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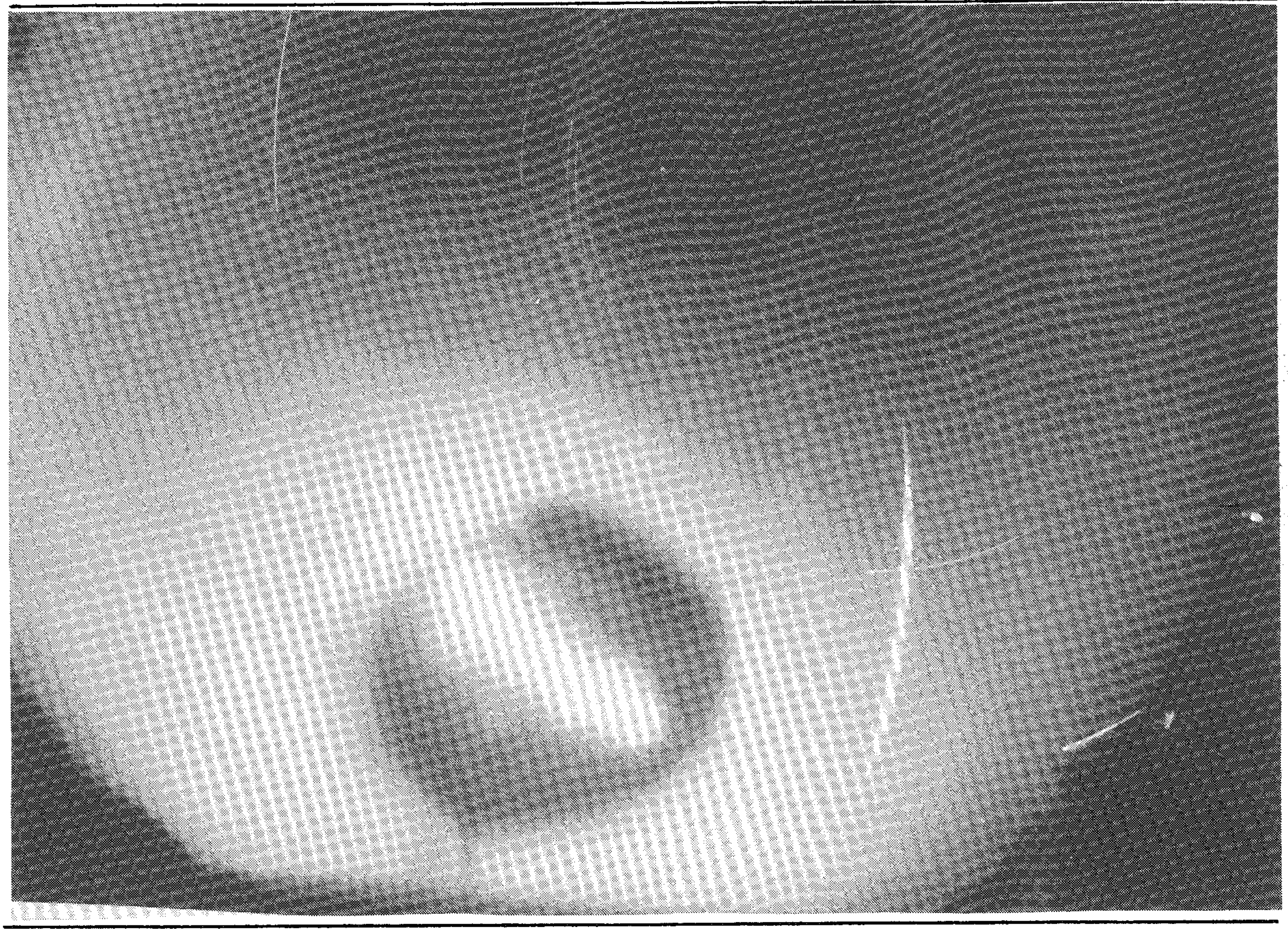
the international circular for meteor observers



This fireball was photographed on March 27, 1988 at $22^h10^m30^s$ by Klaas Jobse (meteor observatory Cyclops, Oostkapelle, the Netherlands), with an all-sky camera.

In this issue:

- More on the International Meteor Organization
- Practical information for observers
- The Murchison meteorite and comet Finlay
- Radio and video meteor observing techniques
- Observations of the Lyrids and the Ursids
- A new gnomonic star atlas

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Useful Information

The October Issue *(WGN 16:5)*

This issue will appear in Belgium in the second week of October. Contributions for the *October issue* are due by *September 1* at the latest. They should be sent to *Marc Gyssens* or to any member of the editorial board (addresses on the inside of the back cover).

Subscriptions 1988

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

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

From the Editor-in-Chief

Marc Gyssens

First of all, I want to apologize for an error in the editorial comment of WGN's June issue. There, I mentioned that every subscriber to WGN could become a founding member of IMO, just be returning the completed registration form, enclosed in the April issue. As you probably noticed, there was no such form in your copy! However, you will find the form in this issue of WGN. Since the IMO-train is going really fast now, we felt we had to make a compilation of all major proposals and decisions made thusfar, and submit them for approval to the founding members. Therefore, we brought all these proposals together in a little booklet, enclosed in this issue. In the booklet is also a voting form that should be returned by the founding members before October 1. Only founding members having formally applied have the right to vote. However, if you are a subscriber to WGN, but not yet a founding member, and you would like to become involved in IMO, just fill out the application form in the booklet and send it to us together with the completed voting form!

Of course, we do not intend to digress on all the proposals in the booklet, except for one, though. From several comments we got on the IMO proposal, we experienced that many people still think that WGN is a purely Belgian initiative, published by a Belgian association. As you should know, WGN has become a truly international journal since the beginning of this year, independent of any national or regional organization. It is intended to be the official IMO journal. In order to emphasize the international character of WGN, we felt the need to establish an editorial board. The following people were contacted and agreed to function in this board: Peter Brown (Canada), Trond Erik Hillestad (Norway), Masahiro Koseki (Japan), Jürgen Rendtel (GDR) and Jeff Wood (Australia). Their addresses are on the inside of the back cover. From now, contributions to WGN can either be sent directly to me, or to any member of the editorial board. We hope this new policy will encourage meteor workers all over the world to submit articles and reports to WGN.

Finally, this issue is a special one, as announced in WGN 16:3. It contains eight extra pages. In this way, we were able to shorten the waiting queue for articles considerably. Unfortunately, we still had to postpone a few articles we would have preferred to include in this issue, among them contributions from Teemu Hankamäki and Richard Taibi. You will read these in the October issue. As the conditions of the 1988 Perseids are very favorable, we expect many groups to organize observing campaigns. We hope the weather in your part of the world has been cooperative; meanwhile we anxiously await your observing reports!

The main article in this issue is a contribution by the very well-known David Seargent, discover of a comet and author of book on comets, over the possible association between the Murchison meteorite and P/Finlay. In this regard, Dr. Seargent mentions vague observational evidence for a weak minor show associated to comet Finlay, producing very slow meteors. Therefore, we ask our readers at southern latitudes to pay attention to possible meteor activity around the end of September and the beginning of October; read more about this in the Observer's Notes and in the article of Dr. Seargent.

Of course, there is much more in this WGN. For those who were not there, we have a report on the International Meteor Weekend, which took place in Oldenzaal, the Netherlands, in March of this year. By the way, you can still order the proceedings; consult the ad on the back of this issue! This issue's observational reports focus on the Lyrids of 1987 and 1988, and on 1987 Ursid observations in the South of France. Furthermore, there are several articles in this issue about radio work, and Klaas Jobse describes his "BETSY", which is of course not his wife, but highly successful video camera for meteor work. Finally, we also included some news from the meteor literature. In particular, a new gnomonic star atlas made in Brno, Czechoslovakia, is presented. Enjoy this special issue!

Still More Reactions on IMO

compiled by Marc Gyssens

At this moment, we can say that IMO is definitely a riding train that can no longer be stopped. We still receive mostly positive reactions from all over the world; some excerpts of these letters (directed to Paul Roggemans) are given here.

V.V. Martynenko in the USSR is definitely positive. He stresses the need for good training programs for beg~~inning meteor~~ observers and the need to restore contacts with professionals.

As regards the creation of an International Meteor Organization, our opinion is not only positive, but enthusiastic, ecstatic and so on! This is a very important project. Beside the conditions you set for successful work, I would like to draw your attention to an extensive packet with different programs for meteor research developed by observers of different qualification. We need to avoid the mixture of observational results obtained by observers of different training levels and different ability. No corrections can help us in this case. Evidently, it is necessary to test the observers to a certain degree and to distinguish them according to level of qualification. Through organized work we could effectively increase the observers' qualities.

It is desirable to have some kind of international unified training system with a test or even an examination. It is necessary to develop laboratory training sets.

To your suggestions, I would like to add a system of encouragement for the long and good results: medals, diplomas, prizes, etc. Evidently, it would be desirable to create some "fund of development".

I believe that it is very important to restore contacts with professional meteor organizations, since I can imagine the certain gap existing between professionals and amateurs originating in the past. In our country, this is connected partly with the fast progress of radiotechnical and photographic methods of observing, and... with the aging of our professional meteor researchers.

V.V. Martynenko, Simferopol, Crimea, USSR

Trond Erik Hillestad in Norway wants to cooperate with IMO, but asks questions about the level required in IMO and the administrative work this organization will involve.

I'm still not 100% sure on what it will mean to become a constitutional member of the IMO. However, I would of course like to help you with the IMO. Hopefully, this won't mean much more work for me than today.

WGN 16:2 had some comments on the IMO from several other meteor workers. I would like to give my own opinion on some of these comments:

- *D. Koschny: "It should stress the amateur aspect more. You tend too much to the professional side. Observing meteors should be fun, not work." It is important to stress the importance of data quality. Low-quality observations aren't very useful. So I think it is necessary to maintain a relatively high level on some of the articles in the new IMO-circular. When people know something about what their observations are used for, they can better understand how to make good observations. For instance, I found your article "On the Perseid Meteor Stream – II" in WGN 16:2 and earlier articles, very interesting, although some people (especially beginners) may have found it a bit on the difficult side. One question needs to be answered: "Who are meant to be readers of the new IMO-journal?" Professionals, experienced amateurs and meteor section leaders? Or perhaps beginners? "Popularized" articles will be necessary to recruit new people. However, it is also important to publish "high-level" articles, this way the the section leaders and experienced amateur can learn from each other. Then the section leaders* *can teach their own members/beginners to do good observations. A balance between these "extremes" may become very difficult, and the problem needs to be clarified before an IMO is founded. Yes, WGN does tend towards the professional side, beginners may have found it difficult to read from time to time, but its level should be kept also for an IMO-circular.*

- *George Spalding: I agree very much with Mr. Spalding. I fear the IMO completely will wear out you and your colleagues! Many people will be needed to keep the organization going. Section leaders and others will probably contribute with articles and observational results, but we can't help with the practical work: word-processing, printing, mailing, etc...*
- *P. Aldrich: "Your example of how to do serious amateur work is more important for the promotion of amateur contributions to meteor astronomy than an IMO." Yes, your inspiring of other groups cannot be questioned! But, I think more people will get to know about the working methods of the VVS-Meteor Section through an IMO.*

Trond Erik Hillestad, Kongsberg, Norway
February 19, 1988

Peter Brown believes in the future of IMO because he sees WGN as a solid base for this organization. Also, he wishes to coordinate activities in North America.

I noticed that a meteor worker commented in WGN that the IMO would end up in a similar situation as the IUAA meteor section and other such similar organizations. I feel that these sort of meteor organizations are often started in response to a perceived need rather than a real one. These groups died out because there was no one medium in which all the group members could exchange information, ideas etc. In most cases the groups plan to put together a newsletter or journal to fill this need. In all cases, though, the newsletter or journal has died as quickly as it started and the organizations fell away with it.

However, the IMO would be very different in this regard as WGN would serve as the central journal. As WGN is a well established journal, it is likely to continue publication well into the future. With WGN as the central medium in the IMO, I think the organization will succeed and prosper and end up ten or twenty years from now as the central clearing house for all amateur meteor work. I would, however, stress trying to keep the bureaucratic side of the organization as small and efficient as possible, as amateur meteor workers often have a distaste for large bureaucracies with a lot of red tape.

I would be pleased to coordinate the activities in North America. As well you can count on my full support of the IMO, and are free to offer my name for councilor or chairman of any committee which will help forward progressive serious meteor work. Also, I would be happy to boost WGN subscriptions over here by handling the monetary side of the subscriptions and sending them over to you by International Postal Money order if you wish for such an arrangement.

Peter Brown, Ft. McMurray, Alberta, Canada
April 28, 1988

Hans Salm in Bolivia wishes to cooperate with IMO too, but is somewhat sceptical.

Possibly, the decision about the IMO is already taken now, therefore may comments may not arrive on time.

However, let me make some observations:

1) *You are trying to organize an IMO based on an already existing structure, Werkgroep Meteoren and WGN. Most meteor observers agree that WGN is an excellent journal, not only for its contents, but also because it is a medium for communication and coordination. All the objectives proposed for the IMO, I think, you could reach with WGN,*

too; organizing a new International Association would only increment the administration (and costs?).

2) *Another problem are the great distances for overseas observers from America, Asia and Australia to participate in the IMWs where the important decisions are taken. For that reason, the IMO would essentially be a European Organization.*

3) *The IMO is mainly based on individual members (not group associations per country); this could debilitate national and regional organizations and that would be very negative.*

Well, probably IMO does exist already and the best we can do is cooperate and make it progress.

Hans Salm, La Paz, Bolivia
May 2, 1988

Dr. Duncan Olsson-Steel of the University of Adelaide in Australia welcomes IMO, which he sees as an organization the professionals could trust to acquire reliable observations from amateurs.

I would consider the idea of an International Meteor Organization to be an excellent one in that there is certainly a need for some wide-scaled coordination of meteor observers around the world. To be honest, I do not think that many of the professional meteor scientists would be very interested (especially since there are almost none left in the Western world, although there are still many in the Soviet Union and Czechoslovakia) since these people tend to be rather solitary workers who tackle specific problems from a rather different angle than do the many excellent amateur meteor astronomers: there is a far bigger difference between amateurs and professionals than just the fact that the latter get paid. Actually, this is the main reason that I believe your idea of an IMO to be a good idea; the fact is that the professional meteor astronomers tend not to use the observations of the various amateur groups (and again I am no exception here) since they are unable to assess fully the reliability of the data. You must realize that scientists of any description, because of their training, tend to be a very cynical and disbelieving lot. I know that this often leads to amateurs (who themselves tend to be over-enthusiastic, and hence may not be sufficiently dispassionate to collect unbiased observations) becoming very upset because the professionals tend to ignore them, but really the professionals have this sort of attitude drummed into them whilest they are training at university; and in general it serves the advance of science well, since that way a minimum number of mistakes are made (although of course many useful observations are then ignored since they are mixed with the poor data). Thus, I would say that apart from an IMO providing the infrastructure whereby useful observing programs, publication of handbooks and so on may be facilitated, such an organization would also be of import since it would allow a "stamp of approval" to be placed upon the observational work of individuals or groups. Of course, for this "stamp" to carry any weight — and I would not expect acceptance from professionals for some years until reliability has been proven — the IMO would have to be most stringent in assessing the work of observers. Of all of the fields of observational astronomy, meteor work has one of the poorest records of reliability, and many observations published are now regarded by practising scientists in much the same light as the famous "canals on Mars". This is an unfortunate situation: but one must realize the way that it is.

Dr. Duncan Olsson-Steel, University of Adelaide
Adelaide, South Australia, Aus.
May 11, 1988

Alastair McBeath from England also welcomes IMO, especially because he hopes this organization can set world-standards for meteor observing, making it possible to compare and combine observations of various groups in a global analysis.

