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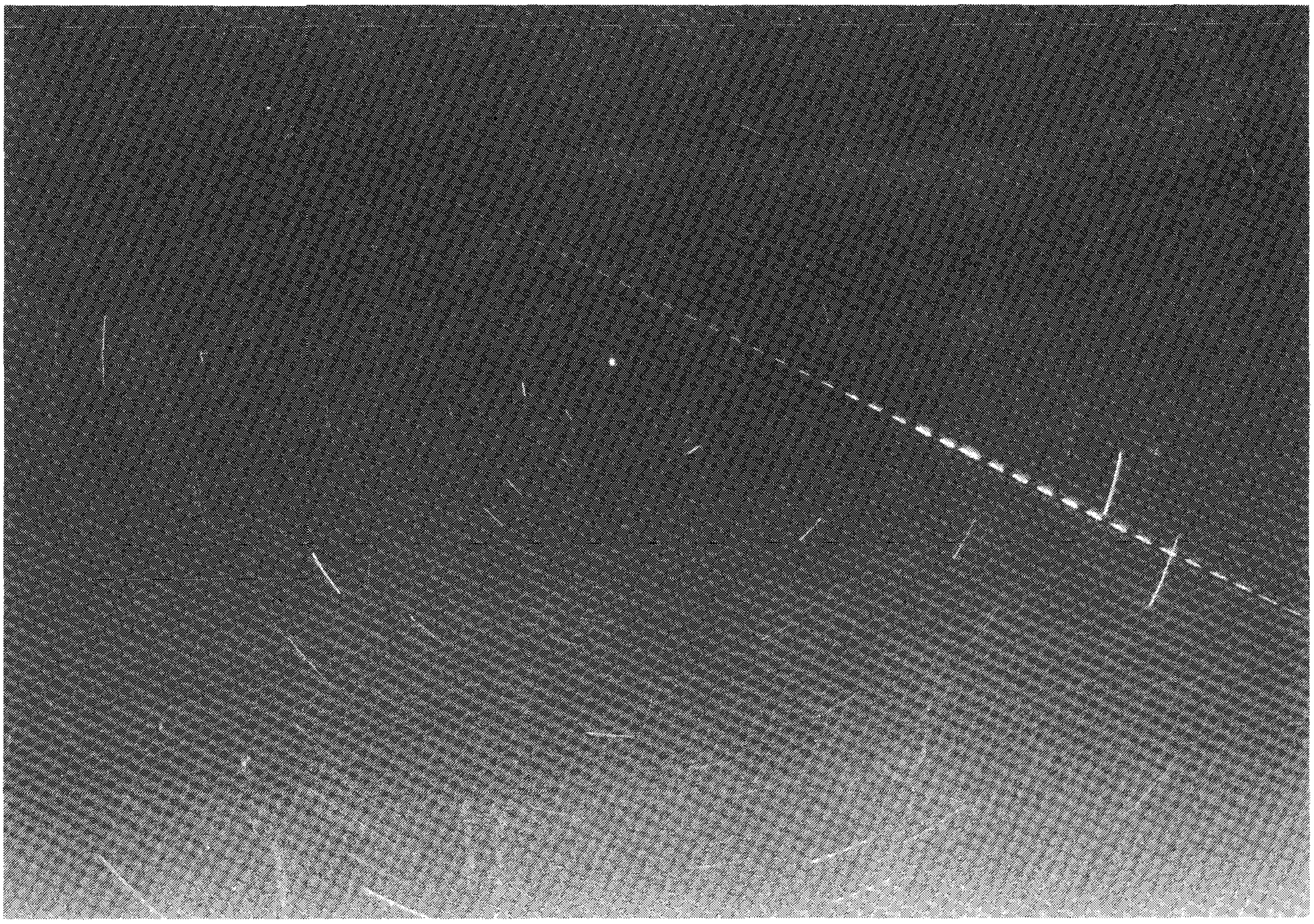
the international circular for meteor observers



This Taurid fireball was caught on November 4, between $4^h21^m00^s$ and $4^h50^m56^s$ UT with a 28 mm f/2.8 lens on HP5 400 ASA film, using a rotating shutter with 20 breaks per second by Noel White (UK).

In this issue:

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

v.u.: Paul Roggemans, Pijnboomstraat 25, B-2800 Mechelen, Belgium

Afgiftekantoor: 2800 Mechelen 3

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Useful Information

The February Issue *(WGN 17:1)*

This issue will be mailed in the first week of February. Contributions for the *February issue* are due by *January 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

All information can be found in *WGN* 16:5 on pp. 143–144 and in this issue on p. 178.

From the Editor-in-Chief

Marc Gyssens

As promised, this issue is considerably thicker than usual. We hope the extra pages compensate for the delay in the production process. At the end of a year, it is customary to look back for a while. In all honesty, I think meteor workers world wide may be satisfied with what has been accomplished during this year. Most important, the International Meteor Organization is a fact. Volume 16 of WGN contains a record number of pages. And the International Meteor Weekend in Oldenzaal, the Netherlands was a big success. All these realizations would have been utterly impossible if it were not for the ever increasing interest and, most importantly, activity of meteor workers all over the globe.

More activity however mercilessly implies more work for those involved in gathering, analyzing and publishing results. Therefore, automatization is not only desirable, but also a must in order to keep up with the growing flow of information. We already had the photographic Meteor Database on personal computer. Several other steps towards automatization were taken this year.

First, it was decided to produce WGN by text processing instead of ordinary typing. This allows potential authors of WGN to submit together with a print-out of their contribution an ASCII textfile on diskette (preferably $5\frac{1}{4}''$ *MSDOS or* $3\frac{1}{2}$ *Apple MacIntosh). If you have a personal computer, please do so; you save as a lot of time which can be used to produce thicker issues at more regular intervals, thus avoiding articles for publication to pile up because of lack of space. Professional astronomers or amateurs having an electronic mail connection on some computer system, can also send their contribution in that way; my e-mail address is* `prlb2!uiag!gyssens` *(uucp) or* `gyssens%uiag.uucp@BLEKUL60.BITNET` *(bitnet).*

Another form of automatization is presented in this issue: the Visual Meteor Database (VMDB) is a fact! VMDB will also be used to produce automatically the tables that are printed in WGN; this has already been partially done in this issue. Therefore, from now on, we will give the observer and observing site codes as they appear in VMDB. This makes it easier to make references if one wants some specific information from VMDB. Needless to say, VMDB being used for producing tables in WGN does not imply a quality seal of IMO on the observations these tables refer to. It is the policy of WGN to publish all reports meeting some elementary standards, such as compatibility with the IMO reporting form, completeness and the absence of striking inconsistencies. The editors however cannot be expected to be able to judge the experience of each observer. Therefore, we give these reports as they are; in particular, this holds for the minor stream information given by the observer.

Apart from VMDB, this issue of WGN also contains information on the Fireball Data Center (FIDAC) of IMO which is set up by the Arbeitskreis Meteore in the GDR. The majority of contributions in this issue, however, deal with the 1988 Perseids. We hope it contains something to everyone's taste: there are reports on visual, telescopic, photographic, video as well as radio work. As in the August issue, we included a booklet on IMO. It contains the results of the voting on the proposals in the previous questionnaire as well as some new and some modified proposals.

Meanwhile, 1989 is approaching. It will probably be of great significance for meteor astronomy: during the International Meteor Weekend in Hungary, for which an announcement is made on the back cover, the founding assembly of IMO will take place. More than ever, IMO will be a challenge to everyone concerned with the international coordination of amateur meteor work. It is our wish that you too may feel this challenge in 1989 and that you may find personal satisfaction and joy in your contributions to meteor astronomy, whether they consist of observations or are of a more theoretical nature, or both; from all of us, a happy New Year!

1989 WGN Subscription/IMO Membership Info

Marc Gyssens and Ann Schroyens

Unless you renew your subscription (or have already done so), this will be the last issue of *WGN* you receive! The subscription rate for volume 17 (1989) is 400 BEF, irrespective of where you live. If you live outside Europe, *WGN* will automatically be shipped to you by airmail. If you already sent us an application form for founding membership of *IMO*, then renewing your *WGN* subscription automatically yields renewal of your membership, unless explicitly required otherwise. If you have a subscription to *WGN* for 1988 and still wish to become a founding *IMO* member, just be very, very fast and send us the application form on the back of the booklet enclosed in the October issue! *After December 31, 1988* we do no longer grant founding membership!

All other renewals will be automatically considered as subscriptions by non-members. However, if you decide to become an *IMO*-member in the course of 1989, this is still possible. On simple demand, we will send you an associate membership application form. As a principle, associated membership will be converted to voting membership at the first occasion by the General Assembly.

Since it is our policy to keep the subscription rate for *WGN* as low as possible, it is most important to us that, after deduction of bank charges and/or exchange costs, we retain the full amount of 400 BEF. Therefore, we must raise the subscription rate in US dollar from 11 USD to 12 USD. Peter Brown also asked that people paying with a US personal check add another 2 dollar for bank charges. Of course, North Americans who already answered our call in the previous issue, will receive *WGN* without additional charges. For your convenience, we summarize the methods of payment again. Note that Japanese subscribers can pay through Masahiro Koseki.

You can pay your subscription/membership fee by:

- an *international postal money order*, made payable to *Ann Schroyens* (*not* to *WGN*, *IMO*, etc.);
- by a *transfer* from a postal giro account to the postal giro account of Ann Schroyens;
- by *Eurocheque*, provided:
  - the check is made payable to *Ann Schroyens* (*not* to *WGN*, *IMO* etc.);
  - the check is drawn in *Belgian francs*;
  - the check mentions a *Belgian city* as the place where the check was drawn;
  - your *Eurocheque card number* figures on the back of the check;
- *through George Spalding for British subscribers.* Please contact Mr. Spalding for further information;
- *through Peter Brown for North-American subscribers.* They can send him a postal money order or a personal check for 12 USD (or the equivalent in Canadian currency). US residents paying by personal check please add another 2 USD;
- *through Masahiro Koseki for Japanese subscribers.* Please contact Mr. Koseki for further information;
- in *cash* by sending to Ann Schroyens bank notes for the required amount. *USD Traveller's Cheques* are also accepted, provided 3 USD is added for each check used. Cash or Traveller's checks are sent at the subscriber's risk;
- by *bank check*, drawn in Belgian francs, made payable to Ann Schroyens, provided you specify explicitly to your bank that all charges for cashing the check are at your own expense.

Finally, something extra is always appreciated. All donations will be used to further improve *WGN* and *IMO*!

The Visual Meteor Database (VMDB)

Paul Roggemans

1. Introduction

Over the past few years several attempts were made to minimize the boring administration about observational results. Some people created programs and set up systems to register all observed meteors immediately into a computer, during observation. A problem with these systems was that all details on meteors had to be entered immediately, a rather painstaking job to do during an observation. Furthermore, this also required to have the hardware outdoors at night, where it was difficult to protect it for damage, cold, humidity, etc. For some groups (e.g. in Switzerland in 1980) the solution to this problem was feeding the data into the computer after observation. This tremendous work, however, discouraged several observers and the question arose whether or not we need to store individual data on meteors into a computer. Despite the wide variety of systems tried out over the past decade, none seemed to be generally applicable . The central coordinators of meteor groups and societies were facing the problem that thousands of meteors would consume too much memory, while little can be done with such data on individual meteors.

At the same time, international meteor work evolved and brought together ten thousands of meteor data, being used to study the density and mass variations through meteor streams. This involved ZHR computations over one hour meteor counts and magnitude distributions per night. These types of data were most suitable to analyze large quantities of observations brought together from interna- tional efforts. The data in these analyzes were already grouped in:

- hourly rate tables with the date, observing conditions and observed numbers of shower meteors per observer;
- magnitude distributions, per observer, per night and per shower.

Most of the time, only a programmable pocket calculator was used to perform all the calculations, a rather time consuming job as no data were stored on a file. For each operation all the numeric data had to be entered again on the calculator's keyboard. The results had to be noted on paper (because no printer was available) and sorted while transcribing the lists. For final publications, all the tabular data had to be typewritten; another time consuming job. It goes without saying that these procedures took months to be completed; there was no way to come up with results in a short period of time. The observers had to wait too long to see any results of their efforts.

From what we actually do with meteor observations, we may conclude that there is really no need to waste Megabytes of memory on individual meteors' information. For occasional double station computations based on visual meteors, or other similar calculations, separate programs can be used that require only input for meteors under investigation. The experience with the meteor expeditions in Southern France from 1984 onwards learned that observers only survive the administration involved in these observing projects when the observing routine was effective and limited to useful data. In 1986, an experimental visual observing form, filled out by the observers the day after using tape recordings of their observations, proved to enable fast data reporting. Some 20 000 meteors were reported on this form that year in a minimum of time.

In 1986, at the International Meteor Weekend in Hingene, Belgium 1986, European meteor workers agreed on a proposed standard for visual observations presented by George Spalding. Today, this method is published and widely used. It has been adopted by *IMO* and the experimental report form of 1986 became the regular *IMO visual* observing form of today, a standard used by most observers.

Within *IMO*, we expect to handle analyzes based on 100 000 meteors and more: a virtually impossible job for one person equipped with only a pocket calculator. From 1987 on, plans were made to create a *Visual Meteor Data Base (VMDB)*, a program that would enable fast input based on the agreements of Hingene 1986 and on the *IMO* reporting form: the partially reduced raw data contributed by the observers as summary reports.

The *VMDB* at its current stage "only" contains hourly rates and magnitude distributions. In order to prevent redundancy, several data files were created which all together define *VMDB*.

2. Setup of the radiant data file

We want to identify a meteor shower in an observation as easily as possible; Therefore, we created `RADIANT.DBF` with all information known so far on established meteor streams. Among other things, this file allows us to enter 15 Perseids as simple as `15 Per`, `Per` being a key to find all information about the Perseids in that file. The file `RADIANT.DBF` has the following structure:

RADIANT	C	20	"Perseids"	RADRIFT	N	4,2
SHOWTYP	C	3	"PER"	DECDRIFT	N	4,2
POSITIONRA	N	5,1	"46.0"	R	N	4,2
POSITIONDE	N	5,1	"+56.2"	ASCNODE	N	7,3
ACTIVSTART	C	5	"23/07"	ARGPERI	N	7,3
ACTIVEND	C	5	"23/08"	INCLIN	N	7,3
MAXIMUM	C	5	"12/08"	ECCEN	N	8,6
SOLARLONG	N	6,2	"139.25"	PERIDIS	N	8,6
VELOCITY	N	4,1	"59.4"	A	N	5
EPHEMERIS	C	15	"Aug.12 7h"	PERIOD	N	4

The current *VMDB* radiant file contains 60 radiants, and can be expanded at all times.

The first problem we had to solve in creating this file was the shower name abbreviation. Three characters were the absolute minimum, and enabled to use code names for major showers that are easy to remember. The radiant drift allows us to calculate the radiant position at the observing date, when comparing various sources of data.

We were astonished by the large differences in solar longitudes $\lambda_{\odot}$ (1950.0) given for the date of maximum meteor activity for each shower. It is obviously a challenge for *IMO* to clarify these differences, in order to be able to produce valid predictions for meteor shower maxima. The list with the shower abbreviations to be used on all summary reports has been reproduced here:

IMO code and name	R.A.	Dec.	Activity	Period
KSE κ Serpentids	230.0	18.0	01/04	07/04
DDR δ Draconids	281.0	68.0	28/03	17/04
BPA β Pavonids	308.0	-61.0	30/03	14/04
SLE σ Leonids	195.0	-5.0	21/03	13/05
LYR Lyrids April	271.4	33.6	20/04	23/04
PPU π Puppids	110.0	-45.0	16/04	25/04
MVI μ Virginids	221.0	-5.0	01/04	12/05
ABO α Bootids	218.0	19.0	14/04	12/05
FBO ϕ Bootids	240.0	51.0	16/04	12/05
ASC α Scorpiids	240.0	-22.0	11/04	12/05
ETA η Aquarids	335.6	-1.9	21/04	12/05
THE τ Herculids	228.0	39.0	19/05	14/06
CSC χ Scorpiids	247.0	-13.0	27/05	20/06
DAR Arietids Daytime	44.0	23.0	29/05	19/06

DDP ζ Perseids	62.0	23.0	01/06	17/06
LIB Librids	227.2	-28.3	08/06	09/06
SAG Sagittarids	304.0	-35.0	08/06	16/06
TOP θ Ophiuchids	267.0	-28.0	08/06	16/06
JLY June Lyrids	278.0	35.0	11/06	21/06
COR Corvids	191.9	-19.1	25/06	30/06
JBO Bootids June	219.0	49.0	28/06	28/06
DBT β Taurids Daytime	86.0	19.0	24/06	06/07
PHO Phoenicids July	31.1	-47.9	03/07	18/07
ACG α Cygnids	315.0	48.0	01/07	30/09
ODR o Draconids	271.0	59.0	07/07	24/07
SDA δ Aquarids South	333.1	-16.5	21/07	19/08
CAP α Capricornids	307.0	-10.0	15/07	10/08
SIA ι Aquarids South	333.3	-14.7	15/07	25/08
NDA δ Aquarids North	339.0	-5.0	14/07	25/08
PER Perseids	46.2	57.4	23/07	23/08
KCG κ Cygnids	286.0	59.0	09/08	06/10
NIA ι Aquarids North	327.0	-6.0	15/07	20/09
AUR Aurigids	84.6	42.0	01/09	01/09
SPI Piscids South	6.0	0.0	31/08	02/11
KAQ κ Aquarids	338.0	-5.0	11/09	28/09
SEX Sextantids Daytime	152.0	0.0	24/09	05/10
AND Andromedids Annual	20.0	34.0	25/09	12/11
GIA Giacobinids	262.1	54.1	09/10	09/10
NPI Piscids North	26.0	14.0	25/09	19/10
EGE ϵ Geminids	104.0	27.0	14/10	27/10
ORI Orionids	94.5	15.8	02/10	07/11
LMI Leo Minorids	162.0	37.0	22/10	24/10
STA Taurids South	50.5	13.6	15/09	26/11
NTA Taurids North	58.3	22.3	19/09	01/12
PEG Pegasids	335.0	21.0	29/10	12/11
LEO Leonids	152.3	22.2	14/11	21/11
PHO Phoenicids December	15.0	-55.0	05/12	05/12
ARI δ Arietids	52.0	22.0	08/12	14/12
ORN χ Orionids North	84.0	26.0	04/12	15/12
MON Monocerotids	99.8	14.0	27/11	17/12
HYD σ Hydrids	126.6	1.6	03/12	15/12
ORS χ Orionids South	85.0	16.0	07/12	14/12
GEM Geminids	112.3	32.5	04/12	16/12
URS Ursids	217.0	75.0	17/12	24/12
COM Coma Berenicids	175.0	25.0	12/12	23/01
QUA Quadrantids	230.1	48.5	01/01	04/01
DCA δ Cancrids	126.0	20.0	13/01	21/01
DLE δ Leonids	159.0	19.0	05/02	19/03
VIR Virginids	186.0	0.0	03/02	15/04
CAM Camelopardalids	118.7	68.3	14/03	07/04

3. Setup of the observers file

The information on observers can serve various jobs, e.g. also printing labels with addresses of *WGN* subscribers. Having only one file with addresses has the definite advantage that changes of address have to be recorded only once. An address file has been created with the following setup:

NAME	C	25	"Roggemans"
FIRSTNAME	C	15	"Paul"
STREET	C	25	"Pijnboomstraat"
BOXNUMBER	C	4	"25"
POSTCODE	C	8	"2800"
CITY	C	25	"Mechelen"
COUNTRYCOD	C	4	"B"
COUNTRY	C	20	"Belgium"
DATA	C	15	"WPV"
PHONE	C	12	"015 41 12 25"
INSTITUTE	C	25	""
BIRTHDATE	C	8	"13/10/58"
OBSERVER	C	5	"ROGPA"

An observer can be called using his *IMO* codename, in general composed by three characters of the last name and two characters of the first name. When a code is used twice, the input program warns for it and suggests to change the combination. The key fields OBSERVER and DATA are important in relation to several other files. The key field DATA contains characters such as W to indicate *WGN* subscription, V means a visual observer, P a photographer, T a telescopic and R a radio observer. Currently some 300 names are registered.

4. Set up for the location file

Most observing sites are used several times. To compute the zenith distance of radiants, we need the geographic coordinates of the place. We can overcome rewriting these over and over again by defining a code number for each site. A new site has to be entered only once and can be called on this key field. The file VMDBSITE.DBF has the following structure:

SITECODE	N	5	"134"	LATDEG	N	2	"59"
NAME	C	20	"Kongsberg"	LATMIN	N	2	"42"
COUNTRY	C	20	"Norway"	LATSEC	N	4,1	"20.0"
LONGITDEG	N	3	"9"	HEIGHT	N	4	"0180"
LONGITMIN	N	2	"35"	NORTSOUTH	C	1	"N"
LONGITSEC	N	4,1	"50.0"	OBSERVTYPE	C	5	"PV"
EASTWEST	C	1	"E"	IMOREF	C	6	"%NOR"

All would be perfect as long as the *VMDB* is not operated simultaneously at several places, when files with observers data and locations may be created with codes already used elsewhere. In that case, a "sub-*VMDB*" can be used by the central *VMDB* using VMDBSITE.DBF and OBSERVER.DBF under an alias name, defined in a key field IMOREF in the rate, magnitude and ZHR-files.

So far we have all we need to start with data input for observations. *VMDB* provides menu selections to call an input screen for facilitating data input in each of these files. For data input executed in sub-*VMDB*s by *IMO* coordinators, the main *VMDB* will be updated with these through programs that add only the new records. Whe hope the *VMDB* will be installed on about 10 PCs distributed over the world. One data center centralizes all the results and redistributes these to the sub-*VMDB*s. This way a reasonably up-to-date copy of all the files can be used by the *IMO*-responsibles running the sub-*VMDB*s. A distributed *VMDB* is also protection against the consequences of possible damage to the central *VMDB*.

It is very important that all cooperators report as many details as possible to complete the VMDBSITE.DBF and OBSERVER.DBF. Respecting the data structure is very important to prevent loss of time in transferring numbers from one format into another. For instance we enter a longitude in degrees, minutes and seconds, not in degrees and decimal degrees. Also, we do not like having to search in an atlas to obtain coordinates for some observing site.

5. Setup of the hourly rate data file

Most important are the hourly rate reports. Most often we get a series of observations of the same period and hence the same streams. A whole package of observing reports has to be entered into the computer with for each observation the same few meteor radiants to be taken into account. Before entering the whole bunch of hourly rates, the shower radiants in use will be defined by their code SHOWTYP. Up to six showers can be defined in the hourly rate file. One additional field can be used to enter a reference in **IMOREF** to identify a group of records that are related to each other. The input for the shower identification is grouped in a first screen. for control purposes, the full name of the shower corresponding with **SHOWTYP** appears on the screen when the input in this first stream is confirmed.

The file VMDBOBS.DBF has the following structure:

OBSERVER	C	5	"ROGPA"	SHOWER1	N	3	"10"	SHOWTYP1	C	3	"PER"
DDAY	C	2	"12"	SHOWER2	N	3	"5"	SHOWTYP2	C	3	"SDA"
DMONTH	C	2	"08"	SHOWER3	N	3	"2"	SHOWTYP3	C	3	"CAP"
DYEAR	C	2	"88"	SHOWER4	N	3	"1"	SHOWTYP4	C	3	"KCG"
BEGINUT	C	4	"2150"	SHOWER5	N	3	"0"	SHOWTYP5	C	3	" "
ENDUT	C	4	"2250"	SHOWER6	N	3	"0"	SHOWTYP6	C	3	" "
TEFF	N	5,2	"1.00"	SHOWERS	N	3	"0"	IMOREF	C	6	"%F"
CLOUDF	N	4,2	"1.11"	SPORADS	N	3	"8"				
LIMMAG	N	4,2	"6.35"	TOTAL	N	3	"26"				

```
                    3. Input of hourly rate data.
                    ============================

Observers'code  : [HEIBE] (99999)to exit)  Sitecode : [241  ]

Date (dd/mm/yy): [07]/[08]/[88]      Begin UT (hhmm) ; [2030] End UT (hhmm) : [2230]

Teff(h) : [0.42]                      F(Cloud): [1.00]  Limiting Magnitude   : [5.80]

  PER     ACG     KCG     CAP                     OTHERS   SPORADIC   TOTAL
  [ 6]    [ 1]    [ 2]    [ 1]                    [ 0]     [ 1]       [11]

BERND HEINRICH from G.D.R. observing at Schmergow in G.D.R.

  When this data is incorrect answer N to correct the input, if all is correct
  answer M to enter magnitudes, H to enter hourly rates : [ ] (N , M or H)
```

Figure 1 —The hourly rate input screen.

SHOWTYP is an important key to link VMDBOBS.DBF with RADIANT.DBF. As soon as the first screen is confirmed the second screen appears as shown in Figure 1. The user types HEIBE and the program consults OBSERVER.DBF to respond with the complete name of the observer. Next, the sitecode is entered which enables the program to consult VMDBSITE.DBF to return the name of the location. Then, the observing circumstances are entered; here it is very essential that the *IMO* standard reporting format is followed in order to avoid loss of time. The day of the date corresponds with the time at which the observation began, not the mean time of the observation. It is important to note that $T_{\rm eff}$ is given in hours and decimal hours (not in minutes) and that F is entered as cloud correction (not the percentage of sky that is covered). When everything is completed the question in the box at the bottom of the screen asks for confirmation.

At the level of screen input, several constraints are checks such as $T_{\rm eff}$ being not longer than the time interval between begin and end of the observation, the total number of meteors being correct, etc. In case of error seen by the user or found by the program, the screen is frozen with the input without any registration in the file VMDBOBS.DBF. When the input is correct(ed), there are two possibilities: if more hourly rates are to be entered, writing H in the bottom right space box reproduces the observer's code, sitecode and date, which are often the same in a series of hourly rates. Pressing *enter* confirms these; otherwise they can be overwritten. Writing M in the bottom right space box calls screen 3 to enter the magnitude distributions, related to the last hourly rate record entered. Much information is recovered from screen 2 so that actually only the number of shower meteors per magnitude class is required. The program presents a screen for each SHOWTYP and for the sporadic magnitude distribution. The data are compared with the previous input data and discrepancies are reported in an error box.

