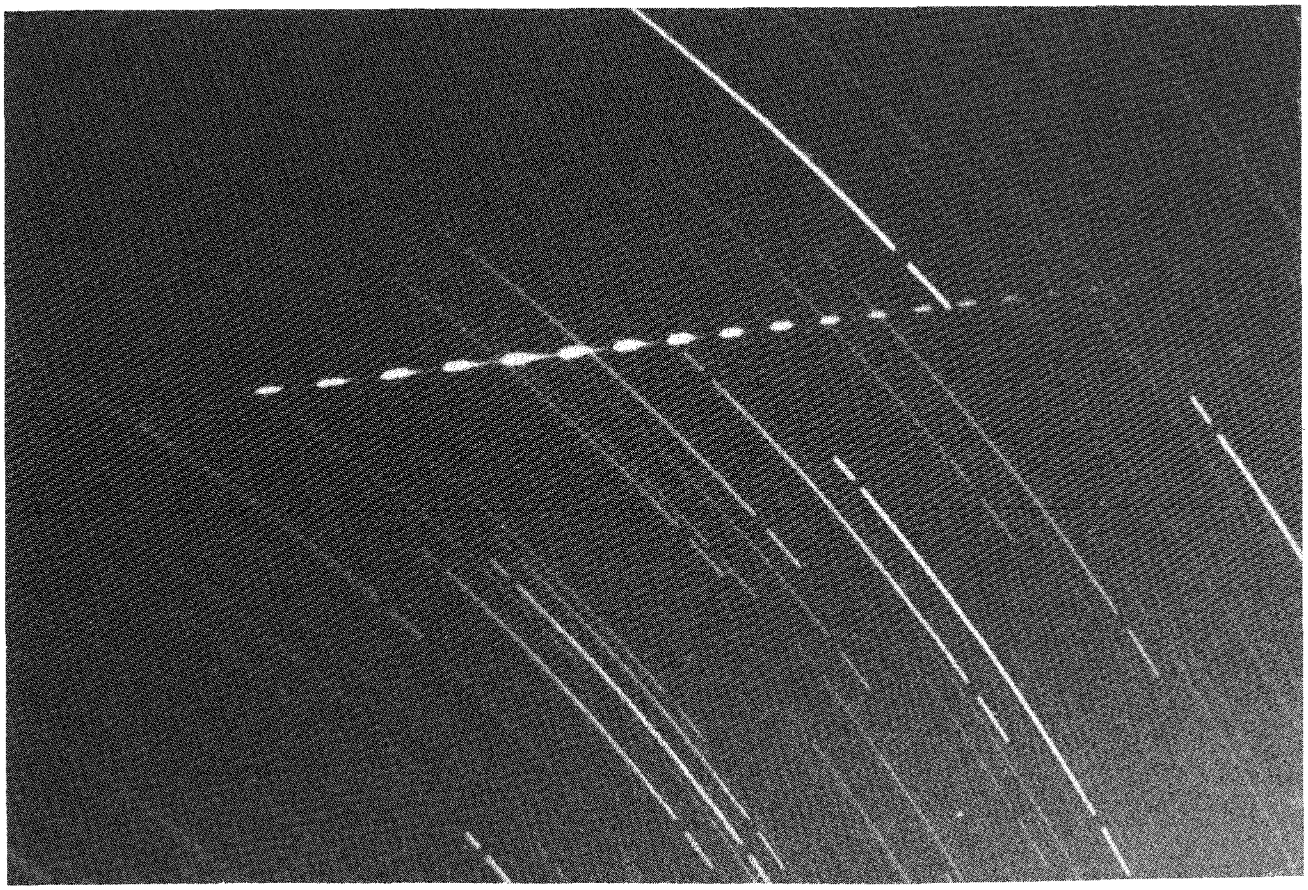
ISSN 1016-3115

wgn

19 — 1

february 1991

bimonthly journal of the international meteor organization



Meteor photographed on December 21, 1987, at $15^h50^m09^s$ UT, by Qin Dao at Sheshan, $\lambda = 121°11'$ E, $\phi = 31°06'$ N, Shanghai, China with a 75 mm $f/3.5$ lens and a rotating shutter yielding 25 breaks/s. A 400 ASA film was used. The center of the plate is at $\alpha = 8^h40^m$ and $\delta = 65°$.

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 19, nr 1, February 1991, pp. 1–26

Contents

Useful Information

The April Issue *(WGN 19:2)*

The *April issue* is expected to be mailed during the second week of April, a little later than usual, due to professional commitments of the Editor-in-Chief abroad. Contributions are due *March 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

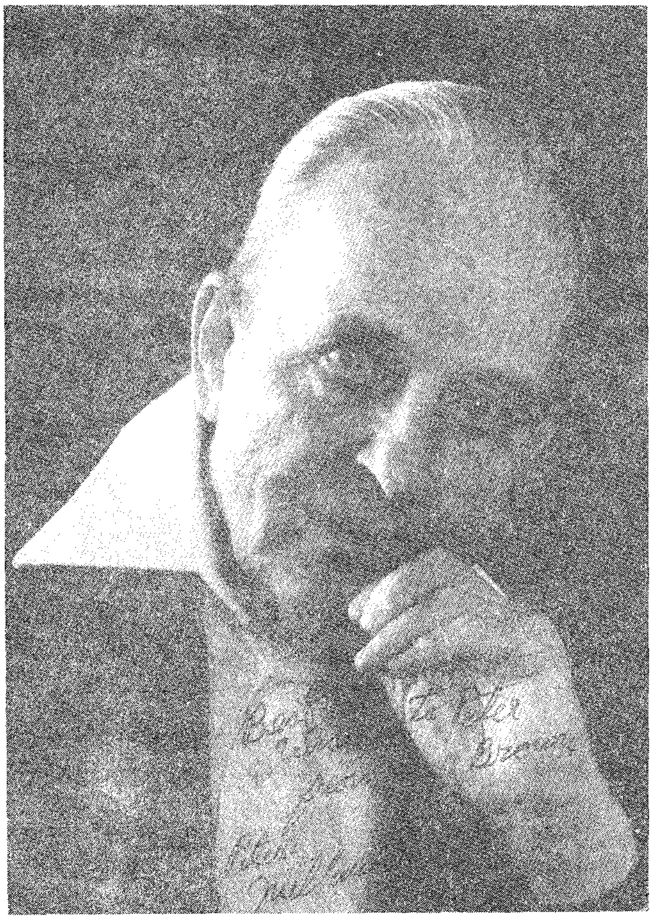
The subscription rate for volume 19 (1991) is 20 DEM for six issues. It is anticipated that volume 19 will contain over 240 pages. Subscriptions should be paid to Ina Rendtel, in DEM and preferably by international postal money order. People who can only pay from a bank account must send an international bankdraft in USD payable to Peter Brown. British subscribers may also contact Alastair McBeath and Japanese subscribers may contact Masahiro Koseki. All addresses can be found on the inside of the back cover. Please make sure we retain the full amount due after deduction of bank and/or exchange charges. Please refer to p. 3 of this issue for further details. Additional gifts are of course welcome.

Administrative Correspondence

Ordering *IMO* publications is done in the same way as paying subscription/membership fees. 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.

In Memoriam
Peter MacKenzie Millman (1906–1990)

Peter Brown



The father of Canadian meteoritics, Peter M. Millman, passed away in Ottawa on December 11, 1990 at the age of 84 after a long and fruitful career in astronomy. Dr. Millman is well known in meteor astronomy for his pioneering work, particularly in meteor spectroscopy where he was recognized as the world authority. He became widely known around the time of the International Geophysical Year to many individuals in the amateur meteor community when he spearheaded the visual component of the meteor studies program to be held during the International Geophysical Year.

His early work in professional Astronomy began in 1927 when he held one of what became a number of student summer positions with the Dominion Astrophysical Observatory in Victoria, British Columbia. After graduating at the top of his class from the University of Toronto in 1929, he went on to complete a Master of Arts degree in 1931 and a Ph. D. in 1932 from Harvard. He left Harvard shortly thereafter and joined the staff of the David Dunlap Observatory of the University of Toronto.

During World War II, Dr. Millman served in the Royal Canadian Air Force (RCAF) retiring in 1946 as Squadron Leader. In that same year a dramatic air lift from Ottawa by the RCAF to northern Ontario of Dr. Millman and his equipment facilitated the acquisition of valuable data regarding the Giacobinid (October Draconid) stream. His work with the Giacobinids helped to establish the friable nature of the meteoroids associated with that stream.

After World War II, Dr. Millman held a position with the Dominion Observatory in Ottawa until 1955 when he began working with the National Research Council (NRC) in Ottawa where he remained for the rest of his life. Although officially retired in 1971, he continued active research in many areas of astronomy. For his contributions to Canadian astronomy he was appointed Researcher Emeritus at the NRC in 1986.

Dr. Millman had served in a wide variety of capacities within the astronomical community. He was past president of the Royal Astronomical Society of Canada (RASC), the Meteoritical Society, IAU commission 22, and the IAU working group for Planetary System Nomenclature. His long association with the RASC included 28 years of publication of Meteor News in the Journal of the RASC, numerous papers in the Journal of the RASC and more than 30 years of contributions to the Handbook of the RASC. In addition to his work within the professional community, Dr. Millman was instrumental in bringing Astronomy to the general public within Canada. He wrote a regular column for Toronto newspapers for dozens of years, gave talks on the national radio service, kept in contact with amateurs throughout the country and was a keen proponent of amateur visual meteor observations. Even in his 80's, Dr. Millman continued to give lectures to school age children.

The literature of meteor astronomy is filled with his work. His early days at Harvard concentrated heavily on meteor spectroscopy, an area of investigation he pursued throughout his career. At the Dominion Observatory he supervised the program of direct photography of meteors with the Super-Schmidt cameras at Meanook and Newbrook observatories in Alberta. His continuing interest in meteorites lead to many studies of meteorite falls and participation in meteorite searches. He was also involved in the early stages of the Canadian program for the study of impact craters. He was the driving force behind the establishment of the Springhill meteor observatory and believed that instrumental observations—by radar and photography—should be supported by visual observations. He remained actively involved in all aspects of research at the observatory until its closing in the mid 1980's.

It is hardly possible to include all the areas of work Dr. Millman touched on in astronomy during his long career. His memory, however, will continue to motivate those working in astronomy and meteor studies to strive for the clarity of thought and integrity of work he exemplified.

From the President

Jürgen Rendtel

Generally, the year 1990 may be regarded as a successful year for the International Meteor Organization. We may state progress in all fields of activity. You find this represented in the various contributions to WGN. From the long list of items I would highlight a few ones.

A major aim of the IMO is to deliver observational results which are of interest for further analysis. This requires the possibility to derive physical quantities such as a particle flux density. Now, for the IMO standard of visual observations, such a treatment of data was done. The photographic branch will improve soon, since at the 1990 International Meteor Conference in Violau, Dieter Heinlein took over the responsibility, and a photographic handbook is under preparation. Analysis of photographs are possible using the astrometric procedures which are also published as a brochure. Many other publications have been produced, too. Among them were general information for new members and to journals as well as special items for advanced observers.

Looking at the report on the 1989 visual and fireball data, presently in print as volume 2 of WGN's Report Series, you will feel the increase of activity. Having at hand only a part of the data of 1990, one can estimate a good success also during the last year in which we obtained reasonable data of all significant showers!

Of course, there also occurred problems. One arose with the resignation of Ann Schroyens as our treasurer. Another is generally the respecting of deadlines by members as well as by Council members. An improvement in this regard would be helpful for all those taking initiatives and being involved in IMO.

The 1990 IMC also showed that we should pay more attention to newcomers to ensure the continuous work of IMO. Therefore we will organize more different workshops at the next IMC. Furthermore, completing instructions should be useful for new observers.