At present, I am the Director of the Meteor Section of the Junior Astronomical Society, one of the UK's national amateur societies aimed particularly at newcomers to astronomy, whatever their age. Having a great interest in meteors — I've been actively observing them since 1977 — I've this year taken to subscribing to WGN via George Spalding of the BAA, and have followed the discussions on the IMO with particular interest. It is chiefly concerning this organisation that I'm writing to you now. I must stress that the views below are my own, and do not represent those of the JAS or any other group.

Meteors are a phenomenon in the Earth's atmosphere which can be observed world-wide. They are not constrained by national boundaries to appear in one place and not another. It is eminently logical that to examine meteor activity in detail to facilitate our understanding of these objects, we should do so on a global scale. If the IMO is to succeed — which I sincerely hope it will — it must remember this.

At the present time, we have groups in various countries throughout the world examining meteors in their own ways, preparing reports and observing guidelines with no real thought to looking at meteors in global terms. The consequence is that we are generally unable to compile meaningful results from several different parts of the world simply because there is no world-standard set of observing procedures or calculation guidelines. This seems to me a nonsensical situation, and worse, to be one which has not been remedied despite more than 150 years of serious examination of the phenomenon. With the IMO we have a real chance to put that situation to rights.

The IMO has begun with a great deal of obvious enthusiasm. We must be positive, and forward-looking, and must base our work on the thoughts of those from all countries where meteor observation is carried out. We must be amateurs in name only, and we shall succeed!

Alastair McBeath, Northumberland, England, UK
June 26, 1988

Of course, the letters we publish only represent a fraction of the reactions we received on IMO. It goes without saying that *WGN* gives priority to articles and observational reports rather than purely administrative matters; therefore we had to make a selection among the letters from which we published excerpts. We tried to choose these ones discussing issues of a broad general interest. Nevertheless, we also wish to thank all other people who commented on more specific matters regarding IMO. We urge all readers of *WGN* to keep following the evolution of IMO and give their criticisms, both positive or negative!

The International Meteor Weekend Oldenzaal, the Netherlands, March 25–27, 1988

Glenn Ticket

From March 25 till 27, meteor observers gathered in Oldenzaal, the Netherlands, for the seventh International Meteor Weekend.

The first of these events took place in 1978 in Bonn, West Germany. Since then, these meetings have been organized with intervals of approximately a year and a half. With each meeting, the interest among meteor observers to participate, increased. In Oldenzaal, over 60 people attended the Meteor Weekend. This clearly demonstrates the success of these events.

Another important aspect was the international character of the conference. At the previous weekends, there were never more than five nationalities represented among the participating amateurs; in Oldenzaal, meteor amateurs from nine countries took part: Belgium, Czechoslovakia, France, FRG, GDR, Hungary, Italy, the Netherlands and Norway. So, one may conclude this meeting was truly international.

Hence, the International Meteor Weekend (IMW) in Oldenzaal was a big success, considering both the number of participants and their origin. It was also a success in view of the professional participation, enpersoned by Professor Lindblad, who, once again, attended the IMW, and gave two lectures. This interest from professionals, twice in a row, clearly proves the value of these meetings.

In total, about twenty lectures were given. Some of these were very relaxing, whereas others were often hard to follow. The overall quality of the lectures, however, was very good.

Friday evening had a very relaxing program. After the introduction of the participants, slide and video presentations were given. This was a very good choice of the organizers, since many people were tired from the large distances they had traveled.

Saturday knew a rather heavy program, but thanks to the many breaks, it was not too overloaded. During the morning and afternoon sessions, the usual lectures were presented. Most groups presented their observational results from recent years. Other talked about some technical devices and their application to meteor observations. Some people took more time for their lecture than they were given, but this is probably unavoidable. Fortunately enough, breaks were provided to compensate for this time loss without making the program too heavy. In the evening session, the brain tank discussions took place. Each participant could chose one or more out of six subjects which would be discussed simultaneously. In this way, the participants were divided in groups of about ten people, allowing the discussions to take place in a more efficient way.

On Sunday, two more lectures were given. The latter one was about meteorites in the antarctic. It was an excellent presentation, worthy to close the IMW '88 with.

As already mentioned above, many breaks were provided. This gave the participants the opportunity to get to know each other. This could also be done during or after breakfast, lunch or dinner. In the evening, people could go to the bar and talk to each other until late at night. As one can see, there was plenty of time for informal meetings between the participants. This was very fortunate, since many people never met before and knew each other only from personal correspondence or articles in journals such as *WGN*.

During the breaks, one could also take a look at the equipment that was exhibited by several groups or buy books about meteors from them. During the Weekend, the foundation of IMO was often discussed. Most people favored the idea, although some other were rather sceptical about the surviving chances of such an organization and its necessity.

Furthermore, the meeting was organized at a hotel were all the necessary facilities and comforte were available. The organizers made sure the entire accommodation was used as efficiently as possible. Also, the conference room was only 100 m away from the actual hotel.

As always, the location (or, better, the organization) of the next IMW were chosen at the end of the meeting. It was decided that the next event would take place in Hungary. Everybody at the IMW '88 was very happy with this choice. Up to now, these conferences had always taken place in Belgium, West Germany or the Netherlands. Organizing an International Meteor Weekend in Hungary can only improve the international character of these events.

In summary, one can say that the IMW '88 was a big success. The number of participants has never been so large, nor the number of nationalities represented. The organization was very good and the same goes for the lectures. There were many informal talks and on leaving, the participants felt definitely stimulated a lot to continue their work on meteors. The organizers managed to make it a very successful Weekend and they can be congratulated for a job well done.

Observer's Notes: September–October 1988

Ghislain Plesier and Marc Gyssens

1. Introduction

The month of September is often a quiet period among meteor observers, especially as 1988 brings us good conditions for Perseid observations. Another reason for the low activity of meteor observers is this month is often believed to be without any significant shower activity. Nevertheless the more active observers will be able to tell you how surprisingly rich the September nights may be. According to G.W. Kronk [1] we find the following showers to be active:

Table 1 — Shower activity in September.

Shower	α	δ	Period	Max	$\lambda_{\odot}$	ZHR
γ-Aquarids	333°	−05°	Sep 1–14	Sep 7	164°	1–4
α-Aurigids	85°	+41°	Aug 25–Sep 6	Sep 1	158°	9
Piscids (South)	0°	+04°	Aug 12–Oct 7	Sep 11	168°	5
Piscids (North)	26°	+10°	?	Oct 12	198°	?

There is still a lot of work to be done to confirm these radiants. Especially the Piscids need some attention, as they have been neglected for some years, while they used to be the best-known shower of that period for some years.

The month of October offers us longer nights and more pronounced shower activity. From mid October onwards, you can even observe a considerable number of Taurids, peaking in early November.

Table 2 — Moonlight and observing conditions in September–October 1988.

Date	k	Date	k
Friday September 2	0.62−	Friday October 1	0.67−
Friday September 9	0.04−	Friday October 8	0.07−
Friday September 16	0.20+	Friday October 15	0.16+
Friday September 23	0.89+	Friday October 22	0.86+
Friday September 30	0.77−	Friday October 29	0.82−

New Moon:	August 12, September 11, October 10, November 9
First Quarter:	August 20, September 19, October 18, November 16
Full Moon:	August 27, September 25, October 25, November 23
Last Quarter:	September 3, October 2, November 1, December 1

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

2. Corona Australids

In this issue, we publish an article by David Seargent about the possible relationship between the Murchison meteorite and comet Finlay. In this article, it is suggested that comet Finlay might produce some meteor activity in late September and early October from radiants within or near Corona Australis. The author also mentions vague observational evidence for slow meteors from these radiants. Therefore we call upon all observers at southern latitudes, in particular, observers in the Southern Hemisphere, to read carefully the aforementioned article and watch for possible activity. Since meteors associated to P/Finlay are very slow (geocentric velocity of about 8.3 km/s), it might be a good idea to observe also photographically, since photographic observations are far more conclusive evidence for the existence of minor showers. Please send us your findings — both positive and negative!

3. Showers active in October

Active from September till October 27 with a maximum occurring on October 8 ($\lambda_\odot = 194°$), the Arietids are a complex of radiants in the Taurus-Aries area. The radiant is said to be at $\alpha = 32°$ and $\delta = +8°$, with a daily motion of $\Delta\alpha = +0.^\circ90$ and $\Delta\delta = +0.^\circ35$. This stream is often neglected by visual observers, due to confusion with the Southern Taurids.

The δ-Aurigids have a radiant at $\alpha = 84.^\circ8$ and $\delta = +51.^\circ9$ with a daily motion of $\Delta\alpha = +1.^\circ2$ and $\Delta\delta = +0.^\circ1$. The maximum occurs between October 6 and October 15 and the visibility period goes from September 22 to October 23. Only since recent years, they were detected as a meteor shower with low hourly rates.

The Draconids are known as one of the most famous periodical streams. The sharp maximum occurs at October 9 ($\lambda = 195°$) from a radiant at $\alpha = 262°$ and $\delta = +54°$. The activity period goes from October 6 to October 10. As the parent comet P/Giacobini-Zinner already passed the Earth's orbit some years ago, no special activity is expected. Nevertheless, observations are needed for a continuous study of this shower.

The ε-Geminids can be observed from October 10 till October 27 with a maximum on October 18. The radiant is at $\alpha = 103°$ and $\delta = +25°$. The radiant has a daily motion of $\Delta\alpha = +0.^\circ7$ en $\Delta\delta = -0.^\circ1$. Few ε-Geminids are seen.

Active from October 15 to 29, the Orionids display a reasonably strong activity each year with a ZHR of about 20. The radiant is located at $\alpha = 95°$ and $\delta = +16°$ with a daily motion of $\Delta\alpha = +1.^\circ23$ and $\Delta\delta = +0.^\circ13$. The Moon ($k = 0.77$ on October 21) will be hampering severely and only the second half of the night will be moon-free.

4. Conclusions

The period September–October offers the observer a lot of possibilities to do some useful work by following the activity of some neglected minor showers. Do not forget to send us a summary report of your observations for publication in *WGN*!

References

[1] Kronk G.W., "Meteor showers, a descriptive catalogue", Enslow Publisher, Hillside, NJ, 1988, pp. 173–210.

More about Bright Radio Meteor over Belgium

Dirk Artoos

In answer to my announcement in *WGN 16:3* of a bright radio meteor over Belgium that appeared on April 21 at $23^h05^m30^s$ UT, I received very interesting news from Dr. M. Šimek of the Astronomical Institute of Ondřejov in Czechoslovakia. Dr. Šimek and his colleagues also observed a very long echo (1^m02^s) at the same time. Their antenna was pointed West (86°) with an elevation angle of 45°. Yet, the meteor was not visually observed since weather conditions were bad. To my great surprise though, Dr. Šimek told me that observers from West Germany photographed a fireball at the same time. For the moment, we are waiting for further data so that calculations can be made in order to obtain more precise information on this tri-multane meteor, which could be a Lyrid fireball.

I would like to thank Dr. Šimek and his colleagues for this very useful piece of information and I hope it will be the start of a fruitful cooperation.

Is the Murchison Meteorite a Fragment of Periodic Comet Finlay ?

David A.J. Seargent

The possible relationship between the Murchison meteorite and comet P/Finlay is examined. Some evidence in favor of such a relationship is given and possible consequences are investigated.

1. Introduction

On the morning of Sunday September 28, 1969, a brilliant daylight fireball appeared over northern Victoria, Australia, and dropped over one hundred meteoritic fragments in a track 3.5 × 11.5 km near the small rural township of Murchison [1]. The event occurred between 10^h45^m and 11^h00^m am local time or 00^h45^m and 01^h00^m UT, with the most probable time being near 10^h57^m UT. This time was noted by a technician working on an outdoor television set near Shepparton, some 20 km north of Murchison, and is considered to be relatively accurate, as the immediate task of the witness was to activate a switch immediately following the 11^h am time signal. The meteor was observed as the witness awaited the signal.

The meteorite was identified as a type 2 carbonaceous chondrite of unusually large mass. Indeed, the amount of carbonaceous matter recovered from the Murchison fall was greater than the total stock of carbonaceous chondritic material hitherto collected. Only the Allende meteorite, falling during February of the same year, was larger, but this carbonaceous chondrite was of the third type and, as such, more closely akin to ordinary chondritic meteorites.

Because of the large quantity of carbonaceous material supplied by the Murchison fall, this meteorite has been widely studied and a great deal of information concerning the inorganic and organic composition of these fascinating objects has been gathered.

The present author became interested in the orbit of the meteorite upon noticing that the direction of fall and, apparently, low angle of approach of the object may have been consistent with a radiant close to those of periodic comets Haneda-Campos and Finlay [2,3]. Carbonaceous chondrites — especially types 1 and 2 — have sometimes been suspected of cometary origin, but no credible association between a particular carbonaceous chondrite and a known comet had ever been established. The discovery of such an association could have profound significance for both cometary and meteoritic cosmogony.

Unfortunately, and partially in consequence of its daylight occurrence, the path of the Murchison fall was not well described. An initial literature search disclosed little by way of description of the path of the fireball, although most witnesses agreed that it approached "from the southeast". Moreover, the trajectory appeared to have been quite shallow, though probably not sufficiently shallow for an object associated with P/Haneda-Campos. A drawing of the path along wich fragments had been recovered did, however, allow an approximate determination of the azimuth of the radiant and, following a suggestion by Prof. C.S.L. Keay of Newcastle, a copy of same, plus available descriptions etc. were forwarded to Dr. I. Halliday and Dr. B. McIntosh of the National Research Council of Canada.

From the dimensions of the scatter ellipse, Halliday and McIntosh estimated the altitude of the radiant as probably less than 40°, and possibly between 20° and 30°. The "most probable" altitude may be, according to Halliday, in the region of 25°.

Fortunately, the velocity of the meteorite was found to be subject to relatively tight constraints. An atmospheric entry velocity (after the Earth's gravitational attraction had been taken into account) of 13 km/s would result in a small orbit having aphelion within the inner regions of the asteroid belt. This is possible, although in view of the carbonaceous nature of the meteorite and the presence of volatiles (see below), an orbit so close to the Sun may not be very probable. On the other hand, a velocity of 15 km/s or greater would place the aphelion beyond the orbit of Jupiter in an orbit of very low inclination. Such an orbit is considered to be highly improbable. An atmospheric entry velocity of about 14 km/s implies a realistic orbit of low inclination, having aphelion within the outer asteroid belt.

Although these possible orbits may, theoretically, be associated with P/Haneda-Campos, such an association is very doubtful in actual fact, especially considering the probable dynamical history of the comet, suggesting that earlier theoretical radiants would have been increasingly remote from that of Murchison. The present radiant is unlikely to be closer than about 30° from any reasonable radiant for the Murchison meteorite. Comet Finlay, however, appeared far more promising, with radiant position, probable velocity and inclination of the orbit all in impressive agreement.

2. Comparing the orbits of the Murchison meteorite and comet Finlay

Following the exciting preliminary results, a more extensive literature search was conducted. A witness of the event was also contacted and interviewed. More detailed diagrams on the scatter ellipse were uncovered and a more accurate azimuth for the fall determined. From eyewitness accounts, the altitude of the radiant was reconsidered, although no significant improvement of accuracy was possible. Nevertheless, it does appear likely that an altitude of close to 30° is to be preferred to one significantly lower (say 20°).

Assuming a geocentric velocity of 8.4 km/s in agreement with Halliday and McIntosh, and correcting for zenithal attraction, possible radiant positions were calculated for altitudes of 25°, 30° and 35°, assuming an azimuth near 125° as implied by the orientation of the scatter ellipse. These positions are given below, together with orbits computed from same. The fourth position is the only provided by Halliday and McIntosh from less accurate descriptions of the azimuth. The region defined by these positions probably encompasses the real uncertainty in the actual radiant. The radiant and orbit of P/Finlay is given for comparison.

