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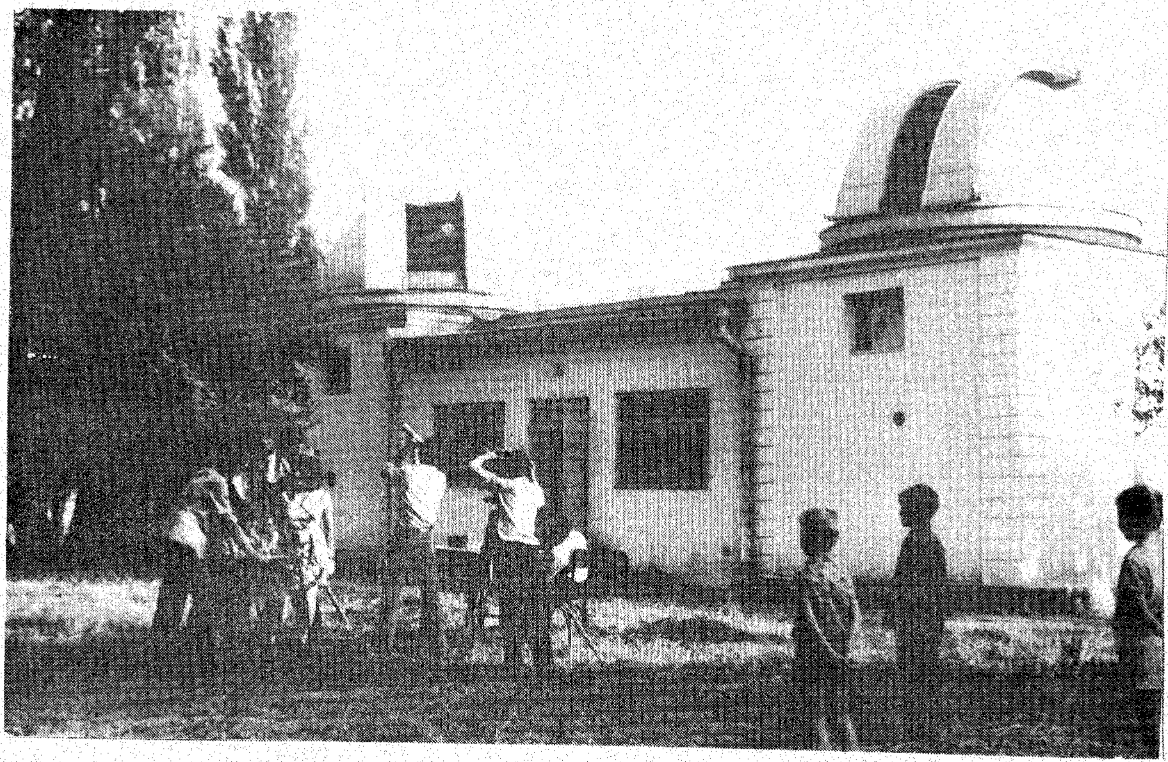
the international circular for meteor observers



Union Astronomical Observatory at Simferopol, Crimea. Read more about the 1987 Perseid observations from the Soviet Union and other countries in this issue!

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- Comments on the International Meteor Organization
- Practical information for observers
- The η-Aquarids 1987
- How high is a meteor?
- The Perseids 1987
- The Quadrantids 1987
- Fall 1987 Observational Results

v.u.: Paul Roggemans, Pijnboomstraat 25,2800 Mechelen

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Useful Information

The June Issue *(WGN 16:3)*

This issue will appear in Belgium in the first week of June. Contributions for the *June issue* are due by *May 1* at the latest. They should be sent to *Marc Gyssens* (address on the inside of the back cover).

Subscriptions 1988

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

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

Administrative Correspondence

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

From the Editor

Marc Gyssens

Once again the main article in this issue comes from a professional astronomer : Dr. Olsson-Steel sent us a contribution concerning the height of meteors . Of course we also pay attention to observational results , and more in particular to those of last year's Perseids . Among these there is a contribution from the Soviet Union , which should be considered as a sequel to the Soviet article in the previous WGN-issue. I hope you will enjoy this issue too !

We also received some more comments on the proposed foundation of an International Meteor Organization. I must admit the reactions we got thusfar are mixed. Some people are in favor without any reservation, whereas others are less inclined to the idea. The latter ones argue that everything the International Meteor Organization can give is already offered now by WGN; these people fear that an International Meteor Organization would only cause more administrative work. Moreover, they are sceptical because of failures of similar initiatives in the past.

As the editor of this journal, I feel the time is right now to express my personal views regarding this matter. First, it is true that much of the work an International Meteor Organization could do for meteor amateurs, is already done now in the context of WGN. The people involved in this journal are well aware of the efforts they will have to make to start an international organization and they are prepared for it, because they believe in the necessity of this initiative. Indeed, in considering such a step, one may not let himself be guided by short-term arguments. One should not forget that the publication of WGN is based on the work of only a handfull of people. If, some years from now, one of these people becomes unable to commit himself any further, what will happen to this journal? Too often in the history of amateur meteor astronomy, organizations that were very active during a few decades died away silently, without anyone remembering the many results they obtained. It is, in my opinion, unacceptable that these observations are lost, sometimes for over half a century, until they are rediscovered by an extensive search in literature, as Paul Roggemans did a few years ago. Another important problem is the contact with professional meteor workers. Now, these contacts are based mainly on a few individuals, but, once again, what will happen to these contacts if the persons they have them decide to discontinue their work several years from now? Will these professionals search for other valuable meteor amateurs? I doubt that very much! Even now, it cannot be denied that professionals could use much more amateur material as in the present . But again, to whom do the professionals have to address themselves? How can they be sure that a meteor amateur they know is reliable with respect to his scientific conduct? An International Meteor Organization could be of much help here. It could set observational standards and build up a reputation in which professionals can confide . And, what is important too, a reputed international organization can raise money to support amateur meteor activities, such as international conferences. In this way, personal contacts between meteor workers world-wide could be stimulated.

As I already said, the considerations do not amount to a real problem right now. Although more could be done, WGN takes care of most of the needs meteor observers feel regarding international cooperation. But in the long run, our wishes for the present and our worries for the future, eventually and unavoidably will become a huge problem - provided some action is taken .

Right now, an international cooperation has developed almost spontaneously around WGN. Professionals are even joining in by writing articles. They also get interested in activities such as the International Meteor Weekend. If ever the time was right, it is now. An exceptional opportunity lies right ahead of us; let's not miss it!

About an International Meteor Organization

compiled by Paul Roggemans

We received some more comments on the foundation of an International Meteor Organization, presented in the previous issue. At the time this article was typed, Paul Roggemans also received positive reactions from V.V.Martynenko (Soviet Union) and Trond Erik Hillestad (Norway). These letters , however , arrived too late for publication in this issue.

The International Meteor Organization sounds most promising. You certainly seem to have answers for all the pitfalls that could threaten to destroy such a concept. I would like to let you know that the N.A.P.O. Meteor Section will give our whole-hearted support. Regarding the council of professional and amateur specialists, I would be honoured to be a candidate for election to it. However, I must know what this will entail? The biggest drawback for me at present are financial considerations. If I would need to travel overseas as part of my duties, I would reluctantly have to withdraw my candidature. I believe that sometime in the future circumstances will change and I will be able to come and visit you and your colleagues. But until that time, I am going to have to be content to stay where I am.

Regarding your concern with groups that are unwilling to be part of the Organization, what I suggest is to carry on proceedings the way we know they should be done without them. We should never invoke hostile feelings against them and we should let them know that when they are ready to join we will accept them. In this way, there is no bitterness or strife. We simply get the job done and these groups will come to realize they are missing out in a good thing and eventually will join. All it is going to take is patience and perseverance.

Jeff Wood (Australia, Jan 21, 1988)

I am very happy to hear about the new Organization you are setting up in Europe. You can count on my full support. Please keep me up to date on the formation of the organization.

Peter Brown (Canada, Jan 11, 1988)

Surely it is useful to create observing projects for the study of certain meteor streams. Further it is necessary to arrange an archive of data. We often have observational material from some years ago concerning a certain shower which comes into our attention later. For instance we are now looking through our data for earlier Aurigid results. What do you think the future meteor organization should get for a status? When I sent the annual rapport of our Arbeitskreis to the Kulturbund, I mentioned the problem, and that we should work within such an organization. I hope to get a positive reaction on this. Otherwise the possibility of individual membership should be admitted. A connection (or at least a good cooperation)with the IAU Commission 22 is important, to produce results interesting for professional meteor astronomy. But we also have to think about new members, their training and education, not only by good materials, but by observing camps. Further questions of administration of the intended organization have to be clear: who can join it, and how? What about the leadership? While some parts should be "stationary" (archive, PMDB, publications, WGN), some other parts are not necessarily fixed to a certain location. May be it is good to create some divisions for visual, photographic, radar observations, a "fireball centre", ...

Jürgen Rendtel (DDR, Jan 9, 1988)

I support the idea of a worldwide meteor organization. It is needed to prevent format problems such as the one that occurred with the 1986 Perseids between European and Canadian observers. It is senseless not to have international standards whereas all data could be used and directly compared without correction. I would hope that my fellow meteor observers in the United States would support such a plan but I know that many of them are stubborn and refuse any new standards that may be proposed. We will see what happens.

Robert Lunsford (USA)

Observer's Notes: May–June 1988

Paul Roggemans

1. Introduction

Short nights at the Northern Hemisphere, long nights at the Southern counterpart! For both there is work to be done on some poorly known showers. Use each opportunity of a clear night; there are too few observers!

Table - Moonlight and observing conditions in May-June 1988

Date	k	Date	k
Friday April 29	0.91+	Friday June 3	0.92-
Friday May 6	0.82-	Friday June 10	0.21-
Friday May 13	0.11-	Friday June 17	0.07+
Friday May 20	0.17+	Friday June 24	0.65+
Friday May 27	0.80+	Friday July 1	0.98-

New Moon:	April 16, May 15, June 14, July 13
First Quarter:	April 23, May 23, June 22, July 22
Full Moon:	May 1, May 31, June 29, July 29
Last Quarter:	May 9, June 7, July 6, August 4

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

2. Shower activity: η-Aquarids

The first major shower of this period, the η-Aquarids have a radiant favorably placed for southern observers. For people north of 45° northern latitude, the radiant rises in the eastern sky when twilight begins. Moonwise, the η-Aquarid activity 1988 will be hampered by the moonlight that will be disturbing during each night of the η-Aquarid activity period. Whether or not the observed η-Aquarids will surprise the observers, will be reported in *WGN*. η-Aquarid photographs are most valuable to expand the Photographic Meteor Data Base.

3. Minor showers: α-Scorpiids, Sagittariids and June-Lyrids

Regular observers will from to time notice medium slow meteors radiating from a radiant complex near the ecliptic in the constellations of Scorpius and Sagittarius. The activity level is rather low without any remarkable maxima, but the period of visibility is very long. Visual observers may help to guard the activity and photographic work may produce the first photographed member of this shower for the PMDB.

Much has been discussed about the June-Lyrids in 1969 and the first years of the 70's. June-Lyrids were reported with low rates in 1969, but have disappeared since many years. The question is whether this was a temporary shower, or have observers become more careful and critical when identifying assumed minor shower activity? Check the activity around June 16 and let *WGN* know about your conclusions!

Also, read the *Handbook Visual Meteor Observations* in order to make useful observations!

The η-Aquarids 1987

In order to give some observational apetite to people situated at a favorable latitude, we present two contributions under this title dealing with observations of the 1987 η-Aquarids from respectively Australia and Brazil.

The η-Aquarids 1987 in Australia

Jeff Wood

The results of the Australian observations of the η-Aquarids are presented. They were found to be less active than in previous years.

1987 has seen Australian meteor observers obtain an excellent set of data on the η-Aquarid meteor stream. The 1987 η-Aquarid watch commenced on the morning of April 27-28 and covered 11 nights from this date until May 08-09 when the moon and poor weather prevented further observations being made. 15 people participated in the project; they were coming from 3 Australian States and carrying out 61 man hours of observations. The people who took part in the 1987 η-Aquarid watch were as follows:

> Maurice Clark, Jeff Wood, Craig Hinton, Andrew Whitney, Justin Whitney, Darren Ferdinando, David Cake, Meeghan Clay, Jenny Ball, Fiona Cowie, Louise Cockeram, Michelle Treasure, Brian Macauley, Nicholas Harvey, Chris Natoli.

The activity of the η-Aquarids is shown below:

Table 1 --- η-Aquarid rates in Australia, 1987.

