	12	3.25
	Tau	0	0	0	0	0	0	0	0	4	4	6	3	0	0	17	3.47
	Spor	0	0	0	0	0.5	1.5	1	4	8	8	10	8.5	5.5	0	47	3.34
05	Tau N	0	0	0	0	0	0	0	1.5	0.5	1	4.5	1.5	0	0	9	3.44
	Tau S	0	0	0	0	0	1	0	0	2	0	1.5	1.5	0	0	6	2.75
	Tau	0	0	0	0	0	1	0	1.5	2.5	1	6	3	0	0	15	3.17
	Spor	0	0	0	0	0	2.5	3.5	5	8	5.5	10.5	22.5	3.5	0	61	3.45
07	Tau N	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	2.50
	Tau S															0	
	Tau	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	2.50
	Spor	0	0	0	0	0	0	0	0	1	1	3	2	2	0	9	4.33
08	Tau N	0	0	0	0	0	0	0	0	2.5	2	5	4	0.5	0	14	3.86
	Tau S	0	0	0	0	0	0	0	0	1.5	0.5	2	0	0	0	4	3.13
	Tau	0	0	0	0	0	0	0	0	4	2.5	7	4	0.5	0	18	3.69
	Spor	0	0	0	0	0	1.5	3	7.5	14	15.5	27.5	21.5	18	2.5	111	3.81
09	Tau N	0	0	0	0	0	0	0	0.5	2	2.5	2.5	3.5	0	0	11	3.59
	Tau S	0	0	0	0	0	0	0	0	1	0.5	2.5	6	3	0	13	4.73
	Tau	0	0	0	0	0	0	0	0.5	3	3	5	9.5	3	0	24	4.21
	Spor	0	0	0	0	0	1	1	10.5	10.5	18	30	42.5	24.5	3	141	4.15
Nov 01	Tau N	0	0	0	0	0	0	0	0	5	5.5	4.5	2	2	0	19	3.50
	Tau S	0	0	0	0	0	0	0	0	4	6	4.5	4	0.5	0	19	3.53
	Tau	0	0	0	0	0	0	0	0	9	11.5	9	6	2.5	0	38	3.51
	Spor	0	0	0	0	0	1	2.5	12	21	20.5	28	31	8	0	124	3.46

of 12 and more during a brief period around $\lambda_\odot = 231.^\circ3$. Figure 2 clearly shows the Taurids South maximum of November 3 ($\lambda_\odot = 219°$–$220°$). Another perhaps secondary peak occurs at $\lambda_\odot = 229°$. The Southern Taurid activity dies out at $\lambda_\odot = 235°$, while the northern branch continues to produce meteors.

3. The Magnitude distributions

The magnitude distributions were totalized for each shower, each date centered at 0^h UT. The limiting magnitudes were averaged with the number of meteors as weighing factor.

In Table 3, the limiting magnitude-corrected mean magnitudes and the r-values are given. The Taurids South and North are almost identical in r-value, the mean magnitude for the Souths being brighter. The global data, representing more observations, including those with total magnitude distribution for the entire period, give a lower r.

Table 2 – (continued)