Table 1 — Possible radiants and orbits for the Murchison meteorite. The fourth set of data is the one provided by Halliday and McIntosh. For comparison, the orbit of P/Finlay (1926 V) and the corresponding theoretical radiant is given.

Data	Orbit 1	Orbit 2	Orbit 3	Orbit 4	P/Finlay
h	25°	30°	35°		
α	18^h10^m	17^h45^m	17^h20^m	18^h20^m	18^h04^m (Oct 1)
δ	−32°	−36°	−40°	−40°	−39°
a	2.74 AU	2.65 AU	2.52 AU	2.62 AU	3.60 AU
e	0.63	0.62	0.60	0.62	0.71
q	1.00 AU	1.00 AU	1.00 AU	1.00 AU	1.06 AU
i	1.88	2.77	3.70	3.64	3.43
Ω	4.47	4.47	4.47	4.47	45.56
ω	0.60	357.71	354.94	1.67	320.71
V_∞					8.3 km/s

Each orbit was tested for association with that of P/Finlay according to the *D-criterion* [4,5]. The results are listed in Table 2.

P/Finlay appears to be an old comet that has been confined to a short-period orbit for centuries, oscillating between an orbit of very low inclination (as has been evidenced this century) and one of somewhat higher inclination, while retaining a perihelion distance near 1 AU. Reflecting these changes in inclination, its meteor radiants should be somewhat peripatetic and, although these older sub-streams would probably be too scattered and weak to be recognizable as such, the probability of "stray" Finlay meteors having radiants possibly as far as 20° or more from the current ones is high. Thus, even should the Murchison meteorite have a radiant 20° distant from the present Finlay meteors, an association would remain very possible, but the agreement is, it seems, significantly better than that. Indeed, it does not seem unreasonable to say that the radiant is very probably within 10° and possibly within 5°, with exact agreement certainly not being out of the question.

Table 2 — Results of testing the orbits of Table 1 for association with comet Finlay using the *D*-criterion.

Data	Orbit 1	Orbit 2	Orbit 3	Orbit 4
D	0.102	0.119	0.149	0.114
D'	0.062	0.072	0.089	0.074

The case for a Finlay-Murchison association would be strengthened further if it could be shown that the Finlay radiants are active. According to [3], no meteors have ever been associated with P/Finlay despite the close approach of its orbit to that of the Earth's. Nevertheless, their low geocentric velocity would tend to render the meteors inconspicuous and the southern declination of the radiants would make any shower very unfavorably placed for northern latitudes. Moreover, an old comet such as P/Finlay, would not be expected to produce copious quantities of dust and small particles as is also evidenced by the very meagre tail development displayed by this object.

Southern observers have, nevertheless, noted the occurrence of slow meteors from several radiants in very close proximity to those predicted for P/Finlay in late September and early October [6]. Low rates have been reported between September 25 and October 2 from a radiant near $\alpha = 18^h28^m$ and $\delta = -38°$ and weak activity has also been recorded from several sub-radiants within five degrees of $\alpha = 17^h52^m$ and $\delta = -38°$. between the dates of September 21 and October 2. There seems little doubt therefore, that a weak and probably complex Finlay meteor stream does exist, although our knowledge of it is very meagre. It is to be hoped that the apparent association of the Murchison meteorite with this system, and with its parent comet, will give impetus to serious study of these meteors.

3. The possible cometary origin of the Murchison meteorite

The association of a meteorite with a comet may not find ready acceptance following the model of the nucleus of P/Halley implied by the Giotto and Vega results. Even the most fragile carbonaceous chondrites have a significantly higher density and greater tensile strength than Halley, as implied by the spacecraft results.

Nevertheless, the existence of small-scale inhomogenities is not ruled out by Giotto and Vega, nor is it necessary to assume that Halley is typical for all comets in this respect. A large and active object in a highly inclined retrograde orbit with aphelion beyond the orbit of Neptune certainly cannot be described as a typical short period comet, even if its composition is similar. One may suggest that a distinction be made between primitive comets formed within the true Oort Cloud, and a somewhat less primitive (and possibly higher density?) type of comet formed near the outer planets in a region sometimes termed "the inner Oort Cloud". Non-periodic objects and the longer periodic "periodics" such as Halley would be mainly primitive objects, whereas the great majority of the short-period comets could be of the latter variety.

This might explain the apparent differences between many short period comets and those of longer period. For instance, comets of short period frequently do not appear as active as long-period objects of approximately equal size. P/Neujmin 1, to take an extreme example, has a nucleus at least as large as Halley, yet it only manages to develop a come some 8 magnitudes fainter. Furthermore, a comet such as P/Machholz can pass within 0.2 AU of the Sun every 6 or 7 years and survive, whereas another of Machholz's discoveries (1985*e*) was destroyed during a single passage at similar heliocentric distance, even though it was an intrinsically brighter object.

That such a difference can be explained simply in terms of "age" is doubtful. It seems far more credible to assume that those comets which most frequently end up in orbits of very short period — and which continue to survive in such orbits — are composed of greater portions of refractory material such as would be expected if they had accreted closer to the inner solar system than the comets of the true Oort Cloud.

An intrinsic difference in the density and volatility/refractory ratio of comets is also implied by the diverse morphologies of so-called Brownlee particles [7]. Some of these are extremely porous and if the pores were once filled by ices in the parent comet, strongly hint at having been associated with a parent object consisting largely of volatiles. On the other hand, other Brownlee particles are relatively compact, displaying little capacity for high volatile content. The parent comets of these objects may have been relatively inactive objects of the P/Machholz type.

It is doubtful if the difference in particle morphology could be explained by postulating the latter variety of particle to have arisen deep within a cometary nucleus. Unless the nucleus was of abnormal size, the pressure exerted upon its constituent particles would not be sufficiently great to bring about the required morphological changes. However, one may expect a very large nucleus to be internally heated, by the decay of short-lived radioactive elements, sufficiently to profoundly alter the morphology of constituent particles within its innermost region, yet not even the "dense" Brownlee particles have experienced melting.

It should also be mentioned that few Brownlee particles can be expected to originate within long period comets. Material ejected by these comets will normally move in orbits unlike those of the ecliptic particles continually being picked up by the Earth. The presence of the extremely porous particles, therefore, imply that at least some comets of short period are very rich in volatilities, in agreement with observational evidence of such objects as P/Giacobini-Zinner and other small but active comets.

The Murchison meteorite may provide further evidence in support of heterogenity among comets. According to the major study of the metorite conducted by Fuchs et al. [8], the parent body was formed from a mixture of refractory and volatile material, together with fragments of other meteorites (the so-called *xenolithic inclusions* found within the Murchison) accreting at near zero velocity. This latter requirement was necessitated by the widespread presence within the meteorite of a type of pseudo-chondrule termed "white inclusions" by Fuchs and distinguished by him from the true chondrules by their fragility, larger dimensions and inability to be physically separated from the matrix wherein they were embedded. These inclusions are so fragile that they can be disrupted simply by scratching them with a needle, yet most survived the accretion process intact.

Accretion at low velocities suggests a very gentle environment, such as is not likely to have been found within the inner planetary system. The occurrence of volatile material (water and various inorganics such as pyridine) plus evidence from severe desiccation cracking that significant quantities of volatile material had been lost to the meteorite during its sojourn in space, further suggests a low temperature environment and, ipso facto, one remote from the central regions of the young Solar System.

These findings are consistent with, but do not prove, a cometary origin. Together with the apparent association with P/Finlay however, they add up to impressive evidence.

4. The possible physical relationship between Murchison and Finlay

If the meteorite really is a fragment of P/Finlay, its existence as a separate body would probably be of recent origin. A reasonable determination of this age may be provided by considering the length of time during which it had been exposed in cosmic rays and, indeed, such work has already been undertaken by Macdougall and Phinney [9] and independently by Caffee et al. [10] with remarkably consistent results. Both studies found an exposure time of 800 000 years; short by cosmic standards, but probably too long if interpreted as being equivalent to the time since separation of the meteorite from the cometary nucleus. However there is no need for "exposure time" to be equivalent to the time spent as free orbiting body. The exposure time may equally be interpreted as the time during which the meteorite has been freed of shielding material and thereby exposed to space on the surface of its parent body. Whether the mechanism resulting in this exposure was that of normal cometary activity (not necessarily in an orbit similar to the present one and not necessarily continuous with the contemporary active epoch) or partial disruption following a collision with another object — in which case the Murchison body may either have been exposed at a new surface resulting from breakage or separated as a fragment which subsequently fell back onto the surface of the nucleus — is not known. Regarding the possibility of the nucleus breaking, it is interesting to speculate on the possible relevance this may have to the apparently irregular shape of the Finlay nucleus, as indicated from studies of its erratic non-gravitational effects, and (as a body splitting almost in half may well expose the center of the complete body) it is also interesting to consider that the compact nature of Murchison relative to that of the Halley nucleus may reflect its prior existence deep within a cometary body of significantly greater dimension than the present-day Finlay nucleus, although (as we mentioned above) the dimensions of such a body would be very large by cometary standards and may require greater thermal alteration than is present in the Murchison body. Such however must be recognized as pure speculation in this stage.

We may assume that the Murchison body resided on the surface of Finlay for hundreds of thousands of year until, quite recently, it became detached during the normal process of cometary activity.

5. The composition of the Murchison meteorite and its consequences

We cannot automatically assert that the nucleus of P/Finlay is simply a larger counterpart of the Murchison meteorite. According to [11], the portion of cometary material capable of surviving atmospheric penetration and survival as meteorites may be as small as 0.1% of the nucleus. Nevertheless, the mineralogy of Murchison, presumably being representative of the region of the solar nebula where the comet accreted, may reflect the general composition of the comet (minus most of the more volatile material, of course), even if its density and tensile strength is atypical of the nucleus as a whole.

The meteorite is comprised, according to [8], of minerals that condensed at high temperature from the solar nebula, together with progressively lower-temperature substances until volatiles were finally reached. Thus, substances of widely differing thermal history were thoroughly mixed together in that part of space where the parent body accreted. Since accretion, the meteorite has not been heated beyond 100–200 °C. In all probability, it has experienced no significant heating at all.

Interestingly, recent analyses of the organic material within the meteorite has revealed an isotopic abundance quite different from normal Solar System material, but rather similar to that of interstellar dust and gas. Presumably, much of this material is pre-solar. Yet, the meteorite (and, presumably, its parent body) were apparently not members of the first generation of Solar System objects. This is implied by the discovery of pieces of a type 3 carbonaceous chondrite, in addition to a fragment of another meteorite of hitherto unknown type, intermingled with this very primitive material. The presence of these xenoliths strongly indicates that a minimum of one, and probably two, bodies had accreted and been wholly or partially fragmented before the accretion of the Murchison parent. This, I would suggest, may be taken as evidence for the accretion of P/Finlay somewhat later than the earliest comets and asteroids. In a region of the solar nebula not far beyond the present day orbits of the outer planets... a region where the primitive interstellar constituents of the original nebula has already become "contaminated" by "recycled" and more or less processed planetary material.

The xenolithic meteoritic fragments within Murchison would have been too small to have survived as individual meteorites, had the main carbonaceous body disintegrated in the atmosphere. Nevertheless, their presence does at least raise the question as to whether everything that may fall from a cometary meteor shower is of strictly cometary origin. The presence of volatiles and the general nature of the meteorite presumably precludes Murchison itself from these considerations, but the existence of larger xenolithic inclusions — ones capable of becoming meteorites in their own right — within comets must be considered a real possibility. This could explain such "anomalies" as the fall of a stony-iron meteorite during the 1885 Andromedid shower, associated with P/Biela, and may be offered in support of Öpik's hypothesis [12] that meteorites of originally asteroidal origin are transported via comets into Earth-colliding orbits. The presence within some cometary nuclei of far larger "xenoliths" — of the size of Apollo-asteroids for instance — or of enormous quantities of smaller xenoliths capable of being cemented together into asteroid-size polymict breccias as cometary ices evaporate, may also be suggested, although the credibility of such suggestions is, perhaps, debatable.

Acknowledgments

I would like to thank the many people who assisted in this study, with special acknowledgments to Drs. Halliday and McIntosh of the National Research Council of Canada, Dr. T. Ireland of McDonell Center for the Space Sciences, Washington University, Mr. Jeff Wood and his colleagues from the Meteor Section of the Astronomical Society of Western Australia and National Association of Planetary Observers, Prof. C.S.L. Keay of the Physics Department of the University of Newcastle (New South Wales), Mr. Rob McNaught of Siding Spring Observatory, Messrs. D. Martyn and T.B. Tregaskis of the Astronomical Society of Victoria (Australia) and Mr. William Holyman whose eyewitness account of the fireball proved to be most valuable.

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Appendix

Since writing the above, my attention has been drawn to the apparent association the orbits of P/Finlay and the Apollo asteroid 1979 VA and the close association of the latter with the possible Murchison orbits given above, in addition to the mean orbits of hypothetical Finlay meteoroids intercepting the Earth from the theoretical radiants. The possibility of a system of debris associated with P/Finlay, and including, in addition to "ordinary" meteoroids, larger objects of meteoritic and even asteroidal size may need to be considered. This is especially interesting in the light of our earlier speculations about asteroid-sized objects associated with comets.

A comparison of the orbits of 1979 VA and that of Finlay at its 1926 return yields $D = 0.161$ and $D' = 0.082$, and with Finlay at its discovery return of 1885, $D = 0.157$ and $D' = 0.081$. Comparisons with the four hypothetical Murchison orbits yield:

Table 3 — Results of testing the orbits of Table 1 for association with asteroid 1979 VA using the *D*-criterion.

Data	Orbit 1	Orbit 2	Orbit 3	Orbit 4
D	0.076	0.073	0.090	0.099
D'	0.028	0.027	0.036	0.035

It is interesting to note that photoelectric observations of this asteroid by A.W. Harris (reported in IAUC 3426, 1979 Nov. 29) reveal the object to be carbonaceous; one of the very few Apollos for which photoelectric photometry has revealed a carbonaceous nature. Together with its rather eccentric orbit ($e = 0.627$) and aphelion at 4.27 AU, this observation tends to support the object's candidature for being a defunct cometary nucleus, as indeed, does the suspicion of some meteor observers that its theoretical radiant in early September may be weakly active.

If 1979 VA and Murchison are fragments of comet Finlay, or if all three are remnants of a larger comet which disrupted in the relatively recent past, the existence of other faint cometary and asteroidal objects having similar orbits is possible. Indeed, one object which probably deserves consideration is 1960 UA which shows an association of $D = 0.013$ and $D' = 0.087$ with 1979 VA, but these further questions will not be persued here.

Call for Observations

Peter Brown

The North American section of the International Meteor Organization is actively seeking observations of train phenomena for research work in the area of shower geocentric velocities. Anyone who has train data for showers with known geocentric velocities, has recorded the limiting magnitude and observing conditions under which the data were collected, and has magnitude data for each meteor with and without a train is asked to send me the information (address: see inside of back cover). Duration of each train would be helpful, but is not strictly necessary.

Radio Work: A New Result

Jeroen Van Wassenhove

The use of a penrecorder for registering meteor reflections in radio observations is discussed.