Date	Nr. Obs.	ZHR	Date	Nr. Obs.	ZHR
Apr 27-28	5	8.0 ± 2.5	May 04-05	7	25.7 ± 7.7
28-29	4	7.5 3.5	05-06	4	24.3 7.9
30-31	3	12.3 1.4	06-07	5	34.0 8.2
May 01-02	6	13.1 2.5	07-08	2	24.7 13.0
02-03	18	19.8 2.5	08-09	1	28.7
03-04	6	20.5 5.4			

Quite clearly, the 1987 η-Aquarids were not as active as in previous years, the best rates being obtained on May 06-07. Why the recorded activity should be only 65% that normally seen is a mystery and will need further investigation.

On the next page, we give a magnitude distribution for the η-Aquarids. 1202 η-Aquarids between -4 and +5 gave an average magnitude of 2.56 and an r-value of 2.52.

Table 2 --- Magnitude distribution of the η-Aquarids in Australia, 1987

Magnitude	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6	Tot	$\bar{m}$
Number	2	5	17	32	78	165	238	283	251	110	21	1202	2.56

The following color distribution is for 537 η-Aquarids of magnitude +2 or brighter:

Red	0.9%	White	49.2%	Blue	3.9%
Orange	5.2%	Green	1.5%	Violet	0.0%
Yellow	39.3%				

η-Aquarid meteors frequently produce trains. This year was no exception with 36.1% of all η-Aquarid meteors seen having a train. Most of these were of short duration, though there were a couple of exceptions with the longest being produced by a -4 fireball that lasted for 14 seconds after the meteor itself had disappeared from view.

The η-Aquarids 1987 in Brazil

Gilberto Klar Renner

The results of the Brazilian observations of the η-Aquarids are presented.

For the third consecutive year , observers from Porto Alegre watched the η-Aquarids with relative success In 1987, 14 people living in Porto Alegre (Southern Brazil) and Fortaleza (Northeastern Brazil) have participated in the observations during 10 nights.

All participants observed the eastern sky and centered on 50° altitude. A distinction was only made between η-Aquarids and non- η -Aquarids . All observers with exception of Onofre Décio Dalavia, used a tape recorder for collecting the meteor data .

On May 4 , dense clouds in Southern Brasil interrupted the observations , whereas observers in Northeastern Brasil were hampered by a slight haze over the entire sky .

Ten participants in 1987 also recorded colors and trains of meteors. 31.1% of the η-Aquarids showed a train.

The brightest η-Aquarid was seen on May 5, next to the radiant, after the actual period of observation. Luis Antônio da Silva Machado estimated its magnitude as -6. The meteor path had a length of 4°; the colors blue and green prevailed. The meteor showed a bright flash and produced a greenish train that lasted for 10 seconds.

The participants in the 1987 η-Aquarid watch were:

Southern Brasil: Carlos Arlindo Adib (CAA), Clarice Azevedo Machado (CAM), Darlan Morais (DM), Gilberto Klar Renner (GKR), Hilário José Nunes (HJN), Luís Antônio Reck de Araújo (LARA), Luís Antônio da Silva Machado (LASM), Luiz Augusto Leitão da Silva (LALS), Luís Henrique Frota (LHF), Onofre Dácio Dalávia (ODD).

Northeastern Brasil: Francisco Carlos (FC), Edísio Oliveira Rocha (EOR), Eddie William de Pinho Santana (EWPS), Plínio Coelho de Araújo (PCA).

The observations were carried out at the following locations:

Site 1: Canoas (urban area)	29°55' S	51°10' W
Site 2: Praia de Fora	30°22' S	51°00' W
Site 3: Fazenda Km 34 Br-222	03°34' S	39°00' W
Site 4: Sítio Kappa Crucis	30°14' S	51°30' W

The observations are summarized in Table 1, below.

Table 2 --- Brazilian observations of the 1987 η-Aquarids.

Date (UT)	Obs	Loc	Period (UT)	T_{eff}	Lm	F	h	Aq	Spor
Apr 27	ODD	1	07^h30^m-09^h00^m	1.44	5.5	1.00	39°	7	59
28	ODD	1	07 30 -08 45	1.20	5.6	1.00	37	8	51
May 01	ODD	1	07 30 -09 00	1.39	5.7	1.00	39	36	91
03	CAM	2	07 15 -09 00	1.25	6.2	1.00	38	25	16
03	DM	2	07 15 -07 45	0.50	6.5	1.00	31	10	8
03	GKR	2	07 15 -09 00	1.25	6.2	1.00	38	14	18
03	LASM	2	08 10 -09 00	0.66	6.2	1.00	44	13	18
04	CAM	2	07 30 -07 45	0.25	5.2	1.11	32	4	1
04	EOR	3	06 30 -07 15	0.75	5.2	1.11	38	8	5
04	EWPS	3	06 30 -07 15	0.75	5.0	1.11	38	6	8
04	FC	3	06 30 -07 15	0.75	5.0	1.11	38	3	8
04	GKR	2	07 30 -08 32	0.38	5.2	1.11	37	6	8
04	LASM	2	07 30 -08 50	0.68	5.1	1.11	39	12	7
04	ODD	1	07 30 -08 00	0.46	5.3	1.00	34	15	29
04	PCA	3	06 30 -07 15	0.75	5.0	1.11	38	4	10
05	DM	4	06 15 -08 30	2.00	6.3	1.00	29	54	46
05	GKR	4	06 15 -08 30	1.93	6.3	1.00	29	39	38
05	LALS	4	06 15 -08 30	2.00	6.3	1.00	29	37	23
05	LASM	4	06 15 -06 45	0.50	6.4	1.00	18	11	11
05	ODD	4	06 15 -08 30	1.80	6.6	1.00	29	82	154
06	ODD	1	06 15 -07 15	0.94	5.6	1.00	22	25	47
09	CAA	4	06 45 -07 45	1.00	5.8	1.00	39	7	9
09	DM	4	06 45 -08 45	1.50	6.3	1.00	34	35	35
09	GKR	4	06 45 -08 45	1.45	6.3	1.00	34	27	23
09	HJN	4	06 45 -08 45	1.50	6.3	1.00	34	20	19
09	LARA	4	06 45 -08 45	1.50	6.3	1.00	34	29	31
09	LHF	4	06 45 -08 45	1.50	6.3	1.00	34	30	28
09	ODD	4	06 45 -07 45	0.92	6.6	1.00	39	38	56
10	ODD	1	07 30 -08 45	1.13	5.7	1.00	39	48	85
11	ODD	1	08 00 -09 00	0.92	5.5	1.00	44	25	60

The following magnitude distribution was obtained:

Table 2 --- Magnitude distribution of the 1987 η-Aquarids in Brazil.

Magnitude	-1	0	+1	+2	+3	+4	+5	Tot	$\bar{m}$
η-Aquarids	7	26	71	144	169	210	44	671	2.85
Sporadics	5	15	50	127	220	468	108	993	3.39

200 meteors of magnitude +2 or brighter had their colors estimated: 66.0% were yellow, 22.5% were white, 2.5% were blue, 5.5% were green and 3.5% were orange.

How High is a Meteor?

Duncan Olsson-Steel, University of Adelaide

Some recent observations of the heights of meteors detected with backscatter radars operating at frequencies of 2, 6 and 54 MHz are reviewed, and it is shown that VHF radars detect only a small fraction of the total incident flux of small meteoroids. In addition the implications of these new results for the ecology of the smaller bodies in the solar system, and also the effect of the meteoroids upon the Earth's atmosphere, are discussed.

1. Introduction

Ever since systematic observations of meteors by radar techniques began in the late 1940's, the majority of equipments have operated in the VHF band of the radio spectrum; generally the frequencies used have been between 20 and 70 MHz. There are a number of reasons for this, amongst them being the difficulty of building high-gain antennas at lower frequencies due to the large physical dimensions involved, and also the fact that at higher frequencies fewer meteors are detected due to a number of effects, including the reduced length of the first Fresnel zone as the wavelength is diminished (1).

However, work at the Jodrell Bank station of the University of Manchester in the late 1950's and early 1960's demonstrated that in order to detect a high proportion of the total influx it is necessary to use a radar wavelength rather longer than most often used. The results of these investigations were summarized in a seminal paper by Greenhow (2), who unfortunately died soon thereafter. Greenhow found that in order to detect even 50% of the influx, it is essential to use a radar operating in the HF band, at a frequency of only a few MHz. The reason for this is that at a higher frequency the wavelength is comparable to the transverse dimensions of an underdense meteor train (that is, a train whose electron line density is below the critical value which allows the radiowave to penetrate the train rather than being scattered by the train as a whole, which then acts as a conducting cylinder); if the wavelength and train are of comparable sizes then the echo amplitude will be very much reduced due to destructive interference between reflections from the front and back faces of the train. The transverse dimension of a meteor train (about 1 meter at an altitude of 100 km) is formed essentially instantaneously, since in the ablation process the material leaving the meteoroid does so with a velocity of the same order as the translational velocity of the meteoroid (i.e. tens of kilometers per second), and then moves through a distance of a meter or so (more at a higher altitude, less at lower heights) before coming into thermal equilibrium with the atmospheric atoms. Thereafter the train decays exponentially at a rate which depends upon the ambient diffusion coefficient at the height in question. This is the cause of the well-known "echo-ceiling" which limits meteor radars (1): for example, if the initial width of a meteor is assumed to be 3 meter at a height of 105 km, then this is the echo-ceiling for a radar of wavelength $\lambda = 2\pi \times 3$ meter $\cong$ 19 meter, corresponding to a frequency of about 16 MHz. Thus, 20-70 MHz radars have echo-ceilings which are lower than this, and can detect few if any meteors above that height no matter how many of them exist.

Two additional effects may be briefly mentioned. Firstly, if the meteor is very slow then it is possible that there will be appreciable diffusion of the train before the meteoroid has fully crossed the first Fresnel zone for the view direction of the radar, so that there is less chance of the meteor giving rise to a detectable echo. Secondly, if the pulse repetition frequency (prf) of the radar is low (e.g. only 50 Hz) then there is a good chance that any high-altitude meteor which is is formed just after one pulse will have totally decayed away before the next pulse is transmitted. Both of these effects limit the detectability of meteors which may be formed at high altitude. There is another effect, due to recombination of electrons with atmospheric ions, which slightly reduces the radar detectability of meteors occurring at low altitude (less than 85 km), but is outside of the intended scope of this discussion.

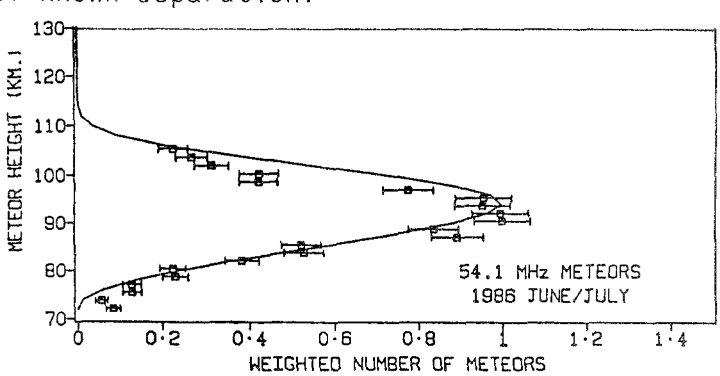
It can be seen, then, that in order to detect a high-altitude population of radar meteors it is necessary to use a set of equipment operating at a much lower frequency than normally utilized. The drawbacks of VHF radars in this respect can be alleviated somewhat by using a forward-scatter rather than a back-scatter system, but such methods also have some problems due to the need for widely separated transmission and reception sites, and very precise measurements of the zenith angle of the incoming echo are required; see section 4 for a reference to some results.

The suggestion of Greenhow that a VHF radar should be used to try to detect the complete influx of small meteoroids (with a mass of less than a milligram) into our atmosphere has more recently been taken up by Elford (3). Preliminary results indicated that Greenhow's conjecture of a large undetected population of high-altitude meteors was correct, and prompted the present research program. This program has been directed towards measuring the height distribution of meteors at HF (2 and 6 MHz), and also for comparison purposes at a typical VHF meteor radar frequency (54 MHz).

2. Observations

The observational data presented here were all collected by the author using radars situated at the Buckland Park Research Station of the Physics Department of the University of Adelaide; this station lies about 40 km north of Adelaide, which is a city of one million people on the southern coast of Australia. Meteor research has been carried out at the University since the early 1950's, when Professor L. Huxley arrived to take up the chair of Physics; Dr. W.G. Elford has been active in this research from the very onset, and has in the past been a president of Commission 22 (Meteors and Interplanetary Dust) of the International Astronomical Union.

