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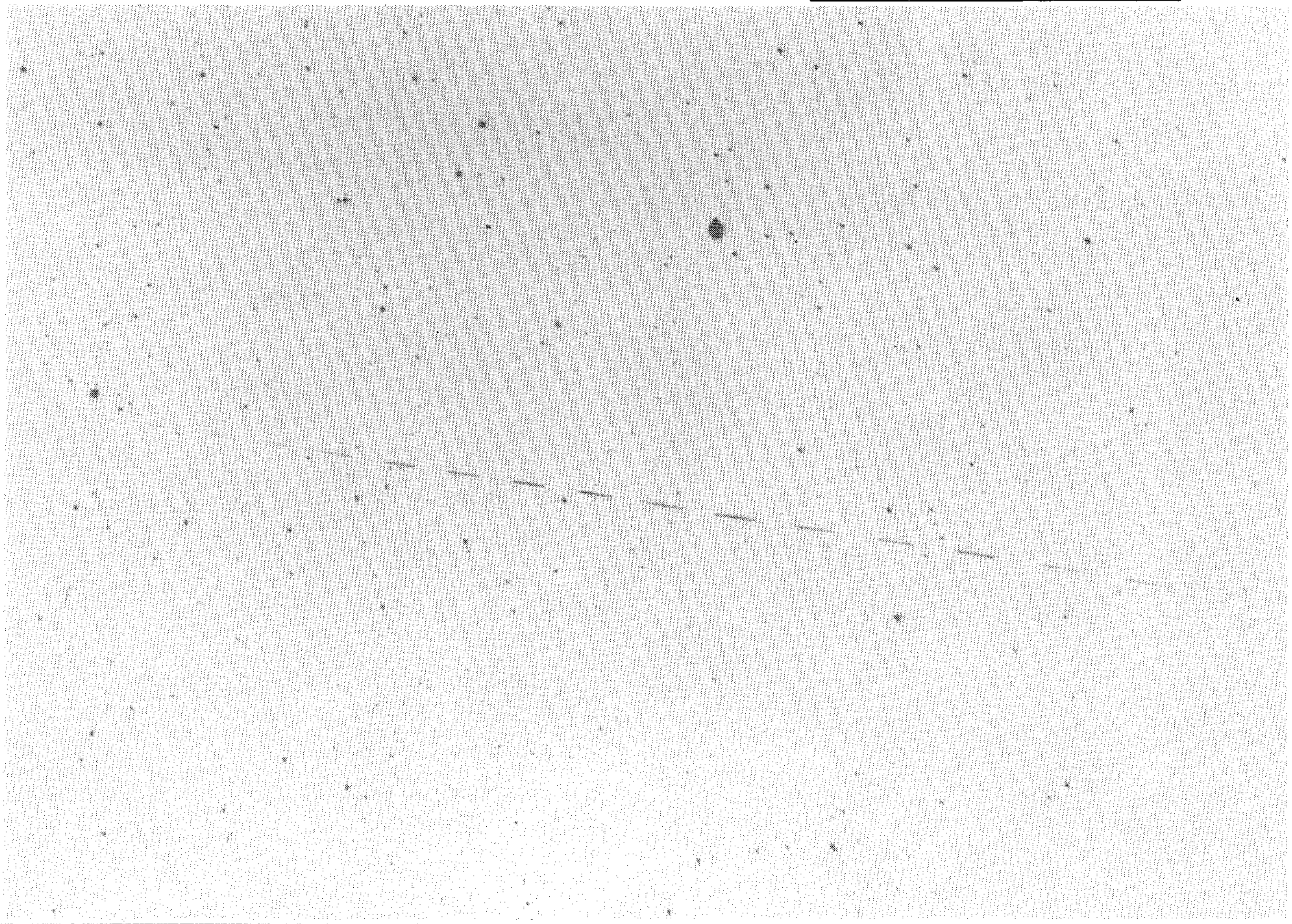

Perseid of magnitude −2 or −3 in Andromeda, photographed on August 12, 1989, between 23^h00^m and 23^h15^m UT, by S. Sposetti in Salorino, Switzerland. The film was Kodak TMAX-400 pushed to 1600 ASA, developed during 10 minutes at 20° C.

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

v.u.: Marc Gyssens, Heerbaan 74, B-2530 Boechout, Belgium

Afgiftekantoor: 2540 Hove

WGN, volume 18, nr 6, December 1990, pp. 191–216

Contents

Useful Information

The February Issue *(WGN 19:1)*

The *February issue* is expected to be mailed during the first week of February. Contributions are due *January 10*. They should be sent to *Marc Gyssens* or to any member of the editorial board (addresses: inside of back cover).

WGN Subscription/IMO Membership 1991

The subscription rate for volume 19 is 400 BEF for six issues. It is anticipated that volume 19 will contain over 240 pages. Subscriptions should be paid to Ina Rendtel, to Ann Schroyens or, for the USA and Canada, to Peter Brown, or, for Japan, to Masahiro Koseki (all addresses on the inside of back cover). Please make sure we retain the full amount due after deduction of bank and/or exchange charges. Therefore it is recommended to pay by international postal money order. Please refer to p. 168–169 of the October issue for further details. Additional gifts are of course welcome.

Administrative Correspondence

In principle, all payments should be addressed to Ina Rendtel or to Ann Schroyens. People from the United Kingdom can pay through Alastair McBeath; people from North America can pay through Peter Brown; and people from Japan can pay through Masahiro Koseki. However, *all* checks other than Eurocheques should be addressed to Peter Brown, including 2 USD for banking costs. Complaints about not receiving *WGN* or changes of address should be sent to Paul Roggemans. Al addresses can be found on the inside of the back cover.

From the Editor-in-Chief

Marc Gyssens

I am pleased that the audience of this journal widely responded to my call for more writing activity in the last issue's editorial. After a "silence" of almost three months, articles again arrive on a more regular basis. Unfortunately the article stream mainly resumed after the December issue's deadline. As a consequence, this issue exceptionally is a regular issue, bringing the total number of pages for volume 18 to 215, which is lower than we expected. However, we can already announce an extra thick February issue. Be sure not to miss this issue and pay your 1991 dues still this calendar year! As we try to keep the cost of this journal as low as possible, it is necessary to have a precise idea of the number of copies we have to print of the February issue, especially since it will be considerably more voluminous than usual. Your contribution to this in the form of an early payment would be greatly appreciated!

As far as major (northern hemisphere) fall showers are concerned, the (scattered) reports I heard about observing conditions from several places in Europe and America were not so favorable. I hope I will receive better news from other sites. In any case, keep monitoring the activity during this months! The Geminids present themselves favorably moon-wise, so let's hope that they do the same weather-wise. As usual, send your observations to the appropriate IMO commissions but do not forget to mail a summary to WGN! Other readers also like to get an early impression of what has been seen.

Finally, at the end of this year, just a few days before the start of the last decade of this century and indeed also of this millennium, I think we may look back with satisfaction. The IMO has become a well-established fact, despite the scepticism of some who did not believe it was possible. Particularly last year, the support from the professional community was considerably broadened and a large majority of professional meteor workers indeed see the IMO as a valuable interface between them and the amateur community. The International Meteor Weekend in Violau, then still West Germany, saw a very international gathering of amateur and professional meteor workers. The concerns expressed there by Dr. Ceplecha eventually led to end the vacancy existing already too long for the Photographic Commission. Dieter Heinlein was indeed prepared to manage this commission. It is my personal conviction (and not mine alone) that a more suitable candidate for this task could hardly be found!

However, more recognition, more members, more initiatives, etc. also require more work. The IMO is what the meteor community makes it to be. If meteor workers think of the IMO as something valuable for their scientific pursuits, they should realize that the IMO is not a kind of an "abstract" institution, but a living society, run by some of their colleagues who badly need reinforcement to share the workload. If you think you can help on a serious basis—the IMO needs reliable hard-working people wishing to give a high priority to international meteor work—do not hesitate and make yourself known to us!

So this is my main New Year's wish to the IMO: more people being prepared to share the loads of the organization. To all of you: happiness for you and your beloved ones, good health, many clear skies and good observations. For me: many articles and observational reports for WGN so that this journal can meet—and maybe surpass—the readers' expectations!

Call for photographs: We already received some new, spectacular photographs for the front cover, but we definitely need more of them. So, if you have a photograph suited for the front cover, please send us a print!

Please ...

Marc Gyssens

- **Do not longer postpone** membership or subscription renewal. We need as quickly as possible a fairly accurate estimate of the number of copies we have to print of the February issue. Also, running up and down to the post office to mail copies for late renewers is a waste of time for the already very busy *IMO* administration. Therefore, late renewers will receive the February issue only when the April issue will be sent out!
- **When you pay,** please follow the guidelines in the October issue, pp. 168–169. In particular note that checks other than Eurocheques can exclusively be cashed by Peter Brown, irrespective of where you live!
- **Maybe you know other interested meteor workers?** It is now the time to advise them to become a *WGN* subscriber or an *IMO* member. In such a case, you can even consider a joint payment to save on bank costs.
- **Another way to save on bank costs** is to combine your renewal with ordering other publications (see outside back cover of the October issue. Notice that both can be paid to the *same person*! If prices are not mentioned in the currency you want to pay with, you should convert at the rate of the day and allow something extra for bank costs of the addressee. Also, application forms for becoming an *IMO* member should be sent to the person to whom you pay your dues.
- **Do not send registered letters** to *IMO* responsibles. Registered letters are usually presented to these persons during office hours, when they are not at home. The registered letter is than kept at the post office for no longer than two weeks. If the addressee is on holidays, or if he is very busy during that period and does not find any spare time during office hours to go to the post office, the letter will be returned to the sender with a stamp "refused" or "not collected". It is our experience that ordinary letters almost never get lost. If you still have doubts about the quality of the mailing system, then it is better to make a copy of your letter before sending it. In the very unlikely case that your letter would not arrive, you still have another copy to send out!