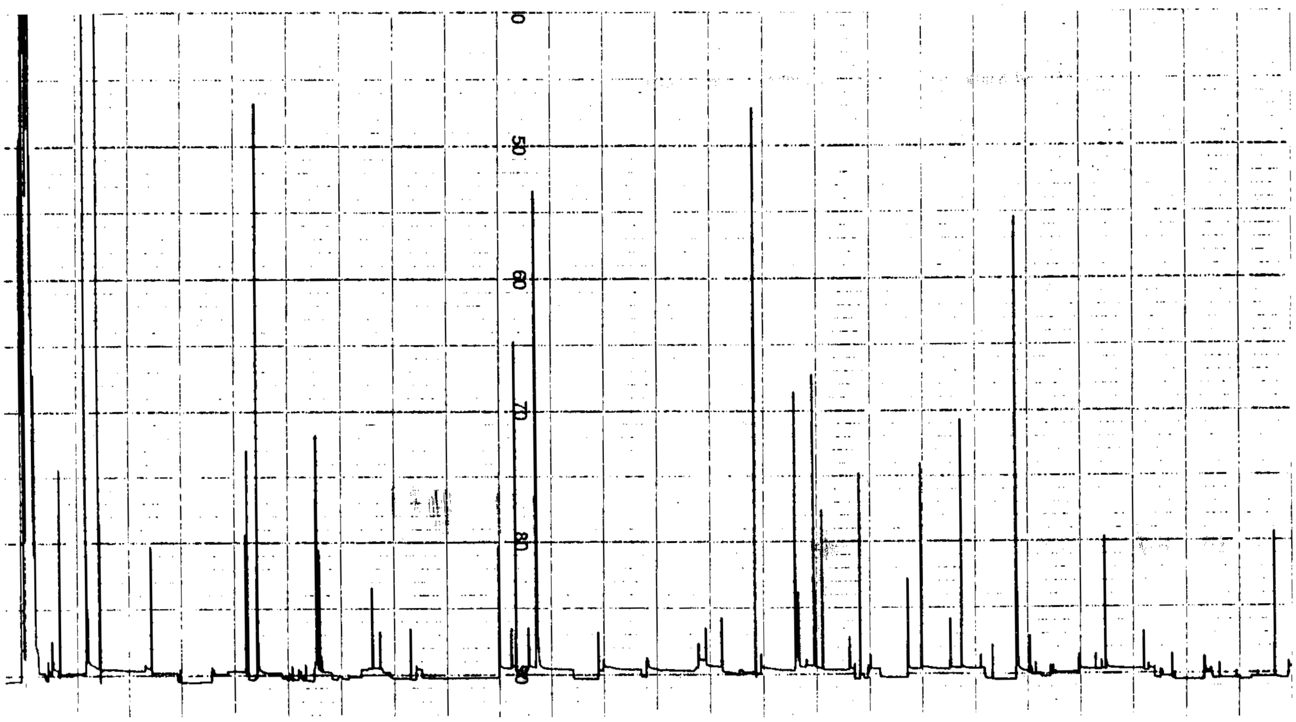

Figure 1 —Pen recordings of meteor reflections by Maurice De Meyere on March 20, 1988 between 14^h25^m and 15^h12^m UT, on 66.17 MHz. Speed is 1 cm/min and sensitivity is 0.5 V full scale.

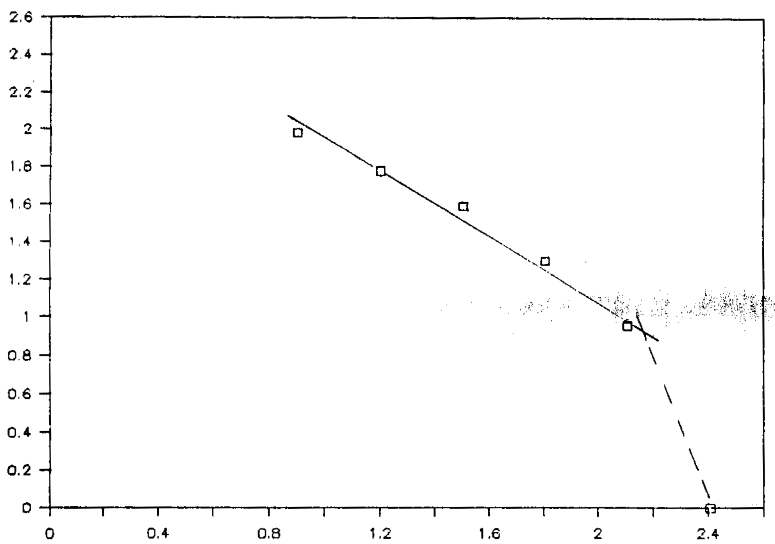

Figure 2 — Double logarithmic graph comparing peak amplitude (horizontal scale) and cumulative number of reflections (vertical scale) for the observations of Maurice De Meyere described in Figure 1.

On March 20, Maurice De Meyere of St.-Martens-Latem, Belgium, connected a penrecorder to his radio for the first time. With this radio, a four element Yagi antenna was used, pointed to the East with an elevation of 60°. He listened on 66.17 MHz. Each sharp peak on Figure 1 represents a meteor reflection. The recorded signal is *not* the audio signal, but the real signal strength. The speed of the penrecorder equals 1 cm per minute and the sensitivity 0.5 V full scale. First, all the meteor reflections were counted, then split into amplitude classes, and a cumulative distribution was made. The results are plot on a double logarithmic scale (Figure 2). The graph is very similar to the one published in [1].

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Meteor Observing by Video

Klaas Jobse

A low light level television camera was built by the authors at Cyclops Observatory. *Cyclops* is a private observatory, founded in 1979, near the village Oostkapelle at the southwest coast of the Netherlands. Some first results of meteor observing with the low light level television camera are discussed.

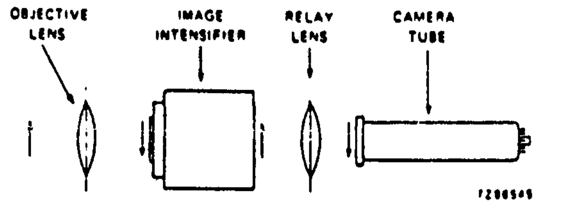

Figure 1 — Schematic arrangement of the image intensifier system.

During the first months of 1987, a low light level television camera was built at Cyclops Observatory, Oostkapelle, the Netherlands, for the study of meteors. This camera was built by using the following components: a fast 50 mm 0.85 objective, a microchannel plate image intensifier and a black and white CCD video camera connected to a video taperecorder (VHS system). The schematic arrangement of the image intensifier is shown in Figure 1.

The image intensifier we used contains a S25 photo-cathode with about the same spectral sensitivity as the human eye and has a maximum gain of 46 000×.

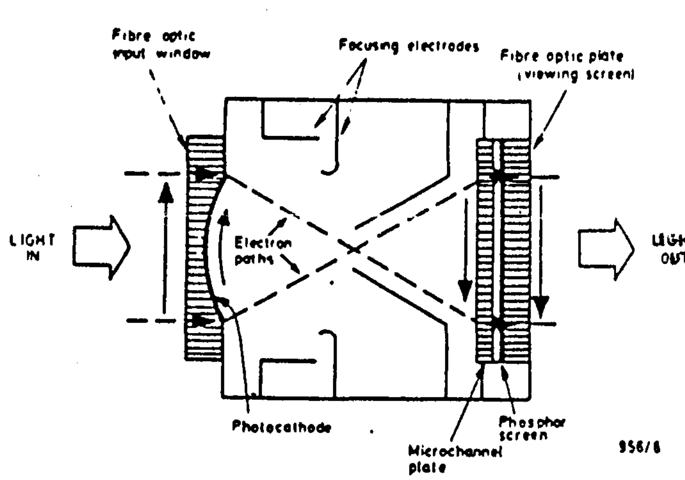

Figure 2 — Inverting microchannel plate image intensifier.

This image intensifier is of the so-called *second generation type*, chosen by us because of its advantages for meteor work. This type does not create image lag or blooming around the brighter parts of the image. Another advantage is the power supply; only two 1.24 V penlites do the job, while the internal voltage of the intensifier can be as high as 7000 V! In Figure 2, the working mechanism of the intensifier is shown.

We started to build this camera in January 1987 and after a lot of hard labor, we were able to try the camera in a testing set-up during two nights: April 22–23 and 23–24. Although the tests were made under rather unfavorable circumstances, the camera worked very well. In 5.5 hours of recording time, we filmed 52 meteors, among which 16 Lyrids. After plotting these meteors on a gnomonic starmap, the Lyrid radiant clearly shows, as can be seen on Figure 3.

The limiting magnitude for stars turned out to be approximately +7.5. When the camera was completed in July and tested under better circumstances, the limiting magnitude had improved to +8.5 for stars and +7 for meteors. The camera which covers 17° of sky, was able to film up to 30 meteors per hour.

In spite of the bad weather during our 1987 summer campaign, the camera recorded 450 meteors in about 22 hours of effective recording time. During our Orionid 1987 campaign, we had more luck with the weather. From October 16 to 26, the video camera operated 25 hours. The result was 850 meteors on video tape; among them were 250 Orionids. As a bonus to our good fall campaign, we were able to film the persistent train from a beautiful Leonid fireball of magnitude −10 on November 17 [1]. The train, which could be seen visually for over two minutes, was videotaped by our camera during more than 15 minutes! It was beautiful to see how the high winds in the atmosphere blew the train out of shape.

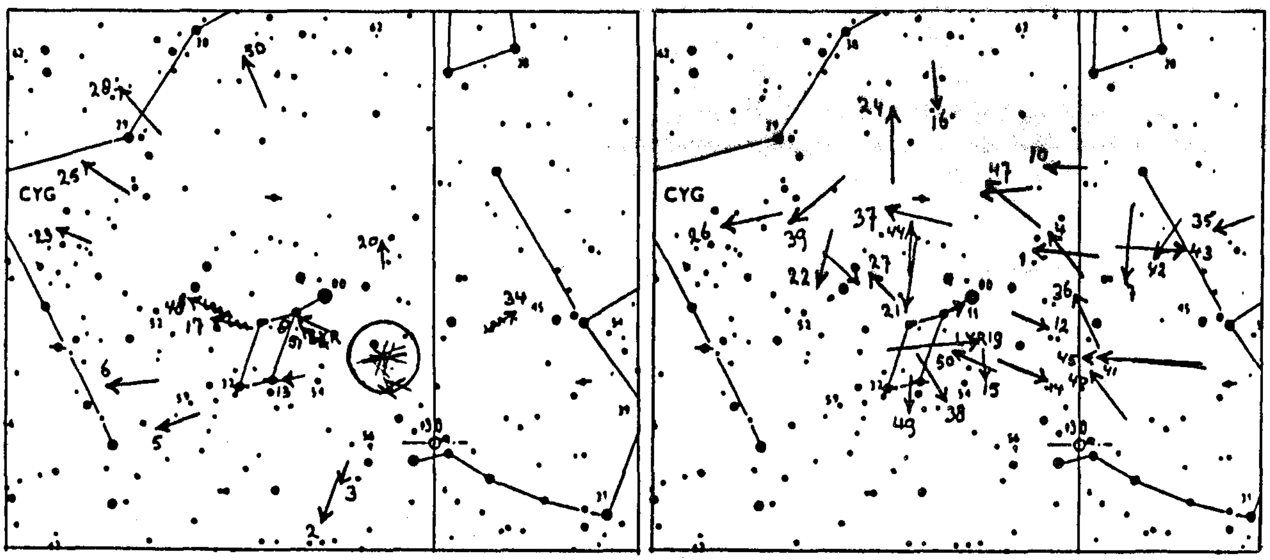

Figure 3 —*Left:* The Lyrids, recorded with the low light level television camera, drawn on a gnomonic starmap. *Right:* The sporadic meteors recorded in the same period.

The Cyclops observing site is a fairly good one, but is not completely free of light pollution, so on hazy nights, the camera will not operate at its full potential. In the future, we are planning an observing session at a darker location.

After completion in July, the camera was given the name *BETSY*, which is a Dutch abbreviation of "image intensified television camera".

Now that *BETSY* operates so well, we must find a way of canvassing all the data. Our plan is to digitize the video frames of the meteors and then hand over the job to a computer, which calculates the position of the meteor between the stars, Also, calculating radiants, ZHRs, magnitudes, lengths of trails as well as lightcurve investigations should be possible.

The resolution of *BETSY* is about 2″, expressed in ca. 450 TV lines (100% signal). But for us, the limiting resolution is the capacity of both the used video tape and the video recorder. In our situation, the video recorder is able to resolve 240 TV lines at 100% signal. This decreases the limiting resolution of *BETSY* by a factor of 2. For meteor work, it is necessary to record continuously, since we do not know when a meteor will appear. So we have to do the digitation job afterwards, from the video signal of the video recorder. If we would have been deep-sky or comet fanatics, we could have digitized directly from the camera signal. How well the digitized image will be, will depend on the quality of the digitizer.

In the near future, we are planning to monitor especially the minor showers, and investigate hourly rates, radiant positions, radiant drift and magnitude distributions. In the years to come, we must have high expectations from upcoming techniques, like High Definition TV and Compact Disc Video. Until the time these will be commercially available, we will monitor the beautiful, mysterious night sky with *BETSY*!

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Lyrids 1987 and 1988

The Lyrids 1987 in the FRG

Bernhard Koch

Observations of the 1987 Lyrids in Ulm, FRG, are presented.

Lyrid observations were carried out on three nights: April 18–19, April 22–23 and April 24–25. Two observers participated: Michael Nolle (MN) and Stefan Ströbele (SS).

The observing sites were as follows:

Table 1 — Observing sites.

Loc	λ	φ
1	09°59′00″ E	48°17′12″ N
2	10°01′18″ E	48°28′00″ N

Below is a summary report of the observations:

Table 2 — West German Data on the 1987 Lyrids.

Date	Obs	Loc	Period (UT)	T_{eff}	Lm	F	Lyr	ZHR	Spor	HR
Apr 18–19	MN	2	20^h30^m–22^h00^m	1.33	5.8	1.00	2	8.2 ± 3.3	4	7.9 ± 3.2
18–19	SS	1	21^h10^m–22^h00^m	0.83	5.8	1.00	1	5.8 ± 3.4	2	6.4 ± 3.7
18–19	MN	2	22^h10^m–23^h00^m	0.83	5.8	1.00	0		9	28.6 ± 9.50
18–19	SS	1	22^h10^m–23^h30^m	1.17	5.8	1.00	1	3.0 ± 1.3	4	9.0 ± 4.0
18–19	MN	2	23^h14^m–00^h15^m	0.90	5.8	1.00	6	19.3 ± 4.7	11	32.2 ± 7.8
18–19	SS	1	00^h10^m–00^h45^m	0.58	5.8	1.00	2	8.9 ± 3.7	4	18.2 ± 7.4
Apr 22–23	MN	2	21^h04^m–22^h00^m	0.93	5.7	1.00	3	16.5 ± 4.4	11	35.9 ± 9.6
22–23	SS	1	22^h00^m–23^h00^m	1.00	5.8	1.00	9	33.7 ± 7.9	9	23.8 ± 5.6
22–23	MN	2	22^h10^m–23^h00^m	0.78	5.7	1.00	8	41.5 ± 10.7	7	27.2 ± 7.0
22–23	MN	2	23^h10^m–00^h00^m	0.75	5.7	1.00	8	35.3 ± 8.3	10	40.4 ± 9.5
22–23	SS	1	23^h11^m–00^h00^m	0.82	5.8	1.00	7	25.5 ± 6.8	7	22.5 ± 6.0
22–23	SS	1	00^h07^m–01^h00^m	0.88	5.8	1.00	4	11.7 ± 2.7	15	45.0 ± 10.3
22–23	MN	2	00^h30^m–01^h22^m	0.87	5.7	1.00	9	24.7 ± 6.4	6	20.9 ± 5.4
22–23	MN	2	01^h29^m–02^h30^m	1.02	5.7	1.00	10	20.8 ± 4.0	17	50.5 ± 9.7
Apr 24–25	MN	1	21^h10^m–22^h20^m	1.03	6.0	1.00	2	7.2 ± 2.0	11	21.4 ± 5.9
24–25	MN	1	01^h10^m–01^h50^m	0.67	6.2	1.00	5	11.6 ± 2.8	12	27.1 ± 6.6

The magnitude distributions for the Lyrids and sporadics in Table 1 are given in Table 2.