Two distinct sets of equipment have been used to collect the data described here; both were originally built for atmospheric studies. The 54 MHz VHF radar, which will be described in more detail in a future article since it is a very useful tool for meteor *astronomy* as well as the meteor *physics* covered here, consists of an array of dipole antennas arranged in a square 80 meter on a side. The same array is used for both transmission and reception in its meteor mode. Nominally one tilts the beam (which has a half-power, half width of just 1°.5) to a zenith angle of about 30°, and operates the transmitter with a prf of 1024 Hz. The returned echo signals are detected by phase-sensitivity receivers; a preliminary smoothing of the signals is performed by parallel microprocessor systems and then the output signals are fed to a mini computer which is used to analyze the data in real time. Since the data are binned into range divisions of 1 km, and the antenna beam is so narrow, it is possible to determine the height of each meteor with a precision of less than 2 km; this is rather better than previous set-ups used elsewhere which depend upon both range and zenith angle measurements, the latter being dependent upon phase comparisons between two antennas of known separation.



A typical height distribution gained at this frequency is shown in Figure 1. The limiting radar

Figure 1 --- The height distribution of sporadic meteors observed with a radar operating at 54.1 MHz. The limiting radio magnitude was +9. The data points show the weighted number of meteors at each height (that is, observational selection effects have been removed and the distribution has been normalized to unity at the peak). The uncertainty in the individual meteor heights is less than 2 km. The solid line is based on a theoretical model.

magnitude for these meteors, which are sporadics, is +9; future improvements in the output power of the radar are expected to permit fainter meteors to be observed. The "weighted number of meteors" implies that in constructing this distribution I have removed various selection effects; for example, as the height increases the cross section through the atmosphere which is illuminated by the radar beam increases, so that more meteors cross that area than would at a lower altitude. In addition, at larger ranges the returned amplitude is less than at shorter ranges for meteors with identical line densities. The data points have uncertainty bars plotted which show the count statistics (i.e. the length of each bar is the square root of the number of meteors observed at each height); as mentioned above, the individual height uncertainty is less than 2 km. The solid line shows the result of a model calculation (*not* a fit to the data), this model taking into account the various effects described in section 1. The model will be described in detail in forthcoming papers to appear in the *Journal of Atmospheric and Terrestrial Physics*.

This 54 MHz height distribution is typical of that normally gained at VHF; for other examples, see (4,5). The main points to note are the peak at about 93 km, and the sparcity of meteors above 100 km (as would be expected from the low echo-ceiling for such a radar).

Our second set of equipment is a HF radar which can be operated at either 2 or 6 MHz. Separate low-gain transmitting antennas are used at the two frequencies, but the same high-gain receiving antenna is used for each. This antenna consists of a filled circle of dipoles, about 1 km in diameter; such a large array is needed since it is necessary to be able to achieve narrow, directable beams. Due to the fact that at these frequencies the F-region of the ionosphere (at a height of around 250 km) acts as a mirror, after a pulse is transmitted one receives back for several milliseconds echoes which are caused by multiple bounces between the F-region and the ground. Because of these echoes, the HF-radar, for meteor observations, must be operated with a low prf; a prf of 20 Hz was used here, and this low value means that even at 2 and 6 MHz there is a drop in the detectability of meteors above 120 km, causing the model drop-off shown later in Figures 3 and 4.

The separation of the dipoles is about 91 meter (in fact, precisely 100 yards), whereas the wavelength at 6 MHz is about 50 meter. Because of this the antenna acts as a two-dimensional diffraction grating, with beam maxima at the vertical, at a zenith angle of near 33° in azimuths to the North, East, South and West, and near 51° at the interstitial points of the compass. By operating the radar at times when known showers are active, and also limiting the ranges from which data are analyzed, it is possible to deduce the individual meteor heights directly from the range since the echo is being received in a beam of known zenith angle. However, there are further limitations which make these observations difficult: firstly, the existence of E-region ionization causes echoes which may be confused with meteor echoes; and secondly, Radio Australia broadcasts at this frequency at all hours except from 8 am to 4 pm local time. Because of this, observations can only be made between these times, and there are few accessible showers available: the only well-known high-flux showers which can be used, in fact, are the Daytime Arietids and ζ-Perseids (in early June), the Daytime β-Taurids (in late June) and the η-Aquarids (in early May), with the last of these being observable only post-transit. In 1986, I observed all of these showers, although equipment malfunction curtailed the β-Taurid campaign.

As for the 54 MHz radar, the incoming signals are analyzed by an on-line minicomputer which is programmed to search for characteristic meteor echoes (fast rise to a level significantly above the noise, with averaging to limit the effects of the noise and impulse suppresion also incorporated). The data for each recognized meteor are stored, and later written onto magnetic tape for analysis with the main-frame computers on the university campus. The limiting magnitude for this 6 MHz system is near +6, and the individual meteor heights are determined to within 3 km.

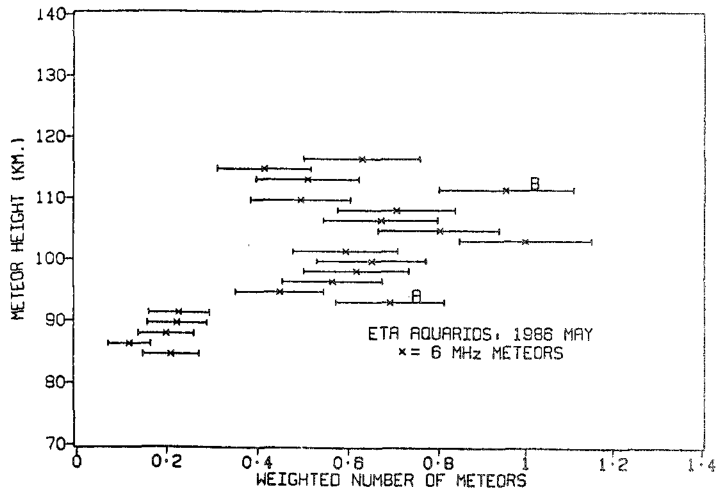


Figure 2 --- As for Figure 1 except for η-Aquarids observed with a 6 MHz radar. The limiting magnitude is +6. Points A and B are not due to meteors but are caused by echoes from a layer of sporadic E-region ionization at a height of 112 km; for details, see the text. Individual meteor heights are measured to within about 3 km. Note that in comparison with Figure 1, now many meteors are detected above 100 km.

The height distribution obtained from observations of the η-Aquarids in 1986 is shown in Figure 2. Points A and B are in error, and are due to echoes from the sporadic E-region ionization being confused with meteor echoes: B results from echoes in an antenna beam at a zenith angle of 33° which are caused by the sporadic-E at a height of 112 km, and A is from sporadic-E at the same height causing echoes in the vertical antenna beam (A occurs at a height of 93 km = 112 km x cos 33°). The features to note in Figure 2 are that now the peak of the distribution is above 100 km, and also that meteors are detected in substantial numbers right up to 120 km.

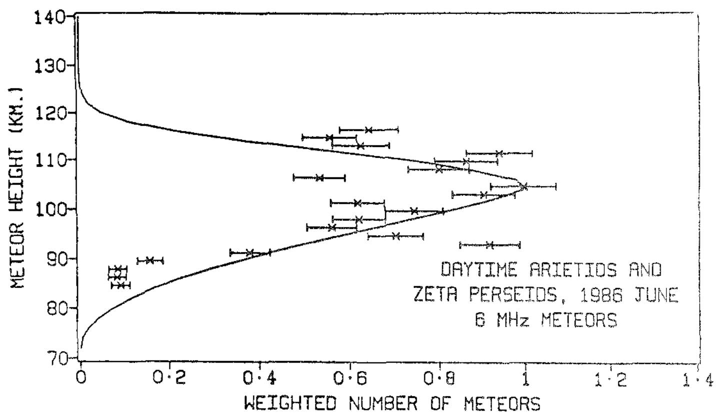


Figure 3 --- As for Figure 1 except for Daytime Arietids and ζ-Perseid meteors. Erroneous points at 93 and 112 km are again due to sporadic-E echoes. The solid curve is again the result of a theoretical model and is *not* an experimental fit to the data: the fact that the model tends to follow the data shows that the model is realistic.

Figure 3 is the 6 MHz height distribution for the combined daytime Arietid and ζ-Perseid showers, which cannot be separated with this equipment. The solid line is again a theoretical model, which shows a reasonable fit to the data. As in Figure 2, sporadic-E pollutes the meteor data at 93 and 112 km. The two showers contributing to Figure 3 have velocities of about 27 and 37 km/s, whilst the η-Aquarids (see Figure 2) have a velocity of about 65 km/s. Although the intrinsic heights of meteors are expected to go upwards with increasing velocity, in fact it turns out that for HF equipment such as this the height distributions should not change appreciably with velocity since other effects predominate. Thus, there are no gross differences between the plots in Figures 2 and 3. As in Figure 1, it appears that the simple theoretical model used to predict the response of the radar gives reasonably good agreement with the observations.

Unlike the 6 MHz radar, at 2 MHz, observations can only be made at night since in the daytime there is too much E-region ionization to allow meteor echoes to be picked out from the other types of echoes; in fact 2 MHz data can only be collected between about 3 and 7 am local time, since it takes several hours after sunset until the amount of ionization has died away to an acceptable level. As mentioned above, much the same set of equipment is used at 2 MHz and at 6 MHz, except that instead of using the full 1 km filled circle of dipoles, now just a few rows of antennas are used so as to make up an inferometer.

The height of each meteor can then be calculated from range and zenit angle determinations, but only to a precision of about 7 km; nevertheless the overall height distribution is statistically useful. Full details of the techniques used here, and the many and various headaches, are given in reference (8).

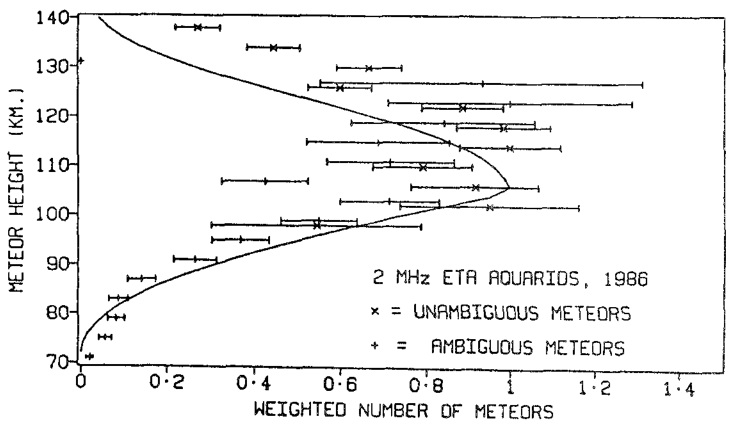


Figure 4 --- The height distribution of meteors observed with a 2 MHz radar. The limiting radio magnitude is +7. For the meaning of the terms "unambiguous meteors" and "ambiguous" meteors, see the text. Individual meteor height precision is about 7 km. The model (solid line) is a reasonable fit to the observational data, except that above 110 km the data overlies the model: thus there seem to be even more high-altitude meteors than this model (which assumes equal numbers of meteors ablating at all altitudes from 105 to 140 km) predicts. It would appear that the "real" peak in the meteor height distribution is even above that shown in this figure, and may be near 120 km.

The 2 MHz height distribution shown in Figure 4 is clearly radically different to the 54 MHz data in Figure 1. The peak now occurs at about 110 km, with many meteors being detected up to 140 km. At high altitude the data overlies the model, which was based upon an assumption of an equal number of meteors at all heights above 105km: thus in fact the number of meteors continues to rise above the peak, but even at such a low frequency they cannot be detected since the trains decay so swiftly. To repeat the comment made above in connection with the 6 MHz data, even though the velocity of the η-Aquarid shower is much higher than most other meteors, the simple model used here indicates that an HF radar such as this should demonstrate a height distribution which does not vary appreciably with velocity; thus the 2 MHz height distribution found from observations of lower velocity showers (6,7) does not appear different to that in Figure 4. It should be understood that this is *not* due to the physics of the ablation process, from which one would expect more high altitude meteors from a high-velocity shower, but rather it is due to the height-dependent factors which grossly effect the amplitude of the radar echo received.

3. Discussion

What are the implications of these new observations? Firstly, one should note that the prime motivation behind these experiments was to investigate the anomaly which exists in the flux versus mass curve of interplanetary solid particles; for example, see references (4,7). Briefly, it has been found in the past that optical meteor data, giving information on the influx of masses above about 10^{-2} g, and satellite impact and lunar exposure data, rendering the flux of particles at masses below about 10^{-6} g, do not agree with the flux derived from VHF meteor radars for the mass range between these limits. This has most often been explained as being due to the fact that the amount of ionization produced by a meteoroid is a strong function of its velocity (about $V^{3.5}$), and thus if most meteors were of low velocity, then many would remain undetected. Contrary to this we have suggested that in fact the vast majority of meteors ablate at heights above the echo-ceiling of VHF-radars, and have therefore not been detectable until now (6,7). It turns out that our height distributions tend to confirm this, and confirmatory measurements using the powerful Jindalee over-the-horizon radar in central Australia have proven this to be true, with the actual radar meteor influx (masses 10^{-6} to 10^{-2} g) being about 30 times higher than previously thought, and in line with the flux expected from satellite data (8) The total radar meteor influx is thus found to be about 12 000 tons per year, and it dominates the total mass influx to the Earth (masses 10^{-13} g to 1 ton) which comes out to be 16 000 tons per year (8); it dominates the influx, that is, unless one includes also the infrequent but massive asteroidal and cometary impacts upon our planet (9)!

