bimonthly

# wgn

16 — 1

february 1988

## the international circular for meteor observers

This unique sporadic fireball of magnitude -7 was captured by S. Zhitelzeif of the Regional Young Astronomical Observatory of the Crimean Young Technicians Station over a castle of the Crimean city of Sudak during a test with a "Zodiak" lens on a "Salut" camera in the course of a Perseid observation campaign on August 6, 1986 at $23^h33^m$ UT.



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

*WGN, volume 15, nr 1, February 1987, pp. 1–34*

# Contents



# Useful Information

## The April Issue *(WGN 16:2)*

This issue will appear in Belgium in the last week of March. As we already have sufficient material for this issue, we unfortunately cannot publish new contributions in it. Meanwhile, please note that articles for the *June issue* are due by *May 1* at the latest. They should be sent to *Marc Gyssens* (address on the inside of the back cover).

## Subscriptions 1988

The subscription rate for volume 16 is 300 BEF. Persons living in Belgium pay 200 BEF. Subscribers from outside Europe can pay a supplement for airmail delivery: 100 BEF for North- and South-America (excluding Hawaii and other Pacific islands), 150 BEF for Japan and 200 BEF for Australia, New Zealand, Hawaii and other Pacific islands. Additional gifts are of course welcome.

Please make sure that we retain the full amount due after deduction of bank and/or exchange charges. It is recommended to pay by international postal money order to Ann Schroyens (address on the inside of the back cover). Other "safe" ways of payment are suggested in *WGN 16:1* on p. 2.

## Administrative Correspondence

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

# *From the Editor*

*Marc Gyssens*

*First of all, my best wishes for 1988 on behalf of the entire team of WGN. May the new year be rich in starry skies, successful meteor observing campaigns and bright fireballs! And may it also be satisfactory in your personal and family lives. Also, I welcome our new readers who join the audience of WGN with this issue. WGN now exists for over 15 years and it has gone a long way during that period. It originated as a circular of the Meteor Section of the Belgian "Vereniging voor Sterrenkunde"; actually "WGN" used to stand for "Werkgroepnieuws" which is Dutch for "Working Group News". Since its becoming in existence, WGN continually improved both its contents and its presentation. This has led to a growing number of readers from all over the world. As a consequence, an ever increasing percentage of articles was published in English. Last year, we even received several contributions of professional meteor astronomers. Also, more and more Belgian and Dutch started to write their articles in English too, to make their results accessable for a wider audience. As a result, we felt that the status WGN had had for nearly fifteen years could no longer be sustained. From this issue onwards, WGN will try to be a full-fledged international English language journal on meteor astronomy. We hope and do our best to succeed in this goal and we hope that all our readers - both new and old ones - will enjoy this and future issues of WGN; your reactions are always welcomed!*

*These ambitious goals for WGN are not an ending point, however. While bringing together so many results from different countries in WGN, a feeling gradually grew stronger that more could be done to improve coordination between meteor workers worldwide. The variable star observers e.g. have the AAVSO, but what do we have? Concrete plans for an International Meteor Organization are developed by Paul Roggemans in this issue; of course, we also like to hear your comments about this matter!*

*Traditionally, New Year is a time for making good intentions; as you can see for yourselves, we have made a lot of them for 1988. The realization of these intentions, however, will depend on the cooperation of the international meteor community, a part of which will meet in March in Oldenzaal, the Netherlands at the occasion of the International Meteor Weekend that will be held there. We count on you!*

# Financial Support for WGN

The following subscribers paid more than required for their subscription in 1987. To all these people and organizations, our sincere thanks for your financial support to *WGN*!

A.S.H. Polaris (Belgium), Gerrit Breuls (Belgium), Dirk Eeckhaut (Belgium), Marc Gyssens (Belgium), W. Korver (the Netherlands), Robert Lunsford (USA), Pekka Parviainen (Finland), Gilberto Klar Renner (Brasil), Paul Roggemans (Belgium), E.J. Van Ballegoy (the Netherlands), Bartel Van De Walle (Belgium), René Van Hove (Belgium), Philippe Vercouter (Belgium), Pierre Vingerhoets (Belgium), Werner Massubich (FRG), Trond Erik Hillestad (Norway), Patrick Wils (Belgium), Casper ter Kuile (the Netherlands), Jost Jahn (FRG), Luc Gobin (Belgium), Erik Bredael (Belgium), Koen Miskotte (the Netherlands), Limburgse Volkssterrenwacht (Belgium), Octaaf Steen (Belgium), Koen Vijverman (Belgium), George Spalding (UK), Bauke Rispens (the Netherlands).

# Methods of Payment for WGN and Its Publications

Effective February 15, *WGN* has a new treasurer: *Ann Schroyens* (address on inside of back cover). Please use the new postal account number, also mentioned on the inside of the back cover from that date onwards. Of course, payments already made before you received this issue of *WGN* to the old account number of Paul Roggemans will still be acknowledged.

In case you did not yet pay your subscription for 1988, you find the necessary information about rates on the inside of the front cover. However, you must make sure that we receive the full amount which is due. Therefore, we ask you to be careful about the way you choose to pay, since bank charges and exchange costs can add up to a considerable amount. The following advice can be helpful for payments from outside Belgium:

- A way of payment that does not involve any charges, is the international postal money order. Although less popular in e.g. North-America, we recommend this way of payment. You can obtain more information at your local post office.
- If you have a postal (giro) account, you can pay your dues by transfering the money from your account to the postal account of Ann Schroyens, which is mentioned on the inside of the back cover. This method too does not involve any charges.
- European subscribers can also pay without invoking any costs by using Eurocheques provided the following conditions are met: the amount must be written in Belgian francs, you must mention a Belgian city (e.g. Brussels) as the place where the check was drawn, the check must be made payable to Ann Schroyens and you may not forget to mention your Eurocheque card number on the back.
- You can also use US dollar traveller's cheques. In that case, you must add 100 Belgian francs for each check you use.
- If you want to pay by a check, other than those mentioned above, you must go to your bank and ask for a bank check and state explicitely that you must be charged with all costs involved in cashing the check. In no case, we can accept personal checks.
- Finally, we must mention what is perhaps the most easiest way, although not the safest and not always allowed by postal regulations: paying cash. You can pay by sending us the equivalent of the required amount in bank notes of any freely convertible currency.

Since it is our policy to keep subscription rates as low as possible, we must insist that you take notice of these simple rules. Of course, these are also valid if you want to order any of the publications listed below!

# Publications from WGN

*Paul Roggemans*

The following publications can be ordered from *WGN*. Please follow the rules for payment listed above. The regular prices include delivery by surface mail. If you want airmail delivery to North- or South-America, to Japan, or to Australia, New-Zealand, Hawaii and other Pacific islands, you should pay the corresponding amount between brackets.

| | |
|---|---|
| Handbook Visual Meteor Observations - 143 p. | 350 BEF (450,450,500) |
| Bibliographic Catalogue of Meteors (1794-1987) - 243 p. | 400 BEF (500,550,600) |
| Photographic Meteor Database - 115 p. | 400 BEF (450,500,500) |
| Proceeding International Meteor Weekend 1986 - 40 p. | 200 BEF (200,200,200) |

It is also possible to obtain back issues of *WGN*. Still available are:

| | |
|---|---|
| *WGN*, Volume 13 (1985) - 6 issues, about 200 p. | 300 BEF (400,450,500) |
| *WGN*, Volume 14 (1986) - 6 issues, about 200 p. | 300 BEF (400,450,500) |
| *WGN*, Volume 15 (1987) - 6 issues, 208 p. | 300 BEF (400,450,500) |

We cannot offer you complete volumes of all earlier years. If you want copies of *WGN* from 1984 or earlier, please write to Paul Roggemans to inquire about availability.

If you want to order some of the above publications and you are planning to attend the International Meteor Weekend 1988 in Oldenzaal, the Netherlands, then ask for your copy there. They will be made available at the Meteor Weekend at reduced rates (with delivery charges deducted!).

# Instructions to Authors of WGN

*Marc Gyssens*

We are very pleased to receive contributions for *WGN* from all over the world! We strongly encourage contributors to continue sending your articles and reports to our journal and at the same time we invite new people to submit something. Sometimes however, we have to deal with minor though time consuming problems while processing some contributions. Since *WGN* is run by amateurs in their spare time, we must insist that contributors satisfy the following requirements for their submissions:

- Deciphering someone's handwriting is often a hard job! Therefore we ask you to *type* your contributions, double spaced (or print them, if you have a word processor). If a type writer or a computer is by no means available to you, then you may submit a handwritten contribution. In the latter case, please make an effort to write as legible as you can!
- If you write an article for *WGN*, try to respect the *style* of *WGN*. The best advice we can give you concerning this matter is looking to articles in previous issues of *WGN*. In particular, we ask you to note the following:
  - *All* contributions should contain an *abstract*, even short reports. As to the required length of such an abstract, we again advise you to look at contributions of a similar nature in previous issues of *WGN*.
  - Long articles should be preferably divided in a number of sections and/or subsections. *References* should be numbered in order of appearance in the text. The bibliographic data must appear at the end of the article in an unnumbered section "References" (and not in the text). If the author wishes to thank someone, this must also be done in an unnumbered section "Acknowledgments", immediately before the references.
  - Of course, all articles must be written in *English*. If you are not so familiar with this language, try to find someone who is and who wants to check your contribution on grammar-, vocabulary- and spelling error. Note that *WGN* in principal uses the *American* spelling.
  - Please use *metric* units for numerical data. If non-metric units are usual in your country, please make the necessary conversion yourself and think of a proper rounding of the result!
  - *Figures* and *tables* should be numbered and provided of a caption. They must be refered to in the text, where their relevancy to the article should be explained.
  - Tables containing *observational data* must follow the standards of *WGN*, which should be clear from looking at the various tables with observational data

that appear in *WGN*. In particular, note the order of the columns. Also, all times should be in UT (not your local time), durations in decimal hours (not in minutes) and clouds should be mentioned by using the corresponding ZHR correction factor (and not by the cloud percentage). If your personal standards do not match ours, please make the necessary conversions yourself; you really save us a lot of time!

- We can publish *photographs*. They should be preferably black and white or halftones and must be of good contrast. They should be treated in the text as a figure. If you want a photograph in your article, please send us a print (not the negative). The prints are not returned.
- Other *figures* must be made *camera-ready*. This implies they should be drawn in black and be of a publishable quality. If your figure contains symbols, numbers or other text, and you do not have any means of inserting them in your figure in a satisfactory way, you can send along with your figure a copy or a sketch on which these insertions are written; in that case we shall type them on your figure. Figures may be made either at their actual size or enlarged.

Since it is our policy to disseminate articles and reports in a fast way to the international meteor community, submissions are not formally refereed. Minor corrections are made without prior consent of the authors. Also, the editor can decide to shorten an article, if he judges parts of it to be irrelevant for the journal, or if space limitations do require such an operation.

Finally, the submission deadlines must be interpreted as the latest date on which an article we receive can be published in the issue under consideration. Whether it will actually be published in that issue depends on several other criteria too, such as available space and the nature of the article. It is also our policy to group related articles together to make *WGN* more coherent and enjoyable to read. So please be understanding if your article cannot be published right away!

# Short Notes

## A Meteor Section in the Danish Astronomical Society

*communicated by Paul Roggemans*

In February last year, the executive committee of *Astronomisk Selskab* (the Danish Astronomical Society, a national organization with about 1000 members, both professionals and amateurs) decided to estabish a Meteor Section. Per Aldrich, in agreement with the chairman, made a proposal about the objectives and the organizational structure of the section, which was accepted. Then the committee appointed Per to director of the Meteor Section. Since then he has been busy recruiting members, writing new observing instructions, coordinating the individual members and so on. Today the Meteor Section has 17 members.

## An Observing Camp in Denmark

*Per T. Aldrich*

This summer, I plan a meteor camp. I got the idea from the Norwegian Meteor Section, which organized a successful camp in 1986. It will take place August 12-14, perhaps at the University of Copenhagen's astronomical observatory in Brorfelde, about 80 km west of Copenhagen. Interested persons can contact the author (address on inside of back cover; phone number: (01)60 68 69).

# About an International Meteor Organization

*Paul Roggemans*

## 1. Introduction

During the past ten years, we enjoyed a growing cooperation among amateur meteor workers from several countries, leading to common activities within a very loose structure, for the benefit of many meteor enthousiasts. Achievements of today are widely appreciated; we cite:

- the journal *WGN*;
- the International Meteor Weekends, organized about every one and a half years;
- observing camps, such as these in the South of France;
- international databases, such as the Photographic Meteor Database;
- exchange of reprints and publications, collected within a Meteor Library;
- handbooks and other publications for observers.

It should be clear however that the present state of affairs cannot be an ending point; at this stage we should rather look at amateur achievements in other astronomical disciplines. A good example in this respect is variable star work which is widely appreciated, also within the professional circle. These amateurs have organized themselves very well in order to take care of continuity, stability, funding, representation and international recognition of their work. A well coordinated structure can handle a large input from members and can guarantee a vast amount of output. Meteor work however never got organized on that scale, certainly compared to most other branches. Who has to be blamed for the lack of an organizational structure?

Some attempts were made in the past to create an international framework for meteor observers. Some existed for a long time and disappeared after many years of good work. Early in this century we had the "Bureau Météoritique d'Anvers" in Antwerp, Belgium, which collected international meteor observations. At the same time, the American Meteor Society, under its dynamical director and founder C.P. Olivier, had a strong international team of meteor workers, not only within America, but also in Japan, India and Australia. The Meteor Section of the British Astronomical Association produced many valuable research paper for which it could count on the efforts of meteor workers outside the United Kingdom, and it continues to do so until this day.

In more recent years, we heard from the "IUAA Meteor Commission"and of the "International Meteor Research Network"; both disappeared quickly. These attempts failed for various reasons none of which can be used as an excuse for the current organizational state of meteor astronomy. The past has shown us what kind of set up has to be avoided. As suggested earlier, the American Association of Variable Star Observers is a good example for what should be possible too in meteor astronomy. The AAVSO is well known among all amateurs and professionals and famous for its important amateur observational work. It is up to us meteor workers worldwide to organize ourselves in a similar way.

Colloquium 98 of the International Astronomical Union, held last June in Paris, once again illustrated the poor organization of meteor work. This most important astronomical meeting stressed the need for a representative meteor organization and is in fact the source of inspiration for the following proposal *to set up such an "International Meteor Organization"!*

This idea has been proposed to be the discussion point at the International Meteor Weekend 1988 in Oldenzaal, the Netherlands. In order to give some general information to prepare this debate and to evoke some response through correspondence, I introduce some personal reflections as to how such an organization could be structured. I hope in this way to awake your interest. I look forward to read your comments. Please prepare your ideas and thoughts and send your suggestions to the organizers of the International Meteor Weekend 1988.

## 2. Legal constitution

The organization will be founded as an international organization with a scientific purpose according to the Belgian law. The bye-laws will be published in French, the French text having legal priority upon any translation. The official language of the organization will be English, which of course does not exclude other languages to be used for regional activities.

## 3. Administration

The administration will be done by the staff already at work within the *WGN*-team. This answers the question *who* will be prepared to take care of the work involved. The organization of course needs a board of directors. More in particular, we need a president, a vice-president, a secretary, a treasurer and about 10 to 15 other councilors, to serve as advisers. Of course, the composition of this board should reflect the international nature of the organization. Furthermore, it is preferable to have also one or more professional meteor workers in the board of directors or at least in an honorary function. Also, the secretary and the treasurer, who have to take care of the daily work, should live in the same area for obvious practical reasons. Furthermore the organization will need project leaders to coordinate observational and theoretical work, public-relations-persons to promote and to stimulate meteor work everywhere and local coordinators to coordinate local groups.

Interested candidates for these functions should make themselves known to the author (address on inside of back cover) who will use their applications for the elections to be organized at the constitutional meeting, which we hope can take place at the occasion of the International Meteor Weekend in Oldenzaal, the Netherlands, at the end of March.

## 4. Membership

The organization will not group associations per country but welcome:

- individual members;
- local meteor observing groups;
- national and regional meteor societies and meteor sections of various astronomical associations with a national or regional character;
- institutes and observatories represented by physical persons.

The annual dues have to be fixed annually and should be as low as possible. They will be defined in ECU (e.g. 10 ECU (about 400 BEF) including the subscription to *WGN*).

## 5. Activities

### 5.1. Journal

Members will live far apart, so *WGN* will be the main communication medium among all the members. *WGN* has major advantages:

- it is not expensive at all and available to everybody;
- being bimonthly and not formally refereed, it appears frequently enough to be up to date. Also, airmail delivery is possible;
- the available space invites a large number of authors to make contributions;
- it offers possibilities for interaction between professional meteor workers and amateurs.

A journal is a very important instrument within an organization and some failures in the past may be explained by the abscence of a common journal.

### 5.2 Meetings

The International Meteor Weekends could become the site of the general assembly of the organization, which is to be held at least once in every two years. More regional activities should be organized as well to overcome travelling costs.

## 5.3. Publications

Handbooks are of course necessary for new, beginning meteor workers and as a tool for standardizing observational techniques. As a result of the International Meteor Weekend in Hingene in 1986, we now have a common handbook for visual meteor observations. More handbooks will cover the various topics within meteor work. Proceedings of the International Meteor Weekends are another example of an international publication. While handbooks are typical publications for beginners, reports such as the Photographic Meteor Data Base[1] will be more useful for advanced amateurs. For this group we are glad to offer the "Bibliographic Catalogue of Meteors". It gives access to the private library of the author which contains over 10 000 papers dealing with meteors. This library will be accessible on zerox copies for members of the organization, copyright regulations permitting, of course.

## 5.4. Observational activities

Through *WGN*, readers will be encouraged to observe during chosen periods for various observing projects. Most observers will carry out observations at their home address or within local facilities of their own team. The organization will organize meteor observing camps, most likely in Southern France in order to study some meteor showers under perfect circumstances. Such camps are also a unique opportunity to introduce new observers to meteor work, right in the field, under a perfect sky. The other advantage is that it is most enjoyable to co-observe with many experienced observers from everywhere.

## 5.5. Projects

The International Halley Watch tried to coordinate Orionid and η-Aquarid observations. It is an example of what a long term project within the organization could be. Someone who plans a long term study of a limited area within meteor astronomy, could appeal to the members to assist with observational and theoretical efforts. Another example is e.g. the coordination of an all-sky fireball network. The project leader would have to take care of the announcements of his or her plans, by means of articles in *WGN*, lectures at meetings, etc. Later on, the members will have to be informed about the progress and the final results of the project.

## 5.6. Public Relations

As an international organization we shall need an image to the outside world. We need to inform other amateur astronomers about our program, plans and results. Articles of a general nature will be offered regularly to as many as possible astronomical magazines. It is quite obvious that many people can make valuable contributions by translating and publishing extracts from *WGN* for example.

Another important aspect concerns the cooperation between amateur and professional meteor astronomers. Amateurs can make useful contributions within meteor astronomy and thus professionals should remain informed through the amateur's publication. Most amateurs enjoy watching meteors as it is something exciting and even funny. Hence knowing very well what can be seen and being informed about the latest developments and achievements of professional meteor workers is a common wish of all amateurs. Therefore it is hoped that this organization can count on the help and support of the members of the IAU Commission 22 to create a good relationship between amateurs and professionals, as it has been proposed at the IAU Colloquium 98 in Paris.

The author welcomes all comments on this proposal. Meanwhile he already received some reactions on the proposed meteor organization as a reply to personal correspondence.

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[1]More information on the Photographic Meteor Data Base can be found elsewhere in this issue (ed.).

## 6. Comments on the proposal for an International Meteor Organization

Below are abstracts from letters the author received:

*An international association for meteor observations could surely be useful, I think, mainly because I hope that the observational results of amateurs would then more easily reach professional astronomers. Such an association could collect observations and, from time to time, for instance publish rate profiles of meteor streams.*

Ingo Reimann (FRG, Nov 25, 1987)

*Wasn't FEMA an international meteor organization? Doesn't it exist anymore? I think we do need such an organization. But: it should stress the amateur aspect more. You tend too much to the professional side. Observing meteors should be fun, not work. If this international organization only accepts people who do nearly-professional work, it 'll be an organization for a very small group of people. That would be a very big mistake. The goal is: to intensify contacts between amateurs and give a common base of communication. This we meteor observers already have: the WGN of your Werkgroep Meteoren.*

Detlef Koschny (FRG, Nov 24, 1987)

*I think it 'll become a VERY important meteor weekend, especially in regard to the projected AAVSO-type association.*

Hans Georg Schmidt (FRG, Dec 16, 1987)

*International cooperation is very good, I think, for all amateur activities. But the main problem is always the time problem, because direct contacts are very seldom. I think a cooperation should not be to tight from the beginning, because then the chance of failure grows. The cooperation itself should slowly grow through the years (and I think this will happen) and should not be based only on single persons, but on the groups themselves, because otherwise contacts can be disrupted very fast.*

Jost Jahn (FRG, Nov 15, 1987)

*Well, I don't really know what to say to the idea of an International Meteor Organization (IMO). You refer to the AAVSO but I don't know exactly how it is organized and what objectives it has. Just from the name I think it is a US-organization - perhaps with members outside the USA - and it collects - and publishes ? - observational results on variable stars.But is it really international?*

*My opinion is that we should be careful not to make too many organizations which just consume money and man-hours but do nothing which isn't already done.*

*The objectives of an IMO could be to collect observational results, to standardize observing and reduction methods, to publish results and observing guides etc. But we already have WGN and the International Meteor Weekend! As long as you feel committed to promote the meteor work it is the best because it gives stability and continuity. An IMO could of course also give stability and continuity, but is more difficult because of the great distances, and an IMO would give more administration - when we build on WGN we utilize an already existing organization.*

*To conclude I think that we obtain an AAVSO-like structure for meteor work when we build on WGN. Your example of how to do serious amateur work is more important for the promotion of amateur's contributions to meteor astronomy than an IMO.*

Per Aldrich (Denmark, Nov 23, 1987)

*It is good that WGN becomes independent and is in English. I believe that it will result in closer ties between meteor workers. The idea of an International Meteor Organization is a good one. I hope that something better becomes of this* *attempt than did with the International Meteor Research Network. One suggestion though. Probably some people will choose not to belong - if the majority are in favour, get it started and don't worry about these people. As soon as it becomes successful, they will either clamour to join or otherwize their organizations will cease to exist. Tere is no need for strife. We just get on with what is needed and be patient with these others. Good luck.*

Jeff Wood (Australia, Dec 2, 1987)

*Regarding the proposed international meteor organisation, I wonder if it is really a very good and practical idea, though I am not opposed on principle. I am sure you will agree that we are all very busy coping with our national organisation already. We already exchange publications and results as it is, and I am not sure what a new meteor organisation would gain. In fact, I think most Europeans, myself included, would consider you and VVS Meteor Section as an effective leader of meteor work in Europe. I am sure you would be the best to lead an International Meteor Organization, and I worry that you would be bogged down by administration. There is a precedent for failure for such a group. Dr. K.B. Hindley set up an International Meteor Centre in the 1970's, but I think it got him bogged down before very long. I am very happy with the current loose cooperation in Europe as it is, and hope we would not lose any of this. However you may disagree strongly with these opinions, and I will be glad to hear what views, plans, etc. you have.*

George Spalding (UK, Nov 20, 1987)

So far some of the first replies to the news of an International Meteor Organization. We look forward to read your thoughts. This article describes the major outlines for the organization. Who wants to join us as constitutional members? This article invites everyone to apply for membership or to be candidate for some function, so do not wait and act now! Be aware that it is in part the responsability of each individual observer to help organizing meteor work, *your* work!

# Short Notes

## A Meteor Section within the VdS in the FRG

*communicated by Paul Roggemans*

Mr. D. Heinlein (see address on inside of back cover) reports that on December 12 a Meteor Section has been founded within the German *Vereinigung der Sternfreunde* at the MPI for Nuclear Physics at Heidelberg. Please contact Dieter Heinlein if you are interested (phone number: (0911)75 14 76).

## Meteor Observing in France: August 6–20, 1987

*Paul Roggemans*

A stay for 15 people of various countries will be organized; several persons already registered. Participants are requested to pay a reservation fee of 2000 BEF as prepayment to Paul Roggemans, who can give you further details on this project too.

# Observer's Notes: February–April 1988

*Paul Roggemans*

## 1. Introduction

This period is perhaps of little importance for casual meteor observers. However, it is necessary to be alert for any meteor activity that may occur. Meteorwise, these months are rather poor, with the Lyrids as one highlight.

Table - Moonlight and observing conditions in February-April 1988

| Date | k | Date | k |
|---|---|---|---|
| Friday February 5 | 0.96- | Friday March 25 | 0.48+ |
| Friday February 12 | 0.39- | Friday April 1 | 0.98+ |
| Friday February 19 | 0.03+ | Friday April 8 | 0.70- |
| Friday February 26 | 0.65+ | Friday April 15 | 0.03- |
| Friday March 4 | 1.00- | Friday April 22 | 0.32+ |
| Friday March 11 | 0.55- | Friday April 29 | 0.91+ |
| Friday March 18 | 0.00- | Friday May 6 | 0.82- |

| | |
|---|---|
| New Moon: | February 17, March 18, April 16, May 15 |
| First Quarter: | February 24, March 25, April 23, May 23 |
| Full Moon: | February 2, March 3, April 2, May 1 |
| Last Quarter: | February 10, March 11, April 9, May 9 |

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

## 2. The δ-Leonids

According to A.F. Cook the δ-Leonids display maximum activity on February 26, with a radiant at $\alpha = 159°$ and $\delta = +19°$. The hourly rates of this minor shower will be very low and embedded within the sporadic background. However these slowly moving meteors are worth being observed. Look up (1) where Dr. Duncan Olsson-Steel points the attention of the meteor observer to the possible relationship between the δ-Leonids and Apollo asteroid 1987 SY. The theoretical radiant for the 1987 SY meteor shower has been computed to be $\alpha = 156°$ and $\delta = +20°$ on February 18, with a pre-atmospheric velocity $V_\infty = 21.6$ km/s, quite close to the observed radiant of the δ-Leonids. Dr. Lindblad identified 24 δ-Leonids among 2401 meteor orbits, leaving no doubt about the actual existence of this minor shower.

It is therefore very likely to have a successful observing project for this δ-Leonid meteor shower. Moreover, the observing conditions are perfect with a New Moon around February 17! So plan your δ-Leonid watch. Meteor activity in this period of the year is completely neglected; who knows what we will observe more? Who photographs the first δ-Leonid by amateur equipment?

## 3. The Virginids

In February, March and April, a radiant concentration in and around Virgo led to the discovery of the so-called Virginid meteor shower. It is a rather diffuse complex of radiants produced by some low density ecliptic meteor showers. "Virginids" stands for a mixture of meteors sharing similar orbits near the ecliptic plane. The hourly rate is very low. However, it is certainly recommended to cover the entire Virginid activity as it is a very poorly known meteoric complex.

Use each clear night around New Moon!

## 4. The Lyrids

The first well known shower on the program is not a very strong one. Compared to other popular showers, the Lyrids give a rather moderate appearance. Nevertheless, the Lyrids often surprised the observers over the past 25 centuries. This rather exciting shower has produced surprisingly high rates at several occasions; the last time was in 1982. This may happen again at any time. Read the interesting history of the Lyrid shower in the recently published *Handbook Visual Meteor Observations*.

The time of maximum is - rather unfortunately for Europe - at April 21 about $20^h \pm 1^h$ UT. At this time, the radiant's zenith distance is very large in Europe. Maximum rates are well placed for Soviet meteor observers and for amateurs in the Far East. The moon is about 5.5 days old at the time of maximum. Hence observations should be concentrated around the last dark hours of the night April 21-22.

Anyway, Lyrids should be guarded and watched carefully. The stream proved to act rather surprisingly: be aware!