Table 3 — Magnitude distribution of the 1987 Lyrids in the FRG, compared to the magnitude distribution of the sporadics during the same period.

Magnitude	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Lyrids	1	0	1	3	11	13	21	16	9	2	77	2.82
Sporadics	0	1	0	1	6	20	32	37	36	4	137	3.59

From these data, a Lyrid population index of 2.9 was computed. Two sporadic fireballs were seen, one of magnitude −5 and the other of −9.

The Lyrids 1987 in Denmark

Per T. Aldrich

Observations of the 1987 Lyrids in Denmark were severely hampered by bad weather.

The weather did not cooperate in April 1987 when five meteor observers in Denmark planned to watch the Lyrids. Only two observers experienced cloudless skies. They saw a total of 3 Lyrids and 8 sporadic meteors during 2.71 hours in the period April 17–27. In Table 1, the data about the observers are given.

Table 1 — Observers and observing sites participating at the Danish 1987 Lyrid observations.

Observer	Init	Location	λ	φ
Per T. Aldrich	PA	Viby	10°42′05″ E	55°29′50″ N
Gotfred M. Kristensen	GMK	Havdrup	12°07′31″ E	55°32′44″ N

In Table 2, the actual meteor data are presented.

Table 2 — Danish data on the 1987 Lyrids.

Date	Obs	Period (UT)	$T_{\rm eff}$	Lm	F	Lyr	Spor
Apr 17–18	PA	21^h00^m–22^h00^m	0.97	5.0	1.20	0	3
23–24	GMK	23^h11^m–00^h15^m	1.04	5.4	1.25	1	4
26–27	GMK	00^h17^m–01^h00^m	0.70	5.5	1.25	2	1

The Lyrids 1987 in Florida

Norman W. McLeod III

During the nights of April 20–21 and 21–22, 1987, a total of 19 Lyrids were observed.

Weather conditions in Florida were very unfavorable during the 1987 Lyrid activity period, due to a so-called El Niño condition. Nevertheless, I was able to carry out some observations, listed in Table 1 below.

Table 1 — Data on the 1987 Lyrids as seen from Florida by N. McLeod.

Date	Period (UT)	$T_{\rm eff}$	Lm	F	Lyr	Vir	Spor
Apr 20–21	06^h26^m–07^h26^m	0.95	6.5–6.0	1.00	4	1	3
20–21	07^h26^m–08^h05^m	0.65	5.5	1.00	1	0	3
Apr 21–22	05^h26^m–06^h26^m	1.00	6.5	1.00	5	0	1
21–22	06^h26^m–07^h26^m	1.00	6.5	1.00	5	0	4
21–22	07^h26^m–08^h11^m	0.75	6.5–6	1.00	4	1	1

Belgian and Danish Radio Observations in April 1987

Jeroen Van Wassenhove

Belgian and Danish radio observations of the 1987 Lyrids and α-Bootids are presented. An analysis of the echo-durations is performed.

1. The Lyrids

The Lyrids are a shower with a rather low activity, having its radiant at $\alpha = 270°$ and $\delta = +33°$. Four Belgian radio observers listened to the activity of this meteor shower. Their results are as follows:

Table 1 — Radio observations of Luc Gobin in April 1987 from Mechelen at a frequency of 66.17 MHz. Observing periods are given in UT.

Date	04^h00^m–05^h00^m	07^h00^m–08^h00^m	20^h30^m–21^h30^m
Apr 19	102	115	60
20	126	151	83
21	165	144	69
22	169		103
23	186		61
24	171		88
25	194		62
26	137		

Table 2 — Radio observations in April 1987 by Maurice De Meyere (St.-Martens-Latem, 72.11 MHz), Christian Steyaert (Bottelare, 91.10 MHz), Jeroen Van Wassenhove (Nazareth, 88.40 MHz).

M. De Meyere			C. Steyaert			J. Van Wassenhove		
Date	Period	Tot	Date	Period	Tot	Date	Period	Tot
Apr 17	16^h43^m–17^h43^m	19	Apr 18	18^h30^m–19^h30^m	7	Apr 20	05^h30^m–06^h30^m	19
18	06^h23^m–07^h23^m	37	19	18^h30^m–19^h30^m	2	21	05^h30^m–06^h30^m	22
21	20^h38^m–21^h38^m	31	20	18^h30^m–19^h30^m	4	22	05^h30^m–06^h30^m	28
22	20^h04^m–21^h04^m	18	26	20^h05^m–21^h05^m	4	23	05^h30^m–06^h30^m	8

One Danish radio observer also listened to the Lyrids. His results are presented below.

Table 3 — Lyrid radio observations of Gotfred Møbjerg Kristensen in April 1987 from Havdrup at a frequency of 100.60 MHz. Observing periods are given in UT.

Date	07^h00^m–08^h00^m	08^h00^m–09^h00^m	09^h00^m–10^h00^m	10^h00^m–11^h00^m
Apr 19		16	7	19
20	15	9	7	6
21	20	18	37	28
22				17

All times are in UT, and all counts are uncorrected.

It would be unwise to calculate the maximum of the Lyrid shower from these data, as there is another meteor shower active during that period, namely the α-Bootids. This is also the reason why the counts were not corrected with the so-called "observability function". So the only conclusion we can make about the 1987 Lyrids is that this meteor shower showed his highest activity on April 22.

2. The α-Bootids

The α-Bootids are a small meteor shower (unknown by most people), active during the period of April 16 till May 12 with a maximum around April 26 [1]. The radiant is located at $\alpha = 218°$ and $\delta = 19°$. The geocentric velocity of these meteors is 23 km/s. The following orbital elements were detected by computer search [2]:

Table 4 — Orbital elements for the α-Bootids.

Data	Orbital elements
a	2.647 AU
e	0.706
q	0.753 AU
i	18.0
Ω	36.2
ω	246.9
V_∞	23 km/s

One Belgian observer, Luc Gobin, observed this meteor shower (Table 1). In the morning of April 25, he counted 194 meteor reflections between 4^h and 5^h UT, which is the highest number he reported during that series of observations. Gotfred M. Kristensen also listened during that period. His results are presented below.

Table 5 — α-Bootid radio observations by Gotfred M. Kristensen in April 1987 from Havdrup at a frequency of 100.60 MHz. Observing periods are given in UT

Date	04^h00^m–05^h00^m	05^h00^m–06^h00^m	06^h00^m–07^h00^m
Apr 25	12	7	6
26	31	41	26
27		5	

We may conclude the α-Bootids show a reasonably high activity around April 26.

3. Echo-Duration

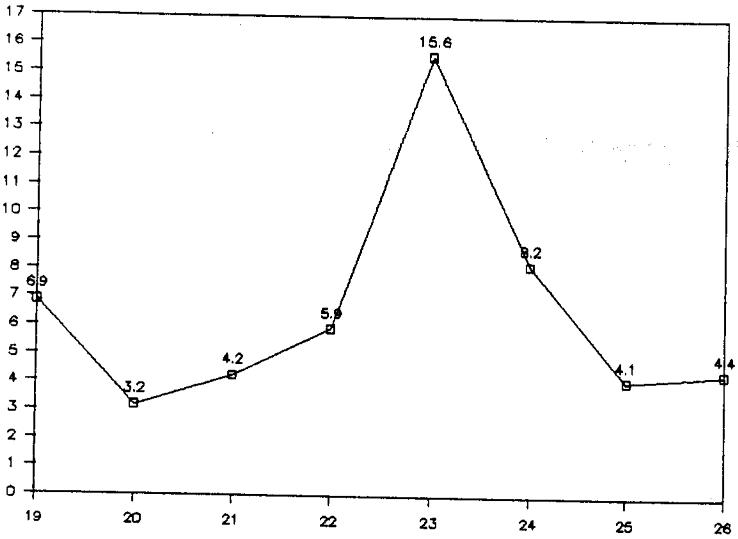


Figure 1 — Number of echo-durations of at least 2 s as recorded by Luc Gobin between 4^h and 5^h UT from April 19 till April 26. Relative numbers are also indicated.

When a radio observers listens to meteor activity, the time, strength, description and echo-duration of each meteor reflection is noted. Especially the last part, the echo-duration, is a very interesting and important item in radio work (forward scatter). The echo-duration of a meteor can be related to its magnitude, as obtained in visual observations. In general, the brighter the meteor, the longer the echo-duration will last.

With a large amount of data from Luc Gobin, we were able to make a classification of the echo-durations. All the echo durations lasting at least two seconds were counted. The percentage these echo-durations represented, was calculated. The results are shown on Figures 1 and 2.

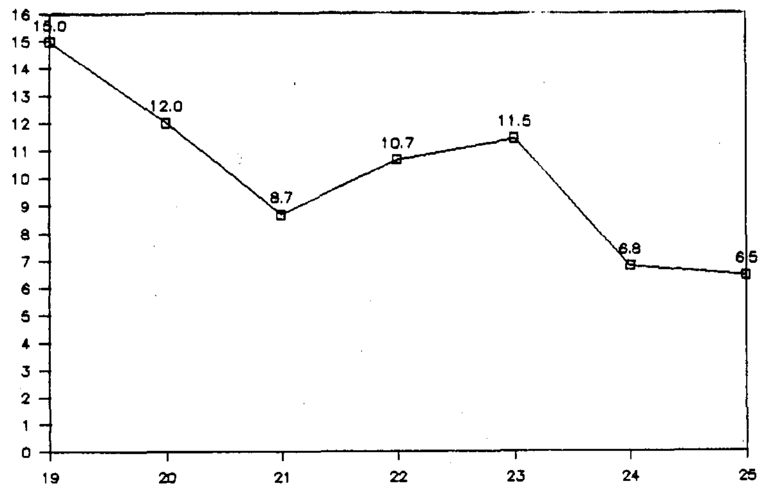


Figure 2 — Number of echo-durations of at least 2 s as recorded by Luc Gobin between 20^h30^m and 21^h30^m UT from April 19 till April 25. Relative numbers are also indicated.

As you can see on Figure 1, there is a high increase of bright meteors on April 23. The average number of echo-durations of at least 2 seconds for the period 04^h00^m–05^h00^m UT equals 6.6 ± 3.4. This high increase indicates there is activity due to (a) meteor shower(s), as in general a meteor shower is characterized by a larger amount of rather bright meteors. Unfortunately, it is difficult to determine which meteor shower(s) is (are) responsible for such an increase. At 5^h UT on April 23, the Lyrid and α-Bootid radiants had elevations of 67° and 24° respectively. Since both radiants were active, it is most probable that the increase was due to a mixture of Lyrids and α-Bootids.

In Figure 2, on the contrary, there is no high increase. Some irregular fluctuations are probably caused by a combination of Lyrids and α-Bootids. At 21^h UT, the radiants of the Lyrids and the α-Bootids have elevations of 19° and 43° respectively. The average number of echo-durations of at least 2 seconds in the period between 20^h30^m and 21^h30^m UT amounts to 9.8 ± 2.9.

4. Remarks

In connection with the observations discussed above, we want to make the following two remarks:

- We have a strong feeling that another minor meteor shower is active around April 26, as indicated by the data of G.M. Kristensen, listed below.

  Table 6 — Radio observations of Gotfred Møbjerg Kristensen in April 1987 from Havdrup at a frequency of 100.60 MHz. Observing periods are given in UT.

Date	Period	Tot
Apr 25	09^h00^m–10^h00^m	17
26	09^h00^m–10^h00^m	42
27	09^h00^m–10^h00^m	16

  The heigh number on April 26 *cannot* have been caused by the α-Bootids, since at that moment, the radiant was −13° below the horizon. Nor can this high activity be explained by the sporadic background or by the Lyrids, the latter being no longer active at that time. Future observations can provide an answer to this question.

- In the future, we hope to obtain more accurate data on echo-durations. Until now, radio observers determine long durations by chrono. The very short ones are estimated, causing large errors. Therefore, only echo-durations of at least 2 seconds were used in our analysis. With the aid of a penrecorder, a computer, and/or other electronical devices, we will be able to measure echo-durations to 1/20th of a second. This will lead to a larger number of accurate data.

Acknowledgment

The author wishes to thank all the observers, in particular Gotfred Møbjerg Kristensen for his valuable help with respect to the α-Bootids.

References

[1] A.F. Cook, "A Working List of Meteor Streams", *Evolutionary and Physical Properties of Meteoroids*, Proc. IAU Coll. 13, 1971, C.L. Hemenway, P.M. Millman, A.F. Cook (eds.), *NASA SP-319*, 1973, pp. 183–191.

[2] B.A. Lindblad, "A Computerized Stream Search among 2401 Photographic Meteor Orbits", *Smithsonian Contributions to Astrophysics, 12*, 1971, pp. 14–24.

The Lyrids 1988 in Australia

Jeff Wood

Australian observations of the 1988 Lyrids, are presented. These observations were facilitated by favorable weather conditions.

Favorable moon and weather conditions saw Australian meteor observers obtain their best observations of the April Lyrid meteor stream for several years. The Lyrids were observed from April 19–20 to April 22–23. Seven people participated watching for a total of 29 man hours of observing time. The observers who took part were as follows:

Jeff Wood, George Platt, Guy Blackman, Martin Coroneos, John Liew, Gary Doiking and Darren Ferdinando

The following ZHR's were obtained:

Table 1 — ZHR-values for the 1988 Lyrids observedin Australia.

Date	ZHR	Nr. Obs.
Apr 19–20	1.4 ± 0.9	4
20–21	3.8 ± 1.5	8
21–22	7.7 ± 1.5	5
22–23	2.5 ± 1.2	12

The date of maximum was April 21–22 with a maximum ZHR of 7.7. For the Lyrids observed, the following magnitude distribution was obtained:

Table 2 — Magnitude distribution of the 1988 Lyrids in Australia.

Magnitude	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Number	2	0	2	1	4	10	19	18	10	1	67	3.00

10.5% of the meteors of magnitude +2 or brighter were yellow and blue with the remaining 79.5% being white in color. 11.9% of the Lyrids seen had a train.

The Lyrids 1988 in the GDR

Jürgen Rendtel

Observations of the 1988 Lyrids in the German Democratic Republic are presented. Unfortunately, the maximum was missed due to bad weather.

As usual, the maximum of this stream was characterized by bad weather. However, observations were possible before and after the night of April 21–22. Unfortunately, in the latter period, observers had to deal with moonlight and temperature around −5°C!

Table 1 — Observations of the 1988 Lyrids in the GDR with limiting magnitude at least 5.8.

