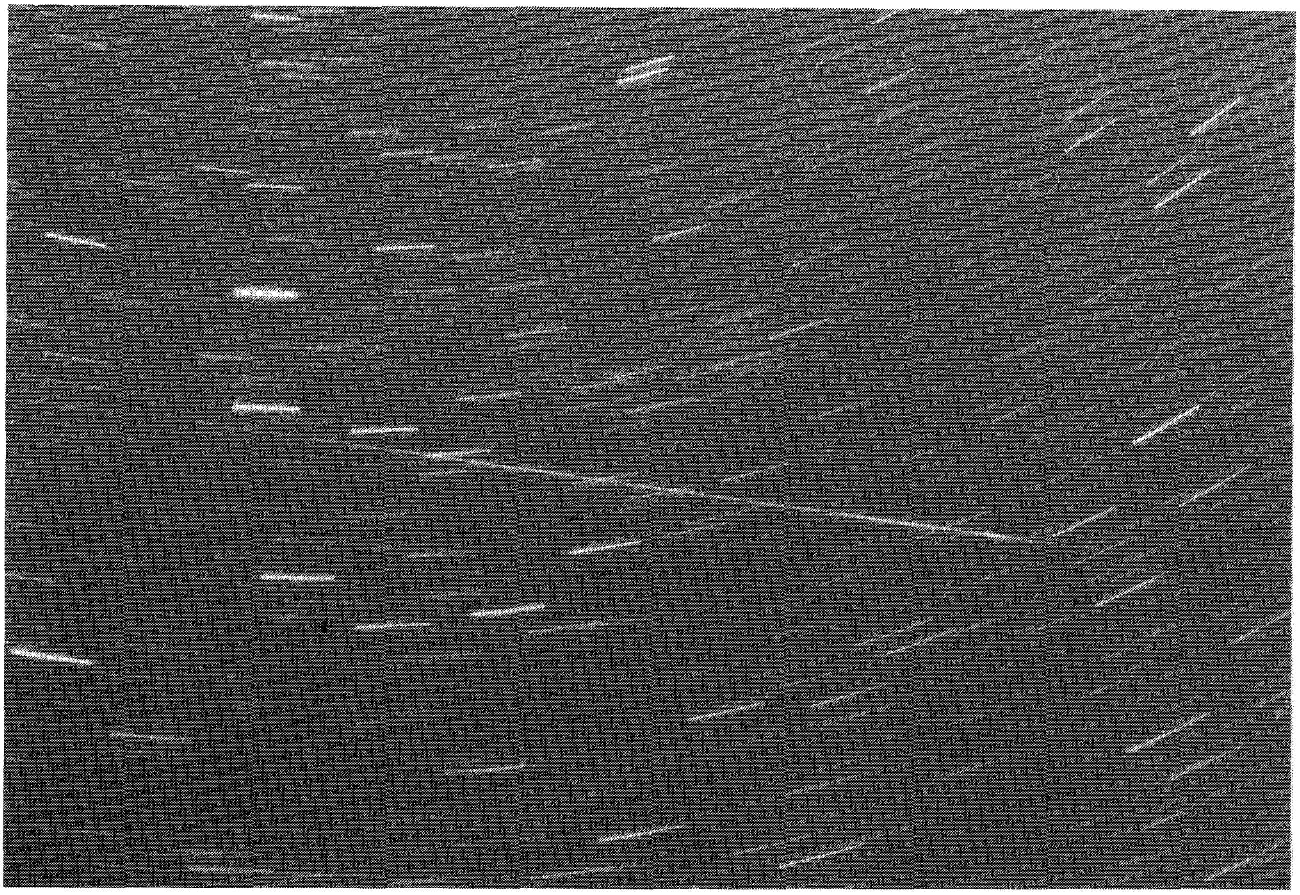
wgn

17 — 1

february 1989

bimonthly journal of the international meteor organization



This magnitude 0 Geminid was photographed on December 14, at $0^h00^m04^s$ UT, by Gotfred Møbjerg Kristensen (Denmark). This nice, yellow meteor started near 48 Cas and ended near Σ3053 Cas, after having shown a little explosion. The photograph was exposed from $23^h50^m00^s$ until $0^h00^m10^s$ UT with a Nikon F2 $f/2.0$ on Kodak TMAX 400, developed during 25 minutes in 1/1 ID 11 at 20 °C.

In this issue:

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WGN, volume 17, nr 1, February 1989, pp. 1–28

Contents

Useful Information

The April Issue *(WGN 17:2)*

This extra thick issue will be mailed in the first week of April. Contributions for the *April issue* are due by *March 3* 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).

From the Editor-in-Chief

Marc Gyssens

First of all, let me convey my best wishes for 1989 to all IMO members and subscribers to WGN. As you have noticed, some small changes took place: WGN has a harder cover and is mailed in an envelope to non-Belgian readers. In this way, we tried to remedy complaints about damage in the mail. As a consequence, the number of pages for a "normal" issue had to be reduced from 34 to 28, in order to keep it below 100 grams. Above this critical weight, postal rates are considerably heigher for mailing WGN abroad. Nevertheless, the 1989 volume of WGN will contain a number of pages comparable to the record one of the 1988 volume; as last year, this will be realized by editing two or three tick issues of about 50 pages, as explained in the previous IMO voting bulletin. This solution is much cheaper than spreading the pages evenly over all issues.

1989 will be the year of the official foundation of IMO, scheduled for the Meteor Weekend at Lake Balaton, Hungary, in September. One of the most important tasks of IMO is beyond any doubt collecting massive amounts of observational data, analyzing them, and redistributing the results to the observers through WGN. Thanks to the Visual Meteor Database (VMDB), this has become possible. In this issue, we present a preliminary analysis of the 1988 Perseids, produced only half a year after the actual event, without having required excessive amounts of work. This contrasts sharply with the report on the 1986 Perseids in last year's February issue, which appeared 2.5 years after the meteors were seen, and only a painstaking effort of its author prevented further delay.

We may safely anticipate that this evolution will cause a shift in the kind of articles published in WGN. Since a comprehensive analysis of a shower can now be produced shortly after receipt of all observations world-wide, we expect the need for publishing raw data in reports from individuals or local groups will slowly fade away. On the other hand, we expect a continued growth of the number of observational data we receive. Towards 1990, this might lead to a separate publication of the raw data, thus relieving WGN, making more room for general articles and global analysis, and finally solving the space problem of this journal.

Does this imply that reports from individuals or single observers will become less desirable? On the contrary! Only, these reports should no longer concentrate on raw data, but on those aspects interesting the reading audience most, such as activity profile, global magnitude distribution, observing conditions and unusual events. Such a report should reach us within the shortest possible delay; otherwise it would miss its aim of providing the reader a first impression of the shower under consideration. Of course, you will still have to send in your raw data, since they are indispensable for a making a comprehensive study, but these should be submitted to IMO's VMDB, rather than WGN.

These are the ideas crossing my mind concerning the near future of WGN; maybe you should give them a thought as well. At the same a time, I feel great satisfaction for what has been accomplished in 1988. My sincere thanks go to all the authors who made this possible; I hope their pens will remain faithful to our journal in 1989. In particular, I wish to extend our invitation to professional meteor workers for making a contribution to WGN, despite their lack of time; in this way they help narrowing the gap between amateurs and professionals, thus allowing amateur observations to become more adapted to their needs.

Meanwhile, enjoy this issue of WGN! Besides the Perseid report, it contains more news on the International Meteor Weekend in Hungary, an article on the suspected relationship between some minor but documented meteor streams and two just recently discovered Apollo asteroids, and first impressions on the 1988 Geminids and even the 1989 Quadrantids. And when you have read this all, you can already look forward to an extra-thick April issue!

About WGN

Supporting Subscriptions in 1988

Ann Schroyens

We wish to thank everyone who paid something extra for his or her subscription in 1988. Their names are:

> *Kai Gaarder, André Gabriël, Luc Gobin, Marc Gyssens, Werner Hasubick, Trond Erik Hillestad, Klaas Jobse, W. Korver, Masahiro Koseki, Mike Morrow, Duncan Ollson-Steel (Univ. of Adelaide), Hugo Piringer, Paul Roggemans, Hans Georg Schmidt, Lieven Smits, George Spalding, Casper ter Kuile, Luc Vanhoeck, Cis Verbeeck, Geert Verlinden, Pierre Vingerhoets.*

These extras were indispensable to us for a good management of *WGN* and will continue to be so. Currently, through *IMO*, international meteor work is undergoing a rapid evolution and *WGN* has a moral obligation to keep in pace. This sometimes urges solutions causing additional expenses, that could not possible have been anticipated when subscription fees had to be fixed. So, if you can afford it, pay a little extra on renewing your membership or subscription, or when ordering a publication. We need it to maintain the service meteor workers world-wide deserve!

Exchange Subscriptions with the GDR

Marc Gyssens

As a result of the first *IMO* voting bulletin in August last year, members agreed on the principle of exchange subscriptions for countries with currency restrictions. We can now make a more concrete offer regarding this matter. *Jürgen Rendtel* sent us a list with East-German publications. The prices mentioned below are low compared to the normal rates charged to foreigners.

If you would like to order one of these journals, send the required amount to *Ann Schroyens* (address on inside of back cover) by international postal money order or by any other means by which we retain the full amount due after deduction of banking charges and exchange costs. If you are not accustomed to Belgian francs (BEF), we mention for your information that at present 100 BEF corresponds to about 2.60 USD.

Together with your payment, you should send Ann your address and, of course, the title(s) of the publication(s) you ordered for. We will then do the necessary. With the money we receive, East-German meteor observers can order subscriptions to *WGN*, other *IMO* publications, or publications on meteor work in general that have to be paid in freely exchangeable currencies.

The journals you can order are:

- *Astronomische Nachrichten* (2300 BEF);
- *Die Sterne* (500 BEF);
- *Astronomie und Raumfahrt* (200 BEF);
- *Astronomie in der Schule* (100 BEF);
- *Wissenschaft und Fortschritt* (350 BEF).

Exchange subscriptions with Hungary

Gabor Süle

We have two publications to offer to you, too. The first one is *Meteor*. It is published monthly in Hungarian. It contains several figures and pictures of our results, not only in meteor astronomy, but also in other fields of amateur astronomy. It also contains English abstracts of the most interesting articles. The other journal is *Meteor Channel*. It is a new non-official publication of the Hungarian Meteor and Fireball Observing Network (MMTÉH), published in English, 3 or 4 times a year. It is intended to communicate to observers abroad results and events in Hungarian amateur meteor life. If you would like to receive one of these publications in exchange for other publications of comparable value, please write to me (address on the inside of the back cover)!

International Meteor Weekend

Lake Balaton, Hungary, September 7–10, 1989

Gabor Süle

Continuing a tradition, there will be another International Meteor Weekend this fall, near Lake Balaton, in picturesque surroundings. The location was chosen last year, at the International Meteor Weekend in Oldenzaal, the Netherlands. This year's conference will last one day longer than the previous one: from September 7 to September 10. It will be a unique occasion for Western and Eastern amateurs and professionals to meat each other and learn about each other's work and results. We would also like to provide the possibility for amateur astronomers to discuss current problems in meteor observing, data processing, standardizing these, and future work. The official language of the conference is English.

The International Meteor Organization, founded de facto on May 1, 1988, will hold its official Founding Assembly at the same time. Here, besides the astronomical program, organizational matters will be discussed too.

Accommodation will be in double or four-bed hotel rooms in a lakefront town. The entire event will take place at the same location. The registration fee will be around 200 DEM *(which is about 4000 BEF or 100 USD, ed.)*. This includes participation in all programs and full board. If you are interested to take part in this International Meteor Weekend, apply for a registration form to the address below:

MACSIT, Pf. 36, H-1387 Budapest, Hungary

After receipt of the completed registration form, we will send the participant an invoice for all payments. This will contain the precise amount and the account to which it has to be transferred. Transfers should be made within two weeks after receiving the invoice; we will then send you a confirmation of your registration. Note that we can only accept payments made before July 31.

A valid passport and a Hungarian visa are required for entry into Hungary, except for those living in Austria, Sweden or Finland. Visas are issued by the Hungarian embassies and consulates throughout the world. For those traveling by car or plane, getting the visas at the boarder crossings is also possible.