At the beginning of the last decade of the 20th century, IMO may be regarded as a well established organization for meteor work. But please bear in mind that your contributions are needed to continue. In this spirit, I wish all members and friends of the IMO a healthy and successful New Year. At the same time, I would like to encourage you to establish or to continue good contacts among each other and hope to see many of you at the next IMC or at other occasions.

From the Editor-in-Chief

Marc Gyssens

Of course, I cannot but fully join the words of our President, above. Despite the troublesome events in the Persian Gulf, I hope that 1991 will see a continuing growth in the international spirit and the achievements of our Organization.

Contrary to what I announced in the last issue, this is, unfortunately, not a thick issue. This is not due to a lack of contributions; the last few months, articles again are coming in at a more frequent pace than was the case in the early fall. Please keep up this effort! The reason for not going beyond the usual size of an issue is the abnormally low rate of renewal at this time of the year. Still of a lot of members and subscribers have to pay their contribution for 1991. Most probably, the transition from Ann Schroyens to Ina Rendtel as IMO treasurer and *the confusing payment instructions arising from this, are the main culprits. The unintended anexation by Belgium of the Germany city of Potsdam (see inside of last issue's back cover) certainly did not help to clear things, for which I apologize. Also, a delay in the mailing of the December issue combined with the Christmas season resulted in that issue arriving very late at several places, particularly overseas. We will do our utmost best to avoid the Christmas season for future December issues.*

Anyway, the current impossibility of making a sufficiently accurate estimate of the final number of 1991 subscribers (and, hence, the number of copies in which WGN should be printed) does not allow us to prepare a thick issue. Indeed, printing too much copies of a thick issue would be too a great risk financially, and printing too little copies would leave us with the risk that many late subscribers will not receive the February issue, since reprinting is not feasible for just a few dozen copies. We ask for your understanding of the conservative policy we have taken in this matter. We also apologize to contributors whose articles could not be accommodated in this issue and ask them for a little extra patience: the April issue will be a thick one beyond any doubt! It might though appear a little later than normal due to professional commitments I have abroad.

So, if you have not yet paid, please do so promptly! The payment instructions from our new treasurer, which by the way not only apply to WGN but to all payments to IMO, are simple and should clear the confusion that has arisen earlier. Moreover, people from which we did not receive payment at the time this issue was mailed, will have already found a reminder containing more personalized instructions.

Meanwhile, have fun reading this issue and enjoy looking forward to a thick April issue!

Important Note from the New Treasurer

Ina Rendtel

The last issue may have caused confusion on how to pay to *IMO*, partly due to the change of treasurer and partly to a typo. We apologize for the inconvenience.

Please note the following correct address and account number for payments in German Marks (DEM):

Ina Rendtel, Gontardstraße 11, D-O-1570 Potsdam, ***Germany***

Postal (giro) account number: 547234-107
Post office code: 100 100 10 Postgiroamt 1000 Berlin

(Please note that post office code and postgiroamt must always be mentioned together with the postal account number.)

You can also pay by international postal money order!

People who can only pay from a bank account should make an international bank draft payable in USD to Peter Brown. British subscribers can contact Alastair McBeath. Japanese subscribers can contact Masahiro Koseki.

All subscriptions and **all** publications can be ordered through any of these persons.

Letters to WGN

compiled by Marc Gyssens

Meteor activity from asteroids

The article of Dirk Artoos in last year's October issue on possible radio meteor activity from asteroid 1989 UR and the reaction on that article from Jeroen Van Wassenhove and Christian Steyaert, published in the December issue, have given rise to some more comments.

In [1], Dirk Artoos made a call for radio observations about 1989 UR. My pen recorder showed higher signal rates on June 11, but if you look to certain literature, I think it must be signals from the Arietids or the Daytime ζ-Perseids, not from the suspected 1989 UR.

[1] Dirk Artoos, "Call for Radio Observations: 1989 UR Again", *WGN* 18:5, October 1990, p. 184.

Gotfred Møbjerg Kristensen

In answer to the letter of Jeroen Van Wassenhove and Christian Steyaert [1], I do not agree with their statement that Earth-grazing asteroids are rather not associated with a wide stream of regular meteors.

There are sufficient examples to the contrary if we read the recent literature. This does not mean that some asteroids indeed produce some spectacular fireballs and are associated with larger fragments, e.g. the impact of large asteroid fragments in Glanerburg, the Netherlands which could have originated from 1981 Midas [2]. Let me discuss now some of the examples I mentioned.

First of all, it is well known at present that the Taurid radiants are a product of not only comet Encke and possibly also comet 1967 II Rudnicki, but also of a stream of four asteroids: 2201 Oljato, 5025 P-L, 1982 TA and 1984 KB [3]. All four asteroids make close approaches to the Earth (less than 0.2 AU) and can cause both pre- and post nighttime showers at different times of the year, as is indeed the case for the Taurid complex.

Another example is asteroid 3200 Phaeton, formerly designated as 1983 TB, which is most likely the parent body of the Geminids [3,4,5]. This Apollo-type asteroid was discovered in 1983 using data from the IRAS satellite, and then turned out to be the parent of the prominent Geminid meteor shower. It was hailed as being the "missing link" which showed that comets (which are well-known producers of meteor showers) evolve to form asteroids, the asteroid presumably being the rocky core left over after the devolatilization of the comet.

Yet another example is 1566 Icarus, also an asteroid which in the past has been suggested as being the parent body of a meteoroid stream, namely the Daytime Arietids [3]. Likewise, two asteroids discovered in 1988 may well be the parent bodies to documented meteor showers, as shown by Kronk [6]. Asteroid 1988 VP4 is probably associated with the ζ-Aurigids of late December and early January, while 1988 TA has two streams included in the Virginid complex of March–May.

From some analysis done in 1988-89, it seems clear that several Apollo-type asteroids are associated with meteor streams. These streams might be evidence of past comet-like activity, indicating the asteroids to be extinct or moribund cometary cores, or might be the result of collisions with boulder-sized objects (a few examples: 944 Hidalgo, 2101 Adonis, ...)

Another issue in [1], which is poor as evidence to refute my tentative conclusions about the histogram of my observational results, is that nobody knows for sure when exactly the major maximum of the ζ-Perseids occurs.

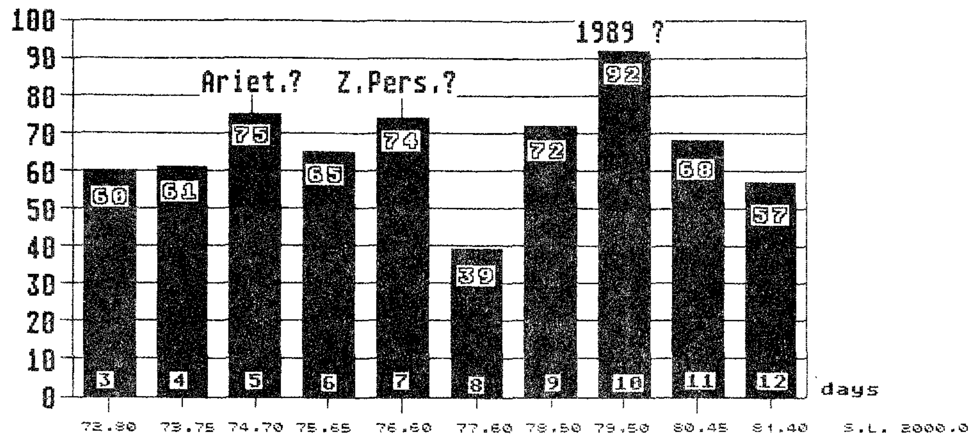


Figure 1 – Radio observations from June 6 to 12 of the possible shower caused by 1989 UR. Uncorrected counts between 12^h15^m and 12^h45^m UT. The average count is 66 ± 14.

In [7], Christian Steyaert writes June 8, while in [1], he writes June 9 or June 10. Kronk, on the other hand, mentions June 13 [8]. Finally in [9], based on radio observations of 1987, Jeroen Van Wassenhove suggests a maximum for the Arietids and the ζ-Perseids on the same date, namely June 8. Therefore, it remains perfectly possible that the maximum in my histogram around June 10 ($\lambda_\odot = 79\overset{\circ}{.}50$, Ep. 2000.0) could have been caused by the asteroid 1989 UR (Figure 1).

Recently, I received observational results from a Japanese colleague, N. Kawamura of Takamatsu (Figure 2). Also here, we see a slight increase of activity around June 9 at 14^h UT and June 11 at 15^h UT. Mr. Kawamura observed constantly between 9^h and 22^h UT.

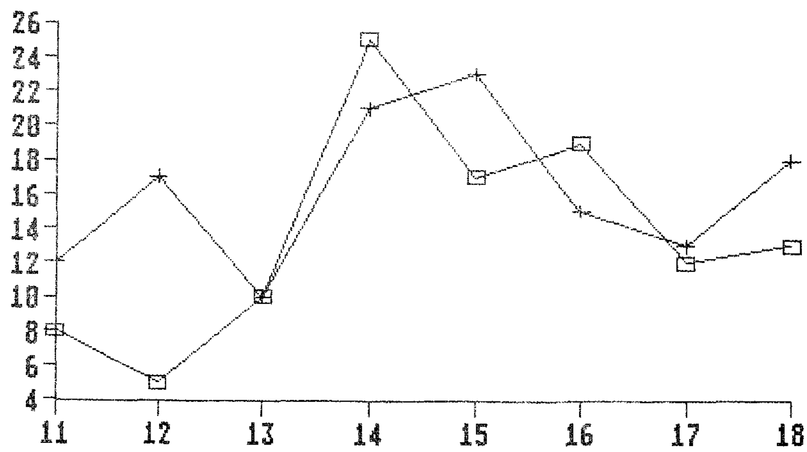


Figure 2 – Radio observations of N. Kawamura from Takamatsu, Japan on June 9 (squares) and June 11 (plusses). Time indications are in UT.

In Figure 3, the observability functions corresponding to these observations are shown. When comparing Figures 2 and 3, one sees that there is no activity from the two great daylight showers (Arietids and ζ-Perseids) at the time they should be most active (11^h–12^h UT). There is, however, a slight peak around 14^h UT, which goes well with the theoretical radiant for 1989 UR.

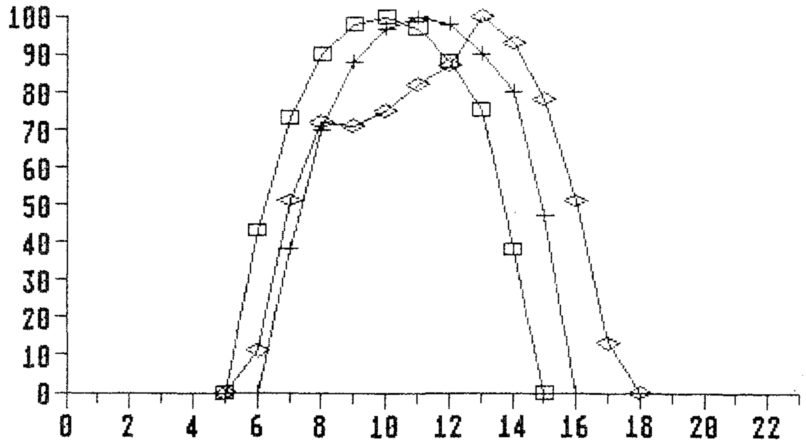


Figure 3 – Observability functions at 35° N (antenna direction: E, transmitter distance: 1000 km, power: 30 kW) for the Arietids (squares), the ζ-Perseids (plusses) and the theoretical shower from 1989 UR (diamonds).

Meanwhile, we had the second approach with 1989 UR, and I noted again a higher number of reflections around the predicted date (Figure 4). A fellow observer, Rik Van Laethem, also has an increased number of reflections. He observed with the same type of equipment (Pro 80-Sony, 4 element Yagi antenna), the same transmitter at 66.45 MHz, azimuth 275° and elevation 40°. As you can see, Rik had increased activity in the early evening of November 24, while my activity increase occurred in the early morning of November 25. Moreover, there are no known large meteor streams active around that period: it is clearly too late for the Leonids and too early for the δ-Arietids or the Geminids.