From the IMO Administration

Paul Roggemans

1. Gifts from members and subscribers

The following people paid more than required for their 1990 membership or subscription. Their financial contribution helped a lot to finance the production of *WGN* this year. Gifts are welcome and help to keep the subscription low for those who cannot afford to pay more than 20 DEM. The donators were:

> Dirk Artoos, David Asher, Peter Brown, Gaetan Chevalier, Ivo Dielen, Kai Gaarder, Luc Gobin, Roberto Gorelli, Marc Gyssens, Teemu Hankamäki, Ichiro Hasegawa, Lars Trygve Heen, Trond Erik Hillestad, Jost Jahn, Klaas Jobse, Limburgse Volkssterrenwacht, Donald Olson, Duncan Olsson-Steel, Pekka Parviainen, Alan Pevec, Guillermo Enrique Rego Canedo, Paul Roggemans, Manfred Schank, Hans-Georg Schmidt, Ann Schroyens, Casper ter Kuile, Richard Taibi, Toshihiko Ueno, Cis Verbeeck, Jeff Wood.

2. Exchange of publications with currency controlled countries

Last year, several members paid an exchange subscription to *IMO*. We hope that everybody received the publications he or she expected. If you have not received what you ordered, please report such facts to the *IMO* Secretary-General. For 1991 the following arrangements are possible:

- *Czechoslovakia:* order the Brno Gnomonic Atlas (5 DEM) from IMO; every 4 copies sold cover the subscription of a Czech reader. Orders are booked by the *IMO* and copies have to be sent from Brno; this procedure may take up to 3 months. If you ordered an atlas and did not receive it in 3 months, please inform the Secretary-General. From some Slovak members we got volumes of the *Bulletin of the Astronomical Institutes of Czechoslavakia* for sale at 40 DEM per volume (25% of the commercial price). Ask the Secretary-General for availability.
- *Hungary:* order the Proceedings 1989 from IMO (12 DEM) and help our Hungarian friends to cover their subscriptions. Copies can be delivered by the newly-appointed *IMO* Treasurer Ina Rendtel as *IMO* has a small stock of these. People who wish to receive the Hungarian journal Meteor should arrange this with an Hungarian correspondent and pay 20 DEM to the *IMO* Treasurer to cover the subscription to *WGN* for this correspondent. *IMO* can assist you in contacting somebody.
- *former GDR:* all exchanges are canceled from January 1, 1991 onwards.
- *Other currency-controlled countries:* you can make donations for the *IMO* fund *Assistance to members from currency-controlled countries*, or you can help by paying for a specific person with whom you made an agreement for some exchange. If you want to obtain a specific publication, for instance Soviet astronomical journals, the Minor Planets Ephemerids 1991, 1992, etc, contact the Secretary-General who will try to arrange this exchange.

3. Complaints about not receiving ordered publications

- In general, we hear very little about complaints, but every now and then it may happen that parcels disappear or are destroyed in the mail. If you do not receive what you ordered from or through *IMO* in, say about three months after your order was placed, do not hesitate to contact us. Lost copies are freely replaced on condition that your payment had reached us.
- If you pay airmail-delivery and your copy reaches you by surface mail, please report this to us, although we have little control over postal activities.
- New members have to receive all copies of *WGN* that already appeared since the beginning of the year together with an introduction parcel consisting of some *IMO* booklets.
- It may happen that something goes wrong in our administration, due to misunderstandings, or because of unclear orders ... Sometimes we receive money without an indication for what or for whom!
- The October issue announced the availability of the *IMW 1988 Proceedings*. This should be read as the *IMW 1989 Proceedings*. We only have copies of the *IMW 1986* and the *IMW 1989* Proceedings.

4. Proposals to the General Assembly of IMO

We remind all *IMO* members that they can make proposals of all kinds according to the constitution of *IMO*. Such proposals have to be addressed to the *IMO* Council. If you got enough of a Council member you may propose to revoke him, or you may propose a new candidate for election as voting member as long as places are free in the Council. You can propose honorary or adherent members. In other words every voting member can make all kind of proposals. It has to be stressed that an official Call for Candidates for the Council will be made only 6 months before the end of the term of the current Council (early 1993), regardless the possible resignation of Council Members before that date.

People who would like to organize a future edition of the *IMO International Meteor Weekend*, should also make a detailed proposal to the council. The earliest year for which different proposals can still be considered is 1992. In case of several proposals for the same year, the proposals will be submitted to the voting members.

Letters to WGN

compiled by Marc Gyssens

About possible radio meteor activity from 1989 UR

In the October issue, Dirk Artoos wondered whether or not the Earth-grazing asteroid 1989 UR could have caused increased radio meteor activity around June 10. Jeroen Van Wassenhove and Christian Steyaert have another opinion.

In [1] the question is raised whether an increase of meteor reflections around June 10 could be due to the Earth-grazing asteroid 1989 UR. However, in June, several daylight showers are active.

It was during daylight hours of June 1946 [2] that the workers of Jodrell Bank found an increase of meteor activity. In the following years, they investigated this high activity and identified two large daylight meteor showers. The Arietids are the best known among radio observers. Their radiant [3] is located at $\alpha = 45°$ and $\delta = 23°$, and the shower has a maximum around June 7 (with a ZHR of approximately 60). The first Arietids appear on May 29, the last on June 19.

There are also the ζ-Perseids [3], which are detectable from June 1 to June 17. The radiant position is located at $\alpha = 62°$ and $\delta = 24°$. The maximum occurs around June 9, with a ZHR of about 40.

Hence the difference between the maxima of the Arietids and ζ-Perseids amounts to only two days, and, also, the radiants are rather close. Hence, these two streams are hard to separate by means of simple forward scatter counts.

The Observability Function [4] was calculated for both meteor showers for the location and time of the observation:

Table 1 – Observability functions for the Arietids and the ζ-Perseids at the location and time of the observation.

Arietids		ζ-Perseids	
Time(UT)	Obs. function	Time(UT)	Obs. function
12^h00^m	3673	12^h00^m	3246
13^h00^m	3436	13^h00^m	3688

As one can notice, the observing circumstances were very good during the time of observation (12^h15^m–12^h45^m UT) for both meteor showers. So the high activity reported on June 10 is almost certain due to the ζ-Perseids. It must be noted that the observations on June 8 (39 reflections, see also Figure 1) were hampered by Sporadic E. Sporadic E makes it difficult for the observer to identify meteor reflections, which can result in wrong identification and/or a great loss of meteor reflections. In Figure 1, the one standard deviation error bars (square root of the number) were indicated.

Earth grazing asteroids might rather be associated with larger fragments, such as fireballs or meteorite falls than with a wide stream of regular meteors.

One can safely conclude that the high increase reported on June 10 is due to the maximum of the ζ-Perseids and not due to the 1989 UR Earth-grazing asteroid. Yet, unbiased observations are essential in studying meteor streams.

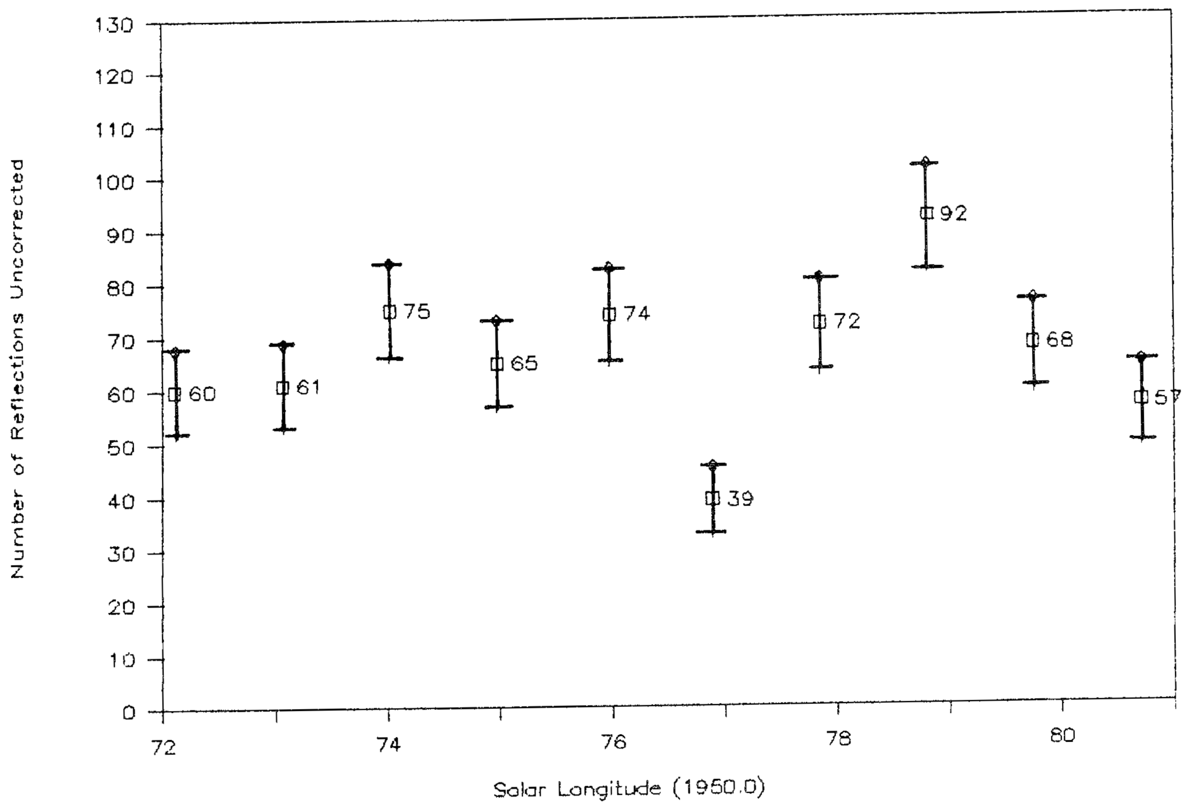

Figure 1 – Uncorrected numbers of reflections registered by Dirk Artoos, with standard deviations indicated.

[1] Dirk Artoos, "Call for Radio Observations: 1989 UR Again", *WGN* 18:5, October 1990, p. 184.
[2] A.C.B. Lovell, "Meteor Astronomy", Clarendon Press, Oxford, 1954.
[3] McKinley, "Meteor Science and Engineering", McGraw-Hill, 1961.
[4] Christian Steyaert, "Forward: A General Program for Calculating the Observability Function", *WGN 15:3*, June 1987, pp. 90–93.