More on the Photographic Meteor Database

Christian Steyaert

The Photographic Meteor Database is now available on dikettes for IBM PCs and compatibles. They are available in three formats (to be specified with your order) for 400 BEF:

360 K	$5\frac{1}{4}''$	3 diskettes	for PC and PC/XT
720 K	$3\frac{1}{2}''$	2 diskettes	for PS/2 and portables
1.2 M	$5\frac{1}{4}''$	1 diskette	for PC/AT

All files are in the dBASE III format (a trademark of Ashton-Tate). The contents of the Photographic Meteor Database is summarized below:

Filename	Length	Description
CAMERA.DBF	1470	Camera's
EMULS.DBF	593	Emulsions
DEVELOP.DBF	560	Developers
PMDB0.DBF	82204	1983, except Switzerland
PMDB1.DBF	134872	1981-1982, except Switzerland
PMDB2.DBF	56563	1982 Switzerland
PMDB3.DBF	53098	1983 Switzerland
PMDB4.DBF	136258	1984 France
PMDB5.DBF	84976	1978-1980 Switzerland
PMDB6.DBF	69730	1968-1980 except Switzerland
PMDBE.DBF	37061	1984 except France
PMDBEXT.DBF	4946	Field descriptions
PMDBF.DBF	150118	1985-1986
PMDBG.DBF	27457	1987-todate
README.TXT	1560	General information
PMDBSITE.DBF	13104	Observing places
PMDBSITE.FRM	1990	Observing places print form
PMDBSEXT.DBF	578	Field descriptions
PMDBOBS.DBF	50642	Observers
PMDBOBS.FRM	1990	Observers print form
OBSEREXT.DBF	482	Field descriptions
STREAM.DBF	3306	Stream data
0022 files	913558	bytes

Some More Explanations on Astro-Mail and IMO

Jost Jahn

Since mid 1988, a special bulletin board named `IMO-METEORE` has been installed in the astronomical mailbox `ASTRO-MAIL`. From some comments on the first *IMO* voting bulletin, I see that there are some misunderstandings. Therefore, let me try to explain the idea behind this bulletin board.

First, this bulletin board makes no claims whatsoever to become the one and only forum for *IMO* members. I think that presently only 5 *IMO* members at the most have the possibility to access this board. Of course, these *IMO* members can as well use electronic mail for personal communications, instead of letters! If these persons have messages of a public nature, they will publish them in *WGN* too, otherwise not very much *IMO* members would know about them!

The electronic forum however, is also intended for the public. This constitutes one of the main advantages of this bulletin board! If some non-*IMO* members, in particular non-meteor observers, will read interesting messages on this board, they might become interested in *IMO* membership or meteor observing, let it be visual, photographic or by radio. Hence this bulletin board will represent a free publicity for *IMO*!

Of course, costs for non-German, especially overseas users will be higher because of telephone charges (as is also the case for "traditional mailing"). One should note however that using a bulletin does not mean that the bulletin board delivers you the messages; you have to get them from the board. So you can easily keep your phone bill under control!

The astronomical bulletin board, where *IMO* is installed, is not run by an amateur astronomical organization, but by a very serious amateur with a professional knowledge of electronic mail systems. He has invested over 5000 DEM into this system, which is now running in its third year. Because this system has the support of two more people, who can also install a mailbox, its future and that of the *IMO* bulletin board seems to depend only of the users of this board. Note, that organizations too can disappear!

Electronic mail is not one the easiest nor the cheapest way of exchanging messages. I think its a valuable addition to existing methods, especially for exchanging hot information and (large) databases. At the moment, the Photographic Meteor Database is available in the *IMO* board and I this is probably only a start.

Since the end of 1988, `ASTRO-MAIL` is available using 300, 1200 and 2400 baud, so that international access is not that expensive any more. The parameters are: 8 bits, no parity, 1 stop bit (8N1). The phone number in the FRG is (49)5851-7896. The mailbox supports Kermit, XModem, YModem and ZModem, so many ways of transferring data and messages are possible.

A "Bright" Radio Meteor

Gabor Süle

János Fekete carried out forward scatter meteor observing on October 1, 1988, in Felsőzsolca. Between 22^h30^m and 23^h00^m UT, he detected a 90 s meteor reflection echoing numerous broadcasting stations. If someone in Western Europe observed a bright fireball at that time, please let me know! *(The author's address is on the inside of the back cover, ed.)*

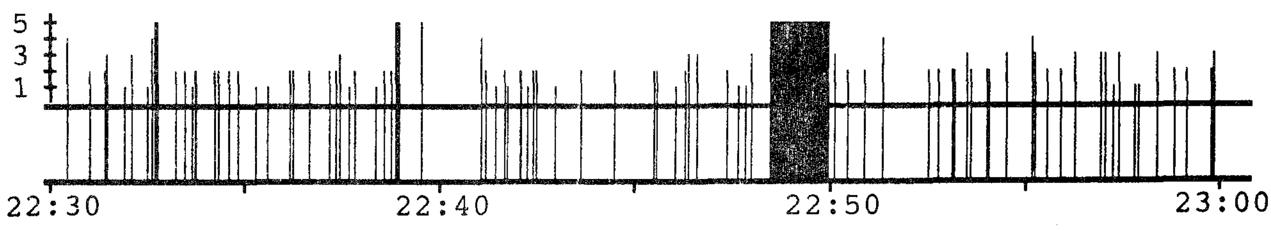

Figure 1 —Observation by János Fekete, Felsőzsolca, Hungary, of a major 90 s meteor reflection on October 1, 1988, between 22^h30^m and 23^h00^m UT.

Observers' Notes: March–April 1989

Jeff Wood

1. Introduction

In March and April, only three prominent showers are active: the γ-Normids, the δ-Pavonids and the April Lyrids. These months are characterized by a whole host of minor streams which makes observing after midnight most interesting. Another feature of March and April is the unusual number of brilliant fireballs that emanate from out of Scorpius, Libra, Centaurus, and the Virgo region. One of these in mid March 1983 was recorded as −18 to −20!

Table 1 — A list of some of the meteor showers to be seen in March-April 1989.

Shower	α	δ	Period	Max
η-Virginids	186°	−1°	Feb 15–Apr 8	Several
γ-Normids	249°	−51°	Feb 25–Mar 22	Mar 14
κ-Virginids	209°	−10°	Mar 12–29	Mar 23
α-Virginids	206°	−9°	Mar 22–May 15	Several
Camelopardalids	119°	+68°	Mar 14–Apr 7	Unknown
δ-Draconids	281°	+68°	Mar 28–Apr 17	Unknown
μ-Virginids	223°	−5°	Mar 19–May 11	Several
δ-Pavonids	305°	−63°	Mar 11–Apr 16	Apr 6
κ-Serpentids	230°	+18°	Apr 1–7	Unknown
Lyrids	271°	+34°	Apr 19–25	Apr 22
π-Puppids	109°	−43°	Apr 15–28	Apr 23
α-Bootids	218°	+19°	Apr 14–May 12	Apr 28
α-Scorpids	246°	−23°	Mar 26–Jun 4	Several
η-Aquarids	337°	−1°	Apr 18–May 29	May 5

Table 2 — Moonlight and observing conditions in March-April 1989.

Date	k	Date	k
Friday March 3	0.28−	Friday April 7	0.01+
Friday March 10	0.08+	Friday April 14	0.60+
Friday March 17	0.75+	Friday April 21	1.00−
Friday March 24	0.98−	Friday April 28	0.59−
Friday March 31	0.44−	Friday May 5	0.01−

New Moon:	March 7, April 6, May 5
First Quarter:	March 14, April 12, May 12
Full Moon:	March 22, April 21, May 20
Last Quarter:	February 28, March 30, April 28

The illuminated part of the Moon is always given for 0^h UT on the date indicated.

2. The Virginids

The η-Virginids, κ-Virginids, α-Virginids and μ-Virginids are the major components of the Virginid complex of radiants that occur from February to May each year. All of these streams appear to have several maxima thus indicating that those listed above really should be divided into more components. The activity of the Virginid complex is generally low usually reaching no more than 1 or 2 meteors per hour at best. However, on odd occasions, especially in late March and early to mid April, rates have been known to reach up to 5 or 6 or even more meteors per hour. Many of the Virginids seen are quite bright and are often colored yellow or orange. Because of their long period of activity and their unpredictable nature, these streams are in need of urgent investigation. Observers are urged to carry out at least some observations of the Virginids in 1989.

3. The Lyrids

This major shower is poorly placed moon-wise for observing in 1989. Nonetheless, observers are encouraged to keep a watch for these meteors from April 19 to 25. The Lyrids are best observed after midnight and can be seen in either hemisphere, though Northern Hemisphere observers have the advantage of higher radiant altitudes. The Lyrids reach maximum on April 22.

4. Minor Southern Hemisphere showers

With the First Quarter Moon setting just after midnight and the radiant rising at about this time, the γ-Normids should make good viewing for Southern Hemisphere observers in 1989. The γ-Normids are active from late February through to late March. Normally they produce 1 or 2 meteors per hour for most of this time, rising to between 5 and 10 meteors per hour at maximum on March 14–15. γ-Normid activity at maximum has been shown to vary from year to year and so we will be very interested to see what happens in 1989. γ-Normid meteors are usually fast, yellow and often have a train. This stream is noted for its bright meteors.

An other Southern Hemisphere stream well placed for observation in 1989 are the δ-Pavonids, associated with comet P/Grigg-Mellish (1907 II). The δ-Pavonid stream is active from March 11 through to April 16 and has several sub-maxima a few days before and after the main maximum on April 6–7. Maximum activity is variable ranging from 5 to 15 meteors per hour. δ-Pavonid meteors are characteristically fast, blue-white in color and have a train. The stream is rich in bright meteors. It is best observed the last couple of hours before sunrise.

With the parent comet P/Grigg-Skjellerup well away from perihelion and a near Full Moon at maximum, the π-Puppids or Grigg-Skjellerupids, a periodic shower, are unlikely to produce any activity in 1989. However, this stream, does spring surprises such as the good display in 1983 and so should be on the observing program of all Southern Hemisphere meteor groups. Remember even if you do not see any meteors, negative observations are just as useful as positive ones, though of course the latter make better viewing.

The α-Scorpids are a major component of a huge complex of radiants situated in the Scorpius-Sagittarius region that occur from late March until late July. The α-Scorpids have several maxima throughout their period of activity with the best rates being recorded in early May. The α-Scorpids are excellent viewing producing at least a couple of meteors per hour through most of their period of activity. At best their rates can reach 10 meteors per hour for Southern Hemisphere observers and 6 meteors per hour for some Northern Hemisphere observers, the difference being due to radiant altitude. The α-Scorpids can be viewed for most of the night. They produce many brilliant orange, yellow and green fireballs. Few α-Scorpids leave a train.

5. Minor Northern Hemisphere showers

The Camelopardalids and the δ-Draconids are two Northern Hemisphere streams that have not been well observed in the past and so need urgent attention to identify rates, magnitudes, durations, etc. The phases of the Moon in 1989 make these streams a good target for the meteor observer who wants to engage in some original research. The κ-Serpentids are active in early April. Once again, not much is known about it except that it appears to produce very low rates. Since the Moon is favorable in 1989, observers are requested to collect data on this stream. The κ-Serpentids can be observed in the morning skies in both hemispheres. The α-Bootids produce 1 or 2 meteors per hour at maximum on April 28. These meteors tend to be slow, bright and yellow-orange. Being an evening shower, they are reasonably well placed for viewing despite a near Last Quarter Moon.

Asteroids 1988 VP4 and 1988 TA: Two Possible Parent Bodies for Meteor Showers

Gary W. Kronk

Two recently discovered Apollo asteroids may well be the parent bodies to some documented meteor showers. Asteroid 1988 VP4 is probably associated with the ζ-Aurigids of late December and early January, while asteroid 1988 TA has an orbit which bears a resemblance to two streams included in the Virginid meteor complex of March–May.