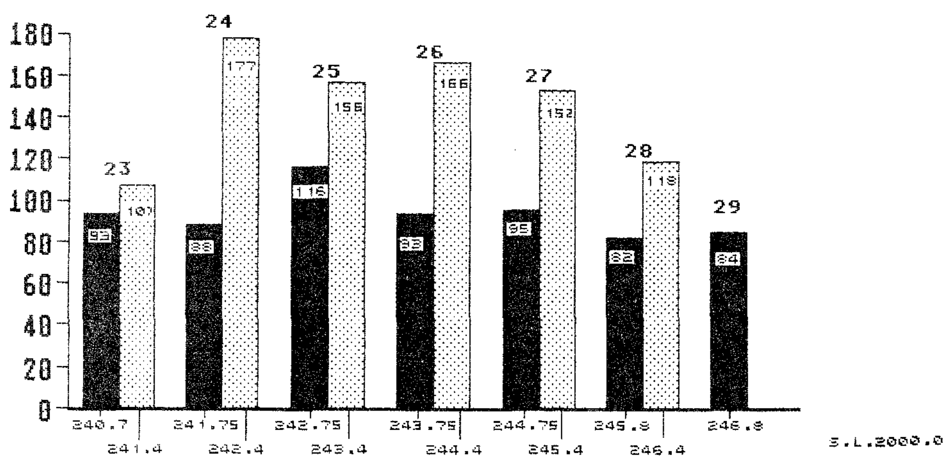


Figure 4 – Radio observations made in November with the same type of equipment at the same frequency by Dirk Artoos (3^h45^m–4^h20^m UT, average count per interval: 93 ± 11) and Rik Van Laethem (19^h00^m–20^h00^m UT, average count per interval: 146 ± 28).

So, we may safely conclude that the increase of end November is not caused by a major shower or by Sporadic-E. The question remains though whether or not it was caused by 1989 UR. Who could give me the answer? I think that it will be the future and a lot of observations, the essence in studying meteor streams. Finally, I wish to thank Jeroen Van Wassenhove and Christian Steyaert for their constructive remarks; this is one of my objectives with my action calls! My special thanks also go to Norihito Kawamura and Rik Van Laethem for being able to use their observations.

[1] J. Van Wassenhove and Ch. Steyaert, in "Letters to WGN", *WGN* 18:6, December 1990, pp. 194–195.

[2] *Heelal* 35:11, November 1990, pp. 303–304.

[3] D. Olsson-Steel, *Apollo Asteroid-Related Meteoroid Streams*, Uppsala, June 1989.

[4] *Sky and Telescope*, December 1990, p. 587.

[5] C.J. Cunningham, "Introduction to Asteroids", Willmann-Bell, Richmond VA, p. 14, 110.

[6] G.W. Kronk, "Asteroids 1988 VP4 and 1988 TA; Two Possible Parent Bodies for Meteor Showers", *WGN* 17:1, February 1989, pp. 8–10.

[7] Ch. Steyaert, "Handboek Radiowaarnemingen", VVS Werkgroep Meteoren, 1985.

[8] G.W. Kronk, "Meteor Showers, a Descriptive Catalogue", Enslow, Hillside NJ, 1988, p. 107.

[9] J. Van Wassenhove, "Radio Observations in June 1987", *WGN* 16:6, December 1988, pp. 216–217.

Dirk Artoos

IMO and meteor research

From a letter of Dr. Alexandra Terentjeva to a colleague, communicated to Paul Roggemans, we quote the following passage, because it must be hart-warming for all meteor workers that have taken great efforts to establish IMO.

I think that the establishing of *IMO* is very important and timely. It is a sort of an active counterbalance to a general fall of interest in meteor investigation which has been taken shape during the past years among professionals. *IMO* can stimulate the creative activity of both amateurs and professional astronomers. For this cooperation to be fruitful, it is necessary to hold special professional amateur workshops and meetings, and the professionals should participate more actively in annual *IMO* meetings.

Alexandra Terentjeva

International Meteor Conference 1991

Potsdam, Germany, September 19–22

Rainer Arlt, André Knöfel, Ina Rendtel, Jürgen Rendtel

First circular – December 1990

The 1991 *International Meteor Conference* will take place at the 1991 autumn equinox weekend at the Schwielowsee (lake) near Potsdam, Germany. The program includes lectures on meteors and related fields, workshops, and the third General Assembly of the *International Meteor Organization*. The official language of the conference will be English, as usual. The conference will start on Thursday, September 19 and end on Sunday, September 22, after lunch.

The registration fee is estimated to be 180 DEM per person including the accommodation, generally in two-bed-rooms, and full board during the conference as well as the proceedings. Special conditions of payment for participants from currency-restricted countries can be arranged on request. Please, write to the organizing committee soon.

Amateur and professional meteor astronomers, who are interested in attending the 1991 *IMC* are asked to complete and return the preliminary registration form, below. *(Make a copy if you do not want to damage this issue, ed.)* The second circular containing more detailed information about site, travel possibilities etc. will then be sent in March 1991. *Please, accept that we consider only registrations if you make a pre-payment of 100 DEM no later than April 30, 1991* to Ina Rendtel, Gontardstraße 11, D-O-1570 Potsdam, Germany.

Note that we prefer payment by international postal money order! Furthermore, you may also transfer the amount to the postal (giro) account of Ina Rendtel, 547234-107 (not forgetting to mention the code 100 100 10 of the Postgiroamt in Berlin, Germany) *(see also on p. 3 of this issue, ed.)*. You may also transfer the amount to the following account: 133213 at Volksbank Potsdam (bank code 1609 2134, also to be mentioned!). Make sure, that we receive the full 100 DEM (ask for transfer costs!). Otherwise, we must ask you to pay these expenses.

Also note that in principle, no refunds are made. Only for cancellations due to very compelling reasons (such as illness), the organizers can consider to make an exception, the decision being made on a case by case basis.

The 1991 *IMC* will be organized by the *Arbeitskreis Meteore (AKM), PSF 37, D-O-1561 Potsdam, Germany*. Correspondence should be sent to this address.

International Meteor Conference 1991

Potsdam, September 19–22, 1991

First name: ______________________ Last name: ______________________

Mailing address: ____

____

____

Phone (fax, telex, e-mail): ______________________________________

How do you plan to travel? ○ by car ○ by train ○ by plane

Do you intend to:

- ○ to introduce your local group
- ○ to give a lecture
  topic: ______________________________
  duration: ______________
- ○ to present a poster

Remarks, suggestions: ______________________________________

____

____

I sent the prepayment on ______________ to ______________.

Date and signature,

Please, return to: *Arbeitskreis Meteore, PSF 37, D-O-1561 Potsdam, Germany.*

Deadline for Reporting 1990 Visual Observations

Paul Roggemans

I would like to prepare the *IMO* report with *all* visual observations of 1990 in April 1991. In order to finish this report in time for printing, **I urgently ask all observers and observing groups to make sure all their visual observations reach me no later than mid April.**

The report on the 1989 visual observations was completed only in September 1990. At that time, observing reports still came in! Several problems needed to be solved in connection with erroneous and incomplete data and these corrections were only finished late November. Some reports simply had to be deleted, because no reply was received from the observers and the errors could not be corrected. Finally, observing reports on 1990 were still being received as late as October and November. Since we could not keep on waiting indefinitely, these observations were not included any more in the 1989 report.

To avoid similar problems with the compilation of the 1990 report, we have the following advice:

- Be sure your reporting format is compatible with the *IMO* standards in all details;
- Use *IMO* observing forms (summary reports, hourly rate data and magnitude distributions). On the new observing forms, two columns are missing. Please add to the right of the hourly rate summary the total number of meteors seen during the interval. Also, add the mean limiting magnitude that applies to the magnitude distributions;
- If you make listings with all data sorted per date for all observers, make sure they are legible and use the *IMO* codes. In particular, the radiants being observed should correspond to the *IMO* reference list for meteor streams. Do not invent your own radiants; we enter shower meteors that do not occur in the *IMO* radiant reference list as sporadics. You would only waste your and our time;
- If you use a database system and provide diskettes, please note that so far, this has been a continuing source of problems. These problems stem from the fact that most people use a database program as a text editor and directly fill in values in the tables of the database. This way of operation is bound to produce typos resulting in all sorts of inconsistencies, fatal for the *VMDB*. If you use database software, stay out of the tables and manipulate them only through appropriate input routines that check for typos and other inconsistencies in the entered data! If you work with a database, be sure your procedure corresponds to the *VMDB* up to the smallest details!

Visual Observers' Notes: March and April 1991

Jeff Wood

In March and April, only the δ-Pavonids and the April Lyrids are active among the major showers. However, these months are characterized by whole host of minor streams that makes observing especially after midnight most interesting when rates in dark skies can reach over 20 meteors per hour on occasions. As well, is the unusual number of brilliant fireballs that emanate out of the Scorpius, Libra, Centaurus and Virgo regions. Two of these seen on March 18, 1983, and April 6, 1975 were recorded as -19 and -15 respectively!

Table 1 lists some of the meteor showers to be seen in March and April 1991. Table 2 shows moonlight and observing conditions. The illuminated part of the Moon is always given for 0^h UT on the date indicated. The dates of the phases of the Moon are also given in UT.

Table 1 – A list of some of the meteor showers to be seen in March–April 1991.

Shower	Activity	Max	Radiant			Drift		V_∞	r	ZHR
			α	δ	Diam.	$\Delta\alpha$	$\Delta\delta$			
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	
γ-Normids	Feb 25–Mar 22	Mar 14	249°	−51°	5°	+1°1	+0°1	56	2.4	8
δ-Pavonids	Mar 11–Apr 16	Apr 07	308°	−63°	10°/15°	+1°2	+0°1	59	2.6	13
Scorpid/Sagittarids	Apr 15–Jul 25	several	260°	−30°	15°/10°			30	2.3	10
Lyrids	Apr 16–Apr 25	Apr 22	271°	+34°	5°	+1°1	0°0	49	2.9	var
π-Puppids	Apr 15–Apr 28	Apr 23	110°	−45°	5°	+0°6	−0°2	18	2.0	var
α-Bootids	Apr 14–May 12	Apr 28	218°	+19°	8°	+0°9	−0°1	20	3.0	3
η-Aquarids	Apr 19–May 28	May 04	336°	−02°	4°	+0°9	+0°4	66	2.7	50

Table 2 – Moonlight and observing conditions in March–April 1991.

Date	k	Date	k
Friday March 01	1.00−	Friday April 05	0.71−
Friday March 08	0.54−	Friday April 12	0.10−
Friday March 15	0.02−	Friday April 19	0.23+
Friday March 22	0.36+	Friday April 26	0.91+
Friday March 29	0.98+	Friday May 03	0.85−

New Moon:	March 16, April 14, May 14
First Quarter:	February 21, March 23, April 21
Full Moon:	February 28, March 30, April 28
Last Quarter:	March 8, April 7, May 7

The Visual Commission of the *IMO* although requiring data on all streams realizes practical considerations like work, study, family, Moon and 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 March and April are the Virginids, δ-Pavonids, α-Scorpids, April Lyrids and the γ-Normids.

1. Virginids

This shower is very complex and is active from February 1 through to May 30. There are many subradiants and submaxima. Observers are encouraged to continue the project outlined in the Visual Observers' Notes for January and February 1991 [1].

2. δ-Pavonids

The δ-Pavonids are thought to have been formed from the debris of Comet P/Grigg-Mellish (1907 II). Observations to date indicate that the shower produces variable activity with rates at maximum varying in the range of 5 to 15 meteors per hour. With the radiant reaching its greatest altitude in the southern hemisphere skies in the pre-dawn hours, the shower is greatly affected by the Moon in 1991. The δ-Pavonids are active from March 11 through to April 16 with the maximum occurring on April 7. They are very fast (V_∞=59 km/s), often bright yellow or blue in color and leave a train. Some of these trains are quite persistent with one seen in 1986 lasting for over a minute after the meteor itself disappeared from view.