Such an increase in the meteoroid influx at 1 AU from the Sun has a number of other implications. Even with the previous value for the flux of small meteoroids there were difficulties in explaining their rate of supply from comets, in view of the fact that we know their lifetimes to be only of the order of 10^4 to 10^5 years (6); if there are in fact 30 times more small meteoroids then the disagreement becomes severe. In the other direction, we know that the lifetime mentioned above for meteoroids is due to the fact that they collide at high velocities with the smaller zodiacal dust particles, and therefore are shattered into smaller grains which themselves replenish the zodiacal cloud (the zodiacal light is caused largely by the scattering of sunlight by particles of diameters between 10 and 100 μm). However, it is known that the present theoretically calculated supply of dust caused by the breakup of meteoroids is about 9 times higher than is needed to maintain the zodiacal cloud in its present state (10); thus it very much appears that at present we have in the solar system a much larger number of meteoroids than is the long-term average. One possible explanation is that quite recently (i.e. less than 10^5 years ago) there was a sudden increase in the number of comets which have since decayed away physically so that they are no longer observed.

However, in this decay they would have produced a very large population of meteoroids, which would now themselves be decaying away so as to bolster the zodiacal dust cloud. A full discussion of this is beyond what is intended here, but it is tempting to suggest that these astronomical events may have been responsible for the last ice ages: the very large influx of meteoric material to the Earth's atmosphere predicted in this scenario would have greatly affected the chemistry of the atmosphere, and hence the climate.

4. Is this all entirely crazy?

Many researchers will think that the results and deductions presented here are entirely crazy, despite the fact that it is clear that there must be a large undetected flux of meteoroids in the radar meteor mass range (4), and also the cause of their non-detection was clearly demonstrated over a quarter of a century ago (2). It is also worthwhile to point out that the radar equipment used here is much more sophisticated than that used in many other countries: most meteor radars have simply used a continuous film of an oscilloscope display for recording meteor echoes, which when compared to synchronous coherent averaging of complex echo signals with dedicated microprocessors and analysis in real time with a minicomputer is much the same as comparing the view of a galaxy through a small refractor with the image obtained using sophisticated solid-state detectors behind a large Earth-orbiting telescope. Obviously the cruder devices will not be able to discriminate many of the features of the meteoritic influx.

However, there are other meteor observations which support the results gained with the Adelaide radars. Just to mention a few, the flux of very faint optical meteors obtained using a very large telescope is not inconsistent with the high meteoroidal influx described here (11); also, in the optical regime, the heights of meteors as observed with a sensitive television system are observed to rise as fainter magnitudes are reached, indicating that for meteor radars with low limiting magnitudes an even higher proportion of the flux remains undetected due to the echo-ceiling effect (12). Forward-scatter experiments made in Canada with a VHF radar have also demonstrated a peak in the height distribution well above 100 km (12); as mentioned in section 1, forward-scatter techniques can overcome some of the problems associated with the echo-ceiling of back-scatter set-ups.

Another type of radar observation of meteors which has been made is of the motion of the meteoroid itself away from a shower radiant and towards the observer, using a powerful UHF radar (frequency 440 MHz); the echoes are again from rather higher than usually found with VHF meteor radars (13). Head-echoes observed by the Ottawa meteor radar also occurred at higher altitude than the normal meteor "body-echoes" (14): head-echoes are not susceptible to the echo-ceiling effect.

It is not only problems of meteor astronomy and physics that these results have a bearing upon: there are also various phenomena in atmospheric physics and chemistry which may be wholly or partially understood with the aid of this new insight into the ablation heights of meteors. A few may be mentioned here: for references to many papers describing current research in these areas, see (6). Firstly, it has for some years been a problem that spacecraft observations show the presence of metallic ions in the atmosphere at heights between 140 and 150 km and above. Now, the original source of these metallic species must surely have been from incoming meteoroids; but if the ions are observed above 140 km, whereas the meteoric deposition occurs almost entirely below 100 km, then one must explain how the metals were transported upwards throught at least 40 to 50 km. This has proved, at least so far, to be an insoluble problem. However, the discovery that there is meteor ablation *occurring* at 140 km, so that the metallic ions are deposited there directly, provides an instant solution to the problem.

Secondly, at the same high altitudes it is known that our atmosphere "superrotates": that is, it rotates faster than does the solid Earth below, so that at these heights the atmosphere spins in less than 24 hours. This again has long been a problem, and several times it has been suggested that the origin of the superrotation might be the meteoroidal influx (4). The meteoroids would provide spin angular momentum to the Earth since they are in eccentric orbits and therefore possess more orbital momentum than does an object in a circular orbit. Again, though, the problems with this idea has been that it was believed that the meteors ablate at much lower altitude than the region of superrotation, a belief which the results presented in Figures 1 to 4 show to be incorrect.

Another aeronomical problem which has required an explanation for some time is the layer of sodium atoms which is observed, through its characteristic yellow glow, to exist close to an altitude of 100 km. There has been great difficulties in explaining the amount of sodium present in this layer, based upon our knowledge of the incoming mass of meteoric material and the fraction of this which is sodium: in fact it has even been suggested that the sodium is supplied by upwelling from the salt (sodium chloride) in the oceans! However, if in fact the mass influx of small meteoroids is higher by a factor of thirty, as has been suggested here, then the problem of the sodium layer is solved.

The aim of this section has been to indicate briefly that the observations obtained using the Adelaide radar are:

- understandable on the basis of what we know of the limitations of VHF radars for meteor observations;
- in agreement with the results of other forms of meteor observation; and
- of importance in solving various other long-standing problems of atmospheric physics and chemistry.

I do not expect to be able to convince everyone immediately. Bertrand Russell once said something along the lines of it being *the most poorly-founded views which are the most strongly held.*

Acknowledgments

Funding for this project which has been described herein was provided by the Australian Research Grants Scheme, which effectively means the Australian people.

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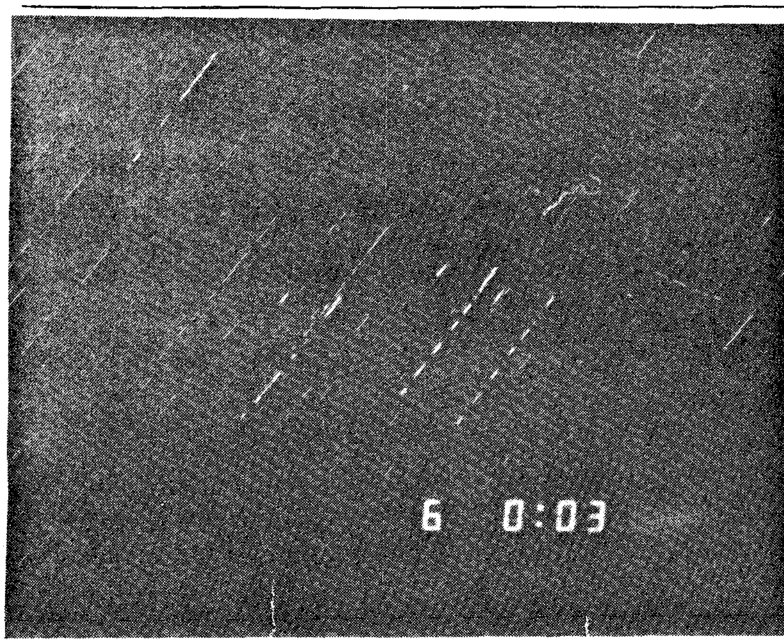

This photograph of a Perseid was taken on August 6th, 1987, 00h03 by Klaas Jobse of the 'Cyclops Oostkapelle' team. The picture was made with a 50mm f/2.8 objective on T-Max. The film was developped in D-19 for 4 minutes at 21°C.

People having meteor photographs with good contrast, are hereby invited to send a print to WGN for publication. If your picture is really spectacular, it might even be printed on the front cover!

The Perseids 1987

So far we received only a few 1987 Perseid reports. The observations were of course severly hampered by moonlight, and bad weather conditions thoroughly spoiled what possibilities were left by the Moon. Anyway, we hope the articles below will give you some idea of the Perseid activity in 1987.

The Perseids 1987 in the Soviet-Union

A. Grishchenyuk, A. Levina and V. Martynenko

The results of Soviet observations of the 1987 Perseids are given. These observations were hampered by bad weather and full moon. A remarkably high activity was seen on the night of August 14-15, 1987.

During the night of the Perseid maximum we had full moon, haze and an almost entirely covered sky in the main stations between the Far East and the Crimea. Conditions were especially bad in the night of August 12-13, so we can only indirectly judge the maximum shower activity. From August 11-13, the weather turned out to be reasonable and Perseids were observed in Simferopol, Sudak, Kirov. The next night observers were able to work in the settlements of Dal' negorsky (Far East), Novotroitsk (Donetsk region, Ukraine) and Solnechnaya Dolina (Sun Valley, Crimea). On August 14-15,Perseids were seen in Novotroitsk, Solnechnaya Dolina, Sudak and Simferopol.

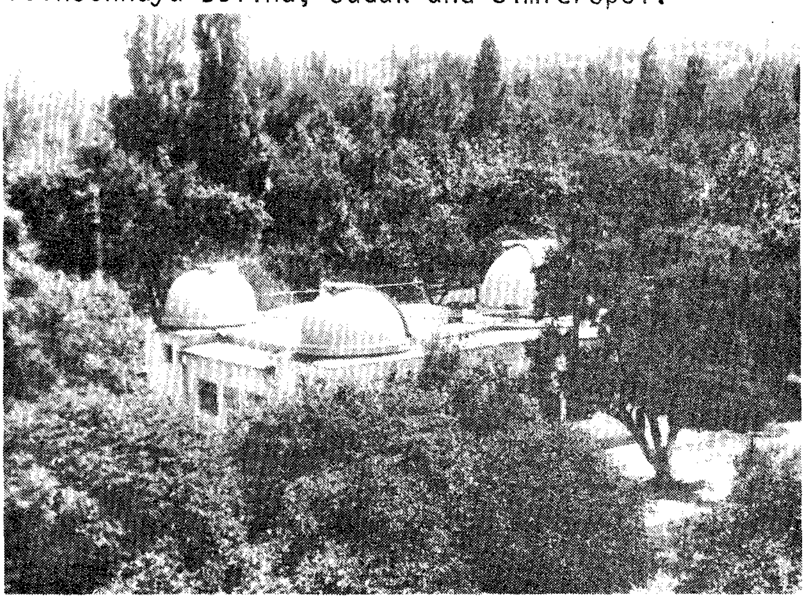

Figure --- Union Astronomical Observatory at Simferopol, Crimea.

In the night of August 11-12, we watched some shower activity in spite of the haze and full moon. According to observations made in Kirov (instructor M. Gorshechnikov) and in the Crimea, relative activity reached 71-77%. In Simferopol, where the limiting magnitude equalled 4.0 to 4.5, 50 Perseids were counted, 19 of which were of magnitude +1 or brighter. These meteors were seen by V. Martynenko, I. Krouzman et al. In Sudak, with limiting magnitudes between 4.5 and 5.5, 100 Perseids were counted, 20 of which were brighter than +1. This slightly exceeded the level of 1986.

On August 12-13, A. Maidik and N. Fedkiv counted 31 Perseids of magnitudes +3 to -2 in Novotroitsk, in between clouds that eventually covered the entire sky. In Kirov, 21 Perseids represented 91% of the total number of meteors that were counted. In Solechnaya Dolina, A. Levina, A. Grishchenyuk, O. Bubnovskaya, E. Shortova, D. Shortov and D. Kalaida also identified 91% of the 59 meteors they saw as Perseids. Here, in between the clouds (where limiting magnitudes reached values ranging from 3.5 to 5.7) 17 Perseids of magnitude +1 or brighter appeared, which is more than two to three times the number reached on August 11-12.
On August 13-14, N.Knyazyuk et al. observed in relatively good conditions. During 6.83 hours, they noticed 78 Perseids, 40 of which were brighter than magnitude +1. In Simferopol, A. Chimak counted 25 Perseids by moonlight, 9 of which were bright. This proves the high activity of the shower.

The night of August 14-15 turned out to be very surprising. During some periods before moonrise, the limiting magnitude exceeded 6.0; towards the morning, it decreased to 4.0. The Perseid hunt that night brought great satisfaction to many observers. From 270 meteors noted in Solnechnaya Dolina for 6.37 hours, 55% were Perseids. 30 of these were brighter than magnitude +1, though no Perseids brighter than -1 were seen. Shower meteors appeared unevenly, grouping in pairs, triplets and "stretched clouds".