1. Asteroid 1988 VP4

The Apollo asteroid 1988 VP4 was discovered on November 4, 1988, by Caroline S. Shoemaker, Eugene M. Shoemaker and H.E. Holt, while using the 46 cm Schmidt telescope [1]. The asteroid was confirmed on November 6, and prediscovery images were subsequently found on plates exposed on October 11. The asteroid's orbit is closest to Earth (0.08 AU) on December 13 ($\lambda_\odot = 260\overset{\circ}{.}6$), with the predicted radiant being at $\alpha = 51°$ and $\delta = +47°$. The asteroid's orbit remains within 0.15 AU of Earth's orbit through the end of December, and within 0.20 AU until about January 24.

A comparison with a list of active visual and radar meteor streams compiled by the author revealed a similarity between the orbit of this asteroid and the orbit for the ζ-Aurigids from data gathered during the two sessions of the Radio Meteor Project conducted during the 1960s — one with a date of maximum on December 31 [2], and the other with a date of maximum around January 14 [3]. These are listed with the orbit of 1988 VP4 in Table 1.

Table 1 — Comparison between the orbital elements for the asteroid 1988 VP4 and the ζ-Aurigid stream.

Data	1988 VP4	ζ-Aur [2]	ζ-Aur [3]
q	0.786 AU	0.816 AU	0.901 AU
e	0.653	0.602	0.513
i	$11\overset{\circ}{.}7$	$6\overset{\circ}{.}7$	$11\overset{\circ}{.}1$
Ω	$282\overset{\circ}{.}2$	$278\overset{\circ}{.}9$	$293\overset{\circ}{.}2$
ω	$215\overset{\circ}{.}5$	$235\overset{\circ}{.}9$	$221\overset{\circ}{.}0$
π	$137\overset{\circ}{.}7$	$154\overset{\circ}{.}8$	$154\overset{\circ}{.}2$

Comparing 1988 VP4 to the two ζ-Aurigid orbits resulted in $D_{\rm SH}/D'$ values of 0.22/0.08 for the December 31 radiant, and 0.24/0.15 for the January 14 radiant. These indicate that the orbit resulting in a December 31 maximum would be an excellent link to 1988 VP4, despite the large discrepancy in π, while the other orbit would only be a marginal link.

The ζ-Aurigids are not a major shower. Denning first detected the radiant during late December 1885, and confirmed the discovery in 1886. The average position of the radiant was given as $\alpha = 77°$ and $\delta = +32°$. Alexander S. Herschel was one of several people to observe a fireball from a radiant of $\alpha = 75°$ and $\delta = +30°$ on December 27, 1863. Occasional visual observations have continued up to present time. The author has also isolated 8 photographic meteor orbits from American and Russian surveys, which seem to possess a similar duration, orbit, and possible date of maximum, but the radiant is situated about 25° to the north. The orbit of this photographic stream is very similar to that given for the January 14 radiant, except for the inclination (nearly 4° greater) and the eccentricity (which is near 0.7). Thus, this stream seems fairly diffuse and has experienced a possible mass separation similar to that predicted by the Poynting-Robertson effect.

2. Asteroid 1988 TA

The asteroid 1988 TA was discovered by J. Mueller and J. Phinney on October 5, 1988, while using the 1.2 m Oschin Schmidt telescope in the course of the second Palomar Sky Survey [4]. Calculations by the author reveal the orbit possesses two close approaches to Earth — one of 0.027 AU on May 11, and the other of 0.007 AU on September 30. The theoretical meteor radiants for these dates are $\alpha = 214°$, $\delta = -21°$ ($\lambda_\odot = 51°$) and $\alpha = 200°$, $\delta = -1°$ ($\lambda_\odot = 187°$), respectively. The May 11 radiant would be visible at night, while the September 30 radiant would be visible only during daylight hours.

An examination of the literature quickly reveals a close similarity between this asteroid and the May α-Virginids. Cuno Hoffmeister gave this stream's visual radiant as $\alpha = 219°$ and $\delta = -18°$ for May 5 ($\lambda_\odot = 44\overset{\circ}{.}7$) [5]. Zdenek Sekanina also isolated this stream during Harvard's Radio Meteor Project of 1962–1965 [6]. He said that on May 9.5 ($\lambda_\odot = 48\overset{\circ}{.}4$) the average radiant as $\alpha = 214\overset{\circ}{.}0$ and $\delta = 10\overset{\circ}{.}7$. The orbit is given in Table 2.

Table 2 — Comparison between the orbital elements for the asteroid 1988 TA and two Virginid meteor streams.

Data	1988 TA	May α-Vir	April α-Vir
q	0.792 AU	0.758 AU	0.477 AU
e	0.518	0.692	0.691
i	2°.7	1°.4	1°.5
Ω	194°.7	48°.4	198°.4
ω	104°.3	247°.1	106°.7
π	299°.0	295°.5	305°.1

The predicted radiant of 1988 TA and the observed radiants of the May α-Virginids are similar and a direct comparison of the orbits produces orbital discriminant values of $D_{\rm SH}/D' = 0.194/0.148$, so that a relationship seems possible. Sekanina's radiant is situated far enough toward the north to reverse the values of Ω and ω for the orbital elements — indicating the possible existence of southern and northern branches. The existence of two branches seems to be an indication of the Poynting-Robertson effect as the small faint radio meteors are situated further north than the large bright visual meteors. An additional point which strengthens the suggested association comes when comparing the longitudes of perihelion (π). The values for 1988 TA and the May α-Virginids are $299\overset{\circ}{.}0$ and $295\overset{\circ}{.}5$, respectively, so that the difference is only $3\overset{\circ}{.}5$.

Table 2 also lists an orbit for the April α-Virginids. It can be seen that the orbital elements are very close except for a difference in the perihelion distance. The April α-Virginids represent the strongest radiant of the Virginid meteor complex, with visual hourly rates typically between 5 and 10. The stream was first detected by A.S. Herschel in 1895, and Hoffmeister said the shower reached maximum on April 14, from a radiant of $\alpha = 205\overset{\circ}{.}0$ and $\delta = -10\overset{\circ}{.}7$. It was well detected by Sekanina during the Harvard Radio Meteor Survey of 1968–69 [7]. He added that the April α-Virginids were probably near maximum on April 8.7 ($\lambda_\odot = 18\overset{\circ}{.}4$), from a radiant of $\alpha = 203\overset{\circ}{.}6$ and $\delta = -11\overset{\circ}{.}7$.

The fact that the April α-Virginids are a large diffuse stream has been known for some time. In 1982, Jack D. Drummond said the duration of the Virginids indicated a radius of 0.517 AU [8]. Also interesting is an orbital study conducted in 1973 by E.I. Kazimirchak-Polonskaya and A.K. Terentjeva [9]. After adopting Harvard photographic meteor 7333 as representing the stream's true orbit, they created ten points evenly spaced around the stream's orbit and then proceeded to examine each point's orbital evolution over the period 1860 to 2060. They demonstrated how Jupiter's influence caused the stream to variously approach and move away from Earth's orbit, as well as how the radiant moves by as much as 30° in both right ascension and declination. The date of maximum for this stream moves in such a way that it could create secondary maxima any time between March 22 and May 12 — coinciding very well with observed values of the Virginid meteor complex. In addition, the magnitude and character of each of these perturbations has a strong influence on the secondary radiants in terms of the diameter, the length of time activity remains visible, and the maximum hourly rates.

Since the April α-Virginids seem to represent the heart of the Virginid meteor complex, then 1988 TA is currently situated about 0.3 AU from the stream's center (at least during April). It is uncertain whether the May α-Virginids are the newest by-product of 1988 TA, or just part of a group of meteors carried out of the April α-Virginid stream around the time 1988 TA's orbit was altered. As a possible solution to this question the author examined the 39 000 meteor orbits obtained during Harvard's Radio Meteor Surveys of the 1960s and isolated all meteors which may have originated from the daytime radiant of September 23. Only 4 or 5 *possible* candidates were found during the period of September 23 to October 10. Thus, it would at least seem probable that 1988 TA has not produced meteors when perturbed into its present orbit.

3. Conclusions

The ζ-Aurigids were produced by 1988 VP4. The weak and diffuse Virginid meteor complex active during March, April and May contains two streams with very similar orbital elements to 1988 TA. It is therefore suggested that 1988 TA might be associated. A search was also conducted for a daylight meteor shower at the end of September and early October, but no convincing evidence was found.

It would appear that neither asteroid is currently adding to the existing meteor population. Both of these meteor streams show signs of great age, as the meteor populations show signs of the Poynting-Robertson effect — they possess northern and southern branches, which represent the separation of large and small particles. Any expected enhancement in activity of these streams when Earth is especially close to their parent bodies, should not be expected, due this apparent age and the already mentioned inactivity of these parent bodies.

Drumond has subsequently confirmed all D_{SH}/D' values and concludes that the ζ-Aurigid/asteroid link is valid, while the May α-Virginid/1988 TA link is a marginal association [10,11]. Concerning the latter link, Drummond added: *The Virginids are so large that almost anything is allowed. This is not to say that 1988 TA is not part of the system, only that it is not possible to prove it.* The author adds that 1988 TA is the best possible candidate so far identified as the Virginid meteor complex' parent body.

4. References

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A Preliminary Analysis of the 1988 Perseids

Paul Roggemans

Until November 1988, over 40 000 meteors were reported seen during Perseid observations. Besides the Perseids, these reports also cover the α-Capricornids, the Aquarid complex and the κ-Cygnids. Maximum occurred around $\lambda_{\odot} = 139.^{\circ}4$ (1950.0) and no peak was reported at $\lambda_{\odot} = 139.^{\circ}25$. Obviously, Europe missed the Perseid maximum, which was reached when the radiant was high up in the morning skies of North America on August 12. Japanese observations still show good rates although they were hampered by poor weather. As a general conclusion, we may call the 1988 return of the 1988 Perseids a rather moderate one.

1. Introduction

The Visual Meteor Database (VMDB) was developed last fall, while Perseid reports came. Files with general data on observers, observing sites and radiants, as well as the programs were created and tested on the incoming data. Some observers are still unaware of the most efficient report format; as a consequence, much time is still lost in converting a considerable number of observations into the *IMO* report format. Taken into account that the development of VMDB was more time consuming than the actual data input, future reports such as this one can be produced shortly after the observations.

For the period July and August, no less than 46 000 meteors are available! The data entered so far had to fulfill some conditions:

- observations had to be carried out according to the method described in the Handbook Visual Meteor Observations; hence, group observations were excluded;
- reports had to be complete and legible.