Jeroen Van Wassenhove and Christian Steyaert

New IMO Publication

Photographic Astrometry

by Christian Steyaert

At the occasion of the 1990 *IMW* at Violau, the publication *Photographic Astrometry: Theory and Practice* (60 pp.) has been presented. It is available from IMO for 10 DEM, plus 3 DEM for the companion diskette (specify the format: $5\frac{1}{4}''$ or $3\frac{1}{2}''$). The price includes surface mail delivery and can be paid in the same way as a *WGN* subscription. In fact, if you have not yet renewed you can do the two things together!

The problem in the past with the *PMDB (Photographic Meteor Database)* has been the time consuming process of identifying reference stars and measuring the prints and/or negatives. This activity cannot be maintained centrally. Moreover, measurements done by the photographer himself were often error prone. The most important sources of errors are:

- *Wrong identification of reference stars.* Most exposures of meteor photographs are non-guided and hence trailed. Also the photographs or negatives are on a different scale from an atlas. In the vicinity of the boundaries of two constellations, sometimes the wrong constellation is indicated.
- *Wrong reference star taken from the catalogue.* This happens e.g. when a greek letter was not clearly written on the exposure.
- *Read-off error.* In using a normal ruler, as is often done in measuring prints, digits are sometimes mixed up, e.g. 152.3 mm instead of 157.3 mm (half centimeter division wrong) or 159.0 mm instead of 150.9 mm.
- *Exposure time.* In the case of non-guided exposures, both the starting and ending point are measured. The difference in right ascension between these two points is nothing but the exposure time. Unfortunately, often errors of up to a few minutes are found. This decreases of course the value of the exposure for a simultaneous trajectory calculation.

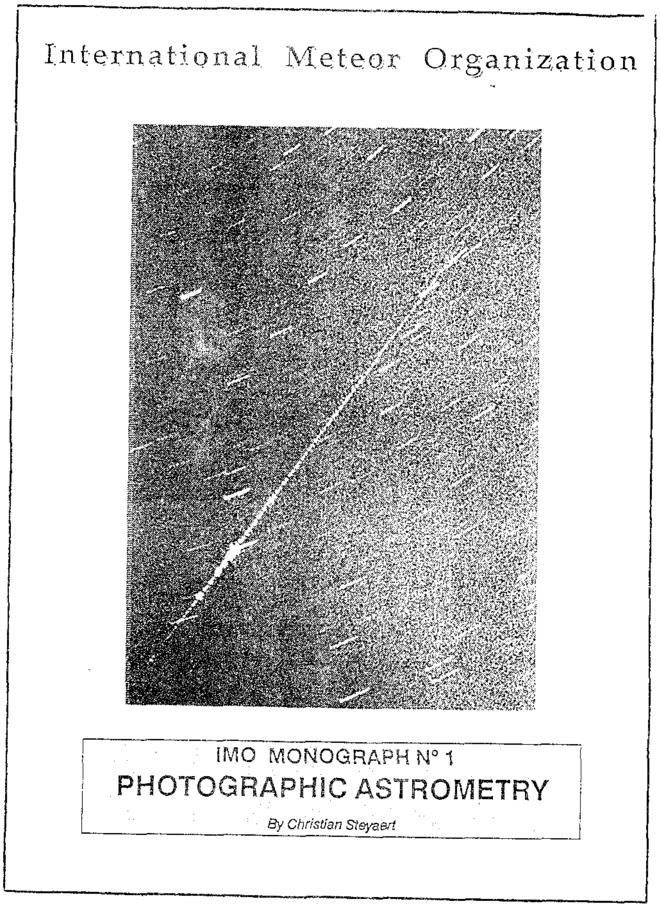

Figure 1 — Photographic Astrometry

Therefore it seems more meaningful to have the calculations also done by the photographer. In this way, the errors can be detected and corrected at the source.

The companion diskette of *Photographic Astrometry* allows for this. It contains both the data entry program in the *PMDB* format, and a separate calculation program. The Becvar catalogue is also supplied on it.

Tamas Zalazak, Hungary, volunteered to test the programs. He added the measurements of 255 negatives of MMTEH, most of very good quality. Occasionally, there was a problem with negatives measured in mirror image. This type of error is easily detected.

Based on this positive experience, the *PMDB* will only be complemented with measured exposures supplied to the author in the dBASE III file format, of the companion diskette.

The data can also be transferred by electronic mail to:

Astromail, BRETT IMO/METEORE, tel (49)58517896, operating at 1200 or 2400 bps

or to:

Chris_Steyaert@f20.n295.z2.Fidonet.org

Comments for Visual Observers

Ralf Koschack

1. Introduction

Since the publication of the latest edition of the *IMO Handbook for Visual Meteor Observations*, visual work has developed a lot. As a consequence, several chapters now need to be updated. I can announce that a new edition of the Handbook is under preparation. Probably, it will be published in early 1992.

Meanwhile, the Workshop of the Visual Commission at the latest *IMW* as well as my correspondence show the necessity of clarifying several important points as soon as possible. Please take into account the following comments in observing and in reporting your observations.

2. On the use of the Atlas Brno

IMO observers having bought this atlas have got the permission of the author, V. Znojil, to make photocopies for their own observations. Since there are currently no better charts for meteor plotting, observers should use this possibility.

For reporting positional data, it is important that the scale of the charts remains unchanged. This means that the distances between the thin crosses has to be 70 mm. Photocopy devices often tend to change the original scale. Therefore, use the *originals* you bought whenever you are going to make copies. Otherwise you add the errors. If the scale error exceeds 3 mm over the whole length of the chart (this means the distance between the thin reference lines differs by more than 3 mm from 280 mm for the short side or/and 350 mm for the long one) you should use an other device.

The origin for the X,Y-coordinates is located in the bottom left corner of the chart (X-axis to the right, Y-axis upwards). The reference lines are the *thin* ones, not the thick lines. In order to minimize the influence of the remaining scale errors all *coordinates of one meteor* have to be measured using the *same coordinate lines*.

As an example, suppose that on map 4, you want to measure the X,Y-coordinates of two meteors. The first one was plotted near the bottom left corner, the other one in the upper right corner. For the fist one it is opportune to measure with respect to the left vertical reference line and the bottom horizontal line. For the second meteor, it would be useful to measure with respect to the right vertical line (and to subtract the result from 280 mm to obtain the X-coordinates) and the upper horizontal line (and to subtract the result from 350 mm to obtain the Y-coordinates), to avoid measuring long distances. In both cases, the measuring procedure is correct since both coordinates of the beginning and the ending point refer to the same coordinate lines. For meteors plotted in the middle of the chart it seems possible to measure e.g. the X-coordinate of the beginning point from the left line and that of the ending point from the right one. In our first two examples, a small scale error results in a small parallel shift of the path which plays little or no role. In the third example, however, the same small scale error results in a *tilt* of the path which must be avoided.

3. What is a good quality observation?

Not every visual observation can be used for serious analyses. If the circumstances were too bad, the results obtained from the affected observation are uncertain. The incorporation of both certain and uncertain results was a general problem of amateur work in the past that reduced the value of analyses. In order to overcome this problem in the future, it was agreed within *IMO* to use only observations meeting certain criteria for further analyses. In the workshop at 1990 *IMW* the question arose which observations should be reported to *VMDB*. The following criteria should be considered as rough guidelines. Especially around the maxima of major showers, it can become necessary to use also observations carried out under less favorable conditions for analyses. Criteria for "regular" observations are:

- limiting magnitude about 5.0 or better;
- field correction factor $F < 1.1$. As soon as more than 20% of the field is covered, take a break or discard the affected interval;
- the elevation of the center of the field of view should be at least 40°. Anything between 50° and 60° is optimal;
- the effective observing time should be at least 1.00 hours. Never report intervals shorter than 1.00 hours effective time! If you have e.g. an observation of 4.5 hours do *not* report three intervals of 2.0, 2.0 and 0.5 hours, respectively. In this case, you should report two intervals (e.g. 2.0 and 2.5 hours).

4. On the determination of the limiting magnitude

The darker and more transparent the sky and the better your eyes, the more meteors you can see. To use your observations for scientific analyses, a quantitative characterization of these factors has to be given. The limiting magnitude, which is defined to be the magnitude of the faintest star the observer can detect by his naked eyes in the zenith, characterizes both the quality of the sky and the quality of the observer's eyes. Please note that the limiting magnitude is an *observer-related* quantity. Do not be puzzled if other observers at the same site obtain other limiting magnitudes than you. This is the rule rather than the exception. Take anyway your own values!

Most observers use the method of counting the number of stars visible in certain areas in the sky [1]. Do not increase your attention artificially when obtaining limiting magnitudes since it should characterize the average state during your observation. Do not interrupt the watch to determine the limiting magnitude, obtain it during the observation at the beginning and then each 30–45 minutes even if there is no considerable change. In this way you reduce random errors of the procedure.

The limiting magnitude refers to the zenith. But looking at an extinction table, you will find out that extinction is about 0.12 magnitudes at 40° elevation, which is a bit less than the certainty of the method. Therefore, you can use fields having at least 40° elevation and should prefer fields in your observing direction. Anyway, extinction tables refer to transparent air. If there is some haze or fog, extinction will be stronger than mentioned in the table. Looking at 50–60° elevation and determining the limiting magnitude in the same range you will obtain a lower value than in the zenith. But that is no error, that is quite correct: The analyzing procedures [2] base on the extinction for transparent air. If you give the limiting magnitude for the zenith, the actual decrease towards the horizon is stronger than assumed by the analyzing procedure. Giving the somewhat lower limiting magnitude determined at lower elevations, the actual conditions are taken into account in some extent as long as you look higher than at 40° elevation.

You should use at least two, better is three fields, for each determination of the limiting magnitude. This is due to random errors and to the "gaps" in the conversion tables (e.g. in between 5.3 and 6.0 at field 1). If you determined a limiting magnitude of e.g 5.8 in two other fields and 5.3 in field 1 (since the star of magnitude 6.0 is still invisible at a limiting magnitude of 5.8), you can discard the value 5.3 determined in field 1. The calculation of the mean limiting magnitude has to be carried out as outlined in [1].