Date	Period (UT)	T_{eff}	Lm	Lyr	ZHR	Spor	HR
Apr 09–10	22^h10^m–23^h10^m	0.96	6.24	0		6	8
09–10	23^h10^m–00^h10^m	0.95	6.22	1	2.0	8	11
09–10	00^h10^m–01^h10^m	0.94	6.26	2	3.4	8	11
09–10	01^h10^m–02^h10^m	0.95	6.31	0		9	12
Apr 13–14	19^h42^m–21^h45^m	1.68	7.37	1	0.6	85	20
13–14	22^h40^m–00^h10^m	1.41	6.40	1	1.1	11	8.7
13–14	00^h10^m–01^h40^m	1.41	6.37	3	2.9	9	7.4
13–14	01^h40^m–02^h40^m	0.92	6.23	0		11	16
Apr 14–15	20^h00^m–21^h30^m	1.46	6.30	1	2.4	10	9.3
14–15	20^h00^m–21^h30^m	1.40	6.37	1	2.1	11	9.0
14–15	00^h24^m–02^h42^m	1.57	7.26	9	2.8	86	24
Apr 15–16	20^h30^m–21^h30^m	0.90	5.90	1	4.9	2	4.3
15–16	20^h30^m–21^h30^m	0.90	5.90	1	4.9	6	13
15–16	20^h55^m–22^h55^m	1.94	6.20	2	2.6	13	9.3
Apr 16–17	20^h00^m–22^h45^m	3.95	6.23	3	1.7	3.5	12
16–17	00^h40^m–02^h40^m	1.53	7.33	10	2.9	63	16
16–17	01^h48^m–03^h30^m	1.56	6.40	4	3.1	15	11
Apr 18–19	20^h45^m–21^h30^m	0.72	6.05	1	5.1	4	8.8
Apr 22–23	19^h30^m–23^h30^m	2.84	6.21	9	8.7	21	10
22–23	19^h30^m–23^h30^m	2.68	6.20	8	8.3	25	13
22–23	19^h30^m–23^h30^m	2.28	6.00	2	3.0	17	13
22–23	19^h30^m–23^h30^m	3.08	7.23	14	4.2	91	13
22–23	19^h30^m–23^h30^m	3.32	7.02	8	2.8	52	8.8
22–23	19^h30^m–23^h30^m	3.80	6.34	7	4.4	47	15
22–23	19^h30^m–23^h30^m	1.92	5.75	2	5.4	8	9.5
22–23	21^h41^m–23^h00^m	1.25	5.80	2	5.6	6	10
22–23	21^h45^m–23^h03^m	1.10	6.01	1	2.5	9	14
Apr 23–24	19^h45^m–02^h25^m	4.00	6.28	6	2.7	37	11
23–24	19^h45^m–02^h25^m	3.27	6.47	9	4.1	34	11
23–24	19^h45^m–02^h25^m	4.00	6.32	1	0.4	36	11
23–24	19^h45^m–02^h25^m	3.54	6.16	1	0.6	33	13
23–24	19^h45^m–02^h25^m	3.94	6.11	1	0.6	50	19
23–24	19^h45^m–02^h25^m	2.00	5.87	1	1.4	19	19
23–24	19^h45^m–02^h25^m	4.60	7.36	19	2.4	121	10
23–24	20^h38^m–02^h10^m	2.25	6.20	3	2.5	20	12
Apr 24–25	00^h45^m–01^h55^m	1.09	6.33	2	2.5	10	11

As one can see from Table 1, the ZHR's are rather low. In Table 2, averages for each night were calculated.

Table 2 — Mean ZHR- and HR-values for the 1988 Lyrids in the GDR.

Date	ZHR	HR
Apr 09–10	1.4 ± 1.4	11 ± 2
13–14	1.2 ± 1.1	13 ± 5
14–15	2.4 ± 0.3	14 ± 7
15–16	3.7 ± 1.1	9 ± 3
16–17	2.6 ± 0.6	13 ± 2
18–19	5.1 ± 5.1	9 ± 5
22–23	5.1 ± 2.2	12 ± 2
23–24	1.8 ± 1.2	13 ± 3
24–25	2.5 ± 1.8	11 ± 4

For the period until April 18–19, an r-value of 2.3 ± 0.5 was obtained for 34.5 meteors between magnitudes -2 and $+5$. For the period after that night, we got $r = 2.1 \pm 0.4$ for 66.5 meteors in the same magnitude range. This is considerably less than the value of $r = 2.9$, found in the literature. However, we need more observations to enlarge the sample, before we can make any conclusions.

So, what we definitely need in years to come, is clear weather during the maximum night of the Lyrid shower!

The Lyrids 1988 in Malta

Bernard Bonnici, Adrian Galea and Gordon Pace

Observations of the 1988 Lyrids carried out by members of the Astronomical Society of Malta are presented. Despite the weather, the observing project turned out to be a success.

Despite the uncomfortable observing time and the adverse weather prevailing throughout the April Lyrid project of the Astronomical Society of Malta, the outcome was a complete success. A good number of observers persisted in showing their true character eventually making this year's initial project as the best ever conducted outside the summer season in terms of observing time. With people starting to observe at $3^{\rm h}$ am local time in an unideal month of the year, few were expecting the outcome. One wonders what would have been the result had good weather prevailed during the project, considering that most participants observed for just a fraction of the total time they spent waking. It must also be mentioned that the official project was eventually extended by three nights and that only one night out of eleven lacks any data. In this first report on the April Lyrids ever to be published locally, the observers who participated must be congratulated on their commendable contribution which augurs well for the rest of the projects this year and for some time after that. The following observers participated in the project:

> Jean Paul Mifsud (JPM), Adrian Galea (AG), Bernard Bonnici (BB), Anna Baldacchino (AB), Godfrey Baldacchino (GB), Martin Debattista (MD), Mark Scicluna (MS), Alexander Gambin (AGA), Gordon Pace (GP) and Franco Gatt (FG).

In total 10 observers saw 221 meteors in 10 nights during 36.36 man hours; 24 watches were organized. In Table 2, a summary of the observational data is given. Table 1 lists the abbreviations used for minor showers.

Table 1 — Abbreviations.

Shower	Abb.
ϕ-Bootids	PB
α-Bootids	AB
α-Scorpids	AS
δ-Cygnids	DC
Virginids	V
η-Aquarids	EA
Aquilids	A
Herculids	H

Table 2 — Observations of the 1988 Lyrids by members of the Astronomical Society of Malta.

Date	Obs	Period (UT)	Lm	Lyr	Spor	Minor Streams
Apr 14–15	JPM	00^h50^m–03^h00^m	4.8	2	9	1PB,1AS,1DC,1V
15–16	MD	01^h11^m–03^h18^m	4.5	5	9	1AB,1DC
15–16	JPM	01^h00^m–03^h10^m	5.0	2	4	2AB,1DC
16–17	AG	01^h45^m–02^h48^m	4.8	1	3	1PB,2V
16–17	MS	01^h38^m–02^h55^m	4.6	2	3	3V
17–18	AGA	01^h50^m–03^h00^m	5.2	3	5	
17–18	AG	01^h53^m–03^h02^m	4.9	3	3	1A,1DC,3H
17–18	GB	01^h33^m–02^h39^m	5.4	1	4	
17–18	AB	01^h33^m–02^h39^m	5.3	1	4	
17–18	JPM	23^h52^m–03^h10^m	4.7	3	8	2DC,1EA
18–19	BB	21^h25^m–23^h25^m	4.6	3	3	
18–19	JPM	23^h30^m–03^h10^m	4.8	7	7	2PB,1AB
18–19	AG	02^h45^m–03^h30^m	4.6	1	1	3A
20–21	AG	00^h56^m–02^h33^m	5.0	4	7	1AB,3A
20–21	AB	01^h22^m–02^h15^m	5.3	2	2	
20–21	GB	01^h23^m–02^h15^m	5.3	1	3	
21–22	GP	01^h13^m–02^h16^m	4.9	3	2	
22–23	AB	01^h26^m–02^h29^m	5.4	1	4	
22–23	GB	01^h26^m–02^h29^m	5.3	1	4	
22–23	BB	00^h15^m–03^h05^m	4.8	14	10	1PB,1AB,1AS,1DC,2A
23–24	AG	22^h05^m–23^h40^m	5.3	1	5	1AB,1 nebulous meteor
24–25	JPM	23^h30^m–03^h10^m	4.9	3	12	2DC,1V

During the analysis we noticed that the rates for some observations were quite realistic as regards ZHR, but the sporadic hourly rates were too high. These were accounted for by some minor showers like the δ-Cygnids, Aquilids and Herculids, whose data we only found in one radiant catalogue (the British Meteor Society Radiant Catalogue). Two of the showers, the Aquilids and Herculids, were only observed on the actual date of maximum as predicted by the said catalogue. Other showers of which some activity was detected include the α- and ϕ-Bootids, the Virginid complex as well as the Scorpio-Sagittarius complex. Also, we suspect to have seen an early η-Aquarid.

Furthermore, two peculiar phenomena were recorded. Jean Paul Mifsud observed a -3 meteor split into two accompanied by a white-blue-green color change, a terminal flare and a 3-second persistent path. Adrian Galea observed what is termed a nebulous meteor (and what looks like a high-speed comet!). This magnitude 0 meteor had a white coma and a short-lived persistent path. It was quite long (estimated at approximately 45°) and twice kinked in its path although it traveled in a straight line.

In Table 3, average ZHR- and HR-values are given.

Table 3 — ZHR-values for the 1988 Lyrids in Malta and corresponding HR-values.

Date	$\lambda_{\odot}$ (1950.0)	ZHR	HR
Apr 15	23.86	6.0 ± 4.2	27 ± 9
16	24.86	12.7 ± 4.8	23 ± 7
17	25.84	9.4 ± 5.4	19 ± 8
18	26.82	8.2 ± 2.5	16 ± 3
19	27.78	14.2 ± 4.3	12 ± 4
21	29.74	10.2 ± 3.9	18 ± 5
22	30.72	16.2 ± 9.4	11 ± 7
23	31.70	14.5 ± 3.6	17 ± 4
23	32.57	3.6 ± 3.6	13 ± 6
25	33.61	4.6 ± 2.7	18 ± 5

The maximum for Maltese observers occurred during the night of April 21–22. However, the rates on April 22–23 were also quite high, indicating that the actual maximum occurred on April 22 during daylight hours for Malta.

The mean sporadic hourly rate for the projected was calculated at 17.3, which is very realistic although slightly high, as mentioned earlier, possibly because of the presence of minor shower meteors that were not recognized as such.

Only 4 Lyrids and 8 sporadics exhibited train phenomena: that is 6% of the April Lyrids and 7% of the sporadics observed. 12 Lyrids and 14 sporadics exhibited terminal flares, representing 19% and 12% of the Lyrids and sporadics respectively.

Observational Results in December 1987

Benelux Observations in Southern France

Ghislain Plesier

A group of seven amateurs traveled to Lardiers, Southern France, from December 12 till 26, to observe the Geminid and Ursid maxima. Ten out of fourteen nights could be used for observations, but both maxima were missed.

On Saturday, December 13, 1987, Bauke Rispens (NL), Pierre and Tilly Vingerhoets (B) and Ghislain Plesier (B) arrived at the two "Gites de France" where we would stay. Later, Paul Roggemans (B) and two French amateurs, members of the Société Astronomique de France, arrived by train.

On the total of the fourteen nights of our stay, four were completely covered, two had a short period of clear sky, and eight were mostly clear. With respect to the quality of the sky, we had no real transparent "Provence night", but two nights were nevertheless very clear; the other nights could "only" be compared to good Belgian skies. By the way, during the same period in Belgium, only two or three nights were clear... In Table 1, totals for each observer are listed.

Table 1 — Totals per observer for the 1987 Benelux Geminid and Ursid observations in Southern France.

Observer	Nights	T_{eff}	Gem	Urs	Spor	Tot
Ghislain Plesier	10	59.36	158	87	963	1208
Bauke Rispens	10	57.46	109	98	1198	1405
Paul Roggemans	8	29.85	120	47	359	526
Pierre Vingerhoets	7	34.24	32	59	292	383
Total	35	180.91	419	291	2812	3522

Figure 1 —The landscape near Lardiers, Southern France.

The daily results were as follows:

Table 2 — Totals per night for the 1987 Benelux Geminid and Ursid observations in Southern France.

Date	T_{eff}	Gem	ZHR_G	Urs	ZHR_U	Spor	HR
Dec 14–15	8.98	378	70	0		458	12
15–16	6.30	40	10	0		118	20
17–18	31.09	1		10	1	349	15
18–19	13.56	0		16	4	254	18
19–20	22.38	0		24	2	255	13
20–21	28.85	0		40	4	445	19
21–22	31.58	0		140	7	760	19
22–23	2.73	0		15	17	48	19
23–24	30.91	0		41	2	734	22
24–25	4.46	0		5	2	100	23

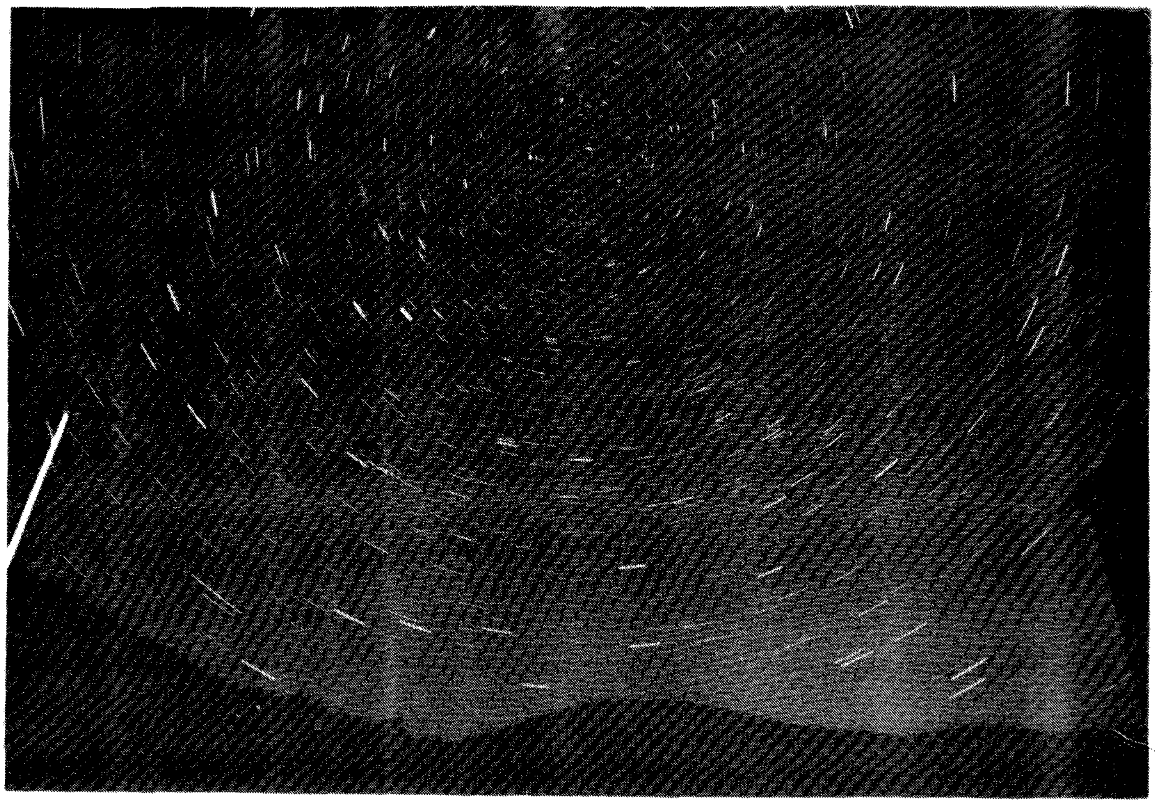


Figure 2 —The night sky at Lardiers.

Some minor showers were detected: on April 18–19, fast meteors from Leo Minor and on April 23–24, from the southern part of Leo. A group of German observers confirmed this.

Table 3 — Magnitude distribution of the Benelux observations of the 1987 Geminids and Ursids in Southern France, compared to the magnitude distribution of the sporadics during the same period.