With still data to be received, we decided to publish preliminary results using the current state of VMDB. Up to now, 25 548 Perseids were used to compute ZHRs and 14 245 sporadics to compute HRs. In total 46 030 meteors were reported for hourly rates. The 131 contributing observers are :

Peter Aneca (ANEPE), Tomi Anttila (ANTTO), Rainer Arlt (ARLRA), Pierre Bader (BADPI), Petra Baldauf (BALPE), Sandro Baroni (BARSA), Dirk Bernaerts (BERDI), Lieve Bresseleers (BRELI), Peter Brown (BROPE), Lucia Bruning (BRULU), Dominique Caris (CARDO), Sven Claeys (CLASV), Koen Clement (CLEKO), Sabine Clement (CLESA), Luigi D'Argliano (D'ALU), Tim Daniels (DANTI), Marc De Lignie (DE MA), Jan De Bie (DEBJA), Bernard De Grootte (DEGBE), Stefano Del Dotto (DELST), Kris Deman (DEMKR), Sylvia De Paepe (DEPSY), Bart De Pontieu (DE BA), Kurt Dequick (DEQKU), Anne De Weert (DEWAN), Jean Deweert (DEWJE), Patrick Dewispelaere (DEWPA), Filip Dierckx (DIEFI), Ivo Dielen (DIEIV), Maurizio Eltri (ELTMA), Raul Fernandez (FERRA), Irina Gaus (GAUIR), Koen Geukens (GEUKO), Hans Goertz (GOEHA), Peter Goris (GORPE), Roberto Gorelli (GORRO), Marc Gyssens (GYSMA), Gabi Haderer (HADGA), Teemu Hankamäki (HANTE), Roberto Haver (HAVRO), Bernd Heinrich (HEIBE), Casper Jans (JANCA), Klaas Jobse (JOBKL), Kurt Jonckheere (JONKU), Timo Kinnunen (KINTI), Becky Kirkwood (KIRBE), John Kirkwood (KIRJO), Robert Kirkwood (KIRRO), André Knöfel (KNOAN), Bernhard Koch (KOCBE), Detlef Koschny (KOSDE), Ralf Koschack (KOSRA), Ralf Kuschnik (KUSRA), Patrick Laenen (LAEPA), Iris Lafaille (LAFIR), Alberto Latini (LATAL), Dirk Laurent (LAUDI), Kris Lavrijsen (LAVKR), Stefan Lobet (LOBST), Robert Lunsford (LUNRO), Hannu Määttänen (MAAHA), Ann Martaux (MARAN), Massino Martini (MARMA), Alastair McBeath (MCBAL), Norman McLeod (MCLNO), Dina Moro (MORDI), Michael Nolle (NOLMI), Kurt Osaer (OSAKU), Pekka Parviainen (PARPE), Dirk Pauels (PAUDI), Francis Plesier (PLEFR), Ghislain Plesier (PLEGH), Giacomo Poleschi (POLGI), Edoardo Radice (RADED), Stefano Raffaelli (RAFST), Leo Rajala (RAJLE), Andreas Rendtel (RENAN), Ina Rendtel (RENIN), Jürgen Rendtel (RENJU), Paul Roggemans (ROGPA), Wim Rogiest (ROGWI), Maarten Roos (ROOMA), Christiaan Rutges (RUTCH), Hans Salm (SALHA), Napoleone Scarpa (SCANA), Ann Schroyens (SCHAN), Daan Schroyens (SCHDA), René Scurbecq (SCURE), Holger Seipelt (SEIHO), Steve Sillis (SILST), Karl Simmons (SIMKA), Wanda Simmons (SIMWA), Wendy Simmons (SIMWE), Lieven Smits (SMILI), Paul Smits (SMIPA), George Spalding (SPAGE), Peter Spanyi (SPAPE), Ulrich Sperberg (SPEUL), Enrico Stomeo (STOEN), Stefano Stomeo (STOST), Dominique Suys (SUYDO), David Swann (SWADA), Richard Sweetsir (SWERI), Richard Taibi (TAIRI), Emmanuel Thienpont (THIEM), Glenn Ticket (TICGL), Emiliano Trizio (TRIEM), José Maria Trigo Rodriguez (TRIJO), Anik Vanhuysse (VANAN), Didier Van Hellemont (VANDI), Filip Van Gorp (VANFI), Griet Van De Steene (VANGR), Hendrik Vandenbruane (VANHE), Jan Vandenbruaene (VANJN), Jonas Vanreusel (VANJO), Karin Van Genegen (VANKA), Mireille Vanheerentals (VANMR), Peter Van den Eijnde (VANPE), Pierre Van Mechelen (VANPI), Tom Van De Vreken (VANTM), Toon Van Borm (VANTN), Tonny Vanmunster (VANTO), Ward Van Nuffelen (VANWA), Frank Van Reeth (VANFK), Cis Verbeeck (VERCI), Ivo Verstraelen (VERIV), Ivo Verlaeckt (VERIV), Sam Vereecke (VERSA), Wim Vinken (VINWI), Jean-Marc Wislez (WISJE), Nikolai Wünsche (WUNNI).

2. Hourly rates

After ZHRs and HRs were computed for all individual observers, several sliding means were considered. The values presented in Table 1 were obtained using a step of 0°25 and an interval of 0°3 in solar longitude. For each average value, the number of observations used and the total number of both Perseids and sporadics are given. The results are presented graphically in Figure 1.

Table 1 — ZHR-values for the 1988 Perseids and corresponding HR-values of the sporadic background.

Date	$\lambda_\odot$	Nr. Obs	Per	ZHR	Spor	HR
Jul 08.94	106°42	2	0	0.0	12	9.4 ± 9.5
09.99	107°42	8	0	0.0	33	14.4 9.7
11.84	109°17	2	0	0.0	17	8.7 1.6
12.09	109°42	4	0	0.0	47	10.6 2.8
17.07	114°17	1	1	1.4 ± 1.4	19	9.8 9.8
18.91	115°92	1	0	0.0	7	12.4 12.4
19.16	116°17	1	0	0.0	7	12.4 12.4
19.95	116°92	8	2	1.1 3.1	65	10.8 4.3
20.21	117°17	1	0	0.0	9	13.0 13.0
20.99	117°92	5	7	2.9 4.7	61	13.9 3.8
21.25	118°17	1	5	10.7 10.7	14	17.4 17.4
23.09	119°92	1	1	2.8 2.8	6	9.8 9.8
23.35	120°17	2	1	1.8 2.5	19	13.2 4.9
23.88	120°67	5	18	3.9 1.3	76	7.9 0.9
24.14	120°92	1	3	4.0 4.0	11	8.6 8.6
24.93	121°67	6	0	0.0	35	19.4 15.4
25.18	121°92	1	0	0.0	3	10.8 10.8
25.97	122°67	5	43	7.9 4.2	132	10.9 2.9
27.02	123°67	8	1	0.1 0.3	50	19.6 13.0
Aug 02.81	130°17	7	19	6.6 ± 5.0	147	10.7 ± 3.6
Aug 03.08	130°42	1	0	0.0	0	0.0
03.86	131°17	14	142	18.1 ± 7.9	379	14.7 ± 4.9
Aug 04.39	131°67	1	0	0.0	0	0.0
04.91	132°17	15	221	14.7 ± 9.7	371	12.2 ± 7.1
Aug 05.69	132°92	8	129	22.7 ± 8.2	247	10.3 ± 2.0
05.94	133°17	27	455	17.1 7.8	574	11.3 7.5
Aug 06.20	133°42	3	20	12.2 ± 10.6	14	15.0 ± 6.9
06.46	133°67	2	4	8.8 12.5	6	18.8 3.0
06.99	134°17	54	270	12.5 9.5	347	12.7 7.8
Aug 07.25	134°42	4	9	7.7 ± 6.1	12	4.9 ± 4.1
07.52	134°67	1	3	4.0 4.0	4	4.0 4.0
07.78	134°92	10	78	16.6 9.8	59	6.3 2.8

Table 1 — continued

Date	$\lambda_\odot$	Nr. Obs	Per	ZHR	Spor	HR
Aug 08.03	135°17	64	663	18.4 ± 10.4	577	10.1 ± 5.8
08.30	135°42	6	75	22.3 14.5	51	9.2 5.7
08.55	135°67	11	76	20.4 14.6	60	5.4 3.1
08.81	135°92	25	382	21.3 8.6	399	7.1 3.8
Aug 09.08	136°17	38	928	20.4 ± 11.8	623	8.6 ± 6.2
09.35	136°42	4	69	23.8 8.0	43	9.4 1.5
09.60	136°67	1	23	30.8 30.8	7	7.8 7.8
09.86	136°92	36	547	26.3 9.7	457	9.7 3.2
Aug 10.12	137°17	47	652	25.4 ± 10.8	350	10.1 ± 6.8
10.38	137°42	9	113	29.2 14.4	70	11.0 8.2
10.65	137°67	2	17	31.5 13.2	19	9.5 2.1
10.90	137°92	67	1715	32.0 13.2	1082	10.8 4.8
Aug 11.16	138°17	60	1642	44.5 ± 24.8	581	11.2 ± 5.6
11.42	138°42	8	270	50.2 9.9	68	9.0 5.1
11.95	138°92	108	5110	71.7 26.2	1246	10.5 6.9
Aug 12.20	139°17	55	2079	70.9 ± 33.5	446	11.9 ± 9.8
12.46	139°42	18	887	82.2 40.3	145	10.1 7.7
12.72	139°67	24	956	73.3 28.2	393	9.5 8.0
12.99	139°92	138	4478	54.4 20.7	1505	11.4 6.1
Aug 13.24	140°17	32	783	45.2 ± 22.1	231	9.2 ± 5.6
13.50	140°42	8	238	40.1 27.2	52	6.0 4.8
13.77	140°67	24	536	34.5 17.0	420	11.6 4.6
Aug 14.02	140°92	73	1716	32.3 ± 14.1	890	12.1 ± 5.7
14.29	141°17	7	101	15.8 6.2	41	5.1 2.8
14.54	141°42	3	22	20.4 7.8	35	14.3 8.8
14.80	141°67	32	454	18.0 8.2	587	10.8 5.8
Aug 15.06	141°92	55	846	19.3 ± 9.1	745	10.4 ± 5.4
15.85	142°67	17	126	14.7 8.8	129	8.7 4.5
Aug 16.10	142°92	17	190	13.3 ± 5.4	175	9.5 ± 5.2
16.63	143°42	2	7	14.4 0.5	11	6.8 6.9
16.88	143°67	24	121	7.7 5.3	237	8.6 5.1
Aug 17.14	143°92	16	118	6.4 ± 3.6	274	13.9 ± 5.6
17.68	144°42	1	3	11.1 11.1	8	12.8 12.8
17.92	144°67	43	194	6.2 3.7	431	8.6 5.1
Aug 18.18	144°92	9	32	4.7 ± 2.7	65	9.4 ± 4.4
18.70	145°42	2	3	5.4 3.7	10	5.3 3.0
18.96	145°67	18	85	9.1 6.4	122	11.1 7.4
Aug 19.22	145°92	5	23	5.2 ± 3.2	40	9.5 ± 4.0
19.75	146°42	1	0	0.0	5	7.6 ± 7.6
Aug 20.00	146°67	4	8	2.4 ± 1.8	40	10.2 ± 4.0
20.80	147°42	1	4	18.3 18.3	6	15.3 15.3
Aug 21.05	147°67	1	4	18.3 ± 18.3	6	15.3 ± 15.3
21.83	148°42	2	6	4.2	14	8.3
Aug 22.08	148°67	4	8	2.4 ± 2.1	37	9.3 ± 1.8
22.34	148°92	3	3	4.7 8.1	12	12.0 2.4
Aug 23.90	150°42	1	0	0.0	1	6.3 ± 6.3
Aug 24.94	151°42	2	6	1.3	38	7.2

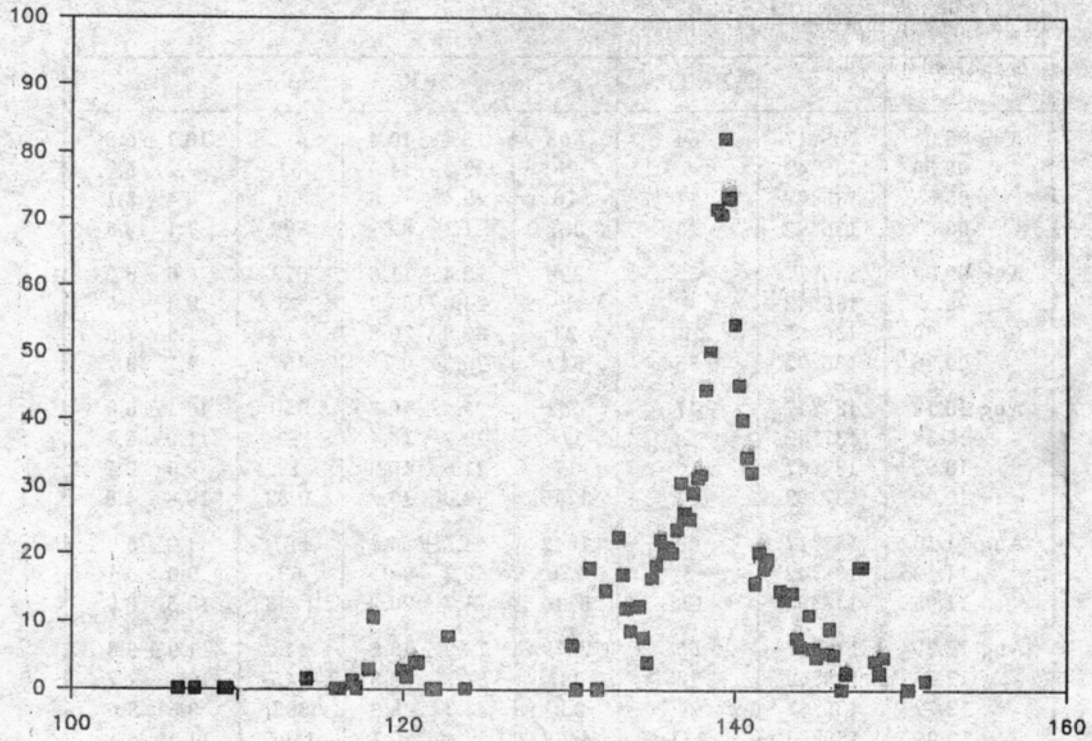

Figure 1 —ZHR profile of the 1988 Perseid activity.