6. Setup of the magnitude distributions file

The magnitude distributions can be recorded by screen 3 either right after hourly rate input or directly. The first option is interesting if a magnitude distribution is given for each observing period. At the end of the magnitude distribution input, the program returns to the hourly rate input screen, ready to enter the hourly rates for the next observing interval. In case of global magnitude distributions a menu selection gives direct access to the magnitude distribution input screen. In this case some additional data will be required, that were otherwise recovered from the hourly rate input. required.

The computed average magnitude is given on the input screen which can be compared with the value given by the observer on his summary report, another additional control to prevent typing errors.

The file VMDBMAGN.DBF has the following structure:

OBSERVER	C	5	"ROGPA"	MAG1	N	6,1	"1.5"
DDAY	C	2	"12"	MAG2	N	6.1	"7.5"
DMONTH	C	2	"08"	MAG3	N	6.1	"14"
DYEAR	C	2	"88"	MAG4	N	6.1	"5"
MAG_6	N	6.1	"0"	MAG5	N	6.1	"2.5"
MAG_5	N	6.1	"0"	MAG6	N	6.1	"0"
MAG_4	N	6.1	"0"	MAG7	N	6.1	"0"
MAG_3	N	6.1	"0"	MEANMAG	N	5.3	"2.81"
MAG_2	N	6.1	"0"	TOT	N	5	"32"
MAG_1	N	6.1	"1"	LIMMAG	N	5.2	"6.1"
MAG_0	N	6.1	"0.5"	IMOREF	C	6	"FRANCE"
				R	N	4.2	

7. Setup of the ZHR results file

The file VMDBZHR.DBF is created by a menu selection that starts the ZHR program. Actually VMDBOBS.DBF is used as information source for the observations, RADIANT.DBF for the radiant position and VMDBSITE.DBF for the computation of the radiant elevation at the observing site. A 12 MHz speed on an IBM compatible PC produces 720 reduced observations in one hour and means no work at all for the analyst; the data with the ZHR for the shower, corresponding sporadic HRs and the solar longitude are automatically stored in a file generated by a *VMDB* program routine.

When all ZHRs are computed for the individual hour intervals, another menu selection will enable to define an extract from VMDBZHR.DBF,if necessary, and average the available ZHRs using a sliding mean with whatever step length and interval the user defines. This yields a smoothed ZHR distribution with averaged values and the corresponding standard deviations, as well as the date and solar longitude associated to the center of the observing interval used to derive the mean ZHR. Such a file can then be recovered e.g. to draw a graph using Lotus 123. There is no need in storing all ZHRs as they can be recomputed at any time from VMDBOBS.DBF.

VMDBZHR.DBF has the following structure:

YEAR	N	4	"1988"	ZHR	N	5,1	"64.3"
MONTH	C	3	"Aug"	ERRORZHR	N	5,1	"27.9"
DAY	N	5.2	"12.83"	HR	N	5.1	"27.9"
OBSERVER	C	5	"HEIBE"	SPORADIC	N	3	"13"
SITECODE	N	5	"241"	ERRORHR	N	5.1	"9.3"
SOLARLONG	N	7.3	"139.783"	SHOWTYP1	C	3	"PER"
SHOWER1	N	3	"259"	IMOREF	C	6	"GDRPER"

8. VMDB as the holiday assurance for IMO staff members

One main scepticism against *IMO* is that the amount of work involved would turn down the *IMO* officers very soon. Attempts to start a coordination of international meteor work failed in the past for such and other reasons. Some people started with a similar society, thinking that a few hours of work each week were sufficient. It is quiet obvious that an organization like *IMO* is a full time occupation preventing the responsible staff members to fulfill commitments in any other occupation.

More serious attempts were undertaken in the 60ties and 70ties with one big difference compared to today ... we have an arsenal of powerful PCs! *VMDB* does the work that would take me several months to complete in only 4 hours! The input is minimal; entering one observation takes us less time than it took the observer to write down his data on a sheet of paper.

In the past, publishing a massive amount of observing reports in *WGN*, required all these boring numbers to be typewritten! Today *WGN* has switched to text processing, using TEX. TEX is not a very popular software program, as the result is beautiful but a lot of rather complicated commands have to be inserted in tables to tell the machine (laser writer) where to draw a box, where to align or to center, etc. This time consuming job too is speeded up by *VMDB*. As soon as hourly rates and magnitude distributions are stored, we can select the data needed for an article in *WGN*.

Already in this issue of *WGN*, many of the tables were transferred by *VMDB* with human hands interfering only in the last stage to arrange the final lay out of *WGN*. long lists of numbers in this issue of *WGN* were typewritten by ... nobody but the PC and its *VMDB* programs. Finally, I have to comment that the present status of *VMDB* is far from complete; various other kinds of utilities will have to be added in the near future.

9. Conclusion

With this article, I hope that PC users will be encouraged to adapt their reporting format in order to standardize also the remaining small details. Local organizers are encouraged to create similar structures which can be easily added to *VMDB* later on. Finally I hope this article convinces those who still have doubts about *IMO*; the 60ties have passed and the technology of today makes possible what failed in past ventures.

On a Fireball Data Center (FIDAC) for IMO

André Knöfel and Jürgen Rendtel

Fireballs are impressive events. All observers wish to be outdoors at such occasions or to have their camera shutter opened. Although the interest in such observations is great, no data center exists. There are several catalogues of fireballs covering restricted periods or fireball data published in a few (astronomical) journals. The *Scientific Event Alert Network (SEAN)* Bulletin reports fireball sightings, but without being complete. Many compilations are not fully usable for statistical analysis. Other fireball centers in the past did not exist for longer periods, and their data are not available now, as far as we know.

Therefore we propose a *Fireball Data Center (FIDAC)* within *IMO*. Data of fireballs should be collected and managed here. We propose a fireball data form for actual observations which should be sent directly to *FIDAC*.

Furthermore we believe it would be useful to look through astronomical literature and include older data into the files. Data on fireballs are useful for different purposes:

- *identification* of photographed meteors (exact time);
- information concerning *color*, *trains*, *fragmentation* and *sound* which are hardly obtainable by other techniques.

As fireballs we take into account meteors of at least apparent magnitude −3. The following remarks should explain the information we want to include into the files:

- *date and time of the event:* We generally use UT: occasionally, that implies a correction of the date (compared to local time) In case of reports from other observers, especially outsiders, pay attention which time is used!
- *location and coordinates of the observing site:* use the customary designation of the location and add country, state, region, province, county, or district if necessary. Make your coordinates unambiguous by explicitly specifying E or W, respectively N or S!
- *coordinates of the apparent trail:* If possible give right ascension and declination. It is also possible to use azimuth[1] and elevation or other descriptions if right ascension and declination are not available. Give an estimation of the accuracy.
- *magnitude:* as far as possible use astronomical magnitude classes; if required note an interval. In case of observations by eye witnesses cite the comparisons they give and add a rough estimation (e.g. "much brighter than Venus"— estimation mag. −5 to −8);
- *duration:* duration of the observed trail in seconds;
- *color:* apparent color and its changes. Avoid vagueness in your description!
- *train:* if existent, note duration, color and brightness;

[1] Note that azimuth is measured counterclockwise. Mention always the direction corresponding to 0°, since there exist different conventions about this.

International Meteor Organization

Fireball Data Center

PSF 37
DDR-1561 Potsdam
German Democratic Republic

FIREBALL REPORT FORM

Date: __________ (year), __________ (month), _____ (day), _____^{h}_____^{m}_____^{s} UT

Location: ______________________________

Longitude: _____°_____′_____″ E/W   Latitude: _____°_____′_____″ N/S

Altitude: __________ meter

Apparent trail: begin: $\alpha =$ ________° $\delta =$ ________°

end: $\alpha =$ ________° $\delta =$ ________°

Description: apparent magnitude: ______________________________

duration: ______________________________

color: ______________________________

train: ______________________________

fragmentation: ______________________________

____

persistent train: ______________________________

angular velocity: __________°/s, or scale number: __________

sounds: description: ______________________________

time lapse: ______________________________

Observer and address: ______________________________

____

Source, reviewer: ______________________________

Additional remarks, sketches, drawings, etc.:

- *fragmentation:* number of fragments, location of the fragmentation (along the train), flight direction of (larger) fragments, brightness of fragments;
- *persistent train:* if existent, note duration and brightness, and position of longest duration;
- *angular velocity:* apparent velocity either in °/s or using the scale 0=stationary, 1=very slow, 2=slow, 3=medium, 4=fast, 5=very fast;
- *sounds:* note all perceptions according to your impression. Use comparisons (e.g. like snow-slip, supersonic sound, rustle, roar), and the time lapse between optical observation and the appearance of noise.
- *observer:* Complete address of the observer(s);
- *source or reviewer:* should be mentioned in the case of excerpts from literature or when passing on observations (e.g. of witnesses).

Even if it is not possible to give information concerning all data we would like to receive reports. Please, always indicate which data are certain and which are not. After treatment we place excerpts of data files at disposal upon request to all members of IMO for further analysis.

Please, send reports of fireballs to *Fireball Data Center, PSF 37, DDR-1561 Potsdam, German Democratic Republic.*

FM Radio Frequences in the USSR

Dirk Artoos

Below, I give a list of about 40 principal frequencies in the Soviet Union which can be used for radio meteor observing. It was not easy to obtain them! I give only those stations with a sending power of at least 4 kW and with frequencies between 65.90 and 70 MHz. I hope they will turn out to be useful!

Table 1 — List of 40 principal FM radio frequences in the Sviet Union which can be used for radio meteor observing.

ν (MHz)	Power	Transmitter	ν (MHz)	Power	Transmitter
65.90	4 kW	Batuni	67.85	4	Cesvaine
66.05	4 kW	Suchuni	67.91	4	Klaipeda
66.08	4 kW	Poltava	67.97	4	Tallinn
66.20	4 kW	Grodna	68.02	4	Riga
66.20	4 kW	Krasnodar	68.03	4	Viesintos
66.20	4 kW	Gomel	68.18	4	Kohtia-Jarve
66.29	4 kW	Cesvaine	68.24	4	Snieckus
66.35	4 kW	Klaipeda	68.27	4	Liepaja
66.47	4 kW	Viesintos	68.50	4	Kiev
66.56	4 kW	Slonio	68.60	4	Poltava
66.56	30 kW	Zamosc	68.78	4	Rezekne
66.68	4 kW	Valmiera	68.90	4	Grodna
66.95	4 kW	Rezekne	69.05	4	Vilnius
66.98	4 kW	Bielorussia	69.11	4	Klaipeda
67.04	4 kW	Gori	69.44	4	Slonia
67.10	4 kW	Pinsk	69.47	4	Kuidiga
67.13	4 kW	Klaipeda	69.50	4	Snieckus
67.48	4 kW	Babrujsk	69.59	4	Tiblisi
67.75	4 kW	Grodna	69.98	4	Grodna

Observers' Notes: January-February 1989

Jeff Wood

1. Introduction

Although early January begins with the major shower, the Quadrantids, this period has been characterized as one with low rates and so must therefore hold little of interest to the meteor observer. This attitude however, is based on a misconception. Even though rates may be low at times, there is still much to see as Southern Hemisphere observers and those in the Northern Hemisphere who have braved the winter weather, have discovered. Table 1 below lists ten of the more important showers that occur.

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

Shower	α	δ	Period	Max
Quadrantids	230°1	48°5	Dec 31–Jan 5	Jan 3
γ-Velids	125°	−47°	Dec 29–Jan 15	Jan 6–9
α-Crucids	188°	−63°	Jan 6–28	Several
δ-Cancrids	126°	+20°	Jan 13–21	Jan 16
α-Carinids	95°	−54°	Jan 24–Feb 9	Feb 1
α-Centaurids	210°	−59°	Jan 28–Feb 23	Feb 8
o-Centaurids	177°	−56°	Jan 31–Feb 19	Feb 12
δ-Leonids	159°	+19°	Feb 5–Mar 19	Feb 22
θ-Centaurids	210°	−40°	Jan 23–Mar 12	Several
η-Virginids	186°	−1°	Feb 3– Apr 15	Several

Table 2 — Moonlight and observing conditions in January-February 1989.

Date	k	Date	k
Friday December 30	0.61−	Friday February 3	0.14−
Friday January 6	0.04−	Friday February 10	0.19+
Friday January 13	0.32+	Friday February 17	0.88+
Friday January 20	0.96+	Friday February 24	0.90−
Friday January 27	0.78−	Friday March 3	0.28−

New Moon:	January 7, February 6, March 7
First Quarter:	January 14, February 12, March 14
Full Moon:	January 21, February 20, March 22
Last Quarter:	December 31, January 30, February 28

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

2. Quadrantids

The Quadrantids are only observable from the Northern Hemisphere and then in the last few hours before sunrise. Frequent poor weather has meant that data on this shower is rather scarce although its activity is comparable to that of the May η-Aquarids, August Perseids and the December Geminids. With favorable Moon conditions, observers are encouraged to brave the cold of winter and observe this shower in 1989.

3. Other showers

The γ-Velids are a Southern Hemisphere stream observable through the first half of January and reaching a broad maximum of 5 to 9 meteors per hour from January 6 to 9. The γ-Velids are medium speed meteors and are mostly blue, yellow and white in color. Few γ-Velid meteors leave a train, but those that do are often quite persistent. The γ-Velids will experience virtually no interference from the Moon in 1989.

The α-Crucids were first observed in the 1920's and 1930's by R. McIntosh anc C. Hoffmeister respectively. Despite being recorded so long ago, very little systematic study was done on it until the past decade. Studies indicate that the stream is active from January 6 to 28 and has several maxima that occur between January 12 and 20. Rates are generally of the order of 2 to 5 meteors per hour and can vary from year to year. In 1989, much of the α-Crucid's period of activity should be free of interference from the Moon.

Very little is known about the δ-Cancrids which can be seen from either hemisphere during mid January. The δ-Cancrids therefore need urgent attention from meteor observers and 1989 is a good time to start. The δ-Canrids are best seen during the early to middle part of the night. However from the middle of the maximum period onwards, there will be increasing interference from the Moon. Studies in the past indicate that the δ-Cancrids produce activity at maximum of 1 to 2 meteors per hour, though there is some evidence that rates are variable from year to year.

The α-Carinids are a virtually unknown Southern Hemisphere stream. They are active from January 24 to February 9 reaching a sharp maximum on February 1 of between 5 and 10 meteors per hour. Observations to date seem to indicate that this stream is quite variable and more research is urgently needed. 1989 promises to be a good time to view the α-Carinids it being best seen in the evening when the Last Quarter Moon is below the horizon.

Following the high activity of 1974 and 1980, we are overdue for another excellent display from the α-Centaurids and so 1989 could be the year this may happen. The New Moon on February 6 means that skies will be dark all night on February 8–9, the maximum of this stream. Even if an enhanced display does not occur, the α-Centaurids are still good viewing with 4 to 8 meteors per hour being seen in a normal year. α-Centaurid Meteors are often bright, colored yellow, blue or green, and leave a train.

The o-Centaurids, which radiate from just above Crux, the Southern Cross, are active over a similar time to the α-Centaurids and produces 3 to 5 meteors per hour of often bright yellow colored, trained meteors. The o-Centaurids reach maximum on February 12 and also have little interference from the Moon in 1989.

The δ-Leonids are a minor shower that occurs during February and March each year. Although Cook lists the δ-Leonids to reach maximum on February 26, it appears that it should be February 22. The δ-Leonids are a fairly weak stream with rates generally about 1 to 2 meteors per hour at best. The δ-Leonids are poorly placed Moon-wise in 1989.

The θ-Centaurids are a Southern Hemisphere stream very similar to the Taurids in terms of duration and activity. However, this is where the similarity ends with the θ-Centaurids possessing a much faster speed and having only one condensed center of radiation. The θ-Centaurids can be seen from January 23 to March 12 and appear to have several maxima in early, mid and late February. Maximum rates appear to be in the range of 4 to 7 meteors per hour. An unusual Characteristic of the θ-Centaurids are the number of meteors of magnitude -4 or brighter and the persistent trains they leave. One θ-Centaurid meteor seen in 1981 was of magnitude -16 at its brightest and left a naked-eye train that lasted for some 32 minutes.

Finally, the η-Virginids are one of the major components of the Virginid complex of radiants to be seen from February to April each year. The η-Virginids appear to have several maxima, one of which occurs towards the end of February. η-Virginid activity like the other components of the Virginid complex is very low usually being one meteor or less per hour. On very rare occasions it has been known to reach three meteors per hour, but this is the best that can be expected. Because of their long period of activity. the observer is urged to carry out a monitoring for at least some of this time.

4. Conclusion

Please submit all of your observations to your national or regional IMO representative. Individuals and groups are invited to send observational results to Paul Roggemans who will take care of combined analyses. 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!

The October Capricornid Meteor Stream

Jeff Wood

Observations of the October Capricornids between 1971 and 1987 are analyzed and discussed. The possible relationship with comet P/Honeda-Campos is examined.

1. Some history

The October Capricornids were first noticed in early October 1971 by Western Australian meteor observers Michael Buhagiar, Maurice Clark, Simon Dimmitt, Greg Kirczenow, Jean Schryver and Jim and Victor Bivoltsis. Over the period September 27–28 to October 11–12 of that year these observers plotted several weak radiants in the vicinity of α Capricorni. As these had never been recorded before, it was considered at the time that this was another of those spurious "streams" that often crop up during visual plotting programs and so was subsequently forgotten about until the great shower of the following year.

In the early evening of October 2–3, 1972 during a routine meteor watch, Dennis Rann and Derek Johns started noticing bright meteors streaking out of the sky in an area of Aquila near the Capricornus border. From 0^h00^m to 0^h35 UT, Derek plotted six shower members and noted two more while Dennis recorded a further two that Derek missed completely. Thus 10 meteors were seen in 35 minutes observing time by the two observers — quite an active shower!

At 0^h35^m UT cloud moved in as often is the case when an important even is on and prevented any further observations being made by Derek and Dennis. Derek therefore began ringing around to other observers in the hope that thy had clear skies so that the shower could be confirmed. Only the area in which Michael Buhagiar lived was clear and after being disturbed from his only TV night of the week, he was out viewing by about 0^h38^m UT. During the excitement of the discovery, Derek's instructions were not accurately received by Michael and he began searching for meteors from the Aquarius region rather than from the Aquila-Capricornus border. Consequently he saw little action with the only real reward for his efforts being a magnificent magnitude -2 fireball. When checking with Derek and Dennis the following day the mis-interpreted instructions came to light and a check of Michael's observing plots revealed two meteors coming from the radiant in question during two hours of observations, one of these being the -2 fireball. Consequently, it appears the best of the display was over before Michael went out to observe. However, the fact that the radiant had a Westerly aspect and so was out of view behind his head needs to be considered when making this conclusion because a significant proportion of any meteors occurring would have been missed by the observer. Certainly, though it was over by the following night as nothing was noted by Derek and Michael in three hours viewing that evening.

The 1972 display was notable for the brightness of the meteors seen. The average magnitude was a brilliant −0.12. Very few of the meteors left trains and most appeared to be fragmenting. The most common color was orange-yellow.

In the years following the 1972 display Michael Buhagiar's team kept a sharp lookout for the stream in the hope of seeing something like this again. Although nothing great was seen it became apparent that there was a weak annual stream that was active from at least October 1 to 4. Its apparent radiant was situated at $\alpha = 307°$ and $\delta = -8°$.

In 1977 a group began that would eventually coalesce into the *NAPO Meteor Section*. Although no observations were made of the stream that year, there has been data collected on the October Capricornids every year since albeit sometimes rather scanty. A search through the NAPO Meteor Section files reveals that there has never been another return like that of 1972, though on a couple of occasions rates have reached 3–4 meteors per hour (ZHR). The files also reveal that the October Capricornids are active for a much longer period than that found by Buhagiar's team, these being seen from Sep 21–22 to at least Oct 11–12.

2. The present time

This now brings us to the present time. In July 1987 a casual remark in a telephone conversation about comet Haneda-Campos and theoretical radiants by the author led David Seargent to conclude that this object may be the parent body of the October Capricornids. Although only observed on one perihelion passage in 1978, its calculated orbit indicated that it had reached perihelion previously in 1972 and that the Earth passes close to the orbit on September 28. Drummond [3] in his cometary meteor radiant list gives a theoretical radiant at $\alpha = 290°$ and $\delta = -5°$ for this date. This of course was some distance and time away from what had been observed and so fresh data was urgently required to verify the relationship.

Immediately the possible relationship had been noted, plans were made to observe the stream at its next appearance. A large group of observers were contacted and a camp was arranged at Yorkrakine, W.A. ($\lambda = 117°35'$ E, $\varphi = 31°22'$ S) from September 25 to October 5, 1987 to view the stream. Unfortunately, the weather and the Moon caused great interference to these plans and so observations were only possible on half of the days we were there. Nonetheless, much valuable data was obtained in regards to radiant position and the time of maximum.

3. Analysis of observational data

Table 1 — Mean ZHR-values for the October Capricornids observed in Australia between 1971 and 1987 (with exception of 1972).

Date	Mean ZHR	Nr. Obs.	Date	Mean ZHR	Nr. Obs.
Sep 21–22	0.2 ± 0.4	6	Oct 01–02	1.6 ± 1.0	7
23–24	0.5 ± 0.4	7	02–03	2.3 ± 1.2	18
24–25	0.4 ± 0.6	7	03–04	2.0 ± 1.5	6
25–26	0.3 ± 0.3	4	04–05	1.7 ± 0.8	6
26–27	0.5 ± 0.7	20	05–06	1.2 ± 0.4	20
27–28	0.7 ± 0.9	15	07–08	0.5 ± 0.6	6
28–29	0.6 ± 0.7	4	08–09	1.0 ± 0.5	7
29–30	0.7 ± 0.5	13	09–10	1.5 ± 0.8	13
30–31	0.9 ± 0.5	5	10–11	0.6 ± 0.5	9

The data of 1987 together with all the previous years' results except for 1972 will be treated as one in this following analysis.

From Table 1, we see that the October Capricornids are a weak stream, 1972 apart. Meteors can be first seen around September 21 and final activity ceases around October 12. A distinctive feature of the stream are two maxima. The first of these is on October 2–3 with a ZHR of 2.3 meteors per hour. This is in excellent agreement with the 1972 observations except the rates were much lower. The second maximum on October 9 – –10 with a ZHR of 1.5 meteors per hour was somewhat of a surprise finding and this will be discussed in detail in the following section.

Table 2 — Average magnitude distribution of the October Capricornids from Australian observations between 1971 and 1987 (with exception of 1972.

Magnitude	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Number	2	5	5	9	23	41	38	13	2	138	2.88

Apart from the 1972 display, a total of 138 reliable October Capricornid magnitude estimates have been recorded. Their average magnitude is 2.88 and the magnitude-numbers relationship r, derived using the Kresakova's [4] correction factors, is 2.81 for $0 \leq m \leq +5$.

Table 3 — Radiant positions for the October Capricornids.

Date	α	δ
Oct 02–03	301°.5	−08°.7
09–10	305°.4	−10°.3

Table 4 — Orbital elements for the October Capricornids

Data	Max 1	Max 2
Max	Oct 2.83	Oct 9.83
α	301°.5	305°.4
δ	−08°.7	−10°.3
P (yr)	7.0	7.5
a	3.65 AU	3.83 AU
e	0.73	0.74
q	0.99 AU	0.99 AU
i	2°.8	2°.1
Ω	189°.3	196°.2
ω	193°.2	191°.3
V_∞	15 km/s	15 km/s

Of 44 October Capricornids of magnitude +2 or brighter, 40.9% were yellow, 11.4% were orange, 2.3% were green and also 2.3% were yellow; the remaining 43.1% were white. Few October Capricornids leave trains. Of those reliably recorded, only 3.6% had a train.

Since 1972, a total of 27 October Capricornid radiant positions have been determined. These reveal that the radiant position changes with the date according to the following formulae:

$$\alpha = 0.559 \times D + 147.243$$

$$\delta = -0.227 \times D + 53.962$$

where D is the day of the year. From this we find that the positions of the radiant at the maxima are as in Table 3.

To calculate an orbit, we need the radiant position and a velocity determination. For the October Capricornids, the observed velocity must lie in the interval 11 to 18 km/s due to orbital requirements. I believe that a figure of 15 km/s is a reasonable approximation for calculation purposes. The results are shown in Table 4.

4. Is comet Haneda-Campos the parent body of the October Capricornids?

Applying the Southworth-Hawkins D-test for the above orbital elements gives a value of 0.19 which is just inside the association limit. When we consider this together with the fact a strong shower was seen in 1972, the year comet Haneda-Campos returned prior to its discovery, the evidence seems to point towards this Comet being the parent body of the October Capricornid meteor stream.

However, before we finally conclude that this is the case, we need to look at the double maximum. Often when we combine data over several years we can get spurious results especially when the rates are so variable. So we have to be careful in drawing conclusions. However, given that I have deliberately omitted the 1972 data as well as the fact that the second peak was recorded on more than one occasion, I believe this is a genuine characteristic of the stream's normal activity.

The fact that we have a double maximum indicates that the parent body laid down meteoroids on at least two different perihelion passages. If the October 2–3 peak was laid down in 1972 or thereabouts, the presumably the October 9–10 peak was laid down sometime prior to this date. This is where we run into problems in assuming Comet Haneda-Campos is the parent body. Belyaev, Kresak, Pittich and Pushkarev [2] have investigated the orbital evolution of this comet. They have found that the orbital elements have changed and are still changing rapidly. The change has been such that it has only been in the last 20 years or so that any association between the October Capricornids and comet Haneda-Campos was viable. Also, significantly the way the orbital elements have changed contradicts the assumption that the October 9–10 peak was laid down first.

Thus we need to keep an open mind as to whether or not comet Haneda-Campos is indeed the parent body of the October Capricornid meteor stream. What is needed to settle the case once and for all is to get improved radiant positions at maximum and to measure the velocity more accurately so that we can get a very precise orbit. Therefore, more observations are needed. The NAPO Meteor Section is planning to monitor the stream each year until this has been done.

References and further literature

[1] Buhagiar M.J., "Apparent Short Duration Meteor Shower", *Journ. Astron. Soc. of Western Australia*, November 1972, pp. 7–8.

[2] Belyaev N.A., Kresak L., Pittich E.M., Pushkarev A.N., "Catalogue of Short Period Comets", Astron. Inst., Slovak Academy of Sciences, Bratislava, 1986, pp. 316–317.

[3] Drummond J.D., "Earth orbit Approaching Comets and their Theoretical Meteor Radiants", *Icarus* 47, 1981, pp. 500-518.