References

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

[2] Koschack R., Rendtel J., "Determination of Spatial Number Densities and Mass Index from Visual Meteor Observations (I)", *WGN* 18:2, April 1990, pp. 44–58.

Visual Meteor Database Statistics and Comparison between 1988 and 1989

Paul Roggemans

1. Introduction

While observing during a cold winter night, when the freezing air makes you feel uncomfortable to persist, you may have wondered why you should go on with observing. Waiting another 10 minutes to see the next first meteor or quit and enter into the warm house? But who else will be observing on Earth if you quit? Is it so obvious that some other observers will watch the sky?

After two full years of data collecting within the *Visual Meteor Database (VMDB)*, it turns out that amateur efforts at a global scale still need many more volunteers. With this article, I would like to show you the impressive totals of observing effort the *IMO* could obtain, but, even more, I would like to stress that there are still many more "fanatic" observers needed to get a complete coverage of the meteor activity on a permanent basis.

Meteor observing can be done in a serious way and yet remain pleasant at the same time. Some amateurs have a poor conception of observations with scientific value. Indeed, some effort is of course unavoidable to produce valuable observations. For instance, the sky with its constellations, star positions and star brightnesses must be very well memorized by the observer. This requirement is often underestimated. Some regular practice is also necessary, otherwise the observation will be disturbed by doubts that arise when the observer is making estimates. However, the fact that some effort is required is not at all in contradiction with the aim of finding satisfaction in observing. Serious meteor observing compares well to sports where training, experience and perseverance are the key words. When we compare meteor observing to sports, we can think about competition and, while an organized competition in *IMO* would not be helpful to improve the quality of the work done, it can at least give some ideas about our most active observers.

Readers who ordered the Report 1988 will have found a lot of statistical data about 1988. Since also the 1989 Report is about ready to go in print, the two years can now be compared.

2. IMO totals : never seen before

Some measures to represent the efforts done by an organization such as the *IMO* are e.g. the total effective observing time spent and the total number of meteors reported. For 1988 and 1989, just 600 different observers contributed to the *VMDB*. The grand totals for these years are:

Table 1 – *VMDB* Grand totals for 1988 and 1989.

	1988	1989
Effective observing hours	5742.59	5213.05
Number of meteors	113451	84631
Number of observers	346	414
Calendar dates covered	262	292
Countries represented	17	21

The effective observing time is the time that the sky was actually watched. The total amount of time spent on these observations is even much more. It is also to be remembered that only observations that are compatible with the *IMO* standards are included. There are still several groups that use different methods which are not accepted by the *IMO*. The importance of the efforts displayed in Table 1 would be even more impressive if expressed in USD as a paid American salary!

The number of meteors strongly depends on the luck with major stream maxima. In 1989, both the Perseids and the Geminids were spoiled by moonlight. Anyhow, no meteor society on Earth has ever before been successful to bring every year data on about 100 000 meteors together! The number of observers is not very meaningful. *IMO* is not meant for casual observers and despite this, many such casual observers send in data. Their total contribution is rather small.

The number of calendar dates covered shows that *IMO* had no observers working during 73 calendar days in 1989: mostly around full moon, of course. It is important not to restrict observing to major shower maxima. Meteor activity requires a never ending attention. It is useful to look at the observing efforts throughout the year:

Table 2 – Meteor observing per month in 1988 and 1989

	1988		1989	
Month	$T_{\rm eff}$	N	$T_{\rm eff}$	N
January	$124^h.56$	1411	$413^h.71$	6106
February	$150^h.78$	1464	$204^h.57$	1922
March	$94^h.74$	567	$200^h.13$	1303
April	$316^h.06$	3725	$232^h.44$	2101
May	$183^h.37$	2439	$322^h.86$	6784
June	$88^h.69$	669	$129^h.68$	934
July	$440^h.11$	4526	$476^h.64$	6781
August	$2868^h.54$	70416	$1921^h.52$	46014
September	$216^h.04$	2955	$256^h.41$	1935
October	$274^h.35$	2924	$401^h.76$	3962
November	$485^h.69$	6147	$371^h.78$	3274
December	$499^h.66$	16208	$281^h.55$	3515

It is most encouraging to see the efforts spread out over the year in 1989. It is also clear that June is poorly covered, despite the longer nights at the southern hemisphere. Any clear night that occurs away from meteor stream maxima should be used. The *IMO* strongly encourages to observe regularly throughout the year!

Some days were really rewarding when we look at the contributions per calendar date. Let us look first at the days with the largest number of meteors reported in 24 hours:

Table 3 – Days with the largest numbers of meteors reported in 24 hours for 1988 and 1989.

Date	1988	Date	1988
Aug 12	14935 (418^h)	Aug 12	11992 (324^h)
Aug 11	13226 (382^h)	Aug 13	6318 (165^h)
Aug 13	9720 (290^h)	Jan 03	3464 (192^h)
Dec 13	6991 (120^h)	Aug 11	3335 (133^h)
Aug 10	5153 (267^h)	Aug 05	2814 (162^h)

The top 5 of success days depends mainly on the number of observers who worked that night.

The Perseid maximum is still the most attractive event it seems. December 13 is much more impressive as far as meteor activity is concerned, but most observers do not make an effort on this date. It is most encouraging to see that 1989 January 3 was one of 1989 most successful days for both effective observing time spent and the total number of meteors reported.

3. The 1988–1989 Meteor Competition

If the question "Which country contributes most to visual meteor observing" is forwarded to astronomers these days, it is very likely they say Great Britain, thinking back to Denning, or the USA thinking back to C.P. Olivier. These people published in well known astronomical series and created a good reputation which held for a long time. Amateur meteor work got poorly organized since the fifties, when observing work was done in small groups per country with as many different methods as there were countries. Reports from the period 1945 to the end of the seventies show few observers and small numbers of meteors, in the order of hundreds. The statistical value of the reports from these years was very small.

At the end of the sixties, the BAA Meteor Section Director Keith Hindley set up an International Data Center. It was not really an international event, but rather an initiative of the BAA Meteor Section. It led to a few analyses of meteor streams in the BAA Journal. As Keith Hindley stood alone to handle all the work, the Center disappeared already after a few years without affecting the meteor observers' community a lot. Most typical for this period is that rather little correspondence was maintained among the observers and that a strong tendency existed to concentrate the rather small groups strictly around national societies.

Only at the end of the seventies, when the current generation of meteor workers got in contact with each other, a new climate was created. What happened in the past ten years finally led to our current *IMO*. Today, there is an intense correspondence and exchange between meteor workers worldwide, but to the outside world it still seems not very clear who delivers the most important contributions to meteor astronomy these years. Indeed, it suffices to look in astronomical publications of the past 10 years: the Australian and East German efforts in meteor observing are almost totally neglected!

Table 4 – Observing efforts per country for 1988 and 1989.

1988			1989		
Country	Obs.	Meteors	Country	Obs.	Meteors
GDR	19	31947	GDR	20	21304
Australia	48	17171	Australia	72	15982
Belgium	75	14450	Hungary	109	7413
Hungary	82	12286	Japan	41	7271
USA	21	7509	Belgium	43	6382
Malta	27	6828	Spain	9	4180
Spain	8	6333	Yugoslavia	18	3390
Norway	6	4487	USA	19	3311
Italy	28	3760	FRG	11	2260
the Netherlands	5	2561	Italy	23	2121
FRG	6	1993	USSR	4	2086
UK	5	1488	Finland	12	1987
Canada	1	965	UK	4	1711
Finland	12	878	Norway	8	1613
France	1	529	the Netherlands	3	968
Bolivia	1	178	Brazil	7	915
Rumania	1	88	Canada	1	730
			France	3	725
			Rumania	2	117
			Hong Kong	1	85
			China	1	35

Well, which country made the biggest contribution in 1988 and 1989? The *IMO* negotiates with all groups for which we know about observing efforts. About all observers reacted positively on the invitation to send reports to the *IMO*. As you can see, some more countries joined in 1989.

So far, only a few British observers refused explicitly to make their observations available to the *IMO*. Apparently, not everybody is ready to cooperate in a truly international spirit!

Assuming that the overall majority of meteor observations reached the *IMO*, the efforts per country are as in Table 4. The GDR, the most productive country meteor-wise, disappeared on October 3, 1990. The GDR and its "little" brother, the FRG, will be counted as one country, Germany, in these statistics. From these as well as previous years it is clear that Germany and Australia are distinct leaders what visual observations are concerned. It seems not to be very important that the country is large. For instance, there are no where on Earth more amateur "astronomers" as in the USA. The most important factor is the presence of at least one person who is much dedicated to meteor observing. Somebody who observes very much and who takes the initiative to make his work and efforts known to friends will easily excite more people. This process takes some years and if experience can be gathered in a climate of enthusiasm and good understanding, groups of 10, 20 or more observers can obtain high quality results that amaze the rest of the world. When the leading person disappears, it is quite possible that everything disappears in few years time. When C.P. Olivier quited his work, there was nobody with his qualities or enthusiasm to take over. American media also explore astronomy at a ridiculous level, in the name of popularization, which is not in favor of a research minded amateur community. In some countries there is a lack of leadership, and when there is really not a single enthusiastic observing "motor", it is difficult to get anything from ground. At this point, the *IMO* is helpful. It is very important that readers from around the world can taste the enthusiasm for observing from *WGN* and other *IMO* publications. Personal encouragement from the *IMO* responsibles is a must and can overcome the lack of such stimuli from local meteor workers.

Table 5 – Top 20 of meteor observers for 1988 and 1989 combined.