From 19^h to 01^h UT, the relative activity of the Perseids suddenly increased from 39 to 95%! Cautious estimates show that August 11-12 ZHRs ranged from 60 to 100. In the night of August 14-15, 1987, from 19^h40^m to 01^h40^m UT, ZHRs changed as follows: 40, 48, 38, 52, 105, 110, 72. We got the impression that we were observing the maximum!

The Perseids 1987 in the DDR

Jürgen Rendtel, translated from MM des AKM Nr. 85

The results of DDR observations of the 1987 Perseids are given. These observations were hampered by bad weather and full moon.

The astronomical predictions were very unfavorable for this shower in 1987. The poor weather did not help the observing possibilities, and the number of clear nights remained far beyond the average number. The length of Table 1 with the observational results is due to the efforts of many individual observers who worked in July and August. Ina and Jürgen Rendtel were able to obtain a long sequence of July observations in Czechoslovakia (near Kosice). Both traditional observing camps (Lausche and Schmergow) yielded of course less meteors than in previous years. The nights at the end of August were interesting, when the Perseids had passed. The maximum activity of the Perseids 1987 reached the usual level and can be called a normal return. The observations from other groups confirm this. The following table gives the observational data, as well as individual ZHRs and HRs.

Table 1 --- Observational data and hourly rates for the Perseids in 1987, as seen by GDR observers.

Date	Period (UT)	T_{eff}	Lm	F	Per	ZHR	Spor	HR
Jul 18-19	20^h42^m-22^h47^m	1.85	6.37	1.00	3	3.5	18	11
18-19	20 42 -22 47	1.85	6.54	1.00	2	2.0	25	13
19-20	20 05 -22 45	2.46	6.39	1.00	6	5.6	20	9.2
19-20	20 05 -22 45	2.46	6.59	1.00	2	1.5	33	12
20-21	20 10 -23 35	2.35	6.17	1.00	5	5.4	21	13
20-21	20 10 -23 35	2.35	6.35	1.00	2	1.8	31	15
21-22	21 05 -00 10	2.68	6.47	1.00	6	3.7	33	13
21-22	21 05 -00 10	2.59	6.79	1.00	12	5.7	46	13
21-22	21 42 -23 47	1.92	6.69	1.00	3	2.1	15	6.2
22-23	20 15 -22 30	1.34	6.22	1.00	4	4.7	17	12
22-23	21 25 -22 30	0.65	6.18	1.00	3	7.2	7	10
23-24	22 27 -00 44	1.95	6.61	1.00	1	0.7	22	9.6
24-25	20 28 -21 32	0.97	6.30	1.00	4	5.3	16	10
25-26	20 45 -01 20	4.12	6.42	1.00	6	2.4	96	25
25-26	22 37 -00 41	1.78	6.64	1.00	7	4.8	35	17
25-26	21 37 -01 15	2.85	7.31	1.00	14	3.3	90	12

Table 1 (continued)

Date	Period (UT)	T_{eff}	Lm	F	Per	ZHR	Spor	HR
Jul 30-31	19^h47^m-20^h50^m	0.58	6.15	1.00	4	24	7	18
30-31	19 47 -21 50	1.85	6.28	1.00	11	16	15	10
30-31	21 50 -23 50	1.72	6.22	1.00	14	16	17	14
30-31	23 50 -00 52	0.95	6.32	1.00	3	4.6	13	17
Aug 02-03	21 15 -23 10	1.66	6.43	1.00	7	7.6	19	12
02-03	22 52 -00 52	1.82	6.50	1.00	13	9.6	22	12
02-03	23 10 -01 00	1.64	6.34	1.00	11	10	17	13
Aug 04-05	21 22 -23 15	1.82	6.42	1.00	16	15	35	21
04-05	21 22 -00 55	3.48	6.29	1.00	20	10	34	13
04-05	22 35 -23 45	1.04	7.20	1.00	8	5.7	31	13
04-05	21 41 -00 41	2.73	6.44	1.03	20	11	32	13
04-05	22 43 -23 44	0.92	6.45	1.00	5	9	15	12
Aug 05-06	22 59 -00 39	1.11	6.28	1.38	6	12	12	19
Aug 06-07	23 20 -00 20	0.96	6.34	1.00	9	14	12	15
06-07	00 20 -01 20	0.96	6.33	1.00	6	8.5	10	13
06-07	00 18 -01 33	1.08	6.22	1.00	8	12	14	18
06-07	00 53 -01 53	0.96	6.30	1.00	7	10	12	16
Aug 08-09	21 20 -22 55	1.58	4.6	1.00	2	14	2	13
Aug 11-12	20 10 -21 10	0.99	5.90	1.58	4	22	4	14
11-12	20 38 -21 16	0.63	5.2	1.00	1	8	3	23
11-12	22 00 -23 12	0.61	5.55	1.00	6	36	1	5
11-12	22 00 -23 12	0.82	5.41	1.00	6	21	1	3
11-12	22 00 -23 12	1.07	5.52	1.00	9	32	3	9
11-12	22 09 -23 09	0.99	5.91	1.00	9	24	6	12
11-12	21 20 -00 15	2.92	5.67	1.00	9	10	26	27
11-12	20 54 -01 00	4.00	5.20	1.00	25	30	34	41
11-12	20 46 -01 05	4.30	5.28	1.00	22	23	30	31
11-12	21 15 -01 00	2.30	5.00	1.00	8	22	13	38
11-12	00 27 -01 08	0.63	6.56	1.34	7	17	5	10
Aug 12-13	22 12 -23 02	1.00	4.1	-	2	-	3	-
12-13	22 12 -23 02	1.00	4.1	-	2	-	0	-
Aug 15-16	20 33 -23 16	0.89	6.31	1.05	11	23	8	12
15-16	22 21 -23 53	1.23	6.26	1.04	5	10	13	18
15-16	20 33 -23 53	1.46	6.18	1.68	13	30	21	36
15-16	22 50 -23 32	0.69	6.08	1.24	2	8	11	33
15-16	22 23 -23 53	0.93	5.90	1.60	7	40	6	27
15-16	20 36 -23 53	1.19	6.20	1.30	11	26	10	18
Aug 17-18	20 27 -21 59	1.27	5.73	1.00	3	8.6	12	24
17-18	22 05 -23 15	1.17	6.02	1.05	3	5.9	9	14
17-18	23 00 -23 40	0.50	5.78	1.00	0	0	7	34
17-18	22 05 -23 55	1.63	5.90	1.00	5	8.0	20	26
17-18	22 05 -00 45	2.07	5.34	1.10	1	2.5	11	25
17-18	22 20 -00 30	1.67	5.19	1.10	2	11	3	17
17-18	22 05 -00 47	1.95	5.55	1.10	2	4.2	6	11
17-18	22 05 -00 48	1.95	5.23	1.05	9	25	34	86
17-18	22 05 -00 48	1.80	5.70	1.10	1	2.0	41	68
17-18	22 05 -00 48	2.25	5.76	1.00	10	14	29	33
17-18	22 05 -00 48	2.25	5.74	1.05	10	14	27	32
17-18	22 05 -00 50	2.02	5.78	1.10	6	9.3	17	21
Aug 19-20	20 44 -23 12	2.23	6.28	1.00	3	2.8	40	23

Table 1 (continued)

Date	Period (UT)	T_{eff}	Lm	F	Per	ZHR	Spor	HR
Aug 20-21	19^h45^m-22^h00^m	2.18	6.60	1.00	11	8.5	34	14
20-21	19 45 -22 00	2.18	6.51	1.00	4	3.4	31	14
20-21	19 41 -22 00	2.06	6.23	1.00	6	7.4	27	18
20-21	19 45 -22 00	1.51	5.88	1.00	0	0	17	24
20-21	19 52 -22 00	1.91	6.33	1.00	3	3.4	26	16
20-21	20 00 -22 50	2.48	5.36	1.00	3	4.9	22	36
20-21	21 05 -23 32	2.01	6.40	1.00	7	5.2	42	23
20-21	21 10 -22 20	1.00	6.50	1.00	5	7.1	27	27
20-21	21 10 -23 23	1.79	6.62	1.00	8	5.5	37	19
20-21	21 05 -22 18	0.91	6.36	1.00	1	1.8	19	15
20-21	21 07 -23 31	2.35	6.20	1.00	3	2.7	35	21
20-21	21 07 -23 31	2.40	6.05	1.00	1	1.0	10	17
20-21	22 00 -00 00	1.92	6.69	1.00	8	4.9	44	19
20-21	22 00 -00 00	1.88	6.56	1.00	8	5.8	37	19
20-21	22 00 -00 00	1.28	6.32	1.00	2	2.8	19	21
20-21	22 00 -00 00	1.32	5.88	1.00	5	11	13	21
20-21	22 43 -00 00	1.12	7.13	1.00	8	5.0	24	9
20-21	22 13 -01 30	2.66	6.23	1.00	10	6.7	33	17
20-21	22 55 -02 00	2.77	5.48	1.00	1	1.0	22	28
20-21	00 00 -01 00	0.87	7.04	1.00	10	7.9	23	14
20-21	00 00 -02 30	2.00	6.45	1.00	8	4.9	38	21
20-21	00 00 -02 30	2.15	6.43	1.00	14	8.2	33	20
20-21	00 00 -02 00	1.43	6.11	1.00	4	5.0	22	25
20-21	00 00 -02 00	1.48	5.50	1.00	7	17	10	23
20-21	01 00 -02 05	0.92	6.96	1.00	3	2.3	26	16
Aug 21-22	20 00 -22 00	1.84	5.49	1.00	1	2.2	16	30
21-22	20 00 -22 30	2.30	6.19	1.00	3	3.3	25	16
21-22	20 00 -22 30	2.00	6.05	1.00	3	4.4	12	10
21-22	20 00 -22 30	2.13	6.09	1.00	3	4.0	15	12
21-22	20 00 -22 30	1.78	6.03	1.00	3	5.1	15	15
21-22	22 35 -23 37	1.00	5.72	1.00	2	6.6	14	36
21-22	22 30 -01 00	2.25	6.32	1.00	9	6.6	31	19
21-22	22 30 -01 00	2.15	6.22	1.00	3	2.6	24	16
21-22	22 30 -01 00	2.33	6.19	1.00	3	2.4	23	21
21-22	22 30 -01 00	1.20	6.19	1.00	1	1.6	9	11
Aug 22-23	19 45 -22 00	2.21	6.59	1.00	6	4.5	43	19
22-23	19 45 -22 00	1.67	6.35	1.00	6	7.8	22	17
22-23	19 45 -22 00	2.12	6.41	1.00	1	1.0	44	25
22-23	19 45 -22 00	2.05	5.95	1.00	2	3.3	29	31
22-23	19 45 -22 00	1.98	5.85	1.00	7	13	16	18
22-23	19 50 -22 00	1.90	6.98	1.00	3	1.8	57	17
22-23	19 55 -22 00	2.00	6.04	1.00	2	2.7	33	29
22-23	19 50 -00 00	3.79	5.43	1.00	2	1.0	63	61?
22-23	22 00 -00 00	1.80	6.68	1.00	3	5.2	47	21
22-23	22 00 -00 00	1.64	6.34	1.00	6	6.3	32	24
22-23	22 00 -00 00	1.94	6.43	1.00	5	4.0	33	18
22-23	22 00 -00 00	1.64	6.15	1.00	8	10	15	14
22-23	22 00 -00 00	1.80	5.90	1.00	2	3.1	16	19
22-23	22 00 -00 00	1.70	6.90	1.00	4	3.2	60	22
22-23	23 30 -00 00	0.50	6.25	1.00	1	3.8	9	24
22-23	00 00 -02 30	2.40	6.55	1.00	9	4.1	54	21
22-23	00 00 -02 30	2.25	6.35	1.00	3	4.9	32	17
22-23	00 00 -02 30	2.13	6.35	1.00	3	1.9	36	20

Table 1 (continued)

Date	Period (UT)	T_{eff}	Lm	F	Per	ZHR	Spor	HR
Aug 22-23	00^h00^m-02^h20^m	2.20	6.15	1.00	7	5.4	19	13
22-23	00 00 -02 30	2.25	5.55	1.00	3	4.1	18	27
22-23	00 00 -02 15	2.08	6.21	1.00	4	3.1	37	25
22-23	00 10 -02 35	1.60	6.97	1.00	4	1.7	75	27
Aug 24-25	20 13 -00 14	3.44	6.20	1.00	0	0	41	17
24-25	20 13 -00 14	3.64	6.15	1.00	2	1.2	46	19
24-25	20 13 -00 14	3.26	6.08	1.00	0	0	36	19
24-25	20 13 -00 14	3.54	6.16	1.00	1	0.6	39	17

In Table 2, the averaged ZHR and HR values are given. Note that some observations got only a half-weight value in the average due to too bad limiting magnitudes or too short observing times. The r-value that was used, is also indicated.