[4] Kresakova M., "The Magnitude Distribution of Meteors in Meteor Streams", *Contr. Astron. Obs. Skalnate Pleso* 3, 1966, pp. 75–111.

[5] Seargent D.A.J., "A New Cometary Meteor Stream", *Southern Astronomy*, January 1988, pp. 22–23.

[6] Wood J.C., "Southern Hemisphere Meteor List", NAPO Meteor Section Observers Guide, 1982.

The 1988 Perseids

JAS Meteor Section Visual Results: 1988 Perseids

Alastair McBeath

A brief summary of naked-eye Perseid data produced by JAS Meteor Section members between 1988 August 5–6 and August 19–20 is presented. Although the time of shower maximum could not be accurately determined, peak activity may have been slightly lower than in recent years.

1. Introduction

JAS is an acronym for the *Junior Astronomical Society*, essentially a UK-based society for newcomers to amateur astronomy whatever their age. Although there are many inexperienced people in the Meteor Section, there is a central core comprising about ten experienced observers on whose data the bulk of this report is based. Most of these ten are also members of the British Astronomical Association's Meteor Section. Below is a listing of all active JAS observers and societies for the 1988 Perseid epoch. Observers are UK-based unless otherwise indicated.

> George Ackinclose (United Arab Emirates), Shaun Ankers, Roy Barclay, Neil Bone, Walter Bradford, Kevin Buckley, Andy Chapman, Norman Galloway, Shelagh Godwin et al., Guernsey Society Astronomical Section, Guildford Astronomical Society, Mark Harris, Terry Holmes, Sebastian Jay, Stephen Lagoe, Robert Leah (Western France), Richard Livingstone, Lee Macdonald (Ontario, Canada), Tony Markham, Alastair McBeath, John Mitton, Newbury Astronomical Society, Graham Pointer, Ian Rigney, Robin Scagell, George Spalding, Adrian Tighe, Martin Trotter, Sven Wair (Southern France), Christopher Willott et al., Simon Wragg, Kyriacos Xylaris (Cyprus).

Overall, 262.81 man-hours of visual observation were performed between 1988 August 5–6 and August 19–20 inclusive, during which time 3161 meteors (1913 Perseids) were seen, making this period the most successful for the Section since the summer of 1983.

2. Data analyses

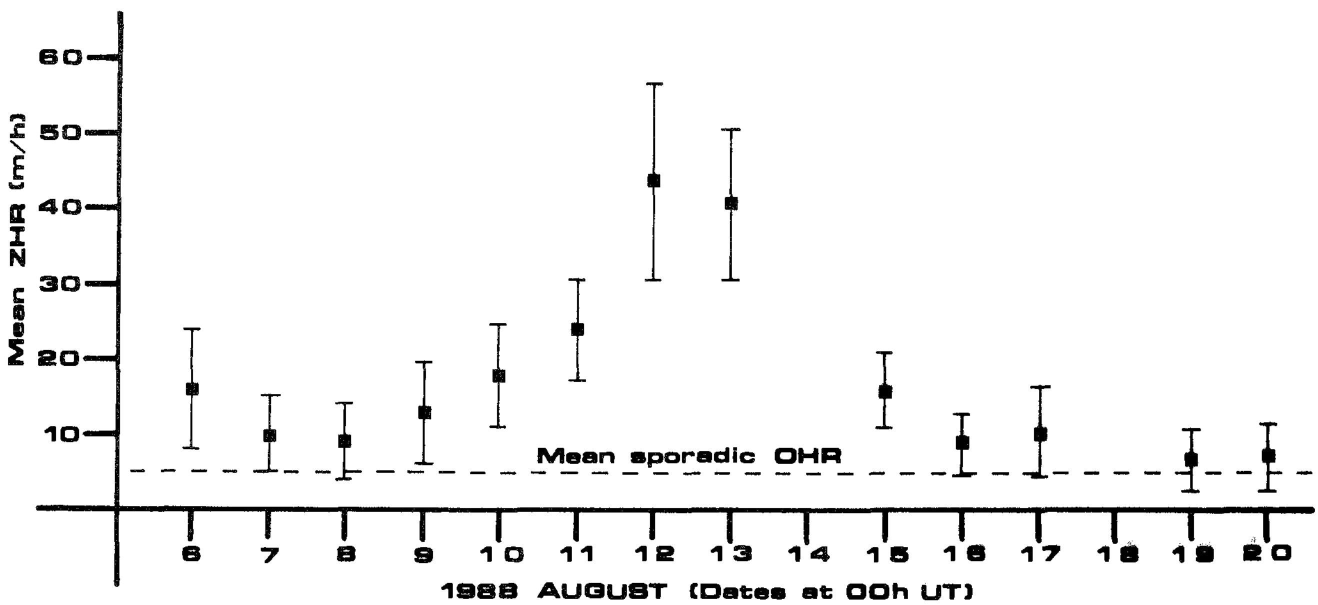

Figure 1 —Mean ZHR-values for the 1988 Perseids as derived from the JAS Meteor Section visual results.

Unless noted, all data used in the analyses was taken from watches performed by experienced observers under skies where the limiting magnitude was +5.5 or better (at best +6.3; mean value +5.73) and cloud obscuration was less than 20%.

Meteor rates

Zenithal Hourly Rate (ZHR) values were calculated for the Perseids using correction factors based on those in [1], but with an additional factor to allow for cloud cover, where necessary. Once computed, a mean Perseid ZHR was derived from data obtained between 22^{h}–02^{h} UT — the period when most observations were performed — for each night, where possible, to yield the simplified activity graph of Figure 1. A mean sporadic observed hourly rate (OHR) has also been plotted for comparison. This OHR has no correction factors applied to it, and for the period in question was 5.0 ± 0.3.

Magnitude distributions

These statistics are given for the Perseids and sporadics in Table 1.

Table 1 — Magnitude distributions of the 1988 Perseids and the sporadic background as obtained from the JAS Meteor Section visual results.

Shower	-5^{-}	−4	−3	−2	−1	0	+1	+2	+3	+4	$+5^{+}$	Tot	$\overline{m}$
Perseids	5	3	7	27	46	107	110	127	166	83	25	706	1.64
Sporadics	0	1	0	3	6	29	55	107	156	81	43	481	2.62

Train details

Table 2 presents the quantities of trained Perseids and Sporadics together with the mean durations of those trains for each magnitude class. Overall, 35% of Perseids and 5.4% of sporadics exhibited persistent trains.

Table 2 — 1988 Perseids and sporadics train details as obtained from the JAS Meteor Section visual results.

Mag	Perseids		Sporadics	
	Nr. trained meteors	Mean duration	Nr. trained meteors	Mean duration
-5^{-}	5	$6^{s}.2$	0	
−4	2	$4^{s}.7$	0	
−3	5	$4^{s}.1$	0	
−2	23	$2^{s}.3$	3	$2^{s}.2$
−1	38	$1^{s}.9$	2	$2^{s}.0$
0	71	$1^{s}.6$	6	$1^{s}.3$
+1	52	$1^{s}.3$	10	$1^{s}.0$
+2	38	$0^{s}.9$	5	$0^{s}.7$
+3	11	$0^{s}.8$	0	
+4	2	$0^{s}.5$	0	
Tot	247		26	

3. Discussion

The three analysis 2.1 to 2.3 give comparable results to those obtained by the JAS and BAA Meteor Sections from the UK for similar periods in previous years, implying a reasonably "normal" Perseid return in 1988. It is clear that the actual shower peak was missed, but that observations from August 11–12 were closer to that event than those from August 12–13, suggesting a maximum at some point between roughly 7^{h}–12^{h} UT on August 12.

Numerically, the Perseid ZHRs on August 11–12 and 12–13 showed no indication that an abnormally high or low maximum rate occurred, and an estimated value of perhaps 60–70 m/h can be inferred, which is slightly lower than either [2] or [3] suggests.

Acknowledgments

My grateful thanks are due to all the observers whose fine efforts have made this report possible.

References

[1] Spalding G.H., "The Activity of the Orionid Meteor Stream in 1985", *J. Brit. Astron. Assoc.* 98, 1, 1987, pp. 28–30.

[2] The Handbook of the British Astronomical Association 1988, *Brit. Astron. Assoc.*, London, 1987, p. 86.

[3] Kronk G.W., "Meteor Streams, A Descriptive Catalog", Enslow Publishers, Hillside, N.J., 1988, p. 162.

The 1988 Perseids in Florida (I)

Karl Simmons and Wanda Simmons

A report is presented on the observations carried out in Callahan, Florida, USA, during August 1988.

Weather cooperated very well this year, with ten observers seeing 1506 meteors in 75 hours and 12 minutes on ten different nights. The following observers participated in the efforts:

> Becky Kirkwood (KIRBE), John Kirkwood (KIRJO), Robert Kirkwood (KIRRO), Brian Simmons, Karl Simmons (SIMKA), Stephen Simmons, Wanda Simmons (SIMWA), Wendy Simmons (SIMWE), Richard Sweetsir (SWERI).

As usual the Perseid stream was brighter than the sporadic meteors seen, and a large percentage of Perseids left trains.

Table 1 — Average magnitudes and train percentages of the 1988 Perseids and the sporadic background in Florida.

Obs	Perseids			Sporadics		
	$\overline{m}$	Trains	Tot	$\overline{m}$	Trains	Tot
SIMKA	2.41	55.9%	202	3.20	11.1%	54
SIMWA	2.55	22.9%	245	3.12	2.0%	99
SWERI	2.20	51.9%	210	3.23	6.1%	115

Once again telescopic meteor observing was done with very poor results. The night before maximum and the night of Perseid maximum (Aug 11–12), the telescopic meteor rates with 7×50 binoculars ranged from 9 to 16% of that seen with the unaided eye. Because of this, no telescopic observing was done on Aug 12–13, the day after maximum. On Aug 10–11 the Perseid telescopic rate was 10% of the naked eye rate, overall telescopic rate being only 16% of the naked eye rate. On the morning of maximum (Aug 11–12), the Perseid telescopic rate was only 9% of the naked eye rate, and the overall telescopic rate 11% that of the naked eye rates.

The new Konica 3200 color film was used for meteor photography with one meteor per hour photographed on the date of maximum. Five to ten minute exposures proved satisfactory.

In Table 3, the following abbreviations are used for minor showers:

Table 2 — Abbreviations.

Shower	Abb.
δ-Aquarids	A
α-Capricornids	C
κ-Cygnids	K
υ-Pegasids	U

Table 3 — Observations of the 1988 Perseids and the sporadic background from Florida.

Date	Obs	Period (UT)	$T_{\rm eff}$	Lm	F	Per	Minor streams	Spor
Aug 03	SIMKA	03^h57^m–04^h17^m	0.33	4.00	1.00	0		0
Aug 07	KIRBE	04^h19^m–01^h20^m	1.01	6.50	1.00	3	2C	4
07	SIMWE	04^h19^m–05^h20^m	1.02	6.50	1.00	3	1C	3
07	SIMKA	04^h19^m–05^h20^m	1.01	6.50	1.00	4	1A,1C	3
07	SIMWA	04^h19^m–05^h29^m	1.15	6.50	1.00	2	1A,3C	3
Aug 09	SIMKA	03^h46^m–04^h46^m	1.00	6.00	1.25	5	1A	0
09	SIMWE	03^h46^m–04^h31^m	0.75	6.00	1.25	1		2
09	SIMWA	03^h46^m–04^h51^m	1.08	6.00	1.25	3	1A	3
Aug 10	SIMWA	03^h55^m–04^h55^m	1.00	6.00	1.00	3	2C	3
10	SIMKA	03^h55^m–04^h55^m	1.00	6.00	1.00	1	1C	1
10	KIRJO	03^h55^m–04^h55^m	1.00	6.00	1.00	3	1A,2C	2
10	KIRRO	03^h55^m–04^h55^m	1.00	6.00	1.00	2		3
10	KIRRO	04^h55^m–05^h55^m	1.00	6.50	1.00	15	1C	3
10	SIMWA	04^h55^m–05^h55^m	1.00	6.50	1.00	8	3A	6
10	SIMKA	04^h55^m–05^h55^m	0.92	6.50	1.00	6	1A,1C	5
10	KIRJO	04^h55^m–05^h55^m	1.00	6.50	1.00	9	2A,1C	5
Aug 11	SIMWA	04^h02^m–05^h02^m	1.00	6.50	1.00	7	1C	3
11	SIMKA	04^h02^m–05^h02^m	1.00	6.50	1.00	8	1C	1
11	SWERI	04^h02^m–05^h02^m	1.00	6.00	1.00	8	2C	5
11	SIMWE	04^h02^m–04^h40^m	0.63	6.50	1.00	6		3
11	SIMKA	05^h02^m–06^h02^m	1.00	6.50	1.00	18		6
11	SIMWA	05^h02^m–05^h47^m	0.75	6.50	1.00	5		5
11	SWERI	05^h02^m–06^h02^m	1.00	6.00	1.00	12		5
11	SWERI	06^h02^m–07^h02^m	1.00	6.00	1.00	14	2A,1C	4
11	SWERI	07^h02^m–07^h22^m	0.33	6.00	1.10	6	1A	3
Aug 12	KIRJO	03^h33^m–04^h33^m	1.00	6.50	1.00	18		3
12	KIRRO	03^h33^m–04^h33^m	1.00	6.50	1.00	16		3
12	SIMWE	03^h33^m–04^h33^m	1.00	6.50	1.00	11		12
12	SIMWA	03^h53^m–04^h53^m	1.00	6.50	1.00	19		7
12	SIMKA	04^h02^m–05^h02^m	1.00	6.50	1.00	16		5
12	KIRJO	04^h33^m–05^h33^m	1.00	6.50	1.00	18		12
12	KIRRO	04^h33^m–05^h33^m	1.00	6.50	1.00	16		13
12	KIRRO	04^h33^m–07^h00^m	0.43	6.50	1.00	12		4
12	SIMWE	04^h33^m–05^h33^m	1.00	6.50	1.00	13	1A	4
12	SIMWA	04^h53^m–05^h53^m	1.00	6.50	1.00	20	1A	6
12	SIMKA	05^h02^m–06^h02^m	1.00	6.50	1.00	15	2A,1C,1U	7
12	SWERI	05^h02^m–06^h02^m	1.00	6.50	1.00	14	2A,1C	14
12	SIMWE	05^h33^m–06^h33^m	1.00	6.50	1.00	19	1A	6
12	KIRJO	05^h33^m–06^h33^m	1.00	6.50	1.00	20		11

Table 3 — continued

Date	Obs	Period (UT)	T_{eff}	Lm	F	Per	Minor streams	Spor
Aug 12	KIRRO	05^h33^m–06^h33^m	1.00	6.50	1.00	22		7
12	SIMWA	05^h53^m–06^h53^m	1.00	6.50	1.00	25		5
12	SIMKA	06^h02^m–07^h02^m	1.00	6.50	1.00	28	1A	3
12	SWERI	06^h02^m–07^h02^m	1.00	6.50	1.00	28	1A	11
12	SIMWE	06^h33^m–07^h06^m	0.55	6.50	1.00	14	1C	2
12	KIRJO	06^h33^m–07^h00^m	0.45	6.50	1.00	10		5
12	SIMWA	06^h53^m–07^h53^m	1.00	6.50	1.00	37	1C	11
12	SWERI	07^h02^m–08^h02^m	1.00	6.50	1.00	33		19
12	SIMWE	07^h20^m–07^h35^m	0.25	6.50	1.00	10		6
12	SIMWA	07^h53^m–09^h03^m	1.16	6.50	1.10	46	1U	15
12	SWERI	08^h02^m–09^h02^m	1.00	6.50	1.00	40		12
12	SIMKA	08^h35^m–09^h02^m	0.45	6.50	1.10	28		5
Aug 13	SIMWE	04^h01^m–04^h45^m	0.73	6.50	1.00	5		7
13	SIMKA	04^h01^m–05^h01^m	1.00	6.50	1.00	13	1U	6
13	SIMWA	04^h01^m–05^h01^m	1.00	6.50	1.00	11	1U	8
13	SWERI	04^h38^m–05^h38^m	1.00	6.50	1.00	13	2C	10
13	SIMWA	05^h01^m–06^h01^m	1.00	6.50	1.00	19	3A,1C	8
13	SIMKA	05^h01^m–06^h01^m	1.00	6.50	1.00	19	3A,1C	4
13	SWERI	05^h38^m–06^h38^m	1.00	6.50	1.00	19		13
13	SIMKA	06^h01^m–07^h01^m	0.91	6.50	1.00	20	1A	3
13	SIMWA	06^h01^m–07^h01^m	1.00	6.50	1.00	17	1A	7
13	SWERI	06^h38^m–07^h33^m	0.91	6.50	1.00	22		18
13	SIMWE	06^h50^m–07^h20^m	0.50	6.50	1.00	15		1
13	SIMKA	07^h01^m–07^h34^m	0.55	6.50	1.00	33	1A,1C,1U	9
13	SIMWA	07^h01^m–07^h45^m	0.73	6.50	1.00	26		8
Aug 18	SIMWA	01^h55^m–02^h33^m	0.63	6.00	1.00	1		1
18	SIMWE	01^h55^m–02^h33^m	0.62	6.00	1.00	1	1C	2
18	SIMKA	01^h55^m–02^h33^m	0.52	6.00	1.00	1	1A	1
Aug 19	SIMWE	01^h30^m–02^h30^m	1.00	5.50	1.00	0	1K	1
19	SIMWA	01^h30^m–02^h30^m	1.00	5.50	1.00	1	1K	5
19	SIMKA	01^h30^m–02^h30^m	1.00	5.50	1.00	1	1K	3

Table 4 indicates Perseid maximum occurred on August 12 sometimes after 9^h UT. The average ZHR reached 65 around 9^h UT.

Table 4 — ZHR-values for the 1988 Perseids and corresponding HR-values of the sporadic background as obtained from observations in Florida.

Date	$\lambda_\odot$	Nr. Obs	Per	ZHR	Spor	HR
Aug 3.17	130.51	1	0	0.0	0	0.0
Aug 7.18	134.35	3	9	8.8 ± 3.5	9	2.8 ± 0.2
7.22	134.39	3	9	8.8 3.5	9	2.8 0.2
7.60	134.75	1	3	4.2 4.2	4	4.0 4.0
7.64	134.79	1	3	4.2 4.2	4	4.0 4.0
Aug 10.23	137.27	4	38	22.8 ± 8.8	19	4.8 ± 1.3
Aug 11.19	138.19	4	28	25.3 ± 10.0	14	4.8 ± 3.5
11.23	138.23	6	58	30.7 11.4	25	5.7 3.1
11.27	138.27	3	44	40.7 1.8	15	7.2 1.4
11.31	138.31	1	14	39.1 39.1	4	6.9 6.9

Table 4 — continued

Date	$\lambda_\odot$	Nr. Obs	Per	ZHR	Spor	HR
Aug 12.15	139.11	4	64	56.5 ± 11.2	25	6.3 ± 4.3
12.19	139.15	9	147	48.9 10.9	65	7.2 4.1
12.23	139.19	12	210	41.6 7.7	94	8.3 3.4
12.27	139.23	12	244	43.1 8.5	86	8.2 3.5
12.31	139.27	6	150	46.8 6.4	51	9.8 5.9
12.35	139.31	4	147	60.9 17.4	51	14.4 3.3
12.39	139.35	3	114	65.0 18.7	32	12.8 1.2
Aug 13.14	140.07	1	5	21.4 ± 21.4	7	9.9 ± 9.9
13.18	140.11	4	42	31.1 7.2	31	8.4 1.8
13.23	140.15	6	94	36.9 4.3	49	8.2 3.1
13.27	140.19	9	190	45.9 18.0	71	9.4 6.1
13.31	140.23	6	133	49.2 21.8	46	9.9 7.2
Aug 19.05	145.75	1	0	0.0	1	3.0 ± 3.0

One observer, Richard Sweetsir, summarized this year's display, "I'm kind of disappointed with the rates and lack of bright meteors this year." The authors can be contacted at their address, write or pay for the magazine *Meteor News*. (For more information, see p. 207 of this issue.)

The 1988 Perseids in Florida (II)

Norman W. McLeod III

A report is presented on the observations carried out by the author in Florida around the 1988 Perseid maximum.

The only clear nights here all summer were for the best of the Perseids. June and September were hot, hazy, and very dry. July and August were cloudy, wet, and cooler. (People could have come here to escape the heat wave that covered much of the United States.) Finally, I get a chance to say the Perseids were briefly better than (my) average. One freak hour had 73 Perseids, best since 1981, and the first of this type I have had from the Perseids. The second-best hour, right before the above, had only 49 but still rates as good. Rates were still good on August 12–13, and the following night showed signs of recovering from recent dismal levels. There were three minimal Perseid fireballs with nice trains of 10 to 15 seconds. The average for 367 Perseids in a 7.0 sky was 2.69, a bit brighter than usual. I did not see a great many faint Perseids, and magnitude +2 was dominant as always. Most other observers seem to have magnitude +4 as most common.

From reports arriving here so far, no one else was above (their) average rates. I had been thinking the maximum was due over Europe this year; perhaps leap-year maxima now occur here. The recent Orionids have become nearly equal with the Perseids for me. The two best Perseids hours restored rank two solidly in 1988, but still fall far short of the Geminids.

The sky over the Florida Keys has been completely ruined. Recent brief visits show that the number of lights has tripled since 1982, and every island is now lit from end to end. The fabulous Bahia Honda site is no longer either: The approach to our site on the end of the old bridge is covered with piles of rock. There is no suitable observing site left in the Keys. I suppose it does not really matter since the weather is no longer good anyway. Another deterrent is the premium room rates being charged by all the motels during lobster season which coincides with δ-Aquarids and Perseids. This began I quit going regularly.

In Table 2, the following abbreviations are used for minor showers:

Table 1 — Abbreviations.

Shower	Abb.
δ-Aquarids Nord	AN
δ-Aquarids South	AS
α-Capricornids	C
κ-Cygnids	K
υ-Pegasids	U
Eridanids	E

Table 2 — Observations of the 1988 Perseids and the sporadic background from Florida by Norman McLeod).

Date	Period (UT)	T_{eff}	Lm	F	Per	Minor streams	Spor
Aug 12	06^h26^m–07^h26^m	1.00	7.00	1.00	42	2AS,1C	3
12	07^h26^m–08^h26^m	1.00	7.00	1.00	49	2AN,2C,1U	7
12	08^h26^m–09^h26^m	1.00	7.00	1.00	73	1AN,1AS,1C,1K,1U	6
Aug 13	06^h26^m–07^h26^m	1.00	7.30	1.00	30	4AN,2AS,1C	6
13	07^h26^m–08^h26^m	1.00	7.30	1.00	41	2AN,2C	6
13	08^h26^m–09^h26^m	1.00	7.30	1.00	42	2AN,1C	12
13	09^h26^m–09^h49^m	0.38	7.00	1.00	12		1
Aug 14	06^h26^m–07^h26^m	1.00	7.40	1.00	13	1AS,2AN	8
14	07^h26^m–08^h26^m	1.00	7.40	1.00	23	3AN	7
14	08^h26^m–09^h26^m	1.00	7.40	1.00	24	1AS,1AN,1C,1K,1U,1E	7

The 1988 Perseids in Spain

José M. Trigo-Campoy Rodriguez

A report is presented on the observations carried out by the author in Spain around the 1988 Perseid maximum.

The 1988 summer observations by the author were quite successful. In Table 2, the following abbreviations are used for minor showers:

Table 1 — Abbreviations.

Shower	Abb.	Shower	Abb.
δ-Aquarids Nord	AN	α-Cygnids	AC
δ-Aquarids South	AS	Bootids	BO
ι-Aquarids South	IS	λ-Sagitarids	LS
α-Capricornids	C	ρ-Sagitarids	RS
κ-Cygnids	K	Piscis Austrinids	PA
υ-Pegasids	U		

Table 2 — Observations of the 1988 Perseids and the sporadic background from Spain by José Trigo-Campoy Rodriguez).