Nr.	Observer	Country	$T_{\rm eff}$	N
1.	Jürgen Rendtel	GDR	$494^{h}.82$	7909
2.	André Knöfel	GDR	$459^{h}.17$	7562
3.	José Trigo	Spain	$260^{h}.59$	5080
4.	George Platt	Australia	$242^{h}.57$	4926
5.	Jeff Wood	Australia	$234^{h}.15$	6948
6.	Ghislain Plesier	Belgium	$233^{h}.83$	2042
7.	Ralf Koschack	GDR	$218^{h}.28$	11314
8.	Rainer Arlt	GDR	$216^{h}.28$	5161
9.	Mark Glossop	Australia	$213^{h}.55$	4250
10.	Ina Rendtel	GDR	$196^{h}.52$	7503
11.	Paul Roggemans	Belgium	$190^{h}.69$	4118
12.	Alastair McBeath	UK	$144^{h}.58$	1230
13.	Richard Taibi	USA	$142^{h}.18$	1200
14.	Adam Marsch	Australia	$137^{h}.46$	1129
15.	Ralf Kuschnik	GDR	$123^{h}.59$	2597
16.	Francis Plesier	France	$112^{h}.92$	1073
17.	Martin Coroneos	Australia	$112^{h}.67$	2651
18.	Gabor Mori	Hungary	$111^{h}.99$	525
19.	Leo Rajala	Finland	$109^{h}.58$	1846
20.	Robert Lunsford	USA	$105^{h}.11$	3486

Every year, the *IMO* Observing Report gives the total number of observing hours and meteors seen per observer. In these reports you have the world top 20 of visual meteor observers, valid for one year. One observer may do a big effort in one year and nothing in the next. Therefore, it is useful to maintain totals for all observers over a period of more than one year. This is not just some competition for fun, but it is useful information about the experience of the observers. These statistics are available for 1988 and 1989 together and from the 600 participants we reproduce the top 20 only as these people really distinguish themselves. Some may be against this kind of publication and say it is socialist propaganda material for the comrades ... maybe one gets a medal for it sooner or later ... Anyhow, it is not bad to mention the most active observers and everybody is free to observe more to see his or her name appear in this top 20. They are shown in Table 5.

4. Conclusion

As you can see, the *VMDB* has been well enriched with data last year. The analysis programs were improved, and, in 1991, new articles may be expected with analyses of shower data. Observers have to be a bit patient to see such results as it takes a lot of time to collect data from around the world. Often, problems with reports must be solved through the mail and that takes also time. For 1990, data are being entered now as reports from the first months of 1990 arrived for input. You can help us by sending your report as complete and as compatible as possible to the *VMDB* format. Read the instructions of the Visual Commission carefully and please avoid modifications of your own. Your work is used and several analyses may be done, even many years after the observations!

Keep observing, and do not forget we wait for your response!

Visual Observers' Notes: January and February 1991

Jeff Wood

After the rich month of December, the often low rates together with the fact that it is winter in the northern hemisphere tends to turn meteor workers away from observing at this time of the year. However despite this, there are plenty of things to be seen by the diligent observer.

Table 1 – Some of the meteor showers to be seen in January and February 1991.

Shower	Activity	Max	Radiant			Drift		V_∞	r	ZHR
			α	δ	Diam.	$\Delta\alpha$	$\Delta\delta$			
Puppid/Velids	Oct 15–Jan 22	several	120°	−45°	20°/5°			40	2.9	12
Coma Berenicids	Dec 12–Jan 23	Dec 17	175°	+25°	5°	+0°.8	−0°.2	65	3.0	5
Quadrantids	Jan 01–Jan 05	Jan 03	230°	+49°	5°	+0°.8	−0°.2	41	2.1	110
δ-Cancrids	Jan 05–Jan 24	Jan 16	130°	+20°	10°/5°	+0°.9	−0°.1	28	3.0	5
α-Crucids	Jan 06–Jan 28	Jan 19	192°	−63°	10°/5°	+1°.1	−0°.2	50	2.9	5
α-Carinids	Jan 24–Feb 09	Jan 31	95°	−54°	5°			25	2.5	
δ-Leonids	Feb 05–Mar 19	Feb 26	159°	+19°	8°			23	3.0	
Virginids	Feb 01–May 30	several	195°	−04°	15°/10°			30	3.0	5
θ-Centaurids	Jan 23–Mar 12	Feb 01	210°	−40°	6°	+1°.1	−0°.2	60	2.6	
α-Centaurids	Jan 28–Feb 21	Feb 07	210°	−59°	4°	+1°.2	−0°.3	56	2.0	25+
o-Centaurids	Jan 31–Feb 19	Feb 11	177°	−56°	6°	+1°.0	−0°.3	51	2.8	
γ-Normids	Feb 25–Mar 22	Mar 14	249°	−51°	5°	+1°.1	+0°.1	56	2.4	8

Table 2 shows moonlight and observing conditions. 2The illuminated part of the Moon is always given for 0^h UT on the date indicated. The dates of the phases of the Moon are also given in UT.

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

Table 2 – Moonlight and observing conditions in January–February 1991.

Date	k	Date	k
Friday December 28	0.80+	Friday February 01	0.96–
Friday January 04	0.86–	Friday February 08	0.37–
Friday January 11	0.21–	Friday February 15	0.00+
Friday January 18	0.04+	Friday February 22	0.51+
Friday January 25	0.66+	Friday March 01	1.00–

New Moon:	January 15, February 14, March 16
First Quarter:	December 25, January 23, Febuary 21
Full Moon:	December 31, January 30, February 28
Last Quarter:	January 7, February 6, March 8

1. Coma Berenicids

This shower is active from December 12 through January 23. Although the maximum occurs on December 17, rates are still moderate during January. The Coma Berenicids are best seen during the last few hours before sunrise from the northern hemisphere. They are fast meteors with a $V_\infty = 65$ km/s. Observers should have their field center situated no further than 30° from the radiant. All possible Coma Berenicid meteors should be plotted.

Table 3 – Radiant positions of the Coma Berenicids.

Date	α	δ
Jan 06	191°	+19°
Jan 11	195°	+18°
Jan 16	199°	+16°
Jan 21	203°	+15°

2. δ-Cancrids

The δ-Cancrids are active from January 5 to 24 with a maximum ZHR of about 5 meteors per hour on January 14. This ecliptical shower has a complex radiant structure, hence the radiant size of $\alpha = 10° \times \delta = 5°$. With very favorable Moon conditions, this shower is a must for all observers. Meteor workers should center their field of view no further than 30° from the radiant and plot all possible δ-Cancrids seen.

Table 4 – Radiant positions of the δ-Cancrids.

Date	α	δ
Jan 05	122°	+21°
Jan 10	126°	+20°
Jan 14	130°	+20°
Jan 19	135°	+20°
Jan 24	139°	+19°

3. Quadrantids

Named after the now defunct constellation Quadrans Muralis, the Quadrantids are the first major shower to occur each year. They are active from January 1 to 5 with a maximum ZHR of around 100 occurring on the morning of Jan 4 at 6^h UT. The Quadrantids are fastish meteors ($V_\infty = 41$ km/s) which radiate from $\alpha = 230°$ and $\delta = +49°$. Their radiant diameter is 5°. They are best observed from the northern hemisphere in the last few hours before sunrise. With a Full Moon on December 31, they are not a good viewing in 1991.

4. δ-Leonids

The δ-Leonids are thought to be possibly related to the minor planet 1987 SY and so a top priority of the *IMO* is to investigate the activity of this shower to see if this is indeed the case. Despite some interference from the Moon at and just after maximum, much of their activity period can be observed in dark skies. δ-Leonid meteors are of average brightness, slow in speed ($V_\infty = 23$ km/s) with a very few leaving a train. Since there are numerous sporadic meteors as well as the Virginid Meteors Shower occurring in the vicinity of the δ-Leonid radiant area, great care needs to be taken in identifying them. Observers should center their fields of view around $\alpha = 180°$ and $\delta = +20°$ or $\alpha = 160°$ and $\delta = 0°$. As the δ-Leonids are few in number, all should be plotted. Meteors coming from the radiant area should only be classified as δ-Leonids if their path lengths and their angular velocity are appropriate.

Table 5 – Radiant positions of the δ-Leonids (diam. = 8°).

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

5. Virginids

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

IMO would appreciate your efforts to monitor this shower in 1991. Intending observers should locate their center of field of view no more than 40° away from the radiant and should plot all meteors seen. Since the "Virginids" have a velocity typical of the sporadic background and also come from a large radiant area, careful attention to path length and angular velocity should be given before classifying a meteor as a "Virginid".

Table 6 – Virginid complex radiant center motion.

Date	α	δ	Date	α	δ	Date	α	δ	Date	α	δ
Feb 03	159°	+15°	Mar 05	182°	+01°	Apr 04	200°	−06°	May 04	211°	−11°
13	167°	+09	15	189°	−02°	14	204°	−08°	14	214°	−12°
23	174°	+05	25	195°	−04°	24	208°	−09°	24	217°	−13°

6. α-Crucids

The α-Crucids are active from January 6 through to 28. With a radiant occurring near the Southern Cross this southern hemisphere stream has very little interference from the Moon in 1991. The α-Crucids have a complex activity period with several sub-maxima occurring on or around January 12, 15, 19 and 24. The January 19 peak seems to be the greatest when the ZHR can reach upward of 5. α-Crucid meteors are fastish and often colored. Since they have relatively low rates, all possible α-Crucids should be plotted. Observers should center their fields around $\alpha = 160°$ and $\delta = -55°$ so that both the tail of the Puppid/Velids and the α-Crucids may be monitored simultaneously.

Table 7 – Radiant positions of the α-Crucids.

Date	α	δ	Date	α	δ
Jan 06	178°	−60°	Jan 19	192°	−63°
Jan 11	183°	−61°	Jan 24	198°	−64°
Jan 16	189°	−62°	Jan 28	202°	−65°

7. θ-Centaurids

This shower has a very complex radiant structure and is active from January 23 to March 12. With the complex radiant structure also comes a complex activity period with several sub-maxima. The main ones seem to occur on or around February 3, 21 and 26 with a peak ZHR of between 7 and 10 meteors per hour. θ-Centaurid meteors are fast and often leave a train. They are also noted for producing fireballs of a lemon yellow or greenish hue. They are best seen in the morning hours from the southern hemisphere. Observers should center their field of view around $\alpha = 200°$ and $\delta = -50°$ to aid in separating the θ-Centaurids from the other two Centaurid showers that occur at a similar time in mid February. In late February and mid March, the observer's field should be centered around $\alpha = 200°$ and $\delta = -20°$ so that the θ-Centaurids and the Virginids can both be monitored. All possible θ-Centaurids should be plotted.