In 1991, southern hemisphere observers are encouraged to give the δ-Pavonids particular attention during initial and final stages of activity when there is no interference from the Moon. They should locate their field center no more than 40° away from the radiant and ensure that all meteors seen are plotted.

Table 3 – Radiant positions of the δ-Pavonids (diam.: 10° × 5°).

Date	α	δ	Date	α	δ
Mar 11	296°	−65°	Apr 05	307°	−63°
Mar 21	301°	−64°	Apr 10	309°	−63°
Mar 31	305°	−63°	Apr 15	311°	−62°

3. γ-Normids

This shower is often misnamed the Corona Australids due to a transcription error by the great New Zealand meteor worker R. MacIntosh in 1935. The γ-Normids are active from February 25 through to March 22. A variable maximum of 3 to 15 meteors per hour occurs on March 14. They are fast meteors and are best seen from the southern hemisphere in the pre-dawn hours. With favorable Moon-conditions, the *IMO* urgently requires observations of this stream. Observers should locate their field center no more than 40° away from the radiant and plot all possible γ-Normids seen. If observers wish to monitor both the δ-Pavonids and the γ-Normids, the field center must be located around $\alpha = 270°$ and $\delta = -55°$.

Table 4 – Radiant positions of the γ-Normids.

Date	α	δ	Date	α	δ
Feb 25	234°	−53°	Mar 14	249°	−51°
Mar 03	237°	−52°	Mar 19	254°	−50°
Mar 08	242°	−52°	Mar 22	258°	−50°

4. April Lyrids

The Lyrids are active from April 16 to 25 reaching a maximum of between 10 and 15 meteors per hour on April 22. On a few occasions, the most recent being in 1982, rates have been much higher almost reaching 100 meteors per hour. The Lyrids' parent body is comet P/Thatcher (1861 I). In 1991, the Lyrid activity period is virtually Moon-free and so the *IMO* urges all observers to give them special scrutiny. With a V_∞ of 49 km/s care need to be taken when identifying meteors as Lyrids. Observers should ensure that the center of their field of view is no more than 40° from the radiant. Also they should plot all meteors see unless the ZHR exceeds 10 when countings are permitted. Only at maximum is this likely to be the case.

Table 5 – Radiant positions of the Lyrids (diameter: 5°).

Date	α	δ	Date	α	δ
Apr 16	265°	+34°	Apr 22	271°	+34°
Apr 19	268°	+34°	Apr 25	274°	+34°

5. α-Scorpids

The α-Scorpids are one of the major components of what Hoffmeister called the Scorpio-Sagittarius complex of showers. This ecliptic stream is active from March 26 to June 4 with a broad maximum of between 4 and 8 meteors being reached during early May. The α-Scorpids are well known for the many brilliant yellow, orange and green fireballs they produce. Few, however, leave a persistent train.

With a velocity V_∞ of 35 km/s, and several other Scorpio-Sagittarid radiants active in the same region of the sky, especially in May and early June, special care need to be taken when recording and classifying these meteors.

Table 6 – Radiant positions of the α-Scorpids (diameter: 5°).

Date	α	δ	Date	α	δ
Mar 26	236°	−21°	May 05	246°	−24°
Apr 05	238°	−21°	May 15	249°	−25°
Apr 15	241°	−22°	May 25	252°	−25°
Apr 25	244°	−23°	Jun 04	254°	−26°

Observers should plot all possible α-Scorpids seen. They should center their field of view no more than 30° from the radiant.

6. Theoretical radiants of 1863 Antinous and 1981 Midas

The Earth has a closest approach to the orbit of the minor planet *1863 Antinous* on April 6 (distance: 0.178 AU). Possible meteors have a V_∞ of 19.6 km/s and should radiate from $\alpha = 204°$, $\delta = +32°$ (April 6), $\alpha = 212°$, $\delta = +31°$ (April 16) [2].

A closest approach with the orbit of *1981 Midas* occurs on March 20 (distance: 0.001 AU). Possible meteors have a V_∞ of 30.1 km/s and a radiant at $\alpha = 205°$, $\delta = +35°$ (March 10), $\alpha = 213°$, $\delta = +34°$ (March 20) [2].

The orbits of both asteroids come close to that of the Earth's and the values of V_∞ make it possible to observe showers related to one or both objects. Due to the close approach and the high V_∞, 1981 Midas is the more favored candidate. The theoretical radiant positions provide northern hemisphere observers with the better viewing conditions though they can be observed in both hemispheres in the evening skies.

It should be noted that the theoretical radiant positions may differ somewhat from the actual observed ones by some degree. This means that it is impossible to carry out shower associations and obtain ZHRs using standard observing procedures. What needs to be done is to investigate whether or not there is a significant radiant in the vicinity of the predicted one. In order to do this, observers should center their field of view at a distance of less than 20° from the predicted radiant position and plot all meteors seen that radiate from an area of about 25° around the predicted radiant position onto the Atlas Brno gnomonic charts. The X,Y-coordinates of the plots should be measured (see [3]) and reported in the table format described in the Aquarid Project (see [4]). Please of course mention the chart number.

The radiant of 1981 Midas should be monitored from about March 19 to 23 (no later due to the Moon) and that of 1863 Antinous from April 2 (Moon) to 15.

References

[1] J. Wood, "Visual Observers' Notes: January and February 1991", *WGN* 18:6, December 1990, pp. 203–297.

[2] Duncan Olsson-Steel, "Theoretical Meteor Radiants of Recently Discovered Asteroids and Comets and Twin Showers of Known Meteoroid Streams", *Australian Journal of Astronomy*, April 1988, pp. 93–101.

[3] R. Koschack, "Comments for Visual Observers", *WGN* 18:6, December 1990, pp. 197–198.

[4] R. Koschack, J. Rendtel, "Aquarid Project 1989", *WGN* 17:3, June 1989, pp. 90–92.

Earth-Grazing Fireball

Czechoslovakia, Poland, October 13, 1990, $03^{h}27^{m}16^{s}$ UT

P. Spurný, Z. Ceplecha and J. Borovicka, Ondřejov Observatory

A fast-moving fireball of −6 maximum absolute magnitude with extremely long trajectory was photographed at two Czech stations of the European Network. The fireball traveled a 409-km luminous trajectory in 9.8 seconds and the visual trajectory was horizontally oriented at the perigee point given by latitude 50°7 N, longitude 17°4 E and height 98 km. From the initial mass of 40 kg, only 370 g were ablated. The body attained meteoritic fusion crust, left the atmosphere again and continued its motion in the Solar System in a changed orbit. During the whole visible trajectory, the deceleration was much less than the gravitational acceleration.

Table 1 – Trajectory data

	Begin	Perigee	End
Velocity (km/s)	41.5	41.5	41.5
Height (km)	100.7	97.9	101.6
Latitude (° N)	49.01	50.70	52.61
Longitude (° E)	17.65	17.40	17.09
Abs. magnitude	− 5.7	− 6.3	− 5.8
Photom. mass (kg)	40.4	40.2	40.0
Z R (°)	88.3	90.0	91.9

Table 2 – Radiant data (1950.0)

Radiant	Observed	Geocentric before encounter	Geocentric after encounter	Heliocentric before encounter	Heliocentric after encounter
α (°)	97.7	97.4	96.9		
δ (°)	−39.0	−41.2	−36.9		
λ (°)				299.4	306.5
β (°)				− 70.4	− 73.0
Velocity (km/s)	41.5	40.0	40.0	38.2	36.2

Table 3 – Orbital data (1950.0).

Orbit	before encounter	after encounter
a	2.80 AU	1.91 AU
e	0.65	0.48
q	0.993 AU	0.986 AU
Q	4.6 AU	2.8 AU
ω	8°9	15°5
Ω	18°9733	18°9733
i	70°7	73°7

This fireball resembles the famous big daylight Earth-grazing fireball of August 10, 1972, over the USA [1], but its mass was more than three orders lower and the perigee height by 40 km heigher.

[1] *Bull. Astr. Inst. Czechosl.* 30, 1979, p. 349.

Photographic Meteor Observations in the Tokyo Meteor Network

Katsuhito Ohtsuka and Hiroyuki Tomioka

The Tokyo Meteor Network implemented a photographic observing program using middle rather than short focus lenses of 85–100 mm, aimed at obtaining more accurate meteor orbital data. In particular, the middle focus lenses allow estimates of the atmospheric deceleration of the velocity of a meteor. Results are presented for two meteors simultaneously photographed from Daisawa and Okitsu. Also, the limiting magnitude for meteors has been improved.

A photographic meteor observation, using the middle focus lenses of the 85–100 mm class, has been started within the *Tokyo Meteor Network (TMN)* since December of 1989. The main aim of the observation is to determine high quality meteor orbits better than before, when photographic observations were used, carried out with short focus lenses.

A list of 325 photographic meteor orbits obtained in Japan was recently published [1,2]. These results were obtained by observations carried out with short focus lenses of 35–50 mm with rotating shutters. Taking into account the accuracy of such short focus lenses, generally speaking, the velocity errors are in the order of 3–5%, and the positional errors are 30–60″. The focal length of these lenses is too short to estimate the atmospheric deceleration of the velocity of ordinary meteors. Therefore, almost no-atmospheric velocities were assumed for the 325 orbits as a mean observed velocity [3]. The inaccuracy of the no-atmospheric velocity has a great effect on the determination of the semi-major axis and the eccentricity of the meteor orbit. Altough the angular elements of the 325 orbits are well-determined, the values obtained for the semi-major axis and eccentricity might be somewhat smaller than the real ones, because of an assumption of the mean observed velocity [3].

On the other hand, the new *TMN* observational system, equipped with 85–100 mm lenses and rotating shutter with high angular velocity, makes it probably possible to estimate the atmospheric deceleration of the velocity, applying the exponential equation

$$V(t) = b + ce^{kt}$$

proposed by Babadzhanov and Obrubov [4]. In this equation, the value of b corresponds to the no-atmospheric velocity.

In fact, this system produces more accurate observations than before, with the short focus lenses. In a tentative observation on the night of December 9, 1989, two meteors were photographed simultaneously from two stations of the *TMN*, and their orbital elements were reduced, applying the program *METEOR*. The atmospheric decelerations for both meteors were determined. The summary of the orbital data are listed in Tables 1–3, and a good example of the determination of the atmospheric deceleration is shown in Figure 2.

The errors in velocity and position for both meteors are 2–3% and 10–20″, respectively. Hence, we can determine more reliable meteor orbital data.

Table 1 – Coordinates of the observing stations and characteristics of the equipment.