Date	Period (UT)	T_{eff}	Lm	F	Per	Minor streams	Spor
Jul 02	$21^h13^m–22^h13^m$	0.95	4.90	1.10	0		4
Jul 03	$22^h41^m–23^h13^m$	0.50	5.00	1.25	0		1
Jul 06	$01^h25^m–02^h25^m$	1.00	5.05	1.25	0	1IS	4
06	$20^h40^m–21^h40^m$	1.00	6.00	1.00	0	2AC	5
06	$21^h40^m–22^h40^m$	1.00	6.10	1.00	0	1AC,1LS	6
06	$22^h40^m–23^h40^m$	1.00	5.90	1.00	0	1RS	9
06	$23^h40^m–00^h40^m$	1.00	5.80	1.00	0	1C,1AC,1IS	12
Jul 07	$00^h40^m–01^h20^m$	0.65	5.70	1.00	0	1IS,1LS	7
Jul 09	$20^h40^m–21^h05^m$	0.40	5.40	1.25	0		5
09	$21^h15^m–22^h00^m$	0.75	6.10	1.10	0	1LS	4
09	$22^h00^m–23^h00^m$	1.00	6.50	1.00	1	1C	8
09	$23^h00^m–00^h00^m$	1.00	6.45	1.00	0	2C	7
Jul 10	$00^h30^m–01^h30^m$	1.00	6.40	1.10	0	3AS,1C	12
10	$01^h30^m–02^h30^m$	1.00	6.25	1.00	1	1AS	12
Jul 12	$20^h50^m–21^h41^m$	0.85	5.50	1.10	0		4
Jul 19	$20^h40^m–21^h40^m$	1.00	5.70	1.00	0		7
19	$21^h40^m–22^h40^m$	1.00	6.20	1.00	0	1C	8
19	$22^h40^m–23^h40^m$	1.00	6.20	1.00	0		4
19	$23^h40^m–00^h40^m$	1.00	6.30	1.00	2	2U	13
Jul 20	$00^h40^m–01^h40^m$	1.00	6.40	1.25	0	1AN,1C,3U	6
20	$01^h40^m–02^h40^m$	1.00	6.25	1.10	0	1AN,2U,1PA	9
20	$21^h10^m–22^h10^m$	1.00	6.05	1.00	0		10
20	$22^h10^m–23^h10^m$	1.00	6.40	1.00	0	1C	11
20	$23^h10^m–00^h10^m$	1.00	6.60	1.00	0	1AN,2U	9
Jul 21	$01^h40^m–02^h40^m$	1.00	6.60	1.00	2	1AN,2U,1PA	17
21	$02^h40^m–03^h40^m$	1.00	6.30	1.00	5	1AS,1C,1U	14
Aug 03	$22^h20^m–22^h52^m$	0.40	4.70	1.25	0		3
Aug 06	$20^h24^m–21^h24^m$	1.00	6.05	1.00	3	2BO,1U	3
06	$21^h25^m–22^h25^m$	1.00	6.50	1.00	4		7
06	$22^h25^m–23^h25^m$	1.00	6.50	1.00	6	2K,2U,1BO	6
06	$23^h25^m–00^h25^m$	1.00	6.35	1.00	12	1AN,2U	7
Aug 07	$00^h25^m–01^h25^m$	1.00	6.20	1.00	13	1K,1BO	7
07	$01^h25^m–02^h25^m$	1.00	6.10	1.00	16	1U,1BO	9
07	$02^h25^m–02^h50^m$	0.40	6.00	1.00	4	1C,1U,1BO	1
07	$20^h31^m–21^h31^m$	1.00	6.10	1.00	6	6K,1U	3
07	$21^h31^m–22^h31^m$	1.00	6.30	1.00	6	1BO	6
07	$22^h35^m–23^h35^m$	1.00	6.30	1.00	12	1K,2U	7
07	$23^h35^m–00^h35^m$	1.00	6.30	1.00	12		10
Aug 08	$00^h35^m–01^h05^m$	0.50	6.30	1.00	2	1C,1K	5
08	$20^h30^m–21^h30^m$	1.00	6.10	1.10	2	1K,1BO	3
08	$21^h30^m–22^h00^m$	0.50	4.50	2.00	1		1
Aug 09	$02^h00^m–03^h00^m$	1.00	6.20	1.00	39	2K,1U	2
09	$03^h00^m–03^h30^m$	0.50	6.05	1.00	4	01K,3U	10
09	$20^h30^m–21^h30^m$	1.00	6.20	1.00.	8	1C,1K,1AC	8
09	$21^h30^m–22^h30^m$	1.00	6.25	1.00	11	1AC	8
09	$22^h30^m–23^h30^m$	1.00	6.20	1.00	13	1C,1U,1AC	7

Table 2 — continued

Date	Period (UT)	T_{eff}	Lm	F	Per	Minor streams	Spor
Aug 09	23^h30^m–00^h30^m	1.00	6.20	1.00	20	1IS,1U	7
Aug 10	00^h30^m–01^h30^m	1.00	6.20	1.00	24	1U	5
10	01^h30^m–02^h30^m	1.00	6.20	1.00	22	1K,1U	8
10	02^h30^m–03^h30^m	1.00	6.20	1.00	27	1AC	14
10	20^h30^m–21^h30^m	1.00	6.10	1.00	12	1U,1BO	7
10	21^h30^m–22^h30^m	1.00	6.20	1.00	15	1C,4K,1U	3
10	22^h30^m–23^h30^m	1.00	6.20	1.00	25	2AN,3U	2
10	23^h30^m–00^h30^m	1.00	6.20	1.00	21	1C,3U,1BO	11
Aug 11	00^h30^m–01^h00^m	0.50	6.20	1.00	13	1U	5
11	01^h00^m–02^h00^m	1.00	6.20	1.00	48	3K,1U	11
11	02^h00^m–03^h00^m	1.00	6.20	1.00	80	3K,5U	7
11	03^h00^m–04^h00^m	1.00	5.80	1.00	69	1K,3U	14
11	20^h30^m–21^h00^m	0.50	6.50	1.00	13	1IS,1C,2K	2
11	21^h00^m–22^h00^m	1.00	6.80	1.00	55	5K,1U	4
11	22^h00^m–23^h00^m	1.00	6.80	1.00	59	4K,3U	5
11	23^h00^m–00^h00^m	1.00	6.80	1.00	69	2K,8U	2
Aug 12	00^h00^m–00^h15^m	0.25	6.80	1.00	26	1U	1
12	02^h48^m–03^h48^m	1.00	6.80	1.00	169	2U	6
12	03^h48^m–04^h00^m	0.20	5.80	1.00	18		3
12	22^h00^m–23^h00^m	1.00	6.30	1.00	38	1IS,1C,4U	3
12	23^h00^m–00^h00^m	1.00	6.25	1.00	43	2K,5U	4
Aug 13	02^h00^m–03^h00^m	1.00	6.20	1.00	49	1IS,5U	8
Aug 20	21^h30^m–22^h30^m	1.00	5.65	1.00	4	2K,1U	6

During the nights of August 10–11, 11–12 and 12–13, only visual *counts* were done, so as not to lose too many meteors while plotting the others. On August 11–12, the Perseid activity was rather spectacular, as show the 169 meteors counted in 1 hour.

Table 3 — Magnitude distributions of the 1988 Perseids as obtained from Spanish observations by José Trigo-Campoy Rodriguez.

Date	−7	−6	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Jul 10	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	2.50
20	0	0	0	0	0	0	0.5	0.5	0	0	1	1	0	0	3	2.17
21	0	0	0	0	0	0	0.5	1.5	0	0	3.5	1	0.5	0	7	2.36
Aug 07	0	0	0	1	0	2	0	1	1.5	8	13	15.5	13	2	57	3.23
08	0	0	0	0	0	3	2	1	1	1	12	9	9	1	39	3.03
09	0	0	0	0	1	0	2	2	2	10	20	14.5	3.5	0	55	2.77
10	0	1	2	0	1	3	5	4.5	2.5	20.5	31	37.5	22	1	131	2.84
11	1	0	1	1	1	6	5	22	17	44	78.5	71	34.5	2	284	2.73
12	0	0	0	1	0	4	10	22	26	47	70	84	98	47	409	3.46
13	0	0	0	0	0	4	3	3	6	16	32	32	29	7	132	3.32
21	0	0	0	0	0	0	0	0	0	0	1.5	2.5	1	0	5	3.90
Tot	1	1	3	3	3	22	28	57.5	56	147.5	263.5	268	210.5	60	1124	3.12

Of the 1124 Perseids observed, 309 showed a train.

At first sight, the 1988 Perseids peaked in the morning of August 12, when from 3^h UT on there was a sudden increase of activity (the interval 3^h18^m–3^h48^m UT, rendered more than

100 Perseids) which went on and got lost in the morning twilight. The author was surprised to have counted 169 meteors between 2^h48^m and 3^h48^m UT, which included 47 meteors of magnitude +6, thanks to the incredible limiting magnitude.

Table 4 — Magnitude distributions of the 1988 κ-Cygnids as obtained from Spanish observations by José Trigo-Campoy Rodriguez.

Date	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Aug 07	0	0	0	0	1	0	1	0	0	1	0	3	2.33
08	0	0	0	0	0	0	1	1	2	4	0	8	4.13
09	0	0	0	0	0	0	1	2	1	1.5	0.5	6	3.75
10	0	0	0	0	0	0	0	0	1	2.0	0	3	4.67
11	0	0	0	0	0	0	3	5	5	1	0	14	3.29
12	1	0	0	0	0	0	0	5	2	3	2	13	3.54
13	1	0	0	0	0	0	0	2	2	0	0	5	2.00
21	0	0	0	0	0	0	0	0	1	1	0	2	4.50
Tot	2	0	0	0	1	0	6	15	14	13.5	2.5	54	3.47

Of the 54 κ-Cygnids observed, 2 showed a train.

Below, we summarize the global magnitude distributions of some other streams.

Table 5 — Global magnitude distributions of minor showers as obtained from Spanish observations by José Trigo-Campoy Rodriguez.

Shower	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
AN	1	0	0	0	2	2	0	0	5	2.60
AS	0	0	0	2	2	3	1	1	9	3.67
IS	0	0	1	1	0	2	0	0	4	2.75
C	1	1	0	4	7	3	5	0	21	3.10
U	2	0	4	5.5	20.5	26	18	4	80	3.66
AC	1	0	0	1	1	3	3	0	9	3.44
BO	0	0	1	1	2	2.5	2.5	0	9	4.11

Finally, the magnitude distributions for the sporadic background are given in Table 6.

Table 6 — Magnitude distributions of the sporadic background during summer 1988 as obtained from Spanish observations by José Trigo-Campoy Rodriguez.

Date	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Jul 03	0	0	0	0	0	2	1	1	0	0	4	2.75
04	0	0	0	0	0	0	0	1	0	0	1	4.00
06	0	0	0	0	0	0	3	2	0	0	5	3.40
07	0	0	0	0	0	4	18	8	6	0	36	3.44
10	0	0	0	2	3	8	13	16	7	1	50	3.26
13	0	0	0	0	0	0	1	3	0	0	4	3.75
20	0	1	3	0	1	4	14	21	4	0	48	3.13
21	0	1	0	3	3	4	22	14	14	0	63	3.38
Aug 04	0	0	0	0	0	0	2	1	0	0	3	3.33
07	0	0	1	0	1	4	11	15	7	1	40	3.55
08	0	0	0	1	1	0	8	15	6	0	31	3.71
09	2	1	0	0	0	0	7	3	6	0	19	2.90
10	0	0	0	0	2	8	16	24	9	1	60	3.55
11	0	0	0	0	1	5	16	29	7	0	58	3.62
12	0	0	0	0	0	0	9	5	7	2	23	4.09
13	0	0	1	0	0	3	5	3	3	0	15	3.13
21	0	0	1	0	0	0	4	3	6	0	14	3.79
Tot	2	3	6	6	12	42	150	164	82	7	474	3.45

The 1988 Perseids in Italy

Enrico Stomeo

A preliminary report is presented on observations carried out in Italy around the 1988 Perseid maximum.

During the period August 9–13, 1988, 16 observers noted 1346 meteors during an effective observing time of 67.5 hours. Among these meteors, 1004 were Perseids. The following observers contributed to the 1988 Perseid campaign:

Sandro Baroni (BARSA), Luigi D'Argliano (D'ALU), Stefano Del Dotto (DELST), Maurizio Eltri (ELTMA), Roberto Gorelli (GORRO), Roberto Haver (HAVRO), Alberto Latini (LATAL), Massino Martini (MARMA), Dina Moro (MORDI), Giacomo Poleschi (POLGI), Edoardo Radice (RADED), Stefano Raffaelli (RAFST), Napoleone Scarpa (SCANA), Enrico Stomeo (STOEN), Stefano Stomeo (STOST), Emiliano Trizio (TRIEM).

Table 1 — Observations of the 1988 Perseids and the sporadic background from Italy.

Date	Obs	Period (UT)	$T_{\rm eff}$	Lm	F	Per	Spor
Aug 09	ELTMA	20^h44^m–21^h44^m	0.83	5.50	1.00	2	1
09	SCANA	20^h59^m–22^h29^m	1.26	5.80	1.00	6	7
Aug 10	BARSA	20^h30^m–21^h30^m	0.99	6.50	1.00	4	0
10	ELTMA	20^h35^m–22^h35^m	1.90	5.20	1.00	7	5
10	SCANA	21^h12^m–23^h12^m	1.32	5.20	1.00	5	7
10	STOST	21^h26^m–22^h26^m	0.73	5.70	1.00	4	5
10	BARSA	21^h31^m–22^h31^m	0.97	6.50	1.00	6	6
10	BARSA	22^h29^m–23^h29^m	0.97	6.50	1.00	9	2
10	HAVRO	23^h10^m–00^h10^m	0.86	6.30	1.00	3	10
10	D'ALU	23^h53^m–00^h53^m	0.92	5.70	1.00	11	3
Aug 11	HAVRO	00^h20^m–01^h20^m	0.83	6.30	1.00	9	6
11	HAVRO	01^h20^m–02^h20^m	0.82	6.30	1.00	9	7
11	ELTMA	20^h01^m–21^h01^m	0.52	5.30	1.00	6	1
11	STOST	20^h05^m–21^h05^m	0.78	6.20	1.00	15	5
11	STOEN	20^h13^m–21^h13^m	0.89	6.20	1.00	12	5
11	RADED	20^h30^m–21^h30^m	0.95	6.10	1.00	12	5
11	BARSA	20^h30^m–21^h30^m	1.00	6.10	1.00	7	6
11	MARMA	20^h36^m–22^h36^m	1.48	6.10	1.00	15	11
11	STOST	21^h11^m–22^h11^m	0.80	6.30	1.00	13	7
11	SCANA	21^h20^m–23^h20^m	1.59	5.30	1.67	6	4
11	RADED	21^h31^m–22^h31^m	0.93	6.10	1.00	22	3
11	BARSA	21^h31^m–22^h31^m	0.93	6.10	1.00	25	2
11	STOEN	21^h52^m–22^h52^m	0.75	6.20	1.00	18	4
11	HAVRO	22^h11^m–23^h11^m	0.83	6.50	1.00	21	10
11	STOST	22^h16^m–23^h16^m	0.77	6.40	1.00	22	6
11	RADED	22^h29^m–23^h29^m	0.93	6.10	1.00	23	4
11	BARSA	22^h29^m–23^h29^m	0.94	6.10	1.00	19	2
11	LATAL	22^h31^m–23^h31^m	0.63	6.10	1.11	14	3
11	STOEN	23^h11^m–00^h11^m	0.56	6.30	1.00	31	3
11	HAVRO	23^h20^m–00^h20^m	0.82	6.50	1.00	23	10
11	GORRO	23^h29^m–02^h29^m	2.24	6.20	1.00	76	15
11	STOST	23^h47^m–00^h47^m	0.94	6.40	1.00	27	6
12	STOST	01^h14^m–02^h14^m	0.59	6.30	1.00	23	1
Aug 12	SCANA	00^h29^m–01^h29^m	0.58	5.30	1.25	9	1
12	STOST	00^h31^m–01^h31^m	0.53	6.40	1.00	36	3
12	STOEN	00^h32^m–01^h32^m	0.72	6.30	1.00	33	3
12	HAVRO	00^h32^m–01^h32^m	0.78	6.50	1.00	28	12

Table 1 — continued

Date	Obs	Period (UT)	$T_{\rm eff}$	Lm	F	Per	Spor
Aug 12	HAVRO	01^h29^m–02^h29^m	0.81	6.50	1.00	29	5
12	STOEN	01^h29^m–02^h29^m	0.57	6.20	1.00	22	1
12	RAFST	19^h54^m–21^h54^m	1.12	5.00	1.25	10	3
12	POLGI	19^h54^m–21^h54^m	1.08	5.00	1.25	9	3
12	MORDI	20^h00^m–23^h20^m	2.52	5.33	1.28	6	8
12	BARSA	20^h30^m–21^h30^m	0.97	6.10	1.00	10	2
12	RADED	20^h30^m–21^h30^m	0.93	6.10	1.00	21	6
12	RADED	21^h30^m–22^h30^m	0.94	6.10	1.00	14	9
12	BARSA	21^h30^m–22^h30^m	0.95	6.10	1.00	13	4
12	D'ALU	22^h02^m–23^h02^m	0.86	5.70	1.11	16	4
12	DELST	22^h02^m–23^h02^m	0.91	5.70	1.11	7	4
12	BARSA	22^h29^m–23^h29^m	0.94	6.10	1.00	17	3
12	RADED	22^h29^m–23^h29^m	0.94	6.10	1.00	19	4
12	DELST	22^h33^m–01^h33^m	1.38	5.90	1.11	19	5
12	HAVRO	22^h59^m–23^h59^m	0.80	6.30	1.00	10	8
12	D'ALU	23^h10^m–00^h10^m	0.84	5.90	1.11	18	5
12	RADED	23^h30^m–00^h30^m	0.89	6.10	1.00	30	10
12	TRIEM	23^h32^m–00^h32^m	0.82	5.70	1.25	6	6
Aug 13	D'ALU	00^h01^m–01^h01^m	0.67	5.90	1.11	18	5
13	HAVRO	00^h12^m–01^h12^m	0.74	6.30	1.00	14	9
13	TRIEM	00^h13^m–02^h13^m	1.33	5.70	1.25	14	7
13	RADED	00^h55^m–01^h55^m	0.90	6.10	1.00	22	13
13	HAVRO	01^h10^m–02^h10^m	0.77	6.30	1.00	15	6
13	RADED	23^h26^m–00^h26^m	0.92	6.10	1.00	20	10
Aug 14	RADED	00^h49^m–01^h49^m	0.93	6.10	1.00	14	11

Table 2 — ZHR-values for the 1988 Perseids and corresponding HR-values of the sporadic background as obtained from Italian observations.

Date	$\lambda_\odot$	Obs	Per	ZHR	Spor	HR
Aug 09.88	136.°94	ELTMA	2	14.2 ± 10.0	1	3.6 ± 3.6
09.91	136.°96	SCANA	6	19.3 7.9	7	12.0 4.5
Aug 10.88	137.°89	BARSA	4	10.6 ± 5.3	0	0.0 0.0
10.90	137.°91	ELTMA	7	26.2 9.9	5	11.0 ± 4.9
10.91	137.°93	STOST	4	25.1 12.5	5	16.5 7.4
10.92	137.°93	BARSA	6	13.1 5.3	6	6.2 2.5
10.93	137.°94	SCANA	5	24.1 10.8	7	22.1 8.4
10.96	137.°97	BARSA	9	16.4 5.5	2	2.1 1.5
10.99	138.°00	HAVRO	3	6.6 3.8	10	14.5 4.6
Aug 11.02	138.°02	D'ALU	11	35.2 ± 10.6	3	7.9 ± 4.5
11.03	138.°04	HAVRO	9	17.2 5.7	6	9.0 3.7
11.08	138.°08	HAVRO	9	15.6 5.2	7	10.6 4.0
11.85	138.°83	ELTMA	6	92.3 37.7	1	7.2 7.2
11.86	138.°84	STOEN	12	51.1 14.7	5	7.8 3.5
11.86	138.°83	STOST	15	75.3 19.5	5	8.9 4.0
11.88	138.°85	BARSA	7	26.2 9.9	6	9.3 3.8
11.88	138.°85	RADED	12	47.2 13.6	5	8.2 3.7
11.90	138.°87	MARMA	15	33.4 8.6	11	11.5 3.5
11.90	138.°88	STOST	13	44.5 12.3	7	10.9 4.1
11.92	138.°89	BARSA	25	81.0 16.2	2	3.3 2.4

Table 2 — continued

Date	$\lambda_\odot$	Nr. Obs	Per	ZHR	Spor	HR
Aug 11.92	138°89	RADED	22	71.3 15.2	3	5.0 2.9
11.93	138°90	SCANA	6	35.2 14.4	4	15.7 7.9
11.93	138°90	STOEN	18	62.1 14.6	4	7.4 3.7
11.95	138°92	HAVRO	21	46.7 10.2	10	12.0 3.8
11.95	138°92	STOST	22	56.9 12.1	6	8.7 3.6
11.96	138°93	BARSA	19	50.8 11.7	2	3.3 2.3
11.96	138°93	LATAL	14	59.6 15.9	3	8.2 4.7
11.96	138°93	RADED	23	62.2 13.0	4	6.7 3.3
11.99	138°96	HAVRO	23	42.4 8.8	10	12.2 3.9
11.99	138°96	STOEN	31	102.9 18.5	3	6.7 3.9
Aug 12.01	138°98	STOST	27	44.6 ± 8.6	6	7.1 ± 2.9
12.04	139°01	GORRO	76	57.9 6.6	15	9.3 2.4
12.04	139°01	HAVRO	28	45.9 8.7	12	15.4 4.4
12.04	139°01	SCANA	9	73.1 24.4	1	8.1 8.1
12.04	139°01	STOEN	33	70.4 12.2	3	5.2 3.0
12.04	139°01	STOST	36	95.3 15.9	3	6.3 3.6
12.07	139°04	STOST	23	55.8 11.6	1	2.1 2.1
12.08	139°05	HAVRO	29	41.7 7.7	5	6.2 2.8
12.08	139°05	STOEN	22	59.2 12.6	1	2.4 2.4
12.87	139°80	POLGI	9	108.6 36.2	3	18.0 10.4
12.87	139°80	RAFST	10	116.3 36.8	3	17.4 10.0
12.88	139°81	BARSA	10	38.0 12.0	2	3.2 2.3
12.88	139°81	RADED	21	83.2 18.2	6	10.0 4.1
12.90	139°84	MORDI	6	18.6 7.6	8	14.7 5.2
12.92	139°85	BARSA	13	40.9 11.3	4	6.5 3.3
12.92	139°85	RADED	14	44.5 11.9	9	14.9 5.0
12.94	139°87	D'ALU	16	80.3 20.1	4	12.4 6.2
12.94	139°87	DELST	7	33.2 12.5	4	11.8 5.9
12.96	139°89	BARSA	17	44.9 10.9	3	5.0 2.9
12.96	139°89	RADED	19	50.2 11.5	4	6.6 3.3
12.98	139°91	HAVRO	10	23.7 7.5	8	12.5 4.4
12.99	139°92	D'ALU	18	63.4 14.9	5	12.8 5.7
Aug 13.00	139°93	DELST	19	38.5 ± 8.8	5	7.8 ± 3.5
13.00	139°93	RADED	30	71.3 13.0	10	17.4 5.5
13.00	139°93	TRIEM	6	26.6 10.9	6	22.0 9.0
13.02	139°95	D'ALU	18	69.9 16.5	5	16.0 7.2
13.03	139°96	HAVRO	14	30.0 8.0	9	15.2 5.1
13.05	139°98	TRIEM	14	33.2 8.9	7	15.8 6.0
13.06	139°99	RADED	22	43.2 9.2	13	22.4 6.2
13.07	140°00	HAVRO	15	27.9 7.2	6	9.7 4.0
Aug 14.00	140°89	RADED	20	46.0 ± 10.3	10	16.9 ± 5.3
14.05	140°94	RADED	14	26.7 7.1	11	18.4 5.5

Table 3 — Magnitude distributions of the 1988 Perseids as obtained from Italian observations.

Date	Obs	−6	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Aug 10	ELTMA	0	0	0	0	0	0	0	0	1	1	0	0	0	2	2.50
10	SCANA	0	0	0	0	0	1	0	0	2	3	0	0	0	6	2.00
Aug 11	D'ALU	0	0	0	0	1.5	1.5	0	0	1.5	3.5	3	0	0	11	1.91
11	ELTMA	0	0	0	0	0	0	0	3	1	1.5	1.5	0	0	7	2.21
11	HAVRO	0.5	1.5	0	0	0	0	3.5	1.5	0.5	1.5	4	6.5	1.5	21	2.57
11	SCANA	0	0	0	0	0	0	0	0	1	2	2	0	0	5	3.20
11	STOST	0	0	0	0	0	0	1.5	0.5	1	1	0	0	0	4	1.38
Aug 12	ELTMA	0	0	0	0	0	0	2	0	0	2.5	1.5	0	0	6	2.25
12	HAVRO	0	0	0	1.5	4	5.5	10.5	11	5.5	15	19	25	4	101	2.71
12	LATAL	0	0	1	0.5	0.5	1.5	3.5	3	4	0	0	0	0	14	0.21
12	MARMA	0	0	0	0	0	0	2	4	6	1	2	0	0	15	1.80
12	SCANA	0	0	0	0	0	2	0	2.5	4.5	5.5	0.5	0	0	15	1.87
12	STOEN	0	0	0	0	3	4	8.5	17.5	38	26.5	14.5	4	0	116	2.08
12	STOST	0	0	0	0	2	6	11.5	21	33	46.5	16	0	0	136	2.06
Aug 13	D'ALU	0	0	0	0	2.5	3.5	12.5	10	7.5	10	6	0	0	52	1.36
13	DELST	0	0	0	0	0	2.5	4.5	3	4	9.5	2.5	0	0	26	1.81
13	HAVRO	0	0	1	0	0.5	1.5	2.5	8.5	2	3.5	6.5	11.5	1.5	39	2.79
13	MORDI	0	0	0	0	0	0	1	0	1	3	1	0	0	6	2.50
13	TRIEM	0	0	0	0	0	2	1	5	9	3	0	0	0	20	1.50

Table 4 — Magnitude distributions of the sporadic background during the 1988 Perseids as obtained from Italian observations.

Date	Obs	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Aug 10	ELTMA	0	0	0	0	1	0	0	0	0	1	2.00
10	SCANA	0	0	0	2	1.5	3	0.5	0	0	7	2.29
Aug 11	D'ALU	0	0	1	0	0.5	0.5	1	0	0	3	2.17
11	ELTMA	0	0	2	0	0.5	2.5	0	0	0	5	1.70
11	HAVRO	0	0	2	1	3.5	4	3	6	3.5	23	3.61
11	SCANA	1	0	0	0	0	1.5	4.5	0	0	7	2.93
11	STOST	0	0	0	0	2	2.5	0.5	0	0	5	2.70
Aug 12	ELTMA	0	0	0	0	0	1	0	0	0	1	3.00
12	HAVRO	1	0	0	1	3	6	4	17.5	4.5	37	4.15
12	LATAL	0	0	0	0	0	2	1	0	0	3	3.33
12	MARMA	0	0	2	1	5	2	1	0	0	11	1.91
12	SCANA	0	0	0	0	1	3.5	0.5	0	0	5	2.90
12	STOEN	0	0	1	1	3.5	6.5	3.5	0.5	0	16	2.75
12	STOST	1	1	1	2.5	9	9.5	6	0	0	30	2.33
Aug 13	D'ALU	0.5	1.5	1	2	3.5	3.5	1.5	0.5	0	14	1.82
13	DELST	0	0	2	3	1.5	1.5	1	0	0	9	1.61
13	HAVRO	0	0	1	0	2	4	4.5	9.5	2	23	4.07
13	MORDI	0	0	0	4	0	2	2	0	0	8	2.25
13	TRIEM	0	0.5	1.5	4.5	7.5	0	0	0	0	14	1.36

The average magnitude of 602 Perseids was 2.11. The population index r, which stands for the increase in (real) number of Perseids $N(m)$ per magnitude class, was calculated from:

$$N(m) = 140 \times 2.22^m$$

for meteors between −2 and +5. The probabilities of perception $p(m)$ factors were all shifted for use with a limiting magnitude of 5.98. The time of maximum activity was computed and occurred at solar longitude $\lambda_\odot = 139\overset{\circ}{.}35$.

Table 5 — ZHR-values for the 1988 Perseids and HR-values for the sporadic background as obtained from Italian observations, averaged using a sliding mean.

