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Steve Evans
IMC 2008
Video meteors
WGN history

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Front cover photo

Steve Evans; photo courtesy of Mrs. Evans. See the Obituary on the facing page.

Writing for WGN This Journal welcomes papers submitted for publication. All papers are reviewed for scientific content, and edited for English and style. Instructions for authors can be found in WGN **31:4**, 124–128, and at `http://www.imo.net/articles/writingforwgn.pdf` .

Legal address International Meteor Organization, Mattheessensstraat 60, 2540 Hove, Belgium.

In Memoriam — Steve Evans (1953–2008)

Alastair McBeath[1]

Stephen (Steve) Evans died unexpectedly on March 7th, from a massive heart attack. He turned 55 this January. Steve first appeared on the UK meteor scene in the early 1980s, with a strong interest in photographic work. I first recall seeing his name in meteor activity reports from the start of 1983. In 1985, he took on the role of Photographic Meteor Coordinator for the British Astronomical Association (BAA), which he held until 1997, although he continued in almost as active an advisory role as before in this regard until he was officially replaced in 1999. Much of his efforts during that time were centred around encouraging and carrying out solo and multiple-station meteor photography, and as the 1990s progressed, video observing too, especially with his long-time friend and colleague Andrew Elliott. From 1990 to 1999 he maintained a schedule of publishing at least one or two detailed analysis papers per year in the BAA's Journal, often from campaigns during particular showers, despite the very time-consuming nature of such data-reduction.

Although I met him once briefly in 1993, my first real contact with Steve began at the start of 1999, when, in his words, 'extremely impressed by the wealth of information' on the IMO website, he decided to join the IMO. Steve found in the international meteor community more like-minded souls outside Britain, who encouraged and helped him realize his hopes of observing the strong to storm Leonid showers between 1999 and 2002 from really good sites, away from the less-than-dependable skies over his UK home. Of all his meteor work, I know he particularly enjoyed participating in joint expeditions with professional observers from the Czech Republic and amateurs from the Netherlands in Spain in 2000 and 2002, and Arizona in 2001, to obtain high-quality triangulated images of meteors during the Leonid returns (see next page). He always felt the highlight of those was seeing the 2001 storm from the wonderful, dark skies of Arizona, as he said 'a truly once in a lifetime experience.' The computer reduction of the more than 5000 meteor trails recorded by his own video system during that same storm took until 2003 to finish, data that subsequently featured in several professional science journal papers, along with those of his friends and colleagues from the expeditions. He continued to operate various automated video meteor cameras from home up until his death, contributing regularly to the IMO's Video Commission monthly reports and analyses, the UK's only such observer. In 2005, when I decided to stand down as IMO Assistant Treasurer for Sterling payments, Steve volunteered to take over, as he put it, 'keen to give something back' to an Organization he saw as having greatly helped him. He approached all his meteor activities with the same enthusiasm, knowledge and dedication, and was ever the most pleasant of correspondents.

The global meteor community is a relatively small one, so the death of any of its more active members tends to be keenly felt. Steve's tragically early passing has been felt more than most, as has been clear from the numerous comments I have received, beginning immediately after the event was announced. It is equally clear that he has been and will continue to be greatly missed. Our heartfelt sympathies go to his family, to whom IMO President Jürgen Rendtel has sent a message of sincerest condolence on behalf of the Organization.

For those who may care to revisit some of Steve's published work, part of it has been featured in the SPA Meteor Section reports since 1999 in this journal, including several of his video meteor images and some personal recollections, particularly in WGN 30:3 (2002), pp.68-69 on the 2001 Leonids, WGN 31:5 (2003), pp.164-165 on the 2002 Leonids, and WGN 34:1 (2006), p.20 on his recollections from the Leonids between 1998 and 2002. His 2001 and 2002 Leonid images, with some others and a video clip of an impressive shower fireball from 2001 November 18, are also available online in the Leonid reports from those years off the SPA meteor homepage at `www.popastro.com/sections/meteor.htm`. In addition, with five others, he co-authored 'Video Observations of the 1999 Leonid Meteor Storm Recorded at Different Locations', in WGN 28:5 (2000), pp.150–165 (for which paper Jürgen Rendtel was lead author).

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IMO bibcode WGN-361-mcbeath-evansobit NASA-ADS bibcode 2008JIMO...36....1M

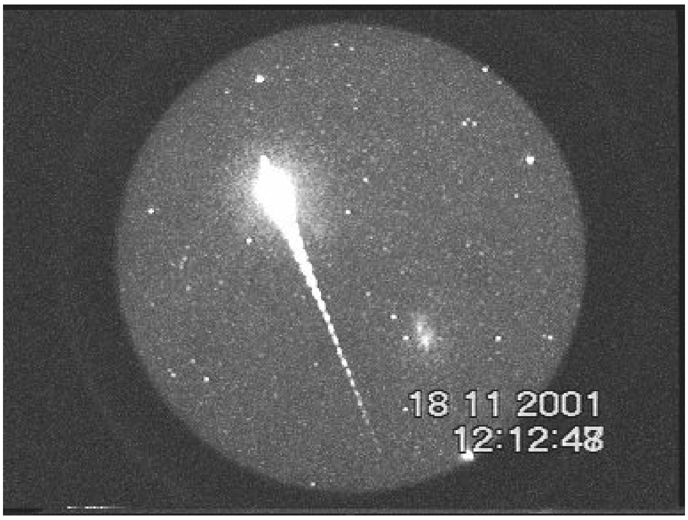

Figure 1 – A spectacular Leonid caught on video by Steve Evans on 2001 November 18. From WGN **30:3**, p. 69.

Janus

Javor Kac [1]

This year makes it 15 years since my first serious meteor observation. I started observing at a youth astronomical camp in 1993, watching for minor shower members and sporadic meteors. A few weeks later in August that year, we witnessed a splendid display of the Perseids that turned me into a meteor enthusiast. Ever since, I have observed major showers, hoping that one day I would again see a meteor shower of comparable strength. That wish was fulfilled years later with the Leonid meteor storms. When I learned about the existence of the International Meteor Organization I quickly became a member to enjoy a global friendship of fellow observers. The friendly atmosphere is especially well perceived when many of the observers gather at a yearly event – an International Meteor Conference.

The International Meteor Organization celebrates 20 years since its foundation in 1988. The Organization has done an incredible job, setting the standards of visual observation, coordinating observations throughout the world, collecting observations, analyzing data and communicating the results to everybody interested. Thanks to IMO, the observers, and the researchers using data obtained, meteor science has come a long way in the last couple of decades. Werkgroepnieuws, or WGN in short, was adopted as an official IMO journal. It has evolved from a local circular in Dutch into an international journal written in English, also recognized between the professionals. This could be realized thanks to the hard work of the former editors Paul Roggemans, Marc Gyssens and Chris Trayner, and of course all the contributing authors.

In the coming months a new editor will take over the production of the Journal and we are all looking forward to that. Although most of the Editorial board will stay the same, that should bring some fresh ideas for the WGN. Chris will be leaving a wealthy heritage, so the transition of editorship will not be too hard for the newly appointed editor. This will also be a chance to encourage the readers, be them researchers or meteor observers, to submit more papers for the publication in WGN. I would love to see more observing reports and impressions, and observer's (or groups') own analyses of the showers. Of course, any work that professionals would be willing to share will be most welcome, too.

Perhaps this year, the new edition of the Handbook for Visual Meteor Observers, the meteor observer's Bible will be published as well. This publication will present up-to-date knowledge about the meteor showers, and give directions for visual meteor observations and their analysis for the future generations of meteor observers. In all, we can look forward to the bright future of the International Meteor Organization.

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IMO bibcode WGN-361-kac-janus NASA-ADS bibcode 2008JIMO...36....2K

Guest editorial — From the President

Jürgen Rendtel [1]

Several events made the year 2007 a very successful and interesting year. The astronomical circumstance for optical observations of most major meteor showers were good and yielded a huge amount of data which still needs to be analysed in detail. The live-analyses, introduced by Geerst Barentsen already in 2006, do not only allow to follow the activity of meteor showers, but obviously also encourage many observers to participate with own observations and to to provide their data reports immediately. Both aspects will improve the quality of the analyses directly.

The annual IMC took place in June 2007. This is much earlier than usual, but was chosen to allow a convenient combination of the participation in the IMC in Bareges in the Pyrenees and the immediately following 'Meteoroids 2007' in Barcelona. While it was not clear how such a change would affect the IMC participants, we saw more than 80 meteor people at the IMC. Nineteen of them met again at the professional conference, showing that the combination of both meetings was well used. It also allowed numerous contacts between amateurs and professionals. As shown in the issues of our Journal WGN, many interesting results were produced over the last year. For example, we reported and discussed the unusual Orionid activity in 2006. It was topic of several observational reports and theoretical papers at the IMC and the Meteoroids. The prediction of another rich Orionid return in 2007 became true and was well documented through the already mentioned live page.

Further encouraging events were the observations of the predicted Aurigid outburst on September 1 and the enhanced Ursid rates on December 22, both under rather poor conditions (moonlight). Without the predictions, we may assume that both events would have been missed. This indicates that probably similar short-lived events in the past went unobserved.

The chances to record (almost) all such activities has improved when data of different observing techniques are combined. Systematic radar and video observations certainly help to obtain a more complete data material. It also provides us with information about radiants and activity of previously undetected sources. Respective results have been presented in 2007 and an IAU task group to establish an 'official list' of meteor showers was established, where results of the amateur community are considered in the same way as professional data.

Many discussions happened in the IMO Council, including topics like the IMO support possibilities or the handling of everyday matters. In the past, the number of IMO members actually taking part in voting procedures was alarmingly low. With the newly introduced electronic voting this improved a lot. The Council considered this an important point, because we need feedback about the decisions we make. The successful implementation of the electronic voting was done by Luc Bastiaens who also carefully looked at the IMO's web pages. A continuing problem is the small number of IMO members actively taking part in the Council or administrative work. Fortunately, we have the well accepted offer of Jean-Louis Rault to coordinate activities of the radio meteor observers within the IMO, and he accepted the appointment to the director of the Radio Commission.

Another essential task in the IMO is the preparation and production of our Journal WGN. Therefore we thank Chris Trayner a lot for all his work as the Editor of WGN. After several years, he now asked to retreat from this position. An announcement was published in the previous issue, and I would like to encourage all people who might be interested to work in this respect, to contact Chris or any other Council member

2008 will certainly become an interesting year for meteor astronomy: meteor showers as well as meetings provide us with numerous possibilities to deal with our field. I wish everyone a prosperous and successful 2008 and hope to hearing about your activities or meeting you at our IMC in September.

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IMO bibcode WGN-361-rendtel-editorial NASA-ADS bibcode 2008JIMO...36....3R

IMC 2006 Proceedings now available

Fexil Bettonvil [1]

On behalf of the Organizing Committee, I am glad to announce that the 2006 proceedings of the annual International Meteor Conference (IMC) recently have been released. The 2006 conference was held in Roden, The Netherlands from September, 14–17, 2006 and hosted by the Royal Dutch Association for Meteorology and Astronomy (KNVWS). During beautiful post-summer weather, almost 70 meteor enthusiasts from in- and outside Europe gathered three-and-a-half days to listen to lectures about meteor science, observations reports, instruments and observing techniques. 2006 was the year of the 25th (!) edition of the IMC and moreover the KNVWS Meteor celebrated its 60th anniversary.

The proceedings contain in total 190 pages, and include 28 papers of oral contributions and posters. Questions and answers related to the contributions are also included and in order to make the proceedings even more attractive, empty space has been filled with pictures, taken by participants at the conference.

As follow up from the year before in Belgium, where for the first time a real workshop was organized (the Radio Meteor School which was a tremendous success and ended up in the production of their own proceedings), two other workshops were scheduled in the days before the conference: the Orbit Meteor Determination Workshop and the second Radio Meteor School. Brief summaries about the two workshops are included in the proceedings.

As council members of the KNVWS Meteor Section we must confess that it was a big job to organize the IMC and it took, like always, more time than we expected. But looking back at all the efforts, it was more than worthwhile: it is absolutely great to organize an IMC yourself!

All participants get automatically a copy of the proceedings. Didn't you participate but are interested in a copy? A limited number are available and can shortly be ordered through the IMO website **http://www.imo.net/imo/publications**.

Last but not least, thank you all for coming to this IMC! It was a real pleasure to organize it and to have you here. We never should forget that although we all are much interested in meteor science and want to discover and learn as much as we can, we all do it because we like it, because it is our hobby, and we make the sometimes very long trip to the IMC, to share that!