3. Magnitude Distributions

For the observers having supplied magnitude data, we created the following magnitude distributions. Table 2 gives daily magnitude distributions of the Perseids centered around 0^h UT.

Table 2 — Daily magnitude distributions of the 1988 Perseids.

Date	−6	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	+7	Tot
Aug 03	0	0	0	0	0	0	2.5	6	6	2	6	3.5	1	0	27
04	0	0	0	0	1.5	9.5	9	11.5	18.5	36.5	32.5	16	7	0	142
05	0	0	0	0	0.5	3.5	13.5	23.5	51	41	51.5	40	7.5	0	232
06	0	0	0	0	0	3.5	33	62	92.5	100	64	65	10.5	0.5	432
07	0	0	1	0	2	3	4.5	17.5	47.5	62.5	60	31	4	0	233
08	0	0	1	1	4	7	29	56	127.5	153	117.5	73.5	11.5	0	581
09	0	0	0	2.5	9	26.5	47	129.5	243.5	266	238.5	173.5	57.5	6.5	1200
10	1	2	0	2	4.5	25.5	43.5	74	132	172.5	153	107	11	0	728
11	1.5	2.5	8	7.5	21	46	118	218	389	434.5	368	237	80	12	1943
12	0	2	10	21	74.5	185	368.5	741.5	1045	1047	878.5	529.5	160.5	7.5	5070
13	0	3	10.5	11.5	35.5	106	214	399.5	657	668	539.5	296.5	73.5	1.5	3016
14	0	0	0	6	15.5	39	61	221	411	392.5	295.5	204	91	15.5	1752
15	0	0	0	1.5	8.5	19	36	80.5	180	197	179.5	81.5	36.5	7	827
16	0	0	0	0	0.5	3	19	20.5	42.5	48.5	53.0	37.5	6.5	0	231
17	0	0	0	0	0	2	7	15.5	27.5	53.5	41.5	27.5	10.5	1	186
18	0	0	0	0	0	0	3.5	6.5	21.5	43.5	53	36	6	3	173
19	0	0	0	0	0	1.5	2	0.5	3	8	8.5	3.5	0	0	27
20	0	0	0	0	0	0	0	0	0	0.5	0.5	0	0	0	1
21	0	0	0	0	0	0	0	0	0	1.5	2.5	1	0	0	5
25	0	0	1	0	0	1	4	5	15	22	12	5	0	0	65

For all these distributions, we computed the average limiting magnitude, weighted by the number of meteors per individual distribution. The r-values and correlation coefficients were computed too. These data are given in Table 3, together with the number of meteors involved. Most of the r-values are quite high. A limiting magnitude corrected perception function was applied according to TN4 (Steyaert, 1982). It may be useful to consider other perception functions too.

Table 3 — Daily average magnitudes and r-values for the 1988 Perseids.

Date	Avg. Lm	Per	$\overline{m}$	r	Corr.
Aug 03	6.40	27	2.65	2.33	0.981
04	6.51	142	2.80	2.55	0.987
05	6.49	232	3.00	3.19	0.984
06	6.51	432	2.76	2.92	0.979
07	6.14	233	3.04	2.78	0.991
08	6.34	581	2.85	2.87	0.999
09	6.58	1200	2.98	2.89	0.995
10	6.34	728	2.76	2.40	0.992
11	6.56	1943	2.76	2.45	0.998
12	6.41	5070	2.51	2.71	0.991
13	6.43	3016	2.50	2.53	0.997
14	6.62	1752	2.85	2.71	0.995
15	6.58	827	2.88	2.84	0.993
16	6.35	231	2.97	3.27	0.983
17	6.40	186	3.24	3.12	0.996
18	6.51	173	3.64	3.46	1.000
19	6.25	27	2.98	2.59	0.984
20	6.20	1	3.50		
21	5.65	5	3.90		
25	6.58	65	2.60	2.50	0.994

The computations made to obtained Table 3, were also done for the sporadics. The results of these are shown in Table 4.

Table 4 — Daily average magnitudes and r-values for the sporadics seen during the 1988 Perseid campaign.

Date	Avg. Lm	Spor	$\overline{m}$	r	Corr.
Aug 03	6.62	167	4.38	3.90	0.984
04	6.59	381	4.43	4.07	0.986
05	6.39	378	4.18	3.70	0.994
06	6.66	521	4.42	4.13	0.992
07	6.18	256	3.58	3.23	0.988
08	6.45	521	3.90	3.59	0.998
09	6.72	947	3.37	4.28	0.987
10	6.44	528	3.91	4.20	0.996
11	6.72	1080	4.16	3.33	0.989
12	6.53	1125	3.87	3.64	0.997
13	6.55	1067	3.84	2.59	0.982
14	6.72	1028	4.14	3.27	0.990
15	6.73	912	3.97	3.48	0.996
16	6.37	230	3.66	3.42	0.997
17	6.46	402	3.94	4.05	0.996
18	6.54	430	3.92	4.58	0.996

Table 4 — continued

Date	Avg. Lm	Spor	$\overline{m}$	r	Corr.
19	6.23	42	3.42	3.63	0.992
20	6.20	8	3.50		
21	5.65	14	3.79		
22	7.00	18	5.19		
25	6.58	59	3.31	3.03	0.995

Table 5 gives global magnitude distributions for several Summer showers in 1988, among which of course the Perseids.

Table 5 — Global magnitude distributions of 1988 Summer showers and sporadics.

Shower	−6	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	+7	Tot
α-Cyg	0	0	0	0	0	0	2	19	53	108	165	207.5	82.5	13	650
Cap	2	0	0	1	1.5	7	28	73.5	162	195	255	273	102	16	1116
δ-Aqr S	0	0	0	0	0.5	1.5	16.5	62.5	140.5	230.5	323	262	98	11.5	1147
δ-Aqr N	0	0	0	0	2.5	8.5	29.5	57	167	205.5	332.5	298.5	157	27	1285
ι-Aqr N	0	0	0	0	0	0	1	0	3	7.5	8.5	4.5	0	0	25
ι-Aqr N	0	0	0	0	0	0	1	1.5	2.5	5	10	6.0	0	0	26
Per	2.5	9.5	31.5	53	177	481	1015	2089	3510	3750	3155	1969	574.5	54.5	16871
κ-Cyg	0	0	2	0	1	7	15.5	71.5	196.5	245.5	309.5	278	110	22.5	1259
Psc S	0	0	0	0	0	0	0	1	3	17.5	28.5	43.5	25	13.5	132
Aur	0	0	0	0	0	0	0	0	4	6	0	0	0	0	10
Spor	2	0.5	5.5	5	13.5	50	133	362.5	1034	1809	2410	2566	1463	261.5	10114

Finally, Table 6 presents the average magnitudes and r values corresponding to the data in Table 5.

Table 6 — Global average magnitudes and r-values for the August 1988 showers and sporadics.

Shower	Avg. Lm	Tot	$\overline{m}$	r	Corr.
α-Cyg	6.44	650	4.20		
Cap	6.64	1116	3.64	3.19	0.966
δ-Aqr S	6.67	1147	3.75		
δ-Aqr N	6.77	1285	3.85	3.45	0.996
ι-Aqr N	6.21	25	3.40	3.48	0.995
ι-Aqr S	6.26	26	3.52	3.53	0.993
Per	6.47	16871	2.70	2.76	0.996
κ-Cyg	6.63	1259	3.68	3.17	0.989
Aur	6.00	10	2.60		
Psc S	6.59	132	4.81		
Spor	6.59	10114	4.03	3.12	0.990

4. Conclusion

In this article, we presented a preliminary analysis of the partial results received thus far on the Summer 1988 showers in general and the 1988 Perseids in particular. A fast compilation of over 45 000 meteors would not have been possible without the help of the Visual Meteor Database (VMDB); VMDB will allow to produce reports shortly after collection of the data, even when 100 000 meteors are involved. I wish to thank all observes already having sent data and I hope others will follow soon!

The Perseids 1988 in Malta

David Gatt

An overview is given of successful Maltese observations of the 1988 Perseids, conducted under excellent weather conditions.

The Perseid meteor shower for 1988 was the subject of an intense period of activity for the Astronomical Society of Malta. The shower was observed over a period of 3 weeks and included visual and photographic watches. These were an important part of a one-week astronomy camp in Gozo. During this project, special arrangements were made so that the data collected could be used to investigate the effect of experience on observation parameters. In this report, only the visual aspects of the project will be dealt with.

The shower was observed by 29 observers who made 230 watches, totaling over 500 hours of observation. In the process, 7355 meteor events were recorded. Of these, 4231 were Perseids, 2229 were sporadics and 895 were meteors from minor showers. Some reports were, unfortunately, unsuitable for analysis, but the utilizable reports still totaled over 475 hours. The observers were as follows:

> Adrian Galea, Antoine Grima, Jean-Paul Mifsud, Bernard Bonnici, Alex Gambin, Godfrey Baldacchino, Anna Baldacchino, Gordon Pace, James Mizzi, Edwin Camilleri, Christopher Cachia, Martin Debattista, Eileen Grech, Chris Carabott, Raymond Pace, Sandro Lanfranco, David Gatt, Stephen Abela, Edwin Grech, Leslie Vella, Mark Scicluna, Franco Gatt, Pierre Gatt, Nevelle Aquilina, Yosanne Cinni, Stephen Brincat, Marcel Farrugia, James Samut, David Pace.

The shower and sporadic activity are listed in Table 1 below.

Table 1 — Daily average ZHR-values for the 1988 Perseids and corresponding HR-values of the sporadic background as obtained from Maltese observations.

Date	$\lambda_\odot$	Per	ZHR	Spor	HR
Jul 31–32	129°18	0	0	1	4.2 ± 4.2
Aug 01–02	130°08	3	3.7 ± 2.1	28	18.0 3.4
02–03	131°04	22	14.1 3.0	56	17.3 2.3
03–04	132°00	46	14.6 2.2	51	13.0 1.8
04–05	132°95	50	15.5 2.2	59	13.9 1.8
05–06	133°95	20	10.9 2.4	26	12.7 2.5
06–07	134°87	224	22.3 1.5	242	19.8 1.3
07–08	135°83	395	26.3 1.3	347	18.0 1.0
08–09	136°79	280	33.5 2.0	250	22.1 1.4
09–10	137°75	394	38.6 2.0	184	14.2 1.0
10–11	138°71	443	39.1 1.9	205	14.3 1.0
11–12	139°67	1428	120.7 3.2	297	22.9 1.3
12–13	140°63	568	81.3 3.4	159	16.4 1.3
13–14	141°59	50	29.2 4.1	38	16.9 2.6
14–15	142°55	1	12.0 12.0	8	12.0 4.3
15–16	143°51	34	20.6 3.5	38	13.8 2.2
16–17	144°47	3	8.2 4.8	8	11.3 4.0
17–18	145°43	19	19.3 4.4	24	12.2 2.5
18–19	146°39	2	6.2 4.4	9	18.2 6.1
19–20	147°36	5	11.8 5.3	14	22.5 6.0
20–21	148°32	13	17.0 4.7	20	13.1 2.9
21–22	149°28	2	6.7 4.7	8	9.0 3.2
22–23	150°22	0	0	3	11.0 6.4

The error range was obtained by dividing the ZHR respectively the HR by the corresponding number of meteors seen.

The first observation was made by Bernard Bonnici, who started a watch on the night of July 31–Aug 1 at 19^h18^m UT. The last observation was made by Adrian Galea, who closed the watch on August 22 at 22^h48^m UT. The longest watch was also made by Adrian Galea, who clocked up a marathon 6.98 hours on the night of August 9–10. During this period, observations were carried out on every night of the project.