## 5. Grigg-Skjellerupids

The Grigg-Skjellerupids are one of the youngest meteor showers of the last decade! Amateur meteor workers at the Southern Hemisphere witnessed the birth of this new meteor shower in the seventies. An account of the observational facts can be found in the article published by Dr. Lindblad in (2). 1988 offers another opportunity to study the meteoroid population near the parent comet's perihelion passage.

Maximum may be expected at April 23.0 UT. However, as this time is rather uncertain, observers are urged to watch some days around the maximum. Moonlight will be disturbing in the evening hours.

## 6. Visual and photographic observations

Submit your observations to your national or regional organization. Individuals and groups are invited to send observational results to the author 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. Of course descriptive reports will be published in *WGN*.

A database with astrometric data on amateur meteor photographs exists and is still growing. (See the report on the Photographic Meteor Data Base elsewhere in this issue.) Make sure that your photographic efforts are of some use and send us a paper print of your negative. Write the date, the exposure period and the data about the meteor on the back of the paper print. Make also sure that you mention all times in UT! The astrometric results will be communicated to you after measurement. In case you take care about the measurement yourself (forms are available), you help us to advance faster and to work more efficiently.

We look forward to hear from your observational results. Good luck!

## References

(1) D. Olsson-Steel, "Apollo Asteroid 1987 SY and the δ-Leonid Meteor Shower", *WGN 15:6*, December 1987, pp. 179-180.

(2) B. Lindblad, "The Meteor Stream Associated with Comet Grigg-Skjellerup", *Proceedings of the 20th ESLAB Symp. on the Exploration of Halley's Comet*, ESA, SP-250 vol. III, 1986, pp. 399-400.

see also the abstract in: P. Roggemans, "The Meteor Library", *WGN 15:4*, August 1987, p. 135.

# On the Perseid Meteor Stream 1986 (II)

## Zenithal Hourly Rate Data

*Paul Roggemans*

Using 39 884 meteors observed from ten countries by 96 persons during 1456 man-hours, a rate profile of the Perseids 1986 is derived. Apart from a remarkably high activity around August 15.0, the 1986 return of the Perseids can be characterized as "normal". From a discussion on the use of a zenith exponent $\varepsilon = 1.5$ instead of $\varepsilon = 1.0$ and a comparison with the 1985 results, it is concluded that the latter correction gives the best results.

### 1. Introduction

1985 offered the largest amount of observational results ever collected for the Perseid shower. It resulted in a very detailed picture of the 1985 transit through the meteor stream. The observational effort was concentrated in Southern France, but data from Belgium, Canada, the GDR, Finland, Japan, the Netherlands, Norway and the USA enabled to complete the picture. A total of 800 ZHR's was available in 1985 (1). European observations represented some 75% of the total number of ZHR's. A call was made to all meteor observers worldwide to cover the 1986 Perseids. This article covers the hourly rates obtained for the 1986 Perseids.

### 2. The observational material

Several observers were inspired by the 1985 results and sent in results according to the reporting format proposed by the author. We could welcome reports from Belgium, Denmark, Finland, France, the GDR, Italy, Norway and the USA. The 1985 analysis also included Japanese results obtained by a slightly different method, but this caused some artifacts on the hourly rate profile, explainable by the different observing methods. For 1986, I decided not to include the Japanese results. In this way we were unable to obtain a 24 hour a day coverage of the Perseid cross section. It is a pity that not yet a uniforming reporting format *and* observing method can be applied by all meteor observers worldwide.

All the results mentioned in this article were obtained according to the agreements defined at the International Meteor Weekend 1986 in Hingene, Belgium (2,3). Reports that were not in agreement with the recommended data reporting format were not accepted.

The following observers contributed to this analysis; the names and initials are grouped according to the country where the observation took place.

*Belgium:*

Dirk Artoos (AD), Geert Calis (GC), Erwin Declercq (ED), Piet Delagaye (DP), Tim Deschaumes (TD), Bart Dhoedt (BD), Koen Geukens (GK), Paul Laenen (PL), John Morel (JM), Lieven Philips (LP), Renaat Philips (RP), Francis Plesier (FP), Ghislain Plesier (GP), Maarten Ruyschaert (MR), René Scurbecq (RS), Tom Segal (TS), Octaaf Steen (OS), Frank Tamsin (FT), Hendrik Vandenbruaene (HV), Jos Vandenbruaene (JV), Peter Van den Eijnde (PVDE), Tom Vangierdegom (TV), Michel Van Speybroeck (MVS).

*Denmark:*

Per T. Aldrich (PA), Svend Aage Andreasen (SA), Bjørn Jørgensen (BJ), Gotfred M. Kristensen (GMK), Niels-Hendrik R. Larsen (NL), J. Østergaard Olesen (JO), Kent Vestesen (KV).

*Finland:*

Teemu Hankamäki (TH), Timo Kinnunen (TK), Ismo Luukokonen (IL), Veiko Mäkelä (VM), Pekka Parviainen (PPA), Marko Pekkola (MP), Leo Rajala (RL), Markku Sihvonen (MS), Roosa Toivonen (RT).

*France:*

Philippe Canceil (PC), Ludwig Cluyse (LC), Filip Degreef (FDG), Dirk Gevaert (DG), Dirk Laurent (DL), Koen Miskotte (KM), Peter Pelgrims (PP), Bauke Rispens (BR), Paul Roggemans (PR), Ann Schroyens (AS), George Spalding (GS), Glenn Ticket (GT), Bartel Vandewalle (BV), Jeroen Van Wassenhove (JVW), Davy Viaene (DV), Ilse Wauters (IW).

*GDR:*

Rainer Arlt (RA), Pierre Bader (PB), Petra Baldauf (BP), Andrea Knöfel (AK), Ralf Koschack (RK), Andreas Krawietz (KA), Ina Rendtel (IR), Jürgen Rendtel (JR), Ulrich Sperberg (US).

*Greece:*

Kristiaan Neyts (KN).

*Italy:*

Maurizio Eltri (ELT), Livio Rossani (ROS), Napoleone Scarpa (SCA), Enrico Stomeo (STO), Stefano Stomeo (STS), Emiliano Trizio (TRI).

*Norway:*

Kai Gaarder (KG), Terje Larsen (TL), Tor Vidar Lian (TVL), Lars Trygve Heen (LTH), Trond Erik Hillestad (TEH), Kai Stokkeland (KS).

*Switzerland:*

Kris Deman (KD).

*USA:*

Robert Lunsford (LR), Norman McLeod (NM).

Table 1 --- Statistics for each country.

| Country | Nr Obs | Nr Met | Hours |
|---|---|---|---|
| Belgium | 24 | 4 036 | 330.77 |
| Denmark | 13 | 738 | 62.54 |
| Finland | 13 | 541 | 31.40 |
| France | 16 | 19 462 | 510.09 |
| GDR | 9 | 8 164 | 315.05 |
| Greece | 1 | 215 | 5.20 |
| Italy | 6 | 631 | 36.26 |
| Norway | 9 | 3 702 | 65.93 |
| Switzerland | 1 | 340 | 9.75 |
| USA | 4 | 2 055 | 89.00 |
| Total | 96 | 39 884 | 1 456 |

The observations of some of the persons included in Table 2, were not used in this analysis. Their names are:

Jan De Weerdt, Rasmus Allin, Michael Andersen, Kim Andersen, Martin Larsen, Adrian Rasmussen, Ove Toft, Jani Kimanen, Paavo Lötjönen, Pentti Ramberg, Finn Gundersen, Grandum Øyvind, Magne Svanemsli, Wanda Simmons, Karl Simmons.

The author is greatful to all these observers, both those of whom the observations were used and the others, for enabling him to carry out this analysis. We hope that this article will convince everyone that a large amount of data is needed to carry out a meaningful study of a meteor stream.

Table 2 — Individual ZHR-values for the Perseids 1986, computed with both $\varepsilon = 1.0$ and $\varepsilon = 1.5$.

| Date (UT) | Obs | P | ZHR (1.0) | ZHR (1.5) | S | HR |
|---|---|---|---|---|---|---|
| Jul 25.99 | LTH | 1 | 3 ± 3 | 3 ± 3 | 8 | 20 ± 7 |
| 26.88 | AK | 0 | – | – | 11 | 25 7 |
| 26.90 | BP | 0 | – | – | 12 | 18 5 |
| 26.90 | JR | 2 | 5 4 | 7 5 | 8 | 14 5 |
| 26.90 | IR | 0 | – | – | 11 | 13 4 |
| 26.90 | RK | 2 | 2 1 | 3 2 | 18 | 11 3 |
| 26.94 | RA | 0 | – | – | 13 | 24 7 |
| 27.96 | PR | 0 | – | – | 10 | 12 4 |
| 28.01 | PR | 1 | 4 4 | 4 4 | 1 | 3 3 |
| 28.90 | PR | 2 | 5 4 | 8 6 | 9 | 11 4 |
| 28.90 | DL | 1 | 3 3 | 5 5 | 6 | 10 4 |
| 28.94 | PR | 5 | 11 5 | 15 7 | 11 | 14 4 |
| 28.96 | DL | 3 | 6 4 | 8 5 | 7 | 9 4 |
| 28.98 | PR | 2 | 6 4 | 7 5 | 1 | 2 2 |
| 29.02 | PR | 4 | 10 5 | 12 6 | 12 | 24 7 |
| 29.02 | DL | 3 | 7 4 | 8 5 | 8 | 15 5 |
| 29.90 | PR | 2 | 5 4 | 7 5 | 9 | 10 3 |
| 29.93 | RP | 0 | – | – | 6 | 29 9 |
| 29.93 | LP | 0 | – | – | 5 | 26 12 |
| 29.93 | GP | 6 | 5 2 | 6 3 | 9 | 4 1 |
| 29.94 | PR | 3 | 7 4 | 9 5 | 6 | 8 3 |
| 29.96 | LC | 6 | 10 4 | 13 5 | 15 | 18 5 |
| 29.96 | ED | 0 | – | – | 2 | 5 4 |
| 29.96 | MR | 0 | – | – | 6 | 13 5 |
| 29.96 | FT | 1 | 3 3 | 4 4 | 4 | 11 6 |
| 29.98 | PR | 4 | 9 4 | 11 6 | 6 | 9 4 |
| 29.98 | DL | 6 | 16 6 | 20 8 | 4 | 7 4 |
| 30.03 | DL | 13 | 16 4 | 18 5 | 15 | 14 4 |
| 30.88 | PR | 4 | 7 3 | 10 5 | 9 | 6 2 |
| 30.91 | RA | 2 | 2 1 | 2 1 | 25 | 15 3 |
| 30.91 | LP | 0 | – | – | 7 | 22 8 |
| 30.91 | AK | 1 | 1 1 | 1 1 | 32 | 18 3 |
| 30.91 | JR | 5 | 4 2 | 5 2 | 25 | 12 3 |
| 30.91 | IR | 6 | 6 2 | 7 3 | 22 | 13 3 |
| 30.92 | RK | 9 | 6 2 | 8 3 | 26 | 11 2 |
| 30.92 | RP | 0 | – | – | 6 | 21 9 |
| 30.93 | BV | 10 | 18 6 | 25 8 | 8 | 9 3 |
| 30.95 | PA | 1 | 5 5 | 6 6 | 4 | 14 7 |
| 30.96 | DL | 4 | 7 4 | 9 5 | 7 | 8 3 |
| 30.96 | OS | 5 | 8 4 | 10 5 | 15 | 18 5 |
| 30.98 | PR | 3 | 7 4 | 9 3 | 3 | 5 3 |
| 30.98 | LP | 0 | – | – | 4 | 14 7 |
| 30.98 | RP | 0 | – | – | 8 | 21 7 |
| 31.01 | RA | 9 | 7 2 | 9 3 | 30 | 18 3 |
| 31.01 | AK | 3 | 2 1 | 3 2 | 34 | 19 3 |
| 31.01 | JR | 6 | 4 1 | 4 2 | 27 | 15 3 |
| 31.01 | IR | 3 | 6 4 | 7 4 | 5 | 9 4 |
| 31.02 | ED | 3 | 9 5 | 11 6 | 3 | 9 5 |
| 31.02 | MR | 3 | 8 4 | 9 5 | 5 | 11 5 |
| 31.02 | FT | 4 | 13 7 | 16 8 | 2 | 6 4 |
| 31.85 | LC | 3 | 27 15 | 45 26 | 0 | – |
| 31.85 | PR | 3 | 22 13 | 38 22 | 0 | – |
| 31.85 | DL | 3 | 23 14 | 39 23 | 4 | 12 6 |
| 31.88 | IR | 1 | 8 8 | 10 10 | 2 | 10 7 |
| 31.88 | RA | 1 | 7 7 | 9 9 | 3 | 12 7 |
| 31.90 | LC | 1 | 4 4 | 5 5 | 2 | 4 2 |
| 31.90 | PR | 3 | 8 5 | 13 7 | 9 | 12 4 |
| 31.90 | DL | 4 | 11 6 | 17 8 | 9 | 12 4 |
| 31.94 | LC | 2 | 8 6 | 11 8 | 5 | 12 5 |
| 31.94 | PR | 4 | 9 5 | 12 6 | 10 | 13 4 |
| 31.94 | DL | 4 | 9 5 | 12 6 | 7 | 9 3 |
| Jul 31.96 | PA | 0 | – | – | 1 | 6 6 |
| 31.98 | BV | 28 | 13 ± 12 | 16 ± 3 | 43 | 14 ± 2 |
| 31.98 | RA | 4 | 6 3 | 7 4 | 12 | 14 4 |
| 31.98 | LC | 3 | 6 3 | 7 4 | 9 | 11 4 |
| 31.98 | PR | 8 | 17 6 | 21 7 | 8 | 11 4 |
| 31.98 | DL | 5 | 9 4 | 12 5 | 13 | 16 5 |
| 31.98 | JR | 6 | 10 4 | 12 5 | 9 | 13 4 |
| 31.98 | IR | 8 | 11 4 | 12 4 | 10 | 11 3 |
| Aug 01.02 | LC | 6 | 10 4 | 12 5 | 10 | 13 4 |
| 01.02 | PR | 9 | 16 5 | 19 6 | 12 | 17 5 |
| 01.02 | DL | 7 | 12 5 | 14 5 | 11 | 14 4 |
| 01.06 | LC | 1 | 3 3 | 3 3 | 12 | 33 10 |
| 01.06 | PR | 4 | 8 4 | 9 5 | 5 | 9 4 |
| 01.06 | DL | 7 | 12 5 | 13 5 | 4 | 6 3 |
| 01.10 | LC | 2 | 8 6 | 9 6 | 4 | 18 9 |
| 01.10 | PR | 3 | 8 5 | 9 5 | 2 | 5 4 |
| 01.10 | DL | 1 | 3 3 | 3 3 | 2 | 6 4 |
| 01.85 | PR | 4 | 33 16 | 58 29 | 4 | 11 6 |
| 01.85 | DL | 1 | 9 9 | 16 16 | 5 | 16 7 |
| 01.89 | RA | 3 | 4 3 | 5 3 | 29 | 21 4 |
| 01.89 | AK | 1 | 2 2 | 2 2 | 25 | 25 5 |
| 01.89 | JR | 4 | 8 4 | 11 5 | 10 | 12 4 |
| 01.89 | RK | 5 | 5 2 | 6 3 | 30 | 15 3 |
| 01.90 | PR | 4 | 12 6 | 20 10 | 4 | 5 2 |
| 01.90 | DL | 4 | 15 7 | 24 12 | 7 | 11 4 |
| 01.93 | GP | 3 | 4 2 | 5 3 | 10 | 7 2 |
| 01.93 | PA | 1 | 8 8 | 9 9 | 3 | 19 11 |
| 01.94 | PR | 3 | 7 4 | 10 6 | 9 | 10 3 |
| 01.94 | LC | 2 | 12 9 | 18 12 | 2 | 6 4 |
| 01.94 | KG | 1 | 6 6 | 8 8 | 2 | 11 8 |
| 01.96 | RA | 10 | 7 2 | 8 2 | 44 | 19 3 |
| 01.96 | PB | 7 | 7 3 | 9 3 | 20 | 13 3 |
| 01.96 | AK | 8 | 6 2 | 8 3 | 32 | 19 3 |
| 01.96 | JR | 7 | 7 3 | 8 3 | 13 | 9 3 |
| 01.96 | RK | 13 | 7 2 | 8 2 | 30 | 10 2 |
| 01.96 | OS | 3 | 3 2 | 4 2 | 21 | 14 3 |
| 01.98 | KG | 2 | 7 5 | 9 7 | 7 | 23 9 |
| 01.98 | PR | 5 | 10 4 | 13 6 | 3 | 3 2 |
| 01.98 | LC | 7 | 18 7 | 23 9 | 6 | 9 4 |
| 01.98 | DL | 2 | 10 7 | 13 9 | 2 | 6 4 |
| 01.98 | GP | 2 | 3 2 | 4 3 | 7 | 7 3 |
| 02.00 | GMK | 8 | 16 6 | 19 7 | 6 | 11 4 |
| 02.00 | PA | 6 | 9 4 | 10 4 | 7 | 8 3 |
| 02.02 | PR | 6 | 11 5 | 14 6 | 3 | 4 2 |
| 02.02 | LC | 7 | 15 6 | 18 7 | 2 | 3 2 |
| 02.02 | DL | 7 | 15 6 | 18 7 | 11 | 17 5 |
| 02.04 | RA | 12 | 10 3 | 11 3 | 30 | 18 3 |
| 02.04 | AK | 8 | 8 3 | 9 3 | 26 | 24 5 |
| 02.04 | JR | 9 | 10 3 | 11 4 | 12 | 12 4 |
| 02.04 | RK | 12 | 7 2 | 8 2 | 36 | 17 3 |
| 02.06 | PR | 15 | 26 7 | 30 8 | 5 | 7 3 |
| 02.06 | LC | 5 | 11 5 | 13 6 | 3 | 6 3 |
| 02.06 | DL | 8 | 16 6 | 19 7 | 11 | 19 6 |
| 02.10 | PR | 5 | 10 5 | 11 5 | 5 | 10 4 |
| 02.10 | LC | 4 | 8 4 | 9 4 | 5 | 9 4 |
| 02.22 | NM | 1 | 3 3 | 4 4 | 3 | 6 4 |
| 02.25 | NM | 8 | 11 4 | 13 4 | 13 | 13 4 |
| 02.29 | NM | 9 | 11 4 | 12 4 | 19 | 19 4 |
| 02.33 | NM | 8 | 9 3 | 10 4 | 12 | 12 4 |
| 02.37 | NM | 13 | 15 4 | 15 4 | 19 | 19 4 |
| 02.85 | PR | 1 | 7 7 | 13 13 | 4 | 10 5 |

Table 2 (continued)

| Date (UT) | Obs | P | ZHR (1.0) | | ZHR (1.5) | | S | HR | |
|---|---|---|---|---|---|---|---|---|---|
| Aug 02.85 | DL | 1 | 10 ± 10 | | 17 ± 17 | | 3 | 10 ± 6 | |
| 02.89 | BP | 0 | – | | – | | 9 | 15 | 5 |
| 02.89 | AK | 10 | 16 | 5 | 21 | 7 | 12 | 11 | 3 |
| 02.89 | JR | 9 | 12 | 4 | 16 | 5 | 19 | 15 | 3 |
| 02.89 | IR | 13 | 14 | 4 | 19 | 5 | 22 | 13 | 3 |
| 02.89 | RK | 16 | 12 | 3 | 16 | 4 | 44 | 18 | 3 |
| 02.90 | RA | 14 | 24 | 7 | 32 | 9 | 17 | 17 | 4 |
| 02.90 | GT | 1 | 3 | 3 | 5 | 5 | 2 | 3 | 2 |
| 02.90 | PR | 2 | 6 | 4 | 10 | 7 | 6 | 8 | 3 |
| 02.90 | LC | 4 | 8 | 4 | 12 | 6 | 6 | 5 | 2 |
| 02.90 | DL | 1 | 3 | 3 | 5 | 5 | 5 | 7 | 3 |
| 02.94 | GT | 3 | 12 | 7 | 18 | 10 | 1 | 2 | 2 |
| 02.94 | PR | 6 | 16 | 6 | 23 | 9 | 6 | 8 | 3 |
| 02.94 | DL | 8 | 20 | 7 | 29 | 10 | 6 | 8 | 3 |
| 02.94 | GP | 8 | 10 | 4 | 14 | 5 | 6 | 4 | 2 |
| 02.94 | RP | 3 | 17 | 10 | 23 | 13 | 4 | 15 | 8 |
| 02.94 | FP | 6 | 5 | 2 | 7 | 3 | 21 | 10 | 2 |
| 02.94 | PPA | 4 | 34 | 17 | 39 | 20 | 1 | 8 | 8 |
| 02.95 | ED | 1 | 2 | 2 | 3 | 3 | 11 | 16 | 7 |
| 02.95 | MR | 2 | 3 | 2 | 4 | 3 | 10 | 11 | 3 |
| 02.96 | RA | 7 | 4 | 1 | 5 | 2 | 30 | 11 | 2 |
| 02.96 | BP | 1 | 1 | 1 | 1 | 1 | 15 | 12 | 3 |
| 02.96 | AK | 13 | 9 | 3 | 11 | 3 | 26 | 13 | 3 |
| 02.96 | JR | 11 | 8 | 2 | 9 | 3 | 28 | 15 | 3 |
| 02.96 | TD | 3 | 9 | 5 | 12 | 7 | 8 | 17 | 6 |
| 02.96 | FT | 4 | 9 | 5 | 12 | 6 | 7 | 11 | 4 |
| 02.96 | IR | 15 | 8 | 2 | 10 | 3 | 28 | 11 | 2 |
| 02.96 | RK | 21 | 8 | 2 | 9 | 2 | 34 | 8 | 1 |
| 02.97 | GP | 2 | 6 | 5 | 8 | 6 | 5 | 10 | 4 |
| 02.98 | GT | 6 | 14 | 6 | 19 | 8 | 2 | 3 | 2 |
| 02.98 | PR | 2 | 4 | 3 | 7 | 5 | 3 | 4 | 3 |
| 02.99 | PB | 27 | 13 | 3 | 16 | 4 | 50 | 17 | 2 |
| 02.99 | OS | 5 | 7 | 3 | 10 | 4 | 20 | 20 | 5 |
| 02.99 | RP | 0 | – | | – | | 6 | 22 | 9 |
| 03.00 | DL | 11 | 11 | 3 | 13 | 4 | 16 | 10 | 3 |
| 03.00 | GMK | 6 | 24 | 10 | 27 | 11 | 3 | 12 | 7 |
| 03.00 | PA | 3 | 12 | 7 | 14 | 8 | 2 | 7 | 5 |
| 03.02 | GT | 9 | 16 | 5 | 20 | 7 | 3 | 4 | 2 |
| 03.02 | PR | 8 | 13 | 5 | 16 | 6 | 3 | 3 | 2 |
| 03.02 | LP | 5 | 19 | 8 | 22 | 10 | 7 | 24 | 9 |
| 03.03 | RA | 18 | 12 | 3 | 13 | 3 | 42 | 23 | 4 |
| 03.03 | BP | 1 | 1 | 1 | 1 | 1 | 12 | 14 | 4 |
| 03.03 | AK | 16 | 11 | 3 | 12 | 3 | 18 | 11 | 3 |
| 03.03 | JR | 10 | 7 | 2 | 8 | 2 | 19 | 12 | 3 |
| 03.03 | RP | 5 | 19 | 8 | 20 | 9 | 5 | 16 | 7 |
| 03.04 | IR | 19 | 11 | 3 | 12 | 3 | 28 | 14 | 3 |
| 03.04 | RK | 26 | 10 | 2 | 11 | 2 | 46 | 14 | 2 |
| 03.06 | PR | 5 | 7 | 3 | 8 | 3 | 9 | 9 | 3 |
| 03.06 | DL | 8 | 13 | 4 | 14 | 5 | 10 | 12 | 4 |
| 03.10 | PR | 4 | 6 | 3 | 7 | 3 | 8 | 11 | 4 |
| 03.10 | DL | 5 | 8 | 4 | 9 | 4 | 8 | 13 | 4 |
| 03.85 | KM | 2 | 9 | 7 | 17 | 12 | – | 11 | 4 |
| 03.85 | BR | 2 | 10 | 7 | 19 | 13 | – | 5 | 3 |
| 03.85 | PR | 2 | 11 | 8 | 20 | 14 | 3 | 6 | 3 |
| 03.86 | GT | 3 | 27 | 15 | 47 | 27 | 5 | 16 | 7 |
| 03.89 | RK | 16 | 11 | 3 | 15 | 4 | 39 | 14 | 2 |
| 03.89 | IR | 12 | 15 | 4 | 19 | 6 | 15 | 10 | 3 |
| 03.89 | JR | 4 | 6 | 3 | 8 | 4 | 11 | 15 | 4 |
| 03.89 | AK | 7 | 9 | 3 | 12 | 5 | 18 | 13 | 3 |
| 03.90 | KM | 6 | 20 | 8 | 33 | 13 | – | 18 | 4 |
| 03.90 | BR | 8 | 23 | 8 | 36 | 13 | – | 9 | 3 |

| Date (UT) | Obs | P | ZHR (1.0) | | ZHR (1.5) | | S | HR | |
|---|---|---|---|---|---|---|---|---|---|
| Aug 03.90 | DG | 8 | 30 ± 11 | | 48 ± 17 | | 12 | 19 ± 5 | |
| 03.90 | GT | 6 | 18 | 7 | 30 | 12 | 7 | 9 | 3 |
| 03.90 | PR | 9 | 28 | 9 | 44 | 15 | 8 | 10 | 4 |
| 03.94 | KM | 10 | 23 | 7 | 34 | 11 | – | 17 | 4 |
| 03.94 | BR | 3 | 8 | 5 | 12 | 7 | – | 9 | 4 |
| 03.94 | DG | 5 | 17 | 8 | 25 | 11 | 8 | 14 | 5 |
| 03.94 | GT | 5 | 13 | 6 | 18 | 8 | 13 | 16 | 5 |
| 03.94 | PR | 7 | 18 | 7 | 26 | 10 | 7 | 9 | 3 |
| 03.96 | RK | 23 | 10 | 2 | 11 | 2 | 40 | 11 | 2 |
| 03.96 | IR | 22 | 16 | 3 | 19 | 4 | 18 | 9 | 2 |
| 03.96 | JR | 17 | 13 | 3 | 15 | 4 | 12 | 7 | 2 |
| 03.96 | RA | 38 | 15 | 3 | 19 | 3 | 51 | 13 | 2 |
| 03.96 | AK | 15 | 8 | 2 | 10 | 3 | 24 | 9 | 2 |
| 03.97 | PB | 24 | 9 | 2 | 11 | 2 | 63 | 15 | 2 |
| 03.98 | KM | 6 | 17 | 7 | 23 | 9 | – | 10 | 4 |
| 03.98 | BR | 7 | 13 | 5 | 18 | 7 | – | 12 | 4 |
| 03.98 | DG | 6 | 13 | 5 | 17 | 7 | 5 | 6 | 3 |
| 03.98 | GT | 8 | 14 | 5 | 19 | 7 | 11 | 11 | 3 |
| 03.98 | PR | 5 | 11 | 5 | 14 | 6 | 6 | 8 | 3 |
| 04.00 | US | 11 | 7 | 2 | 7 | 2 | 49 | 25 | 4 |
| 04.02 | KM | 12 | 20 | 6 | 24 | 7 | – | 10 | 3 |
| 04.02 | DG | 3 | 8 | 4 | 9 | 5 | 8 | 14 | 5 |
| 04.02 | GT | 4 | 14 | 7 | 17 | 8 | 11 | 26 | 8 |
| 04.02 | PR | 11 | 20 | 6 | 24 | 7 | 13 | 16 | 5 |
| 04.04 | RK | 26 | 9 | 2 | 10 | 2 | 37 | 10 | 2 |
| 04.04 | IR | 32 | 19 | 3 | 20 | 4 | 12 | 6 | 2 |
| 04.04 | JR | 26 | 21 | 4 | 22 | 4 | 17 | 12 | 4 |
| 04.04 | AK | 15 | 11 | 3 | 12 | 3 | 20 | 13 | 3 |
| 04.05 | KM | 5 | 18 | 8 | 21 | 10 | – | 19 | 7 |
| 04.06 | DG | 4 | 5 | 3 | 6 | 3 | 11 | 11 | 3 |
| 04.06 | GT | 13 | 23 | 6 | 26 | 7 | 15 | 21 | 5 |
| 04.06 | PR | 4 | 7 | 4 | 9 | 4 | 11 | 16 | 5 |
| 04.09 | GT | 2 | 10 | 7 | 11 | 7 | 9 | 37 | 12 |
| 04.10 | PR | 4 | 16 | 8 | 17 | 9 | 5 | 17 | 8 |
| 04.33 | NM | 8 | 13 | 5 | 15 | 5 | 4 | 5 | 2 |
| 04.37 | NM | 15 | 18 | 4 | 20 | 5 | 10 | 10 | 3 |
| 04.93 | GP | 3 | 4 | 2 | 6 | 3 | 5 | 3 | 2 |
| 04.94 | BR | 6 | 23 | 9 | 33 | 14 | 8 | 15 | 5 |
| 04.94 | KM | 4 | 14 | 7 | 21 | 10 | 8 | 15 | 5 |
| 04.94 | PR | 5 | 13 | 6 | 18 | 8 | 6 | 8 | 3 |
| 04.94 | LC | 5 | 15 | 7 | 22 | 10 | 5 | 8 | 4 |
| 04.94 | DG | 6 | 17 | 7 | 25 | 10 | 6 | 9 | 4 |
| 04.94 | GT | 3 | 9 | 5 | 14 | 8 | 6 | 10 | 4 |
| 04.94 | FP | 2 | 5 | 3 | 6 | 5 | 5 | 7 | 3 |
| 04.98 | BR | 4 | 8 | 4 | 10 | 5 | 13 | 15 | 4 |
| 04.98 | KM | 4 | 8 | 4 | 10 | 5 | 12 | 13 | 4 |
| 04.98 | PR | 4 | 9 | 5 | 12 | 6 | 7 | 9 | 4 |
| 04.98 | LC | 3 | 7 | 4 | 10 | 6 | 4 | 6 | 3 |
| 04.98 | GT | 4 | 11 | 6 | 15 | 7 | 8 | 14 | 5 |
| 04.98 | FP | 4 | 7 | 4 | 9 | 5 | 5 | 6 | 3 |
| 04.98 | GP | 8 | 13 | 5 | 16 | 6 | 5 | 5 | 2 |
| 05.02 | BR | 11 | 19 | 6 | 23 | 7 | 11 | 13 | 4 |
| 05.02 | KM | 8 | 13 | 5 | 16 | 6 | 23 | 26 | 5 |
| 05.02 | PR | 10 | 18 | 6 | 22 | 7 | 11 | 44 | 4 |
| 05.02 | LC | 6 | 11 | 5 | 13 | 6 | 12 | 15 | 4 |
| 05.02 | PC | 7 | 13 | 5 | 15 | 6 | 13 | 16 | 5 |
| 05.02 | GT | 14 | 33 | 9 | 40 | 11 | 8 | 14 | 5 |
| 05.02 | FP | 8 | 15 | 5 | 17 | 6 | 6 | 8 | 3 |
| 05.02 | GP | 3 | 4 | 2 | 5 | 3 | 4 | 4 | 2 |
| 05.06 | BR | 5 | 8 | 4 | 9 | 4 | 17 | 21 | 5 |
| 05.06 | KM | 12 | 17 | 5 | 20 | 6 | 18 | 20 | 5 |