Date	Stream	Others	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	$\overline{m}$
Dec 14–15	Gem	0	0	0	4.5	10	17.5	40.5	94.5	124.5	57	23	5.5	2.53
14–15	Spor	0	0	0	0	0	0	3.5	12.5	10.5	28.5	22.5	3.5	3.80
15–16	Gem	0	0	0	0	0.5	3.5	5	7	12	8.5	3.5	0	2.65
15–16	Spor	0	0	0	0	0.5	0.5	2.5	10	17	28.5	18.5	0.5	3.62
17–18	Urs	1 (−7)	0	0	0	0	0	0.5	1.5	3	3.5	0.5	0	2.20
17–18	Spor	0	1.5	2.5	0	5	3.5	5	33	83.5	114	86	4	3.59
18–19	Urs	0	0	0.5	0.5	0	0	0	0.5	4.5	8.5	0.5	1	3.41
18–19	Spor	0	0	1	1	2	0.5	5.5	21	50.5	95	59.5	2	3.70
19–20	Urs	0	0	0	0	1	1	1	3.5	5.5	8.5	3.5	0	3.13
19–20	Spor	0	0	0	0	0	0	5	17	46.5	91	64	7.5	3.93
20–21	Urs	0	0	0	0	0	0	1	2	17.5	14	5.5	0	3.53
20–21	Spor	0	0	2	0	2	2.5	17	35.5	93	157	92	4	3.63
21–22	Urs	0	0	0	0.5	1.5	2.5	8	17	39.5	43.5	23.5	4	3.38
21–22	Spor	0	0	2	4.5	7	10.5	19.5	57.5	106.5	218.5	180	14	3.69
22–23	Urs	0	0	0	0	0	0	0	0.5	7	7.5	0	0	3.47
22–23	Spor	0	0	0	0	0	0.5	0.5	5	6.5	13	7.5	0	3.62
23–24	Urs	0	0	0	0	0	0	0	2	11.5	14	13	0.5	3.96
23–24	Spor	1 (−13)	1	0	2.5	7	9	25.5	58.5	130	233.5	203	21	3.70
24–25	Urs	0	0	0	0	0	0	0	0.5	0.5	2	2	0	4.10
24–25	Spor	0	0	0	0	2.5	4.5	4	6	9	34.5	32	2.5	3.72

A −7 Ursid was seen by Pierre Vingerhoets on December 17–18 and a spectacular sporadic fireball of magnitude −13 near the horizon on December 23–24. This blue-ish meteor left a trail of magnitude −1 to −2 at the beginning for about 20 seconds.

1987 Ursids and Coma Berenicids in Southern France

Bernhard Koch

The author et al. stayed in Southern France between December 20, 1987 and January 1, 1988 for meteor and comet observations. No unusual Ursid activity was registered. The observers also paid attention to the "new" Coma Berenicid stream.

1. Introduction

The observers that took part in the project were Bernhard Koch (BK), Michael Nolle (MN) and Stefan Ströbele (SS), all from Ulm in the FRG. The observing sites were as follows:

Table 1 — Observing sites for the West German 1987 Ursid and Coma Berenicid observations in Southern France

Date	Location	λ	φ
Dec 20–21	St. Etienne les Orgues	5°47′02″ E	44°02′13″ N
21–22	St. Michel le Observatoire	5°42′14″ E	43°54′58″ N
22–23	St. Jurs	6°11′13″ E	43°54′10″ N
22–23	Col de St. Jurs	6°13′19″ E	43°54′16″ N
23–24	Puimichel	6°01′23″ E	43°58′41″ N
24–25	Col de l'Espigoulier	5°39′30″ E	43°19′00″ N

In the first half of the Ursid maximum night (December 22–23), which was partially overcast, we observed near the village of St. Jurs. At 0^h UT, the fog in the valley caught up with us. We had to pack our gear and go higher in the middle of the night! Col de St. Jurs, at an altitude of 1300 m, is an ideal site for meteor observations. Here the conditions were excellent while a fat layer of fog was covering everything below 800 m. Once more, high flexibility paid itself!

On December 24–25, fog was coming up at 23^h UT; December 25–26 was overcast and rainy. The last three days, we spent as holidays (December 30–31 and New Years' Eve were rainy anyway).

2. Telescopic observations

Our main goal was an extensive telescopic observation of the Ursid shower, with one participant observing visually and the others telescopically through three different binoculars: 7×50, 11×80 and 14×100.

We planned to compare the results of different observers respectively instruments with the aim to improve the instrumental correcting factors. This plan failed for the following reasons:

- the main point: a fundamental lack of activity;
- secondly, the instable weather: in the morning hours of December 22, observations were impossible because of dew, and on December 23, a low radiant was covered by cirrus layers in the evening.
- During the night of the Ursid maximum, Stefan Ströbele was knocked down by a neglected influenza.

Observations could be made in the evening hours of December 21 and during the second half of the maximum night. The results are listed in Tables 2 and 3, on the following page.

Obviously, activity was only poor.

Table 2 — West German telescopic observations of the 1987 Ursids in Southern France. Visual magnitudes mentioned for December 22–23 are those determined by BK.

Date	Obs	Instr.	Period (UT)	T_{eff}	Lm_v	Lm_t	Urs	Spor
Dec 21–22	BK	11 × 80	20^h28^m–21^h15^m	0.67	6.6	11.4	1	3
21–22	MN	7 × 50	23^h25^m–00^h10^m	0.70	6.3	9.3	0	2
21–22	BK	11 × 80	23^h15^m–00^h28^m	1.07	6.6	11.4	1	4
22–23	MN	11 × 80	01^h00^m–02^h00^m	0.97	6.7	11.5	1	7
22–23	MN	11 × 80	02^h00^m–02^h33^m	0.52	6.7	11.1	0	1
22–23	MN	11 × 80	03^h00^m–04^h00^m	0.83	6.3	11.2	1	2
22–23	MN	11 × 80	04^h37^m–05^h05^m	0.47	6.4	11.7	1	4
22–23	MN	11 × 80	05^h20^m–06^h00^m	0.67	6.2	11.4	2	4

In Table 3, only the observations with the 11 × 80 binocular were taken into account.

Table 3 — Magnitude distribution for the West German telescopic observations of the 1987 Ursids in Southern France

Date	Shower	+6	+7	+8	+9	+10	Tot	$\overline{m}$
Dec 21–22	Urs	0	0	0	2	0	2	9
21–22	Spor	0.5	1.5	1.5	1.5	2	7	8.4
22–23	Urs	1	1	1	1	1	5	8.0
22–23	Spor	2	1.5	3.5	6	5	18	8.25
Total	Urs	1	1	1	3	1	7	8.3
Total	Spor	2.5	3	5	7.5	7	25	8.30

It seems impossible to derive the date of maximum from these data.

3. Visual observations

More profitable were the visual results. Due to extensive comet observation and photography in Puimichel, further meteor work had to be restricted at that time. On December 20–21, we were tired from the journey and the last three nights, we had to relax from the strains. The data are listed in Table 4.

(continued on following page)

Bright Radio Meteors over Denmark

Gotfred Møbjerg Kristensen

In June, I observed two bright meteors. The first occurred on June 4 at $15^h20^m45^s$ UT, lasting 118 seconds. The second had a duration of 221 seconds and appeared on June 7 at $13^h32^m40^s$ UT. In both cases, I was listening on 100.50 MHz, using an 8-elements Yagi antenna directed to the South. Maybe someone has seen or heard one of these meteors. In that case, please send me a report of your observation at the following address: *Vænget 19 st. th., DK-4622 Havdrup, Denmark.*

Table 1 — West German visual observations of the 1987 Ursids and Coma Berenicids (B) in Southern France. Some activity from a radiant in Cancer (C) was also noticed.

Date	Obs	Period (UT)	T_{eff}	Lm	F	Urs	ZHR	Spor	HR	Others
Dec 20–21	BK	19^h15^m–21^h05^m	1.00	6.5	1.00	0		3	3.0 ± 1.7	
20–21	SS	04^h00^m–04^h52^m	0.87	6.7	1.00	2	3.0 ± 0.5	31	35.7 ± 6.2	
20–21	BK	04^h22^m–05^h23^m	1.02	6.6	1.00	3	3.7 ± 0.7	18	17.6 ± 3.5	5B
20–21	SS	04^h52^m–05^h30^m	0.63	6.7	1.00	2	4.0 ± 1.0	13	27.0 ± 6.6	2B
Dec 21–22	BK	17^h32^m–18^h38^m	1.03	6.8	1.00	1	1.9 ± 0.9	3	2.9 ± 1.7	
21–22	SS	20^h30^m–21^h30^m	1.00	6.4	1.00	3	6.0 ± 2.0	6	6.0 ± 2.0	
21–22	SS	22^h30^m–22^h54^m	0.40	6.4	1.00	0		4	10.0 ± 5.0	
21–22	BK	22^h37^m–23^h07^m	0.50	6.8	1.00	0		3	6.0 ± 1.7	
21–22	SS	23^h15^m–00^h30^m	1.25	6.4	1.00	3	4.2 ± 1.3	7	5.6 ± 1.8	
21–22	BK	00^h55^m–01^h55^m	1.00	6.8	1.00	1	1.6 ± 0.4	14	14.0 ± 3.3	
21–22	MN	01^h18^m–01^h36^m	0.30	6.3	1.00	0		3	13.2 ± 7.6	
21–22	SS	01^h35^m–01^h56^m	0.35	6.4	1.00	1	4.3 ± 1.5	7	20.0 ± 7.1	
21–22	BK	03^h55^m–04^h55^m	1.00	6.8	1.00	1	1.3 ± 0.3	14	$14.0 \pm .3$	3B
21–22	BK	04^h55^m–05^h50^m	0.90	6.8	1.00	3	4.1 ± 1.1	10	11.1 ± 2.9	2B
Dec 22–23	BK	20^h27^m–21^h27^m	1.00	6.3	1.18	0		8	12.5 ± 4.4	
22–23	MN	21^h10^m–22^h33^m	1.38	6.3	1.18	4	7.0 ± 1.9	10	9.6 ± 2.6	
22–23	BK	21^h27^m–22^h27^m	1.00	6.4	1.11	3	6.4 ± 1.9	8	8.9 ± 3.1	
22–23	BK	22^h57^m–23^h57^m	1.00	6.4	1.38	8	19.5 ± 4.5	11	15.2 ± 3.5	
22–23	MN	23^h00^m–00^h00^m	0.77	6.15	1.13	4	15.4 ± 4.4	8	19.1 ± 5.5	
22–23	BK	00^h46^m–01^h24^m	0.63	6.7	1.00	1	2.5 ± 0.7	12	19.0 ± 5.1	1B
22–23	BK	01^h24^m–02^h24^m	1.00	6.7	1.00	6	8.9 ± 2.4	9	9.0 ± 2.3	
22–23	BK	02^h24^m–03^h38^m	1.00	6.35	1.00	7	11.5 ± 2.0	26	32.0 ± 5.5	1B
22–23	BK	03^h38^m–04^h57^m	1.12	6.45	1.00	5	5.8 ± 1.2	11	9.8 ± 2.0	8B
22–23	BK	04^h57^m–05^h51^m	0.90	6.3	1.00	8	13.8 ± 2.6	16	23.5 ± 4.4	4B
Dec 24–25	SS	21^h12^m–23^h00^m	1.80	6.1	1.00	0		5	4.8 ± 2.0	1C
24–25	MN	21^h52^m–23^h00^m	1.13	6.25	1.01	2	4.4 ± 1.1	7	8.5 ± 2.3	1B,5C
24–25	BK	22^h40^m–23^h16^m	0.52	6.1	1.11	0		3	11.1 ± 5.6	1B
Dec 26–27	MN	21^h57^m–22^h40^m	0.60	5.9	1.00	0		2	7.7 ± 3.8	2C
26–27	SS	22^m17^m–23^h00^m	0.72	5.8	1.00	0		4	14.7 ± 5.5	1B,2C
26–27	MN	23^h55^m–01^h00^m	1.08	6.4	1.00	0		10	9.3 ± 2.4	1B,4C
26–27	SS	00^h36^m–01^h00^m	0.40	6.4	1.00	0		2	5.0 ± 3.5	
26–27	BK	00^h27^m–01^h21^m	0.90	6.65	1.00	0		6	6.7 ± 1.7	6B,3C
Dec 27–28	BK	23^h08^m–00^h08^m	1.00	6.3	1.00	0		5	6.6 ± 2.0	3B,3C
27–28	MN	00^h00^m–01^h42^m	1.38	6.2	1.00	0		13	14.3 ± 2.9	7B,4C
27–28	SS	00^h40^m–02^h00^m	1.33	6.6	1.00	0		9	6.8 ± 1.4	9B,6C
27–28	MN	02^h57^m–03^h25^m	0.47	6.5	1.00	0		6	12.8 ± 4.0	4B
27–28	SS	03^h57^m–04^h30^m	0.55	6.6	1.00	0		9	16.4 ± 4.4	4B,1C
27–28	BK	04^h14^m–05^h14^m	1.00	6.75	1.00	0		11	11.0 ± 2.4	5B,5C
Dec 28–29	BK	04^h52^m–05^h52^m	1.00	6.5	1.00	0		11	11.0 ± 2.5	8B,1C

1. The Ursids

As mentioned above, no unusual Ursid activity could be registered. The ZHR never exceeded a value of 20. A magnitude distribution for the 1987 Ursids is listed in Table 5.

The population index was calculated to 3.1. An average magnitude of 3.6 was found for a total of 68 Ursids. The formula for limiting magnitude correction was used for limiting magnitudes below 6.4. The zenith distance correction was computed with a zenith exponent of 1.0.

Table 2 — Magnitude distribution of the 1987 Ursids from West German observations in Southern France

Magnitude	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Number	1	14	22.5	9.5	18	3	68	3.6

2. Other streams

In [1], the unknown shower *Coma Berenicids* is mentioned, being active between mid-December and mid-January. The velocity is given as 65 km/h (fast), the ZGR and the exact date of maximum is said to be unknown. Possible Coma Berenicids can be found in Table 4. The corresponding ZHR-values can be found in Table 6.

Table 3 — ZHR values for the Coma Berenicid and Cancrid observations in Table 4. For some observations, zenith distance correcting factors were as high as 10 and, therefore, the corresponding ZHRs are unreliable. These ZHRs are written between brackets.

Date	Obs	Period (UT)	Com	ZHR_B	Can	ZHR_C
Dec 20–21	BK	04^h22^m–05^h23^m	5	5.4 ± 1.1	0	
20–21	SS	04^h52^m–05^h30^m	2	3.4 ± 0.8	0	
Dec 21–22	BK	03^h55^m–04^h55^m	3	3.3 ± 0.8	0	
21–22	BK	04^h55^m–05^h50^m	2	2.3 ± 0.6	0	
Dec 22–23	BK	00^h46^m–01^h24^m	1	3.1 ± 0.8	0	
22–23	BK	02^h24^m–03^h38^m	1	1.5 ± 0.3	0	
22–23	BK	03^h38^m–04^h57^m	8	7.9 ± 1.6	0	
22–23	BK	04^h57^m–05^h51^m	4	5.8 ± 1.1	0	
Dec 24–25	SS	21^h12^m–23^h00^m	0		1	1.5 ± 0.8
24–25	MN	21^h52^m–23^h00^m	1	(12.4 ± 3.2)	5	9.3 ± 2.0
24–25	BK	22^h40^m–23^h16^m	1	(18.7 ± 9.4)	0	
Dec 26–27	MN	21^h57^m–22^h40^m	0		2	(10.2 ± 5.3)
26–27	SS	22^m17^m–23^h00^m	1	(24.3 ± 9.2)	2	(9.1 ± 3.1)
26–27	MN	23^h55^m–01^h00^m	1	2.0 ± 0.5	4	4.3 ± 1.1
26–27	BK	00^h27^m–01^h21^m	6	12.6 ± 3.3	3	4.0 ± 1.0
Dec 27–28	BK	23^h08^m–00^h08^m	3	11.7 ± 3.5	3	5.2 ± 1.4
27–28	MN	00^h00^m–01^h42^m	7	14.0 ± 2.9	4	4.5 ± 0.9
27–28	SS	00^h40^m–02^h00^m	9	11.2 ± 2.3	6	5.0 ± 1.0
27–28	MN	02^h57^m–03^h25^m	4	10.1 ± 3.2	0	
27–28	SS	03^h57^m–04^h30^m	4	7.9 ± 2.1	1	2.3 ± 0.6
27–28	BK	04^h14^m–05^h14^m	5	5.3 ± 1.2	5	6.9 ± 1.5
Dec 28–29	BK	04^h52^m–05^h52^m	8	8.3 ± 1.9	1	1.6 ± 0.4

Indeed, a remarkable activity of this stream could be registered. Unfortunately, we did not pay attention to this shower the whole time. In these intervals, the hourly rate of the sporadics was probably influenced by possible Coma Berenicids (see Table 4, e.g. Dec 20–21, SS, 04^h00^m–04^h52^m or Dec 22–23, BK, 02^h24^m–03^h38^m). Furthermore, on December 26–27, while photographing comets, a high activity of this "shower" was noticed. At all events, observers should keep their eye on this possible new stream. Table 7 shows the Coma

Berenicid magnitude distribution. The population index was computed to be 3.6.