IMO bibcode WGN-361-bettonvil-imcprocad NASA-ADS bibcode 2008JIMO...36....4B

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Conferences

International Meteor Conference 2008
September 18–21, Šachtička, Banská Bystrica, Slovakia

Stanislav Kaniansky and Daniel Očenáš

Location and period

The 2008 International Meteor Conference (IMC) will take place from September 18 to 21 in a very picturesque setting, in the town of Šachtička. Šachtička is a touristic site popular mainly for winter sports. It is 1000 m above sea level, and only 8 km away from the city of Banská Bystrica. Banská Bystrica (see `http://eng.banskabystrica.sk` for more information on the city in English) is located in central Slovakia. It is the most important historical, cultural and economic center of this part of the country. It is the capital of the Banská Bystrica Region. Banská Bystrica lies on the river Hron and is surrounding by beautiful mountains. The first written reference to the city dates back to year 1255.

Banská Bystrica used to be known as a mining town. Gold, silver, lead, and copper were mined here. Nowadays, it is a modern city with more than 80 000 inhabitants. The Vartovka Hill, very close to the city, is the location of the *Astronomical Observatory of Banská Bystrica*. In the past, Vartovka served as a watch tower.

Venue

The conference will take place in *Hotel Šachtička*. For more information in English, please visit `http://www.sachticka.sk/index_en.html`. There are double rooms and double rooms with an extra bed. Each room has toilet, shower, and TV.

The main conference room can seat 136 people, and is also suitable for posters. There are also smaller conference rooms. They are equipped with a sound system, TV, video, flipcharts, overhead projectors, silver screens, data projectors, DVD players, microphones, internet access, and similar amenities.

How to get there

Banská Bystrica can be reached from the Slovak capital of Bratislava by plane, train or bus. There is an airline connection between Bratislava and Sliac Airport, located 15 km from the city. Train and bus connections between Bratislava and Banská Bystrica are direct, i.e., they do not require a transfer. From Banská Bystrica, a short car ride will take you to your hotel.

To give you an idea, we calculated the distances from some major, capital cities in Central Europe to Šachtička:

Budapest–Šachtička	187 km
Bratislava–Šachtička	200 km
Vienna–Šachtička	282 km
Prague–Šachtička	541 km
Warsaw–Šachtička	554 km

Local Organization

This year, the Local Organization is in the hands of the Maximilián Hell District Observatory and Planetarium at Žiar nad Hronom, and the Observatory of Banská Bystrica. It is co-organized by the Department of Astronomy, Physics of the Earth and Meteorology of the Faculty of Mathematics, Physics and Informatics of the Comenius University at Bratislava, and by the Slovak Central Observatory at Hurbanovo. The Local Organizing Committee (LOC) is composed as follows:

Daniel Očenáš, Observatory of Banská Bystrica;
Stanislav Kaniansky, Maximilián Hell District Observatory and Planetarium;
Juraj Tóth, Comenius University, Bratislava;
Teodor Pintér, Slovak Central Observatory.

IMO bibcode WGN-361-kaniansky-imcann NASA-ADS bibcode 2008JIMO...36....5K

Registration fee

The registration fee amounts to 150 EUR. If you book no later than June 30, 2008, however, you get a 10 EUR deduction, and you pay only 140 EUR. In this amount is included:

- a parking place for those coming by car;
- general conference materials and a 2008 IMC T-shirt;
- accommodation for 3 nights;
- all meals (from dinner of Thursday, September 18, up to lunch on Sunday, September 21);
- refreshments during coffee breaks;
- the conference excursion and barbecue;
- the proceedings.

We also encourage you to give a presentation of your results or the results of your group. Make sure your registration as well as the abstract of the talk(s) you intend to give before August 31, 2008. However, we strongly advise you not to wait that long and register at your earliest convenience.

Practical information

To register, please visit `http://www.imo.net/imc2008` and fill out the registration form that you will find there by following the appropriate link. Alternatively, you can fill out the paper registration form you find here and send it to *Marc Gyssens, IMO Treasurer, Heerbaan 74, B-2530 Boechout, Belgium.* **However, please use the webform if you can!** The paper form is intended only for those having no easy access to the internet.

For your registration to remain valid, the IMO excepts to receive either the full sum of 140 EUR (early)/150 EUR (late) or a prepayment of at least 70 EUR **within two weeks after registration**. If you have registered electronically, you will be automatically directed to the page with payment information. For those who cannot register electronically, the paper form contains this info as well. Electronic registrants get automatic confirmation emails for both receipt of their registration and receipt of (each) payment. If you only make a prepayment, you can pay the balance at a later data or at the conference itself.

Contact information

For more information, check the IMC 2008 website at `http://www.imo.net/imc2008`.

For further questions regarding registration and payment, please contact the IMO Treasurer, Marc Gyssens, via email at `treasurer@imo.net` or write to him—Marc Gyssens, Heerbaan 74, B-2530 Boechout, Belgium.

For all other questions, contact the LOC via e-mail at `imc2008@imo.net` or write to them—Stanislav Kaniansky, Krajská hvezdáreň a planetárium M. Hella, Duklianskych hrdinov 21, SK-965 01 Žiar nad Hronom, Slovakia. This is in particular the case for those needing a formal invitation to obtain a visa. Notice that such invitations will be supplied only to serious applicants known to the international meteor community.[1]

[1] It is the participant's responsibility to obtain all documents required to enter Slovakia. Failure to do so does not constitute a valid reason for full or partial reimbursement of the registration fee or prepayments thereof.

International Meteor Conference
Šachtička, Banská Bystrica, Slovakia, 2008 September 18–21
Registration form

Do not use if you have internet access! Please register electronically on `http://www.imo.net/imc2008` if you can. If you have **no** internet access, fill out one form for each individual participant should fill return it to Marc Gyssens, IMO Treasurer, Heerbaan 74, B-2530 Boechout, Belgium, as soon as possible. Registration will be guaranteed only after Marc Gyssens has received either the full registration fee of 140 EUR (up to June 30)/150 EUR (from July 1 onward) or a pre-payment of at least 70 EUR. We expect this payment to arrive within two weeks after the form.

Name: ______________________ Address: ______________________

____

____

Phone: ____________ Fax: ____________ E-mail: ____________

- I wish to register for the IMC 2008 from September 18 to 21.
- I intend to travel by ________, together with ______________________
- I want to share a room with ______________________
- T-shirt: Size (S-M-L-XL): ________ Gender: ________ (included in fee)
- I am vegetarian.

For participants wishing to contribute to the program:

Lecture: ______________________

Requirements: ______________________

Duration: ________ minutes

Workshop: ______________________

Poster(s): ______________________ Space: ________ m^2

Comments:

- I am paying the entire registration fee of 140 EUR (early)/150 EUR (late)
- I am paying the advance (70 EUR) now, the remainder later
- I want a single room (add 30 EUR to the registration fee).

The indicated amount should be sent to IMO Treasurer, Marc Gyssens. The following payment options are available:

- **International bank transfer** to the International Meteor Organization, Mattheessensstraat 60, B-2540, Hove, Belgium, IBAN account number: BE30 0014 7327 5911, BIC bank code: GEBABEBB (Fortis Bank, Belgium). This is recommended for people living in the European Union, as it is no more costly than a domestic bank transfer when done correctly.
- **PayPal payment** to `payment@imo.net`. In that case, we must ask you to add the costs involved in the transaction (3.4% of the total sum, plus 0.35 EUR).
- **Other arrangements**. Please contact the IMO Treasurer for information.

Financial support for IMC2007 participants

Jürgen Rendtel

As during previous years, *IMO* is making limited funds available to support participation in the *IMC* 2008. To apply for support, please do the following:

1. E-mail your application to *IMO* President Jürgen Rendtel, at `president@imo.net`. Include the word 'Meteor' in the subject line to get round the anti-spam filters. *IMO* cannot be held responsible for applications which are lost or arrive late. The application must be submitted by an *IMO* member, but may also request support for other meteor workers. The proposal must state that all the candidates are committed to attend the *IMC* (except for unforeseen circumstances) if the requested support is granted in full.

2. Complete an *IMC* Registration Form (preferably electronically) for everyone seeking support (unless already done before).

3. Include a brief curriculum vitae of everyone seeking support, focusing on aspects relevant to meteor work. Supported participants are expected to present either a talk or a poster at the *IMC*. (Indicate and detail this on the Registration Form.)

4. The application must explain the motivation for participating in the *IMC* and the importance of this participation it to the person or group of persons requesting support.

5. Include a budget for travel costs and registration, and the amount of support requested. Other sources of external support, or their absence, must be mentioned. The proposal must indicate to what extent *IMO* support is essential to attend the *IMC*.

6. The applications should reach the President no later than 2008 June 20. The decision of the *IMO* Council will be made as soon as possible, probably within two weeks after this deadline. If the support is granted in full, the registration form becomes final. If the requested support is not granted, or only partially granted, the candidates should inform the President within three weeks after notification of the *IMO* Council's decision if they want to sustain or withdraw their registration. The support granted will be paid in cash at the *IMC*. Any unpaid registration fees will be deducted from the amount paid to the candidates.

Should the application be turned down, the standard conference fee (i.e., €140, without the surcharge for a late application) will still apply. We strongly encourage all meteor workers who want to attend the *IMC* 2008, but who are prevented from doing so by financial considerations, to apply for support.

IMO bibcode WGN-361-rendtel-imcsupport NASA-ADS bibcode 2008JIMO...36....8R

Preliminary results

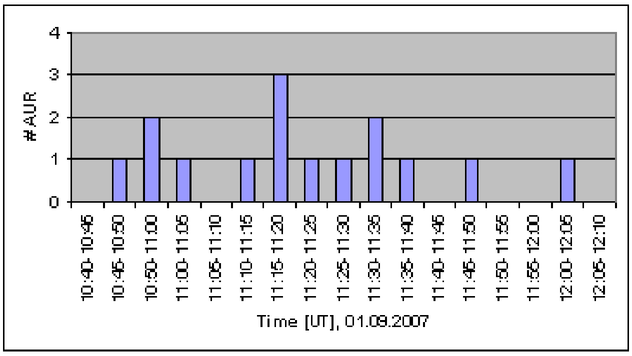
Results of the IMO Video Meteor Network — 2007 September

Sirko Molau [1]

Preliminary results for 2007 October from the Video network are presented. The intention in this new series is to publish (and thus archive) material that has hitherto been published only in ephemeral online form.

1 Introduction

September 2007 was an unexceptional month. The first half was fair to middling, but a short glimpse on the statistics of the second half shows 'compact observing blocks'. September 21 in 22 were in particular favorable. In both nights we could collect more than a hundred hours of observing time. An overall total of five observers managed to obtain more than 20 observing nights, and the monthly totals of 1 600 hours and 7 000 meteors were also considerable.



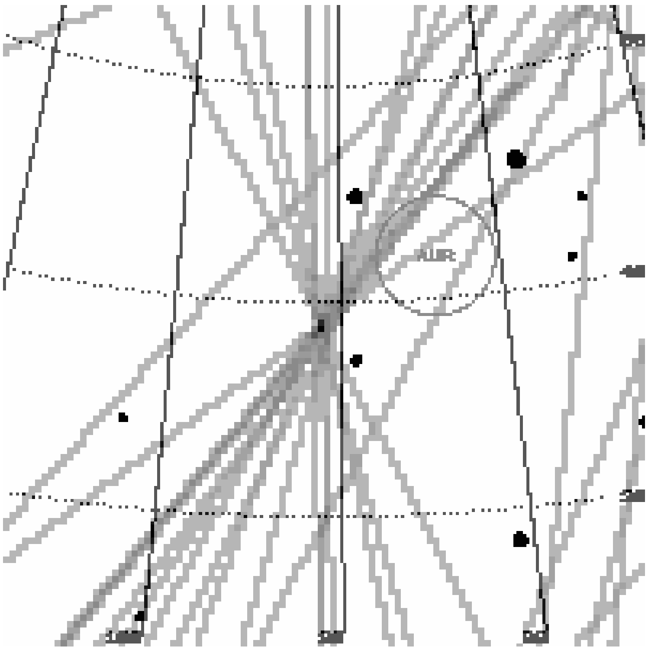
2 Aurigids

Highlight of the month was without doubt the Aurigid outburst near noon (UT) of September 1, which could be observed from the American west coast. Unfortunately, Bob Lunsford, our only regular observer in place, has currently severe computer problems, which is why his video data are not yet analysed. However, Bernd Brinkmann and Daniel Fischer operated one Mintron camera each at Fremont Peak in California. Their fields of view slightly overlapped, since the cameras were operated in a double-station scheme with cameras of Apostolos Christou observing at Lick observatory. Right now, the observations are being analysed at the Armagh Observatory. Here, a first look at the single station results of the two AKM members is given.