Table 2 (continued)

| Date (UT) | Obs | P | ZHR (1.0) | | ZHR (1.5) | | S | HR | |
|---|---|---|---|---|---|---|---|---|---|
| Aug 05.06 | PR | 10 | 16 | ± 5 | 18 | ± 6 | 9 | 12 | ± 4 |
| 05.06 | LC | 10 | 16 | 5 | 18 | 6 | 8 | 10 | 4 |
| 05.06 | PC | 4 | 10 | 5 | 11 | 6 | 7 | 13 | 5 |
| 05.06 | GT | 12 | 20 | 6 | 22 | 6 | 11 | 15 | 5 |
| 05.06 | FP | 10 | 10 | 3 | 11 | 4 | 4 | 3 | 2 |
| 05.06 | GP | 14 | 17 | 5 | 19 | 5 | 8 | 8 | 3 |
| 05.10 | BR | 10 | 17 | 5 | 18 | 6 | 18 | 28 | 7 |
| 05.10 | KM | 11 | 14 | 4 | 16 | 5 | 19 | 21 | 5 |
| 05.10 | PR | 8 | 11 | 4 | 13 | 4 | 8 | 10 | 4 |
| 05.10 | LC | 4 | 6 | 3 | 6 | 3 | 8 | 10 | 4 |
| 05.85 | PR | 7 | 48 | 18 | 87 | 33 | 3 | 7 | 4 |
| 05.85 | BR | 6 | 29 | 12 | 52 | 21 | 18 | 30 | 7 |
| 05.85 | GS | 2 | 25 | 17 | 43 | 31 | 6 | 30 | 12 |
| 05.86 | DG | 9 | 88 | 30 | 155 | 52 | 5 | 17 | 8 |
| 05.86 | KM | 5 | 28 | 12 | 48 | 22 | 15 | 28 | 7 |
| 05.86 | GT | 2 | 15 | 10 | 22 | 16 | 5 | 13 | 6 |
| 05.89 | DG | 5 | 18 | 8 | 30 | 13 | 6 | 9 | 4 |
| 05.89 | RA | 12 | 18 | 5 | 24 | 7 | 16 | 14 | 3 |
| 05.89 | PB | 6 | 10 | 4 | 14 | 6 | 22 | 18 | 4 |
| 05.89 | BP | 3 | 4 | 2 | 6 | 3 | 14 | 11 | 3 |
| 05.89 | AK | 3 | 5 | 3 | 7 | 4 | 11 | 12 | 4 |
| 05.89 | JR | 5 | 8 | 4 | 10 | 5 | 9 | 8 | 3 |
| 05.89 | IR | 7 | 14 | 5 | 18 | 7 | 9 | 10 | 3 |
| 05.90 | PR | 4 | 11 | 6 | 18 | 9 | 8 | 9 | 3 |
| 05.90 | BR | 8 | 21 | 7 | 33 | 12 | 10 | 10 | 3 |
| 05.90 | KM | 2 | 5 | 4 | 8 | 6 | 15 | 15 | 4 |
| 05.90 | GT | 4 | 12 | 6 | 20 | 10 | 12 | 15 | 4 |
| 05.90 | AS | 6 | 15 | 6 | 25 | 10 | 8 | 8 | 3 |
| 05.90 | GS | 3 | 19 | 11 | 30 | 17 | 0 | – | |
| 05.91 | PL | 4 | 23 | 11 | 32 | 16 | 9 | 8 | 3 |
| 05.93 | FP | 3 | 4 | 2 | 5 | 3 | 9 | 6 | 2 |
| 05.93 | GP | 6 | 8 | 3 | 11 | 4 | 16 | 11 | 3 |
| 05.94 | PR | 5 | 12 | 5 | 17 | 8 | 12 | 13 | 4 |
| 05.94 | DG | 2 | 6 | 4 | 8 | 6 | 17 | 24 | 6 |
| 05.94 | BR | 8 | 15 | 5 | 22 | 8 | 22 | 20 | 4 |
| 05.94 | KM | 15 | 29 | 7 | 42 | 11 | 12 | 11 | 3 |
| 05.94 | GT | 3 | 8 | 5 | 11 | 6 | 15 | 19 | 5 |
| 05.94 | AS | 3 | 10 | 6 | 15 | 9 | 17 | 27 | 7 |
| 05.94 | GS | 3 | 14 | 8 | 21 | 12 | 4 | 11 | 5 |
| 05.96 | OS | 5 | 9 | 4 | 11 | 5 | 11 | 12 | 4 |
| 05.96 | ED | 3 | 4 | 2 | 5 | 3 | 9 | 8 | 3 |
| 05.96 | RA | 28 | 21 | 4 | 27 | 5 | 18 | 9 | 2 |
| 05.96 | PB | 5 | 9 | 4 | 11 | 5 | 17 | 21 | 5 |
| 05.96 | BP | 5 | 4 | 2 | 5 | 3 | 20 | 12 | 3 |
| 05.96 | AK | 17 | 12 | 3 | 14 | 3 | 16 | 8 | 2 |
| 05.96 | JR | 19 | 17 | 4 | 20 | 5 | 14 | 10 | 3 |
| 05.96 | IR | 13 | 14 | 4 | 17 | 5 | 6 | 5 | 2 |
| 05.96 | JO | 6 | 24 | 10 | 29 | 12 | 1 | 3 | 3 |
| 05.98 | GP | 9 | 14 | 5 | 18 | 6 | 4 | 4 | 2 |
| 05.98 | FP | 7 | 11 | 4 | 14 | 5 | 3 | 3 | 2 |
| 05.98 | PR | 13 | 25 | 7 | 33 | 9 | 7 | 8 | 3 |
| 05.98 | DG | 4 | 11 | 5 | 14 | 7 | 6 | 10 | 4 |
| 05.98 | BR | 6 | 16 | 7 | 21 | 9 | 10 | 16 | 5 |
| 05.98 | KM | 7 | 12 | 5 | 16 | 6 | 14 | 14 | 4 |
| 05.98 | GT | 16 | 38 | 10 | 50 | 13 | 7 | 10 | 4 |
| 05.98 | AS | 7 | 19 | 7 | 25 | 9 | 9 | 13 | 5 |
| 06.00 | GMK | 11 | 10 | 3 | 11 | 3 | 1 | 1 | 1 |
| 06.02 | GP | 7 | 13 | 5 | 15 | 6 | 6 | 8 | 3 |
| 06.02 | LP | 4 | 17 | 9 | 20 | 10 | 5 | 19 | 9 |
| 06.02 | FP | 8 | 16 | 6 | 19 | 7 | 7 | 10 | 4 |
| 06.02 | TV | 13 | 10 | 3 | 12 | 3 | 16 | 10 | 2 |

| Date (UT) | Obs | P | ZHR (1.0) | | ZHR (1.5) | | S | HR | |
|---|---|---|---|---|---|---|---|---|---|
| Aug 06.02 | MR | 13 | 9 | ± 2 | 11 | ± 3 | 16 | 9 | ± 2 |
| 06.02 | PR | 4 | 7 | 4 | 8 | 4 | 11 | 13 | 4 |
| 06.02 | DG | 6 | 10 | 4 | 13 | 5 | 17 | 20 | 5 |
| 06.02 | BR | 8 | 18 | 6 | 22 | 8 | 9 | 14 | 5 |
| 06.02 | KM | 13 | 18 | 5 | 22 | 6 | 16 | 15 | 4 |
| 06.02 | GT | 7 | 13 | 5 | 15 | 6 | 3 | 4 | 2 |
| 06.03 | BP | 9 | 7 | 2 | 8 | 3 | 9 | 6 | 2 |
| 06.03 | AK | 18 | 13 | 3 | 14 | 3 | 11 | 7 | 2 |
| 06.03 | RK | 15 | 7 | 2 | 8 | 2 | 26 | 10 | 2 |
| 06.04 | RA | 21 | 19 | 4 | 22 | 5 | 13 | 10 | 3 |
| 06.04 | JR | 25 | 21 | 4 | 22 | 4 | 13 | 10 | 3 |
| 06.04 | IR | 21 | 16 | 3 | 17 | 4 | 6 | 4 | 2 |
| 06.06 | PR | 7 | 15 | 6 | 17 | 6 | 10 | 16 | 5 |
| 06.06 | DG | 11 | 18 | 5 | 20 | 4 | 11 | 14 | 4 |
| 06.06 | BR | 11 | 15 | 4 | 17 | 5 | 16 | 16 | 4 |
| 06.06 | KM | 11 | 13 | 4 | 15 | 4 | 19 | 17 | 4 |
| 06.06 | GT | 7 | 14 | 5 | 16 | 6 | 9 | 14 | 5 |
| 06.07 | GP | 14 | 12 | 3 | 13 | 3 | 5 | 3 | 1 |
| 06.07 | TS | 2 | 3 | 2 | 3 | 2 | 5 | 6 | 3 |
| 06.07 | FT | 4 | 7 | 4 | 8 | 4 | 2 | 4 | 2 |
| 06.08 | TD | 12 | 18 | 5 | 20 | 6 | 7 | 10 | 4 |
| 06.08 | PVDE | 8 | 10 | 4 | 11 | 4 | 6 | 7 | 3 |
| 06.09 | BR | 4 | 10 | 5 | 11 | 6 | 7 | 16 | 6 |
| 06.09 | KM | 6 | 10 | 6 | 11 | 4 | 10 | 14 | 4 |
| 06.10 | PR | 19 | 22 | 5 | 24 | 6 | 10 | 10 | 3 |
| 06.10 | LC | 15 | 17 | 4 | 18 | 5 | 11 | 11 | 3 |
| 06.29 | NM | 4 | 7 | 4 | 9 | 5 | 8 | 9 | 3 |
| 06.33 | NM | 24 | 33 | 7 | 38 | 8 | 14 | 14 | 4 |
| 06.37 | NM | 15 | 18 | 5 | 20 | 5 | 7 | 7 | 3 |
| 06.85 | PR | 4 | 25 | 13 | 45 | 23 | 14 | 29 | 8 |
| 06.85 | BR | 5 | 35 | 16 | 62 | 28 | 15 | 39 | 10 |
| 06.85 | KM | 4 | 16 | 8 | 29 | 14 | 19 | 26 | 6 |
| 06.85 | GS | 4 | 46 | 23 | 80 | 40 | 5 | 25 | 11 |
| 06.86 | GT | 4 | 28 | 14 | 50 | 25 | 6 | 15 | 6 |
| 06.86 | AS | 6 | 51 | 21 | 89 | 36 | 9 | 28 | 9 |
| 06.86 | IW | 2 | 7 | 5 | 13 | 9 | 6 | 7 | 3 |
| 06.88 | RA | 11 | 16 | 5 | 24 | 7 | 10 | 7 | 2 |
| 06.88 | PB | 10 | 10 | 3 | 13 | 4 | 11 | 9 | 3 |
| 06.88 | BP | 11 | 14 | 4 | 18 | 6 | 13 | 9 | 3 |
| 06.88 | AK | 5 | 7 | 3 | 9 | 4 | 18 | 14 | 3 |
| 06.88 | JR | 9 | 16 | 5 | 21 | 7 | 11 | 11 | 3 |
| 06.88 | IR | 13 | 14 | 4 | 19 | 5 | 21 | 13 | 3 |
| 06.90 | PP | 3 | 15 | 8 | 23 | 14 | 1 | 2 | 2 |
| 06.90 | GT | 6 | 20 | 8 | 32 | 13 | 9 | 13 | 4 |
| 06.90 | FDG | 7 | 12 | 5 | 20 | 8 | 4 | 3 | 2 |
| 06.90 | AS | 5 | 17 | 8 | 27 | 12 | 11 | 15 | 5 |
| 06.90 | IW | 3 | 6 | 4 | 10 | 6 | 7 | 5 | 2 |
| 06.90 | PR | 7 | 22 | 8 | 34 | 13 | 9 | 11 | 4 |
| 06.90 | BR | 12 | 37 | 11 | 59 | 17 | 16 | 20 | 5 |
| 06.90 | KM | 3 | 8 | 5 | 14 | 8 | 20 | 22 | 5 |
| 06.90 | GS | 4 | 31 | 15 | 49 | 25 | 4 | 14 | 7 |
| 06.92 | PA | 8 | 24 | 9 | 30 | 11 | 6 | 13 | 5 |
| 06.92 | RL | 5 | 11 | 5 | 14 | 6 | 7 | 14 | 5 |
| 06.94 | PP | 3 | 12 | 7 | 17 | 10 | 1 | 2 | 2 |
| 06.94 | GT | 4 | 11 | 6 | 16 | 8 | 7 | 10 | 4 |
| 06.94 | FDG | 5 | 11 | 5 | 15 | 7 | 3 | 3 | 2 |
| 06.94 | AS | 4 | 10 | 5 | 15 | 7 | 10 | 13 | 4 |
| 06.94 | IW | 5 | 8 | 4 | 12 | 5 | 5 | 4 | 2 |
| 06.94 | PR | 6 | 17 | 7 | 24 | 10 | 10 | 14 | 4 |
| 06.94 | BR | 6 | 30 | 12 | 44 | 18 | 7 | 18 | 7 |
| 06.94 | KM | 6 | 26 | 11 | 38 | 16 | 16 | 34 | 8 |

Table 2 (continued)

| Date (UT) | Obs | P | ZHR (1.0) | | ZHR (1.5) | | S | HR | |
|---|---|---|---|---|---|---|---|---|---|
| Aug 06.94 | GS | 5 | 36 | ± 16 | 52 | ± 23 | 3 | 12 | ± 7 |
| 06.94 | KG | 4 | 12 | 6 | 15 | 8 | 9 | 19 | 7 |
| 06.94 | JO | 7 | 30 | 12 | 38 | 14 | 3 | 10 | 6 |
| 06.96 | GT | 7 | 13 | 5 | 18 | 7 | 14 | 16 | 4 |
| 06.96 | RA | 22 | 20 | 4 | 25 | 5 | 17 | 9 | 2 |
| 06.96 | PB | 22 | 14 | 3 | 17 | 4 | 21 | 10 | 2 |
| 06.96 | BP | 14 | 11 | 3 | 13 | 3 | 19 | 10 | 2 |
| 06.96 | AK | 26 | 20 | 4 | 23 | 5 | 14 | 8 | 2 |
| 06.96 | JR | 14 | 16 | 4 | 19 | 9 | 10 | 9 | 3 |
| 06.96 | IR | 19 | 12 | 3 | 14 | 3 | 15 | 7 | 4 |
| 06.98 | PP | 5 | 15 | 7 | 19 | 9 | 2 | 4 | 3 |
| 06.98 | AS | 6 | 12 | 5 | 16 | 7 | 13 | 15 | 4 |
| 06.98 | IW | 4 | 6 | 3 | 8 | 4 | 6 | 5 | 2 |
| 06.98 | PR | 7 | 15 | 6 | 19 | 7 | 17 | 21 | 5 |
| 06.98 | BR | 8 | 17 | 6 | 22 | 8 | 15 | 19 | 5 |
| 06.98 | KM | 8 | 15 | 5 | 20 | 7 | 14 | 16 | 4 |
| 06.98 | GS | 3 | 15 | 9 | 20 | 12 | 3 | 10 | 6 |
| 06.98 | KG | 6 | 12 | 5 | 14 | 7 | 16 | 25 | 6 |
| 07.00 | PA | 10 | 31 | 10 | 36 | 11 | 9 | 26 | 9 |
| 07.00 | GMK | 15 | 22 | 6 | 25 | 6 | 5 | 6 | 3 |
| 07.00 | FDG | 8 | 9 | 3 | 11 | 4 | 7 | 5 | 2 |
| 07.02 | PP | 4 | 21 | 5 | 25 | 13 | 3 | 13 | 7 |
| 07.02 | PR | 8 | 25 | 9 | 30 | 11 | 6 | 13 | 5 |
| 07.02 | BR | 19 | 31 | 7 | 38 | 9 | 13 | 15 | 4 |
| 07.02 | KM | 15 | 20 | 5 | 24 | 6 | 17 | 15 | 4 |
| 07.02 | GS | 6 | 24 | 10 | 29 | 12 | 5 | 15 | 7 |
| 07.04 | GT | 15 | 20 | 5 | 23 | 6 | 14 | 13 | 4 |
| 07.04 | RA | 20 | 19 | 4 | 23 | 5 | 26 | 21 | 4 |
| 07.04 | PB | 22 | 13 | 3 | 15 | 3 | 21 | 10 | 2 |
| 07.04 | BP | 19 | 14 | 3 | 15 | 3 | 21 | 14 | 3 |
| 07.04 | AK | 12 | 13 | 4 | 14 | 4 | 10 | 10 | 3 |
| 07.04 | JR | 20 | 21 | 5 | 23 | 5 | 14 | 14 | 4 |
| 07.04 | IR | 20 | 15 | 3 | 16 | 4 | 16 | 11 | 3 |
| 07.05 | AS | 15 | 14 | 4 | 16 | 4 | 23 | 16 | 3 |
| 07.06 | PP | 6 | 14 | 6 | 17 | 7 | 4 | 9 | 5 |
| 07.06 | FDG | 11 | 14 | 4 | 16 | 5 | 8 | 8 | 3 |
| 07.06 | PR | 12 | 17 | 5 | 20 | 6 | 7 | 8 | 3 |
| 07.06 | BR | 15 | 22 | 6 | 25 | 6 | 14 | 16 | 4 |
| 07.06 | KM | 12 | 13 | 4 | 15 | 4 | 18 | 14 | 3 |
| 07.07 | RK | 34 | 11 | 2 | 12 | 2 | 32 | 9 | 2 |
| 07.10 | PP | 10 | 14 | 5 | 15 | 5 | 13 | 17 | 5 |
| 07.10 | GT | 12 | 14 | 4 | 16 | 5 | 17 | 18 | 5 |
| 07.10 | FDG | 14 | 22 | 6 | 24 | 6 | 12 | 16 | 5 |
| 07.10 | PR | 16 | 21 | 5 | 23 | 6 | 11 | 13 | 4 |
| 07.10 | BR | 23 | 43 | 9 | 46 | 10 | 18 | 31 | 7 |
| 07.10 | KM | 13 | 14 | 4 | 16 | 4 | 33 | 30 | 5 |
| 07.29 | NM | 12 | 19 | 5 | 23 | 7 | 11 | 11 | 3 |
| 07.33 | NM | 5 | 7 | 3 | 8 | 4 | 9 | 9 | 3 |
| 07.37 | NM | 10 | 12 | 4 | 14 | 4 | 12 | 12 | 3 |
| 07.88 | RK | 7 | 9 | 3 | 11 | 4 | 15 | 9 | 2 |
| 07.89 | TH | 2 | 15 | 10 | 18 | 13 | 3 | 19 | 11 |
| 07.92 | GT | 8 | 31 | 11 | 46 | 16 | 9 | 16 | 5 |
| 07.93 | FP | 12 | 17 | 5 | 24 | 7 | 16 | 11 | 3 |
| 07.93 | GP | 7 | 10 | 4 | 15 | 6 | 12 | 8 | 2 |
| 07.93 | PPA | 11 | 22 | 7 | 26 | 8 | 0 | — | |
| 07.93 | MS | 2 | 14 | 10 | 17 | 12 | 2 | 13 | 9 |
| 07.93 | BR | 11 | 57 | 17 | 85 | 25 | 13 | 32 | 9 |
| 07.93 | PB | 21 | 13 | 3 | 16 | 3 | 17 | 6 | 2 |
| 07.93 | BP | 20 | 14 | 3 | 17 | 4 | 30 | 13 | 2 |
| 07.93 | AK | 10 | 8 | 3 | 10 | 3 | 29 | 16 | 3 |
| 07.93 | JR | 15 | 16 | 4 | 19 | 5 | 14 | 10 | 3 |

| Date (UT) | Obs | P | ZHR (1.0) | | ZHR (1.5) | | S | HR | |
|---|---|---|---|---|---|---|---|---|---|
| Aug 07.93 | IR | 30 | 21 | ± 4 | 26 | ± 5 | 15 | 7 | ± 2 |
| 07.93 | US | 9 | 11 | 4 | 14 | 5 | 22 | 19 | 2 |
| 07.93 | DG | 3 | 13 | 7 | 19 | 11 | 9 | 19 | 7 |
| 07.93 | LP | 6 | 26 | 11 | 36 | 15 | 6 | 18 | 7 |
| 07.95 | KM | 5 | 10 | 5 | 15 | 7 | 10 | 14 | 4 |
| 07.96 | PP | 7 | 18 | 7 | 26 | 10 | 4 | 6 | 3 |
| 07.96 | AS | 13 | 32 | 9 | 43 | 12 | 27 | 37 | 7 |
| 07.96 | PR | 16 | 21 | 5 | 30 | 7 | 11 | 8 | 2 |
| 07.96 | LC | 18 | 47 | 11 | 66 | 15 | 13 | 19 | 5 |
| 07.96 | OS | 10 | 50 | 16 | 70 | 22 | 3 | 10 | 6 |
| 07.97 | RA | 24 | 20 | 4 | 25 | 5 | 15 | 8 | 2 |
| 07.98 | FP | 13 | 27 | 8 | 35 | 10 | 5 | 6 | 3 |
| 07.98 | GP | 5 | 9 | 4 | 12 | 5 | 5 | 6 | 3 |
| 07.98 | BR | 7 | 26 | 10 | 33 | 13 | 9 | 22 | 7 |
| 07.99 | DG | 16 | 47 | 11 | 61 | 15 | 14 | 25 | 7 |
| 08.00 | GT | 12 | 29 | 8 | 36 | 10 | 18 | 28 | 7 |
| 08.01 | FDG | 6 | 13 | 5 | 16 | 7 | 5 | 7 | 3 |
| 08.02 | FP | 18 | 21 | 5 | 25 | 6 | 4 | 5 | 3 |
| 08.02 | GP | 7 | 9 | 3 | 10 | 4 | 6 | 6 | 2 |
| 08.03 | RA | 26 | 17 | 3 | 19 | 4 | 18 | 9 | 2 |
| 08.03 | PB | 24 | 10 | 2 | 11 | 2 | 35 | 12 | 2 |
| 08.03 | BP | 27 | 17 | 3 | 19 | 4 | 34 | 17 | 3 |
| 08.03 | JR | 19 | 14 | 3 | 16 | 4 | 14 | 10 | 3 |
| 08.03 | IR | 35 | 18 | 3 | 19 | 3 | 22 | 10 | 2 |
| 08.03 | US | 16 | 11 | 3 | 12 | 3 | 31 | 18 | 3 |
| 08.05 | AK | 15 | 14 | 4 | 16 | 4 | 15 | 13 | 4 |
| 08.07 | FP | 23 | 17 | 4 | 20 | 4 | 8 | 5 | 2 |
| 08.07 | GP | 8 | 7 | 3 | 8 | 3 | 13 | 10 | 3 |
| 08.33 | NM | 8 | 11 | 4 | 13 | 4 | 5 | 5 | 2 |
| 08.39 | NM | 7 | 18 | 7 | 20 | 8 | 8 | 17 | 6 |
| 08.88 | IR | 21 | 24 | 5 | 32 | 7 | 14 | 13 | 4 |
| 08.88 | RA | 15 | 24 | 6 | 35 | 9 | 18 | 14 | 3 |
| 08.88 | PB | 22 | 28 | 6 | 37 | 8 | 10 | 7 | 2 |
| 08.88 | BP | 10 | 12 | 4 | 16 | 5 | 25 | 17 | 3 |
| 08.88 | AK | 10 | 18 | 6 | 24 | 8 | 11 | 12 | 4 |
| 08.88 | STO | 4 | 9 | 5 | 14 | 7 | 7 | 8 | 3 |
| 08.89 | JR | 3 | 8 | 5 | 10 | 6 | 11 | 18 | 5 |
| 08.89 | US | 1 | — | | — | | 28 | 9 | 6 |
| 08.89 | STS | 7 | 16 | 6 | 24 | 9 | 9 | 9 | 3 |
| 08.89 | ELT | 6 | 14 | 6 | 21 | 9 | 6 | 7 | 3 |
| 08.92 | OS | 3 | 11 | 6 | 15 | 9 | 8 | 16 | 6 |
| 08.92 | RL | 5 | 15 | 7 | 18 | 8 | 7 | 19 | 3 |
| 08.92 | MR | 6 | 35 | 14 | 41 | 17 | 2 | 11 | 8 |
| 08.92 | SCA | 1 | 4 | 4 | 6 | 6 | 3 | 8 | 4 |
| 08.92 | RP | 3 | 21 | 12 | 30 | 17 | 5 | 23 | 10 |
| 08.92 | GP | 9 | 11 | 4 | 15 | 5 | 10 | 6 | 2 |
| 08.94 | FT | 7 | 25 | 9 | 34 | 13 | 2 | 4 | 3 |
| 08.95 | PA | 5 | 12 | 5 | 15 | 7 | 9 | 15 | 5 |
| 08.96 | DG | 8 | 18 | 7 | 25 | 9 | 8 | 11 | 4 |
| 08.96 | IR | 40 | 31 | 5 | 37 | 6 | 13 | 7 | 2 |
| 08.96 | RA | 20 | 19 | 4 | 23 | 5 | 20 | 12 | 3 |
| 08.96 | PB | 35 | 24 | 4 | 29 | 5 | 15 | 7 | 2 |
| 08.96 | BP | 7 | 6 | 2 | 8 | 3 | 12 | 8 | 2 |
| 08.96 | AK | 22 | 22 | 5 | 25 | 5 | 15 | 11 | 3 |
| 08.96 | JR | 18 | 22 | 5 | 26 | 6 | 9 | 8 | 3 |
| 08.96 | US | 15 | 15 | 4 | 18 | 5 | 28 | 21 | 4 |
| 08.96 | SCA | 1 | 3 | 3 | 5 | 5 | 4 | 10 | 5 |
| 08.98 | GT | 10 | 27 | 8 | 37 | 12 | 6 | 11 | 4 |
| 08.98 | AS | 7 | 23 | 9 | 31 | 12 | 7 | 15 | 6 |
| 08.98 | LC | 8 | 17 | 6 | 22 | 8 | 3 | 4 | 2 |
| 08.98 | GS | 4 | 19 | 10 | 25 | 13 | 5 | 16 | 7 |