Date	Shower	−6	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	+7	Tot	$\overline{m}$
Oct 12	Tau N															0	
	Tau S	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	3.50
	Tau	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	3.50
	Spor	0	0	0	0	0	1	1	2	4	5	7	7	3	0	30	3.50
16	Tau N	0	0	0	0	0	0	0	1	0	0	4	0	0	0	5	3.40
	Tau S	0	0	0	0	0	0	0	1	2	2	1	1	0	0	7	2.86
	Tau	0	0	0	0	0	0	0	2	2	2	5	1	0	0	12	3.08
	Spor	0	0	0	0	0	1	1	9	8	19	18	11.0	4	0	71	3.27
20	Tau N	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	3.50
	Tau S	0	0	0	0	0	0	0	0.5	0.5	2	0	1	0	0	4	3.13
	Tau	0	0	0	0	0	0	0	0.5	0.5	3	1	1	0	0	6	3.25
	Spor	0	0	0	0	0	0	0	0	1	1	0.5	8.5	10.5	2.5	24	5.42
22	Tau N															0	
	Tau S	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	2.00
	Tau	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	2.00
	Spor	0	0	0	0	0	0	0	0.5	4	4.5	2	1	0	0	12	2.92
23	Tau N															0	
	Tau S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	3.00
	Tau	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	3.00
	Spor	0	0	0	0	1	0	0	1	2	0	2	0	0	0	6	1.83
30	Tau N	0	0	0	0	0	0	3	1	2	0	0	0	0	0	6	0.83
	Tau S	0	0	0	1.5	0.5	0	2.5	1	4	1.5	3	0	0	0	14	1.43
	Tau	0	0	0	1.5	0.5	0	5.5	2	6	1.5	3	0	0	0	20	1.25
	Spor	0	0	0	0	1	0.5	2.5	2.5	5	21.5	11	2.0	0	0	46	2.79
31	Tau N	0	0	0	0	0	0	0.5	1.5	0.5	0.5	2.5	0.5	0	0	6	2.75
	Tau S	0	0	0	0	0.5	0.5	0.5	3	5	11.5	2.5	1.5	0	0	25	2.54
	Tau	0	0	0	0	0.5	0.5	1	4.5	5.5	12	5	2	0	0	31	2.58
	Spor	0	0	0	0	3	1	1	5.5	10.5	18.5	12.5	11.5	2.5	0	66	2.99
Nov 01	Tau N	0	0	0	0	0	0	1	2.5	3	3.5	2	3.5	0.5	0	16	2.97
	Tau S	0	0	1	0	1	1.5	1.5	4	9	13	7.5	10.5	4	0	53	3.02
	Tau	0	0	1	0	1	1.5	2.5	6.5	12	16.5	9.5	14.0	4.5	0	69	3.01
	Spor	0	0	0	0	1	0	3.5	5.5	11	22	30.5	27.5	6	0	107	3.62
02	Tau N															0	
	Tau S	0	0	0	0	0	2	0	1	9	14	6.5	0.5	0	0	33	2.65
	Tau	0	0	0	0	0	2	0	1	9	14	6.5	0.5	0	0	33	2.65
	Spor	0	0	0	0	0	0	0	1	0	6.5	7.5	7	1	0	23	3.98
03	Tau N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	5.00
	Tau S	0	0	0	1.5	3.5	5	6.5	14	11.5	18.5	8.5	2.0	0	0	71	1.69
	Tau	0	0	3	2.5	4.5	5	7.5	19	18.5	21.5	9.5	3.0	0	0	94	1.49
	Spor	0	0	0	1	3	4	7	8.5	19	20.5	21.5	8.0	1.5	0	94	2.45

Table 2 – (continued)