Table 8 – Radiant positions of the θ-Centaurids.

Date	α	δ	Date	α	δ
Jan 23	185°	−37°	Feb 20	209°	−40°
Jan 31	192°	−38°	Feb 28	213°	−41°
Feb 10	202°	−39°	Mar 12	222°	−43°

8. α-Centaurids

The α-Centaurids produce a good display of meteors each year for southern hemisphere observers. They are active from January 28 through to February 21 with a sharp maximum on February 8. For most of their period of activity ZHRs range between 1 and 3 meteors per hour, but at maximum rates generally rise to between 5 and 10 meteors per hour. Every 4 to 6 years, the maximum activity seems to be greatly enhanced and on two notable occasions in 1974 and 1980, rates exceeded 25 per hour. Always this enhancement has been short-lived lasting no more than 2–3 hours.

The α-Centaurids are fast meteors which are noted for their brightly colored fireballs. Many α-Centaurids also leave a train. In 1991 the pre-maximum and the maximum period experience some interference from the Moon. Despite this, observers are encouraged to get out and watch from February 7 to 9 to see if any rate enhancement occurs at maximum. Post maximum, the

α-Centaurids can be observed in dark skies during mid to late evening. If ZHRs are less than 10, then all possible α-Centaurids must be plotted. If ZHRs exceed 10, then they may be recorded in the manner of the major showers. To avoid confusion with the other Centaurid showers, observers should watch for the α-Centaurids with a field center at $\alpha = 200°$ and $\delta = -50°$.

Table 9 – Radiant positions of the α-Centaurids.

Date	α	δ	Date	α	δ
Jan 28	197°	−56°	Feb 13	215°	−60°
Feb 03	203°	−58°	Feb 18	221°	−62°
Feb 08	209°	−59°	Feb 23	227°	−63°

9. o-Centaurids

The o-Centaurids are a minor shower that occurs during a similar time to the other two February Centaurid showers. The o-Centaurids are active from January 31 through to February 19 with a maximum ZHR of about 5 meteors per hour occurring on February 12. The o-Centaurids are visible only from the southern hemisphere and can be seen in dark skies during the late evening hours pre maximum. Post maximum, the Moon has waned sufficiently for the shower to be observed most of the night. The o-Centaurids are fast meteors. Observers should plot all possible o-Centaurids seen. To aid identification, their center of field of view should be located at $\alpha = 200°$ and $\delta = -50°$.

Table 10 – Radiant positions of the o-Centaurids.

Date	α	δ
Jan 31	165°	−52°
Feb 06	171°	−54°
Feb 12	177°	−56°
Feb 18	183°	−58°

Telescopic Observers' Notes: January–February 1991

Malcolm J. Currie

In the northern hemisphere we enter the coldest part of the year and it is not surprising that many observers prefer to stay indoors. Yet there are many showers that are known to be particularly active at faint magnitudes, and there are undoubtedly unknown but observable radiants present. I should urge all telescopic observers to make watches at this time; even if you can only make a couple on a given night over a number of years a more-complete picture will emerge of the meteor activity during the period. Strong interference from moonlight will prevent watches of the only major shower of the period—the Quadrantids.

During January there are several ecliptic showers, with typically long durations of many weeks giving weak activity. Some cases are believed to have multiple radiants—also a characteristic of low-inclination streams. Telescopic and video techniques appear the only way of resolving the component showers. All have maxima or good rates around the new-moon period in 1991, so observers both north and south of the equator have a fine opportunity to increase our knowledge of the complex behavior.

Recently, the most-active of the January ecliptic complex has been the *α-Leonid* shower. According to Kronk [1] it is a long-duration telescopic shower certainly persisting through the latter part of January and probably through the whole of the month. The 1990 reports I received tend to support this view, but the data scanty. Activity greater than the sporadic background has been observed as early as $\lambda_\odot = 291°$ from $\alpha = 140°$ and $\delta = +17°$. The duration, time of maximum and characteristics of this shower remain to be determined. The radiant position near the ecliptic makes it observable from the warmer climes in the southern hemisphere.

Next on the menu we have the *δ-Cancrids*. This minor stream is particularly well-suited to telescopic observations, as it has a large, complex area of radiation which probably comprises several sub-centers. Ostensibly, this ought to be a good telescopic shower ($r = 3.0$ visually) though in recent times it has not been clearly identified with 125-mm telescope observations. If r is a function of magnitude, watches with small binoculars would be of particular interest. The radiant is above the horizon for virtually the whole night. The *α-Hydrids* are active during the latter part of January. In 1990 they gave rates about half the sporadic background emanating from several degrees north-west of the nominal visual radiant.

There is some complex activity in the Leo Minor and Coma region during January *(cfr. last year's notes [3] for more details)*. A series of telescopic watches by several observers should resolve the components or determine if there is but a single shower. In 1989 radio observers recorded a short, but strong burst of faint-meteor activity at $\lambda_\odot = 302\overset{\circ}{.}23$ [4]. Given the time of night, the most likely radiants are in this region. If repeated in 1991, activity is expected at January 22.6. Observers in Japan and western USA and Canada are urged to look for any strong telescopic activity and to determine its source.

The number, proximity and distribution of the above radiants makes the selection of field centers difficult. An ideal scheme is to select a series around Cancer, the head of Leo, Gemini and northern Hydra to provide good coverage. More practically, I would suggest the following for all the above showers: $\alpha = 10^h55^m$, $\delta = +26°$ and $\alpha = 9^h20^m$, $\delta = +35°$ ($\beta > 40°$ N), or $\alpha = 8^h00^m$, $\delta = +13°$ and $\alpha = 8^h55^m$, $\delta = +05°$ ($\beta > 40°$ N); $\alpha = 8^h00^m$, $\delta = -03°$ and $\alpha = 9^h32^m$, $\delta = -02\overset{\circ}{.}5$ ($\beta < 40°$ N). In the north the first field pair has the advantage that it is suitable to study the activity from Leo Minor without occlusion by the α-Leonid radiant.

Kronk [5] has requested data for a possible shower rich in telescopic meteors at $\alpha = 233°$ and $\delta = +37°$ during January 16–18. Dark skies in 1991 offer an opportunity to test for the presence of this shower. Pre-dawn watches when the putative radiant is high in the sky are best. Suggested field centers are $\alpha = 14^h40^m$, $\delta = +18\overset{\circ}{.}5$ and $\alpha = 16^h05^m$, $\delta = +17\overset{\circ}{.}5$.

The α-Aurigids are slow meteors and their telescopic activity can be up to a third of the sporadic background. The meteors are visible during the first half of February, with peak activity around February 7 from $\alpha = 79°$ and $\delta = +42°$. Evening watches are favored while the radiant is high before the moon interferes.

The δ-Leonids are also slow moving, and active during February to mid-March peaking around February 22 from an average radiant $\alpha = 159°$ and $\delta = +19°$. Visually, the rates are low, but this shower is worth checking telescopically. Kronk [2] suggests there may be a telescopic southern component, though observation of its suggested maximum on February 3 will suffer from moonlight. However, telescopic activity may last until February 24.

Turning to the southern hemisphere, the *α-Crucids* is another poorly known minor shower that is active during most of January, and peaking near the time of new moon. Several submaxima in an elongated radiant area have been suggested in the past, but many more results are urgently required to clarify the situation. Coupled with a high population index it is clearly amenable to telescopic investigations. The main radiant at maximum lies over the "Coal Sack" dark nebula in Crux, and is thus circumpolar from many southerly latitudes, though at its highest towards dawn. Suggested field centers are: $\alpha = 12^h35^m$, $\delta = -40°$ and $\alpha = 9^h20^m$, $\delta = -61°$ ($\beta < 25°$ S).

References

[1] G.W. Kronk, "Meteor Showers: a Descriptive Catalog", Enslow, Hillside, NJ, 1988, p. 21.
[2] G.W. Kronk, *ibid.*, p. 29.
[3] M.J. Currie, *WGN* 17:5, October 1989, pp. 186–187.
[4] J. Van Wassenhove, *WGN* 17:6, December 1989, pp. 214–215.
[5] G.W. Kronk, *WGN* 14:6, December 1986, p. 191.

Calls for Radio Observations

An Unsolved January 22–23 Mystery

Dirk Artoos

For the second time (1989 and 1990), I observed an increased meteor activity in the mornings of January 22 and 23. In 1989, there was also an inexplicably high activity around that period. In 1990, I observed twice a day (from 4^h30^m till 5^h20^m UT and from 9^h00^m till 9^h40^m UT) from January 19 to 25 (Figure 1). As you can see the highest peak occurred on January 23, early in the morning ($\lambda_\odot = 302\overset{\circ}{.}4$, Eq. 1950.0). Therefore I ask the attention of radio observers between January 19 and 25, around 11^h UT.

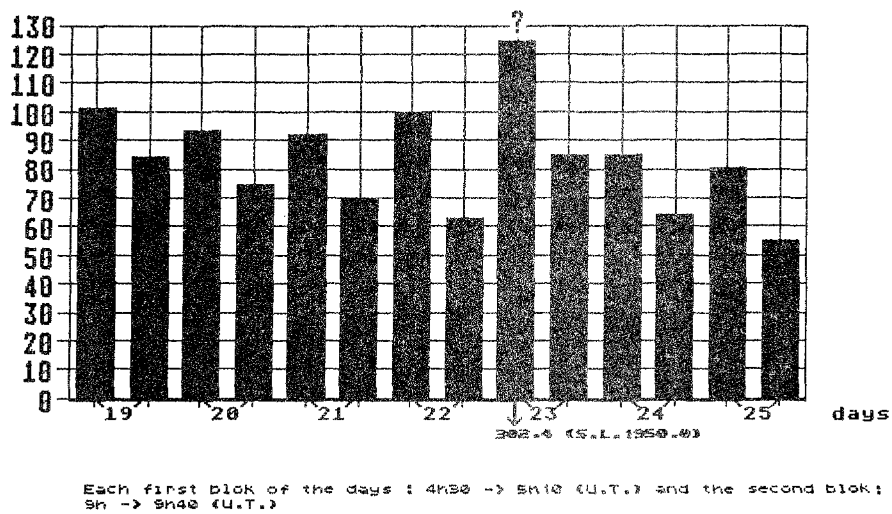

Figure 1 – Radio observations by Dirk Artoos, Mechelen, Belgium at 66.45 MHz with an antenna elevation of 40° and an antenna azimuth of 275°.