Date	$\lambda_\odot$	Nr. Obs	Per	ZHR	Spor	HR
Aug 09.91	136°96	1	6	19.3 ± 19.3	7	12 ± 12
Aug 10.91	137.92	4	22	18.5 7.8	18	9.8 9.3
10.99	138.00	4	32	18.9 11.9	21	8.4 5.1
Aug 11.07	138.08	2	18	16.4 ± 1.1	13	9.8 ± 1.1
11.82	138.80	1	12	51.1 51.1	5	7.8 7.8
11.90	138.88	12	209	52.8 15.2	65	7.8 2.9
11.99	138.96	9	256	58.2 18.2	59	8.2 2.8
Aug 12.07	139°04	7	247	60.9 ± 17.8	40	6.7 ± 4.6
12.91	139°84	8	107	44.2 18.5	40	9.1 4.4
12.99	139°92	10	158	45.2 ± 17.9	59	12.7 5.2
Aug 13.07	140°00	5	83	40.8 ± 17.3	40	15.8 ± 4.5
13.99	140°88	1	20	46 46.0	10	16.9 16.9

Telescopic Observations of the 1988 Perseids in France

Mark Vints

Between August 6 and August 20, 1988, Perseids were observed with 10 × 50 binoculars during an observation campaign in Southern France.

A team of Belgian, Dutch and French meteor amateurs gathered in Lardiers in the south of France to observe the 1988 Perseids in the period of August 6–20. Observations were done visually, photographically, using an image intensifying video system, and telescopically. This article reports on the telescopic results.

Table 1 — Telescopic 1988 Perseids and κ-Cygnids observations by Mark Vints.

Date	Period (UT)	$T_{\rm eff}$	Lm	Per	Cyg	Spor
Aug 06–07	22^h15^m–23^h45^m	0.77	9.5	1	–	4
07–08	21^h00^m–01^h03^m	1.87	9.5	2	–	7
08–09	22^h22^m–00^h30^m	1.18	9.6	1	–	7
09–10	20^h30^m–02^h02^m	2.95	9.5	1	–	12
10–11	21^h00^m–02^h00^m	2.88	9.3	4	–	9
11–12	21^h43^m–23^h35^m	0.90	8.3	2	–	4
12–13	20^h30^m–02^h20^m	3.15	9.7	8	–	15
13–14	20^h30^m–02^h25^m	3.35	9.9	3	–	27
14–15	21^h10^m–23^h47^m	1.48	9.8	1	–	10
14–15	00^h35^m–03^h05^m	1.60	10.0	–	1	10
15–16	21^h15^m–22^h00^m	0.57	9.5	1	–	2
15–16	00^h30^m–00^h55^m	0.37	9.5	–	1	2
17–18	21^h40^m–00^h00^m	1.53	9.3	1	–	8
17–18	00^h20^m–01^h00^m	0.47	9.5	–	0	2
18–19	22^h00^m–01^h00^m	1.52	8.8	1	–	8
18–19	01^h50^m–03^h17^m	1.08	9.5	–	1	6

Telescopic observations were carried out with a pair of 10 × 50 binoculars (5° field) on 12 different nights during a total of over 25 hours net observing time. Two fields were chosen in close vicinity to the radiants: one at $\alpha = 27°$ and $\delta = +60°$ (near α Cas), and the other at $\alpha = 44°$ and $\delta = +53°$ (τ Per). The maps of these fields were drawn from the *Uranometria* 2000.0 atlas. During the last days of the campaign some time was spent looking for κ-Cygnids, on a field centered at $\alpha = 285°$ and $\delta = +52°$. Three possible κ-Cygnids were seen; they were faint and slow. All observational data are combined in Table 1.

It is clear from Table 1 that the large majority of meteors seen are sporadics, even at the maximum of Perseid activity. This agrees well with reports in the literature, e.g. [1], and personal observations over the past few years.

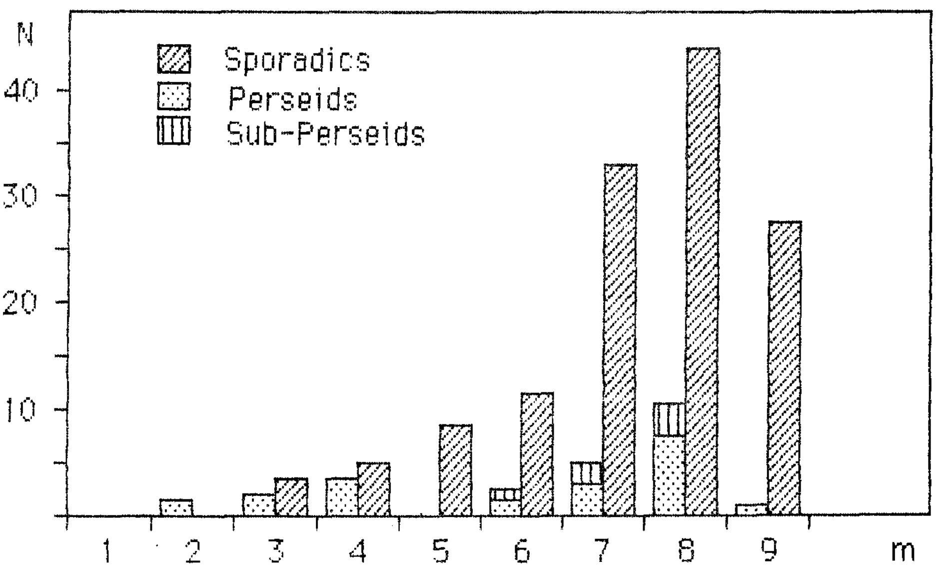

Figure 1 —Magnitude distribution of telescopic Perseids and sporadics as observed by Mark Vints in August 1988.

Figure 1 shows the magnitude distribution of all sporadics and Perseids. The three possible κ-Cygnids were of magnitude 9, 8 and 8 respectively and are not shown in the graph. The designation "Sub-Perseids" refers to six meteors seen on August 12–13 which might belong to a Perseid subradiant, as was reported in the previous issue [2]. The graph clearly shows the lack of Perseids in the faint magnitude region.

References

[1] Kresákova M., "On the Presence of Faint Meteors within the Perseid Stream", *Bull. Astron. Inst. Czechoslovakia 9*, 1958, pp. 82–88.

[2] Vints M., "A New Telescopic Subradiant ?", *WGN* 16:5, 1988, p. 171.

VVS Observations of the 1988 Perseids

Peter Aneca

An overview is given of 1988 Perseid observations conducted by members of the VVS.

As the observation conditions of the 1988 Perseids were extraordinary, a lot of people got interested in observing meteors. This has enlarged the data in quantity, but perhaps not always in quality because a big part of the observation teams consisted of new members. In total 75 members of the *Vereniging voor Sterrenkunde (VVS)* in Belgium participated in the 1988 Perseid campaign. The following groups were active:

> JVS-Auriga (2 obs., Koksijde), JVS-Io (13 obs., Assenede), JVS-Polaris (4 obs., le Castellard), JVS-Quasar (6 obs., Costebelle), Urania (38 obs., Epen)

and two individual observers. Between brackets, the number of observers for each group and their main observation site are mentioned.

Three groups had to deal with the problem that they did not have much experience in this branch of astronomy. How they solved this problem is resumed below. JVS-Polaris, who left Belgium for the beautiful skies of the French Provence, as well as JVS-Quasar, spent the first nights in getting acquainted to estimating the limiting magnitude and stellar magnitudes. In this way they saved a lot of time during the meteor observations, which made the ZHR calculations more accurate. As they had only one tape recorder, they tried to find some system of using it with three observers, by not interrupting the recording. The fourth person handled the photographic devices.

JVS-Quasar observed three nights for practising. During those nights a lot of problems came up which were solved the following day. Tape recorders were only used the last training night, so the observing data were more independent, though it still remains difficult to completely ignore someone else's data.

The five cameras were handled by two people. One was recording the time while the other transported the film. The necessary arrangements were made for a simultaneous photographic action between JVS-Polaris, JVS-Quasar, and Mark de Lignie and Klaas Jobse, who took part in the observing campaign in Lardiers, Southern France. We photographed during four nights. The calculations for the directions of the cameras were made by Mark de Lignie. Klaas Jobse supplied the material for a simultaneous all-sky post (Lardiers-Costebelle) that fortnight (August 6–20).

Urania went to Epen, the Netherlands, where they could observe almost every night. Good observing conditions in the Benelux are possible, as was proven during these two weeks. As for the visual observations, everybody had observed meteors before the maximum of the Perseids, though for some, it was the first meteor campaign. Alos, an interesting project on simultaneous visual and radio observations was organized. Three Urania members went to the International Astronomical Youth Camp in the FRG, but only one of them as a meteor observer.

Due to some interpretation problems about the limiting magnitude, the ZHR calculations are not finished yet. We will report on them later on.

Summary of 1988 Perseid observations in Finland

Teemu Hankamäki

A summary is given of 1988 Perseid observations conducted in Finland.

Last summer, six observers participated in the Finnish Perseid campaign. Their names are listed below:

> Tomi Anttila (ANTTO), Teemu Hankamäki (HANTE), Timo Kinnunen (KINTI), Hannu Määttänen (MAAHA), Pekka Parviainen (PARPE), Leo Rajala (RAJLE).

The observed rates are summarized in the following table.

Table 1 — Observations of the 1988 Perseids, δ-Aquarids, κ-Cygnids and the sporadic background from Finland.

Date	Obs	Period (UT)	T_{eff}	Lm	F	Per	Aqr	Cap	Spor
Aug 05	RAJLE	21^h45^m–00^h00^m	2.05	5.62	1.02	7	2	0	8
05	KINTI	22^h40^m–23^h20^m	0.66	5.00	1.11	1	0	1	4
07	PARPE	23^h00^m–00^h02^m	1.00	5.30	1.00	3	1	0	3
08	HANTE	21^h30^m–22^h30^m	0.97	5.10	1.00	3	0	0	3
08	KINTI	22^h57^m–23^h32^m	0.58	5.30	1.00	4	0	1	0
08	PARPE	23^h00^m–00^h02^m	1.00	5.50	1.00	3	0	0	3
11	PARPE	23^h15^m–23^h35^m	0.33	6.00	4.00	12	0	0	1
14	RAJLE	22^h25^m–23^h10^m	0.55	6.41	1.00	4	1	1	2
14	MAAHA	23^h36^m–00^h55^m	1.20	5.20	1.01	15	0	1	1
18	ANTTO	22^h30^m–23^h25^m	0.65	5.80	1.00	5	0	0	8
21	RAJLE	22^h45^m–23^h30^m	0.70	6.70	1.04	3	2	0	7
24	RAJLE	21^h40^m–00^h15^m	2.42	6.58	1.00	3	3	6	19

Below, a global magnitude distribution of the observed showers is given.

Table 2 — Global magnitude distributions of the 1988 Perseids, δ-Aquarids and κ-Cygnids and the sporadic background, as obtained from Finnish observations.

Shower	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Perseids	1	0	0	1	4	5	15	22	12	5	0	65	2.60
δ-Aquarids	0	0	0	0	0	2	0	4	3	0	0	9	2.89
κ-Cygnids	0	0	0	0	0	1	2	10	0	0	0	13	2.69
Sporadics	0	0	0	1	0	3	14	10	20	11	0	59	3.31

Preliminary Analysis of the 1988 Perseids in Alberta

Peter Brown

A preliminary analysis is made of the author's observations of the 1988 Perseids in Alberta, Canada, which were conducted under very favorable conditions.

The 1988 Perseid display was one of the best in terms of observing conditions in North America the last decade. With a new moon near the time of the peak and maximum predicted to occur in early evening for Eastern North America, conditions were better than anytime since 1980 or 1981.

The display was predicted to peak at 0^h UT on August 12 according to Millman. With this in mind a team of three observers from Alberta, Canada set up an observing camp for the days around maximum in the tiny hamlet of Smithfield in the center of the province. While extensive observations were made by each observer, only the author's observations have been fully analyzed to date. The rest of this paper will give an introductory look at the Perseid shower in 1988 as seen by him. Another more extensive paper will follow with the other two observers' data and hopefully observations from other meteor workers within the North American Section of the IMO.

In all, a total of four nights were clear around the peak of the Perseid shower and extensive observations were carried out by the author on each of these nights.

Table 1 — Observing sites for the 1988 Perseids in Alberta, Canada, used by Peter Brown.

Code	Location	λ	φ
166	Maqua Lake	111°16′00″ W	56°23′00″ N
183	Smithfield	114°24′00″ W	53°35′00″ N

Table 2 — Observations of the 1988 Perseids and the sporadic background from Alberta by Peter Brown.

Date	Loc	Period (UT)	$T_{\rm eff}$	Lm	F	Per	Minor streams	Spor
Aug 08	166	05^h40^m–06^h40^m	0.97	6.30	1.10	13		6
08	166	06^h40^m–07^h40^m	0.98	6.20	1.10	18	3A,1C	8
08	166	07^h40^m–08^h40^m	0.92	6.10	1.10	15	1A	10
Aug 11	166	04^h45^m–05^h45^m	0.97	5.80	1.00	8		3
11	166	05^h45^m–06^h45^m	0.95	6.10	1.00	18	1C	5
11	166	06^h45^m–07^h45^m	0.95	6.10	1.00	21	1C	4
11	166	07^h45^m–08^h45^m	0.97	6.10	1.00	38	1C,1K	2
11	166	08^h45^m–09^h45^m	0.62	6.20	1.00	18		9
Aug 12	183	05^h00^m–06^h00^m	0.97	6.10	1.00	37	1C,1K	6
12	183	06^h00^m–07^h00^m	0.94	6.30	1.00	56	2C	9
12	183	07^h00^m–08^h00^m	0.93	6.20	1.00	58		10
12	183	08^h00^m–09^h00^m	0.93	6.30	1.00	66	2A,2C	8
12	183	09^h00^m–10^h00^m	0.95	6.10	1.00	80	1A,1C	9
12	183	10^h00^m–11^h00^m	0.50	5.60	1.00	33	1C	3
Aug 13	183	05^h00^m–06^h00^m	0.97	6.10	1.00	21	1C,1K	5
13	183	06^h00^m–07^h00^m	0.93	6.10	1.00	25	1A,1C	5
13	183	07^h00^m–08^h00^m	0.93	6.00	1.00	43	1A,1C,2K	10
13	183	08^h00^m–09^h00^m	0.96	6.10	1.00	51	1A,2K	10
13	183	09^h00^m–10^h00^m	1.00	5.90	1.00	30	1A,1K	3

The first clear night was August 7–8 and observations were obtained from Fort McMurray. The aurora was generally quiet this night and permitted collection of a reliable set of data. In three hours of observing some 46 Perseids were recorded, with an average hourly rate of 15 and an integrated ZHR of 32. The average magnitude of the Perseids was 2.2, rather faint for a pre-maximum night. The sporadic average was 3.00, giving a Δm value of 0.80, indicating that Perseids and sporadics were generally well separated. All rate data is presented in Table 2 and all magnitude data in Table 3 for the entire period.

The next clear night was August 10–11, again from Fort McMurray. On this night the Perseid rate had already increased substantially. Unfortunately, a rather extensive auroral display hindered observations somewhat, although the limiting magnitude remained within acceptable limits. The average magnitude of Perseids had climbed substantially to 1.86, and the Δm value had fallen to 0.44, probably due to the influence of the aurora. Hourly rates had only increased to around 20 on average, although the integrated ZHR had risen considerably to 46. This was probably the worse night of the campaign in terms of conditions, although the sky background was still acceptably dark.

With the possibility of the peak night being severely hampered by aurora, I traveled to Smithfield to join the other Alberta meteor workers for a joint camp from a southerly, dark location. Fortunately I managed to obtain a good six hours of sleep before going observing on the peak night. Because of this I was very alert throughout the entire night. Rates had exploded compared to the previous night and the integrated ZHR for the entire night was 120, almost 3 times what it had been just 24 hours earlier. Clearly this observation took place close to maximum activity of the shower. The ZHR remained around 100–110 for the first hours of the session and then rose to 140 and 162 in the last full hour and half-hour respectively. Because of oncoming twilight and the large correction due to the small effective duration, the final half-hour should be ignored as the data required too much correction for standardization.

The high ZHR's on this night (verified by other observers in the group as well) some 10 hours after the predicted maximum leads to one of two conclusions. Either the shower peaked much higher than usual and North American observers witnessed the well-known 24 hour plateau near the peak of the shower, or the peak actually occurred later than 0^h UT on August 12. Some past observations lend credence to the latter conclusion. Paul Roggemans in a study of the 1986 shower found that the maximum occurred near solar longitude $\lambda_\odot = 139^\circ\!.5$, rather than the traditionally accepted $\lambda_\odot = 139^\circ\!.25$. Lindblad for comparison finds the peak to be at $\lambda_\odot = 139^\circ\!.39$ from observations of the shower from 1953–1981.

The high ZHR of 140 and the integrated ZHR remains of 115 (if we eliminate the final half-hour) attest to an unusual peak. This is above average for the peak of the Perseid display and compares with the 1983 display. The shower was much less active than in 1980 or 1981 near maximum.

Table 3 — ZHR-values for the 1988 Perseids and corresponding HR-values of the sporadic background as obtained from Canadian observations by Peter Brown.

Date	$\lambda_\odot$	Per	ZHR	Spor	HR
Aug 8.26	135°38	13	29.1 ± 8.1	6	8.5 ± 3.5
8.30	135°42	18	38.8 9.2	8	12.5 4.4
8.34	135°46	15	33.9 8.8	10	18.6 5.9
Aug 11.22	138°22	8	28.1 ± 9.9	3	6.7 ± 3.9
11.26	138°26	18	43.4 10.2	5	8.2 3.7
11.30	138°30	21	45.1 9.8	4	6.5 3.3
11.34	138°34	38	72.1 11.7	2	3.2 2.3
11.39	138°38	18	44.7 10.5	9	20.2 6.7
Aug 12.23	139°19	37	103.7 ± 17.1	6	9.6 ± 3.9
12.27	139°23	56	117.5 15.7	9	11.9 4.0
12.31	139°27	58	118.6 15.6	10	15.0 4.7
12.35	139°31	66	110.1 13.5	8	10.7 3.8
12.40	139°35	80	142.9 16.0	9	14.7 4.9
12.44	139°39	33	164.7 28.7	3	16.1 9.3
Aug 13.23	140°15	21	58.3 ± 12.7	5	8.0 ± 3.6
13.27	140°19	25	63.1 12.6	5	8.3 3.7
13.31	140°23	43	104.8 16.0	10	18.6 5.9
13.35	140°27	51	98.3 13.8	10	16.2 5.1
13.40	140°31	30	60.8 11.1	3	5.8 3.3

On August 11–12 the 330 Perseids seen yielded an average magnitude of 2.01, and the Δm for this night was 0.75, indicating sporadics and Perseids were very well separated. Several bright Perseids were recorded, but the derived r of 2.3 was not the lowest of the campaign. The peak of the shower was not particularly bright and does not support the idea that huge numbers of bright Perseids are seen near the peak.

The next night also saw observations from the Smithfield site under excellent conditions once again. The shower was obviously in decline from the peak of the previous night. The integrated ZHR was 75, higher than the night previous to the peak and evidence of a slow decline after maximum activity. The average brightness of 170 Perseids on this night was 1.97, brighter than the peak. Δm was 0.68 indicating that once again the sporadic and Perseid meteors were well separated.

Table 4 — Magnitude distributions of the 1988 Perseids and the sporadic background as obtained from Canadian observations by Peter Brown

Date	Shower	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Aug 08	Perseids	0	1	1	0	1	4	3	12	15	8	1	0	46	2.20
08	Sporadics	0	0	0	0	0	0	4	3	9	5	3	0	24	3.00
11	Perseids	0	0	1	0	4	12	24	30	17	11	4	0	103	1.86
11	Sporadics	0	0	0	0	1	1	5	3	9	4	0	0	23	2.30
12	Perseids	1	1	1	6	22	28	60	68	68	67	8	0	330	2.01
12	Sporadics	0	0	0	1	0	2	4	10	9	13	5	0	44	2.86
13	Perseids	0	0	1	2	8	13	33	52	35	22	4	0	170	1.97
13	Sporadics	0	0	0	1	0	0	4	11	7	8	2	0	33	2.64

In general terms, the 1988 display was probably one of the best three or four of the last decade. While not even comparing to the 1980 or 1981 displays, it was at least as strong as the 1983 display and certainly stronger than the 1985 and 1986 displays. The shower did not change in terms of particle constitution (as would be expected) as comparison of this year's magnitude distribution and 1986 results vividly portray. In 1986, the Alberta Meteor Group found an average magnitude of 1.98 and an r-value of 2.38 from 650 Perseids, most seen near maximum. This year of 649 Perseids, the average magnitude turned out to be 1.98 and the r-value was 2.39. The campaigns in 1985, 1986 and 1988 had similar observing conditions in terms of limiting magnitude, so results should be comparable.

It is important to note, though, that in 1985 and 1986 the peak night was cloudy. Observations were possible on the night following maximum, and these are the data that were compared to arrive at the conclusion that the 1988 display was unusually strong. In 1985 the ZHR was approximately 50–60 some 30 hours after the peak. In 1986 the night after maximum displayed an integrated ZHR of 48, only some 18–22 hours after the maximum predicted by Millman. The 1988 data showed an integrated ZHR of 75, averaged 29–34 hours after the predicted maximum.

I invite all other meteor observers in North America to send their Perseid observations with the necessary data (limiting magnitude, effective observing time, cloud factor, etc.) for inclusion in a more complete analysis.

Call for Observations

Dirk Artoos

When I was doing some radio work on September 28 between 8^h45^m UT and 9^h30^m UT, there was a very high activity of meteor reflections recorded. In the first quarter of an hour, I heard 70 reflections, and in the second 66 reflections.

Is there someone else who has also recorded this high activity? Please let me know! My address is: *Nattenhofstraat 74, B-2800 Mechelen, Belgium.*

Summer 1987

Radio Observations in June 1987

Jeroen Van Wassenhove

Belgian and Danish radio observations in June 1987, intended to monitor three major daytime showers (Arietids, ζ-Perseids and β-Taurids), are presented.

In June, three major daytime showers are active: the Arietids, the ζ-Perseids and the β-Taurids. The Arietids and the ζ-Taurids appear in the same period (early June) and have their maximum around the same date, namely June 8. Figure 1 shows the results of the Danish observer Gotfred Møbjerg Kristensen.

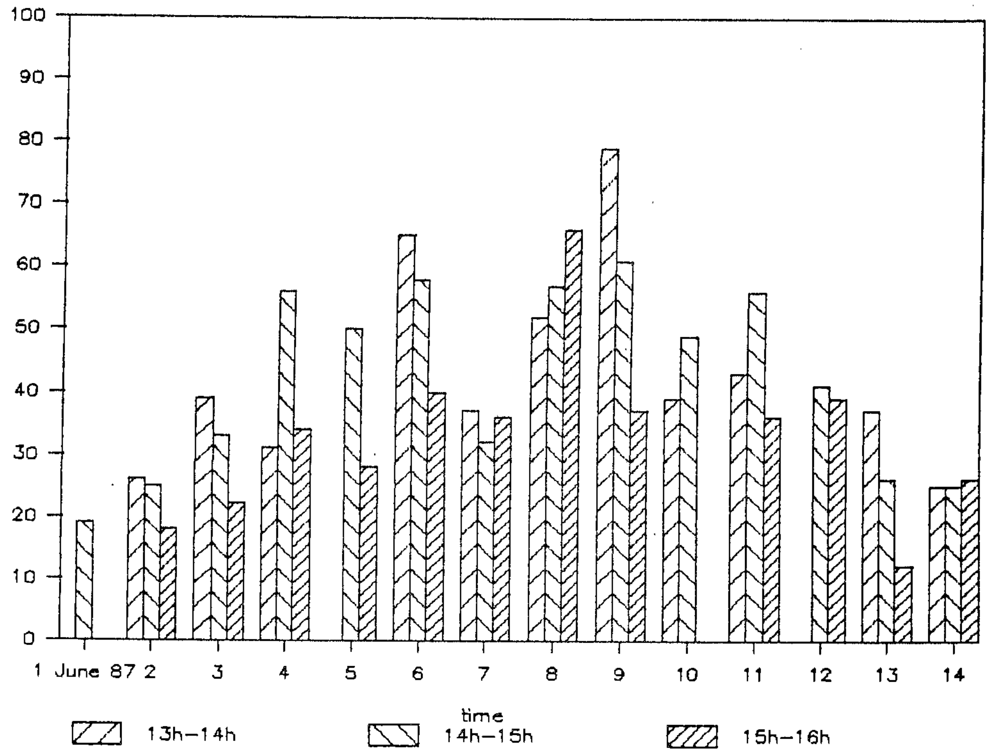

Figure 1 —Radio observations by Gotfred M. Kristensen (Havdrup) in early June 1987 at 100.60 MHz.

Three Belgian observers also listened during that period. Their results are presented below.

Table 1 — Radio observations in early June 1987 by Maurice De Meyere (St.-Martens-Latem, 66.17 MHz) and Christian Steyaert (Bottelare, 91.10 MHz).

M. De Meyere			C. Steyaert		
Date	Period (UT)	Tot	Date	Period (UT)	Tot
Jun 02	16^h00^m–17^h00^m	11	Jun 06	11^h30^m–12^h30^m	12
03	16^h00^m–17^h00^m	14	06	19^h04^m–19^h57^m	10
04	16^h00^m–17^h00^m	12	07	18^h40^m–19^h40^m	10
07	06^h00^m–07^h00^m	73	08	09^h00^m–10^h00^m	20
08	06^h00^m–07^h00^m	88	13	18^h30^m–19^h30^m	10
09	06^h00^m–07^h00^m	68			
10	06^h00^m–07^h00^m	63			

Table 2 — Radio observations in June 1987 by Dirk Artoos (Mechelen).