Table 2 (continued)

| Date (UT) | Obs | P | ZHR (1.0) | | ZHR (1.5) | | S | HR | |
|---|---|---|---|---|---|---|---|---|---|
| Aug 08.98 | KM | 8 | 23 | ± 8 | 30 | ± 11 | 7 | 13 | ± 5 |
| 08.98 | FDG | 9 | 28 | 9 | 38 | 12 | 5 | 9 | 4 |
| 09.00 | GMK | 13 | 21 | 6 | 24 | 7 | 7 | 10 | 4 |
| 09.02 | GT | 8 | 23 | 8 | 29 | 10 | 9 | 18 | 6 |
| 09.02 | DG | 6 | 20 | 8 | 24 | 10 | 5 | 9 | 4 |
| 09.02 | FDG | 3 | 8 | 4 | 9 | 5 | 7 | 13 | 5 |
| 09.02 | AS | 8 | 35 | 12 | 44 | 15 | 7 | 23 | 9 |
| 09.02 | LC | 5 | 11 | 5 | 13 | 6 | 4 | 6 | 3 |
| 09.02 | GS | 5 | 23 | 10 | 28 | 13 | 4 | 15 | 8 |
| 09.02 | GP | 5 | 8 | 3 | 10 | 4 | 2 | 2 | 1 |
| 09.02 | KM | 8 | 18 | 6 | 22 | 8 | 12 | 19 | 6 |
| 09.02 | BR | 16 | 36 | 9 | 45 | 11 | 13 | 20 | 6 |
| 09.04 | PP | 18 | 25 | 6 | 29 | 7 | 7 | 8 | 3 |
| 09.04 | PR | 27 | 20 | 4 | 24 | 5 | 14 | 8 | 2 |
| 09.04 | RA | 27 | 16 | 3 | 18 | 4 | 25 | 11 | 2 |
| 09.04 | PB | 43 | 31 | 5 | 33 | 5 | 14 | 8 | 2 |
| 09.04 | BP | 39 | 23 | 4 | 24 | 4 | 19 | 10 | 2 |
| 09.04 | AK | 26 | 19 | 4 | 20 | 4 | 24 | 15 | 3 |
| 09.04 | JR | 29 | 24 | 4 | 25 | 5 | 17 | 12 | 3 |
| 09.04 | US | 11 | 9 | 3 | 10 | 3 | 52 | 39 | 5 |
| 09.06 | GP | 10 | 12 | 4 | 13 | 4 | 9 | 9 | 3 |
| 09.08 | FDG | 10 | 26 | 8 | 28 | 9 | 3 | 7 | 4 |
| 09.08 | AS | 14 | 28 | 8 | 31 | 8 | 13 | 21 | 6 |
| 09.08 | LC | 8 | 16 | 6 | 18 | 6 | 6 | 10 | 4 |
| 09.08 | IR | 61 | 27 | 4 | 28 | 4 | 20 | 8 | 2 |
| 09.08 | KM | 22 | 56 | 12 | 63 | 13 | 10 | 22 | 7 |
| 09.08 | BR | 16 | 41 | 10 | 44 | 11 | 12 | 26 | 8 |
| 09.33 | NM | 11 | 15 | 5 | 17 | 5 | 14 | 14 | 4 |
| 09.37 | NM | 11 | 14 | 4 | 15 | 5 | 9 | 9 | 3 |
| 09.45 | LR | 10 | 16 | 5 | 18 | 6 | 9 | 13 | 4 |
| 09.49 | LR | 17 | 20 | 5 | 21 | 5 | 9 | 9 | 3 |
| 09.90 | SCA | 3 | 12 | 7 | 18 | 10 | 4 | 10 | 5 |
| 09.90 | JO | 7 | 33 | 13 | 43 | 16 | 2 | 7 | 5 |
| 09.90 | IR | 20 | 28 | 6 | 37 | 8 | 9 | 8 | 3 |
| 09.90 | AK | 6 | 11 | 4 | 14 | 6 | 13 | 14 | 4 |
| 09.90 | AS | 7 | 23 | 9 | 36 | 14 | 13 | 18 | 5 |
| 09.90 | KM | 2 | 12 | 8 | 19 | 13 | 4 | 10 | 5 |
| 09.90 | GT | 5 | 20 | 9 | 32 | 14 | 5 | 8 | 4 |
| 09.90 | PP | 5 | 17 | 8 | 27 | 12 | 2 | 3 | 2 |
| 09.90 | DG | 3 | 15 | 9 | 24 | 14 | 4 | 8 | 4 |
| 09.90 | IW | 7 | 25 | 9 | 40 | 15 | 12 | 19 | 5 |
| 09.90 | GS | 4 | 28 | 14 | 45 | 22 | 6 | 20 | 8 |
| 09.90 | BR | 5 | 22 | 10 | 35 | 16 | 3 | 6 | 3 |
| 09.92 | JR | 8 | 30 | 11 | 38 | 13 | 3 | 8 | 4 |
| 09.92 | RA | 9 | 27 | 9 | 37 | 12 | 4 | 6 | 3 |
| 09.92 | FDG | 5 | 11 | 5 | 17 | 7 | 2 | 2 | 1 |
| 09.92 | RT | 34 | 49 | 8 | 58 | 10 | 11 | 13 | 4 |
| 09.92 | IL | 5 | 28 | 12 | 33 | 15 | 4 | 19 | 9 |
| 09.92 | VM | 6 | 39 | 16 | 46 | 19 | 1 | 6 | 6 |
| 09.93 | GP | 17 | 19 | 5 | 25 | 6 | 8 | 5 | 2 |
| 09.93 | FP | 34 | 43 | 7 | 60 | 10 | 32 | 20 | 4 |
| 09.94 | GT | 4 | 24 | 12 | 35 | 17 | 8 | 26 | 9 |
| 09.94 | DG | 4 | 20 | 10 | 28 | 14 | 5 | 13 | 6 |
| 09.94 | LC | 8 | 31 | 11 | 44 | 16 | 3 | 6 | 3 |
| 09.94 | BR | 5 | 28 | 13 | 41 | 18 | 3 | 9 | 5 |
| 09.95 | SA | 17 | 50 | 12 | 62 | 15 | 0 | – | |
| 09.95 | KV | 18 | 33 | 8 | 41 | 10 | 1 | 2 | 2 |
| 09.95 | BJ | 20 | 40 | 9 | 49 | 11 | 1 | 2 | 2 |
| 09.95 | RA | 9 | 17 | 6 | 21 | 7 | 0 | – | |
| 09.95 | KG | 8 | 19 | 7 | 24 | 9 | 9 | 12 | 4 |
| 09.95 | LTH | 9 | 19 | 6 | 23 | 8 | 17 | 26 | 6 |
| Aug 09.95 | GS | 6 | 33 | ± 13 | 47 | ± 19 | 6 | 20 | ± 8 |
| 09.96 | TEH | 12 | 30 | 9 | 35 | 10 | 8 | 15 | 5 |
| 09.96 | TL | 11 | 29 | 9 | 34 | 10 | 1 | 2 | 2 |
| 09.96 | FDG | 9 | 16 | 5 | 21 | 7 | 5 | 2 | 2 |
| 09.97 | HV | 23 | 43 | 9 | 56 | 12 | 6 | 10 | 4 |
| 09.97 | OS | 21 | 20 | 4 | 26 | 6 | 13 | 9 | 2 |
| 09.98 | KG | 13 | 26 | 7 | 31 | 9 | 12 | 18 | 5 |
| 09.98 | GT | 6 | 35 | 14 | 46 | 19 | 6 | 13 | 5 |
| 09.98 | PP | 6 | 35 | 14 | 47 | 19 | 4 | 16 | 8 |
| 09.99 | GMK | 11 | 21 | 6 | 24 | 7 | 6 | 9 | 4 |
| 09.99 | PA | 32 | 30 | 5 | 35 | 6 | 20 | 15 | 3 |
| 09.99 | LTH | 10 | 19 | 6 | 2 | 7 | 15 | 22 | 6 |
| 09.99 | TEH | 13 | 28 | 8 | 32 | 9 | 5 | 9 | 4 |
| 09.99 | AS | 12 | 27 | 8 | 35 | 10 | 7 | 10 | 4 |
| 09.99 | FP | 13 | 16 | 5 | 20 | 6 | 18 | 14 | 3 |
| 10.00 | BD | 21 | 16 | 4 | 20 | 4 | 11 | 6 | 2 |
| 10.00 | MR | 19 | 19 | 4 | 22 | 5 | 4 | 3 | 2 |
| 10.00 | TV | 8 | 15 | 5 | 18 | 6 | 7 | 9 | 4 |
| 10.00 | MVS | 23 | 22 | 5 | 27 | 6 | 10 | 7 | 2 |
| 10.00 | KM | 13 | 24 | 7 | 30 | 8 | 9 | 11 | 4 |
| 10.00 | IW | 14 | 11 | 3 | 14 | 4 | 15 | 8 | 2 |
| 10.00 | GP | 7 | 11 | 4 | 20 | 7 | 5 | 5 | 2 |
| 10.00 | BR | 12 | 35 | 10 | 44 | 13 | 9 | 17 | 6 |
| 10.02 | KG | 18 | 31 | 7 | 35 | 8 | 13 | 19 | 5 |
| 10.02 | ED | 12 | 12 | 4 | 15 | 4 | 11 | 9 | 3 |
| 10.02 | DG | 11 | 16 | 5 | 20 | 6 | 4 | 4 | 2 |
| 10.02 | GP | 10 | 14 | 5 | 16 | 5 | 6 | 7 | 3 |
| 10.03 | LTH | 9 | 16 | 5 | 18 | 6 | 8 | 12 | 4 |
| 10.03 | TEH | 8 | 24 | 8 | 26 | 9 | 1 | 3 | 3 |
| 10.05 | AS | 6 | 22 | 9 | 25 | 10 | 7 | 20 | 7 |
| 10.06 | GT | 6 | 11 | 4 | 12 | 5 | 8 | 11 | 4 |
| 10.06 | PP | 9 | 19 | 6 | 22 | 7 | 2 | 4 | 3 |
| 10.06 | LC | 8 | 14 | 5 | 16 | 6 | 3 | 4 | 2 |
| 10.06 | FDG | 10 | 19 | 6 | 22 | 7 | 6 | 9 | 4 |
| 10.08 | BR | 9 | 23 | 8 | 26 | 9 | 7 | 13 | 5 |
| 10.29 | NM | 13 | 20 | 6 | 25 | 7 | 8 | 8 | 3 |
| 10.33 | NM | 16 | 22 | 5 | 25 | 6 | 9 | 9 | 3 |
| 10.35 | LR | 17 | 30 | 7 | 40 | 10 | 10 | 10 | 3 |
| 10.37 | NM | 13 | 16 | 4 | 18 | 5 | 16 | 16 | 4 |
| 10.39 | LR | 13 | 19 | 5 | 23 | 6 | 8 | 8 | 3 |
| 10.43 | LR | 19 | 25 | 6 | 28 | 6 | 7 | 7 | 3 |
| 10.47 | LR | 25 | 30 | 6 | 32 | 6 | 13 | 13 | 4 |
| 10.86 | PR | 2 | 18 | 12 | 31 | 22 | 1 | 3 | 3 |
| 10.89 | GMK | 2 | 19 | 13 | 25 | 18 | 3 | 19 | 11 |
| 10.91 | VM | 11 | 36 | 11 | 42 | 13 | 7 | 20 | 8 |
| 10.91 | AK | 25 | 31 | 5 | 40 | 8 | 4 | 3 | 2 |
| 10.92 | PL | 4 | 14 | 7 | 20 | 10 | 5 | 10 | 4 |
| 10.93 | STO | 2 | 18 | 13 | 24 | 17 | 2 | 12 | 8 |
| 10.93 | IL | 10 | 14 | 4 | 16 | 5 | 10 | 11 | 4 |
| 10.93 | MP | 11 | 29 | 9 | 34 | 10 | 9 | 21 | 7 |
| 10.93 | STS | 4 | 31 | 16 | 43 | 21 | 3 | 15 | 9 |
| 10.94 | US | 15 | 18 | 5 | 22 | 6 | 18 | 16 | 4 |
| 10.94 | IR | 23 | 28 | 6 | 34 | 7 | 12 | 10 | 3 |
| 10.94 | JR | 15 | 26 | 7 | 31 | 8 | 5 | 6 | 3 |
| 10.94 | BP | 14 | 20 | 5 | 24 | 6 | 26 | 25 | 5 |
| 10.94 | PB | 21 | 19 | 4 | 22 | 5 | 11 | 7 | 2 |
| 10.94 | RA | 18 | 23 | 5 | 31 | 7 | 8 | 6 | 2 |
| 10.94 | JV | 5 | 47 | 21 | 65 | 29 | 3 | 21 | 12 |
| 10.96 | KG | 17 | 43 | 10 | 51 | 12 | 5 | 9 | 4 |
| 10.98 | KM | 5 | 10 | 5 | 14 | 7 | 12 | 12 | 3 |
| 10.98 | BR | 9 | 48 | 16 | 64 | 21 | 2 | 7 | 5 |

Table 2 (continued)

| Date (UT) | Obs | P | ZHR (1.0) | | ZHR (1.5) | | S | HR | |
|---|---|---|---|---|---|---|---|---|---|
| Aug 10.99 | LTH | 16 | 24 | ± 6 | 28 | ± 7 | 12 | 15 | ± 4 |
| 10.99 | KS | 15 | 39 | 10 | 45 | 12 | 3 | 6 | 2 |
| 10.99 | ED | 25 | 23 | 5 | 28 | 6 | 7 | 4 | 2 |
| 11.00 | GMK | 20 | 33 | 7 | 37 | 8 | 8 | 11 | 4 |
| 11.00 | BD | 40 | 27 | 4 | 33 | 5 | 13 | 6 | 2 |
| 11.00 | MR | 26 | 16 | 3 | 19 | 4 | 20 | 9 | 2 |
| 11.00 | TV | 33 | 28 | 5 | 34 | 6 | 25 | 16 | 3 |
| 11.00 | MVS | 34 | 22 | 4 | 26 | 5 | 16 | 7 | 2 |
| 11.02 | PA | 35 | 35 | 6 | 40 | 7 | 18 | 15 | 4 |
| 11.02 | DG | 16 | 39 | 10 | 48 | 12 | 4 | 7 | 4 |
| 11.04 | OS | 27 | 27 | 5 | 29 | 6 | 14 | 13 | 4 |
| 11.04 | JR | 18 | 19 | 4 | 20 | 5 | 13 | 12 | 4 |
| 11.04 | PB | 10 | 18 | 6 | 19 | 6 | 2 | 3 | 2 |
| 11.04 | RA | 19 | 18 | 4 | 20 | 5 | 7 | 6 | 2 |
| 11.04 | GT | 37 | 64 | 10 | 75 | 12 | 21 | 25 | 5 |
| 11.04 | BR | 45 | 60 | 9 | 71 | 11 | 25 | 22 | 4 |
| 11.04 | RS | 5 | 11 | 5 | 13 | 6 | 12 | 23 | 7 |
| 11.05 | IR | 23 | 17 | 4 | 18 | 4 | 13 | 9 | 2 |
| 11.05 | AK | 18 | 22 | 5 | 23 | 6 | 10 | 12 | 4 |
| 11.06 | KM | 36 | 55 | 9 | 63 | 10 | 13 | 15 | 4 |
| 11.06 | AS | 32 | 35 | 6 | 40 | 7 | 21 | 17 | 4 |
| 11.06 | GS | 24 | 85 | 17 | 95 | 19 | 11 | 35 | 10 |
| 11.06 | LC | 33 | 52 | 9 | 59 | 10 | 17 | 21 | 5 |
| 11.06 | PR | 33 | 52 | 9 | 59 | 10 | 21 | 26 | 6 |
| 11.08 | AS | 39 | 41 | 7 | 45 | 7 | 14 | 23 | 3 |
| 11.10 | KM | 31 | 65 | 12 | 71 | 13 | 26 | 50 | 10 |
| 11.10 | GT | 26 | 37 | 7 | 41 | 8 | 8 | 10 | 4 |
| 11.10 | GS | 14 | 39 | 10 | 43 | 11 | 12 | 33 | 10 |
| 11.11 | LC | 31 | 37 | 7 | 40 | 7 | 8 | 9 | 3 |
| 11.11 | PR | 25 | 30 | 6 | 33 | 7 | 9 | 9 | 3 |
| 11.11 | BR | 32 | 44 | 8 | 48 | 8 | 37 | 46 | 8 |
| 11.29 | NM | 13 | 20 | 6 | 25 | 7 | 6 | 6 | 2 |
| 11.33 | NM | 22 | 30 | 6 | 35 | 7 | 6 | 6 | 2 |
| 11.35 | LR | 19 | 34 | 8 | 45 | 10 | 4 | 4 | 2 |
| 11.37 | NM | 23 | 28 | 6 | 31 | 7 | 10 | 10 | 3 |
| 11.39 | LR | 24 | 33 | 7 | 43 | 9 | 13 | 13 | 4 |
| 11.43 | LR | 35 | 46 | 8 | 52 | 9 | 10 | 10 | 3 |
| 11.47 | LR | 31 | 37 | 7 | 40 | 7 | 13 | 13 | 4 |
| 11.90 | RA | 23 | 24 | 5 | 32 | 8 | 6 | 4 | 2 |
| 11.90 | PB | 27 | 30 | 6 | 40 | 8 | 12 | 8 | 2 |
| 11.90 | BP | 28 | 23 | 4 | 29 | 6 | 40 | 19 | 3 |
| 11.90 | AK | 29 | 30 | 6 | 39 | 7 | 15 | 10 | 3 |
| 11.90 | JR | 19 | 25 | 6 | 33 | 8 | 11 | 9 | 3 |
| 11.90 | IR | 42 | 38 | 6 | 50 | 8 | 14 | 7 | 2 |
| 11.90 | US | 17 | 17 | 4 | 23 | 6 | 30 | 19 | 4 |
| 11.90 | NL | 8 | 85 | 30 | 113 | 40 | 3 | 24 | 14 |
| 11.90 | SA | 6 | 74 | 30 | 99 | 41 | 0 | – | |
| 11.90 | KV | 4 | 41 | 21 | 55 | 28 | 0 | – | |
| 11.92 | JO | 30 | 99 | 11 | 75 | 14 | 5 | 8 | 3 |
| 11.94 | KG | 33 | 59 | 10 | 74 | 13 | 8 | 9 | 3 |
| 11.94 | LTH | 28 | 63 | 12 | 76 | 14 | 12 | 20 | 6 |
| 11.95 | TEH | 22 | 58 | 12 | 71 | 15 | 12 | 23 | 7 |
| 11.95 | TVL | 13 | 21 | 6 | 25 | 7 | 11 | 13 | 5 |
| 11.95 | KS | 29 | 73 | 14 | 88 | 16 | 4 | 7 | 2 |
| 11.97 | JR | 11 | 38 | 12 | 44 | 13 | 5 | 14 | 6 |
| 11.97 | PB | 24 | 52 | 11 | 59 | 12 | 12 | 22 | 6 |
| 11.97 | IR | 22 | 42 | 9 | 51 | 11 | 9 | 12 | 4 |
| 11.97 | US | 6 | 35 | 14 | 40 | 16 | 3 | 16 | 9 |
| 11.98 | KG | 43 | 77 | 12 | 91 | 14 | 18 | 24 | 6 |
| 11.98 | LTH | 37 | 75 | 12 | 86 | 14 | 20 | 32 | 7 |
| 11.98 | TEH | 29 | 63 | 12 | 73 | 14 | 13 | 22 | 6 |

| Date (UT) | Obs | P | ZHR (1.0) | | ZHR (1.5) | | S | HR | |
|---|---|---|---|---|---|---|---|---|---|
| Aug 11.98 | RA | 10 | 32 | ± 10 | 37 | ± 12 | 2 | 5 | ± 3 |
| 11.98 | AK | 9 | 44 | 15 | 50 | 17 | 5 | 21 | 9 |
| 11.98 | PA | 54 | 80 | 11 | 94 | 13 | 24 | 29 | 6 |
| 11.99 | TVL | 10 | 24 | 8 | 28 | 9 | 4 | 7 | 4 |
| 12.00 | KS | 34 | 67 | 12 | 77 | 13 | 6 | 10 | 4 |
| 12.00 | GMK | 28 | 30 | 6 | 35 | 7 | 6 | 5 | 2 |
| 12.02 | LTH | 30 | 53 | 10 | 59 | 11 | 24 | 36 | 7 |
| 12.03 | KG | 45 | 52 | 8 | 57 | 9 | 16 | 17 | 4 |
| 12.03 | TEH | 49 | 71 | 10 | 79 | 11 | 17 | 21 | 5 |
| 12.03 | TVL | 16 | 36 | 9 | 40 | 10 | 12 | 23 | 7 |
| 12.04 | BR | 46 | 73 | 11 | 83 | 12 | 20 | 24 | 5 |
| 12.04 | RA | 17 | 32 | 8 | 36 | 9 | 7 | 11 | 4 |
| 12.04 | PB | 31 | 36 | 6 | 40 | 7 | 14 | 15 | 4 |
| 12.04 | BP | 20 | 44 | 10 | 48 | 11 | 8 | 16 | 6 |
| 12.04 | AK | 32 | 42 | 7 | 45 | 8 | 9 | 11 | 4 |
| 12.04 | JR | 18 | 31 | 7 | 33 | 8 | 8 | 13 | 4 |
| 12.04 | IR | 35 | 39 | 7 | 42 | 7 | 8 | 8 | 3 |
| 12.04 | US | 15 | 23 | 6 | 25 | 6 | 13 | 19 | 5 |
| 12.04 | KS | 51 | 98 | 14 | 107 | 15 | 8 | 14 | 5 |
| 12.06 | KM | 116 | 100 | 9 | 106 | 10 | 34 | 22 | 4 |
| 12.06 | GT | 50 | 82 | 12 | 100 | 14 | 9 | 10 | 3 |
| 12.06 | PP | 39 | 86 | 14 | 98 | 16 | 0 | – | |
| 12.06 | AS | 49 | 64 | 9 | 74 | 11 | 25 | 25 | 5 |
| 12.06 | LC | 53 | 85 | 12 | 97 | 13 | 12 | 15 | 4 |
| 12.06 | PR | 41 | 68 | 11 | 78 | 12 | 7 | 9 | 4 |
| 12.06 | FDG | 50 | 87 | 12 | 98 | 14 | 9 | 13 | 4 |
| 12.07 | GS | 45 | 129 | 19 | 145 | 22 | 4 | 10 | 5 |
| 12.08 | BR | 65 | 65 | 8 | 70 | 9 | 37 | 30 | 5 |
| 12.09 | KM | 119 | 109 | 10 | 117 | 11 | 37 | 30 | 5 |
| 12.09 | KN | 24 | 84 | 17 | 99 | 20 | 9 | 29 | 9 |
| 12.10 | PP | 32 | 64 | 11 | 70 | 12 | 3 | 5 | 3 |
| 12.10 | LC | 33 | 54 | 9 | 59 | 10 | 6 | 8 | 3 |
| 12.10 | FDG | 54 | 86 | 12 | 92 | 13 | 8 | 12 | 4 |
| 12.11 | GS | 39 | 97 | 16 | 107 | 17 | 11 | 28 | 8 |
| 12.11 | GT | 60 | 67 | 9 | 73 | 9 | 18 | 18 | 4 |
| 12.11 | AS | 77 | 76 | 9 | 83 | 10 | 25 | 21 | 4 |
| 12.11 | PR | 49 | 55 | 8 | 60 | 9 | 16 | 16 | 4 |
| 12.11 | BR | 57 | 59 | 8 | 63 | 8 | 25 | 42 | 8 |
| 12.29 | NM | 31 | 51 | 9 | 66 | 12 | 2 | 2 | 1 |
| 12.33 | NM | 31 | 42 | 8 | 49 | 9 | 8 | 8 | 3 |
| 12.35 | LR | 20 | – | | – | | – | – | |
| 12.37 | NM | 38 | 62 | 10 | 68 | 11 | 11 | 14 | 4 |
| 12.39 | LR | 48 | 71 | 10 | 86 | 12 | 10 | 10 | 3 |
| 12.43 | LR | 55 | 72 | 10 | 82 | 11 | 8 | 8 | 3 |
| 12.47 | LR | 61 | 73 | 9 | 79 | 10 | 6 | 6 | 2 |
| 12.84 | KM | 14 | 74 | 20 | 125 | 33 | 9 | 17 | 6 |
| 12.84 | BR | 17 | 68 | 17 | 119 | 29 | 5 | 11 | 5 |
| 12.85 | GT | 23 | 95 | 20 | 160 | 33 | 5 | 8 | 4 |
| 12.85 | DG | 21 | 96 | 21 | 163 | 36 | 6 | 10 | 4 |
| 12.85 | IW | 22 | 91 | 19 | 154 | 33 | 8 | 12 | 4 |
| 12.85 | PR | 23 | 102 | 21 | 172 | 36 | 6 | 10 | 4 |
| 12.85 | AS | 23 | 125 | 26 | 210 | 44 | 15 | 32 | 8 |
| 12.85 | GS | 19 | 158 | 36 | 259 | 59 | 4 | 16 | 8 |
| 12.85 | KD | 19 | 105 | 24 | 177 | 41 | 3 | 7 | 4 |
| 12.87 | STO | 11 | 44 | 13 | 68 | 20 | 6 | 12 | 5 |
| 12.87 | STS | 13 | 58 | 16 | 88 | 24 | 5 | 11 | 5 |
| 12.88 | KM | 39 | 105 | 17 | 168 | 27 | 20 | 21 | 5 |
| 12.88 | BR | 30 | 86 | 16 | 138 | 25 | 29 | 33 | 6 |
| 12.88 | ELT | 8 | 39 | 14 | 58 | 21 | 4 | 11 | 5 |
| 12.88 | ROS | 9 | 56 | 19 | 83 | 28 | 3 | 11 | 6 |
| 12.88 | TRI | 5 | 35 | 16 | 51 | 23 | 3 | 27 | 10 |