Date	Shower	−6	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	+7	Tot	$\overline{m}$
Nov 04	Tau N	0	0	1	0	0	2	2.5	6.5	0	8	11.5	11.0	1.5	0	44	3.06
	Tau S	0	0	1	0	11	14	12	15	23	24	17.5	11	4.5	0	133	1.84
	Tau	0	0	2	0	11	16	17.5	24.5	26	32	30.0	22	6	0	187	2.10
	Spor	0	0	1.5	0.5	3.5	12.5	15.5	21.5	45.5	65	71.5	56	27	0	320	3.15
05	Tau N	0	0	0	0	0	1	2	2	5	4.5	6	8	6.5	4	39	3.99
	Tau S	0	0	0	0	0	7	4	9.5	8	16.5	16.5	13.0	3.5	2	80	2.92
	Tau	0	0	0	3	1	8	7	12.5	16	23	22.5	21	10	6	130	3.01
	Spor	0	0	0	0	2	2	3	11	22	27.5	46	48	19	4.5	185	3.79
06	Tau N	0	0	0	0	1	1	1	2	2	2	9.5	9	5	1.5	34	3.90
	Tau S	0	0	0	1.5	0.5	0.5	4.5	5	6.5	16.5	16.5	14.5	4	0	70	3.20
	Tau	0	0	0	1.5	1.5	1.5	5.5	7	8.5	18.5	26	23.5	9	1.5	104	3.43
	Spor	0	0	0	0	0	0	2.5	7.5	13	12.5	27	31.5	17	6	117	4.11
07	Tau N	0	0	0	0	0.5	0.5	0	1.5	7	10.5	2	2	0	0	24	2.65
	Tau S	0	0	0	0	0	0	0	0	1	3	0	0	0	0	4	2.75
	Tau	0	0	0	0	1	1	2	3	23.5	33.5	6	4.0	0	0	74	2.59
	Spor	0	0	0	0	0	0	0	0	7	24	20	11.0	1	0	63	3.60
08	Tau N	0	0	0	0	0	0	2	2	0	2	3	1	1	0	11	2.82
	Tau S	0	0	0	0	0	0	0	0	2	1	1	0	0	0	4	2.75
	Tau	0	0	0	0	0	0	2	2	2	5	4	1	1	0	17	2.82
	Spor	0	0	0	0	0	0	2	1	1.5	6.5	4.5	4.5	1	0	21	3.33
10	Tau N	0	0	0	0	0	0	0	1	1	4	6	4.5	3.5	0	20	4.13
	Tau S	0	0	0	0	0	0	0	0	2	1	6	3.5	1.5	0	14	4.11
	Tau	1	1	0	0	0	0	1	1	3	6	12	8	5	0	38	3.47
	Spor	0	0	0	0	0	0	2	3.5	5	13	28	30.5	13	0	95	4.16
11	Tau N	0	0	0	0	0	0	0	1	0.5	0.5	3	2	1	0	8	3.94
	Tau S	0	0	0	0	0	0	0	0.5	1.5	1.5	3.5	4.5	0.5	0	12	3.96
	Tau	0	0	0	0	0	0	0	1.5	2	2	6.5	6.5	1.5	0	20	3.95
	Spor	0	0	0	0	0	0	0.5	1.5	4.5	6	13	12.5	6	0	44	4.07

Table 3 – Mean magnitudes, r-values and correlation coefficients for the Taurids (total), the Taurids North, the Taurids South and the sporadic background.

	Taurids					Taurids North				
Date	Tot	Lm	$\overline{m}_{corr}$	r	Corr.	Tot	Lm	$\overline{m}_{corr}$	r	Corr.
Oct 09	24	6.37	4.34							
11	38	6.27	3.74	3.28	0.995					
30	20	5.71	2.04	1.92	0.993					
31	31	5.88	3.20	2.96	0.997					
Nov 01	69	6.20	3.31	2.37	0.980					
02	33	6.00	3.15	2.55	0.972					
03	94	5.65	2.34	2.10	0.993					
04	187	6.01	2.590	2.25	0.987	44	6.14	3.42	2.68	0.975
05	130	6.14	3.37	2.35	0.985	39	6.65	3.84	2.93	0.973
06	104	6.33	3.60	2.44	0.986	34	6.46	3.94	2.35	0.964
07	74	6.35	2.74	2.68	0.989	24	6.35	2.80	2.51	0.991
10	38	6.32	3.65	1.83	0.887	20	6.50	4.13	3.87	0.996
11	20	6.14	4.31							
14	39	6.14	2.90	2.20	0.982					
15	35	6.20	4.03							
Tot	1820	6.11	3.00	2.36	0.997	368	6.35	3.60	2.64	0.988

Table 2 – (continued)