Table 2 --- Averaged ZHR values for the Perseids 1987 , obtained by GDR observers, compared to the corresponding non-Perseid HR values.

Date	r	ZHR	HR	Date	r	ZHR	HR
Jul 18-19	2.6	3.0 ± 0.6	12 ± 0.7	Aug 05-06	2.6	12 ± 4.9	19 ± 2.8
19-20	2.6	3.6 2.1	11 1.4	06-07	2.6	11 2.1	16 1.8
20-21	2.6	3.6 1.8	14 1.8	08-09	2.6	14 9.9	13 9.2
21-22	2.6	3.8 1.5	12 2.7	11-12	2.5	22 7.4	18 12
22-23	2.6	5.5 1.2	11 1.0	15-16	2.8	23 11	24 8.7
23-24	2.6	0.7 0.7	9.6 2.1	17-18	2.9	8.5 6.1	31 20
24-25	2.6	5.3 2.7	10 2.5	19-20	2.9	2.8 1.6	23 3.6
25-26	2.6	3.5 1.0	18 5.3	20-21	3.0	5.2 2.8	19 4.7
30-31	2.6	14 6.5	14 3.1	21-22	3.0	3.8 1.6	17 6.7
Aug 02-03	2.6	9.1 1.0	12 0.5	22-23	3.0	4.4 2.8	21 4.7
04-05	2.6	10 3.0	14 3.3	24-25	3.0	0.5 0.3	18 1.0

The reported magnitude distributions of the Perseids 1987 were used to compute the population index r for several time intervals during the activity period. In order to have sufficient data for an analysis, the consecutive observations were taken together. It is surprising that in spite of the rather poor limiting magnute on August 11-12 (Moon), it has been possible to make a good computation, if one limits the magnitude range to +4. Usually, all +5 meteors are included for these computations. The observations of August 17-18 under rather poor conditions had to be eliminated (limiting magnitude about 5.9, 54 meteors yielded r = 3.4 with a very large spread on this value).

The following results were obtained:

Table 3 --- Population index for the 1987 Perseids

Date	Per	Range	r
Jul 18-23	43	0 - +5	2.32 ± 0.43
23-26	27	-2 - +5	2.05 0.53
30-34	56	-1 - +5	2.30 0.39
Aug 04-05	63	-1 - +5	2.43 0.37
05-07	30	0 - +5	2.27 0.50
11-12	102	-1 - +4	2.33 0.32
15-16	49	-2 - +5	2.08 0.41
20-21	116	-2 - +5	2.26 0.31
21-23	116	0 - +5	3.05 0.31

The population index obviously varies for a long period around 2.3 (nothing can be said about some intervals in 1987). Towards the end of the activity period, the population index is almost equal to that of the sporadic background. This is an indication that at this point the Earth leaves the meteoroid cloud, where smaller, perturbed particles are encountered, with a mass distribution similar to that of the sporadics.

The Perseids 1987 in Belgium

Glenn Ticket

The results of the Belgian Summer 1987 observations are given. These observations were hampered by bad weather and full moon.

This report contains the Belgian observations for July and August 1987. The observations were severely hampered by bad weather: in Belgium, the summer of 1987 was the worst one since long. The first two weeks of July were excellent, but few observations were made in that period since almost only sporadic activity is present and because of the moon (especially in the second week).

After these first two weeks, the weather changed and observations were only occasionally possible.

The following list contains the names of the people that were able to observe in that period. Between brackets you will find the observer's initials and total effective observing time.

Hendrik Vandenbruaene (HV, 9.93), Octaaf Steen (OS, 9.57), Ann Martaux (AM, 6.41), Ghislain Plesier (GP, 5.66), Piet Delagaye (PD, 4.47), Sabine Clement (SC, 4.17), Jan Vandebruaene (JV, 4.00), Patrick Laenen (PL, 3.91), Paul Smits (PS, 3.82), Didier Van Hellemont (DVH, 3.45), Frank Tamsin(FT, 3.43), Tom Vangierdeghom (TV, 3.43), Glenn Ticket (GT, 2.93), Cis Verbeeck (CV, 2.83), Paul Roggemans (PR, 2.83), Peter Van den Eijnde (PVDE, 2.45), Jeroen Van Wassenhove (JVW, 2.41), John Morel (JM, 1.92), Carl De Pooter (CD, 1.25), Bart Dhoedt (BD, 1.23), Bert Smits (BS, 1.17), Tom Segal (TS, 1.00), Filip Dierckx (FD, 0.87).

Some Belgian observers (Paul Roggemans, Christian Steyaert, Dirk Laurent and Glenn Ticket) went to the Haute-Provence to observe visually and photographically in the second half of July. Their observations are not included in this report; they will appear in a later issue.

Listed on the next page are the observational results. Apart from the Perseids, the numbers of Aquarids (A, δ- and ι-Aquarids), α-Capricornids (C) and κ-Cygnids (K) were also counted by many observers.

As one can see, there are sometimes large variations in the ZHR and HR for different observers in the same night. This is due to the influence of correction factors. Most observations were made in the period from August 2 to 16, when the Moon induced low limiting magnitudes (mostly from 5.0 to 5.5). This results in large correction factors (for the sporadics from 3 to 5.2 and for the Perseids from 2.5 to 4). Sometimes we needed an additional correction for cloudiness (especially on the night of the Perseid maximum). Most of the time the clouds restricted the observations to short periods. Only three observations lasted 3 hours or more and 7 observations lasted less than an hour. Because of these bad circumstances the HR and ZHR are often based on only a few meteors (there are but four observations with more than 10 sporadics and 7 with more than 10 Perseids). This makes the resulting HR and ZHR unreliable.

Table --- Belgian summer 1987 observations

Date	Obs	Period (UT)	T_{eff}	Lm	F	Per	ZHR	Showers	Spor	HR
Jul 02-03	GP	$22^h20^m-00^h20^m$	2.00	6.3	1.00	0	0		2	1.2
03-04	GT	00 30 -01 30	1.00	5.6	1.00	0	0		5	13.4
04-05	OS	23 23 -01 01	1.52	6.1	1.00	0	0		7	7.1
10-11	PR	21 50 -01 15	2.83	5.0	1.00	2	3.9	2A	6	11.0
25-26	GP	21 20 -02 20	3.66	6.7	1.00	11	3.8	7A,9C	20	4.4
25-26	OS	22 13 -00 55	2.40	6.1	1.00	2	1.7	1C	15	9.7
27-28	HV	21 18 -23 25	2.00	5.3	1.10	7	20.0	3A,3C	2	4.1
27-28	OS	22 56 -00 11	1.12	6.1	1.00	3	5.7	1A,1C	3	4.2
Aug 02-03	HV	21 20 -22 04	0.73	4.9	1.00	2	23.4	1A,2C	1	7.9
02-03	OS	22 56 -23 30	0.55	5.6	2.17	3	38.9		0	0
03-04	DVH	22 15 -01 19	2.45	5.4	1.27	6	12.2	1K	8	13.9
03-04	PVDE	22 15 -01 19	2.45	5.4	1.27	8	16.2	1A,1K	9	15.6
03-04	TS	22 15 -23 15	1.00	5.5	1.00	0	0		9	27
04-05	HV	21 20 -23 15	1.90	5.5	1.20	10	28.3	3A,1C	6	11.4
06-07	PL	21 00 -21 30	0.48	5.3	1.11	2	29.0		0	0
Aug 10-11	PD	20 47 -00 07	2.62	4.9	1.14	3	9.9		1	2.5
10-11	HV	21 00 -21 30	0.50	4.9	1.00	2	37.1		1	11.6
10-11	JV	21 00 -22 00	1.00	4.9	1.00	3	26.6		1	5.8
10-11	BD	22 15 -23 45	1.23	5.2	1.00	6	26.2		1	3.4
10-11	FT	22 15 -23 45	1.23	5.0	1.00	5	26.2		1	4.2
10-11	TV	22 15 -23 45	1.23	5.2	1.00	3	13.1		1	3.4
Aug 12-13	PD	21 23 -23 34	1.85	4.9	1.10	21	94.6		0	0
12-13	HV	21 30 -23 18	?	5.1	1.59	58	161.0	7A,2C	5	11.2
12-13	JV	21 30 -23 15	?	5.1	1.59	45	139.5	2C	1	2.5
12-13	JM	22 50 -00 45	1.92	5.1	1.41	31	120.8	1C	2	6.8
12-13	GT	22 52 -00 03	1.18	5.3	1.23	15	72.0		6	23.4
Aug 15-16	FT	20 45 -23 00	2.20	5.3	1.00	7	18.6		7	11.9
15-16	TV	20 45 -23 00	2.20	5.0	1.00	5	17.5		3	7.1
15-16	HV	21 00 -22 30	1.50	5.7	1.00	6	16.0	1K	1	1.6
15-16	PL	21 00 -23 03	2.00	5.8	1.11	7	14.0	1A,2C,1K	5	6.0
15-16	OS	21 08 -00 03	2.73	6.0	1.00	8	7.9		9	5.7
15-16	JVW	21 25 -00 17	2.41	5.2	1.05	2	4.8	4K	8	14.5
15-16	AM	21 36 -23 00	1.40	5.5	1.00	1	3.2		2	4.3
15-16	PS	21 36 -23 00	1.40	5.2	1.00	4	15.3		4	10.7
15-16	CV	21 36 -23 00	1.40	5.3	1.00	3	10.5	1C	2	4.8
Aug 16-17	PL	21 30 -23 00	1.43	6.1	1.11	4	7.9	1C,2K	12	14.4
16-17	OS	21 40 -23 00	1.25	5.6	1.00	2	6.7		3	6.5
16-17	AM	21 45 -23 00	1.25	5.5	1.00	0	0		3	6.5
16-17	PS	21 45 -23 00	1.25	5.4	1.00	3	10.7		4	9.6
16-17	CD	21 45 -23 00	1.25	5.3	1.00	1	3.9		5	13.4
16-17	SC	21 47 -22 34	0.78	5.5	1.00	3	17.5		7	26.3
16-17	DVH	21 47 -22 47	1.00	5.5	1.00	2	9.2	1A	3	9.0
Aug 20-21	AM	21 35 -22 45	1.17	6.0	1.00	1	1.6		4	5.9
20-21	PS	21 35 -22 45	1.17	6.0	1.00	1	1.6	3A,2C	5	7.4
20-21	BS	21 35 -22 45	1.17	6.0	1.00	3	4.4	3A,2C	6	8.0
23-24	SC	21 00 -02 00	2.37	5.4	1.04	2	3.7	1A	10	14.7
23-24	CV	22 36 -02 00	1.43	5.5	1.06	0	0		5	11.5
26-27	SC	01 50 -03 20	1.02	6.0	1.05	1	1.8		6	10.7
26-27	FD	01 50 -03 06	0.87	6.1	1.05	1	2.0	1A	3	5.6
29-30	AM	21 25 -23 00	1.36	5.7	1.00	0	0		1	1.6
30-31	AM	21 00 -22 15	1.23	6.0	1.00	0	0		9	12.5
31-32	GT	20 51 -21 36	0.75	5.6	0.75	0	0		4	16.9

The Perseids 1987 in Florida

Wanda Simmons

The results of observations of the 1987 Perseids from Florida, USA, are given. These observations were hampered by bad weather and full moon.

This year's Perseid stream appeared normal a week before maximum. On the night of August 04-05, Wanda and Karl Simmons and Richard Sweetsir had Perseid counts of 2 to 12 per hour and ZHRs between 7 and 17. The highest observed rate was 12 Perseids seen between 03^h26^m and 04^h27^m am EDT[1] by Wanda Simmons.

Rates were similar three mornings later when 3, 6 and 9 Perseids were seen in 41 minutes by Karl, Stephen and Wendy Simmons between 05^h14^m and 05^h55^m am EDT. Shower meteors were identified by having each child trace the meteor path in the sky with their hands. This was the last morning to observe without severe moonlight interference. The Moon set around 5 am and twilight began to interfere half an hour later.

Observations around the time of Perseid maximum had been planned despite the full moon but it was mostly cloudy.

After maximum, rates were about the same as earlier in the month, never getting above 4 Perseids per hour on the mornings of August 16 and 17 as seen by the Simmons family. Later on the morning of August 16, Walter Tyre reports two Perseids were seen (02^h37^m and 03^h08^m am EDT) just looking at the sky occasionally from South Ponte Vedra Beach, Florida.