First back to the predictions: the peak time was forecast by Peter Jenniskens and Jérémie Vaubaillon as $11^{\mathrm{m}}36^{\mathrm{m}}$ UT $\pm 20^{\mathrm{m}}$. The equivalent ZHR (i.e. the short term ZHR at the time of maximum) was expected to reach about 200. Already first reports confirmed the outburst, even though the eZHR was only close to 100. Every visual observer spotted between 30 and 40 on average quite bright Aurigids. The preliminary analysis of visual data from four observers (`http://www.astro.uni-bonn.de/~dfischer/skyreports/2007/analysis1.html`) prepared by Daniel Fischer (as always a highly scientific free-hand sketch on scale paper ;-) yielded an early maximum at about $11^{\mathrm{h}}15^{\mathrm{m}}$ UT. The online activity graph of IMO came to the same conclusion, that the maximum was about 20 minutes early.

According to the IMO Working List of Meteor Showers, the AUR radiant was expected at $\alpha = 84°$, $\delta = 42°$. Peter Jenniskens listed the position with $\alpha = 92°$, $\delta = 39°$.

Bob Lunsford reported that he visually observed a double radiant. One component matched with the IMO position, whereas the other was farther east ($\alpha = 95°$, $\delta = 42°$). Pete Gural, who observed together with Bob, confirmed two equally strong radiants with his Meteorscan software.



3 Other observations

Now back to the observations of the two AKM observers: Bernd's camera HERMINE recorded 40 meteors between $10^{\mathrm{h}}08^{\mathrm{m}}$ and $13^{\mathrm{h}}08^{\mathrm{m}}$ UT, 11 of them being AUR. Daniel's camera FISHCAM was operated with four times integration (resulting in larger angular velocity errors) between $10^{\mathrm{h}}00^{\mathrm{m}}$ and $13^{\mathrm{h}}06^{\mathrm{m}}$. It recorded

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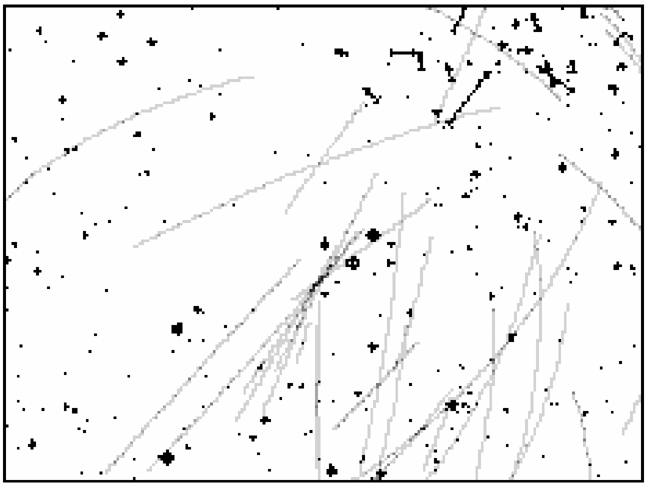
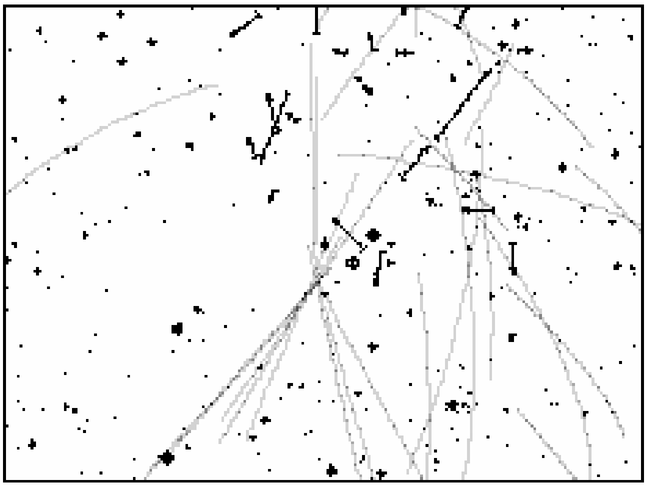
IMO bibcode WGN-361-molau-vidsep
NASA-ADS bibcode 2008JIMO...36....9M





30 meteors, among them 10 Aurigids. If the double detections are omitted, we end up with a data set of 16 Aurigids recorded between 10^h49^m and 12^h02^m UT. Highest activity occurred in the interval 11^h15^m–11^h20^m. This fits well to the visual results, whereat their dataset is much bigger, of course.

The MetRec radiant plots show that the fields of view were not optimal for radiant position determination from single station data. However, it becomes obvious that the radiant position differed significantly from the value given in the IMO Shower List, and that these video data show only one radiant.

A more detailed analysis of the 16 Aurigids with the Radiant software underlines the results. The radiant was located at $\alpha = 91°$, $\delta = 39°$, which matches almost exactly the position given by Peter Jenniskens. There is no double radiant structure.

4 Summary

THE big Aurigid outburst that some observers had hoped for in secret did not show up, but the observations agreed with the predictions within the given error bars. The outburst can be compared with the alpha Monocerotids in 1995, even though today's forecasting methods are naturally much more elaborate.

Results of the IMO Video Meteor Network — 2007 October

Sirko Molau [1]

Preliminary results for 2007 October from the Video network are presented. The intention in this new series is to publish (and thus archive) material that has hitherto been published only in ephemeral online form.

1 Introduction

The first video observations you find in the IMO Video Meteor Database are from January 1993. During the Quadrantid maximum, the 'legendary' image-intensified video camera MOVIE recorded 49 meteors in 9 hours observing time. Until the official start of the video network in March 1999, four AKM observers had collected almost 5 000 meteors during major showers. The 100 000th meteor was recorded in August 2003, i.e. 11 years after the first meteor (or 5 years if only the years of the camera network are counted). Three years later, in July 2006, we reached 200 000 meteors, and the 300 000th meteor was observed only 16 month later in October 2007. That's an amazing development we really can be proud of, but on the other hand I hardly manage anymore to check the consistency of all meteor records and to archive them by the end of each month.

BTW, this anniversary just precedes my own jump over the 100 000 meteor limit, from which I am now separated by no more than 1 500 meteors.

2 2007 October

Last month could not keep up with the record-breaking October 2006, but with 1 900 hours of effective observing time and 11 500 meteors it still ranked 4^{th} in the long-term statistics of the network. On the one hand, that is thanks to a large number of observers (17 observers with 25 video cameras), and on the other hand thanks to the good weather in the first half of the month.

The proverbial 'golden autumn' yielded many clear nights which were only hampered by cirrus clouds and fog. Close to the Orionid maximum the weather deteriorated, and between October 25 and 27 the rock bottom was reached. Even though the camera networks spans several thousand kilometers between northern and southern Europe, just one observer was able to catch a short cloud gap in each of the three nights, respectively.

It comes as no surprise that the Orionids were the dominating shower last month. Thanks to them, we recorded more than a thousand meteors on October 21/22 alone. However, this time two minor showers were in the focus of the analysis.

2.1 Draconids

The first one are the Draconids. Two Czech observers reported enhanced activity of this shower on October 13, $18^{h}30^{m}$-$19^{h}30^{m}$ UT, i.e. well apart from the usual activity interval. Within one hour they observed six Draconids, as reported in WGN. The evening before at about 23 UT, a Spanish observer noticed 'unusual activity' originating from about the same region in the sky. The question was, whether these were just local random fluctuations, or whether the video data would confirm the enhanced activity.

To keep it short: our data showed no sign of enhanced activity. On October 12/13, the weather was not perfect at all. The shower assignment of those 78 meteors recorded by 7 cameras was as follows: 43 SPO, 14 ORI, 7 NTA, 5 TUM (τ Ursa Majorids), 4 STA, 4 EGE and only 1 GIA.

Weather was much better in the next night, such that 17 cameras were in operation. On October 13/14, they recorded an overall of 588 meteors (actually half of these were captured by the two intensified cameras AVIS2 and AKM2). 29 meteors were recorded in the time interval in question, with the following shower assignments (in brackets the numbers for the whole night): 24 (358) SPO, 1 (63) STA, 0 (62) ORI, 1 (44) NTA, 0 (40) EGE, 2 (14) TUM and 1 (7) GIA. It's no surprise that in the early evening hours there were hardly any Orionids, epsilon Geminids and Taurids due to the low radiant altitude. However, all cameras together recorded just a single Draconid between $18^{h}30^{m}$ and $19^{h}30^{m}$ UT.

2.2 ι Cancrids

The second shower analysed more closely is a possible candidate for a new meteor shower that was noticed by Esko Lyytinen: the ι Cancrids (ICA). On October 10/11, Esko and Ilkka Yrjölä recorded in double station mode to meteor pairs with almost identical radiants. Even though their orbits did not fit well, Esko checked the list of radiants from my 2006 meteor shower search (`http://www.imonet.org/imc06/radiants.html`). Between October 11 and 17 (solar longitude 198° to 203° degree) he found six individual radiants that were not marked as a shower by me even though they fit quite well to each other; see Table 1.

The individual radiants show typical signs of a meteor shower like a small drift and a clear activity profile with a maximum at October 15. It remained to check whether this potential meteor shower candidate was also observed in 2007.

Fortunately, the nights surrounding the expected maximum were the best of October with respect to the weather. Hence, we could collect a sufficient data set of more than 5 000 meteors between October 10/11 and 19/20. The meteor shower analysis revealed 2494 SPO, 1164 ORI, 274 EGE, 331 NTA, 467 STA, 192 TUM and

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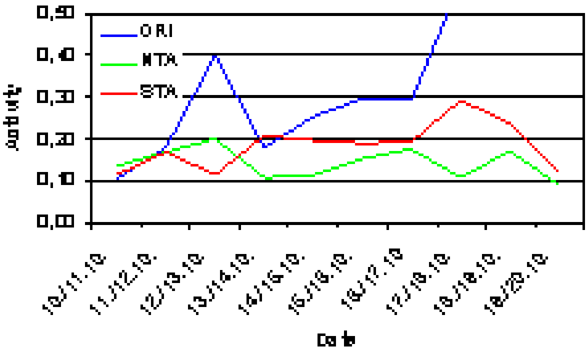
Table 1 – Analysis of observations possible ι Cancrids.

Solar Longitude [°]	Right Ascension [°]	Declination [°]	Velocity [km/s]	Rel. Strength	Meteors
198	128.5	27.5	58	8.73	65
199	133.5	25.5	58	7.98	83
200	131.5	29.0	63	13.50	117
201	132.1	29.5	62	15.48	76
202	133.3	29.5	60	11.24	53
203	133.2	32.0	62	10.23	89

218 ICA. The following graphs (Figure 1) show the activity profile over time. The number of shower meteors was divided by the number of sporadics to compensate for the variable observing time. For clarity, the activity profiles were spread over two diagrams.

The first graph shows the rising Orionid activity towards the middle of October, as well as approximately constant Taurid activity. The second graph shows nearly the same activity level (not corrected for the different radiant altitude and culmination time) for the ϵ Geminids and the τ Ursa Majorids, which were discovered last year. The suspected new ι Cancrid shower had the same level of activity. On October 12/13, it even outperformed the Taurids and was the second strongest shower after the Orionids. However, that activity peak is not significant as it is based on a small meteor number only (9 ICA among 78 meteors).

Now it remains to see whether the ι Cancrids are confirmed by other observers as well.



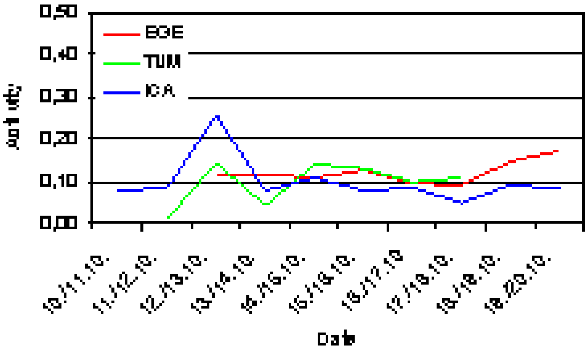


Figure 1 – Activity profiles of the various showers over the month.

Results of the IMO Video Meteor Network — November 2007

Sirko Molau [1]

Just like in October, the weather of last month was not particularly favourable. On the contrary: whereas in the first half of the month at least the Italian observers enjoyed a number of clear nights, it was overcast at all sites after the Leonid maximum. The weather was especially poor between November 21 and 25, such that on November 24 not a single meteor could be recorded in the camera network. Towards the end the weather improved slightly this time mainly for the more northern observers.