Station	λ	ϕ	h	Lens	n	Rotating shutter
Daisawa	139°40″41.″10 E	35°39′07.″45 N	36 m	85 mm $f/1.2$	6	50 breaks/s
Okitsu	140°41″21.″4 E	36°38′21.″9 N	40 m	100 mm $f/2.8$	4	40 breaks/s

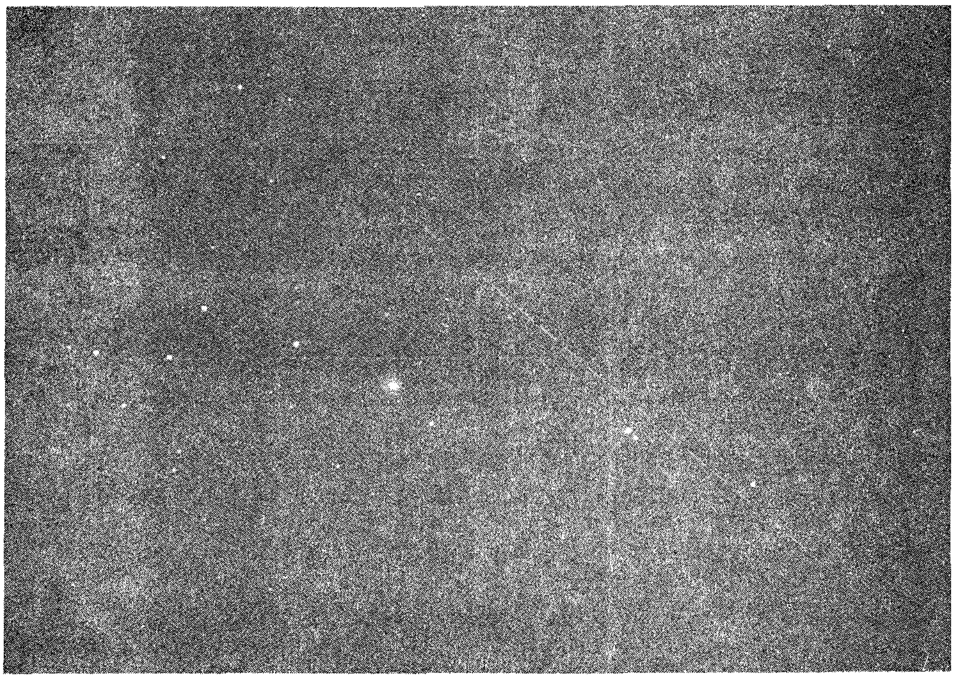


Figure 1 – Meteor T891201 as photographed from Daisawa.

Table 2 – Orbital data of meteor T891201 (1950.0)

Time of appearance	1989 Dec 09.7311 UT
Solar longitude	$\lambda_\odot = 257°1$
Magnitude	0
Classification	α-Taurid
Corrected radiant position	$\alpha = 71°1 \quad \delta = +13°3$
sin Q	0.988
cos Z	0.692
Height	$h_{\text{begin}} = 90.3$ km $\quad h_{\text{end}} = 68.5$ km
Velocity	$V_{\text{geo}} = 19.6$ km/s $\quad V_{\text{hel}} = 37.7$ km/s
Angular elements	$\omega = 77°2 \quad \Omega = 77°1 \quad i = 5°4$
Other elements	$e = 0.717 \quad q = 0.665$ AU $\quad a = 2.346$ AU

Q: angle between the great circles of the meteor paths from both stations
Z: zenith distance of the apparent radiant

Table 3 – Orbital data of meteor T891202 (1950.0)

Time of appearance	1989 Dec 09.8383 UT
Solar longitude	$\lambda_\odot = 257°2$
Magnitude	–1
Classification	σ-Hydrid
Corrected radiant position	$\alpha = 127°1 \quad \delta = +01°7$
sin Q	0.748
cos Z	0.702
Height	$h_{\text{begin}} = 110.1$ km $\quad h_{\text{end}} = 80.7$ km
Velocity	$V_{\text{geo}} = 60.1$ km/s $\quad V_{\text{hel}} = 42.5$ km/s
Angular elements	$\omega = 114°4 \quad \Omega = 77°2 \quad i = 130°6$
Other elements	$e = 1.000 \quad q = 0.289$ AU $\quad a = -869.0$ AU

Q: angle between the great circles of the meteor paths from both stations
Z: zenith distance of the apparent radiant

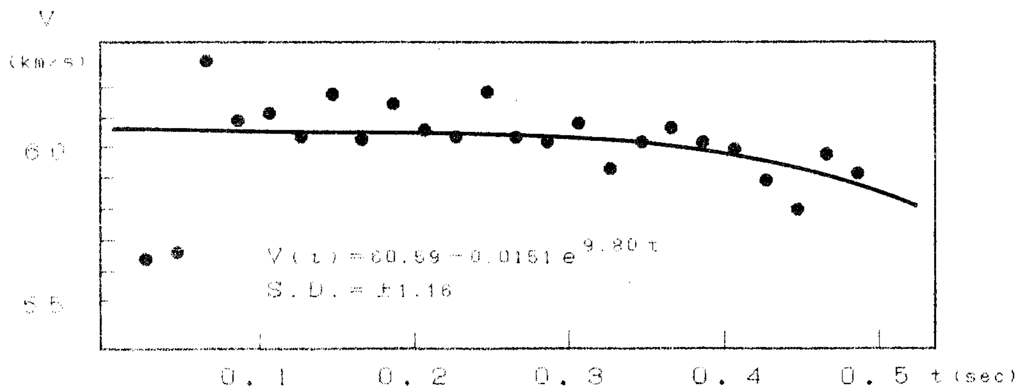


Figure 2 – Atmospheric deceleration of meteor T891201 observed at Daisawa.

As to cameras in the *TMN*, a set of Canon T-70 (35 mm size) cameras with 85 mm $f/1.2$ lenses is installed at the Daisawa and Hadano stations. The aperture of the lenses is about 70 mm, twice as large as for a 50 mm $f/1.4$ lens. These 85 mm lenses correct some kinds of aberration because their surface is aspherical. Therefore, a good image should also be formed at the edge of the film. It should be noted that the limiting magnitude for meteors on the film is about +4 (!), as expected from the high power. So, we can also photograph fainter meteors than before. A set of Mamiya Press (6×9 size) cameras with 100 mm $f/2.8$ lenses is installed at the Okitsu and Tsukuba stations. The limiting magnitude for meteors there is about +2; however, these lenses cover a field twice the wide of that of the 85 mm lenses. We have improved the photographic meteor observation in this way with respect to the observations using 35–50 mm lenses before, and we will continue such improved observations from now on.

References

[1] M. Koseki, "Amateur meteor studies in Japan", *Proc. Asteroids, Comets, Meteors III*, C.-I. Lagerkvist, H. Rickman, B.A. Lindblad and M. Lindgren (eds.), Uppsala, 1990, p. 543.

[2] M. Koseki, T. Sekiguchi, K. Ohtsuka, "Photographic meteor observations in Japan", *ibid.*, p. 547.

[3] B.A. Lindblad, "A study of meteor orbits obtained in Japan", in *Origin and Evolution of Interplanetary Dust*, IAU Colloquium 126, 1991, D. Reidel, in press.

[4] P.B. Babadzhanov, Yu.V. Obrubov, *Komety i Meteory* 27, 1980, p. 51.

Radio Observations of Meteors

Jeroen Van Wassenhove

This introductory article covers some basic fundamentals of how to carry out radio observations, without going into too great detail.

1. Introduction

To some people, radio observations of meteors are somewhat weird. Most often, the first thing they think of is that it must be very technical and, therefore, very difficult. This is however not true! This article tries to explain the basic method of this uncommon method of detecting meteors without going into the technical stuff.

Radio work covers two techniques: forward scatter and back-scatter. In back-scatter, the transmitter (e.g. a radio station) and the receiver (the observer) are located at the same place. In forward scatter, the transmitter and receiver are separate from each other. Back-scatter is mainly used by professionals and is better known by the term *radar* (radio detection and ranging). Amateur radio observers only use forward scatter. So, only this method is used in the *IMO Radio Commission*.

2. The principle of forward scatter

When a meteoroid enters to the atmosphere, it produces an ionized column of gas molecules. This ionized trail has the feature to influence the propagation of electromagnetic waves, especially those between 40 MHz to 150 MHz. The optimum lies between 40 MHz to 70 MHz.

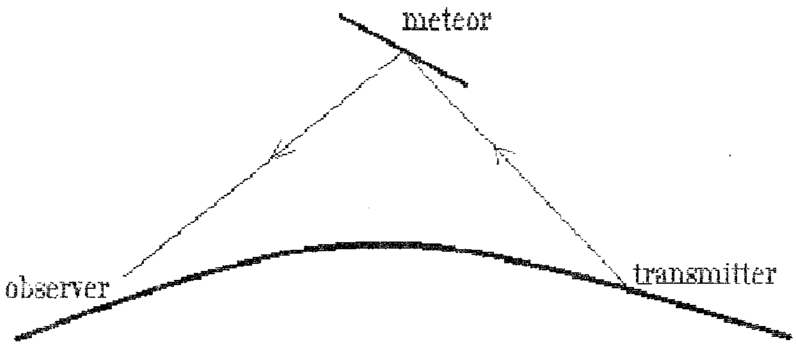


Figure 1 – Principle of forward scatter.

The technique used to register meteors is quite simple (Figure 1). A receiver is tuned to a radio station that is located below the horizon. This station may not be heard; only background noise is apparent. At the moment a meteor appears under the correct angle, there is a short contact (0.1 to 4 seconds) with that radio station. This contact can be a short piece of music, voice or noise increase. The distance between receiver and transmitter varies between 300 and 2000 km. Most often a commercial radio station is used as transmitter. Beacons are also suitable.

As this technique uses electromagnetic waves, it can also be used during daylight, when there is moonlight, rain or clouds. This is definitely a big advantage.

3. What do you need to observe

Before one sets up his radio equipment, one first has to chose a proper frequency or frequency band. Important is that the frequency band you chose should be rather silent and not overcrowded by local commercial radio stations. This choice is important as it influences your future results and determines your receiver, which is the most expensive part of the equipment set up. Once this is done, one can start with the equipment.

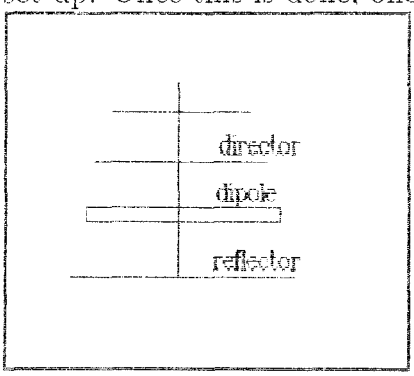


Figure 2 — Schema of a Yagi antenna.

A basic equipment set up consists of three essential parts: the antenna, the transmission line and the receiver.

The most suitable antenna for this kind of work is a Yagi antenna (Figure 2). This is a cheap, good antenna with a reasonable gain. The antenna consists of a half wave dipole, a reflector and one or more directors. The more directors the antenna has, the higher the gain and the more direction sensitive it becomes. The antenna can be placed under the roof, if it is a wooden roof, or outside. The antenna should best be directed to the transmitter (beacon or radio station), with an elevation of about 50°.

For the transmission line, one can chose between coax cable and twin lead. Twin lead is not shielded and suffers from radiation loss. Coax does not has these disadvantages, which implies that this type of cable can be used in the neighborhood of interference to a certain degree. Special attention should be paid when connecting the transmission line to the antenna, especially when the antenna is mounted outside. Also, the length of the cable should not be too long (less than 15 meters) for signal loss. The shorter, the better.

The most important part of the equipment set up is the receiver. The receiver must have the correct frequencies you chose for. One can use a receiver with an analogue scale. This can work quite well if the scale is gauged. A digital display on the other hand is very accurate and is more reliable. In this respect, a digital display is not a luxury. Sometimes a receiver has a squelch or muting circuit which suppresses the weak signals. In that case, the circuit must be turned off or disabled, otherwise no meteor will ever be heard.

One can extend the equipment with extra devices such as chart recorders, computers, etc. in a later stadium.

4. How to observe

The first stadium is to get acquainted with the "meteor reflection" sound. A meteor reflection is always very sudden and has a very short duration. About 90% of all meteor reflections are shorter then 2 seconds. During that short duration, one can hear a piece of music, voice or noise increase. It is such a typical sound that once heard you will not forget any more. For each meteor reflection one should record time, estimated duration, strength and a short description.

Before one starts to observe a meteor shower, one should first know how his "radio observing circumstances" are (described by the *observability function*). In general, one can claim that the observing circumstances are at their best when the radiant has a height of about 45° and is perpendicular to the receiver-transmitter plane. For rough and quick use, this method gives good results but in fact, the situation is a bit more complicated. The observability function depends on a lot of parameters such as equipment set up, used frequency, etc. and can be calculated with the *FORWARD* program, which is available from the Radio Commission. One can not compare the visual observing circumstances with the radio observing circumstances as they do not at all coincide. For example, when the radiant is higher than 70°, no meteor reflection of the meteor shower will be heard. For visual work, the situation then becomes ideal.