The highlight of these eight nights of observing were not the meteors seen but a "Draco Flasher". On the morning of August 17, Wanda Simmons saw a second magnitude flash lasting half a second at 00^h22^m am EDT. A second flash was seen about one minute later about 2° south and having the same magnitude and duration. Both flashes were stationary. The first flash occurred 5° east of the four stars forming the head of Draco. Alerted by the first event, Karl Simmons saw the second flash, but thought it moved slightly north instead of being stationary. No other flashes were seen, and it is reasonable to assume a tumbling satellite was see.

Only a half hour of simultaneous naked eye and telescopic meteor observing was attempted. From 01^h04^m to 01^h34^m am EDT on August 15-16, Karl Simmons saw 1 Perseid in 7 x 50 binoculars and Wanda Simmons saw 2 sporadics with unaided eye.

The following persons took part in the observations:

> Brian Simmons (BS, age 4), Karl Simmons (KS), Stephen Simmons (SS, age 5), Wanda Simmons (WLS), Wendy Simmons (WS, age 8), Richard Sweetsir (RS).

All observations were conducted from Callahan Florida. In the table below, the following abbreviations are used: C = α-Capricornids, A = δ-Aquarids, Y = υ-Pegasids, K = κ-Cygnids. "ZLm" refers to the faintest star at zenith.

In the table, which starts on the following page, all times are converted from EDT to UT.

Also, note that the limiting star magnitude at zenith was only estimated to a quarter of a magnitude.

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[1]EDT (Eastern Daylight Saving Time) is Four hours earlier than Greenwich time. Hence UT = EDT + 4^h. (editor)

Table --- Florida observations of the Perseids 1987

Date	Obs	Period (UT)	T_{eff}	ZLm	Per	ZHR	Showers	Spor
Aug 01-02	BS	03^h30^m-03^h45^m	0.25	5.5	1		1C	0
01-02	SS	03 30 -03 45	0.25	5.5	1		1C	0
Aug 02-03	SS	04 33 -05 18	0.75	5.5	1			0
02-03	WS	04 33 -04 57	0.40	5.5	1			2
02-03	KS	04 33 -05 18	0.75	5.5	1		1C	1
Aug 03-04	KS	04 47 -05 47	1.00	5.75	5			5
03-04	BS	04 47 -05 47	1.00	5.75	2			6
03-04	SS	04 47 -05 47	1.00	5.75	4			2
03-04	WS	04 47 -05 47	1.00	5.75	1			10
Aug 04-05	RS	04 55 -05 25	0.50	4.5	3			0
04-05	WLS	04 56 -05 26	0.50	5.0	0			0
04-05	SS	04 56 -05 36	0.67	5.0	0			0
04-05	WS	04 56 -05 56	1.00	5.0	1			1
04-05	KS	04 56 -05 26	0.50	5.0	0			1
04-05	RS	05 25 -06 25	1.00	6.0	5	10	4A	3
04-05	WLS	05 26 -06 26	1.00	6.0	2	5	3A,1Y	3
04-05	KS	05 26 -06 26	1.00	6.0	3	7	3A,1Y	2
04-05	WS	05 56 -06 20	0.35	6.0	0		2A,1Y	2
04-05	RS	06 25 -07 25	1.00	6.0	5	9	3A	22
04-05	WLS	06 26 -07 26	1.00	6.0	6	11	2A,2C	4
04-05	KS	06 26 -07 26	1.00	6.0	6	11	2A,1C,1Y	4
04-05	RS	07 25 -08 25	1.00	6.0	8	12	3A,1C	6
04-05	WLS	07 26 -08 27	1.02	6.0	12	17	3A,1C	5
04-05	KS	07 26 -08 27	1.02	6.0	6	9	3A	5
Aug 07-08	KS	09 14 -09 55	0.68	5.75	3			1
07-08	SS	09 14 -09 55	0.68	5.75	6			0
07-08	WS	09 14 -09 55	0.68	5.75	9			5
Aug 15-16	WS	04 01 -04 45	0.73	7.0	2			8
15-16	WLS	04 01 -05 01	1.00	6.5	2	4	1K	8
15-16	KS	04 01 -05 04	1.05	7.0	4	7	1A	5
15-16	BS	04 01 -04 21	0.33	7.0	0			2
15-16	SS	04 01 -05 01	1.00	7.0	0			2
15-16	WLS	05 01 -05 41	0.67	6.5	1	3		2
Aug 16-17	WLS	03 56 -04 56	1.00	7.0	3	7		11
16-17	KS	03 56 -04 56	1.00	7.0	3	7		5
16-17	BS	03 56 -04 26	0.50	7.0	1			4
16-17	SS	03 56 -04 26	0.50	7.0	1			1
16-17	WLS	04 56 -05 34	0.63	7.0	1		1K	6
16-17	KS	04 56 -05 26	0.50	7.0	2		1A	5
Aug 17-18	KS	01 01 -01 31	0.50	6.5	0			2
17-18	BS	01 01 -01 24	0.38	6.5	0			2
17-18	SS	01 01 -01 31	0.50	6.5	0			1
17-18	WS	01 01 -01 31	0.50	6.5	0			4

Erratum

In the 16-1, February 1988-issue of WGN a mistake has been made in the list of supporting subscribers. Instead of Werner Massubich, *it should be* Werner Hasubick.

The Quadrantids 1987

In the following articles you will get an idea of the Quadrantid activity in 1987. The observations come from Southern France and Denmark.

The Quadrantids 1987 in Southern France

Bernhard Koch

The results of the observations of the Astronomische Arbeitsgruppe Ulm of the Quadrantids 1987 obtained in Southern France are presented.

The youth group of the *Astronomische Arbeitsgruppe Ulm* undertook an observation expedition to the Provence at the time of the Quadrantid maximum (from 31/12 to 5/1). The reason for this expedition was to escape from the guaranteed bad weather in our home region during this season. The four participants of this expedition were: Bernhard Koch (BK), Stefan Ströbele (SS), Mario Lucic (MC) and myself (MN). We were able to cover practically the whole period of this stream.

The aim of the expedition was to catch the Quadrantids not only visually, but also telescopically. This part of our meteor work could not be started until the morning of January 3rd, because in the previous nights our watches were disturbed by clouds. Since I observed telescopically in the morning of the 3rd and during the night of the 3rd and the 4th, my visual data are not listed here for this period.

On New Year's eve we were still very tired from the long journey, and adding to that cirrus clouds covered the sky at about 1 hour UT, so that we stopped our observation for that night. On January 1-2, we were able to use only the early evening and the late morning for observations. In the following night and in the night of maximum, the weather was very good and we observed without problems.

During the period mentioned above, we changed our observing sites:

Dec 31-Jan 1	St. Etienne
Jan 1-2	Plateau de Valensole
2-3	St. Michel
3-4	Puimichel

Water poisoning, caused by water from a well (the water did not come from Puimichel), knocked out the observers after the night of the maximum. In addition, the dictaphone of Bernhard Koch broke down without him being aware of it, during the night of the maximum. This meant that the data of three hours (1.45 to ca. 5 hours UT) of his observing time were lost.

Table 1 --- Observational data and hourly rates for the Quadrantids in 1987, as seen by observers of the *Astronomische Arbeitsgruppe Ulm*.

Date	Obs.	Period U.T.	T_{eff}	Lm	F	Quad.	Spor.
Dec 31-Jan 1	MN	$22^h50^m-00^h00^m$	0.62	6.2	1.00	1	8
	SS	23 11 -00 07	0.93	6.4	1.00	1	10
	ML	23 13 -00 15	1.03	6.3	1.32	2	13
	BK	23 15 -00 30	1.10	6.3	1.00	1	15
	MN	00 00 -01 00	1.00	6.1	1.00	0	11
	ML	00 15 -01 25	1.17	6.3	1.00	1	8
	BK	00 30 -01 24	0.90	6.4	1.00	1	6
	MN	01 00 -02 30	1.37	5.9	1.00	1	16
	SS	05 00 -06 00	1.00	6.4	1.00	2	15
	BK	05 03 -06 00	0.95	6.4	1.00	0	12
Jan 01-02	MN	18 40 -20 00	1.22	6.2	1.00	1	6
	BK	19 00 -21 10	2.00	6.4	1.00	0	6
	MN	20 00 -21 00	0.60	6.4	1.02	0	4
	ML	04 24 -05 22	0.97	6.5	1.18	0	8

Table 1 (continued)

Date	Obs	Period U.T.	T_{eff}	Lm	F	Quadr.	Spor.
	BK	$04^h20^m-05^h56^m$	1.60	6.6	1.01	6	28
	SS	04 41 -05 45	1.07	6.6	1.00	3	21
Jan 02-03	ML	18 53 -20 00	1.12	6.5	1.00	0	6
	BK	19 00 -20 00	1.00	6.4	1.01	0	8
	MN	19 00 -20 00	1.00	6.2	1.05	0	10
	BK	20 00 -21 00	1.00	6.4	1.00	1	6
	MN	20 00 -21 00	1.00	6.2	1.00	3	6
	ML	20 00 -21 18	1.30	6.4	1.00	0	5
	MN	21 00 -23 00	1.50	6.2	1.00	0	13
	BK	21 00 -23 23	1.98	6.4	1.00	0	15
	ML	21 50 -23 22	1.47	6.4	1.00	0	8
	MN	23 00 -01 00	0.55	6.4	1.00	1	5
	ML	23 59 -01 39	1.58	6.4	1.21	2	8
	BK	00 44 -02 00	1.27	6.4	1.13	7	15
	MN	01 00 -02 00	0.97	6.0	1.22	4	14
	BK	02 00 -03 00	1.00	6.5	1.00	4	12
	ML	02 48 -04 00	1.00	6.4	1.15	6	17
	BK	03 05 -03 50	0.75	6.5	1.00	3	13
	MN	02 00 -05 20	0.98	6.3	1.01	8	16
	SS	03 22 -04 00	0.63	6.4	1.00	9	5
	ML	04 00 -04 59	0.98	6.4	1.00	14	5
	SS	04 00 -05 00	0.77	6.4	1.00	5	16
	SS	05 00 -05 55	0.92	6.4	1.00	13	11
	BK	05 34 -06 00	0.43	6.5	1.00	5	6
Jan 03-04	SS	19 00 -23 00	2.27	6.6	1.00	2	8
	ML	20 27 -21 00	0.55	6.4	1.00	2	1
	BK	20 08 -23 00	1.20	6.4	1.00	8	9
	ML	21 00 -22 00	1.00	6.4	1.00	5	1
	ML	22 00 -23 20	1.33	6.4	1.00	16	4
	SS	22 50 -23 30	0.67	6.4	1.00	6	5
	BK	23 00 -00 00	1.00	6.4	1.00	19	7
	ML	23 45 -01 00	1.25	6.4	1.00	16	7
	BK	00 00 -01 00	0.52	6.4	1.00	14	4
	BK	01 00 -02 00	1.00	6.4	1.00	41	8
	ML	01 00 -02 00	0.82	6.4	1.00	46	11
	BK	02 00 -02 47	0.73	6.4	1.00	30	8
	ML	02 00 -02 48	0.80	6.4	1.00	33	5
	SS	01 55 -03 00	1.08	6.4	1.00	42	8
	SS	03 00 -04 15	1.25	6.4	1.00	69	18

Table 2 --- The following table shows the average magnitude of the Quadrantids and of the sporadic meteors before maximum and at maximum. The number between brackets gives the number of meteors that belong to it.

Obs.	Before maximum		At maximum	
	Spor.	Quadr.	Spor.	Quadr.
Bernhard Koch	3.06(141)	3.11(28)	3.20(35)	2.54(114)
Stefan Ströbele	2.72(86)	2.89(35)	3.03(31)	2.77(117)
Mario Lucic	3.17(77)	3.04(25)	2.83(29)	2.65(127)
Michael Nolle	2.88(109)	2.79(19)		
All	2.96(413)	2.96(107)	3.02(95)	2.65(358)

You can see that the average brightness of the Quadrantids and the sporadic meteors are nearly the same before maximum, but that they clearly differ from each other at maximum itself. Bernhard Koch determined the population index for the period before maximum to be 2.8 and for the maximum itself 2.3.

Table 3 --- The following table shows the magnitude distribution of the Quadrantids, which is divided in 'before maximum' and 'at maximum', as in table 2. The rather different distribution 'before maximum' is caused by the low number of meteors and the low statistical security.

Obs		Before maximum									Tot	At maximum									Tot
	Mag	-2	-1	0	1	2	3	4	5	6		-2	-1	0	1	2	3	4	5	6	
MN	Quadr.	–	–	–	3	7	3	3	3	–	19	–	–	–	–	–	–	–	–	–	0
	Spor.	1	2	5	11	21	26	28	15	–	109	–	–	–	–	–	–	–	–	–	0
BK	Quadr.	–	1	–	3	4	4	15	1	–	28	–	2	4	12	42	30	15	9	–	114
	Spor.	2	2	4	11	31	29	34	26	2	141	–	–	–	4	4	12	11	4	–	35
SS	Quadr.	–	–	–	5	8	12	6	4	–	35	–	–	10	15	23	24	33	12	–	117
	Spor.	1	–	4	7	24	24	21	5	–	86	–	–	2	3	4	10	7	5	–	31
ML	Quadr.	–	1	2	2	3	8	3	3	3	25	–	2	5	18	35	31	25	9	2	127
	Spor.	1	2	1	5	12	25	18	6	7	77	–	–	–	4	11	5	4	5	–	29

Table 4 --- Telescopic Quadrantids.