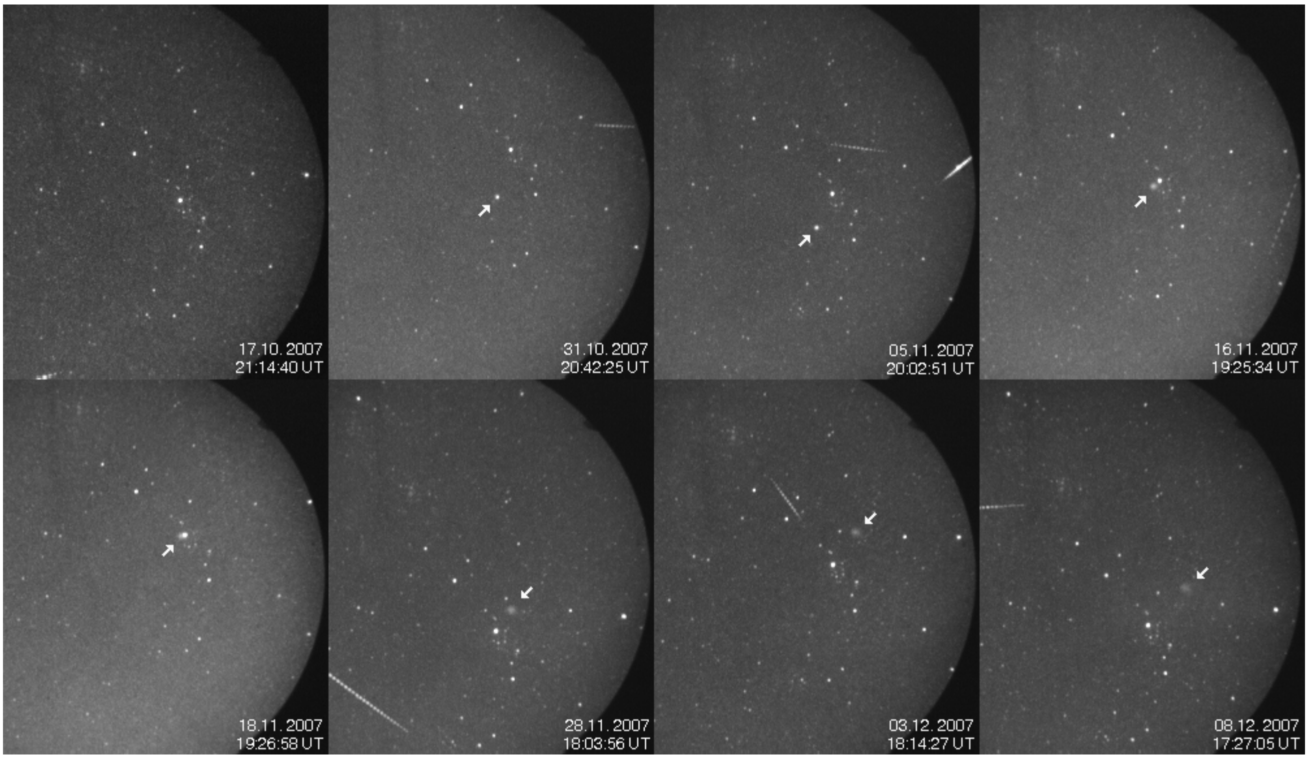
In summary, only two observers managed to collect more than 20 observing nights, and with 1500 hours and 6000 meteors, the total of November was mediocre, too.

Last month we could welcome a new observer in the camera network, even though his first observations date back from June. With his 87 years, Miloš Weber of the Czech Republic has become the by far oldest observer in the video network. Miloš is especially interested in the June Lyrids, and so he decided to analyse this shower not only by means of visual observations, but also with a video camera. Miloš is supported by his nephew Tomas Weber, who helped to install the hardware and software, and to analyse the video tapes. Miloš applies a 50 mm lens, an image intensifier and a digital camcorder. Now the first four observations of June 2007 were analysed. Within four hours of observing time, 55 meteors were recorded.

The highlight of November was not a meteor shower, but a typical source for meteors, a comet. On October 24, comet 17/P Holmes experienced a sheer incredible outburst increasing its brightness by 15 magnitudes. Typically this comet would be visible in large telescopes only, but after the outburst the constellation of Perseus all of a sudden showed a new star of third magnitude. In November, the coma of 17/P Holmes increased significantly and the comet became to the naked eye a blurred spot that moved through Perseus and faded slowly.

Our meteor cameras are not particularly well suited for comet observations, but as the comet was bright enough and all night long placed high in the sky, it was recorded by a number of cameras. The best pictures were provided by Wolfgang Hinz with AKM2. This camera has not only a good limiting magnitude thanks to the image intensifier, but also a relatively small field of view of 30 degree, such that also the diffuse appearance became visible. The following picture shows the comet between October 17 (i.e. before the outburst) and December 8. Please, pay attention to the image of November 5, when two meteors appeared in parallel near the comet.

Figure 1 – Comet 17/P Holmes as observed by the image-intensified video camera AKM2 between October 17, and December 8, 2007.



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Ongoing meteor work

Thirteen Meteor Showers from Double-Station TV Meteors in 2004 and 2005

Masayoshi Ueda [1,2] *and Sadao Okamoto* [2]

We set up two cameras (WAT-100N) with $f = 6$ mm $f/0.8$ lenses (field of view $56° \times 43°$) in two places and performed automatic TV simultaneous observations of meteors nightly from 2004 April to 2005 December. As a result, Ueda filmed for 426 nights totaling 3 623 hours in Osaka, Japan, capturing 6 341 meteors, while in Aichi prefecture, Okamoto filmed 409 nights totaling 3 543 hours capturing 5 939 meteors. The most faint magnitude of a fixed star which we could photograph with this device was about 4, and the most faint meteor magnitude was about 2. During this period, 1 521 simultaneous meteor orbits were obtained. Further, the radiant point, daily drift and trajectories of 13 meteor showers were determined.

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1 Introduction

Double-station TV meteor observations were performed in 2004 April – 2005 December with TV systems installed in Osaka (point A) and Aichi (point B). The basic distance between points A and B was 142 km. The positions of observational stations are as follows: point A: $\phi = +34°32'$, $\lambda = 135°38'$, $H = 45$ m. point B: $\phi = +35°07'$, $\lambda = 137°01'$, $H = 30$ m. The cameras are Watec CCD type 'WAT-100N' (minimum illumination 0.001 lx) with a frame rate of 30 frame/s, a resolution of 640×480 and lens of $f = 6$ mm $f/0.8$. Our technique gives a field of view of $56° \times 43°$ and a limiting magnitude about +4 for stars and +2 for meteors. The mean errors of the measured positions are 3. The software that we used is as follows:
Observational software:

- UFOCapture Pro ver 1.85

Software for measuring meteor positions:

- RBAVIMeteor (Video meteors from 2004 April to 2004 September)
- UFOAnalyzer V2 ver 2.07 (Video meteors from 2004 October to 2005 December)

Software for analysing meteor trajectories :

- orbit3.bas (Video meteors from 2004 April to 2004 September)
- UFOOrbitV2 ver 2.01 (Video meteors from 2004 October to 2005 December)

2 Observational results

The basic observational data are given in Table 2, separately for TV meteors of each year (2004 and 2005) and for point A, point B and double station meteors, where N_{MET} is the total numbers of meteors observed, N_{DOU} is the final number of the best reduced double station meteors.

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IMO bibcode WGN-361-ueda-showers
NASA-ADS bibcode 2008JIMO...36...14U

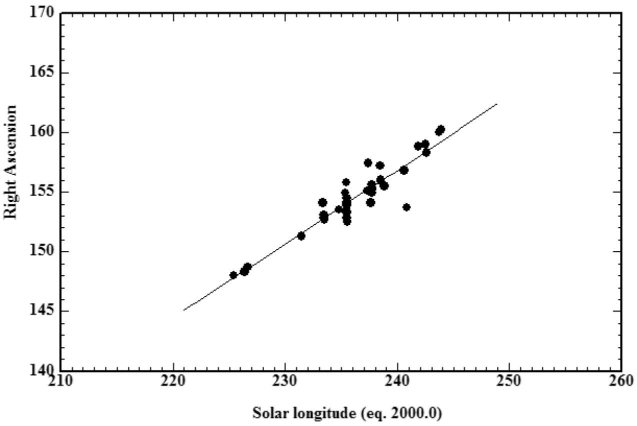

Figure 1 – Radiant drift for the Leonid shower in 2004 and 2005. $\alpha = 153\overset{\circ}{.}87 + 0.618(\lambda - 235\overset{\circ}{.}16)$

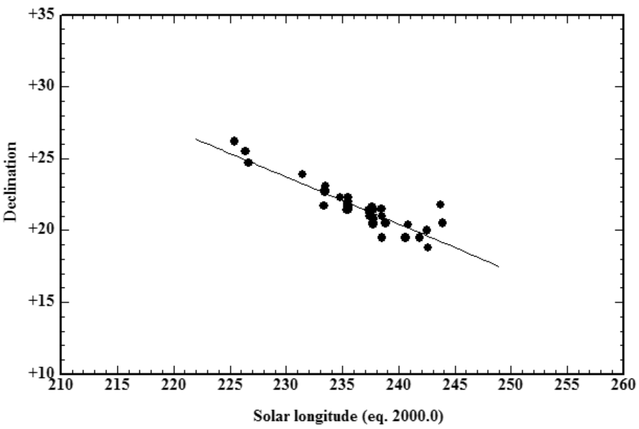

Figure 2 – Radiant drift for the Leonid shower in 2004 and 2005. $\delta = +22\overset{\circ}{.}03 - 0.327(\lambda - 235\overset{\circ}{.}16)$.

3 Distribution of meteor radiants

Figure 3 shows the radiant point distribution for 1,521 simultaneous TV meteors in the celestial sphere. The activities of 13 meteor showers were obtained from these radiant point concentrations. Daily drift was determined from the relation of each meteor shower's radiant point to right ascension and solar longitude (Figure 1). Daily drift of declination was similarly determined (Figure 2).

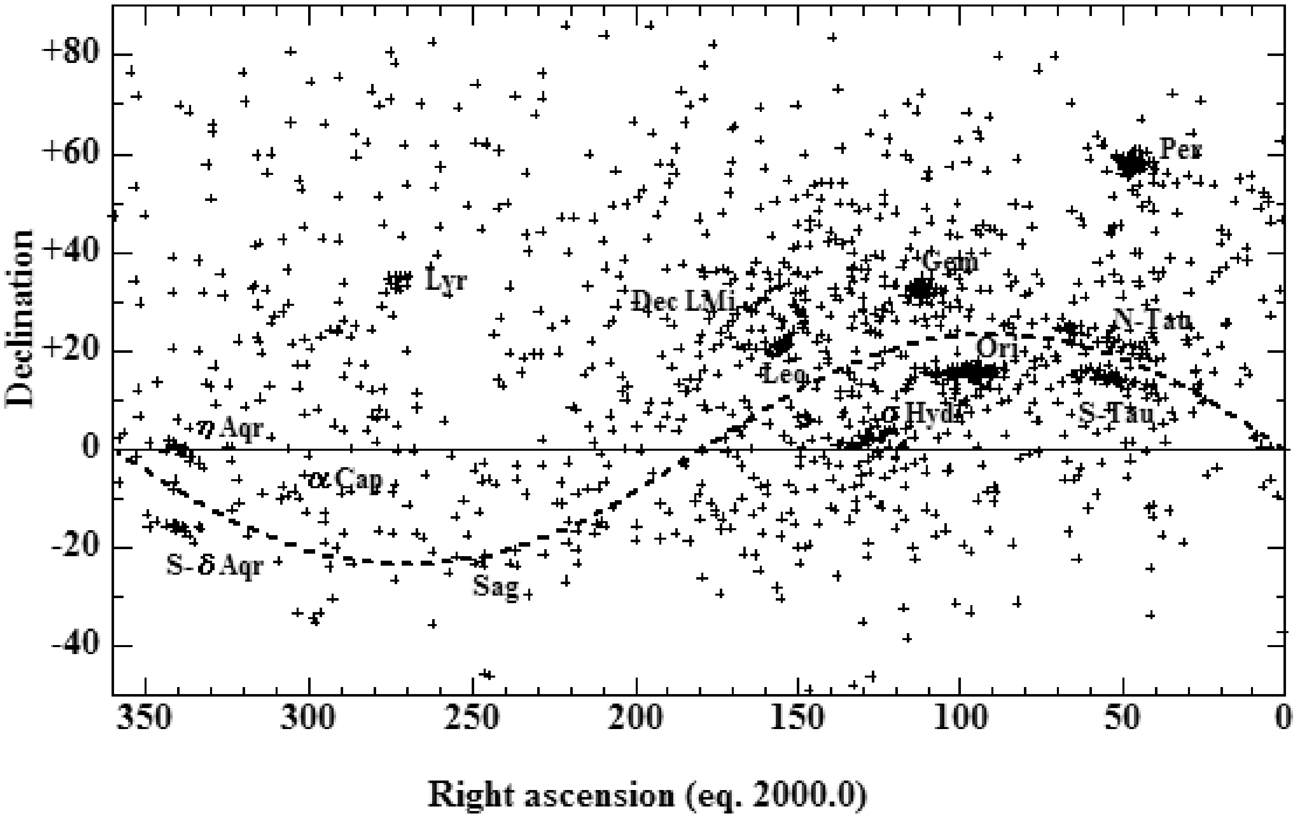

Figure 3 – A plot of Right Ascension against Declination for the 1 51 meteors in 2004 and 2005. +: radiant of the TV meteor. - - -: the Ecliptic.