When a suitable period of time is chosen, one can start observing. It is strongly recommended to listens during a series of days during the same period of time without changing equipment set up, frequency, etc. This makes it much more easier to compare results from the different days. Do not forget that one can always listen to the sporadic activity (around the clock), which is already very fascinating in its own right.

5. The Radio Meteor Database (RMDB)

The incoming radio observations are entered into the *Radio Meteor Database (RMDB)*, where they are used for analysis. The *RMDB* contains at this moment about 1.5 Megabyte (or more than half a million meteor reflections) of radio data of several countries. Figure 3 represents the input screen for the technical data about the equipment set up.

```
      Equipment nr  601                     Observer     BROPE
          Sitecode    199                 Valid from     10/10/87

      Antenna Type  YAGI            Number of reflect    1
Number of directors  3            Height above ground     2.0
 Polarisation(HVC)  H                  Design Frequen    90.0MHz
 Amplifier Faktor     .

  Line(coax/lead)  COAX                        Type     RG 59B/U
         Lenght      2.3                  Impedance       75
                                         Loss dB/m      0.1

 Antenna Amplifier N                         Noise fakt
        Place(A,R)                      Amplifier fakt     .

        Receiver    AUDIODEK CAR RADIO     Display(A/D)   D
          (S+N)/S                          Sensitivity     .
      Bandwith(kHz               Demodulation(FM,AM,SSB)  FM
```

Figure 3 – *RMDB* equipment set up input screen.

6. IMO Radio Commission services towards the observer

The Radio Commission provides several services for IMO members:

- the calculation of the observability function with the *FORWARD* program;
- the distribution of lists and information about suitable radio stations;
- free technical and observing report forms;
- giving general and technical information.

If you are interested in radio work or have questions, contact the Radio Commission.

All radio observations (also from previous years) of all countries around the world are welcomed at the Radio Commission. Please send them in!

Literature

[1] Gerard L. Hall, "The ARRL Antenna Handbook", The American Radio Relay League, 1984.

[2] Ch. Steyaert, "Handboek Radiowaarnemingen", VVS Werkgroep Meteoren, 1985.

Observational Results

1990 Summer Results of the JAS Meteor Section

Alastair McBeath

A brief overview of UK July-August 1990 summer results is given. Global magnitude distributions for the δ-Aquarid and Perseid meteor showers are presented. Attention is drawn particularly to an annual "burst" of Perseid fireballs on the night of August 12-13.

1. Introduction

Twenty-four individuals and/or groups contributed observations to the *JAS Meteor Section* from UK sites during July and August 1990, recording 2061 meteors in 264.5 hours. The observers were:

> Shaun Ankers, Thomas Banks et al., Roy Barclay, Neil Bone, Debbie Borrell et al., Shelagh Godwin et al., M. Groves, Guernsey AS, Hartlepool AS, Terry Holmes, Sebastian Jay, Craig Johnson, Richard Livingstone, David Lloyd, Lee Macdonald, Julie Maginn, Tony Markham, Alastair McBeath, Stewart Moore, Bob Paterson, Graham Pointer, Ian Rigney, Stephen Williams, Simon Wragg.

Weather conditions overall were rather poor (mean limiting magnitude of +5.56)—certainly worse than in the previous two years—with August suffering especially. Most moonless nights received some coverage, however, if only by one or two people.

2. δ-Aquarids

Some 64 δ-Aquarid meteors were noted in late July from a total of 74 shower members seen, though only data on 66 were reliable enough to be further examined. Of these, 23 meteors were given as Northern stream members, 19 as Southern ones, with the remainder simply reported as "δ-Aquarids", thus only a global magnitude distribution for all δ-Aquarid meteors observed is shown in Table 2.

ZHR results revealed combined activity in the 15–25 meteors per hour range between roughly July 24-25 and July 30-31, with Southern stream rates about 10–20 throughout this period when they could be defined separately. No clear peak was apparent. The train proportion was 6%.

Table 1 – Global magnitude distributions derived from JAS 1990 Summer observations.

Shower	-3^-	-2	-1	0	+1	+2	+3	+4	$+5^+$	Tot	$\overline{m}$	$\overline{m}_{6.5}$
δ-Aquarids	1	1	4	3	4	19	25	9	0	66	2.18	3.12
Perseids	9	14	17	44	65	73	57	18	1	298	1.27	2.21
Sporadics	1	4	13	62	84	142	191	82	35	614	2.31	3.25

3. Perseids

The single most obvious shower, as usual, was the Perseids, with 961 recorded members. A magnitude distribution based on the 298 seen in good skies by reliable observers forms part of Table 1.

ZHRs rose from about 3 meteors per hour on July 23-24 to around 8–10 meteors per hour by August 1-2, but thereafter moonlight took its toll, and no reliable activity could be calculated near the peak, despite many observers enjoying clear skies for August 12-13. Rates were only about 10–15 by August 14-15 in dark skies, and fell steadily thereafter. As ever, some 34% left persistent trains.

One curious feature about August 12-13 was the high incidence of Perseid fireballs. Between 21^h49^m UT and 23^h43^m UT no fewer than 20 individual events seem to have occurred (roughly one fireball every 5-6 minutes), at least seven of which were recorded at several sites. The most widely-seen was of roughly magnitude −6/−8 with a 12-15 second train, which took place at 23^h43^m UT as noted by six observers. Although many of these meteors were seen by inexperienced individuals who may have exaggerated the brightness of what they saw, seven were witnessed by reliable observers at various times during this spell (often in conjunction with less-reliable reports from other sites), and only three further Perseid fireballs were recorded after this time before 03^h30^m UT.

Admittedly, more observers were active before midnight UT than afterwards, but the proportionate mixture of experienced versus novice people remained similar. No record of a similar "burst" of fireballs near the Perseids' peak has been found in a search of the Section records from 1984 onwards, and it will be interesting to see if this can be corroborated by data from elsewhere, or whether UK observers were simply very fortunate.

4. Sporadics

For contrast, magnitude details on the 614 reliably-reported sporadics (from the 798 seen) are also given in Table 1. Observed hourly rates were around 7–8 through most of the summer (Corrected HRs about 15 on the average), while 7% gave rise to trains.

5. Conclusion

In all, the summer was less useful for British observers than either 1988 or 1989 with regard to both weather and Moon. The unexpected bonus of quite a number of fine Perseid fireballs on August 12-13 was some compensation, however.

Acknowledgments

I am indebted to all the above watchers for their splendid efforts, in spite of conditions, this summer.

The 1990 Perseids in France

Jean-Baptiste Feldmann

An overview is given of 1990 Perseid observations from France.

This is the third year in France that few observers are taking part in the Perseid watch. This year, the observing was done on 24 different nights between July 25 and August 22. During 77.75 hours, 963 meteors were registered, among which 431 Perseids and 532 other meteors (sporadics and minor showers). A total of 8 observers participated in the project. Their names are as follows:

> Sébastien Lebouc, Jean-Christophe Lernould, Xavier Delfosse, Cédric Catteau, Stephan Ker, Bernard Beauvisage, Cyril Follin, Jean-Baptiste Feldmann.

All observers estimated magnitudes, speeds and train. The distributions of speeds and trains are shown in Figure 1.

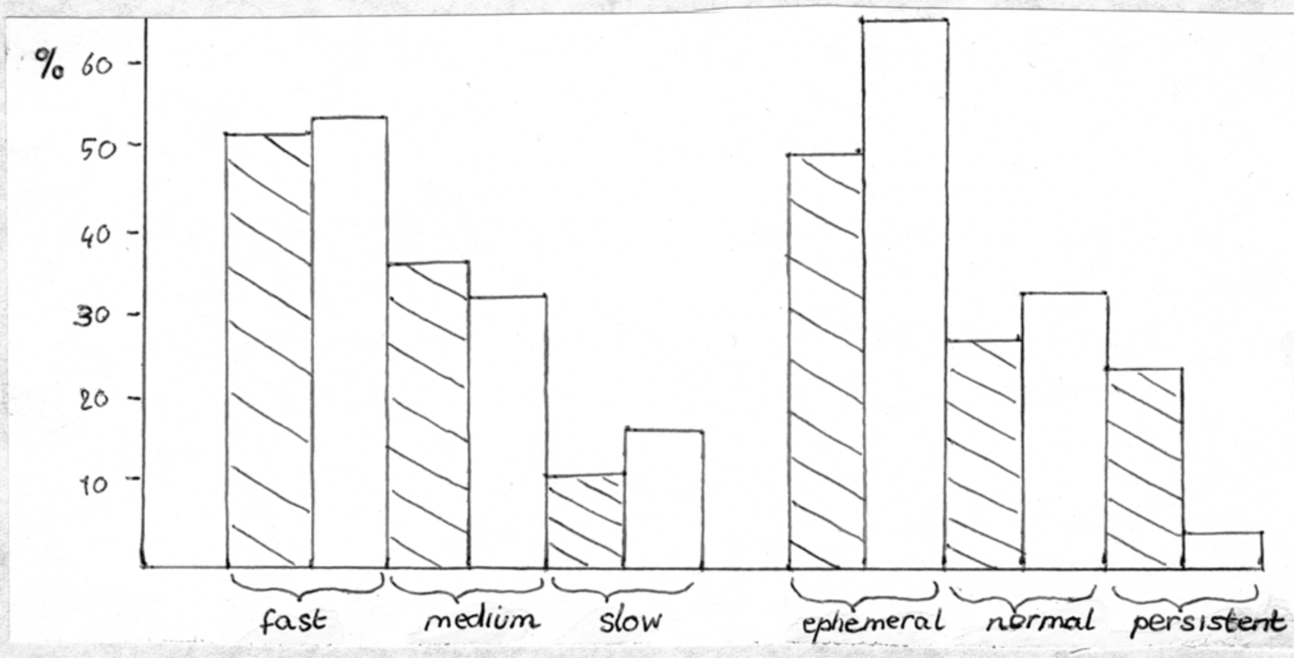


Figure 1 – Distribution of speed (left) and trains (right) for the Perseids (filled blocks) and the corresponding sporadic activity (open blocks).

In Table 1, average magnitudes per observer are presented.

Table 1 – Average magnitudes for Perseids and sporadics per observer.

Observer	FELJE	LEBSE	DELXA	FOLCY	LERJE	CATCE	KERST	BEABE
$\overline{m}$ Perseids	2.85	0.20	2.20	1.53	1.84	1.68	2.20	2.02
$\overline{m}$ others	3.51	2.33	3.44	2.25	2.56	1.80	2.58	2.75

The personal magnitude distribution for each observer in Table 1 is shown in Figure 2.

My grateful thanks are due to all observers whose fine efforts have made this report possible, and to Paul Roggemans and Evelyne Blomme for their encouragement to develop meteor observations in France.