Table 2 (continued)

| Date (UT) | Obs | P | ZHR (1.0) | | ZHR (1.5) | | S | HR | |
|---|---|---|---|---|---|---|---|---|---|
| Aug 12.88 | STS | 17 | 47 | ± 11 | 64 | ± 16 | 8 | 13 | ± 5 |
| 12.90 | GT | 38 | 111 | 18 | 170 | 28 | 6 | 8 | 4 |
| 12.90 | DG | 36 | 104 | 17 | 159 | 27 | 15 | 19 | 5 |
| 12.90 | DV | 28 | 103 | 19 | 156 | 30 | 7 | 12 | 5 |
| 12.90 | IW | 32 | 53 | 9 | 81 | 14 | 7 | 5 | 2 |
| 12.90 | PR | 31 | 83 | 15 | 124 | 22 | 11 | 14 | 4 |
| 12.90 | AS | 28 | 92 | 17 | 138 | 26 | 16 | 25 | 6 |
| 12.90 | HV | 31 | 126 | 23 | 172 | 31 | 3 | 8 | 5 |
| 12.90 | GS | 29 | 149 | 28 | 220 | 41 | 9 | 26 | 9 |
| 12.90 | DK | 29 | 89 | 17 | 135 | 25 | 8 | 11 | 4 |
| 12.91 | LP | 7 | 56 | 21 | 75 | 28 | 2 | 12 | 8 |
| 12.91 | GC | 11 | 74 | 22 | 99 | 30 | 2 | 10 | 7 |
| 12.91 | RP | 9 | 60 | 20 | 81 | 27 | 7 | 34 | 13 |
| 12.91 | FDG | 18 | 88 | 21 | 128 | 30 | 5 | 12 | 5 |
| 12.91 | JM | 31 | 106 | 19 | 154 | 28 | 4 | 7 | 4 |
| 12.91 | SCA | 10 | 36 | 11 | 50 | 16 | 7 | 15 | 6 |
| 12.92 | KM | 62 | 95 | 12 | 131 | 17 | 33 | 25 | 4 |
| 12.92 | BR | 69 | 123 | 15 | 178 | 21 | 29 | 23 | 4 |
| 12.92 | PP | 65 | 142 | 18 | 206 | 26 | 8 | 9 | 3 |
| 12.92 | LTH | 52 | 135 | 19 | 169 | 23 | 10 | 18 | 6 |
| 12.92 | KG | 43 | 113 | 17 | 145 | 22 | 18 | 31 | 7 |
| 12.92 | TEH | 47 | 110 | 16 | 136 | 20 | 21 | 35 | 8 |
| 12.92 | TVL | 21 | 46 | 10 | 59 | 13 | 3 | 4 | 2 |
| 12.92 | ELT | 11 | 45 | 14 | 62 | 19 | 4 | 11 | 5 |
| 12.93 | OS | 25 | 85 | 17 | 111 | 22 | 3 | 7 | 4 |
| 12.93 | KS | 69 | 153 | 19 | 185 | 22 | 6 | 9 | 4 |
| 12.93 | STO | 18 | 56 | 13 | 75 | 18 | 2 | 4 | 3 |
| 12.93 | ROS | 7 | 34 | 13 | 46 | 17 | 4 | 13 | 7 |
| 12.93 | TRI | 9 | 40 | 13 | 53 | 18 | 4 | 12 | 6 |
| 12.94 | GT | 61 | 129 | 17 | 179 | 23 | 9 | 10 | 3 |
| 12.94 | DG | 54 | 161 | 22 | 223 | 30 | 7 | 11 | 4 |
| 12.94 | DV | 35 | 92 | 16 | 127 | 22 | 4 | 6 | 3 |
| 12.94 | IW | 61 | 80 | 10 | 110 | 14 | 9 | 6 | 2 |
| 12.94 | PR | 49 | 110 | 16 | 150 | 21 | 11 | 13 | 4 |
| 12.94 | AS | 69 | 151 | 18 | 198 | 24 | 19 | 23 | 5 |
| 12.94 | FDG | 47 | 106 | 16 | 139 | 20 | 9 | 11 | 4 |
| 12.94 | GS | 48 | 186 | 27 | 248 | 36 | 6 | 15 | 6 |
| 12.94 | KD | 37 | 113 | 19 | 157 | 26 | 5 | 8 | 4 |
| 12.94 | DP | 30 | 131 | 24 | 179 | 33 | 7 | 22 | 8 |
| 12.94 | MS | 34 | 142 | 24 | 162 | 28 | 2 | 8 | 6 |
| 12.95 | HV | 33 | 66 | 12 | 82 | 14 | 3 | 5 | 3 |
| 12.95 | KN | 42 | 133 | 21 | 180 | 28 | 7 | 14 | 5 |
| 12.95 | TK | 64 | 81 | 10 | 93 | 12 | 2 | 2 | 1 |
| 12.95 | PPA | 21 | 53 | 12 | 61 | 13 | 1 | 2 | 2 |
| 12.96 | KM | 82 | 100 | 11 | 127 | 14 | 26 | 19 | 4 |
| 12.96 | BR | 83 | 121 | 13 | 160 | 18 | 21 | 17 | 4 |
| 12.96 | JM | 34 | 53 | 9 | 65 | 11 | 3 | 3 | 1 |
| 12.96 | LTH | 65 | 134 | 17 | 157 | 20 | 9 | 14 | 5 |
| 12.96 | KG | 84 | 145 | 16 | 177 | 19 | 16 | 20 | 5 |
| 12.96 | TEH | 75 | 124 | 14 | 146 | 17 | 16 | 20 | 5 |
| 12.96 | TVL | 38 | 54 | 9 | 63 | 10 | 9 | 8 | 3 |
| 12.96 | ELT | 10 | 34 | 11 | 43 | 14 | 2 | 5 | 4 |
| 12.96 | ROS | 12 | 65 | 19 | 82 | 24 | 2 | 8 | 6 |
| 12.96 | SCA | 10 | 23 | 7 | 28 | 9 | 11 | 18 | 6 |
| 12.97 | KS | 89 | 162 | 17 | 188 | 20 | 9 | 13 | 4 |
| 12.97 | PP | 26 | 41 | 8 | 39 | 8 | 5 | 7 | 3 |
| 12.98 | GT | 76 | 122 | 14 | 137 | 16 | 9 | 9 | 3 |
| 12.98 | DG | 60 | 116 | 15 | 147 | 19 | 12 | 14 | 4 |
| 12.98 | DV | 45 | 108 | 16 | 137 | 20 | 6 | 10 | 4 |
| 12.98 | IW | 66 | 85 | 10 | 106 | 13 | 7 | 5 | 2 |
| 12.98 | PR | 56 | 107 | 14 | 133 | 18 | 7 | 9 | 3 |
| Aug 12.98 | AS | 63 | 103 | ± 13 | 129 | ± 16 | 6 | 6 | ± 3 |
| 12.98 | FDG | 23 | 82 | 17 | 103 | 21 | 2 | 5 | 3 |
| 12.98 | AD | 115 | 66 | 6 | 83 | 8 | 22 | 9 | 2 |
| 12.98 | STS | 12 | 29 | 8 | 36 | 10 | 4 | 7 | 4 |
| 12.98 | STO | 15 | 36 | 9 | 44 | 11 | 3 | 5 | 3 |
| 12.99 | GS | 58 | 168 | 22 | 202 | 27 | 9 | 20 | 7 |
| 12.99 | KN | 45 | 118 | 18 | 146 | 22 | 2 | 4 | 3 |
| 12.99 | DK | 69 | 135 | 16 | 167 | 20 | 23 | 31 | 7 |
| 12.99 | FT | 80 | 85 | 10 | 104 | 12 | 25 | 22 | 4 |
| 12.99 | RK | 38 | 34 | 6 | 38 | 6 | 15 | 10 | 3 |
| 12.99 | TRI | 9 | 32 | 11 | 38 | 13 | 6 | 18 | 7 |
| 13.00 | KM | 110 | 125 | 12 | 154 | 15 | 10 | 7 | 2 |
| 13.00 | BR | 101 | 130 | 13 | 160 | 16 | 15 | 12 | 3 |
| 13.00 | JVW | 99 | 132 | 13 | 161 | 16 | 22 | 21 | 5 |
| 13.00 | PP | 80 | 147 | 17 | 181 | 20 | 5 | 7 | 3 |
| 13.00 | HV | 32 | 79 | 14 | 91 | 16 | 3 | 6 | 4 |
| 13.00 | LTH | 81 | 171 | 19 | 195 | 23 | 23 | 40 | 8 |
| 13.00 | KG | 88 | 141 | 15 | 161 | 17 | 19 | 24 | 5 |
| 13.00 | TEH | 112 | 176 | 17 | 197 | 19 | 28 | 36 | 7 |
| 13.00 | TVL | 69 | 85 | 10 | 95 | 12 | 14 | 13 | 4 |
| 13.00 | ELT | 14 | 38 | 10 | 45 | 12 | 2 | 5 | 3 |
| 13.01 | LP | 10 | 54 | 17 | 62 | 19 | 5 | 27 | 12 |
| 13.01 | GC | 8 | 44 | 16 | 51 | 18 | 8 | 45 | 16 |
| 13.01 | KS | 55 | 123 | 17 | 136 | 18 | 11 | 21 | 6 |
| 13.01 | ROS | 13 | 28 | 8 | 33 | 9 | 5 | 10 | 4 |
| 13.02 | PPA | 21 | 68 | 15 | 78 | 17 | 5 | 20 | 9 |
| 13.02 | GT | 80 | 132 | 15 | 156 | 17 | 7 | 8 | 3 |
| 13.02 | DG | 53 | 153 | 21 | 181 | 25 | 10 | 21 | 7 |
| 13.02 | DV | 47 | 87 | 13 | 103 | 15 | 2 | 3 | 2 |
| 13.02 | PR | 74 | 112 | 13 | 122 | 14 | 11 | 12 | 4 |
| 13.02 | AS | 73 | 96 | 11 | 112 | 13 | 11 | 10 | 3 |
| 13.02 | FDG | 66 | 135 | 17 | 158 | 19 | 4 | 6 | 3 |
| 13.02 | JM | 28 | 56 | 11 | 63 | 12 | 3 | 5 | 3 |
| 13.02 | STS | 13 | 30 | 8 | 34 | 9 | 6 | 12 | 5 |
| 13.02 | STO | 19 | 43 | 10 | 49 | 11 | 2 | 4 | 3 |
| 13.03 | GS | 63 | 144 | 18 | 161 | 20 | 16 | 33 | 8 |
| 13.03 | KN | 54 | 97 | 13 | 111 | 15 | 11 | 17 | 5 |
| 13.03 | RS | 106 | 123 | 12 | 138 | 13 | 22 | 25 | 5 |
| 13.03 | TRI | 14 | 48 | 13 | 55 | 15 | 3 | 10 | 6 |
| 13.04 | KM | 118 | 117 | 11 | 134 | 12 | 27 | 19 | 4 |
| 13.04 | BR | 112 | 127 | 12 | 145 | 14 | 25 | 21 | 4 |
| 13.04 | LTH | 48 | 102 | 15 | 111 | 16 | 10 | 19 | 6 |
| 13.04 | KG | 68 | 120 | 15 | 131 | 16 | 15 | 24 | 6 |
| 13.04 | TEH | 70 | 117 | 14 | 126 | 15 | 21 | 32 | 7 |
| 13.04 | TVL | 46 | 63 | 9 | 68 | 10 | 5 | 6 | 3 |
| 13.04 | KS | 56 | 124 | 17 | 133 | 18 | 2 | 4 | 3 |
| 13.05 | LP | 8 | 50 | 18 | 55 | 19 | 5 | 35 | 16 |
| 13.05 | GC | 9 | 41 | 14 | 45 | 15 | 4 | 20 | 10 |
| 13.05 | ELT | 20 | 37 | 8 | 40 | 9 | 10 | 17 | 5 |
| 13.06 | GT | 97 | 120 | 12 | 134 | 14 | 20 | 20 | 5 |
| 13.06 | DG | 85 | 122 | 13 | 135 | 15 | 14 | 16 | 4 |
| 13.06 | DV | 48 | 79 | 11 | 87 | 13 | 9 | 13 | 4 |
| 13.06 | PP | 73 | 142 | 17 | 158 | 19 | 10 | 17 | 5 |
| 13.06 | IW | 119 | 104 | 10 | 119 | 11 | 21 | 13 | 3 |
| 13.06 | PR | 87 | 127 | 14 | 141 | 15 | 13 | 16 | 14 |
| 13.06 | AS | 95 | 116 | 12 | 128 | 13 | 21 | 21 | 5 |
| 13.06 | FDG | 80 | 135 | 15 | 149 | 17 | 14 | 20 | 5 |
| 13.06 | HV | 56 | 87 | 12 | 94 | 13 | 3 | 5 | 3 |
| 13.06 | STS | 14 | 28 | 7 | 30 | 8 | 8 | 15 | 5 |
| 13.06 | TRI | 9 | 30 | 10 | 32 | 11 | 6 | 20 | 8 |
| 13.07 | KA | 41 | 45 | 7 | 47 | 7 | 16 | 16 | 4 |

Table 2 (continued)

| Date (UT) | Obs | P | ZHR (1.0) | | ZHR (1.5) | | S | HR | |
|---|---|---|---|---|---|---|---|---|---|
| Aug 13.07 | STO | 25 | 61 ± | 12 | 66 ± | 13 | 3 | 7 ± | 4 |
| 13.08 | KM | 114 | 113 | 11 | 124 | 12 | 23 | 18 | 4 |
| 13.08 | BR | 110 | 119 | 11 | 130 | 12 | 28 | 24 | 5 |
| 13.08 | JM | 24 | 65 | 13 | 69 | 14 | 2 | 6 | 4 |
| 13.08 | GS | 69 | 144 | 17 | 153 | 18 | 20 | 41 | 9 |
| 13.08 | KN | 43 | 83 | 13 | 87 | 13 | 9 | 17 | 6 |
| 13.09 | IW | 29 | 88 | 16 | 93 | 17 | 6 | 15 | 6 |
| 13.10 | GT | 108 | 122 | 12 | 128 | 12 | 19 | 20 | 5 |
| 13.10 | DG | 75 | 92 | 11 | 97 | 11 | 24 | 26 | 5 |
| 13.10 | DV | 58 | 82 | 11 | 88 | 12 | 3 | 4 | 2 |
| 13.10 | PP | 80 | 123 | 14 | 132 | 15 | 18 | 26 | 6 |
| 13.10 | LC | 147 | 119 | 10 | 124 | 10 | 26 | 19 | 4 |
| 13.10 | FDG | 98 | 108 | 11 | 128 | 13 | 19 | 19 | 4 |
| 13.11 | KM | 77 | 121 | 14 | 127 | 15 | 15 | 21 | 6 |
| 13.11 | BR | 69 | 119 | 14 | 125 | 15 | 19 | 27 | 5 |
| 13.11 | PR | 92 | 99 | 10 | 105 | 11 | 17 | 17 | 4 |
| 13.11 | AS | 115 | 111 | 10 | 116 | 11 | 34 | 28 | 5 |
| 13.11 | GS | 37 | 151 | 25 | 158 | 26 | 15 | 65 | 17 |
| 13.29 | NM | 46 | 63 | 9 | 73 | 11 | 7 | 7 | 3 |
| 13.30 | LR | 28 | 82 | 16 | 121 | 23 | 8 | 11 | 4 |
| 13.33 | NM | 33 | 40 | 7 | 45 | 8 | 9 | 10 | 3 |
| 13.34 | LR | 49 | 87 | 12 | 116 | 16 | 12 | 12 | 3 |
| 13.38 | LR | 51 | 75 | 11 | 92 | 13 | 13 | 13 | 4 |
| 13.42 | LR | 85 | 111 | 12 | 126 | 14 | 8 | 8 | 3 |
| 13.46 | LR | 74 | 88 | 10 | 96 | 11 | 13 | 13 | 3 |
| 13.85 | KM | 11 | 50 | 15 | 83 | 25 | 18 | 30 | 7 |
| 13.85 | PR | 13 | – | | – | | 6 | 30 | 12 |
| 13.86 | GT | 13 | 82 | 23 | 133 | 37 | 3 | 8 | 5 |
| 13.86 | BR | 12 | 63 | 18 | 104 | 30 | 9 | 18 | 6 |
| 13.88 | LC | 31 | 113 | 20 | 179 | 32 | 10 | 17 | 5 |
| 13.90 | STS | 18 | 52 | 12 | 73 | 17 | 9 | 14 | 5 |
| 13.90 | STO | 10 | 39 | 12 | 56 | 18 | 4 | 9 | 5 |
| 13.90 | AS | 17 | 72 | 18 | 108 | 26 | 5 | 11 | 5 |
| 13.90 | GT | 19 | 61 | 14 | 92 | 21 | 8 | 12 | 4 |
| 13.90 | BR | 15 | 37 | 10 | 55 | 14 | 18 | 20 | 5 |
| 13.90 | KM | 21 | 68 | 15 | 101 | 22 | 12 | 17 | 5 |
| 13.90 | GP | 4 | 14 | 7 | 22 | 11 | 4 | 6 | 3 |
| 13.90 | PR | 21 | 74 | 16 | 111 | 24 | 5 | 9 | 4 |
| 13.91 | LTH | 31 | 114 | 20 | 142 | 26 | 8 | 22 | 8 |
| 13.92 | TEH | 50 | 142 | 20 | 175 | 25 | 12 | 24 | 7 |
| 13.92 | FP | 13 | 16 | 4 | 21 | 6 | 29 | 21 | 4 |
| 13.92 | KG | 38 | 102 | 17 | 116 | 19 | 17 | 29 | 7 |
| 13.92 | JO | 40 | 52 | 8 | 67 | 11 | 3 | 3 | 2 |
| 13.93 | TVL | 25 | 57 | 11 | 64 | 13 | 5 | 7 | 3 |
| 13.93 | GMK | 23 | 49 | 10 | 63 | 13 | 2 | 3 | 2 |
| 13.94 | AS | 28 | 72 | 14 | 99 | 19 | 19 | 28 | 6 |
| 13.94 | GT | 31 | 93 | 17 | 127 | 23 | 3 | 5 | 3 |
| 13.94 | BR | 16 | 47 | 12 | 64 | 16 | 19 | 30 | 7 |
| 13.94 | KM | 48 | 90 | 13 | 123 | 18 | 22 | 22 | 5 |
| 13.94 | GP | 8 | 17 | 6 | 23 | 8 | 2 | 2 | 1 |
| 13.94 | RA | 8 | 22 | 8 | 28 | 10 | 5 | 8 | 4 |
| 13.94 | PR | 26 | 64 | 13 | 88 | 17 | 6 | 8 | 3 |
| 13.94 | AK | 12 | 38 | 11 | 46 | 13 | 5 | 11 | 3 |
| 13.94 | IR | 15 | 53 | 14 | 64 | 17 | 4 | 10 | 5 |
| 13.95 | GS | 12 | 89 | 26 | 119 | 34 | 4 | 19 | 10 |
| 13.95 | PB | 18 | 56 | 13 | 68 | 16 | 3 | 7 | 4 |
| 13.95 | US | 5 | 23 | 10 | 27 | 12 | 10 | 35 | 11 |
| 13.95 | LTH | 30 | 70 | 13 | 83 | 15 | 13 | 23 | 6 |
| 13.96 | TEH | 67 | 121 | 15 | 141 | 17 | 24 | 34 | 7 |
| 13.96 | PP | 38 | 73 | 12 | 95 | 15 | 5 | 6 | 3 |
| 13.96 | BP | 10 | 20 | 6 | 24 | 7 | 16 | 25 | 6 |

| Date (UT) | Obs | P | ZHR (1.0) | | ZHR (1.5) | | S | HR | |
|---|---|---|---|---|---|---|---|---|---|
| Aug 13.96 | KG | 54 | 96 ± | 13 | 113 ± | 15 | 15 | 20 ± | 6 |
| 13.97 | GS | 9 | 61 | 20 | 77 | 26 | 5 | 24 | 11 |
| 13.98 | GT | 48 | 82 | 12 | 103 | 15 | 11 | 12 | 4 |
| 13.98 | BR | 51 | 72 | 10 | 89 | 13 | 21 | 19 | 4 |
| 13.98 | KM | 59 | 84 | 11 | 105 | 14 | 18 | 16 | 4 |
| 13.98 | GP | 13 | 30 | 8 | 38 | 10 | 3 | 4 | 3 |
| 13.98 | PR | 35 | 66 | 11 | 82 | 14 | 13 | 16 | 5 |
| 13.98 | TVL | 36 | 44 | 7 | 52 | 9 | 5 | 4 | 2 |
| 13.98 | FDG | 56 | 80 | 11 | 102 | 14 | 19 | 16 | 4 |
| 13.99 | PB | 44 | 115 | 17 | 129 | 19 | 5 | 12 | 5 |
| 13.99 | FP | 11 | 13 | 4 | 15 | 5 | 17 | 15 | 4 |
| 13.99 | AK | 29 | 34 | 6 | 38 | 7 | 6 | 6 | 2 |
| 13.99 | JR | 33 | 42 | 7 | 47 | 8 | 4 | 4 | 2 |
| 13.99 | US | 19 | 26 | 6 | 30 | 7 | 18 | 21 | 5 |
| 13.99 | LTH | 36 | 67 | 11 | 77 | 13 | 8 | 12 | 4 |
| 14.00 | TEH | 67 | 106 | 13 | 120 | 15 | 19 | 25 | 6 |
| 14.00 | RA | 32 | 38 | 7 | 45 | 8 | 6 | 5 | 2 |
| 14.00 | KG | 63 | 102 | 13 | 115 | 15 | 17 | 23 | 6 |
| 14.01 | GS | 32 | 93 | 17 | 110 | 20 | 10 | 24 | 8 |
| 14.01 | IR | 27 | 46 | 9 | 50 | 10 | 6 | 9 | 4 |
| 14.01 | GMK | 17 | 26 | 6 | 29 | 7 | 2 | 3 | 2 |
| 14.02 | AS | 59 | 74 | 10 | 87 | 11 | 18 | 17 | 4 |
| 14.02 | PP | 11 | 29 | 9 | 34 | 10 | 6 | 5 | 2 |
| 14.02 | GT | 36 | 49 | 8 | 58 | 10 | 9 | 9 | 3 |
| 14.02 | BR | 54 | 67 | 9 | 78 | 11 | 25 | 23 | 5 |
| 14.02 | KM | 76 | 95 | 11 | 111 | 13 | 28 | 25 | 5 |
| 14.02 | GP | 9 | 14 | 5 | 16 | 5 | 5 | 5 | 2 |
| 14.02 | PR | 41 | 67 | 11 | 67 | 11 | 15 | 19 | 5 |
| 14.02 | OS | 25 | 43 | 9 | 50 | 10 | 9 | 14 | 5 |
| 14.03 | LTH | 42 | 74 | 11 | 81 | 12 | 8 | 13 | 5 |
| 14.04 | TEH | 72 | 116 | 14 | 125 | 15 | 20 | 29 | 7 |
| 14.04 | KG | 63 | 104 | 13 | 112 | 14 | 27 | 25 | 6 |
| 14.06 | AS | 47 | 66 | 10 | 73 | 11 | 10 | 12 | 4 |
| 14.06 | PP | 34 | 52 | 9 | 58 | 10 | 6 | 8 | 3 |
| 14.06 | GS | 36 | 86 | 14 | 96 | 16 | 17 | 37 | 9 |
| 14.06 | GT | 48 | 59 | 9 | 65 | 9 | 15 | 15 | 4 |
| 14.06 | BR | 58 | 64 | 8 | 71 | 9 | 27 | 25 | 5 |
| 14.06 | KM | 69 | 77 | 9 | 85 | 10 | 19 | 17 | 4 |
| 14.06 | GP | 14 | 17 | 5 | 19 | 5 | 4 | 4 | 2 |
| 14.06 | RA | 18 | 33 | 8 | 36 | 9 | 9 | 16 | 5 |
| 14.06 | PR | 33 | 51 | 9 | 57 | 10 | 12 | 16 | 5 |
| 14.06 | PB | 28 | 38 | 7 | 39 | 8 | 5 | 7 | 3 |
| 14.06 | BP | 19 | 26 | 6 | 27 | 6 | 18 | 23 | 6 |
| 14.06 | AK | 23 | 33 | 7 | 34 | 7 | 6 | 8 | 3 |
| 14.06 | JR | 19 | 30 | 7 | 32 | 7 | 12 | 19 | 5 |
| 14.06 | IR | 29 | 35 | 6 | 36 | 7 | 16 | 18 | 5 |
| 14.06 | US | 8 | 34 | 12 | 35 | 12 | 3 | 14 | 8 |
| 14.10 | GP | 21 | 24 | 5 | 25 | 6 | 3 | 3 | 2 |
| 14.11 | AS | 61 | 68 | 9 | 71 | 9 | 16 | 17 | 4 |
| 14.11 | PP | 47 | 55 | 8 | 58 | 9 | 10 | 11 | 4 |
| 14.11 | GS | 57 | 93 | 12 | 98 | 13 | 13 | 21 | 6 |
| 14.11 | GT | 75 | 72 | 8 | 76 | 9 | 16 | 14 | 4 |
| 14.11 | BR | 84 | 76 | 8 | 80 | 9 | 29 | 24 | 5 |
| 14.11 | KM | 94 | 80 | 8 | 90 | 9 | 28 | 22 | 4 |
| 14.11 | PR | 61 | 65 | 8 | 69 | 9 | 12 | 12 | 4 |
| 14.35 | LR | 23 | 54 | 11 | 72 | 15 | 17 | 23 | 5 |
| 14.39 | LR | 31 | 46 | 8 | 56 | 10 | 13 | 13 | 4 |
| 14.43 | LR | 29 | 38 | 7 | 43 | 8 | 13 | 13 | 4 |
| 14.47 | LR | 37 | 44 | 7 | 48 | 8 | 22 | 22 | 5 |
| 14.89 | KM | 4 | 28 | 14 | 43 | 22 | 3 | 10 | 3 |
| 14.90 | LR | 6 | 20 | 8 | 24 | 10 | 9 | 27 | 9 |