Figure 4 – An η Aquarid meteor of magnitude -0.1 recorded on 2004 April 29 at $18^{h}08^{m}55^{s}$ UT from the automatic TV camera located in Osaka.

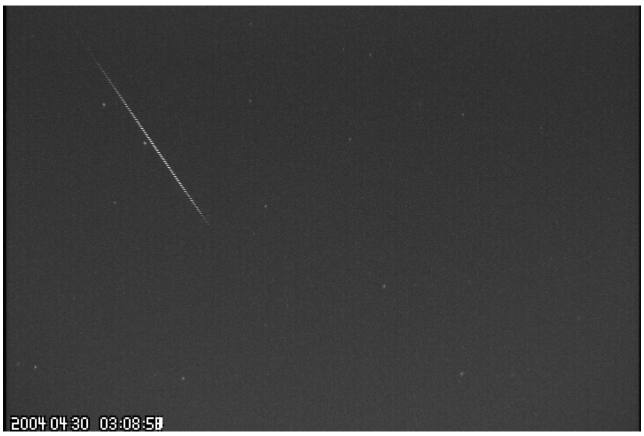

Figure 5 – An η Aquarid meteor which appeared on 2004 April 29 at $18^{h}08^{m}55^{s}$ UT from Aichi.

4 Results

By automatic TV observation, we were able to make simultaneous observations over a long term. 1 521 simultaneous meteors were obtained. From their radiant points, the radiant points, daily drift, velocities and trajectories of 13 meteor showers were determined (Table 1). We have posted the orbital elements of the 1 521 TV simultaneous meteors at the following Web page: **http://meteor.chicappa.jp/ TVMeteorsOfOrbitsIn20042005.html**

Table 1 – Working list of meteor showers. See Table 3 for explanations of the variables.

No.	Shower	Source	Date	$\lambda_\odot$	Range of $\lambda_\odot$	RA α	Dec δ	±RA $\pm\alpha$	±Dec $\pm\delta$	ΔRA $\Delta\alpha$	ΔDec $\Delta\delta$
1	Lyrids	This work	Apr. 22	32.1	30.8–38.4	271.7	33.9	1.3	0.9	0.73	0.07
		IMO	Apr. 22	32.1		271.9	33.6			1.1	0.0
2	η Aquarids	This work	May 6	45.5	39.7–53.0	337.9	−1.0	0.8	0.4	0.75	0.35
		IMO	May 6	45.5		338	−1			0.9	0.4
3	Sagittarids	This work	May 13	53	50.1–62.5	244.7	−22.9	3.7	0.8	0.82	0.00
		IMO	May 20			246	−22				
4	Southern δ Aquarids	This work	Jul. 28	125	120.1–139.1	338.3	−16.8	1.0	0.6	0.84	0.23
		IMO	Jul. 28	125		339	−16			0.75	0.21
5	α Capricornids	This work	Jul. 30	127	115.1–131.2	305.6	−9.5	1.3	0.7	0.45	0.29
		IMO	Jul. 30	127		307	−10			0.9	0.3
6	Perseids	This work	Aug. 12	140.1	112.1–145.7	48.0	57.9	1.9	1.1	1.46	0.26
		IMO	Aug. 13	140.1		46.2	57.4			1.4	0.18
7	Orionids	This work	Oct. 21	208	199.4–219.3	95.2	15.6	0.8	0.6	0.79	0.00
		IMO	Oct. 21	208		95	16			0.65	0.11
8	Southern Taurids	This work	Nov. 5	223	200.2–242.5	53.2	14.1	2.0	1.2	0.69	0.14
		IMO	Nov. 6	223		50	13			0.79	0.15
9	Northern Taurids	This work	Nov. 12	230	202.6–242.1	58.7	22.8	1.8	1.0	0.76	0.19
		IMO	Nov. 13	230		58	22			0.76	0.10
10	Leonids	This work	Nov. 17	235.16	225.4–243.8	153.9	22.0	1.0	0.7	0.62	−0.33
		IMO	Nov. 18	235.16		153.2	22.0			0.70	−0.42
11	σ Hydrids	This work	Dec. 12	260	250.8–262.9	128.3	1.5	0.9	0.9	0.94	−0.24
		IMO	Dec. 11	260		127	2			0.7	−0.2
12	Geminids	This work	Dec. 13	262.0	254.7–263.1	113.5	32.3	0.9	0.7	1.02	−0.11
		IMO	Dec. 14	262.0		112.3	32.5			0.97	−0.08
13	December Leo Minorids	This work	Dec. 19	268.0	254.9–278.2	161.5	30.5	1.1	0.5	0.91	−0.43

Source column:
This work: the present paper.
IMO: Handbook for Visual Meteor Observers, IMO, 1995.

No.	Shower	Source	V_{obs} (km/s)	SD V	V_{g} (km/s)	SD V	H_{b} (km)	H_{e} (km)	a (AU)	e	q (AU)	Ω (°)	i (°)	ω (°)	P (yr)	n
1	Lyrids	This work	47.9	2.1	46.4	2.1	106.4	87.8	22.72	0.959	0.921	32.10	78.75	213.93	108.3	11
		IMO	49				107	88	28	0.968	0.919	31.7	79.0	214.3	164.0	
2	η Aquarids	This work	66.8	1.3	65.5	1.3	111.5	103.9	10.28	0.944	0.574	45.50	163.74	96.43	32.9	17
		IMO	66				116	100	5.0	0.882	0.584	45.5	165.7	95.9	11	
3	Sagittarids	This work	32.2	4.7	30.2	5.2	92.9	84.4	2.09	0.853	0.308	232.98	1.94	120.76	3.0	6
		IMO	30						2.235	0.905	0.212	229.5	3.5	132.0	3.3	
4	Southern δ Aquarids	This work	40.5	1.7	38.9	1.8	95.7	87.7	1.97	0.958	0.083	304.99	24.21	151.24	2.8	16
		IMO	41				100	88	3.09	0.967	0.102	309.6	26.2	149.5	5.4	
5	α Capricornids	This work	25.4	1.1	22.7	1.5	94.0	81.9	2.69	0.780	0.592	127.03	7.20	267.21	4.4	6
		IMO	25				98	86	2.421	0.758	0.587	126.9	7.3	270.2	3.8	
6	Perseids	This work	59.9	2.1	58.7	2.2	110.2	94.5	10.21	0.907	0.949	140.12	113.02	150.13	32.6	61
		59				114	94	81	0.996	0.948	139.61	113.27	150.53	730		
7	Orionids	This work	67.1	2.6	66.0	2.7	112.4	98.6	7.78	0.926	0.578	28.00	163.58	82.72	21.7	107
		IMO	66				117	99	11.5	0.951	0.575	28.2	164.3	82.7	40	
8	Southern Taurids	This work	29.1	2.3	26.9	2.6	96.6	77.4	1.95	0.804	0.381	43.02	5.37	112.39	2.7	46
		27				101	82	2.2	0.82	0.40	33.4	5.8	113.2	3.2		
9	Northern Taurids	This work	29.9	3.2	27.7	3.5	97.9	78.8	2.08	0.822	0.369	230.03	2.66	292.94	3.0	30
		IMO	29				103	80	2.3	0.83	0.38	228.1	3.3	293.4	3.4	
10	Leonids	This work	70.8	2.0	69.7	2.0	113.4	100.1	5.78	0.830	0.983	235.17	161.74	171.19	13.9	38
		IMO					128	87	15	0.931	0.984	234.5	162.3	173.1	54	
11	σ Hydrids	This work	60.3	2.8	59.2	2.9	108.3	93.1	83.17	0.997	0.256	80.06	128.10	118.88	758.5	12
		IMO					113	97	37	0.991	0.294	73.2	132.5	114.4	220	
12	Geminids	This work	35.0	1.7	33.1	1.9	96.1	82.2	1.26	0.880	0.151	262.00	21.91	324.05	1.4	85
		IMO	35.0				100	80	1.39	0.901	0.137	260.2	24.4	324.7	1.63	
13	December Leo Minorids	This work	63.6	2.4	62.4	2.4	109.3	96.8	6.96	0.921	0.549	267.99	134.21	265.47	18.3	17

Source column:
This work: the present paper.
IMO: Handbook for Visual Meteor Observers, IMO, 1995.

Table 2 – Numbers of meteors observed.

Year	Station A		Station B		Double station
	N_{MET}	Obs. hours	N_{MET}	Obs. hours	N_{DOU}
2004	3 170	1 392$^{\mathrm{h}}$	2 328	1 282$^{\mathrm{h}}$	649
2005	3 171	2 231$^{\mathrm{h}}$	3 611	2 261$^{\mathrm{h}}$	872

Table 3 – Explanation of variables in Table 1.

$\lambda_\odot$	Solar longitude (2000.0, degrees)
R.A.	Radiant point. Right ascension (2000.0) corrected for diurnal aberration and zenithal attraction (geocentric radiant) (degrees)
± RA	Standard deviation of RA
Dec.	Radiant point. Declination (2000.0) corrected as above.
± Dec	Standard deviation of Dec
ΔR.A., ΔDec.	Daily drift of the radiant. (degrees)
V_{obs}	Observed velocity (km/sec)
V_{G}	Pre-atmospheric geocentric velocity corrected as above (km/s)
SD V	Standard deviation of the velocity (km/s)
H_{b}	Height at which the meteor was first observed (km)
H_{e}	Height at which the meteor vanished (km)
a	Semi-major axis (AU)
e	Eccentricity
q	Perihelion distance (AU)
Ω	Longitude of the ascending node (degrees, 2000.0)
i	Inclination of the orbit (degrees)
ω	Argument of perihelion (degrees)
P	Period (year)

History

An analysis of the meteoric portents identified in the texts of Livy and Obsequens, 218–87 BC

Alastair McBeath[1]

An analysis and further discussion of the catalogue of potentially meteoric or meteoritic portents recorded anciently by Livy and Obsequens between 218–87 BC is given. In general the more likely meteoric events found were probably comparable in nature, quantity and frequency to what we might expect modernly. Some additional comments on the nature of the events reported are also presented.

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1 Introduction

Gheorghe & McBeath (2006) presented a catalogue of potentially meteoric portents identified in the work *Ab Urbe Condita* by Titus Livius (commonly called just Livy today; 59 BC to 17 AD), and the portents lists extracted ultimately from the lost, later, portion of Livy's text given in Julius Obsequens' *Prodigiorum Liber* (probably dating to the circa 4th century AD). From that lengthy list of possible items, it would be easy to find occurrence patterns in a casual inspection which did not really exist. In order to investigate whether any genuine such patterns were involved, an analysis by date, place and type of event was carried out, which is provided with discussion here.

To avoid repetition of reference material, the interested reader should consult (Gheorghe & McBeath, 2006) for specific source details on individual events. Although all the events previously distinguished were considered, most of this analysis concentrated on the period when very regular — at times annual — details of portents reported were preserved, between 218–87 BC. Although selective, for reasons outlined in the earlier WGN article, it was felt the items from this core period probably provided as nearly complete and representative a record as can now be established for most of it from ancient Classical sources.

2 Analysis methods

Four classes of event were defined:

1. rains of stones;
2. meteors and meteoric fireballs;
3. falls of earth or chalk;
4. uncertain events.