Date	ν (MHz)	Period (UT)	Tot	Date	ν (MHz)	Period (UT)	Tot
Jun 01	88.20	12^h11^m–12^h41^m	3	Jun 11	88.20	09^h25^m–10^h00^m	11
01	88.20	16^h23^m–17^h15^m	8	11	88.20	14^h40^m–15^h06^m	8
01	88.20	19^h10^m–19^h40^m	0	12	91.10	05^h52^m–06^h22^m	0
02	88.20	07^h54^m–08^h45^m	7	12	88.20	08^h08^m–08^h28^m	3
02	88.20	10^h24^m–10^h39^m	1	12	88.20	15^h48^m–16^h02^m	0
02	88.20	14^h59^m–15^h16^m	0	19	91.30	13^h04^m–13^h34^m	2
02	88.20	16^h30^m–17^h00^m	1	19	88.20	15^h42^m–16^h12^m	2
03	88.20	08^h01^m–08^h31^m	3	20	88.20	07^h38^m–07^h58^m	1
03	88.20	10^h25^m–10^h55^m	4	24	91.30	12^h50^m–13^h30^m	3
03	88.20	15^h15^m–15^h45^m	1	24	91.10	14^h35^m–15^h05^m	3
03	88.20	19^h13^m–19^h43^m	2	24	88.20	20^h03^m–20^h43^m	1
04	88.20	06^h30^m–07^h00^m	1	25	88.20	10^h27^m–10^h47^m	2
04	88.20	08^h41^m–09^h11^m	3	25	88.20	12^h24^m–13^h24^m	3
04	88.20	10^h37^m–10^h52^m	2	26	88.20	07^h23^m–08^h23^m	2
04	88.20	11^h50^m–12^h50^m	18	26	88.20	12^h00^m–12^h50^m	2
04	88.20	13^h51^m–14^h21^m	9	26	88.20	15^h11^m–15^h21^m	0
04	88.20	16^h07^m–16^h52^m	6	27	88.20	12^h36^m–13^h36^m	4
04	87.60	18^h23^m–18^h38^m	3	28	88.20	07^h45^m–08^h53^m	9
05	88.20	07^h00^m–08^h00^m	31	28	94.70	09^h20^m–09^h30^m	0
05	88.20	08^h15^m–09^h00^m	10	28	88.20	11^h15^m–12^h45^m	5
06	88.20	11^h08^m–12^h08^m	18	28	88.20	16^h27^m–16^h42^m	2
07	88.20	11^h06^m–12^h06^m	60	29	91.10	07^h01^m–07^h31^m	3
08	88.20	11^h08^m–11^h49^m	13	29	91.10	08^h19^m–08^h49^m	5
08	88.20	17^h26^m–17^h41^m	5	29	88.20	08^h55^m–09^h25^m	4
09	88.20	08^h29^m–08^h50^m	5	29	88.20	09^h36^m–10^h13^m	8
09	88.20	10^h47^m–11^h10^m	9	29	88.20	11^h00^m–11^h45^m	4
09	88.20	11^h45^m–12^h05^m	10	29	88.20	13^h07^m–13^h43^m	3
09	91.10	12^h09^m–12^h24^m	2	29	88.20	13^h51^m–14^h31^m	2
09	91.10	16^h07^m–17^h00^m	7	30	88.20	09^h00^m–09^h40^m	1
10	88.20	08^h02^m–08^h32^m	5	30	88.20	11^h00^m–11^h40^m	3
10	88.20	15^h34^m–16^h04^m	3	30	88.20	14^h30^m–14^h45^m	3
11	88.20	08^h25^m–08^h50^m	7	30	88.20	16^h10^m–16^h30^m	0

As both meteor showers are mixed up with each other, it is almost impossible to make separate conclusions about them.

The β-Taurids appear around the end of June, with a maximum on June 29. The observations of Dirk Artoos in that period are listed in Table 2; those of Maurice De Meyere are presented below.

Table 3 — Radio observations in late June 1987 by Maurice De Meyere (St.-Martens-Latem, 66.17 MHz).

Date	Period (UT)	Tot
Jun 25	06^h00^m–06^h30^m	28
27	06^h00^m–06^h30^m	48
29	07^h00^m–08^h00^m	61
30	07^h00^m–08^h00^m	33

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Radio Observations in July and August 1987

Jeroen Van Wassenhove

An overview is given of Belgian and Danish radio observations in July and August 1987. From these observations, an estimation of the radio-maximum of the Perseids was calculated

1. Observations in July

Three Belgian observers were able to carry out radio observations of the sporadic activity and *delta*-Aquarids in July 1987. Luc Gobin (Mechelen) listened between 04^h00^m and 05^h00^m UT on 66.17 MHz. His results are presented in Figure 1.

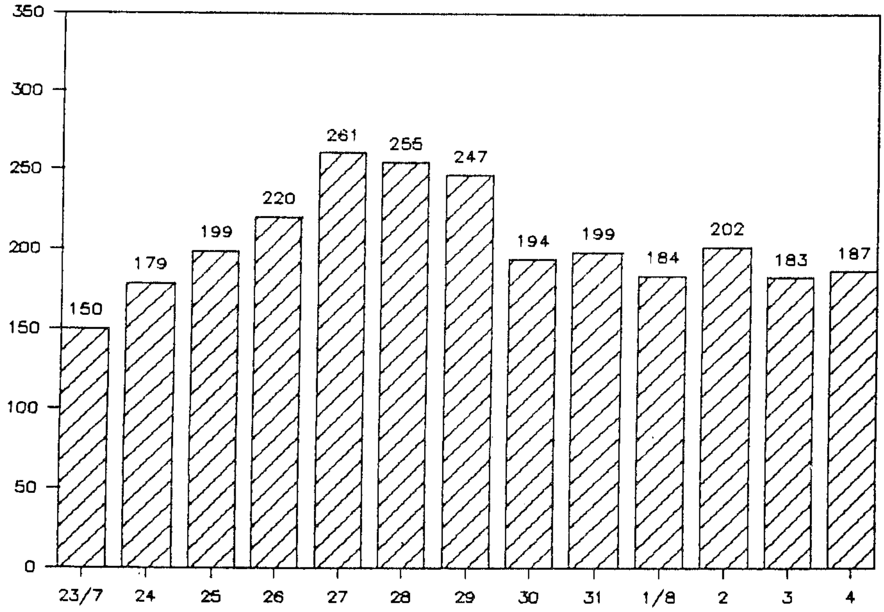

Figure 1 —Radio observations of Luc Gobin (Mechelen) in late July and early August 1987 at 66.17 MHz, between 4^h and 5^h UT.

The observations of Maurice De Meyere and Dirk Artoos are given below.

Table 1 — Radio observations in late July and early August 1987 by Maurice De Meyere (St.-Martens-Latem, 66.17 MHz) and Dirk Artoos (Mechelen, 88.30 MHz).

M. De Meyere			D. Artoos		
Date	Period (UT)	Tot	Date	Period (UT)	Tot
Jul 28	08^h00^m–09^h00^m	27	Jul 27	01^h30^m–02^h30^m	18
29	08^h00^m–09^h00^m	33	28	01^h30^m–02^h30^m	18
30	08^h00^m–09^h00^m	47	29	01^h30^m–02^h30^m	12
31	08^h00^m–09^h00^m	37			
Aug 01	08^h00^m–09^h00^m	29			

There is an increase at the end of July due to the δ-Aquarids. However, it is difficult to conclude on which day the maximum felt as the observations of Luc Gobin and Maurice De Meyere do not agree with each other. Maurice De Meyere has its highest count (47) on July 30, Luc Gobin on July 27 (261).

One Danish observer, Gotfred Møbjerg Kristensen, also listened in July. His results are as follows.

Table 2 — Radio observations of G.M. Kristensen in early July 1987 from Havdrup at a frequency of 100.60 MHz. Observing periods are given in UT.

Date	10^h00^m–11^h00^m	11^h00^m–12^h00^m	12^h00^m–13^h00^m
Jul 1	9	10	17
2	9	5	8
3	5	9	14
4	9	8	8
5	3	4	6
6	6	2	5
7	10	5	4
8	6	4	3

All counts are uncorrected.

2. Observations in August

In Belgium, Maurice De Meyere, Luc Gobin and Jeroen Van Wassenhove carried out radio observations of the 1987 Perseids. Their results are presented in the corresponding figures.

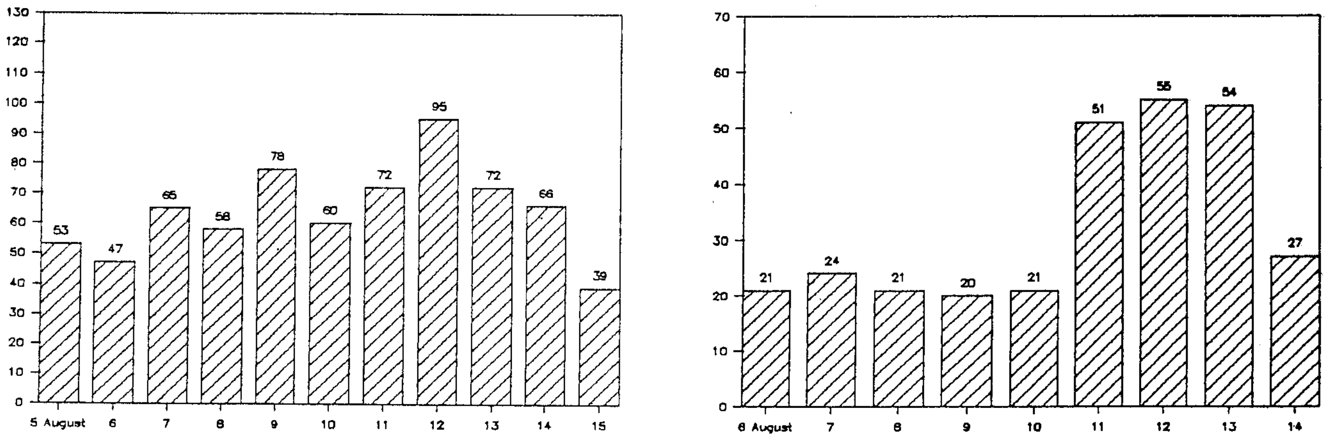

Figure 2 —1987 Perseid radio observations by Maurice De Meyere (St.-Martens-Latem, 66.17 MHz, left) and Jeroen Van Wassenhove (Nazareth, 88.40 MHz, right), both between 21^h and 22^h UT.

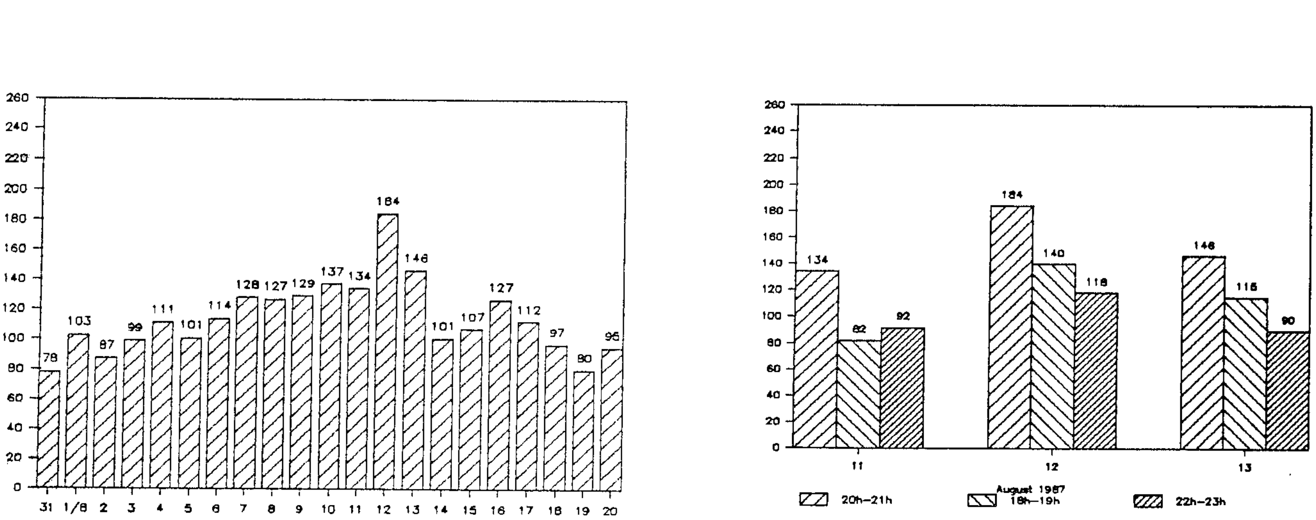

Figure 3 —1987 Perseid radio observations by Luc Gobin (Mechelen, 66.17 MHz between 20^h and 21^h UT (left). Additional observations were made around the Perseid maximum (right).

Dirk Artoos (Mechelen) and Christian Steyaert (Bottelare) listened several days during irregular intervals. The observations of G.M. Kristensen are shown below.

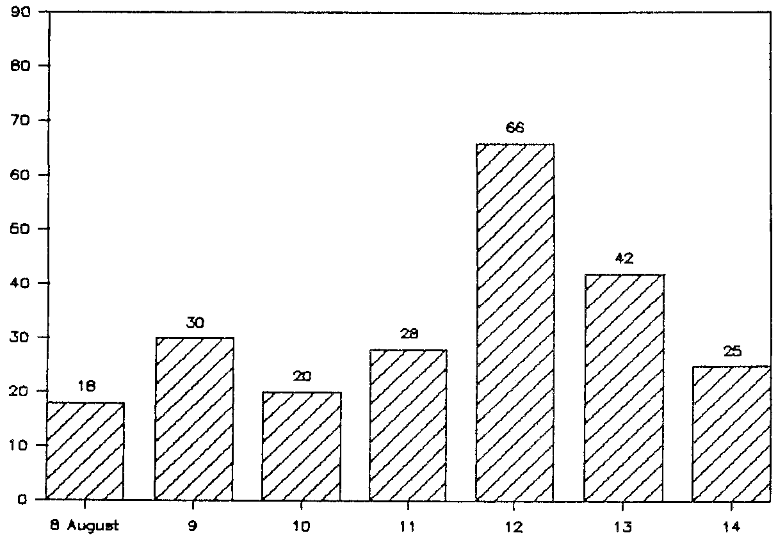

Figure 4 —1987 Perseid radio observations by Gotfred M. Kristensen (Havdrup, 100.60 MHz) between 22^{h} and 23^{h} UT.

With this data the maximum was calculated for each series of observations. The results are shown in Table 3.

Table 3 — Calculated radio-maxima for the 1987 Perseids.

Observer	Period (UT)	Calculated maximum
L. Gobin	$18^{h}00^{m}$–$19^{h}00^{m}$	Aug 13 $02^{h}.2 \pm 3^{h}.6$
L. Gobin	$20^{h}00^{m}$–$21^{h}00^{m}$	Aug 12 $23^{h}.2 \pm 3^{h}.4$
L. Gobin	$22^{h}00^{m}$–$23^{h}00^{m}$	Aug 12 $22^{h}.3 \pm 6^{h}.3$
M. De Meyere	$21^{h}00^{m}$–$22^{h}00^{m}$	Aug 12 $21^{h}.7 \pm 3^{h}.9$
J. Van Wassenhove	$21^{h}00^{m}$–$22^{h}00^{m}$	Aug 12 $21^{h}.8 \pm 9^{h}.6$
G.M. Kristensen	$22^{h}00^{m}$–$23^{h}00^{m}$	Aug 13 $03^{h}.4 \pm 2^{h}.4$

We combined the values of Maurice De Meyere and Luc Gobin as both observers listened on the same frequency and during the same hours, giving us the result 1987 August 12 at $23^{h}.3 \pm 4^{h}.3$ UT.

The 1987 Perseids in Finland

Teemu Hankamäki

Finnish observations of the 1987 Perseids are presented. They had to be conducted under rather weather conditions.

This report contains the results of visual meteor observations made in Finland in the period between August 06–07 and August 30–31. Rather poor weather greatly affected the 1987 Finnish Perseid watch. The mean limiting magnitude was 5.34.

16 observers monitored 13 nights and a total of 598 meteors was recorded, 273 of which were Perseids, 26 Aquarids, 34 κ-Cygnids and 265 sporadics. The 1987 Perseids produced a normal display, although in the night of August 12–13, maximum rates reached only 20 Perseids per hour. We did observe, but under bad weather conditions ...

The mean Perseid magnitude was 1.64; the sporadics were on average 1.43 magnitude fainter. This difference also reflects the bad observing conditions. 16.5% of the Perseids showed trains of mainly 2 seconds or more. 4.0% of these showed a color; most of these were yellow. The brightest Perseid was of magnitude −5.

The mean sporadic magnitude was 3.07. Apart from Perseids, Aquarids and κ-Cygnids have been observed in August. This resulted in a mean magnitude of 3.31 for 26 Aquarids and 2.50 for the κ-Cygnids. 5.9% of the κ-Cygnids showed a train and 8.8% of these showed color.

In Table 1, the observers with their observing sites are listed.

Table 1 — Observers and observing sites for the 1987 Perseids in Finland.

Observer	Code	λ	φ
Tomi Anttila	ANTTO	26°00′00″ E	61°02′00″ N
Niclas Forsström	FORNI	24°23′42″ E	60°13′09″ N
Teemu Hankamäki	HANTE	23°02′30″ E	61°12′30″ N
Mikko Juhola	JUHMI	24°24′ E	60°13′09″ N
Timo Kinnunen	KINTI	24°48′58″ E	60°14′29″ N
Jari Kuula	KUUJA	22°09′31″ E	61°21′37″ N
Ismo Luukkonen	LUUIS	24°23′42″ E	60°13′09″ N
Veikko Mäkelä	MAKVE	24°23′42″ E	60°13′09″ N
Markku Nissinen	NISMA	27°54′ E	62°17′ N
Markku Nousiainen	NOUMA	24°23′42″ E	60°13′09″ N
Pekka Parviainen	PARPE	21°18′17″ E	60°37′26″ N
Leo Rajala	RAJLE	25°04′ E	61°51′30″ N
Pentti Ramberg	RAMPE	25°16′ E	60°16′ N
Marko Riikonen	RIIMA	29°59′ E	62°44′ N
Markku Sihvonen	SIHMA	30°17′ E	62°54′ N
Roosa Toivonen	TOIRO	24°23′42″ E	60°13′09″ N

Below are the observational data. As mentioned, also Aquarids (A) and κ-Cygnids (K) were recorded.

Table 2 — Observations of the 1987 Perseids and the sporadic background from Finland.

Date	Obs	Period (UT)	$T_{\rm eff}$	Lm	F	Per	Min. str.	Spor
Aug 06–07	RAJLE	21^h45^m–00^h15^m	1.63	5.77	1.02	6		6
Aug 10–11	TOIRO	22^h08^m–23^h50^m	1.40	4.90	1.20	10		8
10–11	TOIRO	22^h39^m–23^h59^m	1.28	5.50	1.01	7		4
10–11	JUHMI	22^h40^m–00^h00^m	1.28	5.30	1.50	7		4
10–11	NOUMA	22^h40^m–00^h00^m	1.28	4.85	1.06	7		3
Aug 11–12	RAJLE	21^h15^m–22^h15^m	0.95	5.60	1.30	7	2A	1
11–12	PARPE	22^h15^m–23^h00^m	0.75	4.20	2.00	2	1A	0
11–12	KUUJA	21^h45^m–23^h28^m	1.63	4.30	1.82	7		0
11–12	KUUJA	22^h20^m–23^h20^m	0.95	4.30	1.25	2		2
Aug 12–13	FORNI	21^h45^m–22^h12^m	0.42	5.30	1.92	4		3
12–13	HANTE	21^h30^m–22^h15^m	0.75	5.00	1.11	6		0
12–13	TOIRO	21^h40^m–22^h40^m	0.67	5.16	1.41	7		4
12–13	PARPE	22^h00^m–23^h20^m	1.33	4.50	1.19	18	1A	0
12–13	KUUJA	21^h56^m–23^h56^m	1.35	4.94	1.67	21		4
12–13	JUHMI	00^h00^m–00^h50^m	0.90	5.49	1.82	7		1
12–13	NOUMA	00^h05^m–00^h53^m	0.73	4.75	1.79	14		0

Table 2 — continued

Date	Obs	Period (UT)	$T_{\rm eff}$	Lm	F	Per	Min. str.	Spor
Aug 13–14	RAMPE	22^h50^m–23^h35^m	0.67	4.80	1.25	5		0
13–14	NOUMA	22^h15^m–23^h10^m	0.72	5.00	3.28	9		0
13–14	LUUIS	22^h00^m–23^h25^m	1.33	5.90	1.67	16		3
13–14	FORNI	22^h02^m–23^h27^m	1.15	5.27	1.82	11		1
13–14	TOIRO	22^h02^m–22^h24^m	0.37	5.50	1.26	1		1
13–14	MAKVE	22^h40^m–23^h39^m	0.80	5.40	1.49	5		0
Aug 14–15	SIHMA	22^h20^m–23^h30^m	1.03	4.30	1.25	6	1K	3
14–15	RAJLE	21^h30^m–00^h00^m	2.37	5.88	1.11	25	5A,3K	14
14–15	NISMA	23^h05^m–00^h44^m	1.15	3.90	1.11	5		1
Aug 16–17	RAMPE	21^h45^m–23^h50^m	1.83	5.20	1.00	9	5K	2
16–17	RAJLE	21^h30^m–00^h30^m	2.75	5.96	1.00	16	7A,9K	32
16–17	KINTI	00^h00^m–00^h35^m	0.53	5.90	1.00	3	1A	4
Aug 17–18	RAJLE	21^h45^m–23^h30^m	1.68	6.21	1.00	7	2A,8K	15
Aug 18–19	RIIMA	21^h19^m–23^h55^m	1.97	6.01	1.02	8	2A,5K	9
Aug 24–25	RAMPE	22^h10^m–23^h55^m	1.50	6.00	1.00	4	1K	5
24–25	RAJLE	22^h20^m–00^h15^m	2.50	6.33	1.00	4	2A,2K	47
27–28	RAJLE	22^h10^m–23^h10^m	0.93	6.30	1.19	0	3K	21
Aug 29–30	RAJLE	22^h00^m–00^h00^m	1.83	6.10	1.00	0		37
Aug 30–31	RAMPE	22^h00^m–23^h05^m	1.00	6.00	1.00	3		5
30–31	RAJLE	21^h20^m–23^h20^m	1.60	6.40	1.00	0		20
30–31	ANTTO	00^h00^m–00^h30^m	0.37	5.60	1.11	0		5

In Table 3, a global magnitude distribution of the observed showers is given.

Table 3 — Magnitude distributions of the 1987 Perseids, Aquarids, κ-Cygnids and the sporadic background as obtained from Finnish observations.

Shower	−5−	−4	−3	−2	−1	0	+1	+2	+3	+4	+5+	+6	Tot	$\overline{m}$
Perseids	1	0	6	7	18	38	50	58	54	31	10	0	273	1.64
Aquarids	0	0	0	0	0	0	3	0	11	10	2	0	26	3.31
κ-Cygnids	0	0	0	1	1	2	4	8	8	7	2	1	34	2.50
Sporadics	0	1	2	4	2	7	19	43	69	70	46	2	265	3.07

Finally, we give the percentage of meteors showing trains or colors.

Table 4 — Percentage of meteors showing trains and colors in the 1987 Perseid, Aquarid, κ-Cygnid and sporadic background observations from Finland.

Shower	Trains	Colors
Perseids	16.5%	4.0%
Aquarids	11.5%	0.0%
κ-Cygnids	5.9%	8.8%
Sporadics	9.4%	3.4%

The 1987 κ-Cygnids in Spain

Joseé Marìa Trigo-Campoy Rodríguez

The κ-Cygnids, being one of the more prominent streams visible in the Northern Hemisphere during August and September, became the object of a study program set up by the Spanish Meteor Society.

1. Introduction: peculiarities of the stream

Taking into account the low hourly rates of this stream — not surpassing 10 meteors per hour — the summer period offers the best conditions for observing κ-Cygnids, as the radiant remains visible all night. Indeed, it would have surprised us very much not to have observed one single κ-Cygnid on any of three nights.

From our visual observations we were able to get an idea of the radiant's activity, which peaked between August 6 and August 9, and died out in the first nights of October. As I have already stated, the month of September still brings us κ-Cygnid activity, but the hourly rates get even lower then. The only moments one can speak of real activity, are the few short hours near maximum — which in 1987 happened around solar longitude $\lambda_\odot = 144\overset{\circ}{.}95$ on August 18.

The low angular velocity which is characteristic of κ-Cygnids provides a good means for distinguishing them from sporadic meteors appearing in the same direction. The radiant's position at maximum is situated at $\alpha = 286^\circ$ and $\delta = +59^\circ$, and changes much between August and October. Yet the peculiar characteristics which are specific of κ-Cygnids make these meteors so easy to identify, e.g. the fireballs which are not exceptional, like the -6 one, which was observed by our member Miguel Camasara Yuste on August 20, 1987.

2. κ-Cygnid activity in 1987

What follows now is a study of the κ-Cygnid activity in August 1987. Note that κ-Cygnids were observed for from July onwards. However, no κ-Cygnids were seen during the entire month of July, confirming the activity period given in the *Handbook Visual Meteor Observations*. The observers were:

> José M. Trigo R. (JMT), Raúl Fernández S. (RFS), Antonio Fco Marín (AFM), Joseé Vicente Díaz (JVD), Oscar Cervera Garc. (OCG), Vicente Soldevila P. (VSP), Andrés Rafael Paños (ARP), José Luis Martín H. (JLM), Miguel Camarasa Y. (MCY), Antonio Juan Mont. (AJM), Miguel Angel Garc. (MAG), Angel José Nicolás (AJN).

The observations were conducted in the vicinity of Valencia, Teruel and Murcia.

Table 1 — Observations of the 1987 κ-Cygnids from Spain.