Table 2 (continued)

| Date (UT) | Obs | P | ZHR (1.0) | | ZHR (1.5) | | S | HR | |
|---|---|---|---|---|---|---|---|---|---|
| Aug 14.90 | JO | 7 | 19 | ± 7 | 25 | ± 9 | 1 | 2 | ± 2 |
| 14.90 | IR | 7 | 21 | 8 | 27 | 10 | 4 | 8 | 4 |
| 14.90 | RA | 13 | 29 | 8 | 39 | 11 | 8 | 10 | 4 |
| 14.90 | KD | 7 | 33 | 12 | 48 | 18 | 7 | 18 | 7 |
| 14.90 | BP | 14 | 30 | 8 | 38 | 10 | 13 | 18 | 5 |
| 14.90 | AK | 7 | 18 | 7 | 24 | 9 | 3 | 5 | 3 |
| 14.91 | US | 5 | 18 | 8 | 23 | 10 | 6 | 15 | 6 |
| 14.91 | GT | 9 | 30 | 10 | 44 | 15 | 3 | 5 | 3 |
| 14.92 | RM | 23 | 15 | 3 | 18 | 4 | 5 | 2 | 1 |
| 14.92 | BR | 9 | 44 | 16 | 65 | 21 | 9 | 24 | 8 |
| 14.92 | JR | 11 | 17 | 5 | 20 | 6 | 6 | 7 | 3 |
| 14.94 | KM | 17 | 48 | 12 | 66 | 16 | 10 | 16 | 5 |
| 14.94 | PR | 9 | 33 | 11 | 46 | 15 | 5 | 11 | 5 |
| 14.94 | KD | 9 | 32 | 11 | 44 | 15 | 5 | 11 | 5 |
| 14.97 | PB | 9 | 17 | 6 | 19 | 6 | 5 | 8 | 4 |
| 14.98 | BR | 25 | 43 | 9 | 54 | 11 | 22 | 24 | 5 |
| 14.98 | KM | 22 | 38 | 8 | 47 | 10 | 18 | 20 | 5 |
| 14.98 | PP | 10 | 32 | 10 | 40 | 13 | 5 | 11 | 5 |
| 14.98 | GT | 24 | 45 | 9 | 56 | 11 | 11 | 14 | 4 |
| 14.98 | PR | 11 | 29 | 9 | 36 | 11 | 8 | 15 | 5 |
| 14.98 | AS | 20 | 35 | 8 | 43 | 10 | 17 | 19 | 5 |
| 14.98 | IW | 32 | 29 | 5 | 37 | 7 | 18 | 9 | 2 |
| 14.98 | FDG | 17 | 33 | 8 | 46 | 11 | 18 | 20 | 5 |
| 14.98 | KD | 18 | 41 | 10 | 51 | 12 | 7 | 11 | 4 |
| 15.01 | IW | 23 | 30 | 6 | 35 | 7 | 13 | 11 | 3 |
| 15.01 | KD | 7 | 24 | 9 | 28 | 11 | 7 | 18 | 6 |
| 15.02 | BR | 24 | 40 | 8 | 46 | 9 | 29 | 35 | 7 |
| 15.02 | KM | 32 | 54 | 9 | 63 | 11 | 14 | 17 | 5 |
| 15.02 | PP | 20 | 27 | 6 | 32 | 7 | 2 | 2 | 1 |
| 15.02 | GT | 33 | 45 | 8 | 53 | 9 | 13 | 13 | 4 |
| 15.02 | PR | 29 | 57 | 11 | 67 | 13 | 7 | 11 | 4 |
| 15.02 | AS | 34 | 42 | 7 | 50 | 9 | 14 | 13 | 4 |
| 15.02 | FDG | 12 | 33 | 9 | 38 | 11 | 5 | 10 | 5 |
| 15.06 | BR | 28 | 42 | 8 | 46 | 9 | 18 | 22 | 5 |
| 15.06 | KM | 40 | 60 | 9 | 66 | 10 | 11 | 13 | 4 |
| 15.06 | PP | 23 | 29 | 6 | 32 | 7 | 1 | 1 | 1 |
| 15.06 | GT | 25 | 34 | 7 | 37 | 7 | 15 | 17 | 4 |
| 15.06 | PR | 17 | 25 | 6 | 28 | 7 | 12 | 15 | 4 |
| 15.06 | AS | 32 | 39 | 7 | 43 | 8 | 15 | 15 | 4 |
| 15.06 | IW | 19 | 21 | 5 | 24 | 5 | 16 | 14 | 3 |
| Aug 15.06 | FDG | 16 | 29 | ± 7 | 33 | ± 8 | 10 | 15 | ± 5 |
| 15.09 | IW | 35 | 36 | 6 | 38 | 6 | 13 | 11 | 3 |
| 15.10 | FDG | 22 | 41 | 9 | 43 | 9 | 7 | 12 | 4 |
| 15.11 | BR | 61 | 64 | 8 | 68 | 9 | 27 | 27 | 5 |
| 15.11 | KM | 70 | 68 | 8 | 71 | 8 | 31 | 28 | 5 |
| 15.11 | PP | 39 | 52 | 8 | 55 | 9 | 6 | 9 | 4 |
| 15.11 | GT | 43 | 50 | 8 | 52 | 8 | 16 | 18 | 4 |
| 15.11 | LC | 29 | 36 | 7 | 38 | 7 | 9 | 10 | 3 |
| 15.11 | PR | 36 | 43 | 7 | 45 | 7 | 14 | 16 | 4 |
| 15.86 | TH | 4 | 18 | 9 | 23 | 11 | 7 | 26 | 10 |
| 15.93 | FP | 4 | 6 | 3 | 7 | 4 | 13 | 11 | 3 |
| 15.93 | LR | 13 | 16 | 4 | 18 | 5 | 24 | 26 | 5 |
| 15.94 | GP | 7 | 13 | 5 | 17 | 7 | 6 | 6 | 2 |
| 15.95 | KM | 8 | – | | – | | 4 | 23 | 12 |
| 15.96 | KM | 10 | 25 | 8 | 32 | 10 | 10 | 16 | 5 |
| 15.98 | GP | 9 | 13 | 4 | 16 | 5 | 4 | 4 | 2 |
| 15.99 | FP | 4 | 8 | 4 | 9 | 5 | 6 | 9 | 4 |
| 15.99 | OS | 15 | 12 | 3 | 14 | 4 | 12 | 8 | 2 |
| 16.00 | KM | 18 | 29 | 7 | 34 | 8 | 16 | 18 | 5 |
| 16.02 | GP | 12 | 14 | 4 | 17 | 5 | 4 | 3 | 2 |
| 16.02 | GT | 9 | 15 | 5 | 17 | 6 | 8 | 10 | 4 |
| 16.02 | AS | 7 | 11 | 4 | 13 | 5 | 16 | 19 | 5 |
| 16.04 | PR | 17 | 14 | 4 | 16 | 4 | 17 | 12 | 3 |
| 16.04 | LC | 23 | 19 | 4 | 21 | 4 | 20 | 13 | 3 |
| 16.06 | KM | 4 | 19 | 10 | 21 | 11 | 3 | 12 | 7 |
| 16.06 | GP | 13 | 14 | 4 | 16 | 4 | 4 | 3 | 2 |
| 16.06 | GT | 9 | 13 | 4 | 15 | 5 | 6 | 8 | 3 |
| 16.06 | AS | 17 | 24 | 6 | 26 | 6 | 9 | 11 | 4 |
| 16.10 | PR | 12 | 17 | 5 | 18 | 5 | 8 | 11 | 4 |
| 16.10 | LC | 12 | 32 | 9 | 34 | 10 | 10 | 25 | 8 |
| 16.10 | GT | 16 | 24 | 6 | 25 | 6 | 14 | 21 | 6 |
| 16.10 | AS | 20 | 23 | 5 | 25 | 6 | 12 | 13 | 4 |
| 17.06 | JR | 10 | 9 | 3 | 10 | 3 | 9 | 8 | 3 |
| 18.05 | IR | 5 | 8 | 4 | 9 | 4 | 7 | 11 | 4 |
| 18.06 | JR | 6 | 9 | 4 | 9 | 4 | 6 | 8 | 4 |
| 22.89 | KG | 1 | 10 | 10 | 14 | 14 | 6 | 35 | 4 |
| 23.85 | RK | 4 | 5 | 2 | 6 | 3 | 13 | 7 | 2 |
| 23.88 | JR | 2 | 4 | 3 | 5 | 4 | 8 | 9 | 3 |
| 23.97 | RA | 1 | 2 | 2 | 3 | 3 | 13 | 15 | 4 |
| 24.93 | JR | 0 | – | | – | | 13 | 15 | 4 |

## 3. How the observed rates were corrected

The corrections used are in agreement with the conventional ZHR computation as defined on the International Meteor Weekend 1986 in Hingene (2,3). This method is described in the IMW Proceedings and in the Handbook for Visual Meteor Observations (4). Table 2 above lists all the individual ZHR's and sporadic HR's; over 3000 values were computed this way!

For the radiant zenith distance correction factor, the formula $\sec^{\varepsilon} Z$ was used. Table 1 mentions the ZHR-values obtained with both $\varepsilon = 1.0$ and $\varepsilon = 1.5$. This is a consequence of the doubt left after the publication of the 1985 results, whether or not to use a zenith exponent $\varepsilon = 1.5$ instead of $\varepsilon = 1.0$ (5,6). For the 1986 results, we used both to avoid any discussions. Both results are treated independently further in this article.

The individual ZHR's were averaged with a step of 0.02 day within intervals of 0.02 days before and after the time indicated (which gives periods of about 1 hour). The averaged values obtained in this way, are listed in Table 3.

Table 3 --- Average ZHR-values for the Perseids 1986, computed for 1 hour periods each 0.5 hour, with both $\varepsilon = 1.0$ and $\varepsilon = 1.5$.

| Date (UT) | Nr Obs | ZHR (1.0) | | ZHR (1.5) | | HR | |
|---|---|---|---|---|---|---|---|
| Jul 25.98 | 1 | 3 | ± 3 | 3 | ± 3 | 20 | ± 7 |
| 26.88 | 5 | 1 | 2 | 2 | 3 | 16 | 6 |
| 26.90 | 5 | 1 | 2 | 2 | 3 | 16 | 6 |
| 26.92 | 5 | 1 | 2 | 2 | 3 | 16 | 5 |
| 26.94 | 1 | 0 | | 0 | | 24 | 7 |
| 27.96 | 1 | 0 | | 0 | | 12 | 4 |
| 28.00 | 1 | 4 | 4 | 4 | 4 | 3 | 3 |
| 28.02 | 1 | 4 | 4 | 4 | 4 | 3 | 3 |
| 28.90 | 3 | 6 | 4 | 9 | 5 | 12 | 2 |
| 28.94 | 3 | 8 | 3 | 10 | 4 | 8 | 6 |
| 28.98 | 4 | 7 | 2 | 9 | 2 | 13 | 9 |
| 29.02 | 3 | 8 | 2 | 9 | 3 | 14 | 11 |
| 29.90 | 4 | 3 | 3 | 3 | 4 | 17 | 12 |
| 29.92 | 5 | 3 | 3 | 4 | 4 | 15 | 11 |
| 29.94 | 8 | 3 | 4 | 4 | 5 | 14 | 9 |
| 29.96 | 7 | 6 | 6 | 8 | 7 | 10 | 4 |
| 29.98 | 8 | 8 | 6 | 9 | 8 | 11 | 4 |
| 30.02 | 3 | 14 | 4 | 16 | 5 | 10 | 4 |
| 30.90 | 8 | 3 | 3 | 4 | 4 | 15 | 5 |
| 30.92 | 8 | 5 | 6 | 6 | 8 | 15 | 5 |
| 30.94 | 6 | 7 | 6 | 10 | 8 | 14 | 5 |
| 30.96 | 6 | 5 | 4 | 6 | 5 | 13 | 6 |
| 30.98 | 5 | 4 | 4 | 6 | 5 | 13 | 7 |
| 31.00 | 10 | 6 | 4 | 7 | 5 | 13 | 6 |
| 31.02 | 7 | 7 | 4 | 8 | 4 | 12 | 5 |
| 31.86 | 5 | 17 | 9 | 28 | 17 | 7 | 6 |
| 31.88 | 5 | 8 | 3 | 11 | 4 | 10 | 3 |
| 31.90 | 5 | 8 | 3 | 11 | 4 | 10 | 3 |
| 31.92 | 6 | 8 | 2 | 12 | 4 | 10 | 3 |
| 31.94 | 4 | 7 | 4 | 9 | 6 | 10 | 3 |
| 31.96 | 11 | 9 | 4 | 11 | 5 | 12 | 3 |
| 31.98 | 8 | 9 | 5 | 11 | 6 | 12 | 3 |
| Aug 01.00 | 10 | 11 | 4 | 13 | 5 | 13 | 2 |
| 01.02 | 3 | 13 | 3 | 15 | 4 | 15 | 2 |
| 01.04 | 6 | 10 | 4 | 12 | 5 | 15 | 9 |
| 01.06 | 3 | 8 | 5 | 8 | 5 | 16 | 5 |
| 01.10 | 3 | 6 | 3 | 7 | 3 | 10 | 7 |
| 01.86 | 2 | 21 | 17 | 37 | 30 | 14 | 4 |
| 01.88 | 4 | 5 | 3 | 6 | 4 | 18 | 6 |
| 01.90 | 6 | 8 | 5 | 11 | 9 | 15 | 7 |
| 01.92 | 7 | 9 | 4 | 13 | 7 | 10 | 5 |
| 01.94 | 11 | 7 | 2 | 9 | 4 | 12 | 5 |
| 01.96 | 14 | 8 | 4 | 10 | 5 | 11 | 6 |
| 01.98 | 13 | 8 | 4 | 10 | 5 | 12 | 6 |
| 02.00 | 10 | 11 | 5 | 14 | 6 | 9 | 6 |
| 02.02 | 9 | 11 | 3 | 13 | 4 | 13 | 7 |
| 02.04 | 10 | 13 | 6 | 15 | 7 | 13 | 7 |
| 02.06 | 7 | 13 | 7 | 14 | 8 | 15 | 7 |
| 02.08 | 5 | 14 | 7 | 16 | 8 | 10 | 5 |
| 02.10 | 2 | 9 | 1 | 10 | 2 | 10 | 1 |
| 02.22 | 1 | 3 | 3 | 4 | 4 | 6 | 1 |
| 02.25 | 1 | 11 | 4 | 13 | 4 | 13 | 4 |
| 02.29 | 1 | 11 | 4 | 12 | 4 | 19 | 4 |
| 02.33 | 1 | 9 | 3 | 10 | 4 | 12 | 4 |
| 02.37 | 1 | 15 | 4 | 15 | 4 | 19 | 4 |
| 02.86 | 2 | 9 | 2 | 15 | 3 | 10 | 0 |
| 02.88 | 5 | 11 | 6 | 14 | 8 | 14 | 3 |
| 02.90 | 10 | 10 | 7 | 14 | 9 | 11 | 5 |
| 02.92 | 12 | 13 | 9 | 18 | 11 | 8 | 4 |
| 02.94 | 17 | 10 | 8 | 13 | 10 | 11 | 4 |

| Date (UT) | Nr Obs | ZHR (1.0) | | ZHR (1.5) | | HR | |
|---|---|---|---|---|---|---|---|
| Aug 02.96 | 20 | 10 | ± 8 | 13 | ± 10 | 10 | ± 4 |
| 02.98 | 17 | 9 | 6 | 11 | 6 | 12 | 5 |
| 03.00 | 11 | 12 | 7 | 15 | 7 | 11 | 8 |
| 03.02 | 13 | 13 | 6 | 15 | 7 | 13 | 6 |
| 03.04 | 12 | 12 | 5 | 13 | 6 | 13 | 6 |
| 03.06 | 4 | 10 | 3 | 11 | 3 | 12 | 2 |
| 03.08 | 4 | 9 | 3 | 10 | 3 | 11 | 2 |
| 03.10 | 2 | 7 | 2 | 8 | 2 | 12 | 1 |
| 03.86 | 4 | 14 | 9 | 26 | 14 | 10 | 5 |
| 03.88 | 10 | 19 | 8 | 29 | 15 | 13 | 4 |
| 03.90 | 10 | 19 | 8 | 29 | 15 | 13 | 4 |
| 03.92 | 10 | 20 | 7 | 31 | 11 | 13 | 4 |
| 03.94 | 10 | 14 | 5 | 19 | 8 | 11 | 3 |
| 03.96 | 16 | 14 | 4 | 18 | 6 | 11 | 3 |
| 03.98 | 12 | 12 | 3 | 15 | 5 | 11 | 5 |
| 04.00 | 10 | 14 | 4 | 17 | 6 | 14 | 7 |
| 04.02 | 9 | 14 | 6 | 16 | 7 | 15 | 7 |
| 04.04 | 12 | 15 | 6 | 17 | 7 | 15 | 6 |
| 04.06 | 8 | 14 | 7 | 16 | 7 | 14 | 5 |
| 04.08 | 5 | 12 | 7 | 14 | 8 | 20 | 10 |
| 04.10 | 2 | 13 | 4 | 14 | 4 | 27 | 14 |
| 04.33 | 1 | 13 | 5 | 15 | 5 | 5 | 2 |
| 04.37 | 1 | 18 | 4 | 20 | 5 | 10 | 3 |
| 04.94 | 8 | 13 | 6 | 18 | 9 | 9 | 4 |
| 04.96 | 15 | 11 | 5 | 15 | 8 | 10 | 4 |
| 04.98 | 7 | 9 | 2 | 12 | 3 | 10 | 4 |
| 05.00 | 15 | 13 | 7 | 16 | 8 | 14 | 10 |
| 05.02 | 8 | 16 | 8 | 19 | 10 | 18 | 12 |
| 05.04 | 16 | 15 | 6 | 17 | 8 | 14 | 10 |
| 05.06 | 8 | 14 | 4 | 16 | 5 | 13 | 6 |
| 05.08 | 12 | 14 | 4 | 15 | 5 | 14 | 7 |
| 05.10 | 4 | 12 | 5 | 13 | 5 | 17 | 9 |
| 05.86 | 6 | 29 | 12 | 50 | 24 | 18 | 11 |
| 05.88 | 16 | 14 | 7 | 21 | 11 | 13 | 5 |
| 05.90 | 14 | 13 | 6 | 20 | 10 | 11 | 3 |
| 05.92 | 16 | 13 | 7 | 20 | 10 | 14 | 6 |
| 05.94 | 18 | 12 | 7 | 16 | 10 | 13 | 7 |
| 05.96 | 24 | 15 | 8 | 19 | 11 | 12 | 6 |
| 05.98 | 18 | 15 | 8 | 19 | 11 | 9 | 5 |
| 06.00 | 18 | 15 | 7 | 19 | 10 | 11 | 5 |
| 06.02 | 17 | 13 | 5 | 15 | 5 | 10 | 5 |
| 06.04 | 21 | 14 | 4 | 16 | 5 | 12 | 5 |
| 06.06 | 13 | 14 | 5 | 15 | 6 | 10 | 5 |
| 06.08 | 14 | 13 | 5 | 15 | 5 | 11 | 5 |
| 06.10 | 6 | 15 | 5 | 16 | 6 | 11 | 3 |
| 06.29 | 1 | 7 | 4 | 9 | 5 | 9 | 3 |
| 06.33 | 1 | 33 | 7 | 38 | 8 | 14 | 4 |
| 06.37 | 1 | 18 | 5 | 20 | 5 | 7 | 3 |
| 06.86 | 7 | 30 | 16 | 53 | 27 | 24 | 10 |
| 06.88 | 18 | 18 | 12 | 29 | 21 | 12 | 7 |
| 06.90 | 17 | 16 | 8 | 24 | 13 | 11 | 5 |
| 06.92 | 22 | 18 | 10 | 27 | 14 | 12 | 8 |
| 06.94 | 20 | 17 | 8 | 23 | 12 | 12 | 7 |
| 06.96 | 26 | 16 | 7 | 21 | 10 | 12 | 7 |
| 06.98 | 17 | 16 | 5 | 19 | 6 | 13 | 7 |
| 07.00 | 16 | 18 | 7 | 22 | 8 | 14 | 7 |
| 07.02 | 15 | 20 | 6 | 23 | 8 | 13 | 5 |
| 07.04 | 18 | 18 | 5 | 21 | 7 | 13 | 3 |
| 07.06 | 14 | 16 | 3 | 18 | 4 | 12 | 4 |
| 07.08 | 12 | 18 | 9 | 20 | 9 | 16 | 8 |

Table 3 (continued)

| Date (UT) | Nr Obs | ZHR (1.0) | | ZHR (1.5) | | HR | |
|---|---|---|---|---|---|---|---|
| Aug 07.10 | 6 | 21 | ± 11 | 23 | ± 12 | 21 | ± 8 |
| 07.29 | 1 | 19 | 5 | 23 | 7 | 11 | 3 |
| 07.33 | 1 | 7 | 3 | 8 | 4 | 9 | 3 |
| 07.37 | 1 | 12 | 4 | 14 | 4 | 12 | 3 |
| 07.90 | 3 | 18 | 11 | 25 | 19 | 15 | 5 |
| 07.92 | 14 | 20 | 13 | 26 | 19 | 14 | 7 |
| 07.94 | 19 | 22 | 14 | 30 | 21 | 15 | 9 |
| 07.96 | 10 | 26 | 14 | 36 | 19 | 14 | 10 |
| 07.98 | 11 | 30 | 13 | 40 | 18 | 16 | 11 |
| 08.00 | 8 | 23 | 13 | 29 | 17 | 13 | 10 |
| 08.02 | 10 | 16 | 6 | 18 | 8 | 12 | 7 |
| 08.04 | 9 | 15 | 4 | 16 | 5 | 11 | 4 |
| 08.06 | 3 | 13 | 5 | 15 | 6 | 9 | 4 |
| 08.33 | 1 | 11 | 4 | 13 | 4 | 5 | 2 |
| 08.39 | 1 | 18 | 7 | 20 | 8 | 17 | 6 |
| 08.88 | 9 | 17 | 7 | 24 | 10 | 13 | 7 |
| 08.90 | 15 | 17 | 8 | 23 | 10 | 14 | 6 |
| 08.92 | 7 | 17 | 10 | 23 | 12 | 12 | 7 |
| 08.94 | 17 | 17 | 9 | 22 | 11 | 12 | 5 |
| 08.96 | 17 | 20 | 7 | 25 | 9 | 10 | 4 |
| 08.98 | 16 | 20 | 7 | 25 | 9 | 11 | 4 |
| 09.00 | 16 | 21 | 8 | 27 | 11 | 13 | 6 |
| 09.02 | 18 | 21 | 8 | 24 | 10 | 13 | 9 |
| 09.04 | 18 | 20 | 9 | 23 | 11 | 14 | 8 |
| 09.06 | 15 | 25 | 12 | 27 | 13 | 14 | 9 |
| 09.08 | 7 | 29 | 15 | 32 | 17 | 15 | 8 |
| 09.33 | 1 | 15 | 5 | 17 | 5 | 14 | 4 |
| 09.37 | 1 | 14 | 4 | 15 | 5 | 9 | 3 |
| 09.45 | 1 | 16 | 5 | 18 | 6 | 13 | 4 |
| 09.49 | 1 | 20 | 5 | 21 | 5 | 9 | 3 |
| 09.90 | 18 | 24 | 10 | 33 | 12 | 10 | 6 |
| 09.92 | 24 | 25 | 10 | 35 | 12 | 11 | 6 |
| 09.94 | 22 | 29 | 11 | 37 | 13 | 11 | 8 |
| 09.96 | 19 | 29 | 9 | 37 | 12 | 12 | 8 |
| 09.98 | 22 | 24 | 9 | 30 | 11 | 10 | 5 |
| 10.00 | 21 | 22 | 8 | 27 | 10 | 11 | 5 |
| 10.02 | 14 | 19 | 7 | 23 | 8 | 9 | 6 |
| 10.04 | 11 | 18 | 6 | 21 | 6 | 9 | 6 |
| 10.06 | 6 | 18 | 5 | 21 | 5 | 10 | 6 |
| 10.08 | 5 | 17 | 5 | 20 | 6 | 8 | 4 |
| 10.29 | 1 | 20 | 6 | 25 | 7 | 8 | 3 |
| 10.33 | 1 | 22 | 5 | 25 | 6 | 9 | 3 |
| 10.35 | 1 | 30 | 7 | 40 | 10 | 10 | 3 |
| 10.37 | 1 | 16 | 4 | 18 | 5 | 16 | 4 |
| 10.39 | 1 | 19 | 5 | 23 | 6 | 8 | 3 |
| 10.43 | 1 | 25 | 6 | 28 | 6 | 7 | 3 |
| 10.47 | 1 | 30 | 6 | 32 | 6 | 13 | 4 |
| 10.88 | 2 | 19 | 1 | 28 | 4 | 11 | 11 |
| 10.90 | 4 | 25 | 10 | 32 | 11 | 13 | 8 |
| 10.92 | 14 | 25 | 9 | 32 | 13 | 13 | 7 |
| 10.94 | 13 | 25 | 10 | 32 | 14 | 13 | 6 |
| 10.96 | 10 | 28 | 13 | 36 | 18 | 12 | 7 |
| 10.98 | 11 | 28 | 11 | 34 | 14 | 9 | 4 |
| 11.00 | 12 | 29 | 11 | 35 | 14 | 10 | 4 |
| 11.02 | 14 | 30 | 16 | 35 | 19 | 13 | 7 |
| 11.04 | 16 | 38 | 21 | 43 | 25 | 16 | 9 |
| 11.06 | 15 | 38 | 22 | 43 | 26 | 17 | 9 |
| 11.08 | 9 | 51 | 16 | 57 | 18 | 26 | 12 |
| 11.10 | 7 | 42 | 11 | 46 | 12 | 26 | 18 |
| 11.29 | 1 | 20 | 6 | 25 | 7 | 6 | 2 |
| 11.33 | 1 | 30 | 6 | 35 | 7 | 6 | 2 |

| Date (UT) | Nr Obs | ZHR (1.0) | | ZHR (1.5) | | HR | |
|---|---|---|---|---|---|---|---|
| Aug 11.35 | 1 | 34 | ± 8 | 45 | ± 10 | 4 | ± 2 |
| 11.37 | 1 | 28 | 6 | 31 | 7 | 10 | 3 |
| 11.39 | 1 | 33 | 7 | 43 | 9 | 13 | 4 |
| 11.43 | 1 | 46 | 8 | 52 | 9 | 10 | 3 |
| 11.47 | 1 | 37 | 7 | 40 | 7 | 13 | 4 |
| 11.90 | 11 | 41 | 22 | 53 | 30 | 12 | 7 |
| 11.92 | 13 | 44 | 22 | 57 | 28 | 12 | 7 |
| 11.94 | 6 | 56 | 18 | 68 | 22 | 13 | 7 |
| 11.96 | 15 | 54 | 18 | 64 | 22 | 18 | 8 |
| 11.98 | 13 | 51 | 20 | 59 | 23 | 17 | 9 |
| 12.00 | 10 | 55 | 21 | 63 | 25 | 19 | 12 |
| 12.02 | 15 | 48 | 21 | 54 | 23 | 16 | 8 |
| 12.04 | 20 | 60 | 24 | 67 | 28 | 17 | 7 |
| 12.06 | 18 | 66 | 29 | 74 | 33 | 16 | 6 |
| 12.08 | 14 | 83 | 20 | 93 | 22 | 17 | 9 |
| 12.10 | 11 | 74 | 18 | 81 | 20 | 22 | 11 |
| 12.29 | 1 | 51 | 9 | 66 | 12 | 2 | 1 |
| 12.33 | 1 | 42 | 8 | 49 | 9 | 8 | 3 |
| 12.37 | 1 | 62 | 10 | 68 | 11 | 14 | 4 |
| 12.39 | 1 | 71 | 10 | 86 | 12 | 10 | 3 |
| 12.43 | 1 | 72 | 10 | 82 | 11 | 8 | 3 |
| 12.47 | 1 | 73 | 9 | 79 | 10 | 6 | 2 |
| 12.86 | 9 | 102 | 27 | 160 | 29 | 14 | 8 |
| 12.88 | 17 | 81 | 33 | 122 | 50 | 16 | 8 |
| 12.90 | 29 | 86 | 34 | 124 | 49 | 17 | 9 |
| 12.92 | 39 | 100 | 38 | 138 | 51 | 14 | 8 |
| 12.94 | 38 | 99 | 42 | 129 | 56 | 13 | 8 |
| 12.96 | 37 | 98 | 41 | 125 | 55 | 10 | 6 |
| 12.98 | 38 | 98 | 45 | 116 | 53 | 13 | 9 |
| 13.00 | 40 | 95 | 44 | 113 | 52 | 14 | 10 |
| 13.02 | 35 | 102 | 41 | 117 | 48 | 17 | 11 |
| 13.04 | 35 | 95 | 38 | 106 | 44 | 16 | 8 |
| 13.06 | 28 | 94 | 37 | 103 | 41 | 18 | 9 |
| 13.08 | 25 | 98 | 33 | 107 | 37 | 17 | 8 |
| 13.10 | 17 | 109 | 22 | 117 | 24 | 23 | 14 |
| 13.29 | 1 | 63 | 9 | 73 | 11 | 7 | 3 |
| 13.30 | 1 | 82 | 16 | 121 | 23 | 11 | 4 |
| 13.33 | 1 | 40 | 7 | 45 | 8 | 10 | 3 |
| 13.34 | 1 | 87 | 12 | 116 | 16 | 12 | 3 |
| 13.38 | 1 | 75 | 11 | 92 | 13 | 13 | 4 |
| 13.42 | 1 | 111 | 12 | 126 | 14 | 8 | 3 |
| 13.46 | 1 | 88 | 10 | 96 | 11 | 13 | 3 |
| 13.86 | 5 | 77 | 27 | 125 | 42 | 21 | 9 |
| 13.88 | 11 | 61 | 26 | 94 | 42 | 13 | 5 |
| 13.90 | 13 | 65 | 37 | 88 | 45 | 15 | 8 |
| 13.92 | 24 | 60 | 32 | 80 | 40 | 14 | 9 |
| 13.94 | 23 | 64 | 34 | 80 | 42 | 17 | 11 |
| 13.96 | 25 | 63 | 27 | 78 | 35 | 16 | 10 |
| 13.98 | 21 | 65 | 32 | 78 | 38 | 15 | 8 |
| 14.00 | 27 | 59 | 29 | 70 | 34 | 13 | 7 |
| 14.02 | 17 | 67 | 32 | 76 | 35 | 16 | 9 |
| 14.04 | 26 | 55 | 27 | 61 | 30 | 16 | 8 |
| 14.06 | 15 | 47 | 20 | 51 | 23 | 16 | 8 |
| 14.08 | 16 | 45 | 20 | 49 | 23 | 15 | 9 |
| 14.10 | 8 | 67 | 21 | 71 | 22 | 16 | 7 |
| 14.35 | 1 | 54 | 11 | 72 | 15 | 23 | 5 |
| 14.39 | 1 | 46 | 8 | 56 | 10 | 13 | 4 |
| 14.43 | 1 | 38 | 7 | 43 | 8 | 13 | 4 |
| 14.47 | 1 | 44 | 7 | 48 | 8 | 22 | 5 |
| 14.90 | 13 | 25 | 8 | 34 | 14 | 12 | 8 |
| 14.92 | 15 | 27 | 10 | 37 | 15 | 12 | 8 |