Classes 1 and 2 overall probably represent all the more likely meteoritic and meteoric events respectively, while including some which would probably not fit such a categorization modernly.

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IMO bibcode WGN-361-mcbeath-livy
NASA-ADS bibcode 2008JIMO...36...19M

Information on the date, place and nature of each event was extracted from the catalogue, and a preliminary classification was made.

As the analysis proceeded, it became obvious that not all the events could be neatly slotted into the four-class structure. The unique glowing stones said to have fallen from the sky at Praeneste in 217 BC, for example, might have been meteors, or meteorites, or something else entirely — man-made incendiary missiles perhaps. In order to allow for an element of this uncertainty to be factored in, a simple, and rather subjective, scaling was applied, using a 0–10 measure, where 0 represented no chance of the event being so classified, and 10 a definite classification. So a 'rain of stones' would be a definite class 1 event, but a rain of stones lasting three days (such as that listed for Picenum in 186 BC) would be allocated scores of '3' in class 1 and '7' in class 4, since such an event accurately recorded could scarcely really have been meteoritic, but the possibility the tale may have grown later from an original, perhaps genuine, meteorite shower, could be taken some account of. This was not a strict attempt to suggest probabilities, but more so as not to ignore how the event was reported, while still allowing that some of the descriptions seemed modernly implausible meteorically.

In order to retain a useful measure of the numbers of events, the classification scaling score was divided by ten. The apparent partial events thus implied by the literal figures must not be taken at face value, of course.

It became clear too that there were concentrations of reports in particular areas, so apart from the overall totals, subgroups of events noted from places in the province of Latium, and the city of Rome (itself within Latium), were compiled. Graphs and diagrams were prepared from these statistics, as detailed below. Figures 1 and 2 are given to help in orientation with the various places mentioned.

3 Results

Figure 3 gives a simple plot of all the events recorded in each year from the core period. Although it may seem from this that there was a marked decrease in possibly meteoric events after Livy's complete extant text broke off in 167 BC, it should not be assumed this was anything other than a lack of such events being reported, as

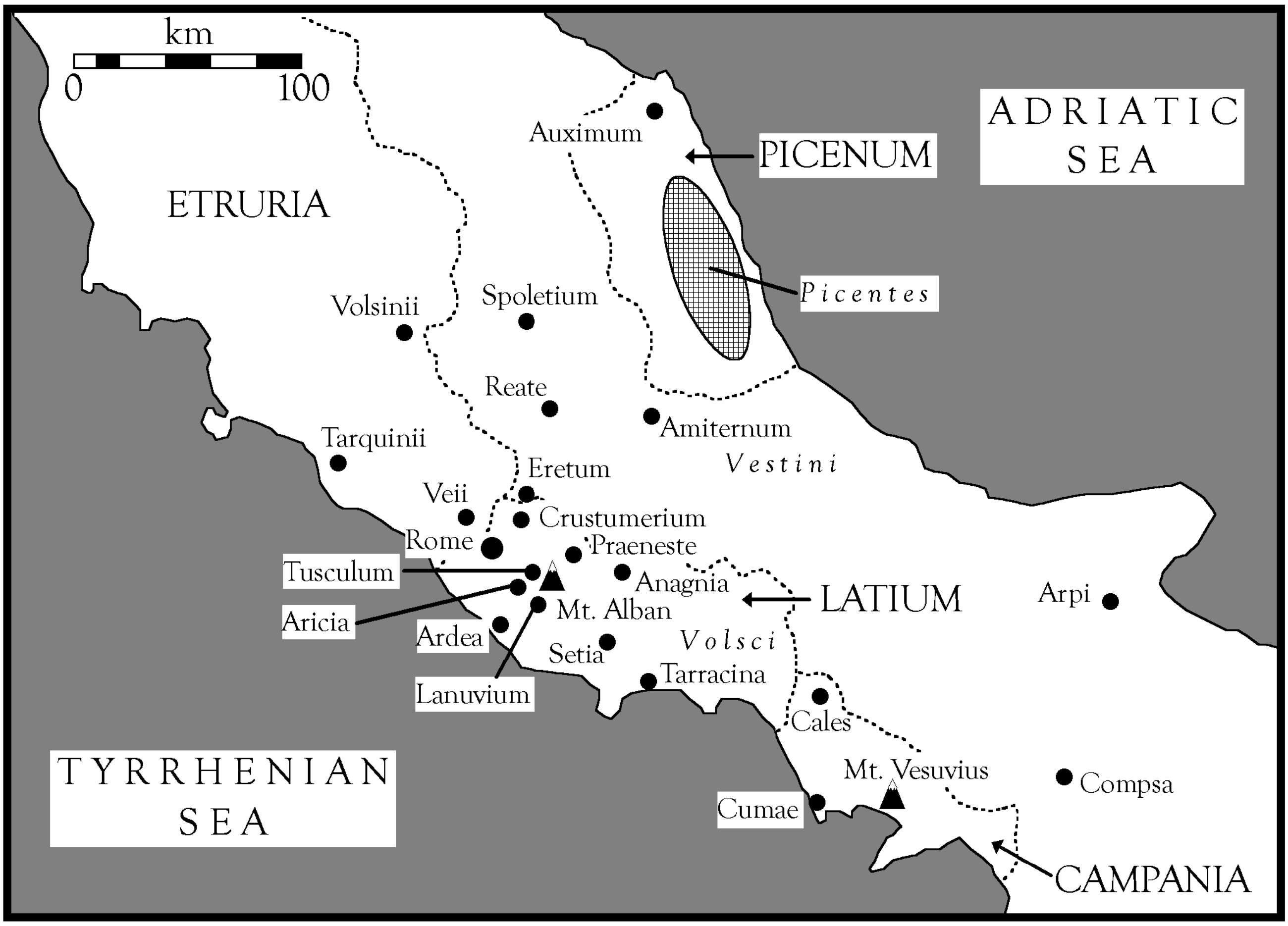

Figure 1 – A sketch-map of central Italy showing the named ancient towns and the city of Rome (filled circles), mountains (triangular symbols), regions (bounded by dashed lines and identified using capital letters), or tribal areas (in italics; the caption or shaded area approximately defines the area they were most active in), taken from (Gheorghe & McBeath, 2006).

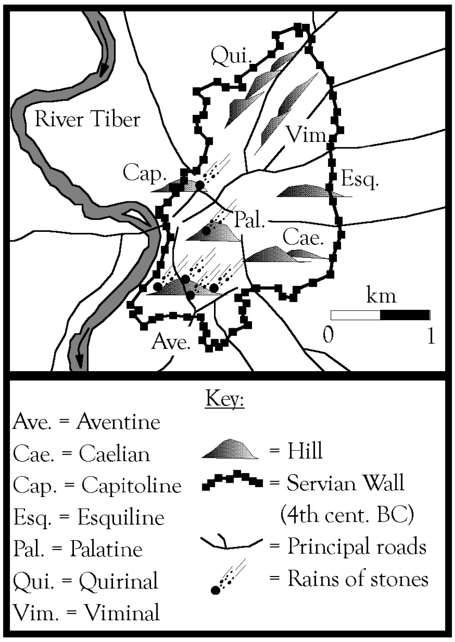

Figure 2 – A sketch-map of Republican Rome, relevant for most of the period discussed in this article. The seven hills of the city are shown, together with the city's approximate boundary from the 4th century BC (the Servian Wall). A schematic idea of roughly where the various rains of stones fell is provided too. Only that rain reported as falling on the Capitoline Hill sometime between 345–343 BC occurred without the core period in this paper.

the frequency of prodigy lists in Obsequens was much the same as in Livy. Given that Obsequens was in theory copying from Livy, this should not be surprising, but it is helpful to know that his copying, in terms of quantity at least, seemed consistent with Livy's earlier original. There was also a partial overlap in the two sources, from 190–167 BC, although missing sections of the Obsequens manuscript meant not all the dates were covered. The gap in Obsequens unhappily included the four-event year of 169 BC in Livy, for instance.

While the number of events in any given year was small, there were clusters of reported sightings from 218–202, 194–186, 177–163 and 108–87 BC, with an equally striking extended trough in reports between 162 and 109 BC. What this pattern represented was far from clear, however. Weather conditions, the availability of interested observers/reporters, the variability in occurrence of suitable events, through to the loss of a manuscript before Livy or Obsequens were able to compile their data, aside from any decision by the original authors, or their subsequent copiers, to omit items from their lists, might be invoked to explain it. Other factors too, such as decisions that officially collecting portents was necessary only during times of especial trouble, could have been involved.

Judging by the quantity, frequency and notes in Livy's text associated with the records of prodigies over-

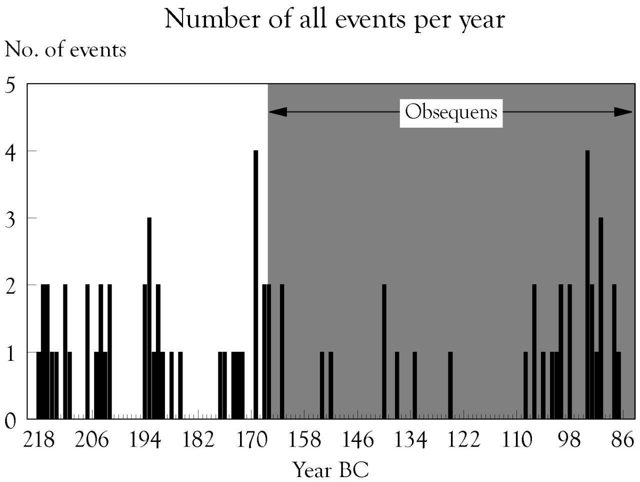

Figure 3 – A graph showing the quantities of all classes of identified potentially meteoric or meteoritic portent events per year. Note that in all the graphs here, events given as multiple, but without specific numbers stated in the original texts, were treated as just single events, for simplicity. The period during which the portent lists from Julius Obsequens' text formed almost the sole source of information is shown by the indicated shaded region.

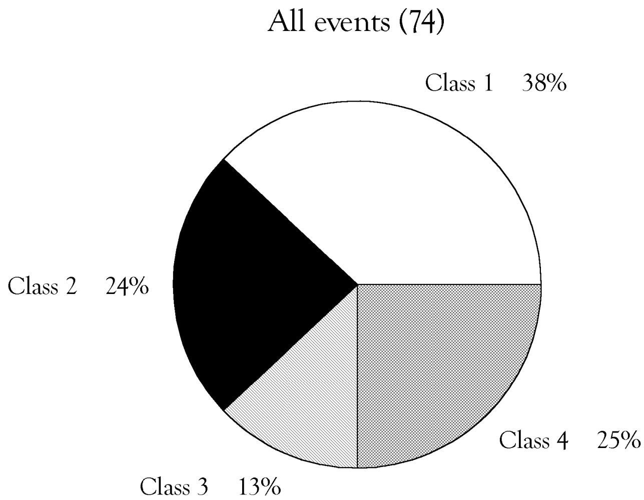

Figure 4 – A pie diagram to show the relative proportions of each class of the 74 events recorded during the 132 years represented by Figure 3.

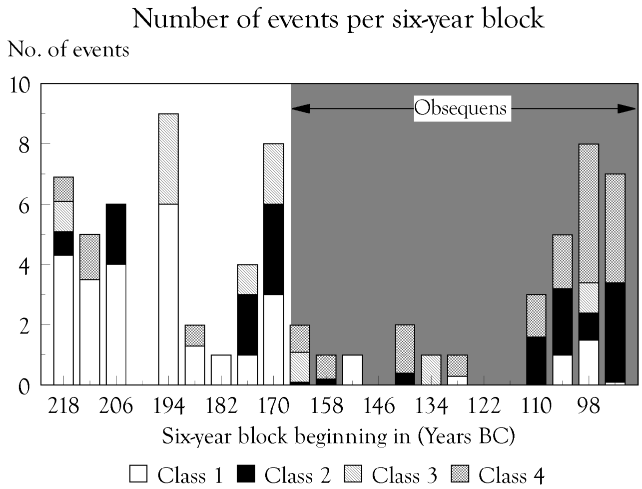

Figure 5 – A breakdown of events in each six-year block throughout the core period examined. The shaded area is as described for Figure 3.

all, it seems likely we may assume that if an event was seen by 'reliable witnesses' or by a significant number of people, it would have been recorded officially, and later presented by Livy. Consequently, since lists of portents were no less frequent for most of the 162–109 BC 'meteoric drought', it was probable this quieter spell reflected that less potentially meteoric activity was happening.