Date	Obs	Period (UT)	$T_{\rm eff}$	Lm	F	Cyg	ZHR
Aug 11–12	JMT	20^h53^m–21^h53^m	1.00	5.0	1.20	2	6 ± 4
11–12	JLM	21^h15^m–22^h15^m	1.00	5.0	1.20	1	3 5
Aug 13–14	JMT	02^h00^m–03^h00^m	1.00	5.0	1.10	1	3 ± 3
13–14	JLM	21^h25^m–22^h25^m	1.00	6.0	1.10	2	6 4
Aug 14–15	JMT	22^h00^m–23^h00^m	1.00	5.2	1.00	1	3 ± 3
14–15	JLM	22^h30^m–23^h30^m	1.00	5.5	1.20	2	6 4
Aug 15–16	JMT	22^h00^m–23^h00^m	1.00	5.5	1.20	1	3 ± 3
Aug 16–17	AFM	01^h00^m–02^h00^m	1.00	5.0	1.00	1	3 ± 3
Aug 17–18	AFM	21^h00^m–22^h00^m	1.00	5.9	1.00	1	2 ± 2
17–18	AFM	01^h00^m–02^h00^m	1.00	5.5	1.00	1	3 3
17–18	RFS	22^h00^m–23^h00^m	1.00	4.5	1.00	1	4 4

Table 1 — continued

Date	Obs	Period (UT)	T_{eff}	Lm	F	Cyg	ZHR
Aug 18–19	AFM	21^h30^m–22^h30^m	1.00	5.7	1.00	2	4 ± 3
18–19	AFM	22^h40^m–23^h40^m	1.00	5.7	1.00	5	12 5
18–19	AFM	23^h40^m–00^h40^m	1.00	5.7	1.00	2	6 4
18–19	AFM	01^h00^m–02^h00^m	1.00	5.7	1.00	3	10 6
Aug 19–20	AFM	02^h00^m–03^h00^m	1.00	5.5	1.00	1	4 ± 4
19–20	MCY	23^h00^m–00^h00^m	1.00	6.0	1.00	2	4 3
19–20	MCY	00^h00^m–01^h00^m	1.00	5.5	1.00	2	6 4
Aug 20–21	MCY	23^h00^m–00^h00^m	1.00	6.0	1.00	2	5 ± 3
20–21	AFM	22^h00^m–23^h00^m	1.00	6.0	1.00	4	8 4
Aug 21–22	MAG	22^h30^m–23^h30^m	1.00	5.5	1.00	1	3 ± 3
Aug 22–23	JMT	21^h15^m–22^h15^m	1.00	5.2	1.00	2	5 ± 3
22–23	RFS	23^h21^m–00^h21^m	1.00	5.8	1.20	2	4 3
Aug 23–24	RFS	19^h45^m–20^h45^m	1.00	6.3	1.00	1	2 ± 2
23–24	JMT	20^h00^m–21^h00^m	1.00	6.3	1.00	2	3 2
23–24	JMT	21^h30^m–22^h30^m	1.00	6.2	1.00	2	3 2
23–24	JMT	01^h30^m–02^h30^m	1.00	6.1	1.00	2	5 3
Aug 24–25	JMT	21^h30^m–22^h30^m	1.00	6.35	1.00	1	3 ± 3
24–25	MCY	22^h00^m–23^h00^m	1.00	6.2	1.00	2	6 4
24–25	RFS	20^h30^m–21^h30^m	1.00	6.2	1.00	3	5 2
Aug 25–26	JMT	21^h00^m–22^h00^m	1.00	5.2	1.00	1	3 ± 3
Aug 28–29	JVD	21^h30^m–22^h30^m	1.00	5.0	1.10	1	4 ± 4
Aug 31–32	OCG	20^h50^m–21^h50^m	1.00	5.6	1.00	2	5 ± 3

The other observers did not notice any κ-Cygnids.

Table 2 — Global magnitude distributions per observer of the 1987 κ-Cygnids, as obtained from Spanish observations.

Obs	−6	−5−	−4	−3	−2	−1	0	+1	+2	+3	+4	+5+	Tot	$\overline{m}$
AFM	0	0	0	0	0	1	3	3	5	11	1	0	24	2.05
JMT	0	0	0	0	2	1	4	2	2	2	8	1	22	2.00
MCY	1	0	0	0	0	1	1	4	2	2	1	0	14	0.78
OCG	0	0	0	0	1	0	6	3	2	1	0	0	13	0.91
RFS	0	0	0	0	0	2	1	0	2	3	3	0	11	2.10
JLM	0	0	0	0	0	0	0	0	1	4	1	0	6	3.00
JVD	0	0	0	0	1	0	1	2	1	1	0	0	6	1.17
ARP	0	0	0	0	0	0	2	0	1	0	0	0	3	
MAG	0	0	0	0	0	0	0	0	0	1	0	0	1	

Lately, we receive little contributions on photographical work. We also constantly worry about finding a photograph for the front cover of the next issue of *WGN*. If you have something suitable, or if you have a report on your photographical observations, do not hesitate to send it to us!

The SONY ICF-PRO80

Dirk Artoos

The author describes his experiences with the SONY ICF-PRO80 world receiver for meteor work.

Not so long ago I bought myself a very compact and easy world receiver, especially useful for meteor reflections. However, before expanding on this event I would like to go back in the past a little. I have been active in all kinds of astronomical activities since 1971. Yet meteor observing always had something special, something unexpected and wondrous, and it provided ideal ways of getting to know astronomy in several of its aspects. In June 1973 *JVS Pallas* came into existence as a group of amateur astronomers, living in and around Mechelen, Belgium, which soon specialized in observing meteors. The results were incredible and always culminated at Perseid maximum. Some four years later I heard for the first time that radio observations were made in Great Britain and especially in Poland, and I soon regarded this as the ideal way for catching meteors day and night.

However, I had to wait until 1987 before I was able to buy a digital SONY world receiver, more specifically the ICF 7600 A, ranging from 76 MHz to 108 MHz on FM. This meant I could receive all Western European stations with the six element Yagi antenna mounted on my roof. Those were my first radio observations. Some months later my enthusiasm dropped considerably when I learned that other observers heard ten times as many meteor reflections within the same observing periods. They had used receivers of much wider range (65 MHz–108 MHz) which meant they could also get Eastern European stations. This drastically increased their number of reflections because there was no interference from nearby stations, very little from airplanes and almost no background noise from other transmitters. It also gave you the chance to work much more selectively.

So I started looking for a decent world receiver and after a while I came across an ideal one. "Ideal" means: not too expensive, having both a broad FM and AM range, compact, very handy to work with, and with a store of more than ten memories. In other words: SONY's ICF PRO80. This is an instrument of professional quality having the very broad range of 150 kHz–108 MHz, plus 115.15 MHz–223 MHz, direct digital display with 10 buttons and 40 memories, automatic or manual tuning. The scan can be restricted and memorized too. Detection on FM narrow/FM/AM wide/AM narrow, SSB with AM and SSB precise tuning is possible. The squelch can be controlled manually or automatically. Four 1.5 Volt batteries provide the required energy for memorizing and for functioning the radio. The ICF PRO80 measures 90 by 182 by 50 mm. The question was: how to buy this equipment? Via certain connections I got some very favorable sales conditions. While I waited for my order to arrive (which was too long, of course, for my taste) I prepared everything for the improvement of my future radio observations. The RG 58 coax cable was shortened from 18 meters to 8 and linked with a BNC connector. The six element Yagi antenna was replaced by a four-elements, better suited for the 4 m band. At last I could observe! I chose Krakow $A = 270°$ (East) and put my Yagi at 40° elevation. The results were astounding. Meteor reflections kept coming in and already after a few days I was able to put my observations into a daily rate curve.

Since november 1987 I have been observing at least 30 minutes per day, if possible in the mornings as well as in the evenings and sometimes at night. The mean number of reflections varies with the time of day. From 6^h to 12^h UT: 40 to 50 reflections per half hour. From 14^h to 20^h UT: 20 to 30 reflections per half hour and from 20^h to 24^h UT: 50 to 60 reflections per half hour, and all this in a rather quiet meteor season from January to March. The mean number of reflections was much lower before, when I was observing on Western European frequencies with additional disturbances. I have used this quiet period of the year to test some of the frequencies and I have come to the conclusion that 66.90 MHz and 68.75 MHz for me are the best. Preference goes to 66.90 MHz because of low background noise and few disturbances.

Perhaps you have already noticed that the frequency (66.90 MHz) has been rounded to 1 kHz. This is because the receiver in the FM mode (wide) rounds to 50 kHz and in the narrow mode to 5 kHz (see table below).

Table 1 — Rounding of frequencies by the SONY ICF-PRO80.

Frequency reach	Rounded to:	Frequency reach	Rounded to:
150-528 kHz	3 kHz	115.15–115.528 MHz	3 kHz
531–1602 kHz	9 kHz	115.531–116.602 MHz	9 kHz
1605-45 995 kHz	5 kHz	116.605–160 MHz	5 kHz
50-75.995 MHz (N. FM)	5 kHz	165–190.995 MHz (N. FM)	5 kHZ
50-75.995 MHz (W. FM)	50 kHz	165–190.995 MHz (W. FM)	50 kHZ
76–108 MHz	50 kHz	191-223 MHz	50 kHz

Except for meteor observations, the PRO80 is useful for us amateur astronomers in other fields. It gives all time stations above 150 kHz, which comes in very handy e.g. at stellar occultations. There are other types available:

- ICF-PRO70:
  - type 1: 150 kHz–108 MHz
  - type 2: 150 kHz–29.995 MHz and 87.6 MHz–108 MHz
  - type 3: 150 kHz–26.100 MHz and 87.6 MHz–108 MHz
- ICF-PRO80: 150 kHz–108 MHz
  - + adaptor: 115.15 MHz–223 MHz

For further information, turn to the Radio Coordinator or contact me personally (addresses elsewhere in this issue).

Fall and Winter 1987

The 1987 Orionids in the Netherlands

Klaas Jobse

An overview is given of the visual, photographic and video observations of the 1987 Orionids in the meteor observatory *Cyclops* in Oostkapelle, the Netherlands.

Bearing in mind the successful 1985 Orionid campaign, we (that is Marc de Lignie, Sicco van Hoegee and the author) decided to try again and watch for Halley-debris. Besides the all-sky camera, we also mounted four small-frame cameras. But even though the Cyclops crew can be considered very experienced in photographic meteor watches, some rather stupid mistakes were made, such as forgetting to uncap the lens, etc. We will spare you further details ...

We harvested 13 photographic meteors. Visually, over 1000 meteors were recorded, the best night being October 22–23 when there appeared 10 to 15 Orionids per hour (October 21–22 remained clouded). Also, activity seemed to be exceptionally high during the morning hours of October 26, when the author together with the image intensified video camera *BETSY* kept watching on for a few more hours. 16 Orionids appeared between 3^h and 4^h UT; the limiting magnitude was 6.3. It was also here that the brightest Orionid of all appeared ($3^h57^m01^s$) which activated the PMT and was photographed by one of the Nikon cameras.

The very brightest meteor came one day too late to be observed visually, but it was caught by the all-sky camera on October 26–27 as a meteor flaring to magnitude −6 at 60° elevation in the SSW. Unfortunately no timing was done because the PMT was at that moment inactive. The all-sky camera was opened from 3^h10^m to 5^h00^m UT.

Stimulated by several publications, we also looked for a possible high ε-Geminid activity. Quantitatively speaking the results were rather poor. ε-Geminids were remarkably fewer than Taurids, and very difficult to distinguish from the equally fast-moving Orionids. The Taurids appeared 3 to 5 per hour; one bright one was of magnitude −2. Very special were some slow, red to orange colored meteors with long paths in the sky, that kept fragmenting. A possible radiant would be located in the Cygnus-Draco region or more to the north. In the last few nights of the campaign some Lyncids and Leonids were also observed.

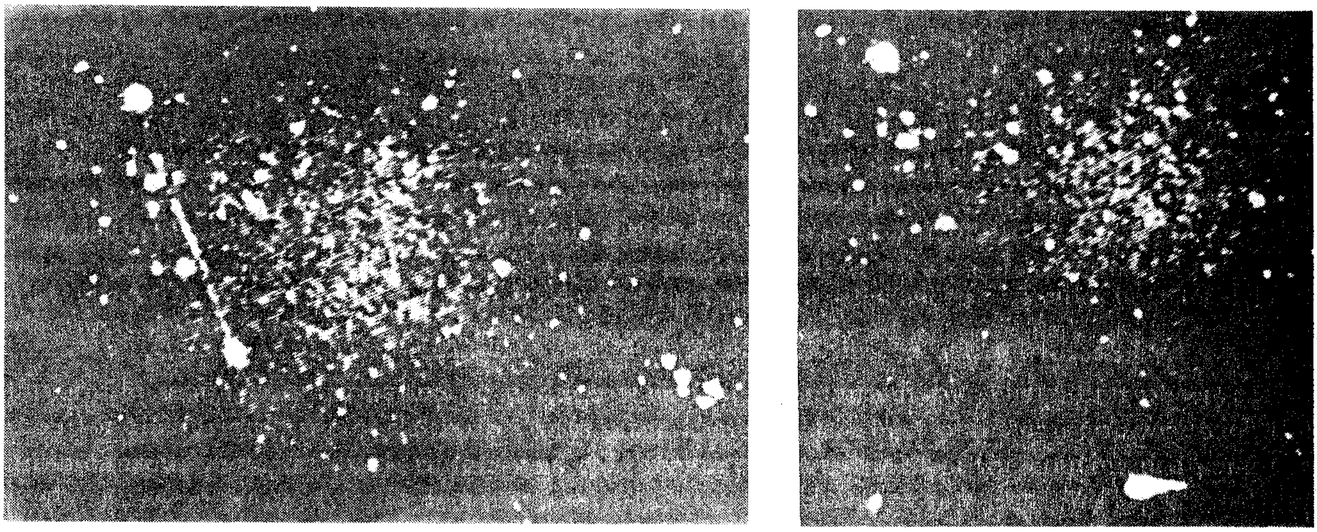

Figure 1 —Both pictures show the Hyades-Pleiades region. An Orionid of +2 was captured on October 22–23 at $0^h36^m57^s$ UT by *BETSY* (left). A persistent train is clearly visible. Seconds later, at $0^h37^m12^s$, a sporadic meteor was captured of magnitude +1 (right).

BETSY worked for 28 hours in total. During the first part of the night she viewed the Pleiades-Hyades and later on Gemini with a field diameter of 18°. The center of the field is always chosen in such a way that the meteors are easily traceable and identifyable and completely within view. This means we choose areas rather close to the radiant. During the Orionid campaign some 4 radiants were active, so we had to puzzle around a bit in order to find a suitable area for the camera. It is mounted equatorially and in this way it could keep the same field of view over longer periods of time. And this in turn eases the work afterwards (same reference stars). We guess we caught about 500 meteors on video during the Orionid watch. Some 1000 had to be processed ... So we can say it is quite a success!

1987 October Observations in Australia

Jeff Wood

An overview is given of the Australian observations of the Orionids, ε-Geminids and Taurids in October 1987, which were severly hampered by poor weather.

Favorable moon conditions led to a huge watch being planned by Australian observers to monitor the Orionid meteor stream. As is often the case, the best plans can go awry with the main cause being a series of troughs and cold fronts covering most of the continent during the major part of activity. Consequently observations in October 1987 were only able to be made on 6 nights. Poor weather continued through November, and during that month, Taurids were monitored during only 3 nights. Details of the observers are as follows:

Maurice Clark, Jeff Wood, Darren Ferdinando, Craig Hinton, Brian Macauley, Nicholas Harvey, Michelle Treasure, Jenny Ball, Tanya Gaitskell, Chris Beer, Andrew Anderson, Frank Farr, Louise Cockeram.

Table 1 — Australian observations of the 1987 Orionids, ϵ-Geminids and Taurids.

Date	Orionids		ε-Geminids		Taurids	
	Mean ZHR	Nr. Obs.	Mean ZHR	Nr. Obs.	Mean ZHR	Nr. Obs.
Oct 17–18	6.9	1	–	1	1.8	1
20–21	8.0 ± 1.0	3	3.3 ± 0.3	3	0.7 ± 0.5	3
21–22	10.3 ± 1.1	3	1.8 ± 0.2	3	0.7 ± 0.5	3
22–23	11.9 ± 0.8	4	2.4 ± 0.5	4	1.0 ± 0.7	4
23–24	7.8 ± 1.9	19	2.1 ± 1.6	19	1.7 ± 1.3	25
24–25	6.2 ± 0.5	3	1.6 ± 0.3	3	1.4 ± 0.6	3
Nov 18–19					2.3 ± 1.2	3
21–22					2.6 ± 1.4	14
23–24					2.3 ± 1.4	6

Table 2 — Global magnitude distributions of the 1987 Orionids, ε-Geminids and Taurids as obtained from Australian observations.

Shower	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$	Trains
Orionids	1	0	2	5	12	39	96	90	31	6	282	3.28	20.2 %
ε-Geminids	0	0	0	1	1	6	15	19	13	3	58	3.74	25.9 %
Taurids	0	2	0	2	7	18	29	26	14	1	99	3.09	3 %

For the Orionids, an r-value of 3.25 was derived for meteors between −1 and +5.

As far as colors are concerned, of the 59 Orionids of +2 or brighter, 53.6% were white, 34.5% were yellow, 5.1% were blue, 3.7% were orange, 1.7% were red and 1.7% were green. Of the 8 ε-Geminids of magnitude +2 or brighter, 2 were yellow and the remainder white in color. Finally, of the 29 Taurids of at least +2, 44.9% were white, 37.9% were yellow, 6.9% were orange, 6.9% were blue and 3.4% were green.

1987 October Observations in Maryland

Richard Taibi

An overview is given of the author's observations of the Orionids, ε-Geminids and Taurids in October 1987.

Table 1 — Observing sites for the 1987 October observations by Richard Taibi from Maryland.

Location	Abb.	λ	φ	h
McKendree, MD	MK	76°38′12″ W	38°46′50″	36 m
Camp Springs, MD	CS	76°54′12″ W	38°47′36″	73 m

Table 2 — Observations by Richard Taibi from Maryland in October 1987.

Date	Loc	Period (UT)	T_{eff}	Lm	F	Ori	ε-Gem	Tau	Spor
Oct 01–02	MK	07^h00^m–09^h00^m	2.00	6.0	1.00	2	0	0	14
04–05	MK	08^h00^m–09^h00^m	0.97	4.5–5.8	1.00	0	0	0	5
04–05	MK	09^h00^m–10^h00^m	1.00	5.8–4.5	1.00	0	0	0	5
15–16	CS	08^h30^m–09^h30^m	1.00	5.0	1.00	2	0	0	3
17–18	CS	07^h33^m–09^h23^m	1.83	4.5	1.00	0	0	1	7
18–19	CS	08^h03^m–09^h03^m	1.00	4.5	1.00	2	0	0	2
21–22	MK	06^h00^m–07^h00^m	1.00	6.0	1.00	7	2	0	4
21–22	MK	07^h00^m–08^h00^m	1.00	6.0	1.00	3	2	2	7
21–22	MK	08^h00^m–09^h30^m	1.50	6.0–5.5	1.00	14	2	2	7
22–23	MK	06^h57^m–08^h00^m	1.05	6.0	1.00	8	0	4	6
22–23	MK	08^h00^m–09^h00^m	1.00	6.0	1.00	7	1	1	4
22–23	MK	09^h00^m–10^h00^m	1.00	5.5	1.00	5	0	3	6
25–26	MK	06^h30^m–08^h00^m	1.50	6.0	1.00	5	0	3	13
25–26	MK	08^h00^m–09^h00^m	1.00	6.0	1.00	5	1	1	7
25–26	MK	09^h05^m–10^h00^m	0.01	5.5–5.0	1.00	6	0	0	5

Finnish Observations during the 1987 Fall

Teemu Hankamäki

An overview is given of the Finnish observations of the 1987 Orionids, Taurids, Geminids and Ursids.

The fall weather was rather poor in Finland. It was not ideal so that the Orionid as well as the Taurid and Leonid maxima were lost in the clouds. Geminids were well observed during two postmaximum nights, maximum night itself not being clear. In total, we observed 366 sporadics, 9 Orionids, 17 Taurids, 132 Geminids and 8 Ursids. The average magnitude of all sporadics was 3.07. The Giacobinids disappeared in the bad weather. Orionids were observed only during the night of October 13–14. Taurids we did observe: 17 Taurids resulted in an average magnitude of 2.59, and 5.9% showed train and color. Geminids were only well observed during the nights of December 13–14 and 14–15. The 1987 Geminids produced a good display but we had to observe under poor weather conditions. the average magnitude for the Geminids was 2.30. 6.1% of the Geminids showed a train and 4.4% had a color: most of these were yellow. The brightest Geminid was of magnitude −4. The following persons took part in the observations:

Leo Rajala (RAJLE), Tomi Anttila (ANTTO), Ismo Luukkonen (LUUIS), Teemu Hankamäki (HANTE), Markku Nissinen (NISMA), Hannu Määttänen (MAAHA).

Table 1 — Observations of the 1987 Orionids (O), Taurids (T), Geminids (Gem) and Ursids (U) from Finland.

Date	Obs	Period (UT)	T_{eff}	Lm	F	Gem	Other	Spor
Sep 03–04	RAJLE	21^h30^m–22^h40^m	1.13	5.87	1.08	0		16
15–16	ANTTO	20^h30^m–21^h50^m	1.15	5.38	1.11	0		7
17–18	RAJLE	20^h55^m–23^h00^m	2.03	6.47	1.00	0	1T	29
21–22	RAJLE	22^h15^m–23^h56^m	1.65	6.39	1.00	0	1T	28
28–29	RAJLE	21^h45^m–23^h20^m	1.33	6.22	1.00	0	1T	17
30–31	RAJLE	21^h25^m–22^h40^m	1.22	6.15	1.18	0	1T	26

Table 1 — continued

Date	Obs	Period (UT)	T_{eff}	Lm	F	Gem	Other	Spor
Oct 02–03	LUUIS	20^h05^m–22^h06^m	1.98	6.35	1.05	0		27
02–03	RAJLE	22^h15^m–01^h10^m	2.83	6.27	1.02	0	1T	66
13–14	RAJLE	22^h00^m–00^h00^m	1.93	5.60	1.11	0	9O,2T	19
19–20	HANTE	18^h00^m–18^h45^m	0.75	5.50	1.11	0		4
19–20	NISMA	18^h20^m–19^h45^m	1.07	5.11	1.11	0		8
30–31	RAJLE	21^h40^m–23^h30^m	1.58	6.36	1.01	0	8T	25
30–31	ANTTO	23^h00^m–00^h30^m	1.02	5.50	1.00	0	1T	4
Nov 03–04	RAJLE	19^h10^m–20^h10^m	0.98	5.80	1.00	0	1T	4
Dec 11–12	HANTE	16^h30^m–17^h05^m	0.50	5.00	1.11	1		3
11–12	LUUIS	19^h54^m–21^h54^m	1.97	6.18	1.11	8		17
13–14	HANTE	18^h00^m–18^h30^m	0.50	5.80	1.05	8		2
13–14	ANTTO	22^h25^m–22^h55^m	0.62	5.50	1.23	9		5
14–15	RAJLE	16^h00^m–17^h00^m	0.97	5.93	1.11	26		7
14–15	RAJLE	21^h55^m–23^h05^m	1.12	6.37	1.00	46		15
14–15	MAAHA	23^h00^m–00^h34^m	1.40	5.03	1.05	31		3
16–17	LUUIS	20^h59^m–22^h10^m	1.00	6.05	1.14	3		13
22–23	HANTE	18^h00^m–21^h00^m	2.75	5.80	1.11	0	8U	21

Table 2 — Global magnitude distributions of the 1987 Orionids, Taurids, Geminids and Ursids, and of the sporadic background, as obtained from Finnish observations.

Shower	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	Tot	$\overline{m}$
Orionids	0	0	0	0	1	0	1	2	4	1	11	2.55
Taurids	0	0	0	1	0	1	4	8	3	0	17	2.59
Geminids	1	3	2	5	7	18	23	40	24	9	132	2.30
Ursids	0	0	0	0	0	0	1	3	3	1	8	3.50
Sporadics	0	1	3	7	15	24	48	111	97	60	366	3.07

An Analysis of the 1987 Geminids in Canada

Peter Brown

Visual and radio observations of the 1987 meteor stream as recorded by the North American section of IMO are presented and discussed. The visual results are found to be of moderate to poor quality and allow for only a limited analysis. The radio data is found to be useful in determining maxima, but is generally too small for useful analysis. The hypothesis of Hughes is examined, as well as that of Jones in the context of these observations.

1. Introduction

The Geminid meteor shower remains one of the strongest and best observed meteor showers. It is a dynamic and unusual meteor stream having one of the smallest perihelion distances (a mere 0.14 AU) and shortest orbital periods of all known meteor showers: only 1.65 years. It is also the first meteor stream positively identified as having an asteroid (extinct cometary nucleus) as its parent body. While a great deal has been discovered about the stream in the last decade or so, many unresolved questions remain. Meteor observers are in a unique position to add valuably to our understanding of the stream by confirming or denying some of the present theories concerning the stream through their observations.

Hughes et al. [1] have suggested through extensive theoretical calculations that the stream is currently in decline and should become invisible from the Earth in about 100 years. They also deduce that the large nodal regression of 1.6 degrees per century should result in a change in the time of maximum of about 1 day per century. As the Geminid shower ages, Earth based observers should note a change in the rate profile, with the values skewing to one side, causing a slow rise to maximum and a rapid decline after that as the stream ages.

Jones [2] made use of extensive computer simulations of the orbit of 71 test particles with Geminid-like orbits to calculate the effect the perturbations by Jupiter would have on the distribution of these particles. The results showed that the Geminid particles are gradually arranging into a torus-like structure, with the main axis of the torus perpendicular to the Earth's orbit. This effect should manifest itself as a secondary maximum observed some hours after the main maximum, both showing characteristic mass sorting, with the largest particles found well after the main maximum.

The last major analysis of the Geminid stream was done by Roggemans [3] in 1986. His analysis of the 1985 Geminid return showed that no extensive shift had occurred in the maximum of the stream, still situated at $\lambda = 261.3°$. The r-value derived from over 2000 meteors studied in his 1986 paper was 2.5, very similar to results found in past years such as the 1980 analysis by Spalding [4].

2. Some general comments on the observations

The results presented here are from visual and radio observations made in 1987 from Alberta, Canada, under the guidance of the North American section of IMO. The 1987 return of the Geminids was very favorable as the moon was last quarter and did not rise until well after midnight, permitting extensive observations to be made in dark skies. The 1987 return was a mixed blessing for Alberta, with clouds hampering observation on every night except the maximum, but with the aurora very quiet allowing good visual observations to be made on the night of maximum, as well as accurate radio observations for many days on either side of the maximum.

Only two observers obtained useful visual results from two separate sites in Alberta. They were Mark Zalcik (MZ) observing from Elk Island National Park (112°51′ W, 53°37′ N) and Peter Brown (PB) observing from Maqua Lake (111°16′ W, 56°23′ N). In all some 251 Geminids and 52 sporadics were observed and recorded on the night of maximum.

Radio observations were made from Fort McMurray (111°26′ W, 56°43′ N), using a five element Yagi and a standard commercial digital car radio receiver. All radio results were obtained with the antenna pointed at 180° azimuth and 13° altitude, with the radio tuned to 90.0 MHz, unless otherwise noted. In all, some 229 radio echoes were recorded from November 30 to December 17.

3. Visual Observations

Table 1 lists the hourly rates and computed ZHRs for all the visual observations made on the night of maximum. Due to a low radiant and less than perfect observing conditions, the uncertainty in the individual ZHRs is too large to allow for conclusions based on specific data of any one hour. In addition, the ZHRs reported by MZ are more than a factor two below those found by PB.