Date	Shower	−6	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	+7	Tot	$\overline{m}$
Nov 14	Tau N	0	0	1	0	0	0	1	1	4	3	1	1	1	0	13	2.23
	Tau S	0	0	0	0	0.5	0.5	0	3	2	9	3.5	1.5	0	0	20	2.70
	Tau	0	0	1	0	0.5	1.5	1	4	7	14	5.5	3.5	1	0	39	2.54
	Spor	0	0	0	0	0	0	1.5	4.5	6.5	17	9.5	5	1	0	45	3.06
15	Tau N	0	0	0	0	0	0	1	2	2	1	5.5	4.5	3	0	19	3.76
	Tau S	0	0	0	0	0	0	0	0	3	4.5	4	3.5	1	0	16	3.69
	Tau	0	0	0	0	0	0	1	2	5	5.5	9.5	8	4	0	35	3.73
	Spor	0	0	0	0	0	1.5	0.5	3.5	8.5	14	21	13.5	5.5	0	68	3.61
17	Tau N	0	0	0	0	0	0	0.5	0.5	0	1.5	2	2	0.5	0	7	3.71
	Tau S	0	0	0	0	0	0	0	0	0	0	0.5	0.5	0	0	1	4.50
	Tau	0	0	0	0	0	0	0.5	0.5	0	1.5	2.5	2.5	0.5	0	8	3.81
	Spor	0	0	0	0	0	0	0.5	0.5	4	9	5	6.5	0.5	0	26	3.50
18	Tau N	0	0	0	0	0	0	0	0	0	0.5	1.5	0.5	0.5	0	3	4.33
	Tau S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	3.00
	Tau	0	0	0	0	0	0	0	0	0	1.5	1.5	0.5	0.5	0	4	4.00
	Spor	0	0	0	0	0	0	0	0	1.5	1.5	3	0	0	0	6	3.25
28	Tau N	0	0	0	0	0	0	0	0	1	0	1	1	0	0	3	3.67
	Tau S															0	
	Tau	0	0	0	0	0	0	0	0	1	0	1	1	0	0	3	3.67
	Spor	0	0	0	0	0	0	0	1	1	4.5	8.5	4	2	0	21	3.93
30	Tau N	0	0	0	0	0	0	0	0	3	1	2	3	4	0	13	4.31
	Tau S	0	0	0	0	0	0	0.5	0.5	0	1.5	1.5	1	0	0	5	3.20
	Tau	0	0	0	0	0	0	0.5	0.5	3	2.5	3.5	4	4	0	18	4.00
	Spor	0	0	0	0	0	0	2	5.5	11	27.5	42	37	16	0	141	3.96
Tot	Tau N	0	0	2	0	1.5	4.5	15.5	30.5	47.5	62	92.5	74.5	32	5.5	368	3.45
	Tau S	0	0	2	4.5	17.5	32	32	60	108.5	158	120.5	87.5	23	2.5	648	2.68
	Tau	3	2	15	16.5	35.5	65	98.5	189	326.5	444.0	354	202	61	8	1820	2.61
	Spor	0	1	3.5	3.5	29.5	63	103.5	271.5	502.5	778.5	888.5	761.5	301.5	27	3735	3.43

Table 3 – (continued)

Date	Taurids South					Sporadics				
	Tot	Lm	$\overline{m}_{corr}$	r	Corr.	Tot	Lm	$\overline{m}_{corr}$	r	Corr.
Oct 09						141	6.49	4.16	3.58	0.991
11						124	6.30	3.66	3.56	0.993
30						46	5.86	3.43	2.86	0.992
31	25	5.81	3.23	2.86	0.994	66	5.82	3.67	2.79	0.969
Nov 01	53	6.17	3.35	2.30	0.974	107	6.21	3.91	3.16	0.991
02	33	6.00	3.15	2.55	0.972	23	6.00	4.48		
03	71	5.61	2.58	2.32	0.996	94	5.74	3.21	2.67	0.991
04	133	6.00	2.34	2.25	0.981	320	6.09	3.56	2.72	0.991
05	80	6.09	3.34	2.55	0.972	185	6.19	4.10	3.13	0.986
06	70	6.26	3.44	2.46	0.981	117	6.34	4.27	3.55	0.989
07						63	6.35	3.75	4.06	0.993
10						95	6.51	4.15	4.03	0.990
11						44	6.19	4.38	4.65	0.994
14	20	6.17	3.03	2.54	0.997	45	6.16	3.40	3.30	0.997
15						68	6.20	3.91	3.38	0.990
Tot	648	6.06	3.12	2.62	0.992	3735	6.18	3.75	3.14	0.997

The Southern Taurids were richer in bright meteors on November 3–4. The northern branch may be a bit richer in fainter meteors than the southern, but the entire stream tends to show more bright meteors than other showers: the r-value for the Taurid-total is typical for an older stream.