Figure 4 gives a pie chart breakdown for the 74 events represented by Figure 3, illustrating the proportions of events in each of the four classes used. Almost two-thirds (62%) were of classes 1 and 2, the more probable meteoritic/meteoric ones. Figure 5 provides a similar breakdown by class, but graphed over time. In order to make the classes legible, the events were entered into six-year long blocks (so the first ran from 218–213 BC inclusive), as with a 132-year long timeline, this provided a suitable compromise in using short enough intervals to indicate variations, while still being readable, and providing a number of equal-sized bins throughout the whole core period. Each interval can thus be compared directly with any other.

The most notable feature of Figure 5 was the consistent reporting of rains of stones during the 218 to 170 BC blocks, which vanished almost entirely later. Meteoric events were scattered fairly randomly for most of the time, until the last 24 years, while during this same late interval, uncertain events became surprisingly common too. Indeed $\sim 63\%$ of the uncertain category items fell within this final spell. Removing these would reduce the slice of class 4 events in Figure 4 to just 11%. The small contributions from the falls of earth and chalk mostly occurred irregularly in and before the 164 BC block.

As mentioned earlier, there were clear concentrations of events reported from the Roman province of Latium (whose location is shown in Figure 1), and Rome itself (Figure 2). Figure 6 gives pie diagrams for both places to compare with Figure 4, while Figure 7 provides a timeline for Latium for contrast with Figure 5. The events in Rome, not illustrated here, were spread evenly over time, with 0, 1 or 2 events per six-year block, except for the final one (92–87 BC), when 3 events occurred. Figure 8 reinforces the point of what a substantial proportion of events were reported from Latium (37 events = 50% of the total), while Rome accounted for almost half the Latium reports (16 events = 22% of the total).

The nature of Figures 4 and 6 was very similar. The Rome breakdown was virtually identical to the all-events one, and the main differences between Figure 4 and the Latium pie chart were the higher proportions of meteor reports, and the lower percentage of uncertain events, in Latium. This may be of interest to IMO colleagues who observe from this area of Italy today, knowing they are continuing a tradition of reporting meteor sightings going back more than 2200 years. The first definite meteor sighting in Livy was made at Setia in 204 BC, while the first probable meteor shower ('...there were at first shooting-stars at intervals and then a great meteor blazed out...') was reported from Anagnia in 203 BC.

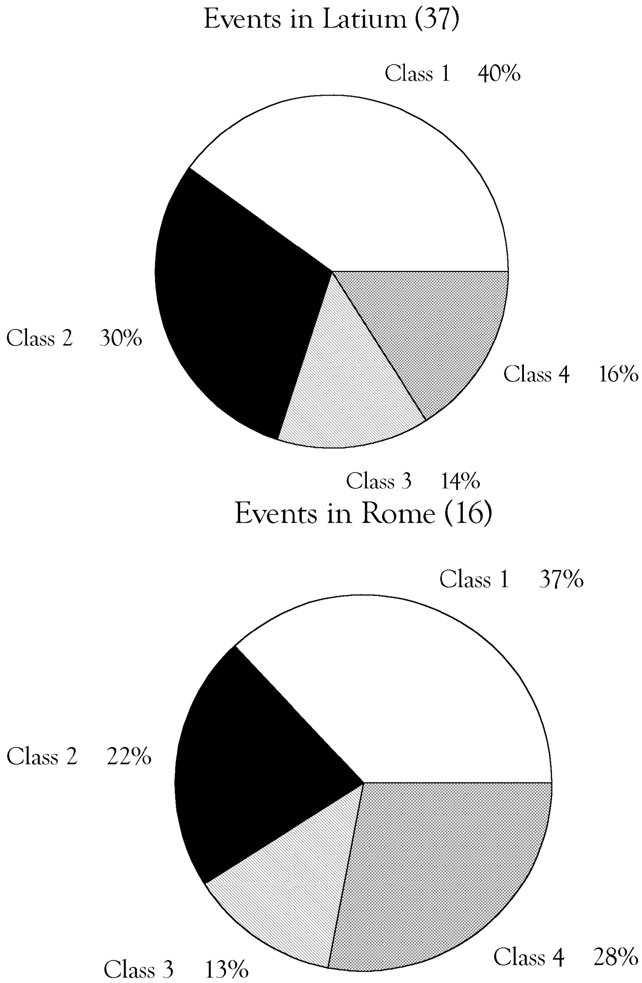

Figure 6 – Two pie diagrams illustrating the relative proportions of events (totals in parentheses) in the various classes for Latium and Rome respectively, similarly to Figure 4.

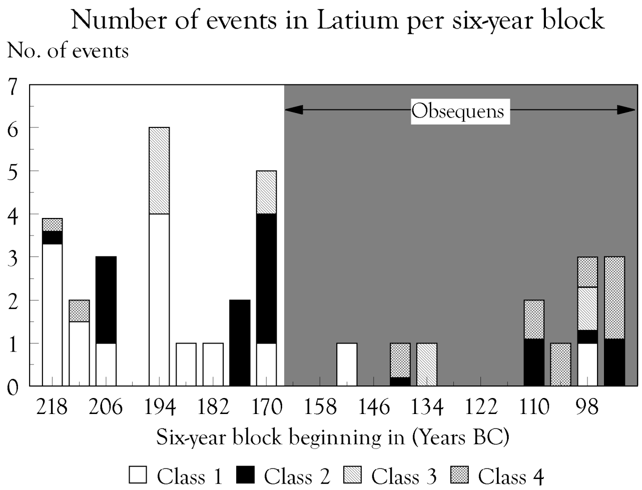

Figure 7 – A variant graph of event types over time, as Figure 5, but for the province of Latium.

Given the substantial proportion of events seen from Latium, it was unsurprising that Figure 7 largely mirrored Figure 5. Latium was a roughly rectangular province, $\sim 160 \times 60$ km in size, an area slightly larger than the island of Cyprus in the east Mediterranean Sea, and $\sim 3\%$ of the land area of modern Italy (including Sicily and Sardinia). That such a small region should have been so prominent is readily explicable by

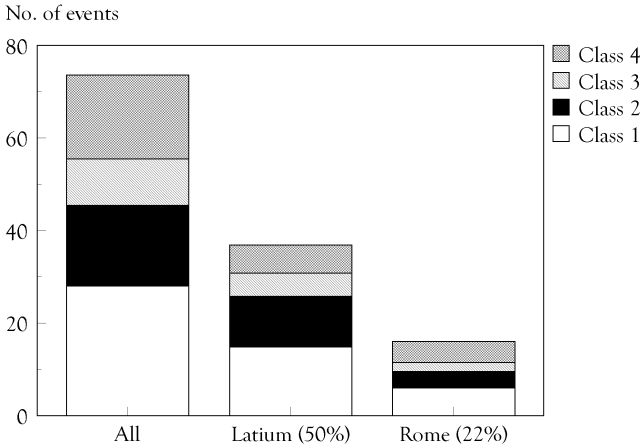

Figure 8 – The total numbers of events reported from various places.

considering Figure 9, which shows the same base map as Figure 1, but with the labels removed, and areas of anciently greater population density added. As this Figure also demonstrates, most of the reported prodigies were observed from other more densely populated zones.

From the catalogue of events presented previously, it would be easy to lose track of the interval over which they were recorded, and this analysis has demonstrated there were no unusual concentrations of events. There were some times with more possibly meteoric activity, and a long spell with very little reported during the early to mid second century BC, however. There was also a tendency towards less easily-definable events during the final quarter-century of the core interval, when probable meteor sightings were somewhat more prevalent too. Overall, the 74 events spread over 132 years yielded an average of one event every 1.78 years, or 5.6 per decade. Most were reported from the better-populated regions, largely as we would have expected in advance.

4 Nature of the events

Some discussion of what the events may have been was given in (Gheorghe & McBeath, 2006), which should also be consulted, as not all the points raised there are reiterated below.

Class 1: Rains or showers of stones Considering the size of this class, it was frustrating to have so little information on what the majority of the 'stones' may have been. Occasionally they were called 'pebbles' instead, which might be taken to mean 'rounded stones', but this is scant improvement. The glowing stones at Praeneste in 217 BC could have been volcanic, though the nearest known sources active in ancient days would have been Vesuvius and parts of the area westward, towards Cumae, roughly 150 km from Praeneste, with many towns in between where such pyroclastic volcanic bombs might have dropped near too. The association between the call to seek the probably meteoritic Magna Mater stone from Phrygia, and the 'frequent showers of stones' before the stone was collected (McBeath & Gheorghe, 2005), might infer a meteoritic source for

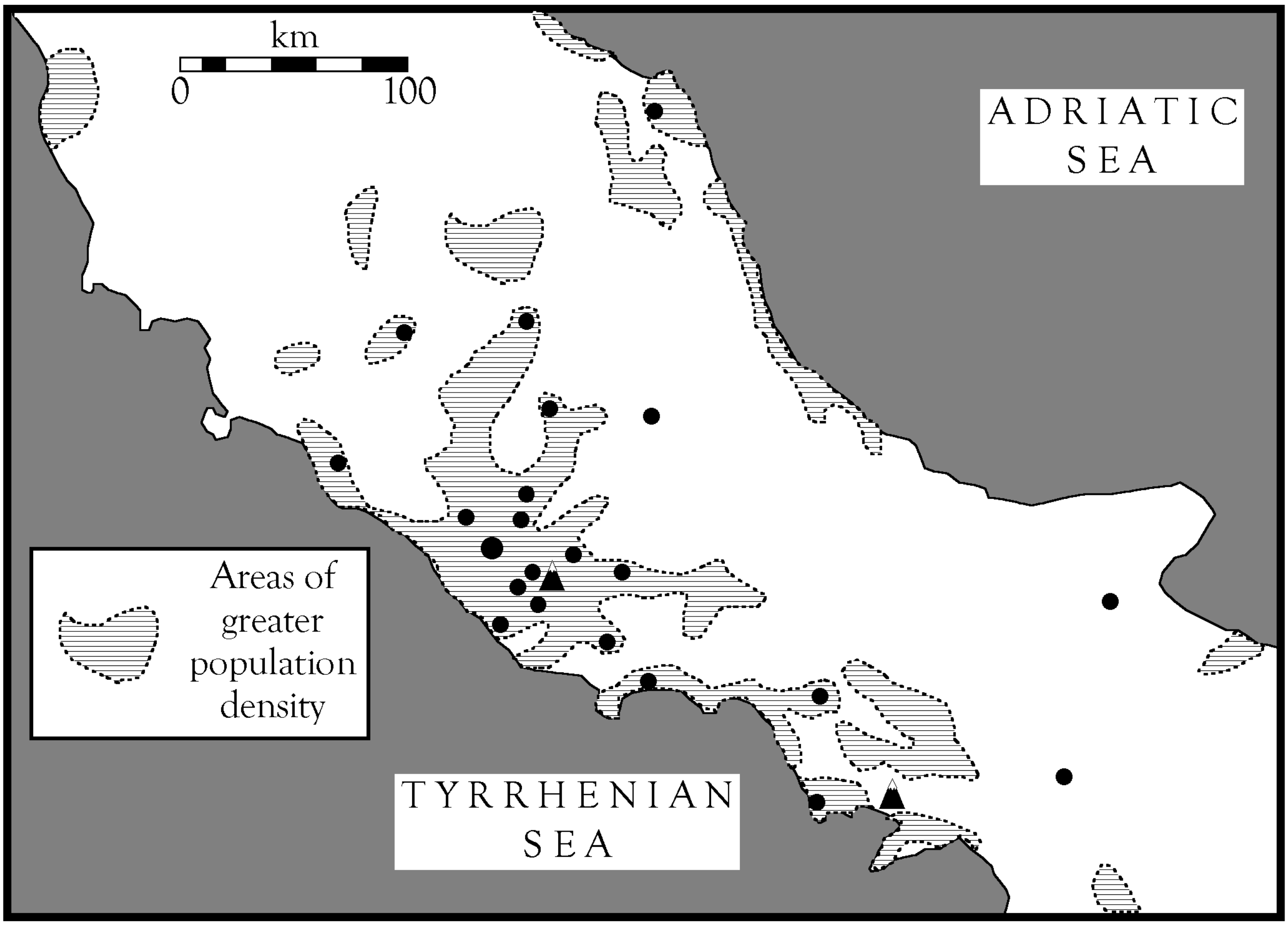

Figure 9 – The same map as in Figure 1, but with the provinces, place and tribal names removed, and areas of greater population density marked by the shaded regions. These were estimated by the relative densities of ancient settlements as shown on the source maps for Figure 1 (references were in (Gheorghe & McBeath, 2006)).

some, though the most plausible meteorite was that single stone said to have fallen at Crustumerium in 177 BC. Assuming this one event in 132 years was a genuine witnessed fall in Latium, a value of 0.79 falls per year per 10^6 km^2 can be derived. If all the stone-rains in Latium are considered, this value rises to 12.68 falls per year per 10^6 km^2. These outlying values can be contrasted with statistics in Buchwald (1975, pp. 38–40), where a range between 0.36 to 0.72 falls per year per 10^6 km^2 was suggested from data for three geographic areas (Japan, northern Italy and the central USA), for various intervals between 1750 and 1970 AD. While it is not possible to say definitely that such modern statistics provide a suitable baseline for ancient studies, they do imply either that a similar to greatly increased meteorite flux was present in the last two centuries BC, or that most of the stone-rains were not meteoritic.