The peak zenithal hourly rate observed was around 120 meteors per hour. Interpolation on the activity curve indicates that maximum occurred at solar longitude $\lambda_\odot = 139^\circ\!.9$, which corresponds approximately to August 8 at 5^h45^m UT. This is in good agreement with the predicted value [1] of August 8 at 8^h UT. The sporadic activity during the period of observation was around 17 per hour.

A global magnitude distribution of the 1988 Perseids and the sporadic background is shown in Table 2.

Table 2 — Global magnitude distributions of the 1988 Perseids and the sporadic background as obtained from Maltese observations.

Shower	−6	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	Tot	$\overline{m}$
Per	1	23	42	78	197	471	705	958	804	479	208	36	4002	0.91
Spor	0	3	7	10	57	114	223	374	481	457	295	48	2069	1.85

For the Perseids an r-value of 2.55 was calculated (corr. coef. of 0.97); for the sporadics, a value of 3.03 (corr. coef. of 0.98) was found. For the computation of r, we used the $p(m)$-values of Kresakova [2]. Since we were not observing under optimum, we calculated a mean limiting magnitude, weighted by the number of Perseids respectively sporadics seen. This gave values of +5.43 respectively +5.42. The values for $p(m)$ were then modified accordingly, using linear interpolation for intermediate values.

The r-value obtained for the sporadics suggests a distribution brighter than that published by most sources. This discrepancy may be due to the erroneous classification of meteors from other showers active during the period as sporadics by some of our observers.

In conclusion, we may safely say that the 1988 Perseid shower has been a very satisfying project. The weather conditions were excellent. The enthusiasm of a record number of observers has allowed us to to collect a very respectable database. Finally, the results of our observations are in fair agreement with the known characteristics of the shower; showing that our sleepless nights have been worth the effort.

Acknowledgments

This report could not have been prepared without the assistance of Godfrey Baldacchino and Adrian Galea, who helped reduce the observations to manageable data, Gordon Pace, who provided some of the software for ZHR analysis, and to the observers, who provided the data in the first place.

References

[1] BAA, *British Astronomical Association Handbook* 1988, p. 86.

[2] M. Kresakova, "The Magnitude Distribution of Meteors in Meteor Streams", *Contr. Astr. Obs. Skalnate Pleso* III, 1966.

A First Impression of the 1988 Geminids

Paul Roggemans

A preliminary report is presented on the 1988 Geminids, based on observations from Western Europe and Texas. Apparently, rates were already declining when the European observers could start in the night of December 13–14. Japanese and Australian reports are awaited to confirm this.

1. Introduction

The Geminids are known to be a very active shower, but this cannot remedy the poor coverage of the shower. Although the Geminid radiant is idealy placed for Northern Hemisphere observers, few of them take the effort to monitor this shower; probably, most of them are discouraged by low winter temperatures. Nevertheless, *IMO* hopes to be able to collect enough data to obtain a good picture of the Geminids' activity profile each year. This is just a preliminary report on the activity of this shower in 1988; it is based on only four observers. Thanks to *IMO*'s Visual Meteor Database (VMDB), we are able to produce a report shortly after receipt of the observations. With this preliminary report, we intend both to give our readers a first impression of the 1988 Geminids as quickly as is humanly possible, and to encourage other observers to send us their observations promptly; in this way they will help us to compile a final analysis within a reasonable time.

2. Observational data

The four observers mentioned above, are:

> Alastair Mcbeath (United Kingdom, MCBAL), Paul Roggemans (France, ROGPA), David Swann (United States, SWADA), José Maria Trigo-Campoy Rodriguez (Spain, TRIJO).

The coordinates of their observing sites are given below:

Table 1 — Observing sites for the 1988 Geminids.

Code	Location	λ	φ
5	Lardiers (France)	5°42′35″E	44°3′29″ N
136	Mariano Cavia (Spain)	0°25′0″W	39°29′0″ N
186	Morpeth (UK)	1°41′48″W	55°9′36″ N
221	Dallas (TX, USA)	96°39′0″W	32°42′16″ N

Table 3 contains the raw hourly rate data. Of interest are some minor showers making a considerable contribution to the overall activity. These streams are listed in Table 2. Alastair McBeath also reported some sporadics that may have originated from an area roughly centered on $\alpha = 91°$ and $\delta = +02°$ on December 4–5 and 5–6, both nights at least three times. The other observers were not watching on these nights. Did anyone else see activity from this radiant?

Table 2 — Abbreviations.

Shower	Abb.
Monocerotids	M
Coma Berenicids	CB
σ-Hydrids	SH
χ-Orionids North	XN
χ-Orionids South	XO

Table 3 — Raw hourly rate data on the 1988 Geminids.

Date	Obs	Period (UT)	$T_{\rm eff}$	Lm	F	Gem	Minor streams	Spor
Dec 04	MCBAL	22^h50^m–23^h50^m	1.00	5.70	1.00	0		8
04	MCBAL	23^h50^m–00^h50^m	1.00	5.70	1.00	1		7
Dec 05	MCBAL	23^h00^m–00^h00^m	1.00	5.60	1.00	0		12
Dec 06	MCBAL	00^h00^m–01^h00^m	1.00	5.60	1.00	0		6
06	TRIJO	22^h00^m–23^h00^m	1.00	5.30	1.00	0	2M,1XN	5
06	MCBAL	22^h00^m–23^h00^m	1.00	5.50	1.00	1		4
06	MCBAL	23^h00^m–00^h00^m	1.00	5.50	1.06	0		8
06	TRIJO	23^h00^m–23^h30^m	0.50	5.30	1.00	0		0
06	TRIJO	23^h45^m–00^h45^m	1.00	5.30	1.00	2		5
Dec 07	TRIJO	00^h45^m–01^h45^m	1.00	5.40	1.00	2	1M,1SH	11
07	TRIJO	01^h45^m–02^h21^m	0.60	5.45	1.00	0	1CB	9
07	TRIJO	23^h10^m–00^h10^m	1.00	5.30	1.00	2		3
Dec 08	TRIJO	00^h10^m–01^h10^m	1.00	5.30	1.00	3	1M,1SH	4
08	TRIJO	01^h10^m–02^h10^m	1.00	5.30	1.00	1		1
08	TRIJO	02^h10^m–02^h41^m	0.50	5.35	1.00	0		0
08	TRIJO	21^h20^m–22^h20^m	1.00	5.15	1.00	2	1XO	3
08	TRIJO	22^h20^m–23^h20^m	1.00	5.30	1.00	0	1SH	1
08	TRIJO	23^h20^m–00^h20^m	1.00	5.30	1.00	2		2
Dec 09	TRIJO	00^h20^m–01^h00^m	0.65	5.35	1.00	4		2
Dec 10	TRIJO	21^h30^m–22^h30^m	1.00	5.00	1.00	1	1M,1XN	2
10	ROGPA	21^h45^m–23^h00^m	1.25	6.35	1.00	6	3M,1CB,1SH,1XN	15
10	TRIJO	22^h30^m–23^h30^m	1.00	5.20	1.00	2	1SH	2
10	ROGPA	23^h00^m–00^h33^m	1.55	6.20	1.00	12	1CB,2SH,1XN	9
10	TRIJO	23^h30^m–00^h30^m	1.00	5.30	1.00	6		1
Dec 11	TRIJO	00^h30^m–01^h30^m	1.00	5.40	1.00	8		5
11	TRIJO	01^h30^m–02^h30^m	1.00	5.40	1.00	4	1M,1SH	4
11	ROGPA	01^h35^m–02^h30^m	0.92	6.10	1.00	6	2CB,2SH,1XN,1XO	3
11	ROGPA	02^h30^m–03^h19^m	0.81	6.20	1.00	10	1M,1CB	5
11	TRIJO	02^h30^m–03^h06^m	0.60	5.40	1.00	5	1M,1SH	7
11	ROGPA	17^h22^m–18^h00^m	0.63	6.30	1.00	0	2SH,1XN	9
11	ROGPA	18^h00^m–19^h03^m	1.05	6.40	1.00	2	3SH,1XN	5
11	ROGPA	20^h09^m–21^h00^m	0.85	6.40	1.00	4	2SH	10
11	ROGPA	21^h00^m–22^h00^m	1.00	6.35	1.00	8	2M,2SH	3
11	ROGPA	22^h00^m–23^h00^m	1.00	6.30	1.00	29	2M,1CB,1SH,2XN	5
11	ROGPA	23^h00^m–00^h32^m	1.48	6.25	1.00	31	4CB,6SH,2XN,1XO	9
11	MCBAL	23^h20^m–00^h20^m	1.00	5.50	1.09	9		9
Dec 12	MCBAL	00^h20^m–01^h20^m	1.00	5.50	1.32	9		7
12	ROGPA	00^h56^m–02^h00^m	1.07	6.45	1.00	46	2M,3CB,4SH,1XN,4XO	14
12	MCBAL	01^h40^m–02^h40^m	1.00	5.60	1.32	16		9
12	ROGPA	02^h00^m–03^h00^m	0.92	6.25	1.00	23	1M,3CB,4SH,3XN,1XO	7
12	MCBAL	02^h40^m–03^h40^m	1.00	5.60	1.00	11		5
12	ROGPA	03^h00^m–04^h00^m	1.00	6.20	1.00	24	4CB,2XN,3XO	27
12	ROGPA	04^h00^m–05^h00^m	0.92	6.10	1.00	42	1CB,1XO	19
12	ROGPA	05^h00^m–05^h38^m	0.63	6.00	1.00	21	2CB	9
12	ROGPA	17^h49^m–19^h00^m	0.89	6.25	1.00	6		9
12	MCBAL	20^h20^m–21^h20^m	1.00	5.50	1.04	14		6
12	MCBAL	21^h20^m–21^h50^m	0.50	5.50	1.45	5		5
12	ROGPA	22^h00^m–23^h00^m	0.97	6.15	1.49	30	2SH	9
12	ROGPA	23^h00^m–00^h00^m	1.00	6.25	1.11	50	1CB,2SH,1XO	8

Table 3 — continued

Date	Obs	Period (UT)	T_{eff}	Lm	F	Gem	Minor streams	Spor
Dec 13	ROGPA	00^h00^m–01^h00^m	1.00	6.45	1.00	59	2M,2CB,8SH,1XN,1XO	13
13	ROGPA	01^h00^m–01^h55^m	0.30	6.45	1.00	19	1CB,1SH,1XN	2
13	ROGPA	01^h55^m–03^h00^m	1.07	6.30	1.00	79	2M,3CB,9SH,1XN,2XO	14
13	ROGPA	03^h00^m–04^h00^m	1.00	6.30	1.00	79	2CB,4SH	12
13	ROGPA	04^h00^m–05^h00^m	1.00	6.35	1.00	54	1M,1CB,1XN	10
13	ROGPA	05^h00^m–05^h48^m	0.80	6.20	1.00	38	2CB,3XO	12
13	SWADA	10^h27^m–11^h27^m	1.00	5.50	1.25	31		6
13	ROGPA	17^h45^m–19^h00^m	1.25	6.25	1.00	13		9
13	ROGPA	19^h00^m–20^h00^m	0.89	6.25	1.00	17	2SH	5
13	MCBAL	19^h10^m–19^h45^m	0.50	5.40	2.60	0		1
13	ROGPA	20^h00^m–21^h00^m	0.68	6.25	1.00	41		9
13	ROGPA	21^h00^m–21^h45^m	0.75	6.35	1.00	53		4
13	TRIJO	21^h05^m–22^h05^m	1.00	5.00	1.10	27		1
13	TRIJO	22^h05^m–22^h17^m	0.20	5.10	1.00	12		0
13	TRIJO	22^h20^m–23^h20^m	1.00	5.20	1.00	38	2M	12
13	TRIJO	23^h20^m–00^h20^m	1.00	5.40	1.00	42		3
Dec 14	TRIJO	00^h20^m–01^h20^m	1.00	5.50	1.00	63	3M	7
14	TRIJO	01^h20^m–02^h20^m	1.00	5.50	1.00	35	1M,2SH	4
14	TRIJO	02^h20^m–03^h20^m	1.00	5.50	1.00	35	2SH	27
14	ROGPA	21^h52^m–23^h00^m	1.13	6.25	1.00	13	1CB,1SH	10
14	ROGPA	23^h00^m–00^h00^m	1.00	6.15	1.00	11	1CB,1SH	5
Dec 15	ROGPA	00^h00^m–01^h01^m	1.02	6.20	1.00	13		7

3. Zenithal Hourly Rate Data

ZHRs were computed according to the *IMO Handbook Visual Meteor Observations* and then averaged. The results are summerized in Table 4.