Table 3 (continued)

| Date (UT) | Nr Obs | ZHR (1.0) | | ZHR (1.5) | | HR | |
|---|---|---|---|---|---|---|---|
| Aug 14.94 | 6 | 32 ± | 14 | 43 ± | 21 | 12 ± | 8 |
| 14.96 | 13 | 35 | 8 | 45 | 11 | 15 | 5 |
| 14.98 | 10 | 34 | 8 | 43 | 11 | 15 | 5 |
| 15.00 | 18 | 38 | 9 | 46 | 11 | 15 | 7 |
| 15.02 | 9 | 39 | 12 | 46 | 14 | 14 | 9 |
| 15.04 | 15 | 38 | 12 | 44 | 14 | 14 | 8 |
| 15.06 | 8 | 35 | 12 | 39 | 13 | 14 | 6 |
| 15.08 | 10 | 36 | 11 | 39 | 12 | 14 | 5 |
| 15.10 | 8 | 49 | 12 | 51 | 13 | 16 | 8 |
| 15.86 | 1 | 18 | 9 | 23 | 11 | 26 | 10 |
| 15.92 | 3 | 12 | 5 | 14 | 6 | 14 | 10 |
| 15.94 | 5 | 15 | 8 | 19 | 10 | 16 | 8 |
| 15.96 | 4 | 17 | 7 | 22 | 9 | 12 | 9 |
| 15.98 | 5 | 17 | 9 | 21 | 11 | 11 | 6 |

| Date (UT) | Nr Obs | ZHR (1.0) | | ZHR (1.5) | | HR | |
|---|---|---|---|---|---|---|---|
| Aug 16.00 | 7 | 15 ± | 7 | 17 ± | 8 | 10 ± | 6 |
| 16.02 | 6 | 17 | 6 | 20 | 7 | 13 | 6 |
| 16.04 | 9 | 16 | 4 | 18 | 4 | 10 | 5 |
| 16.06 | 6 | 17 | 4 | 19 | 4 | 10 | 4 |
| 16.08 | 8 | 21 | 6 | 23 | 6 | 13 | 7 |
| 16.10 | 4 | 24 | 6 | 26 | 7 | 18 | 7 |
| 17.06 | 1 | 9 | 3 | 10 | 3 | 8 | 3 |
| 18.05 | 1 | 8 | 4 | 9 | 4 | 11 | 4 |
| 18.06 | 1 | 9 | 4 | 9 | 4 | 8 | 4 |
| 22.89 | 1 | 10 | 10 | 14 | 14 | 35 | 4 |
| 23.85 | 1 | 5 | 2 | 6 | 3 | 7 | 2 |
| 23.88 | 1 | 4 | 3 | 5 | 4 | 9 | 3 |
| 23.91 | 1 | 2 | 2 | 3 | 3 | 15 | 4 |
| 24.93 | 1 | 0 | | 0 | | 13 | 4 |

The data points from Table 3 are plotted in Figures 1 and 2 as small black dots. Unfortunately, only European data, concentrating the data points around $0^h$ UT, were available, extended by a few American observations after $5^h$ UT. The absence of Japanese observations created a gap between $12^h$ UT and $20^h$ UT; for this reason, there is no continuous hourly rate profile. At this point, we repeat our call for a universal reporting format for visual meteor observations! A world wide relay race including more North- or South-American and the powerful Japanese and Soviet meteor groups, would enable a detailed study of the fine inner structure of the Perseids. Most of the scatter on the data points in Figures 1 and 2 has to be attributed to statistical fluctuations. A study by our Soviet colleagues (7) on the 1986 data shows the different short term activity patterns as derived from widely separated meteor groups. If the fine inner layered structure within the Perseid stream can be derived within the statistical fluctuations, then the independent groups, although separated by thousands of kilometers, should find the same short term hourly rate profiles. The 1985 data allowed only a combined ZHR-profile which could not be compared to an independent result of the same year. From the European 1985 short term ZHR profiles, it seems likely that some prominent features are due to the inner layered structure within the Perseid stream, rather than pure statistical fluctuations (6).

Table 4 lists the smoothened ZHR values computed with a step of 0.5 day over a 2 day interval in July and a 1 day interval in August. Of course any short term variation in the ZHR then has been smoothened and the results of Table 4 allow to consider the overall Perseid activity for the entire 1986 appearance. The results are much easier to interprete as plotted in curves (Figures 3, 4 and 5).

## 4. Overview of the activity of the 1986 Perseids

The Perseids equal the sporadic activity around August 6-7; it varies around the same ZHR with a very weak increase night after night. The reference sporadic rate is given in Figure 5. Around August 9 until August 11.0 the activity remains remarkably stable; no increase in the ZHR's can be seen night after night: what a tremendous desillusion for all those observers expecting the Perseid activity to grow towards its climax on August 12-13!

Then it happens. Suddenly, shortly after August 11.0, ZHR's start to increase sharply. This sudden increase was monitored on August 11-12 by the observing team in France. The author participated in this international event and remembers the exciting experience of being a witness of this steep increase in hourly rates. Twilight illuminated the starry Southern French sky at $3^h$ UT, first

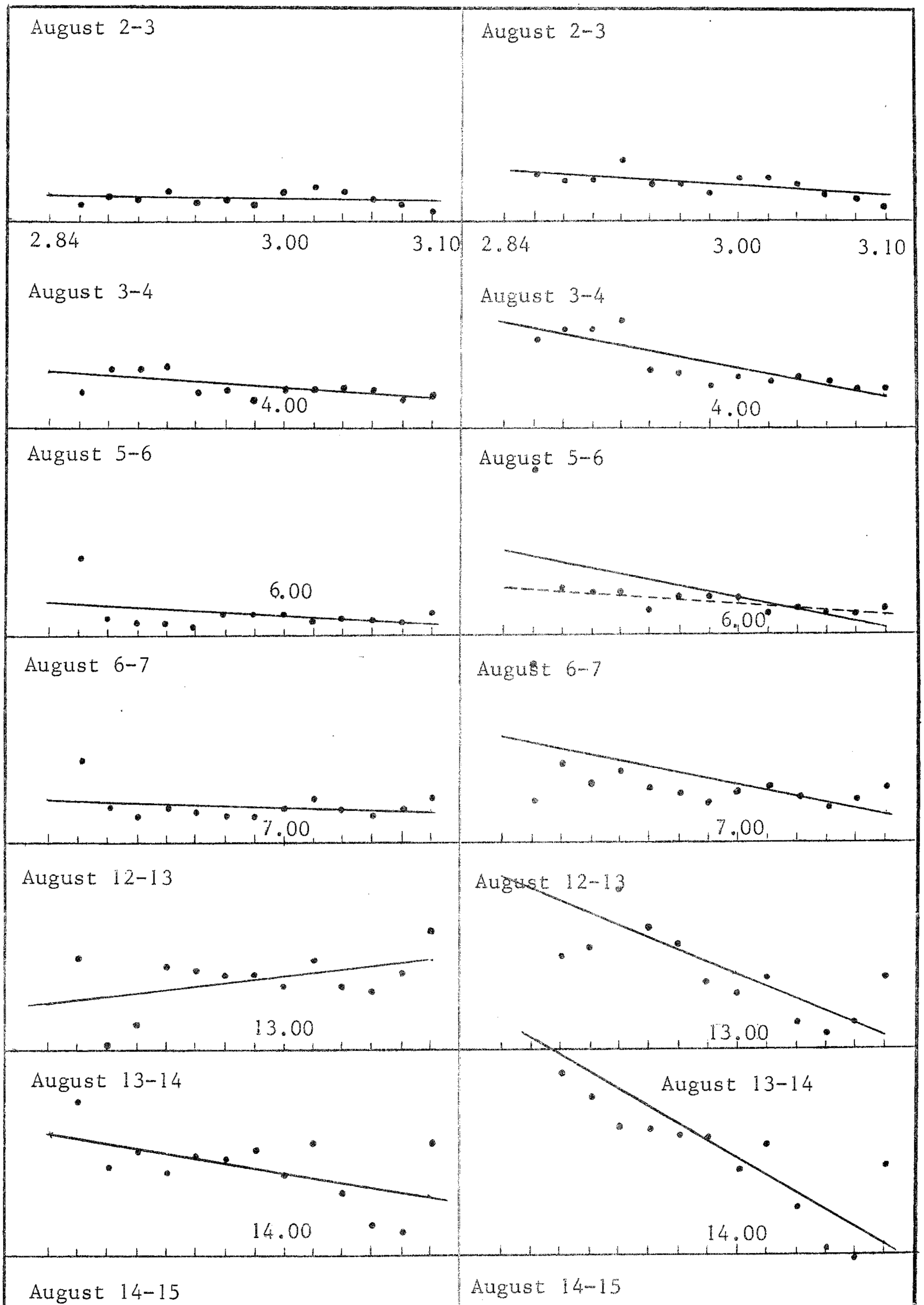


Figure 1 --- Perseid 1986 ZHR's 1 hour averages for $\varepsilon = 1.0$ (left) and $\varepsilon = 1.5$ (right).

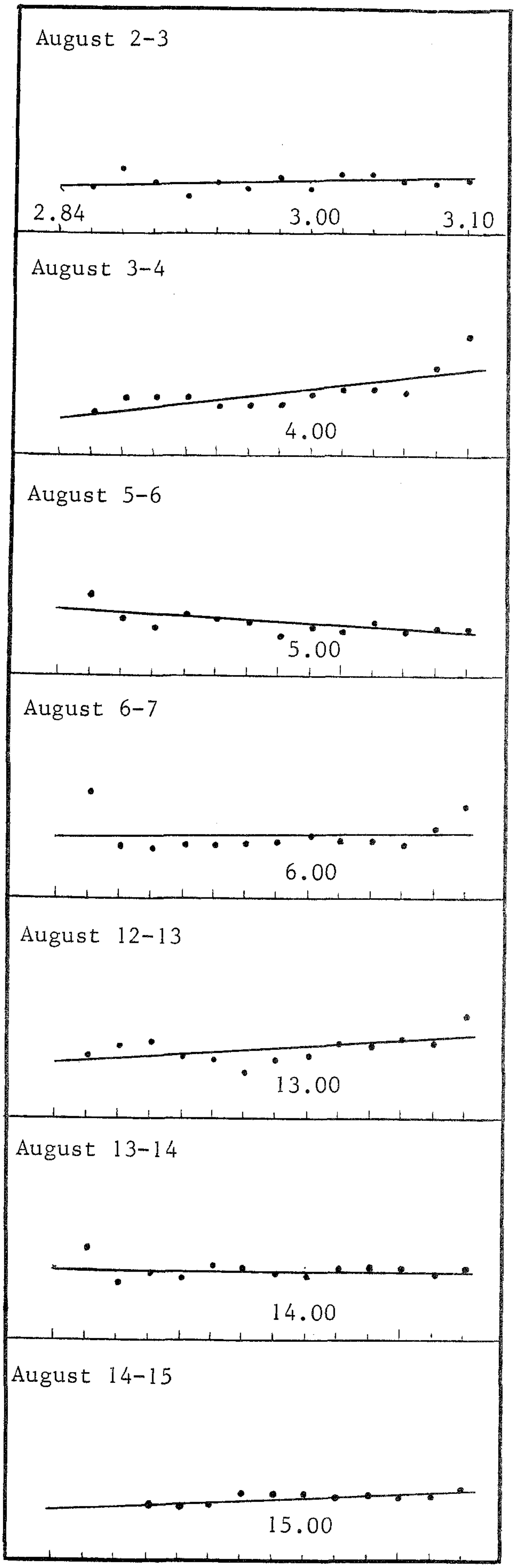


Figure 2 --- Sporadic activity (HR's 1 hour averages) during Perseids 1986.

swallowing the silver river Milky Way, eating stars away in order of increasing brightness as like someone slowly turned on the lights in a planetarium. While the horizon was reddening, most observers were packing, but Perseids continued to appear at the deep purple blue sky. It was not over and as the sun disappeared at the western horizon that evening the spectacle turned on again. ZHR's for August 13.0 were much higher than for August 12.0. Maximum occurred in 1986 aound August 12.75 at about $19^h$ UT ($\lambda_\odot$ = $139\overset{\circ}{.}26$). That night, observers enjoyed ZHR's around 90 all night. The actual decrease in ZHR was compensated in effective hourly rates by the rising of the radiant throughout the night. Only on August 13-14, the decrease in rates became evident. The post maximum activity of the Perseids is much more impressive as rates are surprisingly rich until August 15.0. The density within the main Perseid stream produces a slightly asymmetric ZHR profile. The post maximum branch takes more time four our planet to cross than the pre maximum branch. But after August 16, Perseid activity ceases quite abruptly around August 26. The low density widely scattered component of the Perseid stream being asymmetric in the opposite sense, the pre maximum activity of this component takes more time to be traversed. The low density component according to Ahnert (8) may be produced by perturbed Perseid meteoroids that missed the Earth at a previous close encounter with our planet. The outer regions of this branch meet our planet in its orbit near July 15. Its density is increasing very slowly until the Earth encounters the main unperturbed Perseid stream after August 11.0 (near $\lambda_\odot$ = 138°). After some 3.8 x $10^6$ km Earth penetrates the core of the main Perseid stream which takes over $10^6$ km to be crossed. The post maximum main unperturbed Perseid stream takes the Earth 5.4 x $10^6$ km of its orbit to leave around August 15.0 (near $\lambda_\odot$ = 142°).

The mirrored asymmetry of both Perseid stream components may reflect the result of two different perturbing mechanisms. The asymmetry in the main stream is probably the result of the formation of the stream itself, whereas the low density component is purely the effect

Table 4 --- Average ZHR-values for the Perseids 1986, computed for 2 day periods in July and 1 day periods in August, each 0.5 day, with both $\varepsilon = 1.0$ and $\varepsilon = 1.5$.

| Date (UT) | Nr Obs | ZHR (1.0) | | ZHR (1.5) | | HR | |
|---|---|---|---|---|---|---|---|
| Jul 26.0 | 5 | 1 ± | 1 | 2 ± | 1 | 18 ± | 4 |
| 26.5 | 5 | 1 | 1 | 2 | 1 | 18 | 4 |
| 27.0 | 6 | 2 | 2 | 2 | 2 | 15 | 7 |
| 27.5 | 7 | 2 | 2 | 2 | 2 | 13 | 8 |
| 28.0 | 6 | 5 | 3 | 6 | 4 | 9 | 5 |
| 28.5 | 7 | 5 | 3 | 6 | 4 | 9 | 5 |
| 29.0 | 11 | 5 | 2 | 7 | 3 | 11 | 5 |
| 29.5 | 12 | 6 | 3 | 7 | 4 | 11 | 4 |
| 30.0 | 13 | 6 | 3 | 7 | 3 | 13 | 2 |
| 30.5 | 14 | 6 | 3 | 7 | 3 | 13 | 2 |
| 31.0 | 16 | 8 | 4 | 12 | 6 | 12 | 2 |
| 31.5 | 20 | 8 | 3 | 11 | 5 | 12 | 2 |
| Aug 01.0 | 12 | 10 | 3 | 12 | 5 | 12 | 3 |
| 01.5 | 13 | 10 | 4 | 12 | 8 | 13 | 3 |
| 02.0 | 18 | 10 | 4 | 13 | 7 | 13 | 3 |
| 02.5 | 19 | 11 | 3 | 13 | 3 | 12 | 3 |
| 03.0 | 13 | 10 | 2 | 13 | 3 | 11 | 2 |
| 03.5 | 14 | 14 | 4 | 18 | 8 | 12 | 1 |
| 04.0 | 15 | 15 | 3 | 20 | 6 | 13 | 5 |
| 04.5 | 14 | 13 | 2 | 16 | 2 | 14 | 6 |
| 05.0 | 9 | 13 | 2 | 16 | 2 | 13 | 3 |
| 05.5 | 14 | 15 | 4 | 20 | 9 | 14 | 3 |

| Date (UT) | Nr Obs | ZHR (1.0) | | ZHR (1.5) | | HR | |
|---|---|---|---|---|---|---|---|
| Aug 06.0 | 16 | 16 ± | 6 | 21 ± | 10 | 12 ± | 3 |
| 06.5 | 17 | 17 | 6 | 22 | 10 | 12 | 4 |
| 07.0 | 16 | 18 | 6 | 23 | 9 | 14 | 4 |
| 07.5 | 15 | 19 | 5 | 24 | 8 | 14 | 3 |
| 08.0 | 11 | 19 | 6 | 24 | 9 | 13 | 3 |
| 08.5 | 13 | 17 | 3 | 22 | 5 | 12 | 3 |
| 09.0 | 15 | 19 | 4 | 23 | 4 | 12 | 2 |
| 09.5 | 15 | 22 | 5 | 27 | 7 | 12 | 2 |
| 10.0 | 17 | 23 | 5 | 28 | 7 | 10 | 2 |
| 10.5 | 19 | 23 | 5 | 28 | 6 | 10 | 2 |
| 11.0 | 19 | 32 | 8 | 38 | 8 | 13 | 6 |
| 11.5 | 19 | 40 | 10 | 47 | 12 | 14 | 6 |
| 12.0 | 17 | 59 | 13 | 68 | 13 | 13 | 5 |
| 12.5 | 20 | 76 | 19 | 94 | 31 | 13 | 5 |
| 13.0 | 20 | 90 | 16 | 112 | 24 | 14 | 4 |
| 13.5 | 21 | 79 | 19 | 96 | 22 | 14 | 4 |
| 14.0 | 17 | 57 | 10 | 72 | 20 | 16 | 3 |
| 14.5 | 16 | 45 | 13 | 53 | 13 | 15 | 3 |
| 15.0 | 11 | 35 | 6 | 42 | 5 | 14 | 1 |
| 15.5 | 12 | 27 | 13 | 32 | 14 | 15 | 4 |
| 16.0 | 11 | 17 | 3 | 20 | 3 | 14 | 5 |
| 16.5 | 8 | 16 | 5 | 18 | 6 | 12 | 3 |

of planetary perturbations. Theoretical computer simulations applied to the Perseid stream for various initial models can help to explain the particular shape of the Perseid ZHR curve.

## 4. Daily European ZHR and HR variations

One question remained untouched up to know: whether or not to use a zenith exponent $\varepsilon = 1.0$ or $\varepsilon = 1.5$. The effect can be considered in detail when we consider the short term ZHR variation for the European observing window. Analogous to (6), we compute the linear regression through the ZHR values for each hour per night. This at least indicates whether the ZHR and HR were increasing or decreasing. The results were as follows.

| | | |
|---|---|---|
| August 2–3 | $\varepsilon = 1.0$ | $ZHR = -4.67\,T - 14.96$ |
| | $\varepsilon = 1.5$ | $ZHR = -22.8\,T + 35.42$ |
| | sporadics | $HR = 5.77\,T - 5.81$ |
| August 3–4 | $\varepsilon = 1.0$ | $ZHR = -20.88\,T + 98.02$ |
| | $\varepsilon = 1.5$ | $ZHR = -68.13\,T + 291.25$ |
| | sporadics | $HR = 43.4\,T - 158.4$ |
| August 5–6 | $\varepsilon = 1.0$ | $ZHR = -21.98\,T + 144.43$ |
| | $\varepsilon = 1.5$ | $ZHR = -73.63\,T + 460.34$ |
| | sporadics | $HR = -19.0\,T + 125.3$ |
| August 6–7 | $\varepsilon = 1.0$ | $ZHR = -12.64\,T + 106.82$ |
| | $\varepsilon = 1.5$ | $ZHR = -73.08\,T + 534.92$ |
| | sporadics | $HR = 3.57\,T - 10.7$ |
| August 12–13 | $\varepsilon = 1.0$ | $ZHR = 40.38\,T - 427.5$ |
| | $\varepsilon = 1.5$ | $ZHR = -150.82\,T + 2079$ |
| | sporadics | $HR = 22.3\,T - 273.3$ |

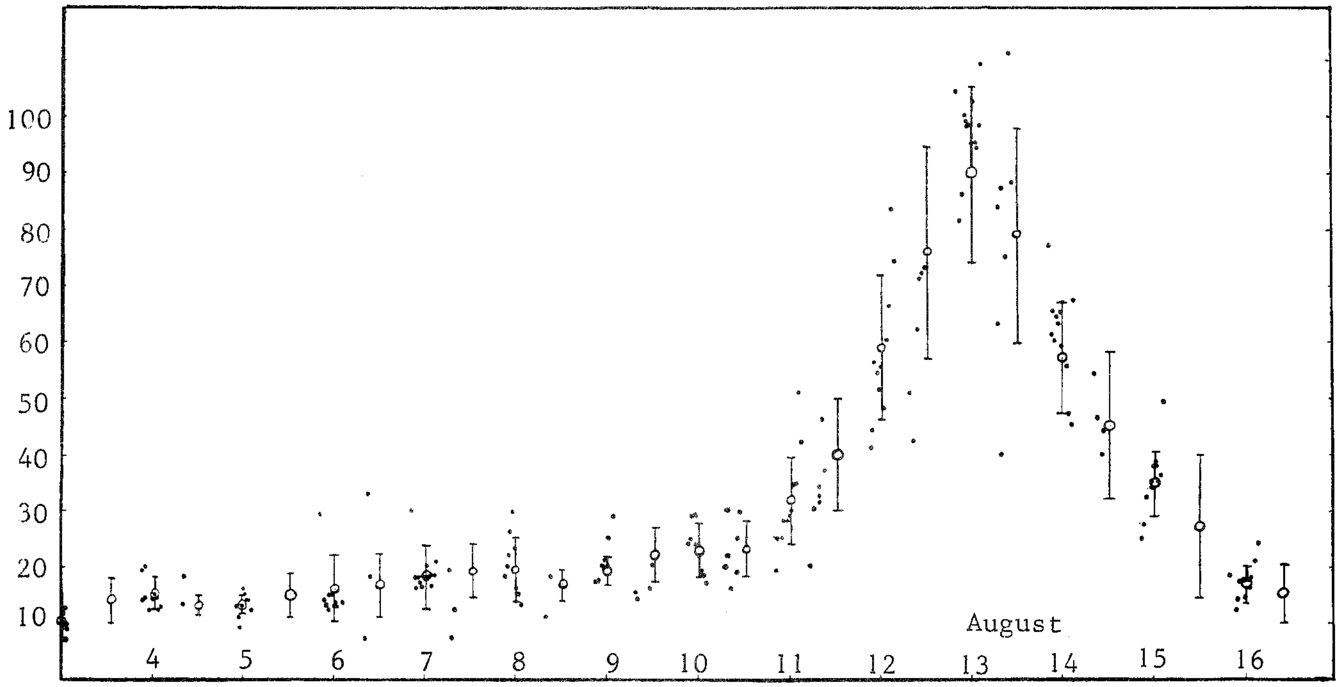


Figure 3 --- ZHR curve for the Perseids 1986, computed with ε = 1.0.

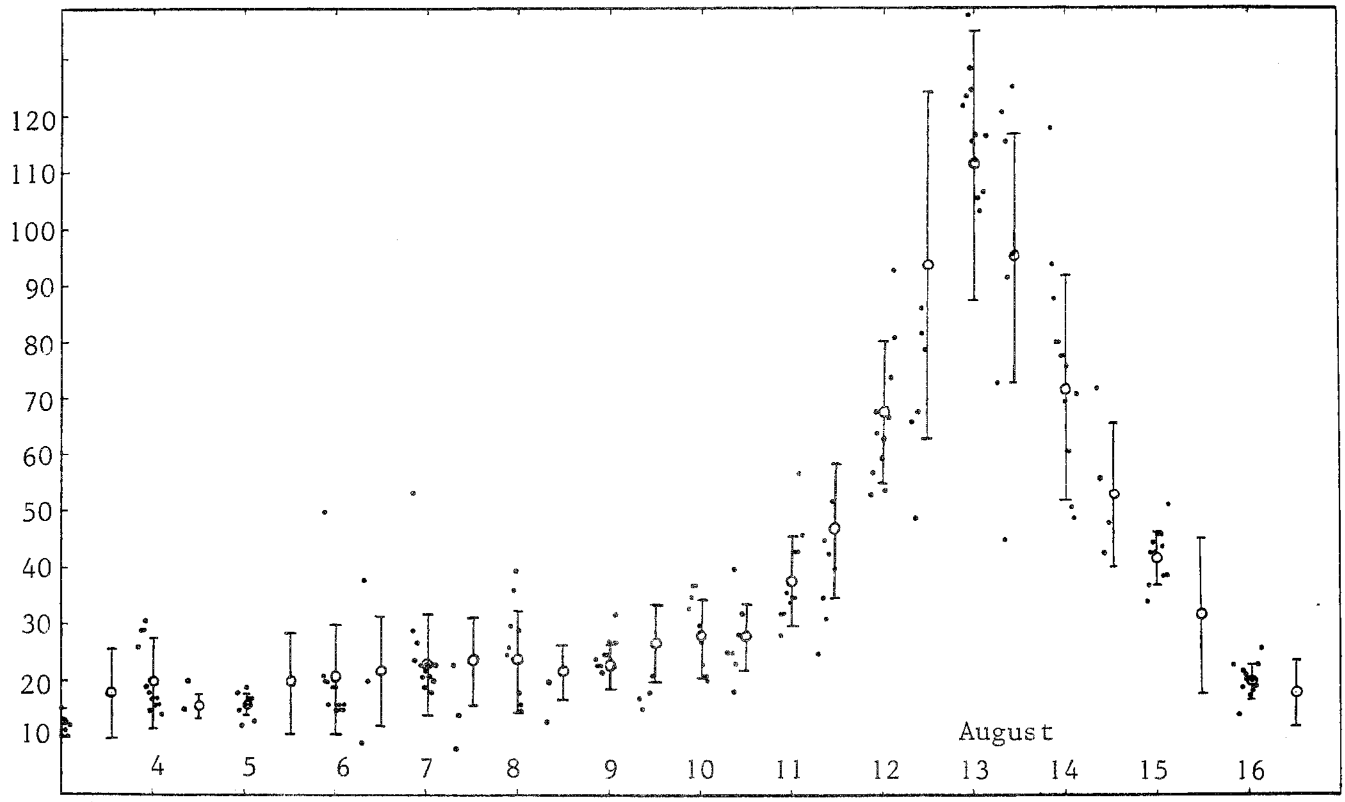


Figure 4 --- ZHR curve for the Perseids 1986, computed with ε = 1.5.