Table 1 — ZHR of the 1987 Geminids and HR of the sporadic background as obtained from Canadian observations.

Date	Obs	Period (UT)	T_{eff}	Lm	F	Gem	ZHR	Spor	HR
Dec 13–14	PB	01^h50^m–02^h50^m	0.96	6.1	1.00	10	48 ± 17	3	5 ± 3
13–14	PB	02^h50^m–03^h50^m	0.81	6.1	1.00	21	86 ± 23	3	5 ± 3
13–14	PB	03^h50^m–04^h50^m	0.88	6.0	1.00	30	78 ± 16	6	11 ± 5
13–14	PB	04^h50^m–05^h20^m	0.30	6.0	1.00	10	82 ± 29	2	4 ± 2
13–14	MZ	05^h00^m–06^h00^m	1.00	5.9	1.00	21	54 ± 13	16	34 ± 9
13–14	PB	05^h40^m–06^h40^m	0.91	6.0	1.00	42	97 ± 14	6	11 ± 5
13–14	MZ	06^h00^m–07^h00^m	1.00	5.7	1.00	22	59 ± 13	7	19 ± 8
13–14	PB	06^h40^m–07^h40^m	0.89	6.1	1.00	49	95 ± 14	5	8 ± 4
13–14	PB	08^h00^m–09^h00^m	0.90	6.0	1.00	52	101 ± 14	4	8 ± 4

One possible explanation lies in the number of sporadic meteors recorded by both observers. PB finds no more than 6 sporadics (including the numerous minor showers) in any one hour, the average being 4.5 (the time block 04^h50^m–05^h20^m UT was omitted due to an inadequate sampling time). In contrast, MZ obtains an average value of 11.25 sporadics per hour. It seems likely that PB is including many sporadics as Geminids and MZ many Geminids as sporadics, thus producing the observed distributions. There also seems to be a real perceptional difference due largely to the difference in observing circumstances (MZ's location had a limiting magnitude some 0.3 below the average at PB's site).

When the ZHR values are qualitatively corrected for these errors it seems that a peak ZHR near 70 or 80 at approximately 06^h00^m–08^h00^m UT on December 14 would be in order. Millman [5] predicted that the Geminid maximum would occur at 18^h UT on December 14, the middle of the day in Alberta, so a maximum in the early morning hours should appear from the visual observations. However, great caution must be placed even on this determination, as it is undoubtedly very inexact due to the small sample and the errors previously noted. Nevertheless, with this in mind it is probably quite safe to say that the Geminid stream has not shown any significant increase or decrease in activity during the 1987 shower when compared to past years, with regard to the period close to maximum.

Table 2 lists the magnitude distributions for the sporadics and the Geminids for Dec 13–14 for both observers. From previous years' observations it is known that the Geminid mean magnitude is roughly 2.5-2.9, e.g. [3].

Table 2 — Global magnitude distributions of the 1987 Geminids and of the sporadic background, as obtained from Canadian observations.

Obs	Shower	−3	−2	−1	0	+1	+2	+3	+4	+5	Tot	$\overline{m}$
MZ	Gem	1	2	5	10	2	5	5	9	3	43	1.51
MZ	Spor	0	0	1	1	0	0	8	7	6	23	3.52
PB	Gem	1	0	1	7	21	42	74	53	9	208	2.79
PB	Spor	0	0	0	0	1	5	9	7	7	29	3.48
Tot	Gem	2	2	7	17	23	47	79	62	12	251	2.57
Tot	Spor	0	0	1	1	1	5	17	14	13	52	3.46

From the mean Geminid magnitudes it is apparent that the two observers were both widely biased in different directions, with PB noting the magnitudes too faint (average of 2.79) relative to MZ's 1.51. Certainly this large a discrepancy cannot be attributed entirely to the differences between the conditions at the two sites. Instead, it appears that real perceptional differences exist, as well as, very likely, differences in competence and level of experience.

Due to the nature of visual meteor work one cannot positively determine which observer was accurately portraying the stream's magnitude distribution. One test value, however, which may be used to determine the relative quality of the observations is the difference between the average magnitude of the sporadics and the shower meteors. This value should be about 0.6 to 0.8 for an accurate set of observations where the sporadic and shower meteors are well separated. For PB's observations the value is 0.69, while for MZ it is 2.01. Taken alone this suggests that MZ was not properly separating the shower and sporadic meteors, and may have had problems with the magnitude estimations as well.

The combined totals should give a fair representation of the overall shower magnitude distribution as a larger data base is used. Unfortunately MZ's data might be expected to adversely affect the results, leading to false conclusions. Nevertheless, when combined, an average magnitude of 2.57 for the Geminids and 3.46 for the sporadics is obtained, giving 0.89 for the difference. The average value for the Geminids is not very far from the weighted average obtained from some 18 544 Geminids as given in [6]. Here a value of 2.68 is found from the huge database. This value is equidistant from the combined results and PB's mean Geminid magnitude. The combined value, therefore, does not appear to be extreme from the average magnitude data, so an analysis of the combined results may lead to proper conclusions, as MZ's data is very diluted in the overall results.

The value r is much more sensitive to any consistent magnitude biased; from past work one expects an r-value of about 2.5 for the shower [3]. PB's data gives an r-value of 3.22, while MZ's gives a value of 1.95. Both these values indicate that each of the observers has been improperly estimating magnitudes. Combining the two data sets gives an r-value of 2.48. However, due to the small size of the data set and the large errors that both observers seem to have made in magnitude estimations, the final result cannot logically be expected to be representative of the stream, even if the two skewed data sets cancel one another out and provide a reasonable picture as in this particular case.

4. Radio Results

Using a radio forward scatter system, observer PB was able to compile a reasonably large data set for the entire 1987 Geminid apparition. Table 3 lists the number of echoes recorded in each hour as well as the number of echoes lasting for more than one second.

Table 3 — Canadian forward scatter results for the 1987 Geminids at 90 MHz (except for December 12–13, when the frequency was 89 MHz).

Date	Period (UT)	Tot	> 1 s	Date	Period (UT)	Tot	> 1 s
Nov 30–31	04^h00^m–05^h00^m	10	1	Dec 09–10	04^h00^m–05^h00^m	18	2
Dec 02–03	04^h00^m–05^h00^m	14	1	10–11	04^h00^m–05^h00^m	18	3
03–04	04^h00^m–05^h00^m	14	3	11–12	04^h00^m–05^h00^m	16	1
04–05	04^h00^m–05^h00^m	9	0	12–13	04^h30^m–05^h00^m	31	3
05–06	04^h10^m–05^h10^m	7	2	14–15	04^h00^m–05^h00^m	40	6
06–07	04^h00^m–05^h00^m	8	0	15–16	04^h00^m–05^h00^m	21	4
07–08	04^h25^m–05^h25^m	10	0	16–17	04^h00^m–05^h00^m	6	0
08–09	04^h00^m–05^h00^m	7	2				

Each of the hourly counts should be intercomparable as the observations were made at the same time each day. The effects of radiant drift are nearly negligible on a system of this sensitivity for the analysis that is to be done.

From the results it is apparent that there is no particular trend in the number of echoes each hour until December 9–10. From that date on, to about Dec 15–16, a significant increase above the normal sporadic background level is observed. Unfortunately as the system requires an operator, no echoes could be obtained on the night of maximum. The largest number of echoes appears to have been picked up on December 12–13, when proper allowance is made for the brief observing period. As well, the well-known mass-sorting effect, which generally leaves the largest particles somewhat after maximum, may have been observed, as the number of long echoes on December 14–15 and 15–16 was considerably higher than in the pre-maximum or sporadic background periods.

5. Conclusions

From both the radio results and visual observations no unusually strong activity appears to have occurred within the Geminid stream while it was near maximum over North America, or during its period of rise and fall from maximum. That is not to say that some unusual activity did not take place somewhere else, or when observations were not being carried out. However, from the observations made, especially those on the maximum night, no unusually strong or weak return of the Geminids in 1987 appears to have occurred.

The observed ZHRs are well withing the statistical range expected for a fairly normal return when all the variables affecting visual rates are examined. The radio results are the first obtained with the new equipment and should be analyzed as such. The decrease in rates predicted by Hughes was certainly not observed to any considerable extent. However, due to the random nature of the quantitative maximum of the shower, only a long-term analysis of visual observations is likely to prove or disprove this hypothesis. An unusually abrupt change in activity of the shower is likely to be due to some other effect. The secondary maximum predicted by Jones could not be confirmed due to the limited number of observations. This too will only be confirmed or disproved through a long-term analysis of visual and radio observations.

The visual observations appear to be very biased in opposite directions. ZHR data indicates that both observers had trouble separating sporadics and Geminids, a conclusion largely supported by the magnitude data. Neither observer had reasonable values of r for the shower and only PB had a mean magnitude for the shower close to that found in previous years.

References

[1] D.W. Hughes,K. Fox, I.P. Williams, "The Evolution of the Orbit of the Geminid Meteor Stream", *Monthly Notices Roy. Astron. Soc.* 199, 1982, pp. 313-324.

[2] J. Jones, "The Structure of the Geminid Meteor Stream – I", *Monthly Notices Roy. Astron. Soc.* 217, 1985, pp. 533–538.

[3] P. Roggemans, "On the Geminid Meteor Stream in 1985", *WGN* 14 : 2, April 1986, pp. 48–63.

[4] G. Spalding, "The Geminid Meteor Stream in 1980", *Journ. British Astron. Ass.* 92, 1982, pp. 227–233.

[5] P.M. Millman, "Meteors, Comets and Dust", *The Observer's Handbook* 1987, R. Bishop (ed.), Univ. of Toronto Press, 1987, pp. 142–143.

[6] G.W. Kronk, "Meteor Showers: A Descriptive Catalogue", Enslow Publishers, Hillside N.J., 1988.

The 1987 Geminids in Australia

Jeff Wood

An overview is given of the Australian observations of the 1987 Geminids.

1987 has seen Australian meteor observers carry out yet another extensive observing program for the Geminids. The 1987 Geminid watch involved 18 people who covered every night from

December 10–11 to 16–17. During this period of time, a total of 62 man-hours of observations were made. Much valuable information was obtained. The following observers participated:

Darren Ferdinando, Louise Cockeram, Jeff Wood, Nicholas Harvey, John Goldsmith, Jenny Ball, Michelle Treasure, Michelle Cockeram, Brian Macauley, Martin Coroneos, Andrew Caminischi, Guy Blackman, George Platt, John Liew, Robert Price, Elizabeth Price, Mark Sheppard, Johnathon Rothwell.

Table 1 — ZHR-values for the 1987 Geminids observed in Australia.

Date	ZHR	Nr. Obs.
Dec 10–11	6.6 ± 2.2	6
11–12	11.3 ± 1.7	5
12–13	16.8 ± 2.4	7
13–14	37.4 ± 13.1	11
14–15	61.0 ± 12.8	23
15–16	10.7 ± 2.9	6
16–17	3.5 ± 0.6	4

Few Geminids leave a train. Only 4.96% of those seen in 1987 had one. All of these were of short duration lasting no more than 5 seconds.

Table 2 — Global magnitude distribution of the 1987 Geminids as obtained from Australian observations.

Magnitude	−6	−5	−4	−3	−2	−1	0	1	2	3	4	5	6	Tot	$\overline{m}$
Number	2	3	1	4	9	21	55	137	328	344	292	139	16	1351	2.74

For the meteors of magnitude −4 to +5, an r-value of 2.78 was derived. Of all Geminids of magnitude +2 or brighter, 49.5% were white, 38.5% were yellow, 5.8% were orange, 3.0% were green, 2.2% were blue, 0.8% were red and 0.2% were violet.

The 1987 Geminid meteor stream did not produce the high level of activity as seen in the previous years. The maximum ZHR was reached on the night of December 14–15 and this was only 61 meteors per hour. The comparatively low ZHR, the fact that rates were continually rising on the night of December 13–14 and falling on the night of December 14–15, and the average magnitude was brighter on December 14–15 than on December 13–14 all seem to indicate that the true maximum occurred during daylight hours in Australia. Extrapolation of the activity curve reveals that the true maximum occurred at around 18^h UT with a ZHR of 80–90. It will be interesting to compare our findings with those of our American and European colleagues.

Wherever you live, if you were able to carry out Geminid observations in 1988, let us know and send us a report for *WGN*! Particularly in the Northern Hemisphere, this magnificent meteor shower is often ngelected because of cold weather or examinations. We hope *you* were successful this year!

Some typing errors were spotted in this issue while part of it was already in print. On p. 207, in the heading of the table, read "Obs" instead of "Nr. Obs". On p. 212, in the heading of Table 1, read "Cyg" instead of "Cap".

The 29th Annual Assembly of the NMS

Kyoto, August 20–21, 1988

Masahiro Koseki

Over hundred participants attended the meeting. We had two lectures by professionals and 18 papers were presented. In the evening debate we discussed the new observational form necessary for the use of the new ZHR formula.

Dr. K. Nagasawa explained in his lecture the possibility to use the differences between the arrivals of the shock wave caused by a fireball to calculate its path in the Earth's atmosphere. Mr. Y. Hanaoka gave an introduction to a CCD camera and discussed the problems to be considered when using a CCD camera and computer aided system. Image-intensified (I.I.) observations were one of the most exciting subjects throughout this meeting and three papers were presented without this lecture.

All the participants were fascinated by the video display of the Geminids and η-Aquarids. K.Suzuki and three other persons reported, "Our I.I. system consists of four sets of I.I. with a video camera in front of which a 135 mm camera lens is placed. We read the position of a meteor each 1/30 of a second directly from the screen using a transparent sheet of graph paper. This rather simple method results in an error of about $2'$ on the position, but this is better than for short trail meteors photographed by small cameras and there is no improvement in spite of using an expensive apparatus. We got five η-Aquarid meteors registered from two or three stations mainly of magnitude 5 or 6 during 180 minutes observation. The calculated orbits suggest that the semi major axis is generally short and the orbits resemble those of TV meteors. But a quite important problem arises. The image of a meteor on the screen is naturally different from ordinary photographs and the orbit would certainly differ when we use the first part of the trail or another part of the meteor trail." M. Ueda also reported I.I. observations, "I use a second hand I.I. imported from the USA which costs about 1200 USD in total. It shows spots and an irregular sensitivity, which changes sometimes . However it is a reasonable price enabling me to observe meteors fainter than magnitude +6 in a city where light pollution hamper all observing seriously. It is necessary to use a telelens, such as a 200 mm, in order to get 2 to 3 minutes of arc accuracy in the position."

Visual and FM radio observations, used for meteor observations were successful after years of endeavour. K. Izumi confirmed the daily and annual variations of sporadic meteor rates from his 17 years observations. K. Maeda gave his β-Ursid observations for the period 1982–1987 with FM radio reflections. "The activity of the β-Ursids has been rather low, but the number of over 5 second duration echoes shows the stable activity every year. In 1982 an unexpected high rate was recorded and the proportion of the long duration echoes was high." Next, T. Shimoda took the chair and also spoke about FM radio observations. "From 1982-1988 observations I confirmed the double or triple peaks of the Geminids. I compensate the data in order to compare the number of echoes by taking the number when the radiant transits the meridian as the standard. Quadrantids showed the highest activity in 1987 and in other years it was a medium activity level." Y. Shigeno said he made 30 sets of mountings with a rotating shutter and had distributed these to the people who desired to obtain one.He also mentioned the full automated mount which can be driven, corrected for wind, etc.

Another most important subject was the new ZHR formula and the new form of the report. M. Koseki gave an introduction to the formula and the practical problems when it is used. The main problem is the exponent law for the zenithal correction, the calculation of the magnitude ratio and the limiting magnitude estimation. In the evening debate, we determined that we will use a new form which requests to fill in the limiting magnitude in steps of 0.1 magnitude unit and the magnitude distribution of sporadic meteors as well as for shower meteors. We will publish two ZHRs for the present. One of them is based on the ordinary formula and the other is a new one. The new formula has the form:

$$\text{ZHR} = \frac{r^{(6.5-\text{lm})}}{\sin^{\gamma} Z} \times \text{Hourly rate}$$

We should endeavor to find a more suitable method of estimating the limiting magnitude and investigate to define the exponent law of the zenithal correction γ. The magnitude ratio r and γ may differ from hour to hour and from stream to stream. It is stressed that "Ramka" observations is the most suitable method to obtain the mass flux and this should be encouraged, though the method of the analysis for it is not popular and the results are not able to compare the ZHR values directly.

M. Koseki gave the general report for the session of 1987 to 1988. He read the message from P. Roggemans and introduced IMO. Three newly published handbooks, the IMO-handbook, that of DMS and Babadzhanov's were exhibited in envisioning the publication of the NMS' own handbook. It is stressed that we should make efforts to get applicable data for the new formula and to continue cooperative works with foreign groups. He concluded that we will meet again in Hiroshima next August.

The Meteor Library

compiled by Paul Roggemans

- *Duncan Olsson-Steel, "Identification of Meteoroid Streams from Apollo Asteroids in the Adelaide Radar Orbit Surveys", Icarus 75, 1988, pp. 64–96.*

A search is made for asteroid-related meteoroids among the 3759 orbits determined in two Adelaide radar meteor orbit surveys of the 1960s; these are the only southern hemisphere surveys yet completed. All meteor orbits are compared to the orbits of all known comets and established meteor showers. For the comets comparatively modest numbers of correlated meteors are found. In contrast, a similar comparison with the orbits of all Aten, Apollo and Amor asteroids discovered through 1986 October reveals strong meteor associations for several of the Apollo asteroids. A new and powerful technique is developed which allows the recognition of streams associated with specific parent objects, when large orbit surveys are analyzed. Apart from 3200 Phaeton, the Geminid parent, meteoroid streams are found to be associated with 1566 Icarus, 2101 Adonis, 2201 Oljato, 2212 Hephaistos, 1973 UB (Hermes), 5025 P-L, 1982 TA, and 1984 KB. These all give rise to meteors of velocity at least 22 km/sec. There is also evidence of meteor activity for a few other Apollos; no streams are found for any of the Atens or Amors. Theoretical radiants and velocities are calculated for all asteroids of perihelion distance less than 1.025 AU which approach the Earth to within .1 AU, and it is shown that the lack of observed meteor streams for each can be explained in terms of the radiants being inaccessible from the Adelaide site (35° S), the lack of observations at the appropriate time of year, or the expected meteor velocities being below 20 km/sec and hence producing little ionization and having a severely reduced probability of detection. It therefore appears that meteoroid streams are a general feature associated with Apollo asteroids.

- *V. Porubčan, R.P. Chebotarev, "Activity of the Lyrid Meteor Shower from Radio Observations at Dushanbe", Contrib. Astron. Obs. Skalnaté Pleso 17, 1988, pp. 293–300.*

Radio observations of the Lyrid meteor shower at Gissar Observatory in 1982–1986 are analyzed and discussed. The Lyrid activity, derived on the basis of range distribution analysis, exhibits a compound maximum at solar longitude $\lambda_{\odot} = 31\overset{\circ}{.}9$ (epoch 1950.0).

- *B.A. Lindblad, "The IAU Meteor Data Center in Lund" Proc. 10th Europ. Reg. Astron. Meeting of the IAU, Prague, 1987, vol. 2, Interplanetary Matter (Z. Ceplecha, P. Pecina, eds.), Publications Astron. Inst. Czechosl. 67, pp. 201–204.*

The purpose of the IAU Meteor Data Center in Lund is to archive information on meteoroid orbits. At present some 5000 photographic double-station orbits and more than 60 000 radio determined orbits are archived. The paper describes the available data and discusses some problems encountered in the archiving process.

- *P. Pecina, "Derivation of Fresnel Characteristics with Deceleration of the Meteoroid Taken into Account", Bull. Astron. Inst. Czechosl. 39, 1988, pp. 193–208.*

The work deals with incorporation of the meteoroid deceleration into the concept of Fresnel characteristics used for the determination of meteoroid velocities. The theory so far employed was able to determine the velocity v_0 which the bodies possess in the vicinity of the specular point. Since v_0 differs generally from v_l directly from the measured amplitudes. As a byproduct, the ablation parameter σ can also be obtained with a low relative error. The theory developed is based on concepts published by Pecina and Ceplecha (1983, 1984) improving the precision of finding the principal parameters of meteor physics theory. If the new theory was to be developed, the electron volume density $\mathrm{Ne}(r,t)$ produced by the source subjected to deceleration was to be established. First, having obtained the expression for $\mathrm{Ne}(r,t)$, its inclusion in the radar equation enabled the derivation of the theoretical formula for Fresnel characteristics. the basic formulae of the method of gradients ensuring the applicability of the new nonlinear theory to observations can be derived. Using the gradient method, we compare the squares of normalized amplitudes instead of those ensuring better convergence of the applied iteration procedure. Some numerical problems with the theory applied to testing amplitudes of Fresnel characteristics are mentioned as well. The problem of initial estimate of the searched parameters is also treated.

- *P. Pecina, "Meteoroid Deceleration and the Fresnel Characteristics", Proc. 10th Europ. Reg. Astron. Meeting of the IAU, Prague, 1987, vol. 2, Interplanetary Matter (Z. Ceplecha, P. Pecina, eds.), Publications Astron. Inst. Czechosl. 67, pp. 205–210.*

The work describes briefly the application of the complete solution of the basic equations of meteor physics, found in connection with solving the problems of photographic meteor theory, to the construction of theoretical Fresnel characteristics. It is shown how the meteoroid deceleration can be incorporated into concepts of radar physics. The corresponding equations are derived and the possibility of using these Fresnel characteristics for the evaluation of the ablation parameter σ and the pre-atmospheric velocity v_∞ from the registered amplitudes is briefly discussed.

- *P. Pecina, "Meteor Physics", Proc. 10th Europ. Reg. Astron. Meeting of the IAU, Prague, 1987, vol. 2, Interplanetary Matter (Z. Ceplecha, P. Pecina, eds.), Publications Astron. Inst. Czechosl. 67, pp. 183–188.*

Some comments on problems connected with our knowledge and understanding of events observable during the meteoroid flight through the atmosphere are presented. The review is divided into three parts. The first part deals with the section of flight characterized by the increase of body temperature from the value reached at the heliocentric distance 1 AU, i.e. at the frontier of the Earth's atmosphere, which was estimated to be approximately 280° K, to the temperature at which the evaporation of the meteoroid can start. This process is designated as pre-ablation heating. The second part deals with effects connected with the visible trajectory as well as with ionization trails and problems related to them. There exists generic connection between luminous flight of meteoroids and dark flight with the possibility of finding the meteorites fallen to the ground namely with the predictability of the impact area and the impact itself. This is the subject of the third part.

WGN — Useful Addresses

Administration

Paul Roggemans, Pijnboomstraat 25, B-2800 Mechelen (015/41 12 25)

Treasurer

Ann Schroyens, Stuivenbergvaart 48, B-2800 Mechelen
postal (giro) account number: 000–1601407–34

Coordination Visual Work

Glenn Ticket, Koninginnelaan 11, B-8470 De Panne (058/41 42 18)

Coordination Radio Work

Jeroen Van Wassenhove, 's-Gravenstraat 66, B-9730 Nazareth (091/85 61 09)

Coordination Computational and Photographic Work

Christian Steyaert, Dr. Van de Perrestraat, B-2440 Geel (014/58 20 75 or 091/62 75 03)

WGN — Production

Editor-in-chief: Marc Gyssens, Heerbaan 74, B-2530 Boechout (03/455 68 18)

Editorial board: Peter Brown, 181 Sifton Ave, Ft. McMurray, *Alberta T9H 4V7, Canada*
Trond Erik Hillestad, Stengelsrud, N-3600 Kongsberg, *Norway*
Masahiro Koseki, 4-3-5 Annaka Annaka-shi, Gunma-ken 379-01, *Japan*
Jürgen Rendtel, PSF 37, DDR-1561 Potsdam, *GDR*
Jeff Wood, 37 Hodgson Street, Tuart Hill, *West-Australia 6060, Australia*

Typesetting: Urania, the Public Observatory of Antwerp

Printing: André Gabriël

Some Correspondents of WGN

Per T. Aldrich, Næsbyholmvej 6 st.th., DK-2700 Brønshoj, *Denmark*
Evelyne Blomme, 5 ave. P. Picasso, appt. 217 (1), F-94120 Fontenay sous Bois, *France*
Ignacio Ferrin, Apartado 700, Merida 5101-A, *Venezuela*
Teemu Hankamäki, SF-38280 Illo, *Finland*
Dieter Heinlein, Puschendorferstraße 1, D-8501 Veitsbronn, *FRG*
Carl Johannink, Wilhelminastraat 27, NL-7591 TR Denekamp, *the Netherlands*
V.V. Martynenko, Crimean Technical Institute, Observatory, Simferopol, Box 52, *Crimea* 333 000, *USSR*
Klar G. Renner, Rua Ramiro Barcelos, 1820/801 Porto Alegre-RS, *Brasil*
Hans Salm, Casilla 10030, La Paz, *Bolivia*
Hans Georg Schmidt, Dr. Machstraße 111, D-8013 Haar, *FRG*
Gilbert Schmitz, 3 Rue Bender, L-1229 Luxembourg, *Luxemburg*
Wanda Simmons, Route 3, Box 1062, Callahan, *Florida 32011, USA*
George Spalding, 2 Hyde Rd, Denchworth, Wantage, Oxon OX12 0DR, *England, UK*
Enrico Stomeo, Maurizio Eltri, Via Bragadin 2, I-30126 Lido (VE), *Italy*
Gabor Süle, Egry 47/B u.11, H-8200 Veszprém, *Hungary*
José Trigo-Campoy Rodriguez, Avda Antic Regne de Valencia 35, 9 aptda, E-46005 Valencia, *Spain*
Yabu Yasuo, 878 Maruyam-cho, 523 Shiga-ken, *Japan*

Preliminary Announcement

International Meteor Weekend 1989

Balatonszavszo, Hungar, September 7–10, 1989

From now on, registration forms can be obtained from the *Hungarian Amateur Atsronomical Society (MACSIT), Pf. 36, H-1387 Budapest, Hungary.* Accomodation will be provided in a hotel, 10 minutes from Lake Balaton (two or four bed rooms, shower, etc.) The participation fee has not been set yet, but is expected to be about 250 DEM (West-German Marks).

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.

Available now !!! Proceedings

International Meteor Weekend 1988

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People having prepaid will receive the proceedings around December 15 without any additional charges.