Table 4 — ZHR-values for the 1988 Geminids and corresponding HR-values for the sporadic background.

Date	$\lambda_\odot$	Nr. Obs	Gem	ZHR		Spor	HR	
Dec 04.97	252°51	2	1	1.4	± 1.9	15	18.1	± 1.7
06.94	254°51	7	5	2.5	3.2	42	22.7	15.7
07.19	254°76	2	2	3.0	4.2	20	42.1	7.6
07.93	255°51	3	6	7.0	3.6	7	8.7	4.3
08.18	255°76	3	4	4.4	5.2	4	5.0	5.7
08.91	256°51	3	6	9.0	9.8	4	5.5	1.9
09.16	256°76	1	4	19.5	19.5	1	5.4	5.4
10.88	258°51	5	34	14.4	7.1	32	10.2	5.2
11.13	258°76	7	51	16.6	5.9	34	13.5	12.1
11.87	259°51	6	81	21.9	16.5	44	12.8	9.6
12.11	259°76	10	232	43.6	18.4	105	21.5	10.4
12.36	260°01	1	21	71.1	71.1	8	22.0	22.0
12.85	260°51	2	80	80.9	1.9	17	16.0	6.1
13.10	260°76	8	408	81.7	12.8	80	14.6	4.6
13.35	261°01	3	123	92.0	19.2	28	18.4	5.8
13.59	261°26	1	31	113.0	113.0	6	22.5	22.5
13.83	261°51	6	191	105.6	60.8	33	17.4	14.8
14.08	261°76	5	213	126.4	36.6	51	33.4	30.3
14.81	262°51	2	24	17.5	0.9	15	9.4	3.0
15.06	262°76	3	37	17.5	0.7	22	9.5	2.2

Averages were computed with interval of 0°.33 and steps of 0°.25 in solar longitude. ZHRs that required a total correction factor larger than 5 were ignored.

The Geminid maximum was probably most prominent and impressive in Japan and Australia. Rates were already declining when European observers took over on December 13–14. The author stayed in Lardiers, Southern France, where a strong mistral wind made observing uncomfortable. Mistral winds however have the definite advantage of clearing out the sky perfectly. In addition, they area had an electricity black out at maximum night. The Milky Way could be seen from horizon to horizon. Unfortunately, the author felt ill after 4 hours of observing, and was forced to quit. It was the first time in 14 years that health failed him while observing. Only Murphy's Law can explain why such a thing had to coincide with both a splendid Geminid maximum and a perfectly dark sky! Moreover, the other sites used in this report had poorer sky conditions, introducing rather large corrections. More data definitely can clear up the picture!

4. Magnitude Distribution

The following table lists global magnitude distributions per observer for the Geminids only.

Table 5 — Global magnitude distributions per observer for the 1988 Geminids

Obs	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
MCBAL	0	1	3	11	9	8	15	10	1	0	58	1.90
TRIJO	1	6	11	16	30	49	86	75	21	0	295	2.59
ROGPA	0	1.5	5.5	14	54.5	136.5	295.5	235	95.5	1	839	3.13
SWADA	0	0	1	1.5	3	6.5	12	7	0	0	31	2.55

5. Conclusion

This report proves that fast reporting is possible because of *IMO* and its VMDB. All tables were transferred automatically from the VMDB to the text file of this *WGN*-article. More observations will only improve the value of reports like this, without causing any additional work but the input of the data.

The 1989 Quadrantids in Southern France

Paul Roggemans

An overview is given of the author's observations of the 1989 Quadrantids in the Haute-Provence, Southern France Activity was rather low. Around January 5, at least 18 meteors were seen apparently originating from a radiant coinciding with the August Perseid radiant.

The results presented here are from the author, observing in Lardiers, Southern France. As can be seen in Table 1, rates were very moderate, often strongly corrected because of the low elevation of the radiant. Meteor activity became enjoyable in the morning of January 3, but was already declining strongly in the night of January 3–4. There is no doubt that maximum must have occurred in the afternoon of January 3, somewhere between 14^h and 18^h UT.

Sporadic activity was extremely low and rather boring to observe, since not many meteors were seen. Minor showers were almost absent. The cold (−4 °C) made it hard to observe for longer periods. So regular rather long breaks were taken to warm up. Fortunately, the sky in the Haute-Provence was perfect once more, so even when there were only a few meteors to see, the beautifully dark starry sky provided some compensation.

Around January 5, 0^h UT, meteors, considered as sporadics, were noticed since, at first sight, they seemed to originate from the August Perseid radiant. At least 18 of these were seen some of which I plotted, including a nearly-point meteor. The radiant was determined at $\alpha = 54° \pm 4°$ and $\delta = +66° \pm 2°$. The meteors were comparable in speed to the δ-Aquarids and a little faster than the Geminids. If someone had a similar experience, please contact me (address on the inside of the back cover). If nobody saw this sort of meteors, it might have been a spurious radiant, caused by statistical randomness.

Table 1 — ZHR-values for the 1989 Quadrantids and corresponding HR-values, as seen by the author in Southern France.

Date	$\lambda_\odot$	Quad	ZHR	Spor	HR
Jan 1.78	280°68	1	8.8 ± 8.8	2	1.6 ± 1.1
1.86	280°76	0	0.0	5	4.2 1.9
1.97	280°87	1	4.1 4.1	8	6.2 2.2
Jan 2.01	280°91	5	41.5 ± 18.5	7	17.4 ± 6.6
2.06	280°96	3	7.8 4.5	7	8.1 3.1
2.10	281°00	3	7.6 4.4	3	4.6 2.7
2.77	281°65	1	10.0 10.0	6	5.9 2.4
2.81	281°70	1	21.9 21.9	8	9.4 3.3
2.89	281°78	2	27.3 19.3	6	5.8 2.4
2.94	281°82	2	16.9 12.0	2	2.2 1.6
2.99	281°87	7	22.6 8.5	9	7.1 2.4
Jan 3.09	281°98	26	38.1 ± 7.5	16	13.0 ± 3.3
3.15	282°03	19	36.3 8.3	10	13.9 4.4
Jan 4.02	283°08	6	25.0 ± 10.2	9	12.9 ± 4.3
4.09	283°15	6	16.4 6.7	7	10.8 4.1
4.13	283°19	9	21.8 7.3	3	5.0 2.9
4.76	283°83	0	0.0	3	4.2 2.4
4.88	283°96	0	0.0	12	10.4 3.0
4.97	284°05	0	0.0	12	13.9 4.0
Jan 5.02	284°10	0	0.0	10	11.8 ± 3.7
5.11	284°20	1	1.6 ± 1.6	11	11.4 3.4
5.76	284°86	0	0.0	6	8.2 3.4
5.89	284°98	0	0.0	8	7.0 2.5
5.94	285°03	0	0.0	5	6.2 2.8
5.98	285°08	0	0.0	7	9.1 3.4
Jan 6.10	285°20	0	0.0	7	15.1 ± 5.7

The 1987 Quadrantids in Maryland

Richard Taibi

On December 30–31 and January 3–4, I saw 40 Quadrantids:

Table 1 — Magnitude distributions of the 1987 Quadrantids in Maryland.

Shower	−6	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	Tot	$\overline{m}$
Qua	1	0	0	0	0	0	2	5	10	7	12	3	40	2.58
Spor	0	0	0	0	1	1	2	4	12	10	12	4	46	2.67

The Debris of Comet Grigg-Skjellerup in 1987 and 1988

The 1987 π-Puppids in Australia

Jeff Wood

Australian observations of the 1987 π-Puppids or Grigg-Skjellerupids show that this stream was virtually non active, unless there was a short sharp display between April 23, 14^h30^m and April 24, 9^h30^m UT.

Following good displays in 1977 and 1982, the return of comet P/Grigg-Skjellerup in 1987 was expected to produce another burst of strong activity from the Grigg-Skjellerup meteor stream. Although the time of maximum would see the radiant below the southern horizon in Australia, extensive plans were made to observe the stream pre and post maximum. The 1987 Grigg-Skjellerupid watch was to have covered the nights of April 19–20 to 26–27 inclusive. However, as is often the case, the weather stepped in and interfered somewhat with our plans. Pre-maximum, Western Australia was clear and much of the eastern states except around Melbourne was cloudy. This situation changed on April 23 when a huge low pressure system moved in and put paid to any further observation from the West. However, fortunately, the clouds cleared from eastern Australia and so we were at least able to get a complete daily coverage, though not as good as we would have liked.

Table 1 — Australian observations of the 1987 π-Puppids, also called Grigg-Skjellerupids.

Date	Obs	Loc	Period (UT)	Lm	Pup
Apr 19	RV	1	10^h05^m–11^h05^m	6.2	0
Apr 20	JG	2	11^h00^m–12^h00^m	6.0	0
20	FF	3	11^h25^m–13^h45^m	6.0	0
Apr 21	JG	2	11^h00^m–13^h00^m	6.1	1?
21	DF	4	11^h00^m–12^h00^m	6.1	0
21	MC	5	12^h00^m–13^h00^m	6.1	1?
21	JW	6	12^h00^m–13^h00^m	6.0	0
21	FF	3	12^h15^m–13^h15^m	6.0	0
Apr 22	JW	6	11^h00^m–12^h00^m	6.5	0
22	DF	6	11^h00^m–12^h00^m	6.5	0
22	BM	7	11^h20^m–12^h20^m	6.0	0
Apr 23	RM	8	09^h35^m–14^h25^m		0
23	GG	9	09^h35^m–14^h25^m		0
23	GJ	9	09^h35^m–14^h25^m		0
23	RV	1	10^h35^m–11^h35^m	6.2	0
23	FF	10	11^h40^m–12^h40^m	4.0	0
Apr 24	RM	8	09^h35^m–14^h25^m		0
24	GG	9	09^h35^m–14^h25^m		0
24	GJ	9	09^h35^m–14^h25^m		0
24	FF	10	12^h50^m–13^h20^m	3.0	0
Apr 25	SB	1	10^h30^m–11^h30^m	6.2	0
25	RH	10	12^h10^m–13^h10^m	5.6	0
25	RH	10	14^h45^m–15^h45^m	5.7	0
25	FF	10	12^h00^m–13^h30^m	4.0	1?

Twelve people participated watching for a total of 50 man hours of observing time:

Jeff Wood (JW), Darren Ferdinando (DW), Meeghan Clay (MC), Brian Macauley (BM), John Goldsmith (JG), Gordon Jones (GJ), Robert MacNaught (RM), Gordon Garradd (GG), Stephen Ball (SB), Russell Hall (RH) and Roger Vodicka (RV).

Observations took place at:

Noble Park, Victoria (1), Bedfordale, Western Australia (2), Merbein, Vic. (3), Maida Vale, W.A. (4), Armadale, W.A. (5), Ballajura, W.A. (6), Belmont, W.A. (7), Coonabarabran, New South Wales (8), Tamworth, N.S.W. (9) and Melbourne, Vic. (10).

The results show that the Grigg-Skjellerupids were virtually non-active in 1987 unless there was a short sharp display between April 23, 14^h30^m and April 24, 9^h30^m UT. In view of the fact that the 1977 and 1982 displays produced meteors over several days and that only 3 possible meteors were seen a couple of days before and after maximum, but not on the nights surrounding it, I believe the former position to be the case.

The 1988 π-Puppids in Australia

Jeff Wood

Contrary to 1987 when the π-Puppids or Grigg-Skjellerupids were virtually absent, a moderate Grigg-Skjellerupid activity was seen in 1988. In the morning hours of April 23 (April 22 21^h UT), several Grigg-Skjellerupid fireballs were seen although the radiant was well below the horizon, indicating that a sizable shower might have been in progress on the other side of the world.