4. Call for 1988 reports

This article is the first global analysis produced from the *VMDB* as a final report on the Taurids of 1988. The *VMDB* contains statistical data for nearly 100 000 meteors reported to *IMO* for 1988. The *Arbeitskreis Meteore* in the GDR reports its data monthly in a very well adapted report format prepared by Rainer Arlt. This way, a major contribution came from this group. Australian reports represent another major input of data, although the format requires some more work to enter the data into the *VMDB*. A successful transfer of data came from the Norwegian Meteor Section, who used a copy of the *VMDB* for input of data in Norway. The files were sent to Mechelen on diskette. In two minutes, all the observational data from Norway were added to the *VMDB*. Most other reports are entered from individual reports sent by various observers. Groups are encouraged to contact us to consider the fastest transfer of data possible.

Some groups use older text processors to print reports, often with reduced rather than raw data, unsuitable for input in the *VMDB*. We call upon each reader's goodwill to make an effort towards complete standardization of report formats. The Taurid and Leonid reports published in this issue are the first two of a whole series of global analysis on meteor stream activity in 1988. For the next issue, we announce the complete and final Perseid 1988 report, the 1988 Geminids and 1989 Quadrantids global analysis as well as some reports on less popular showers. Please send us all your 1988 reports promptly if you have not done this yet. This week is your last chance to get your 1988 observational results in the mail if you want your work to be used in *IMO*'s global meteor stream analyses for 1988!

References

[1] Jeff Wood, "Observers' Notes", *WGN* 16:5, October 1988, p. 145.

New Edition of IMO Visual Handbook

Marc Gyssens

As *IMO* members probably know from Voting Bulletin 1, *Sky Publishing Corporation* made us an offer to publish a new edition of *IMO*'s *Handbook for Visual Meteor Observations.*

The first version of this handbook was edited by Paul Roggemans in Dutch in 1982. Apart from the editor, contributions were made by Luc Gobin, Marc Gyssens, Christian Steyaert and Tonny Vanmunster. With the help of George Spalding, Ann Schroyens and Lieven Smits, an English translation was produced in 1987. This edition has now been completely revised. Especially the descriptive section on various meteor streams has been revised, updated and extended. With the help of Jeff Wood, the bias towards the northern hemisphere was somewhat relieved. Also, various maps and forms were added in order to make the handbook self-contained for those who wish to use it immediately to get out in the dark. Ralf Koschack and Jürgen Rendtel rewrote the chapter on fireballs.

Since the founding members agreed to have the handbook published by Sky Publishing Corporation, the necessary action was taken as a result of which the handbook is now available. You can order it from *Sky Publishing Corporation, P.O. Box 9111, Belmont, Mass. 02178-9111, USA, phone +1(617)864-7360* at a price of 19.95 USD (order number: 46573, *IMO HANDBOOK*. Purchases can be charged to MasterCard or Visa. For more details, please refer to *Sky and Telescope*.

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Don't miss it!

International Meteor Weekend 1989

Lake Balaton, Hungary, October 5–8, 1989

A registration form can be found in this issue of *WGN*. Accomodation will be provided in a hotel, 10 minutes from Lake Balaton (two or four bed rooms, shower, etc.). The participation fee will be about 180 DEM (West-German Marks). More information in this issue of *WGN*!

The Founding Assembly of the *International Meteor Organization* will be held at this conference. *IMO* responsibles may find it useful to have some technical workshops during the days preceding the conference, which can be arranged within a stay of a week or so in Hungary.

Bibliographic Catalogue of Meteors (1794–1987)

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