At present, this increased meteor activity cannot be associated with any known meteor shower. However, I do not think we are dealing with a variation in the sporadic background. It is possible that some observers cannot detect the increased activity due to the used frequency or the direction of their antenna. Therefore, try to direct your antenna to the East ($A = 270°$) or to the South ($A = 0°$).

As far as visual activity is concerned, high rates were not reported in 1990. But Richard Taibi reported he saw, apart from a few γ-Leonids and Coma Berenicids, also one meteor which might have belonged to the so-called *Association 60 (twin shower)* [1]. He suggested a telescopic hunt for January 22–23. Richard has also given met the results of three other North-American observers. They too may have seen some activity from this twin shower. L.R Bellot and F.R. Andrés from Spain did not notice anything particular. Anyway, keep watching.

The author wishes to thank all observers who supported me and sent me their findings (R. Taibi, G.M. Kristensen, L.R. Bellot, F.R. Andrés, N. White, ...)

Reference

[1] D. Artoos, "Call for action: January 1990", *WGN* 17:6, December 1989, p. 215.

Activity from Honda-Mrkos-IAU?

Dirk Artoos

The Earth-grazing comet P/Honda-Mrkos-IAU (1990 f) is a candidate for producing meteors. According to [1], the closest approach of the comet with the Earth's orbit occurs on February 13. The distance is then 0.06 AU. The coordinates of the possible radiant are $\alpha = 328.^\circ5$ and $\delta = -20^\circ$. As you see, this is a daytime radiant. The necessary data for listening to possible activity are given in Table 1.

Table 1 – Observability function for a four-element antenna elevated at 45° for each hour of the day (local time), four cardinal directions and four latitudes (100 = best observability, 0 = radiant below the horizon). For the calculations a transmitter distance of 1000 km and a transmitter power of 30 kW were assumed.

Lat.	Dir.	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
+50	S	0	0	0	0	0	0	0	0	0	32	66	93	98	100	86	56	21	0	0	0	0	0	0	0
+50	W	0	0	0	0	0	0	0	0	0	50	76	93	100	99	90	70	34	0	0	0	0	0	0	0
+50	E	0	0	0	0	0	0	0	0	0	47	77	93	100	99	89	69	36	0	0	0	0	0	0	0
+50	N	0	0	0	0	0	0	0	0	0	35	70	95	98	100	90	60	22	0	0	0	0	0	0	0
+35	S	0	0	0	0	0	0	0	0	25	60	89	100	92	96	98	82	51	14	0	0	0	0	0	0
+35	W	0	0	0	0	0	0	0	0	36	72	86	97	100	99	93	82	60	20	0	0	0	0	0	0
+35	E	0	0	0	0	0	0	0	0	34	68	86	96	100	100	94	82	64	21	0	0	0	0	0	0
+35	N	0	0	0	0	0	0	0	0	22	53	85	99	98	100	97	78	44	12	0	0	0	0	0	0
00	S	0	0	0	0	0	0	0	28	66	93	99	71	15	30	84	100	87	56	15	0	0	0	0	0
00	W	0	0	0	0	0	0	0	35	71	91	100	85	73	62	61	69	76	62	19	0	0	0	0	0
00	E	0	0	0	0	0	0	0	34	68	74	65	60	64	77	100	98	86	62	19	0	0	0	0	0
00	N	0	0	0	0	0	0	0	23	57	81	94	90	98	100	92	91	76	48	13	0	0	0	0	0
−35	S	0	0	0	0	0	0	20	50	75	92	99	91	98	100	95	98	89	69	42	10	0	0	0	0
−35	W	0	0	0	0	0	0	29	63	78	92	100	98	63	44	38	48	66	73	56	15	0	0	0	0
−35	E	0	0	0	0	0	0	29	65	75	62	41	39	48	70	100	100	81	77	56	15	0	0	0	0
−35	N	0	0	0	0	0	0	21	52	79	96	98	69	9	25	82	100	94	72	44	11	0	0	0	0

Reference

[1] C. Steyaert, "Earth-Grazing Asteroids", *WGN* 18:5, October 1990, pp. 185–186.

Fireball Data

Czechoslovakia, Germany, September 14, 1990, $20^h45^m07^s$ UT

Z. Ceplecha and P. Spurný, Ondřejov Observatory

A very slow-moving fireball of −9 maximum absolute magnitude was photographed by three Czech stations of the European Network. The fireball traveled a 125-km luminous trajectory in 9.7 seconds and terminated its light at a height of 51 km. Its trajectory was practically horizontal, the slope to the horizon was only about 11° and the difference between the beginning and the terminal height is only 25 km.

The following preliminary results are based on three Czech records, but further records from the German part of the European Network are expected.

Table 1 – Trajectory data

	Beginning	Maximum light	Terminal
Velocity (km/s)	13.173	12.89	11.5
Height (km)	76.33	60.0	51.0
Latitude (° N)	49.3892	50.088	50.493
Longitude (° E)	12.2104	12.212	12.212
Abs. magnitude	− 3.1	− 8.8	− 3.0
Photom. mass (kg)	32.4	13.2	none
Z R (°)	77.9		79.0

Fireball type: III A
Ablation coefficient: 0.1 s^2/km^2

Table 2 – Trajectory data

Radiant (1950.0)	Observed	Geocentric	Heliocentric
α (°)	316.6	314.0	
δ (°)	− 28.7	− 56.2	
λ (°)			267.8
β (°)			− 7.1
Initial velocity (km/s)	13.193	7.08	34.57

Table 3 – Orbital data.

Orbit (1950.0)	
a	1.560 AU
e	0.371
q	0.9817 AU
Q	2.137 AU
ω	24°.3
Ω	351°.2032
i	7°.14

The orbit calculated in Table 3 is an Apollo asteroid orbit with the cometary meteoroid in.

Erratum on Meteor Colors

Ulrich Sperberg

Because of an incomplete correction, the following equations should be modified in the text in *WGN* 18:4, *August 1990, p. 113.*

$$CI_0 = 2.5 \log \frac{N_V(m)}{N_B(m)} - \rho_V m$$

Transformation leads to:

$$CI_0 = 2.5 \log \frac{N_V(m)}{N_B(m) 10^{0.4 \rho_V m}}$$

Also the following equations are incorrect:

$$CI_0 = 2.5 \log \frac{N_V(m) p(\Delta m)^{-1}}{N_B(m) 10^{0.4 \rho_V m} p(\Delta m)^{-1}}$$

$$CI^\theta = 2.5 \log \frac{\sum_{m=+1}^{-3} \left(N_V(m) p(\Delta m)^{-1}\right)}{\sum_{m=+1}^{-3} \left(N_B(m) 10^{0.4 \rho_V m} p(\Delta m)^{-1}\right)}$$

The newly calculated CI^θ in Table 2 are:

Spor: 1.91; Per: 2.25; Gem: 0.80; Vir: 2.17; Tau: 2.51; Qua: 3.09; Ori: 3.77

Please change the passages mentioned in your issue. I apologize for the inconvenience.

Erratum on Determination of Spatial Number Densities and Mass Index from Visual Meteor Observations (II)

Ralf Koschack and Jürgen Rendtel

The following modifications should be made in the text in *WGN* 18:4, *August 1990, pp. 119–140.*

- On p. 125, the 5th line from the top has to be read as follows: ... of Table 9 with Figure 16, ... (change of the figure number).
- On p. 130, the last point before Table 17 has to be read as follows: $\overline{\mathrm{lm}} = 6.0$ ... (average). The same change should be made in the caption of Table 17.
- On p. 136, the first sentence has to be read as follows: The radii of the isohypses r_h as given in Figures 3 and 4 ... (Figures instead of Tables).
- On p. 137, the first line has to end as follows: ... curve (left of Figure 19). (change the figure number).
- On pp. 138–139, the areas given in Tables 20–22 are in km.

Please change the passages mentioned in your issue. We apologize for the inconvenience.

On the Comparison of Two Methods for Determining Meteor Stream Spatial Densities

A. Grishchenyuk

Results obtained with the method for determining meteor stream spatial densities suggested by Koschack and Rendtel [1,2,3] are compared to results obtained by more classical methods. They are found to be in good agreement.

Very interesting papers by Ralf Koschack and Jürgen Rendtel were published in some issues of *WGN* [1,2,3]. These papers give a method for the determination of meteor stream densities and then spatial densities on the basis of the ZHR. The suggested method is revolutionary indeed as it permits to connect individual observations made without restriction of sky area with the particles' density in the stream. So far, special independent group observations were carried out and from their results the spatial characteristics of showers were derived taking into consideration perception coefficients. However, every method must be checked scrupulously for coincidence with the results of previous calculations. In the USSR, extensive series of determinations of shower densities have been obtained both visually and by radar.

Tables 1 and 2 give values of ρ (km^{-3}) that were derived by B. Yu. Levin [4] from visual observations for limiting meteor magnitude 4.3 that corresponds to a limiting magnitude for stars equal to 6.0–6.2. Comparing the values from *WGN* [3] and from Tables 1 and 2 shows that they are in good agreement, except perhaps for the Perseids.

In [5], there is an example of a density determination method that is similar to the classical method using group observations. The particle influx Φ ($\mathrm{m}^{-2}\mathrm{s}^{-1}$), the spatial density of the stream ρ (km^{-3}), the law of the distribution of stream densities as a function of mass, exponents of the luminosity function κ and masses M were obtained for the Perseids of 1989. The same material was processed using the method from [3] for the period 22^{h} to 1^{h} UT on August 12-13. The mean ZHR values (for 5 observers) were 112.9, 135.6, and 130.6 respectively and the total mean for this period was equal to 126.36. The value of r was equal to 3.1. The remaining correction factors were found from the tables in [2]: $c(r) = 21$; $\rho(M \geq 2 \times 10^{-4}) = 5 \times 10^{-7}$ km^{-3}; $\rho(M \geq 10^{-3}) = 1.53 \times 10^{-8}$ km^{-3}. Now let us compare thes values with those given in [5]. The particle influx $\Phi(M \geq 10^{-3}) = 8.71 \times 10^{-3}$ $\mathrm{m}^{-2}\mathrm{s}^{-1}$. Taking into consideration the units and after division by the geocentric velocity of the Perseids, we find the spatial density equal to 1.45×10^{-8} km^{-3}. An excellent agreement!