After the failure to detect any π-Puppids or Grigg-Skjellerupids in 1987, Australian observers were pleasantly surprised with the activity shown in 1988, a non-comet year. The 1988 Grigg-Skjellerupid watch began on April 21–22 and finished on April 23–24 when no further observations could be made due to poor weather.

Table 1 — Australian observations of the 1988 π-Puppids, also called Grigg-Skjellerupids.

Date	Obs	Period (UT)	Lm	Pup	Date	Obs	Period (UT)	Lm	Pup
Apr 21	JW	12^h00^m–13^h00^m	6.5	1	Apr 22	GP	13^h10^m–14^h10^m	6.5	1
21	DF	12^h00^m–13^h00^m	6.5	0	22	JW	13^h10^m–14^h10^m	6.5	2
Apr 22	GP	11^h10^m–12^h10^m	6.5	1	22	MC	13^h10^m–14^h10^m	6.5	2
22	JW	11^h10^m–12^h10^m	6.5	2	22	GB	13^h10^m–14^h10^m	6.5	0
22	JL	11^h10^m–12^h10^m	6.5	1	22	GP	20^h30^m–21^h30^m	6.5	2
22	MC	11^h10^m–12^h10^m	6.5	3	22	JW	20^h30^m–21^h10^m	6.5	3
22	GB	11^h10^m–12^h10^m	6.5	2	22	JL	20^h30^m–21^h30^m	6.5	2
22	GP	12^h10^m–13^h10^m	6.5	1	22	GB	20^h30^m–21^h30^m	6.5	2
22	JW	12^h10^m–13^h10^m	6.5	1	Apr 23	JW	11^h20^m–12^h20^m	6.3	3
22	JL	12^h10^m–13^h10^m	6.5	1	23	CH	11^h20^m–12^h20^m	6.3	3
22	MC	12^h10^m–13^h10^m	6.5	0	23	JW	12^h20^m–13^h20^m	6.3	1
22	GB	12^h10^m–13^h10^m	6.5	1	23	CH	12^h20^m–13^h20^m	6.3	2

Over the three nights when observations were possible, 24 man hours of data was recorded by 9 observers. Those who took part were as follows:

Jeff Wood (JW), Darren Ferdinando (DF), George Platt (GP), John Liew (JL), Mark Glossop (MG), Michael Keating (MK), Martin Coroneos (MC), Guy Blackman (GB) and Craig Hinton (CH)

The data in Table 1 indicate that although rates were very low, there was indeed some Grigg-Skjellerupid activity in 1988. The biggest surprise we received was on the morning of April 23 when several Grigg-Skjellerupid fireballs were seen with the radiant some 15° below the southern horizon. This would seem to indicate that a sizable shower was in progress on the other side of the world. However, this was well and truly over by the time when darkness fell on April 23 as rates were only 1–3 meteors per hour. It will be interesting to see South American observations on April 22–23 in order to find out just how good the 1988 Grigg-Skjellerupid display really was.

Table 2 — Global magnitude distribution for the 1988 Geminids

Magnitude	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	Tot	$\overline{m}$
Number	4	0	4	1	2	3	7	11	5	0	37	1.22

Of the 21 Grigg-Skjellerupid meteors of magnitude +2 or brighter, 18 were yellow-orange and 3 orange-red in color. 6 meteors had a train; all were of short duration.

Spring 1988 Observations

Spring 1988 Observations in Alberta, Canada

Peter Brown

An overview is given of Spring 1988 observations by the author in Alberta, Canada. Observations of the Lyrid maximum were severely hampered by auroral display.

With winter drought conditions gripping much of Western Canada, the skies have been clear on a large number of nights, and nighttime temperatures have been absolutely balmy around −5 to −10° C. This has allowed several productive sessions for spring minor shower searches, and attempts at covering the Lyrid shower in April. While the weather has definitely been much better than past years, the aurora is beginning to become a real problem as sunspot activity and recurrent geomagnetic activity begin to rise again. This added factor has actually meant that an average number of dark, clear sessions have been had for this time of the year. Thus even though a great many days have been clear, many have been rendered useless due to aurora.

The first session of the 1988 observing year occurred on March 12–13, 1988, at the dark site, South of town. The air was slightly humid, and the limiting magnitude was about 0.1 below normal, at about 6.2. This session was particularly notable due to the appearance of a Camelopardalid late in the session. As well several δ-Leonids were noted throughout the night, while the Virginid complex managed to produce its usual meteor or two. The second session was also held at Maqua Lake, but was much shorter, due to auroral inference. The only truly notable observation was that of a Camelopardalid in the first hour. This brought my Camelopardalid total for the year to two, a new record, as in all past years I have managed to see only one.

After the next full moon, I began the 1988 Lyrid watch from Maqua Lake. On April 9–10, the first session in April turned out to be washed out by aurora. Nevertheless, a consistent Lyrid rate of about 1/hour was obtained. The next session, on April 16–17, was much longer and proved to be quite dark, and very nearly aurora free. Again a consistent Lyrid rate of 1/hour was observed. Several minor showers also proved somewhat active, with members of the φ-Bootids, α-Bootids and α-Scorpids being observed. While the low rates associated with these showers leave a large possibility of a mixup with the sporadic background, both the φ-Bootids and Camelopardalid geocentric velocities are low enough to be nearly certain of stream membership. The peak of the Lyrids was clear from Fort McMurray but coincided with a major magnetic storm. This lead to an almost complete wipe-out due to the aurora and low limiting magnitude values. A maximum rate of 5/hour was obtained on April 22–23 from 7^h00^m till 8^h00^m UT. No unusual activity was witnessed and no fireballs were seen.

The last couple of sessions on May 7–8 and May 13–14 were twilight ridden and had correspondingly low limiting magnitude values. In fact the only stream member observed throughout both these sessions was a −2 α-Bootid seen on May 13–14, under 5.9 skies.

Finnish Meteor Observations during Spring 1988

Teemu Hankamäki

An overview is given of Finnish observations of the 1988 Virginids and Lyrids. Bad weather conditions hampered observations severely.

Because of awful weather during the first three months of this year, only 24 observations were made; the results are listed in the tables below. We have observed only 319 meteors during spring, 63 of which were Lyrids, 34 Virginids and 222 sporadics. The mean magnitude of all the sporadics was 3.23. The 34 Virginids seen had an average magnitude of 2.76. 29.4% of them showed a train and 14.7% showed a color. The observers were:

Ismo Luukkonen (LUUIS), Hannu Määttänen (MAAHA), Markku Nissinen (NISMA), Petriina Paturi (PATPE), Leo Rajala (RAJLE), Pentti Ramberg (RAMPE), Markku Sihvonen (SIHMA), Vuokko Vuorinen (VUOVU).

Table 1 — Finnish observations during spring 1988.

Date	Obs	Period (UT)	T_{eff}	Lm	F	Vir	Lyr	Spor
Jan 07	RAJLE	21^h30^m–22^h30^m	0.91	5.75	1.25	0	0	10
Mar 04	RAJLE	16^h50^m–18^h15^m	1.38	5.52	1.00	0	0	9
18	NISMA	18^h48^m–20^h41^m	1.57	4.99	1.05	0	0	2
18	RAJLE	21^h45^m–22^h15^m	0.47	6.20	1.00	1	0	4
19	RAJLE	22^h30^m–01^h00^m	2.25	6.40	1.00	1	0	21
Apr 05	RAJLE	22^h00^m–00^h00^m	1.91	6.45	1.05	5	0	20
Apr 07	RAJLE	22^h15^m–22^h50^m	0.58	6.12	1.19	3	0	5
Apr 10	RAJLE	21^h10^m–23^h30^m	2.25	6.75	1.00	6	0	18
Apr 13	MAAHA	21^h00^m–21^h48^m	0.80	4.80	1.00	1	0	3
Apr 14	RAMPE	21^h05^m–23^h15^m	2.16	5.20	1.00	2	0	9
14	MAAHA	21^h15^m–23^h13^m	1.77	5.00	1.00	3	0	9
14	RAJLE	22^h00^m–00^h00^m	1.88	6.66	1.00	2	0	19
Apr 18	RAJLE	21^h25^m–01^h00^m	3.38	6.55	1.00	6	13	27
18	LUUIS	22^h14^m–00^h16^m	2.00	6.35	1.05	0	2	20
Apr 19	RAJLE	21^h30^m–23^h00^m	1.43	6.39	1.00	3	7	9
Apr 20	LUUIS	22^h22^m–23^h18^m	0.63	6.30	1.30	0	1	5
Apr 21	VUOVU	21^h00^m–22^h30^m	1.42	5.27	1.00	0	5	1
21	PATPE	21^h00^m–22^h30^m	1.42	6.10	1.00	0	5	1
21	NISMA	21^h22^m–23^h15^m	1.52	5.23	1.00	0	3	6
21	RAMPE	21^h30^m–23^h15^m	1.75	4.60	1.00	0	6	9
21	MAAHA	21^h40^m–23^h17^m	1.58	4.60	1.00	1	9	6
21	LUUIS	22^h27^m–22^h57^m	0.45	6.20	1.08	0	3	4
21	SIHMA	22^h30^m–00^h00^m	1.42	5.00	1.11	0	4	9
Apr 22	SIHMA	22^h30^m–23^h20^m	0.83	5.00	1.11	0	3	1

Table 2 — Global magnitude distributions of the 1988 Virginids and Lyrids and the sporadic background, as obtained from Finnish observations.

Shower	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Virginids	0	0	0	0	2	2	10	9	10	1	0	34	2.77
Lyrids	1	1	2	0	6	7	16	19	5	6	0	63	2.14
Sporadics	0	1	3	4	5	8	28	71	62	36	4	222	3.23

Amateur-Professional Cooperation in Astronomy

The IAU General Assembly in Baltimore

Colin Keay, Newcastle University, NSW

(This message by Dr. Keay, directed to the members of IAU Commission 22, was communicated to us by Dr. Olsson-Steel, Univ. of Adelaide, for publication in WGN, ed.) At the Closing Session of the 20th General Assembly of the International Astronomical Union in Baltimore, Maryland, it was resolved that the IAU,

- *recognizing* the long-standing tradition of excellent and practical collaboration which has existed between amateur and professional astronomers, particularly during the first seven decades of our Union's existence;
- *noting* that additional communication for common projects is needed today between amateurs and professionals;
- *recommends* that a Working Group be established to foster this cooperation;
- *and instructs* the General Secretary to communicate this proposal by national and international organizations both amateur and professional.

This resolution has, I believe, great significance for the future of Commission 22. It is evident, from research reported to the Commission, that amateur meteor observers are making an increasingly valuable contribution to meteor research through visual, photographic, video and radio observations.

In most countries of the world professional meteor research is suffering severe lack of funding and, more disastrously, manpower. The Soviet Union and Czechoslovakia are the major exceptions. It seems to me that our Commission discussions with the various amateur groups around the World, such as the Japanese Meteor Society, the Meteor Section of the British Astronomical Association, the American Meteor Society and the very active European groups. Many personal links have already been forged through the International Halley Watch.

You may know that the amateur groups themselves propose to set up an *International Meteor Organization*. If it can achieve the reputation and esteem from professionals enjoyed by the American Association of Variable Star Observers (AAVSO) and their international affiliates, it will greatly assist the objectives of our Commission. To what extent should Commission 22 become involved in this development? I would be very pleased to receive the views of Commission 22 members on this.

Founding members should not forget to return their voting bulletins no. 2!

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Don't miss it!

International Meteor Weekend 1989

Balatonszavszo, Hungary, September 7–10, 1989

From now on, registration forms can be obtained from the *Hungarian Amateur Astronomical Society (MACSIT), Pf [illegible] H-1387 Budapest, Hungary*. Accomodation will be provided in a hotel, 10 minu[illegible]rom Lake Balaton (two or four bed rooms, shower, etc.) The participation fee will be about 200 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 preceeding the conference,, which can be arranged within a stay of a week or so in Hungary.

Proceedings

International Meteor Weekend 1988

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