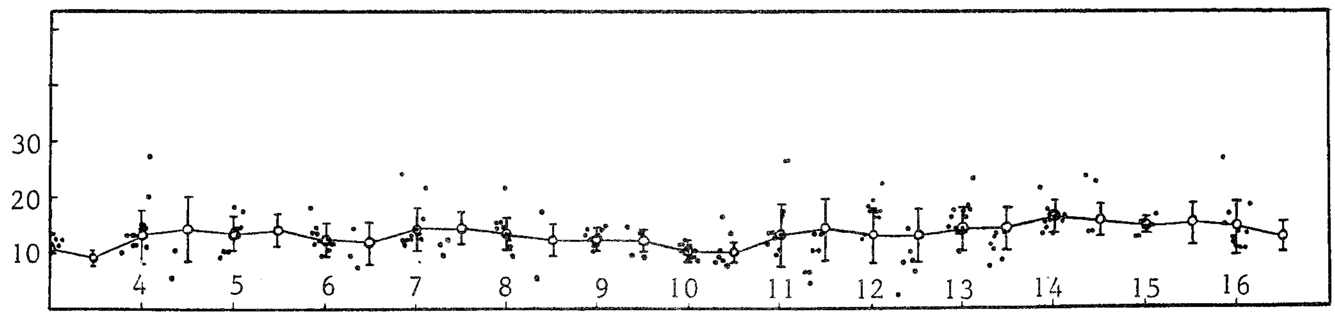


Figure 5 --- HR curve for the sporadic background in August 1986.

| | | |
|---|---|---|
| August 13-14 | $\varepsilon = 1.0$ | ZHR = $-61.88\ T + 925$ |
| | $\varepsilon = 1.5$ | ZHR = $-211.5\ T + 3034$ |
| | sporadics | HR = $-4.12\ T + 73.2$ |
| August 14-15 | $\varepsilon = 1.0$ | ZHR = $80\ T - 1165$ |
| | $\varepsilon = 1.5$ | ZHR = $37\ T - 517$ |
| | sporadics | HR = $14.1\ T - 197.5$ |

The nights August 2-3, 3-4, 5-6 and 6-7 show a stable ZHR hour after hour for $\varepsilon = 1.0$. The use of $\varepsilon = 1.5$ leads towards a decreasing ZHR from the evening towards the morning, which indicates that the zenith distance correction with $\varepsilon = 1.5$ overcorrects during these nights. This was not so clear from similar graphics made for the 1985 Perseids (6).

August 12-13 shows an increasing ZHR for $\varepsilon = 1.0$, which is unlikely as the maximum was around August 12.75 UT. For August 12-13 and 13-14, the result obtained from a zenith correction with $\varepsilon = 1.5$ shows a sharp decrease, which is perhaps too steep. Should $\varepsilon$ be somewhere in between 1.0 and 1.5?

August 14-15 is peculiar, as both hourly rate profiles show an increasing ZHR, as if a secundary maximum occurred at about August 15.0. This is the only indication for an inner layered structure within the Perseid stream in 1986. Short duration depressions in the ZHR profile as found in 1985 could not be confirmed in 1986. All the rate variations in 1986, except the rise in ZHR's towards the morning of the night of August 14-15, may be considered as the result of statistical fluctuations.

The sporadic hourly rate variation HR has been plotted in a similar way for the same nights. As it is generally accepted, the sporadic activity shows a daily variation. During none of the nights in Figure 2, this daily variation can be confirmed, except for August 3-4. On average, there is a slight increase towards the morning, but far from being as pronounced as in the literature. August 5-6 even indicates a decrease in the sporadic HR towards the morning! This result is rather unexpected, and in 1985, similar daily HR diagrams could be obtained. The reason why the observational facts for the sporadic HR are in contradiction with the theory, may be explained by assuming that some minor showers, productive in the evening, were not distinguished from the sporadics and counted as such. Only Perseids, $\delta$- and $\iota$-Aquarids, $\alpha$-Capricornids and $\kappa$-Cygnids were identified as shower meteors.

## 6. Comparison with the 1985 Perseids

The 1985 data for the Perseids were recomputed for the period August 11.00 till August 16.00 and averaged in the same way as for the 1986 Perseids over a 1 day time interval with a step length of 0.5 day. The data obtained in this way are listed in Table 5, below.

Table 5 — **Average ZHR-values for the Perseids 1985, computed for 1 day periods in August, each 0.5 day, with both $\varepsilon = 1.0$ and $\varepsilon = 1.5$.**

| Date (UT) | ZHR (1.0) | | ZHR (1.5) | | HR | |
|---|---|---|---|---|---|---|
| Aug 11.0 | 26 ± | 6 | 37 ± | 16 | 17 ± | 3 |
| 11.5 | 45 | 12 | 67 | 19 | 16 | 2 |
| 12.0 | 58 | 18 | 74 | 13 | 16 | 2 |
| 12.5 | 78 | 11 | 102 | 24 | 15 | 2 |
| 13.0 | 86 | 9 | 113 | 16 | 15 | 2 |

| Date (UT) | ZHR (1.0) | | ZHR (1.5) | | HR | |
|---|---|---|---|---|---|---|
| Aug 13.5 | 72 ± | 21 | 91 ± | 21 | 17 ± | 4 |
| 14.0 | 54 | 10 | 72 | 22 | 18 | 3 |
| 14.5 | 37 | 13 | 46 | 18 | 17 | 2 |
| 15.0 | 30 | 9 | 38 | 15 | 17 | 2 |
| 15.5 | 28 | 9 | 33 | 10 | 18 | 3 |

When we compare the ZHR profile plots for 1985 with those of 1986 (Figures 3 and 4) for the period between August 11.0 and August 16.0, we can at least conclude that the appearance of the main Perseid stream was very similar in both years. No obvious differences are to be reported between for both years.

The ZHR plots for $\varepsilon = 1.0$ and $\varepsilon = 1.5$ also show in both years that the standard

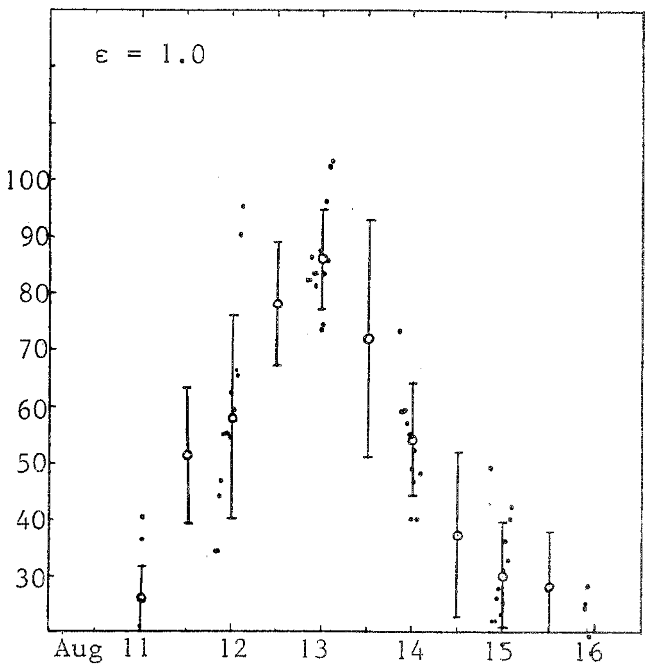


Figure 6 --- ZHR curve Perseids 1985

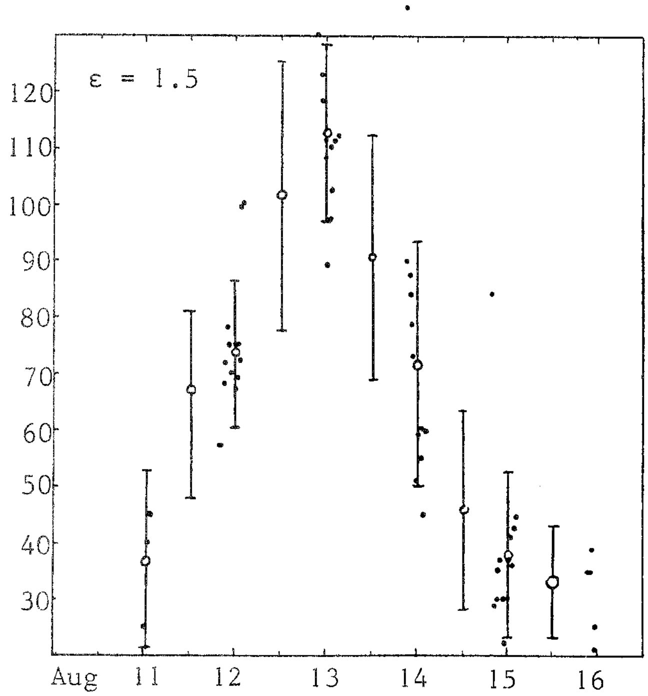


Figure 7 --- ZHR curve Perseids 1985

deviation on the averaged ZHR's for $\varepsilon = 1.5$ is much larger than for $\varepsilon = 1.0$. The use of a stronger zenith distance correction factor is not favorable for the spread on the ZHR's.

## 7. General Conclusions

The 1986 Perseid results indicate a normal Perseid return with the same general large scale activity profile as observed in 1985. The use of $\varepsilon = 1.5$ as a zenith exponent instead of $\varepsilon = 1.0$ for the zenith distance correction factor did not improve the result. On the contrary, the spread on the average ZHR's became worse. It is therefore recommended to use the simple zenith distance correction sec $Z$, for $Z$ smaller than 70°.

1988 will see another excellent Perseid display. At this occasion, I ask all observers to pay attention to the hourly rate data and magnitude distribution per observer independently per night for shower meteors and sporadics separately. Look up the Handbook for Visual Meteor Observations to verify *how* to register sky conditions (e.g. limiting magnitudes averaged to ±0.1 magnitude; 0.5 magnitude is far too unsufficient). Please respect the summary reporting format for raw data (see *WGN* for examples). We would appreciate to get access to raw data from American, Japanese and Soviet observers, reported in such a way that they can be analyzed by the same method as the European data.

## References


(1) Roggemans P., "On the Perseid Meteor Stream 1985", *WGN 14:4*, 1986, pp. 108-125.

(2) Vanhoeck L., "Saturday Evening Debate", *IMW Proceedings I*, 1986, pp. 25-28.

(3) Koschny D., Vanhoeck L., "ZHR Correction Factors", *idem*, pp. 29-31.

(4) Roggemans P. (ed.), "Handbook Visual Meteor Observations", 1987.

(5) Roggemans P., "Perseids 1985 and the Zenith Distance Correction, *WGN 14:5*, 1986, pp. 149-152.

(6) Roggemans P., "The ZHR Profile of the 1985 Perseids, Recomputed", *WGN 15:6*, 1987, pp. 181-183.

(7) Grishchenyuk A., Levina A., Martynenko V., "Soviet Observations of the Perseids 1986", *WGN 16:1*, 1987, pp. 32-34.

(8) Ahnert-Rohlfs E., "Zur Struktur und Entstehung des Perseidenstroms", *Veröffentlichungen der Sternwarte in Sonneberg Band 2*, 1952-56, pp. 5-38.

# Soviet Observations of the Perseids 1986

*A. Grishchenyuk, A. Levina and V.V. Martynenko*

**Some observational results of the Perseids 1986 in the Soviet Union are discussed. Observations were conducted under the general direction of the Crimean G.O. Zateishchikov Meteor Station of the All-Union Astronomical-Geodetical Society (AAGS) and the Regional Young Astronomical Observatory of the Crimean Young Technicians Station.**

The Perseids 1985 made such a strong impression on the observers, that they were waiting for the new encounter with the shower in 1986 with great impatience. According to the "meteor relay-race" program, observers of the settlement Dal'negorsky in the Far East and the towns Alma-Ata, Chelyabinsk, Kirov, Rostov-at-Don, Zaporozh'ye, Gorky, Simferopol, Sudak, Alushta et al. were invited to follow the development of the shower's activity.

Organization, methodical and scientific direction of the "meteor relay-race" were accomplished by the Crimean G.O. Zateishchikov Meteor Station of the AAGS and the Regional Young Astronomical Observatory of the Crimean Young Technicians Station. During the observations in 1986 the observers of Alma-Ata were helped by observers-instructors from the Crimea (M. Bidnichenko et al.). V. Kravchenko from the Crimea with a group of experienced observers carried out observations at the Northern Caucasus near the settlement of Nizhni Arkhyz during and after the work of the VIth Young Astronomers and Cosmonauts Rally. At the Crimea, Perseids were studied by groups of experienced observers at Sudak, Simferopol, and on the Demerji Mountain. (Instructors were V. Martynenko, A. Levina, S. Zhitelzeif, A. Grishchenyuk, G. Akman et al.). More than 70 persons took part in these observations, and among them were pupils, students, teachers, directors of astronomical groups, scientists and engineers. They registered during August 22 170 meteors, 11 650 of which were Perseids.

Unfortunately, the August meteor relay-race turned out to be shortened by heavy cloudiness and rains in the Far East, where Perseids were not seen at all during the nights of maximum.

Crimean observers began to register their first Perseids on July 10 already. It is interesting to note that Perseid observations that year started with a double jubilee: the 100th Crimean meteor expedition and the 40th anniversary of the Crimean Society of Young Amateur Astronomers.

In 1986, some peculiarities of the shower structure were discovered that went unnoticed earlier. At the Sudak Meteor Station, continuous observations from the evening until the morning were set up. They permitted to register groups of both bright and weak Perseids. In the night of August 5-6, observers on duty noticed a unique batch of weak Perseids. If those meteors would have appeared separately, even the most experienced observers could have had doubts about their belonging to the Perseids, as they were very short (about 5°) and flashed up far from the radiant (30-40°). Nevertheless, they were Perseids, since all of them radiated from the radiant. Evidently, we could only see their flares in this case. It is possible that inexperienced observers obtained lower ZHR's because of an incorrect identification of shower meteors.

The period of August 6-10 is the time when the Perseids' activity increases sharply. Hundreds of Perseids were seen during these nights, but their share in the total meteor activity did not exceed 50%. Meteors appeared in groups: many twins and triplets were noticed. Often, calm periods of 5-9 minutes were observed between groups. On a total of 109 meteors in the night of August 9-10, 16 very bright Perseids with magnitudes between -4 and +1 were registered.

On August 6 at $23^h33^m$ UT, observers in Sudak saw a very bright fireball at 45° altitude. They estimated its brighteness at -7. It could be followed over more than 35° and it showed two flares and a strong double train that drifted during 9 minutes. One group of observers attributed this fireball to the $\alpha$-Perseids, but another group, that conducted observations in better conditions, noticed that it appeared as a very weak reddish meteor near α Aurigae. The head of the expedition camp was lucky to photograph this fireball in the course of a test with a new Soviet objective "Zodiak" ($D/F$ = 3.5, $F$ = 30 mm, field = 180°). (*This unique photograph is shown on the front page, ed.*)

In the night of August 10-11, 192 Perseids were registered over Sudak, on a total of 407 meteors. Among them, there were 30 pairs and triplets within time intervals from 2 to 30 seconds. Some groups consist of over 3 meteors. Over the Kamenskoye Plateau near Alma Ata at $22^h10^m$ UT a great batch of 8 Perseids was noticed, followed by a 20 minute period of no activity.

In the night of August 11-12, observers on the Kamenskoye Plateau were the first to meat the Perseids in the USSR. No essential increase in activity was noticed here at this time. From a total of 446 meteors, only 214 were Perseids; this is less than 50%. 38 of them were bright (magnitudes between +1 and -3). At $20^h53^m$ UT, observers saw a sporadic fireball of -7.5 that exploded into three fragments. Many twin Perseids and some great batches were also observed. The relay race was taken over from the Alma Ata group by observers in the Northern Caucasus. From $22^h$ to $1^h$ UT, they registered 40 pairs and twins and more than 20 batches of 3 to 11 meteors within 1 to 2 minutes. In one batch, Sudak observers counted 6 bright Perseids within 20 seconds. Most of the bright Perseids were of magnitude -4. For the night of August 11-12, a total of 470 meteors were seen in Sudak, 317 of which were Perseids. So, relative activity had increased to 67%. Most high ZHR's for that night were registered at the Nizhni Arkhyz settlement (50) and at Sudak (70).

In this night, the Perseid activity surpassed all expectations. By $19^h$ UT of August 12, the Shower's intensity had increased so much that in some periods relative activity reached 99%. At a time, 7 to 9 Perseids were registered within one minute! It is necessary to say however that bright Perseids were absent during this night. Meteors of magnitudes 0 and 1 were common, but brighter ones only appeared casually. But from $20^h30^m$ UT on, Perseids of -2 and -3 were also noticed. From $23^h30^m$UT onwards, such powerful intensification of the shower's activity had begun, that observers in N. Arkhyz had difficulties to keep up: 3 to 10 meteors appeared within one minute! Dozens of them flashed up almost at the same time or with intervals of 1 to 2 seconds, grouping in pairs, triplets, quadruplets,... Beautiful bright twins and triple meteors appeared over Sudak in the night of August 12-13. Often, the narrow pairs were followed by a third meteor after a few seconds. 8 Perseids appeared during 30 seconds after $23^h45^m$ UT. The brightest Perseid over Sudak was of magnitude -4. One of the most sharp-sighted observers, I. Shchedrov noted chains of five Perseids of magnitudes 4.5 to 5 near the star clusters $h$ and $\chi$ Persei.

Meteor counts at some major observational points are listed in the table below.

Table --- Perseid 1986 meteor counts on August 12-13 in the Soviet Union.

| Location | Total | Perseids | % |
|---|---|---|---|
| Kamenskoye Plato | 843 | 563 | 67 |
| Nizhni Arkhyz | 805 | 656 | 84 |
| Sudak (group nr. 1) | 935 | 748 | 80 |
| Simferopol | 514 | 434 | 84 |

The most qualitative results are those of Sudak group nr. 1. This group conducted observations of the whole sky without interruption. ZHR's for the time interval from $16^h$ to $2^h$ UT of August 12-13, 1986 are shown in Figure 1. In this figure, resulsts from West-European and Japanese observers are also shown, besides results from Soviet observers.

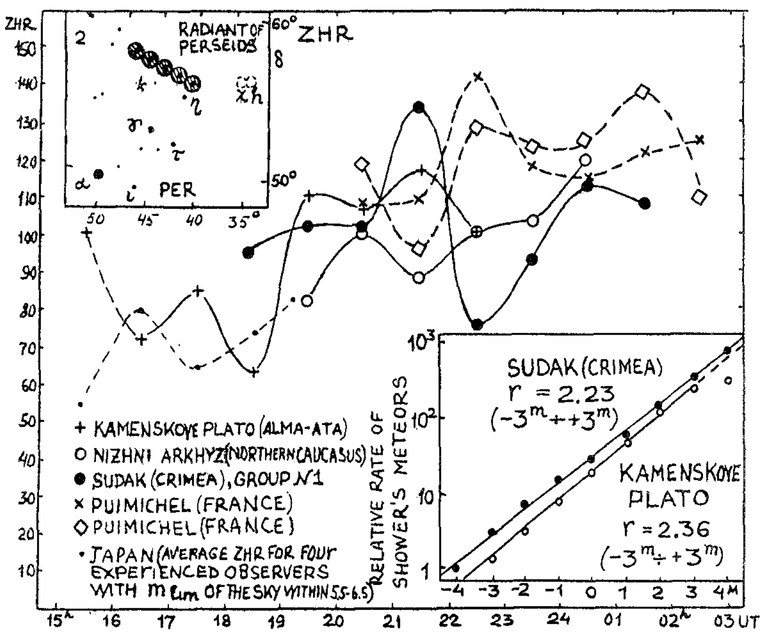


Figure --- Comparison of ZHR-profiles of the Perseids 1986, obtained on August 12-13 by various Soviet-groups and observers in France and Japan.

The ZHR profile shows two peaks of activity: near $21^h$ UT on August 12 and between $1^h$ and $2^h$ UT on August 13. These peaks are seen especially clear on profiles using only meteors brighter than +2, recorded in Novotroitsk, Sudak, the Demerji Mountain and Simferopol. The comparison between Crimean and West-European data shows their fine resemblance. It is clear therefore that meteor relay-race must be further developed. It is however necessary to say that ZHR values from different, even when obtained in near-standard conditions, do not have to match perfectly, as the observers saw different groups of meteors.

Data about the drift of the main radiant, from which about 90% of the Perseids radiated and on the $r$-value can be found on the Figure.

# Status of the Photographic Meteor Data Base

*Christian Steyaert*

The Photographic Meteor Data Base tries to collect in a consistent way positional data of photographed meteors.

Table --- Status of the Photographic Meteor Data Base.

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1966 | | | | | | | | | | | 4 | | 4 |
| 1967 | | | | | | | | | | | | | 0 |
| 1968 | | | | | | | 1 | 1 | | | | | 2 |
| 1969 | | | | | | | | | | | | | 0 |
| 1970 | 1 | | | | | | 2 | 4 | | | | | 7 |
| 1971 | | | | | | | | | | | | | 0 |
| 1972 | | | | | | | | 5 | | | | | 5 |
| 1973 | | | | | | | | | | | | | 0 |
| 1974 | | | | | | | | 2 | | | | | 2 |
| 1975 | | | | | | | | 4 | 1 | | | | 5 |
| 1976 | 1 | | | 3 | | 1 | 1 | 3 | | 2 | | | 11 |
| 1977 | | 1 | | | | | | 5 | | | | | 6 |
| 1978 | | | | | | | | 39 | | | | | 39 |
| 1979 | | | 1 | | | | 1 | 8 | | | | | 10 |
| 1980 | | | | | 2 | | 1 | 105 | | | 1 | 8 | 117 |
| 1981 | | | | 3 | 1 | | 17 | 68 | | 3 | 2 | | 94 |
| 1982 | | 1 | | 12 | | | | 149 | | 3 | 2 | 6 | 173 |
| 1983 | 1 | | 1 | 1 | | | 1 | 174 | 1 | | | 5 | 184 |
| 1984 | 3 | | | 6 | | | 26 | 9 | | 2 | 2 | 2 | 50 |
| 1985 | 1 | | | 4 | 1 | | 1 | 283 | 2 | 25 | | 13 | 330 |
| 1986 | | | | 1 | 1 | | 1 | 60 | 6 | 1 | | 4 | 74 |
| 1987 | 3 | | | | | | 16 | | | 2 | | | 21 |
| Tot | 10 | 2 | 2 | 30 | 5 | 1 | 68 | 919 | 10 | 38 | 11 | 38 | 1134 |

The *Photographic Meteor Data Base* (*see list of publications earlier in this issue, ed.*) is an attempt to bring together as much as possible positional data about photographed meteors in a consistent way. Only lots of data allow meaningful conclusions. Meteors observers world wide have already contributed to this work: 119 persons made photographs from 179 different sites. The PMDB is constantly growing: since the first issue of the printed volume a year ago, 150 meteors have been added.

Observers sending photographs to the author (address on inside of back cover) receive the printout of the astrometrical calculations. Because of the volume of work, observers are encouraged to measure themselves their photographs.

Blank forms for filling in the data are available at request.

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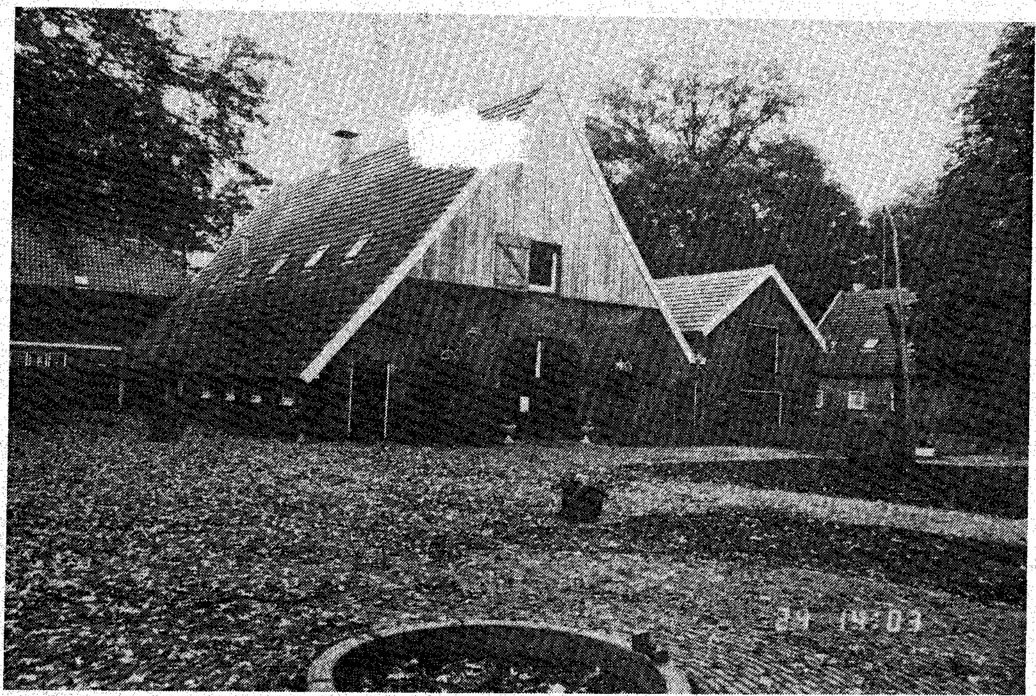
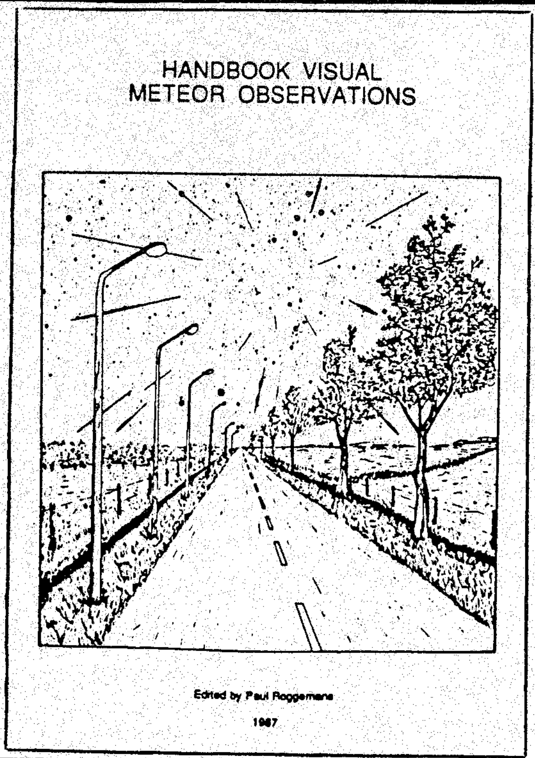


The International Meteor Weekend is *the* opportunity to meet your colleagues meteor observers from all over Europe, to hear about their work and to exchange with them your experiences and results. Do not miss this unique event! More information on pp. 206–208 of *WGN 15:6* (December 1987).

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