Now let us make yet another comparison. P.B. Babadzhanov derived the equation for the Perseids that describes the dependence of number on mass [6]:

$$\log N(M) = -14.2 - 0.67 \log M \qquad (\mathrm{m}^{-2}\mathrm{s}^{-1})$$

where N is the number of meteors with mass M. For $M = 2 \times 10^{-4}$ g, we have $\rho(M \geq 2 \times 10^{-4}) = 3.16 \times 10^{-8}$ km^{-3}. Jürgen Rendtel obtained from visual observations $\rho(M \geq 2 \times 10^{-4}) = 2.7 \times 10^{-8}$ km^{-3}. As one can see, the difference between the values falls within the error limits.

It is necessary to note, however, that the method in question is not free from some deficiencies, the main of these being the impossibility (so far, at least) to determine the law of the change of the density with the mass, as in [5,6]. There is a danger of errors in determining r from observations with not many meteors. Comparison of individual and group observations shows that individual values of r are much higher than for the group observations.

It is necessary to develop the suggested method in every possible way and to define more precisely all correction factors involved.

Table 1 – Particle influx and density obtained from visual observations.

Stream	$\Phi(\text{Mag} \geq 4.3)$ ($km^{-2}s^{-1}$)	$\rho(\text{Mag} \geq 4.3)$ (km^{-3})	Δ (km)
Quadrantids	19×10^{-7}	44×10^{-9}	280
Lyrids	4×10^{-7}	8×10^{-9}	500
η-Aquarids	5×10^{-7}	7×10^{-9}	520
δ-Aquarids	2.5×10^{-7}	6×10^{-9}	550
Perseids	9×10^{-7}	15×10^{-9}	400
Orionids	0.7×10^{-7}	1×10^{-9}	1000
Taurids	9×10^{-7}	28×10^{-9}	300
Leonids	0.8×10^{-7}	1×10^{-9}	1000
Geminids	48×10^{-7}	132×10^{-9}	200
Ursids (1945)	133×10^{-7}	380×10^{-9}	140
Leonids (1866)	0.58×10^{-4}	0.8×10^{-6}	108
Andromedids (1872,1885)	30.0×10^{-4}	140×10^{-6}	19
Draconids (1933)	4.3×10^{-4}	180×10^{-6}	18
Draconids (1946)	8.6×10^{-4}	360×10^{-6}	14
Sporadics	110×10^{-7}	1100×10^{-9}	97

Table 2 – Particle influx and density obtained from radio observations.

Stream	$\Phi(M \geq 2 \times 10^{-4}$ g) ($km^{-2}s^{-1}$)	$\rho(M \geq 2 \times 10^{-4}$ g) (km^{-3})	Δ (km)
Quadrantids	2.6×10^{-5}	0.6×10^{-6}	120
Lyrids	2.8×10^{-5}	1.0×10^{-6}	100
Arietids	5.4×10^{-5}	1.4×10^{-6}	110
Geminids	3.4×10^{-5}	0.9×10^{-6}	104
Sporadics	1.1×10^{-4}	1.2×10^{-5}	44

References

[1] R. Koschack, "Number Density in Meteor Streams", *WGN* 16:5, October 1988, pp. 149–157.

[2] R. Koschack, J. Rendtel, "Determination of Spatial Number Densities and Mass Index from Visual Observations (I)", *WGN* 18:2, April 1990, pp. 48–58.

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[5] A. Grishchenyuk, V.M. Mozhzerin, "Determining a Meteor Stream's Density from Visual Observations in the USSR", *WGN* 18:3, June 1990, pp. 85–88.

[6] P. B. Babadzhanov, *Doklady of USSR Academy of Sciences* 284:4, 1985, pp. 824–826.

Report on the 1st International Tunguska Expedition

G. Andreev, Tomsk University, and K. Korlević

Some data on the First International Tunguska Expedition of 1990 are presented. It was one of the biggest expeditions since 1958. About 120 members from five countries took part. The field work was carried out from June 26 till August 25 and included the following main directions: (i) research on the physics of the Tunguska explosion; (ii) search for the substance of the Tunguska body; and (iii) study of the "ecological after-effects" of the Tunguska event.

1. Introduction

The first International Tunguska Expedition was carried out from June 26 till August 25 in accordance with the international program of the investigation of the Tunguska event 1908. About 120 persons took part in this expedition. There were 26 foreign members (France 8, Yugoslavia 7, Bulgaria 6, Sweden 2) and about 100 members were from the USSR. Let us note that this was the 32th expedition organized by the Complex Independent Expedition of the Tomsk Branch of the All-Union Astronomical-Geodetical Society and it was one of the biggest expeditions since 1958. The scientific program of 1990 fully corresponded to the International Program published in this journal and included the main topics discussed below.

2. Investigation of the physics of the Tunguska explosion.

The representatives from the Swedish academy of Sciences (L. Baath and C. Andersson), Yugoslavia (*IMO* member K. Korlević), Bulgaria (Chairman E. Bojurova, *IMO* member), and from the Soviet Union (Chairmen: N. Vasilyev and G. Andreev) took part in this program. The investigations covered:

- the determination of the border and the inner structure of the Tunguska fire of 1908;
- the determination of the border of the "light-burn" area of the trees and vegetation;
- the search for fragments of the Tunguska body which entered the Earth atmosphere separately (working in the possible ellipse of distribution of this particles); and
- taking samples of the soil for the search of radio-active elements.

Let us note that the search for fragments of the Tunguska body on the edge of the possible ellipse of distribution is a new part of the investigation. It is necessary to note that the probability to find some remains of the Tunguska body is connected with the possibility that this body had greater density and was an Apollo-type asteroid [1]. This project was chosen after joint discussion (April 1990, Tomsk) between *IMO* members (A. Knöfel, K. Korlević, J. Rendtel) and CIE members (G. Andreev, N. Vasilyev) and it is one of the promising projects in the Tunguska research. This investigation will continue in the next years. This year, only first steps were made, but we got some interesting results.

First, the possible ellipse of distribution was calculated by V. Goldin and G. Ryabova (they used only a ballistic model of motion without the effect of ablation to get results quickly). Second, a high sensitivity magnetometric survey near the epicenter was carried out by L. Baath and C. Andersson. A map of the distribution of the gradients of the magnetic field was obtained. In the place of the maximum anomaly of the magnetic field, geological and geochemical research was carried out which will be finished in the future. In the layer of 1908 on the depths of only 3-8 cm in the forest we found ashes, some burned particles of stones and tree resin, embedding the ashes and particles of the time of the post-explosion forest fire.

One group of biologists lead by G. Plekhanov confirm that a forest fire in 1908 covered the entire territory immediately after the explosion. The irradiation was the reason of the fire. Finishing mapping of the irradiation burn, we were able to calculate the fraction of energy transformed in light.

3. Search for the substance of the Tunguska body

This direction of the Tunguska expedition included research about:

- selection of the stratified columns of peat and soil from the different parts of the Tunguska meteorite reserve for future chemical research of presence of elements abounding in meteorites;
- selection of the samples of the trees for dendrochronological and carbonic analysis;
- selection of the sample leaves of some shrubberies for studying the accumulation of some chemical elements.

At the moment, the analyses of the material are in progress.

4. Study of the "ecological after-effects" of the Tunguska event

The effect of accelerated growth of the biomass of the plants and the effect of the mutations of the vegetation and the animal world in the Tunguska region were investigated (chairmen: N. Vasilyev and K. Korlević).

- *Determination of the variability in low migrating species of butterfly (Lepidoptera).* This investigation must be done in four regions: in the middle of the event, on the border and on two control points at 100 and 200 km from the event in similar ecological conditions. Unfortunately, no faunistic study of Lepidoptera exists of this region. The first step in this work was done by K. Korlević, collecting butterflies in this region to determine species for future variability research.
- *The control of the variability of ants in this region will be examined in a new way using electrophoresis analysis on samples collected this year.*
- *Search for the possible chemical reason (dioxine?) for the biological mutations will be made on samples of peat near the epicenter.*
- *Search for the possibility of transmission of genetic anomalies with seeds of the Pinus family.*
- *Macro scale monitoring in search of regions of increased variability in vegetation.* There is a suspicion that some regions of the Tunguska event show an earlier or later start in vegetation growth and different concentrations of chlorophile. To exclude the influence of common forest fires, it is essential to control also some other parts in Siberia involved in forest fires in the last period [2,3]. In cooperation with A. Petricono, responsible for the European branch of EOSAT in Rome, K. Korlević found the availability of photos from Landsat of this region in the form of computer files ready for image processing. Filters in use are blue, green, yellow, red and two infrared spectral windows; resolutions on the ground level is about 30 m, each pixel is 8 bit or 256 levels of grey. Since photos and computer files of the Tunguska region from 1974 to 1990 exist, it will be possible to study possible abnormalities in forest growth, and possible incrementings or decreasings in interesting zones. The problem is that for every filter picture the cost is 700 USD, or for all spectral windows 3500 USD (EOSAT Catalogue, 1989). C. Andersson and L. Baath from Onsala Space Observatory are now trying to find sponsors for this research. It is possible that photos and computer files from Soviet Union satellites will be available in 1991.

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[1] G. Andreev, "Was the Tunguska 1908 Event Caused by an Apollo Asteroid?", in *Proc. "Asteroids, Comets, Meteoroids III*, C.I. Lagerkvist and H. Rickman (eds.), Uppsala University, 1990, pp. 240–244.

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[3] M.Hlavaty, "Estimation of the forest composition on the LANDSAT TM Data", in *Project: FAO: TCP/YUG/4502 (T), 1986–1987*, Roma-Ljubljana, May 1987, pp. 61–63.

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