Rains of stones lasting for several days at the same place — such as Mount Alban in 212, Picenum in 186, or Arpi in 125 BC — or two such rains at the same spot (Mount Alban again, in the reign of the semi-legendary King Tullus Hostilius), seemed more likely to have been meteorologically severe storms, with exceptional hailstones, perhaps. Quite how the 'stones and sherds' that rained on the Vestini for a week in 91 BC could be fitted to this possibility was unclear, though it was a unique event in Livy-Obsequens, as was the rain of stones within a villa, again curiously among the Vestini people, in 94 BC. Given that villas often had open-air walled courtyards or atria, this might account for such an otherwise implausible natural event.

Human-hurled stones would be the simplest solution, and might help account for the very specific locations of stone falls at Rome, for instance (see Figure 2), especially the repeated peppering of the Aventine Hill there. The concentration of stone-falls away from the larger outlying hills of the city, in favour of the more politically-sensitive smaller, central ones, was suggestive of a human agency as well. The relative proximity of the three struck hills to the River Tiber, where one might assume a ready source of stone missiles would come to hand, reinforced all this, for Rome at least.

In respect of unusual hail, there is a very useful, fully-referenced, discussion of different shapes and sizes of hailstones in (Corliss, 1983, pp. 195–205). Since hail up to ~ 10 cm in diameter is a recognised weather phenomenon, as Corliss noted (op. cit., p. 202), it may not be necessary to invoke more than a good number of such hailstorms to account for many 'rains of stones'. Corliss also had some relevant reports of geological stones falling during thunderstorms from the 19th century, together with reports of falls of cinders, mica and coal (op. cit., pp. 266–268).

Some mixture of all these explanations, allocated on a case-by-case basis, would be preferable to trying to fit a single solution to them all, For most, too little information has survived to allow even this.

Regarding the nine-day rite prescribed in 22 of the 36 cases of showers of stones from Livy-Obsequens, why such a protracted period was chosen is unknown. Nine enjoyed considerable significance anciently, and possessed an astronomical/astrological element, though it would stretch the point too far to imply a celestial connection for the stone-falls in such cases on this evidence alone. Things believed to have fallen from the skies were sometimes thought sent from deities — see for example (McBeath & Gheorghe, 2005) — however, which could have provided a link to such an important number.

Class 2: Meteors or meteoric fireballs Many of these were modernly-recognisable meteors. Some were descriptions of weapons or armour of different types in the sky, which might have been auroral forms or meteors, as might the falling images reported at Praeneste and Cephallenia in 140 BC. Noises in the sky could sometimes have been meteoric too, though the firebirds in 108 and 94 BC seemed unlikely to have enjoyed the same link, despite the hopes of a few modern commentators. The fireball that rolled to the ground, then took off again in 91 BC, sounded more plausibly like ball-lightning, yet might still have been a garbled account of a meteoric fireball.

Probable meteor shower records were relatively few, and mostly open to interpretation. The more likely ones included the Anagnia event of 203 BC and the numerous firebrands in the sky at Rome in 174 BC, with the 'possibles' comprising the flying weapons in the sky seen from Compsa in 154 BC, the falling images in 140 BC, the javelins falling from heaven amid uproar in the sky in 106 BC, and the mysterious fighting celestial weapons of 104 BC. If we take these as being six possible strong meteor events in ~ 130 years, that number seems perfectly feasible, assuming a direct contrast with near-modernity is possible. A rapid survey of (Roggemans, 1989) for the 130 years from 1701 to 1830 AD inclusive produced 25 strong to storm events from the Lyrids, Perseids, Leonids, Andromedids and Geminids. Assuming observers somewhere in a given country have a very crude one-in-four chance of seeing part of any given display, would yield ~ 6 events from this simple survey. This early-modern period was deliberately chosen, as there was renewed interest in things in the sky then around the world, but it was before the recurrent nature of annual meteor showers was recognised, so may be taken as a very rough guide for comparison with the ancient reports from their more limited geographical area.

Class 3: Falls of earth or chalk The smallest class overall, and significantly less plausibly meteoric than either of the first two. Apparent falls of earth during rain are well-established meteorologically, since dust washed out of the air will collect on the ground, as if the rain had been of soil. Ancient 'rains of blood', also found among the Livy-Obsequens portents, have been mostly attributed more recently to fine red dust or sand blown across from deserts, and then rained out of the sky. Such things continue today. 'Chalk' might be chalk, or any other fine, white powder. There was little in the ancient records to tell us if larger white stones than this were intended by the chalk rains at Cales (214 BC) or Rome (98 BC), for instance. It was possible some of the 'showers of earth' might have had a meteoritic origin, hence their original inclusion in the events catalogue, but with so little data to work from, most of that idea must remain speculative.

Class 4: Uncertain events This catch-all category was intended to cover those possibly meteoritic or meteoric events for which the presented descriptions needed some revision to fit them to a modernly-believable understanding of meteoric activity. These can only be dealt with individually, as in the earlier catalogue article, since they will not fit to a general pattern.

5 Conclusion

Despite the difficulties with this analysis, in trying to interpret ancient descriptions in modern terms, it has shown the numbers of probable meteoric events at least were not exceptional compared to those in more recent times, and that the overall numbers recorded in recurrent places related simply to the areas of greater population concentration in ancient Italy. Some variations over time were apparent, again much as would be anticipated more or less randomly from a long enough time interval now, and it seems likely the ancient Romans were just as interested in unusual events in the heavens - albeit for somewhat different reasons - as meteor watchers currently. Those people observing and recording data from Italy still, to make their findings known to the larger community, are clearly following a very long tradition of such work.

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WGN volume 36, 2008 or could it have been IMO Journal, volume 21, 2008?

Paul Roggemans [1]

Most magazines about meteors have very self-explanatory names like Meteor News, Meteoros, Radiant, Boliden, Meteoritics, to name a few. But what about WGN? IMO was founded only in 1988, but WGN existed 15 years longer... Many of you may have wondered about the history of WGN and therefore it is perhaps time to look back in time to answer some peculiarities of WGN.

Received 2007 July 10

1 The WGN pre-history and how it started

For several decades the Flemish Astronomical Association (VVS) was ran by professional astronomers and had an almost constant membership of some hundred people. The space exploration in the 1960's with, as magic highlight, the landing of astronauts on the Moon in 1969 stimulated interest in astronomy among the general public, especially the very young generation. To answer the needs of a growing number of active amateur astronomers with specific interests in different aspects of astronomy, different sections were created in 1969, including a meteor section with as first director Jacques Vandaele.

Meteor observers were kept informed by personal correspondence as they were just a few, but excellent observing conditions for the Perseids in 1972 boosted the number of amateurs interested in meteor observing. To keep everyone informed the director had to repeat over and over the meteor stream information and observing guidelines in personal handwritten letters. To limit the amount of handwriting, the new director of the VVS Meteor Section, Eddy Van Den Broecke, started in 1973 to typewrite these meteor activity newsletters using carbon-paper to save time. 'Werkgroepnieuws' was born: it was entirely written in Dutch and invited observers to pay attention to radiants that were expected to display some activity. 'Werkgroepnieuws' means, literarily translated, Working Group News and included announcements and results of the VVS Meteor Section. The periodicity wasn't fixed, neither was the number of pages. The advantage was that it could be sent as printed matter saving a lot of postage. Sometimes nothing appeared for several months, sometimes a Werkgroepnieuws was sent out with intervals of less than a month. Subscription was free of charge as the Flemish Astronomical Association covered the costs.

2 How WGN officially became a journal

The author became the third VVS Meteor Section Director in 1978 and continued Werkgroepnieuws. The periodicity was fixed more strictly as monthly and the international contacts of the new director provided extra news to be communicated via Werkgroepnieuws. In 1979 Hans Betlem had created the Dutch Meteor Society with the new journal Radiant and suggested to co-operate. For a short time the Werkgroepnieuws was suspended and replaced by Radiant. When the cooperation failed just some months later it was decided to resume the edition of Werkgroepnieuws in 1980.

The amount of information to be published had grown so much that the tariffs of the post for printed matter became too expensive. To overcome these costs, Werkgroepnieuws had to be registered as a formal periodic journal in order to be sent at subsidized tariffs. This was a moment to think about the opportunity to start with a brand new Meteor journal, number 1 of volume 1 or to choose for continuity and build further on the existing tradition of the popular Werkgroepnieuws. Several factors favoured the latter solution: the need for sponsorship from the Flemish Astronomical Association, the active meteor observers in Flanders asking to get their familiar Werkgroepniews back... I decided it was the best for all to resume Werkgroepnieuws but as real periodic journal, respecting 1973 as the year it really started and counting 1980 as volume 8, rather than to start with something completely new.

This explains why volumes 1–5 for the years 1973, 1974, 1975, 1976 and 1977 are not on the WGN DVD: the content of these years is of very little use for archiving, as the number of pages and the usefulness of the information is too insignificant.

3 How WGN became of international significance

The author had established a network of correspondents worldwide who reported meteor related news that was translated into Dutch and included in Werkgroepnieuws. When the author had to fulfill his military service, he had plenty of time to prepare articles. In 1981 the typewriting work, printing and mailing were done by Pierre Vingerhoets and his family. Werkgroepnieuws was abbreviated as WGN understood as Working Group News. In 1981 a subscription was as cheap as 2 Euro/year. The typewriting was done mainly by a simple mechanical typewriter. Until 1980 stencils were used for duplications, from 1981 onwards photocopies were used, and from 1984 onwards offset printing. The layout was minimal, really amateur, the content was very representative of the enthusiasm of the amateur meteor observer with observing reports appearing

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shortly after the event describing the emotions of the real work in the field. In these years, 1981–1986, delays in publication were non-existent.

The international character of the content, although provided in Dutch with just a summary in English, became of international interest. WGN soon counted a significant number of non Dutch speaking subscribers. Subscribers from abroad soon out-numbered the Dutch speaking subscribers. By 1986 much of the contents of WGN were published in English and the Journal served for a world wide network of correspondents communicating via the journal.

When WGN started as a local newsletter for a small circle of meteor observers, there wasn't a 'culture' of writing meteor related articles. In order to report results through WGN, many observers gained skills as author and writing articles became more popular.

4 How WGN became the IMO Journal

In 1987 Marc Gyssens became editor of WGN. With the help of members of the Public Observatory, Urania, near Antwerp, the look changed a lot and the layout was improved significantly, using a professional IBM typewriter, paying more attention to the overall presentation. By end 1987 plans were worked out to consolidate the network of meteor correspondents maintained by the author for about 10 years then, creating a formal organizational structure to co-ordinate international meteor work. From 1988 onwards the content of WGN was entirely in English and soon the question arose, to keep or change the name WGN into IMO Journal and to continue or discontinue the volume number. Continuity was considered to be important and therefore name and volume numbering were maintained. With WGN as Journal of the IMO and the IMC the annual conference of IMO, the history is like it is; IMO grew out of the early IMC tradition combined with the communication network out of which WGN had grown.

5 After 35 years WGN

The high quality lay-out using TeX and later LaTeX had its toll in the form of publication delays which became chronic to an extent that the uncertainty on the date of appearance made WGN of little use for urgent observing matter. The more formal editing policy accepted papers offered for publication, but did not work pro-actively as in the early years, when observes were actively pushed to prepare articles. Some delays were a consequence of too little spontaneous input. After 16 years Rainer Arlt took over the job of editor-in-chief from Marc Gyssens, followed by Chris Trayner starting in 2003. Chris Trayner made further improvements in the presentation and editing work, giving WGN the look of a professional academic journal.

The amateur community of meteor observers has gone a long way to achieve a journal referenced by professional journals and a respected reliable resource for professional researchers. Today a lot of attention is paid to the editorial work, layout and high-quality printing work to deliver a meteor journal of the highest standard.

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