Table 4 — Magnitude distribution of the 1987 Coma Berenicids from West German observations in Southern France

Magnitude	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Number	1	2	3.5	8	15.5	21	18.5	6	76	3.7

Finally, on December 24–25, Michael Nolle noticed several meteors coming from Cancer, with a "radiant" near Praesepe. However, in the following nights, this "shower" could not be confirmed with sufficient certainty. Possible *Cancrids* are listed in Tables 4 and 6. The population index was 3.1 (very small sample). Nevertheless, this "stream" should be kept in mind.

3. The sporadic background

The hourly rates of the sporadics were often pretty high, probably influenced by Coma Berenicids that were not recognized as such. The sporadic population index was calculated to be 3.2. In Table 8, below, a magnitude distribution of the sporadic background is given. The 353 sporadic meteors that were seen, had an average magnitude of 3.54.

Table 5 — Magnitude distribution of the sporadics seen during the West German 1987 Ursid and Coma Berenicid observations in Southern France.

Magnitude	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	Tot	$\overline{m}$
Number	1	1	0.5	3.5	28.5	49.5	91	65.5	84	28.5	353	3.54

Gnomonický Atlas Brno 2000.0

Vladimír Znojil

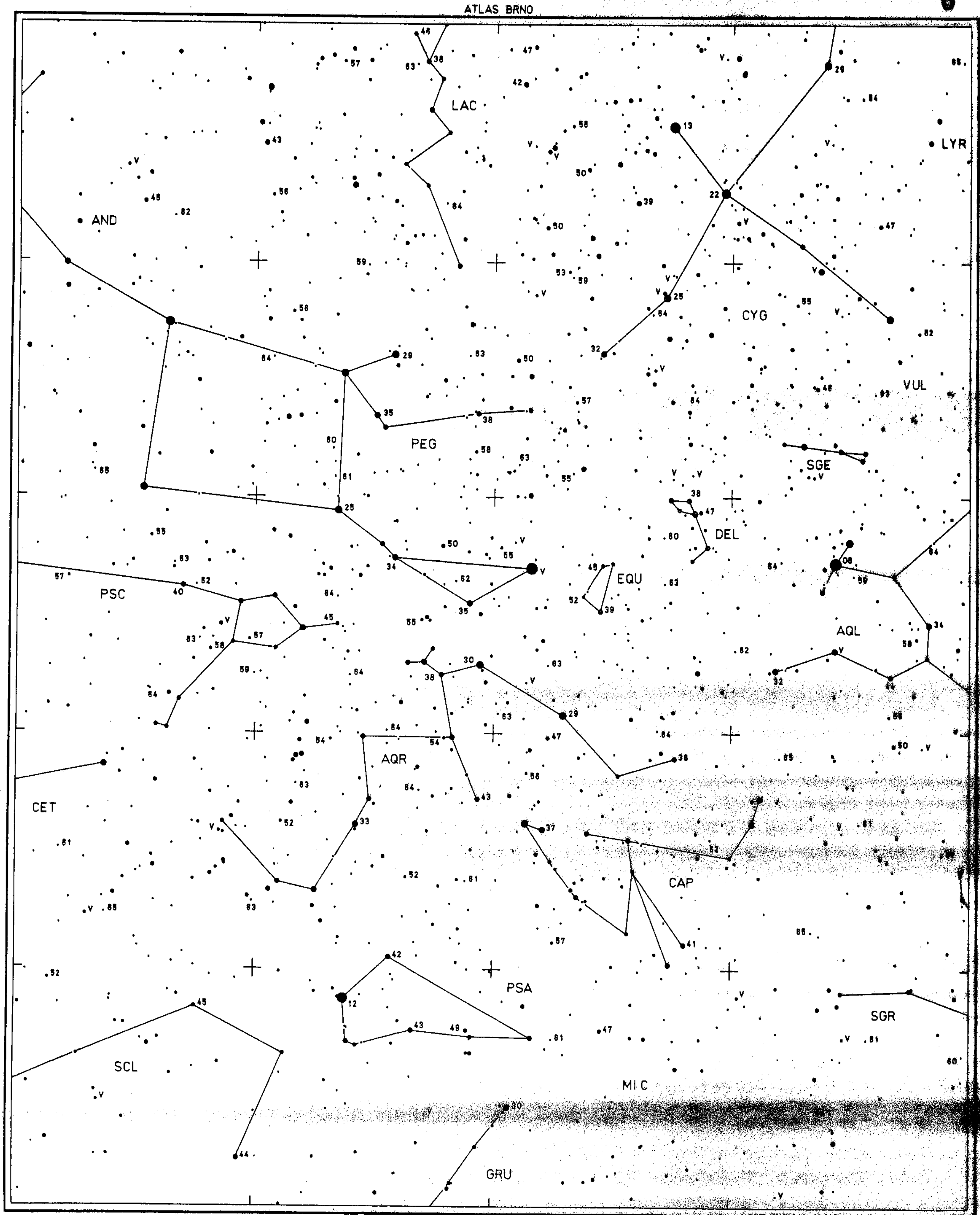
A newly published gnomonic atlas, intended for use by e.g. meteor observers, is presented.

1. Stars and constellations

The atlas contains stars up to magnitude 6.5 in the *UBV* system, according to the SAO catalogue, with addition of a number of stellar objects, not included in the latter. Since it is mainly designed for use by naked eye observers (e.g. meteor watchers), binary and multiple stars are not marked. Objects separated by more than 3′ are recorded separately, while those closer together are depicted as one object, provided their total brightness is over the lower limit of the atlas. Variable stars are drawn according to their maximum brightness, and where the amplitude of their variations is larger than half a magnitude, they are marked with the letter "V" in the atlas.

Reference stars were selected so as to have a small color index $(B - V)$ in the *UBV* system; reference stars fainter than 4.5 have a $(B - V)$ smaller than half a magnitude, but in view of the lack of suitable bright reference stars, the value of this limit increases to 1.25 for stars brighter than magnitude 1.5. The brightness V of the reference stars is expressed in units of 0.1 magnitude, without decimal point. Variable stars were not used as reference stars, though some of them have quite a low amplitude (e.g. Capella).

6


ATLAS BRNO
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CET
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PSA
SGR
SCL
MIC
GRU

Star disc diameters on the maps are in units of 0.7 magnitudes, from 6.5 upwards, in nine classes of magnitude. The position of all stars was calculated for the year 2000.0, also taking into account their proper motion.

Most constellations are depicted with the customary alignments joining their stars, as an aid to orientation. Their names are represented by the official three-letter abbreviations, in capital letters.

2. Page arrangement

The atlas contains nine pages covering the entire northern sky up to a declination of at least $-40°$; on some places, parts of the sky up to $-46°$ occur. The competing demands for a large-scale atlas, along with an overlap of at least 20° between adjacent maps, led to an unconventional arrangement of pages. The page arrangement is based on a representation of the whole sky as a dodecahedron with one of its apices at the North Pole. The nine "uppermost" faces were then optimized with regard to position and shape, in view of the rectangular form of the individual maps. It was thus possible to achieve a scale of 2.8 mm/1° at the center of the maps, with a map size of 280 mm $\times$ 350 mm.

The whole set of maps was then turned in right ascension, so that most of the radiants of main meteor streams were closer to the center of the maps.

3. Coordinates

The atlas contains guidance marks in the form of a set of coordinates at 7 cm intervals (25° according to the scale at the center of the map). Projection or reading of positions according to these is much more precise than in terms of right ascension and declination. The conversion factors are simple, and, given the present widespread use of calculators and small computers, easy to perform.

From the X and Y coordinates, with their origin at the bottom left corner of the map (in mm, X-axis to the right, Y-axis upwards), the conversion to standard coordinates (x, y) with regard to the center of the map goes as follows:

$$\begin{aligned} x &= (X - X_0)/R \qquad & X &= X_0 + Rx \\ y &= (Y - Y_0)/R \qquad & Y &= Y_0 + Ry \end{aligned} \tag{1}$$

where R is the radius of the projection and (X_0, Y_0) the position of the center of the map. With a distance of 70 mm between the marks on the map, $R = 160.43$ mm. For maps 1 to 3 and 7 to 9, $X_0 = 175$ mm and $Y_0 = 140$ mm; for maps 4 to 6, $X_0 = 140$ mm and $Y_0 = 175$ mm.

We further define the direction vector of an object by means of the relations:

$$\begin{aligned} p &= \sin\delta \\ q &= \cos\delta \sin(\alpha - a) \\ r &= \cos\delta \cos(\alpha - a) \end{aligned} \tag{2}$$

where α and δ are the right ascension and declination of the object and a is the right ascension of the center of the map (given in degrees in Table 1).

Table 1 — Right ascension a an declination d of the center of each map in the *Gnomonický Atlas Brno 2000.0*.

Map	1	2	3	4	5	6	7	8	9
a	30°	150°	270°	90°	210°	330°	30°	150°	270°
d	55.68°	55.68°	55.68°	4.89°	4.89°	4.89°	−4.89°	−4.89°	−4.89°

The calculation of the position of an object on the map starts with the calculation of the direction vector using relation (2). Then calculate $s = p\sin d + r\cos d$, with d the declination of the center of the map; the values of d are also in Table 1. If $s < 0.582$, the object cannot be drawn on the map. The standard coordinates of the object are then given by the relation:

$$\begin{aligned} x &= -q/s \\ y &= (p\cos d - r\sin d)/s \end{aligned} \tag{3}$$

from which it is easy to calculate the coordinates (X, Y), using relation (1).

In the other direction, one has to calculate first the standard coordinates using (1) and the polar radius $t = \sqrt{1 + x^2 + y^2}$. The component of the direction vector are then given by:

$$\begin{aligned} p &= (\sin d + y\cos d)/t \\ q &= -x/t \\ r &= (\cos d - y\sin d)/t \end{aligned} \tag{4}$$

from which the values of α and δ can be determined using the relations in (2).

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The atlas can be ordered from the Nicholas Copernicus Observatory and Planetarium, Kraví hora, CZ-616 00 Brno, Czechoslovakia.

Book Review

Masahiro Koseki

- *P.B. Babadzhanov, "Meteors and their Observations", 1987, Nauka.*

The author of this book is the chairman of Committee 22 of the IAU and the most active professional in the photographic observation of meteors. This book is published in the series "Books for Amateur Astronomers", but it contains new observational results and is for advanced amateurs rather than for beginners. It is a small book, but a notable work since Lovell's "Meteor Astronomy". It is to be regretted this book is not popular because of its language. Below is a translation of the table of contents.

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   - List of major meteor showers
   - List of cometary radiants
   - Table of perception coefficients for the multi-count method

The Meteor Library

compiled by Paul Roggemans

- *V. Porubčan, B.A. McIntosh, "Lyrid Meteor Shower of 1982: Enhanced Activity Observed at Ottawa, Canada", Bull. Astron. Inst. Czechosl. 38, 1987, pp. 313–317.*

Radar observations of the Lyrid Meteor Shower in 1982 at Ottawa, Canada (Springhill Meteor Observatory) showed enhanced activity on April 22 peaking at $06^{h}49^{m}$ UT (solar longitude $\lambda_{\odot} = 31^{\circ}\!.380$, equinox 1950.0). The duration of the storm was 22 minutes between half-maximum points, and 50 minutes to quarter maximum. Small particles predominated. A search for non-random pairing of observed particles gave no positive result.

- *V. Porubčan, M. Hajduková, "On the Structure of the Lyrid Meteor Shower from Radio Observations in 1963–1967", Acta Astronomica et Geophysica Universitatis Comenianae XI–XII 1987.*

Radio Observations of the Lyrid meteor shower carried out at Springhill Meteor Observatory in 1963–67 are analyzed and discussed. The analysis shows that the shower is resolvable from the sporadic background for about a week, appearing regular by every year with approximately constant flux of overdense echoes, with the peak activity at the solar longitude $\lambda_{\odot} = 31^{\circ}\!.7$, and the duration between the quarter-maximum points of 2 days. No separation of particles according to their mass is observed. The Lyrid meteor shower is active in the second half of April, extending over a few days only, with a maximum on April 22. Although not so prominent at the present time, the shower exhibited several great displays in the past [Olivier, 1925; Lovell, 1954]. The parent comet of the shower is the long period comet 1861 I P/Thatcher with the period of 415 years. Despite this long period orbit, much shorter periods in apparition of stronger shower maxima, caused by the perturbations from major planets were suggested [Guth, 1947]. Due to mostly not optimal observing conditions for optical techniques in April and a narrow peak of activity, the most consistent data concerning year-to-year monitoring of the Lyrid meteor shower can be provided by radar observations.

- *V. Porubčan, M. Šimek, "Distribution of Lyrid Meteoroids in a Large Range of Echo Durations", Bull. Astron. Inst. Czechosl. 39, 1988, pp. 165–168.*

Radar observations of the Lyrid meteor stream made at the Ondřejev Observatory in 1980–1985, are analyzed and discussed from the viewpoint of determining the mass distribution exponent for overdense echoes in the range of 0.4–50 s. The mass exponent proved to be almost constant over the whole range of echo durations with $s \approx 1.58$. The contribution of larger particles, as compared with other meteor streams, was found to be more significant for the Lyrids. The almost constant value of s indicates a still active contribution of fresh cometary material to the stream.

A New Look for WGN

Marc Gyssens

As our longtime readers can assert, we are continuously trying to improve the presentation of *WGN*. The last major change occurred in the beginning of 1987. From the first issue of that onwards, *WGN* was typed on an electric IBM typewriter. Only the title were made on computer with a text processor. Meanwhile, *WGN* has evolved from a Belgian publication to an international journal, and, therefore, we felt it was appropriate to switch to text processing all together. The program we use is TEX: a typesetting system well suited for scientific texts that is gradually becoming a standard for mathematical and physical articles, book, journals, etc. We hope you like the result. As always, we welcome all comments and critisisms.

Switching to computer text processing has one definite advantage, now that more and more people buy a personal computer. Authors having a personal computer are therefore strongly encouraged to write their article on it and send us, along with a hard copy, a diskette with the text on it. In this way, it is possible to reduce the typing work for *WGN*, leaving me more time for the lay-out. Also, copying errors can be avoided in this way. The file you send us should be an *MSDOS textfile* (*not* processed by any kind of word processor) written on a 360 K $5\frac{1}{4}$" diskette. Shortly, we also hope to be able to use textfiles on Apple McIntosh diskettes, so you can send us these, too. Of course, it goes without saying that people without personal computer can still send us their articles and reports in the traditional "old-fashioned" way!

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