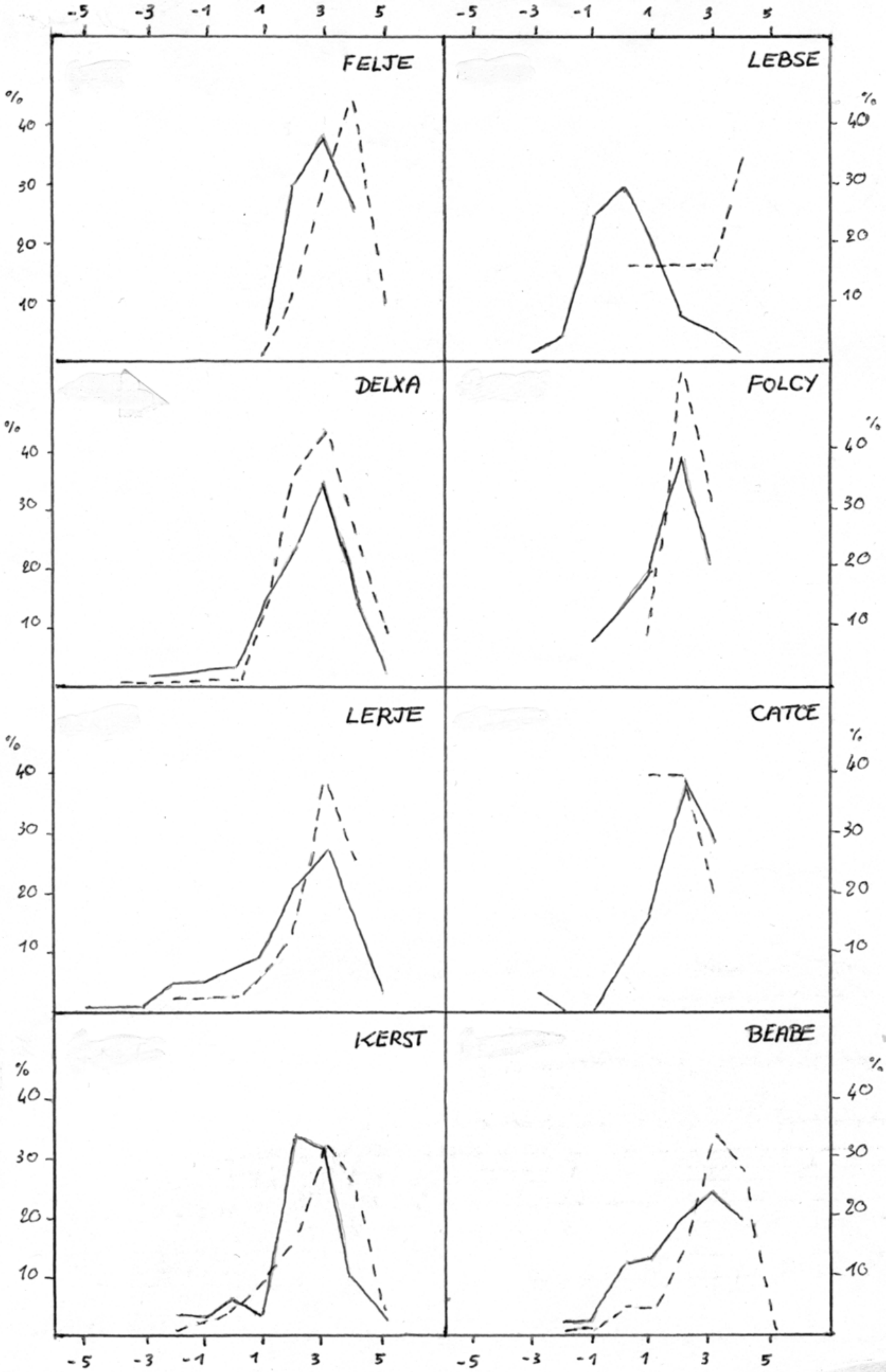


Figure 2 – Personal magnitude distributions for the Perseids (full line) and the other meteors (dotted line).

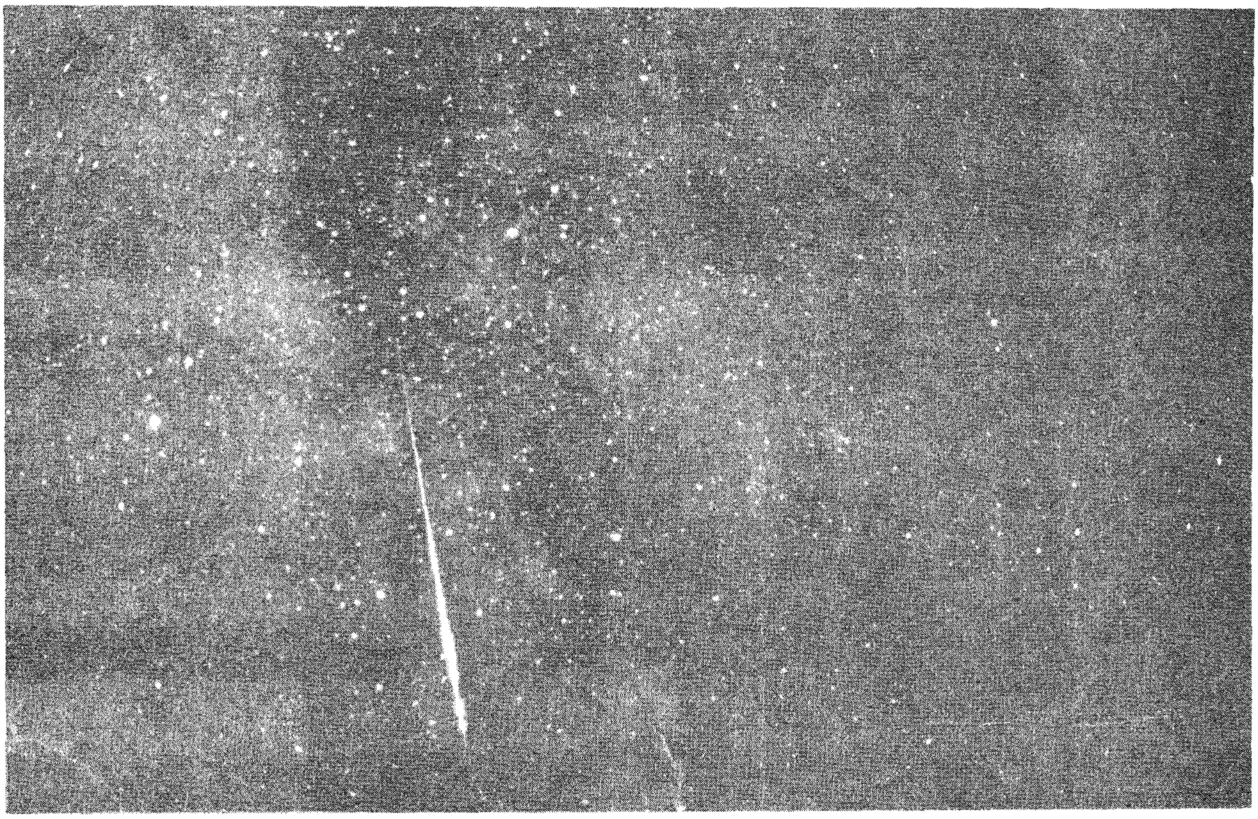


Figure 3 – Meteor photographed by J.M. Bourven and J. Bedel during the 1989 Perseid campaign. The photograph ws taken between 0^h20^m UT and 0^h26^m UT on August 3 with a 50 mm $f/1.9$ lens on TMax 400.

The 1990 α-Aurigids in Germany

Ragnar Bödefeld and Jürgen Rendtel

An analysis of 1990 German α-Aurigid observations is presented. Quite remarkably, activity around August 24 and 25 was higher than between August 26 and 29. A similar pattern has also been found in an analysis of earlier observations [1]. It is not yet clear as to what extent stream count pollution by late Perseids and sporadics could account for this feature.

As in the previous years, a number of German meteor observers of the *Arbeitskreis Meteore (AKM)* met in August 1990. This time, our campaign took place at the Meteorological Observatory Lindenberg (southeast of Berlin) from August 18 to September 2. Main targets were the late Aquarids as well as the α-Aurigids. Another group of *AKM*-observers worked already from August 11 at the Lausche mountain. Thomas Rattei reported about their results at the *IMC* 1990 in Violau.

Untypically for mid-Europe, there were 11 consecutive clear nights. Therefore, the activity profile of the α-Aurigids should have been recorded very well. But Murphy was able to send us clouds and thunderstorms around the maximum itself. The observing conditions in Lindenberg were excellent. The most exciting night, August 20-21, 1990, followed after the passage of a storm. Despite wind force 7 and flying insulating mats, observations were successful. Altogether, the participants observed 5437 meteors in a total effective time of 218.4 hours (cfr. Table 1). Most of the observers (marked with $*$) carried out more observations in August than just those in the Lindenberg camp.

Table 1 – Observers participating in the 1990 Lindenberg camp and their efforts

Obs	Nights	T_{eff}	Obs	Nights	T_{eff}
ARLRA	5	17.0	KOSRA*	11	33.8
BADPI*	5	22.4	KUSRA	6	23.0
BODRA*	11	40.8	RENIN*	8	32.2
HEIBE	1	1.9	RENJU*	5	21.5
KNOAN*	5	20.0	SCHPA*	2	6.0

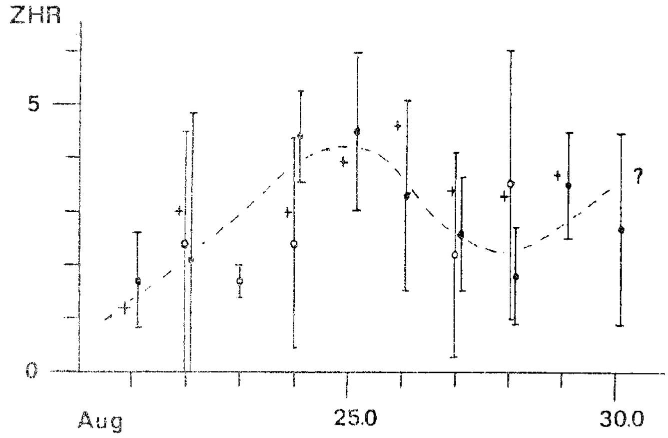


Figure 1 — Activity profile for the 1990 α-Aurigids. The values are ZHR averages of all observers active in the same interval. Dots correspond with radiant elevations above 30°, small circles with radiant elevations between 20° and 30° and crosses with radiant elevations below 20° (very unreliable!)

Besides the visual observations, also photographic work did not go short. Two fish eye lenses (type Zodiak $f/3.5$, $f = 30$ mm) were in use. One of these was equipped with a blue filter in order to analyze colors of meteors. Furthermore, some 24×36 mm cameras with high speed film were directed to the radiant of the α-Aurigids, but these results were not satisfying at all.

The meteors plotted were analyzed for α-Aurigids from August 21 onwards. Curiously, the calculated ZHRs of the α-Aurigids show the same feature as seen in the previous analysis [1]. The rates seem to be higher around August 24 and 25 than in the nights August 26-27 to 28-29. While this could be caused by an unsuitable observing direction and therefore erroneously aligned Perseids before August 24, the reason for this feature at that date remains unclear. The fact that we find a similar behavior for the activity of the α-Aurigids (or what we assume to be the α-Aurigids) in the sample of 1990 and the sample compiled from 10 years before, shows the need for more detailed data as well as for a strong search for the reasons. Since we have at hand plots for all observations presented here and in the previous study we may use the recently developed *PosDat* program to find out possible causes for the surprising result.

Reference

[1] J. Rendtel, "The α-Aurigid Meteor Shower", *WGN* 18:3, June 1990, p. 83, Fig. 2.

The April issue

Due to professional obligations abroad of the Editor-in-Chief, the April issue will be mailed about a week later than usual. Since this issue will be a thick one, we welcome your articles, photographs, observing reports etc.

Please make sure they reach the Editor-in-Chief no later than **March 10**!

Do not forget, this is *your* journal!

The 1990 Taurids and Orionids in Southern France

Jürgen Rendtel

An account is given of 1990 Taurid and Orionid observations carried out in the south of France.

From previous observational campaigns we learned about the good circumstances in the French Provence, namely in Lardiers. This information convinced four members of the *Arbeitskreis Meteore* to observe the 1990 Orionids from this site together with Paul Roggemans.

Our arrival in the late evening of October 13 showed a partially clear sky, and after a short meal and rest, it was possible to observe until the waning Moon reached a certain altitude in the eastern sky. Also the next night allowed some observations, but then it became totally cloudy. The often mentioned air flow named Mistral, which should be a common phenomenon in this area and always cause excellent sky conditions, was not to be felt. To make it short: this wind seems to be in the mind of some old people living in this region. All the time it did not appear. Once, Paul stated that Mistral was blowing—to my opinion this was a normal reverse side of a rather permanent depression we lived to see. Yet this was the only totally clear night out of the seven nights we could use.

If it is clear, the sky is quite good. The house we lived in is at about 900 m altitude. The surrounding mountains, especially in the north and east, obscure the parts near the (mathematical) horizon. To the south you look into a wide valley and no part is covered by hills. Unfortunately, the lights of Marseille can be seen as a brightened dome in southern direction, especially if dust or clouds occur above the city at about 80 km distance. More disturbing are the street lamps of Lardiers itself, but knowing how to turn them off, this obstacle can easily be overcome.

October is a period in which the zodiacal light can be quite easily observed in mid-northern latitudes. Also, the "gegenschein" could be seen on some of the clear nights.

Of course, the main goal were the meteors, namely the Orionids and the Taurids. In the evening hours, when the Orionid radiant is still below the horizon or only a few degreed above it, all observers preferably looked at a common area not far from the Taurid radiants in order to allow a certain association to the northern and southern branches and to carry out "multiple plottings" of meteors. During our observations the five experienced observers (Rainer Arlt, Ralf Koschack, Ina Rendtel, Jürgen Rendtel and Paul Roggemans) got more than 300 double or multiple plots. This should give good information about plotting errors which may occur and which have to be considered when minor showers are to be studied. Results will be presented in *WGN* after analysis.

Countings of Orionids were carried out around the maximum. The ZHR reached about 15 in the night October 20-21. It was characterized mainly by fainter meteors. Many meteors between +4 and +5 appeared, while in a later night (25-26) the portion of +2–+3 meteors was higher. Detailed results, such as the activity profile and the variation of the population index will be analyzed from all Orionid observations entered into the *VMDB* later.

The activity of the Taurids is not spectacular. But this ecliptical radiant complex includes a number of larger objects, too. We were witnesses of the entry of such an meteoroid on October 21 (Figure 1). The trail started with magnitude 0 in Pisces. The brightness steadily increased to −4 (Aquila), then to about −8 towards the horizon. When the fireball vanished behind the hills in the southwest, a terminal flare occurred which may be estimated to at least −12. The photograph even hints to a greater brightness. All observers kept quiet (surprisingly), internally counting the seconds and being fascinated by the event as a whole. Neither synchronous nor normal sounds were heard from this incredible fireball.

Although only seven nights allowed observations, our campaign brought a good sample of various data. Lardiers certainly is not the most suitable site, but it is useful to have access to a known location allowing observations with a higher certainty than other regions of Europe.

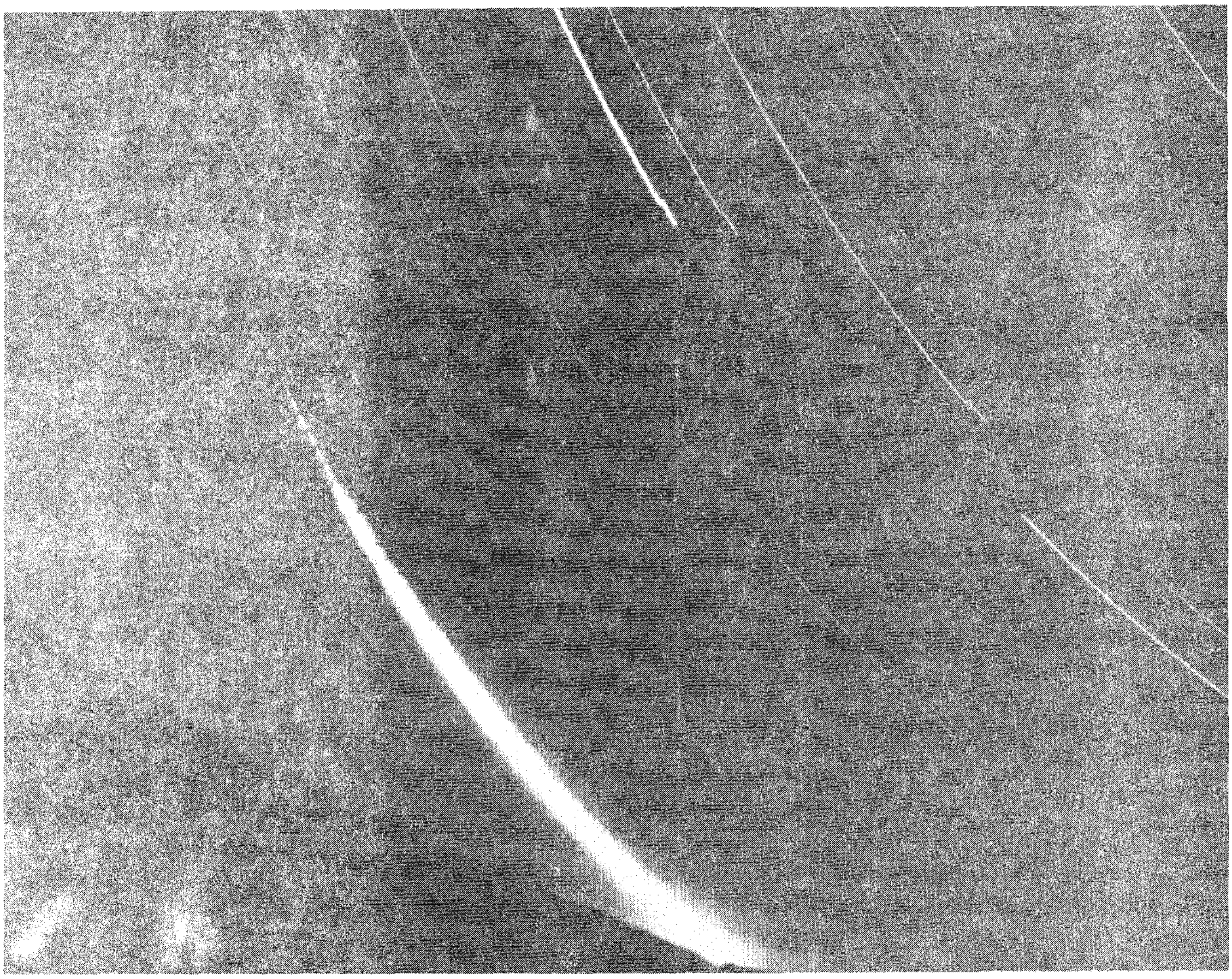


Figure 1 – Taurid fireball of magnitude −8 or even brighter photographed at Lardiers, southern France, on October 21, 1990, $19^h52^m14^s$ UT, on ISO 400/27° with a fish eye Zodiak $f/3.5$, $f = 30$ mm. The photograph was exposed from $18^h49^m02^s$ to $20^h03^m50^s$ UT.

Maryland's View of the 1990 Leonids and Geminids

Richard Taibi

An account is given of observations of the 1990 Leonids and Geminids from Maryland, USA.

Unless the observer in the north temperate climatic zone is able to travel, (s)he is subject to the vagaries of highly changeable weather. This means that you sometimes do not get good weather when you want to observe the maximum of a meteor shower. This was particularly true of late fall and winter 1990.

I was lucky to see the predicted maximum of the Leonids on November 18. And, unlucky to miss the Geminid maximum on December 14. Clouds also claimed the Ursid maximum on December 21-22. The Leonids did not show any unusual increase in number. I was content with the Geminid rate a full day ahead of the maximum. Hopefully next year will be better, with more cooperative weather.

The International Meteor Organization

Council

President: Jürgen Rendtel, Gontardstrasse 11, D-O-1570 Potsdam, *Germany*
Vice-Pres.: A. McBeath, 12A Priors Wk, Kirkhill, Morpeth, Northumberld. NE61 2RF, *Engl.*
Secretary-General: Paul Roggemans, Pijnboomstraat 25, B-2800 Mechelen, *Belgium*, tel. 32 (15) 41 12 25
Treasurer: Ina Rendtel, Gontardstrasse 11, D-O-1570 Potsdam, *Germany*,
postal (giro) account number: 5472 34-107
post office code: 100 100 10 Postgiroamt 1000 Berlin
(post office code and postgiroamt to be mentioned together with account number!)

Other council members:
Peter Brown, 181 Sifton Ave, Ft. McMurray, *Alberta T9H 4V7, Canada*
Malcolm Currie, 25, Collett Way, Grove, Wantage, Oxon. OX12 0NT, *England*
Marc Gyssens, Heerbaan 74, B-2530 Boechout, *Belgium*
Robert Hawkes, Mt. Allison Univ., Physics Dept., Sackville, *N.B. E0A 3C0, Canada*
Detlef Koschny, Ostpreussenstrasse 51, D-W-8000 München 81, *Germany*
Masahiro Koseki, 4-3-5 Annaka, Annaka-shi, Gunma-ken 379-01, *Japan*
Vasilii Martynenko, Astronomical Observatory of the Crimean Regional Young Technicians Station, P.O. Box 52, Simferopol, *Crimea* 333 000*, USSR*
Ann Schroyens, Stuivenbergvaart 48, B-2800 Mechelen, *Belgium*
D. Steel, Anglo-Australian Observatory, Private Bag, Connabarabran, *N.S.W. 2357, Australia*
Christian Steyaert, Dr. Van de Perrestraat 83, B-2440 Geel, *Belgium*
Gabor Süle, Egry 47/B III.11, H-8200 Veszprém, *Hungary*
A. Terentjeva, Astr. Council USSR Acad. Sci., Pjatnitskaja 48, Moscow 109 017, *USSR*
Casper ter Kuile, Akker 145, NL-3732 XD De Bilt, *the Netherlands*
Jeff Wood, 37 Hodgson Street, Tuart Hill, *West-Australia 6060, Australia*

Commission Directors

Visual Commission: Ralf Koschack, Wilhelm-Pieck-Str. 33, D-O-7580 Weisswasser, *Germ.*
Telescopic Commission: Malcolm Currie
FIreball DAta Center: André Knöfel, Anton-Fischer-Ring 96, D-O-1580 Potsdam, *Germany*
Photographic Commission: Dieter Heinlein, Puschendorferstr. 1, D-W-8501 Veitsbronn, *Germ.*
Radio Commission: Jeroen Van Wassenhove, 's-Gravenstraat 66, B-9810 Nazareth, *Belgium*
Computer Commission: Christian Steyaert

WGN — The Journal of the International Meteor Organization and Observational Report Series

Editor-in-chief: Marc Gyssens, tel. 32 (3) 455 68 18
Editorial board: Peter Brown, Masahiro Koseki, Jürgen Rendtel, Jeff Wood, and Trond Erik Hillestad, Stengelsrud, N-3600 Kongsberg, *Norway*
Typesetting: Urania, the Public Observatory of Antwerp
Printing: André Gabriël

Other author's addresses

Gotfred Møbjerg Kristensen, Vænget 13st.th, DK-4622 Havdrup, *Denmark*
Dirk Artoos, Nattenhofstraat 74, B-2800 Mechelen, *Belgium*
Rainer Arlt, Berliner Strasse 41, D-O-1560 Potsdam, *Germany*
J. Borovicka, Z. Ceplecha, P. Spurný, Astron. Inst., CS-25 165 Ondřejov, *Czechoslovakia*
Katsuhito Ohtsuka, 1-27-5, Daisawa, Setagaya-Ku, Tokyo 155, *Japan*
Hiroyuki Tomioka, 4-18-2 Ogitu-cho, 319-14 Hitachi-shi, Ibarak-i-ken, *Japan*
Jean-Baptiste Feldmann, F-21220 Collonges les Bevy, *France*
Ragnar Bödefeld, K. Fischerstrasse 7A, D-O-9001 Chemnitz, *Germany*
Richard Taibi, 7002 Coolridge Drive, Temple Hills, *Maryland 20748, USA*