Date	Obs	Period	T_{eff}	Quadr.	Spor.	HR_{quad}	HR_{spor}	Inst.+field
Jan 02-03	MN	02^h50^m-03^h09^m	0.32	3	3	14.14	14.42	11x80 V CrB
	MN	03 10 -03 35	0.42	4	4	14.33	14.62	11x80 V CrB
	MN	03 35 -04 00	0.42	4	3	14.33	10.96	11x80 V CrB
	BK	04 16 -04 45	0.48	1	0	3.09	0.00	11x80 V CrB
	BK	04 45 -05 22	0.62	1	2	2.42	4.94	11x80 V CrB
Jan 03-04	MN	00 33 -00 53	0.33	0	0	0.00	0.00	14x100 S Boo
	MN	01 00 -01 22	0.37	1	3	2.80	8.18	14x100 S Boo
	MN	01 38 -02 00	0.37	2	3	5.60	8.18	14x100 S Boo
	MN	02 00 -02 30	0.50	0	11	0.00	22.00	14x100 S Boo
	MN	02 30 -02 53	0.38	0	4	0.00	10.43	14x100 S Boo
	MN	03 08 -03 30	0.37	2	0	6.96	0.00	14x100 V CrB

Remarks on these observations and reductions: in contrast with our former recording method (namely plotting the observed meteors on AAVSO-maps) we now immediatly identified the meteors directly as in visual observing, and at the same time estimated the magnitude with the help of comparison stars for variables.

The observations were made with different binoculars at different distances from the radiant. In the following reduction I took the 14 x 100 binoculars as reference instrument. I have calculated that the faintest stars that can be seen with the 11 x80 are 0.5 magnitudes fainter than those in the 14x100 binoculars. I got the levelling of the magnitude difference by the method for limiting magnitude correction.

Because of the different distances from the radiant and the different diameters of the field of view, the tangent angles also differ. These tangents come from the field of view and intersect in the radiant. In other words, from the radiant you can see the field of view under an angle α. The observations were reduced to a standard angle of 20°.

If our data are correct, the telescopic maximum seems to have taken place 24 hours before the visual one. This fact might be confirmed by the data of the radio maximum, which comes before the visual one too.

Some problems appear in making the magnitude distribution. By using different binoculars, only those meteors can be taken into consideration, that can be seen with absolute certainty in the smallest instrument. But this limit decreases the statistical security. By using the meteors with a magnitude of +6 to +8, it becomes clear in the visual part that the average magnitude of the Quadrantids before maximum is clearly fainter than that of maximum. On the other hand the average magnitude of the sporadic meteors remains nearly the same. The number between brackets gives the number of meteors that belong it.

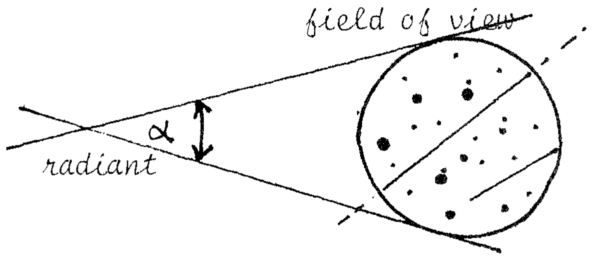

Table 5 --- average magnitudes of telescopic Quadrantids.

	Before maximum	At maximum
Quadr.	7.5 (11)	6.5 (4)
Spor.	7.4 (7)	7.3 (11)

These data should be considered with care. An open question is whether the height of the field of view has an additional influence upon the observed activity, in case the lower limiting magnitude has already been considered. The reduction method mentioned above will only help to adapt the observations with different binoculars and different distances from the radiant. It will not give the absolute rates and it will certainly be necessary to revise it.

Noticeable is also the great difference in the number of meteors between the two observers. This difference cannot be explained. The probability of seeing a meteor should be very high for both observers and so the rates should be nearly the same, since the field of view is limited. The result is that we have to do much more observations to find empirical data about the dependence of observer and instrument and the dependence of the field of view relative to its height and its distance from the radiant.

The Quadrantids 1987 in Denmark

Per T. Aldrich

The results of the Danish observations of the Quadrantids 1987 are presented.

Three Danish observers saw a total of 53 Quadrantids and 40 sporadic meteors in 6.73 hours during the period January 2-4.

The watches were carried out in temperatures around -15°C. Erik Jensen, one of the observers, experienced that his digital wristwatch stopped functioning due to the low temperatures.

The weather did not permit more observations. All other nights in the period January 1-8 remained clouded.

One sporadic meteor and one Quadrantid were photographed by Per Aldrich during his visual watch.

Table 1 --- Observers and observing sites.

Obs	Site	Longitude	Latitude
Per Aldrich (PA)	Viby	10°42'05"E	55°29'50"N
Erik Jensen (EJ)	Vaerløse	12 22 47	55 46 46
Gotfred Kristensen (GMK)	Havdrup	12 07 31	55 32 44

Table 2 --- Danish data about the Quadrantids in 1987

Date	Obs	Period (UT)	T_{eff}	Lm	F	Quadr	Spor
Jan 02-03	PA	23^h15^m-00^h15^m	0.91	5.5	1.2	1	9
	PA	02 45 -06 00	2.53	5.0	1.1	25	26
	GMK	03 17 -04 14	0.90	-	1.3	3	2
03-04	GMK	21 00 -22 00	0.93	5.2	1.3	5	0
	EJ	21 50 -23 00	0.83	4.0	1.5	5	2
	GMK	00 01 -00 45	0.63	5.1	1.3	14	1

Table 3 --- Magnitude distributions of the Quadrantids 1987

Date	Obs	-4	-3	-2	-1	0	1	2	3	4	5	Tot.	$\bar{m}$
Jan 02-03	PA	0	0	0	0	0	0	0	0	1	0	1	4.00
	PA	0	0	0	1	1	3	3	8.5	7	1.5	25	2.76
	GMK	0	0	0	0	0	0.5	1.5	0.5	0.5	0	3	2.33
03-04	GMK	0	0	0	0	1	0	1	2	1	0	5	2.40
	GMK	0	0	0	0	2	4	2	4	2	0	14	2.00

Table 4 --- Magnitude distributions of the sporadic meteors

Date	Obs	-4	-3	-2	-1	0	1	2	3	4	5	Tot.	$\bar{m}$
Jan 02-03	PA	0	0	0	0	0	1	1	3	3.5	1.5	9	3.39
	PA	0	0	0	5	0	3	4	6	7.5	0.5	26	2.17
	GMK	0	0	0	0	0	0	1.5	0.5	0	0	2	2.25
03-04	GMK	0	0	0	0	0	0	0	0	0	0	0	-
	GMK	0	0	0	0	0	0	0	1	0	0	1	3.00

Observational Results Fall 1987

Fall 1987 Observations by Delphinus – the Netherlands

Bauke Rispens

Fall 1987 observations made by the Dutch team Delphinus are presented. ε-Geminids were also distinguished.

Here are my results:

Table 1 --- Summary report September Oktober

Date	Lm	Nspor	$\bar{m}$spor	Taur	Orion	ε-Gem	T_{eff}	remarks
29/30-08	6.3	40	3.56	0	0	0	3^h00^m	k=1.0
31/01-09	6.0	44	3.76	0	0	0	5 32	cirrus, k=1.0
25/26-09 (Puimichel)	6.3	13	4.08	1	0	0	2 38	k=1.0
17/18-10	6.3	38	3.60	12	14	4	4 29	k=1.0
19/20-10	6.1	40	3.53	10	54	6	4 09	k=0.95

Date	Lm	Nspor	$\bar{m}$spor	Taur	Orion	ε-Gem	Teff	remarks
23/24-10	6.2	50	3.76	10	21	1	5^h17^m	k=1.0
29/30-10	6.1	76	3.30	14	16	0	5 25	k=1.0
30/31-10	6.0	6	2.75	5	2	0	1 20	k=1.0

Table 2 --- HR data

Date	Period(UT)	Nsp	$\bar{m}$sp	T	O	ε	Teff	Lm	k	remarks
29/30-08	23^h36^m-01^h00^m	16	3.44	0	0	0	1^h20^m	6.3	1.0	
	01 00 -02 00	14	3.57	0	0	0	1 00	6.3	1.0	
	02 00 -02 40	10	3.75	0	0	0	0 40	6.3	1.0	
31/01-09	20 55 -22 00	6	4.2	0	0	0	1 03	5.8	0.8	cirrus
	22 00 -23 00	6	3.3	0	0	0	1 00	5.7	0.9	cirrus
	23 00 -00 18	9	3.22	0	0	0	1 14	5.9	1.0	
	00 18 -01 00	8	3.81	0	0	0	0 42	5.8	1.0	
	01 00 -02 00	11	3.86	0	0	0	0 58	6.3	1.0	
	02 00 -02 35	4	4.8	0	0	0	0 35	5.8	1.0	
25/26-09	19 40 -21 05	7	3.6	0	0	0	1 25	6.3	1.0	
	21 05 -22 20	6	4.7	0	0	0	1 13	6.3	1.0	
17/18-10	18 15 -20 00	9	3.78	0	0	0	1 45	6.3	1.0	
	20 00 -21 09	10	3.35	2	0	0	0 57	6.3	1.0	
	22 15 -23 14	7	3.5	2	2	0	0 34	6.3	1.0	
	23 14 -00 00	7	3.5	2	6	1	0 43	6.3	1.0	
	00 00 -01 00	5	4.1	6	6	3	1 00	6.3	1.0	
19/20-10	23 44 -01 10	9	3.28	2	8	1	1 23	6.1	0.9	
	01 10 -02 01	7	3.4	2	7	1	0 49	6.1	1.0	
	02 01 -03 07	14	3.64	2	25	1	1 04	6.1	1.0	
	03 07 -04 00	10	3.70	4	14	3	0 53	6.1	1.0	
23/24-10	19 50 -21 00	16	3.66	1	0	0	1 10	6.2	1.0	
	21 00 -22 00	13	4.15	2	0	0	1 00	6.2	1.0	
	22 00 -23 00	7	3.9	3	3	0	0 46	6.1	1.0	
	23 00 -00 00	11	3.73	2	11	0	1 00	6.1	1.0	
	00 00 -01 45	3	3.7	2	7	1	0 43	6.1	1.0	
29/30-10	22 08 -23 00	13	3.50	4	1	0	0 52	6.3	1.0	moon
	23 00 -01 00	14	2.46	3	2	0	1 09	6.1	1.0	haze
	01 00 -02 00	12	3.33	4	2	0	0 57	6.1	1.0	haze
	02 00 -03 00	13	2.88	1	4	0	1 00	6.1	1.0	haze
	03 00 -04 00	19	3.32	2	3	0	1 00	6.1	1.0	haze
	04 00 -04 30	5	4.1	0	4	0	0 30	6.1	1.0	haze
30/31-10	23 40 -01 00	6	2.75	5	2	0	1 20	6.0	1.0	haze

Table 3 --- Magnitude distributions (Puimichel only)

	-2	-1	0	+1	+2	+3	+4	+5	+6	Tot.	$\bar{m}$
Spor	0	1	2	6	26	54	89	35	0	215	3.48
Ori	0	4	4	11	26	24	28	8	0	106	2.67
Ori ∿	0	4	3	11	20	8	3	0	0	51	(=48%)
Tau	1	1	0	4	4	13	18	8	0	51	3.23

Telescopic ε-Geminid Observations

Mark Vints

On four nights between October 16 and 23, a telescopic search for ε-Geminids was conducted, using 10 × 50 binoculars.

The second half of October gave good prospects for meteor observations. Besides the usual Orionid activity and the early Taurids, an enhanced ε-Geminid display had been predicted.

Telescopic observations were carried out during a total of 2^h47^m on four different nights, using 10x50 binoculars. The field of view for this instrument is 5°. The centre of the field was chosen at α=78° and δ=+21°. This way, there would be no problems in distinguishing the Orionid from the ε-Geminid radiant. Observational results are given in the table below.

Only one possible ε-Geminid was seen; it was a fast meteor of magnitude +9 The average magnitude of all meteors seen was mag.+7. The small number of meteors observed allows no valid conclusions regarding the activity of the showers. Other telescopic observers are invited to send their results to Mark Vints, Acacialaan 35, B-3940 Beringen.

Date	Period (UT)	Teff	ε-Gem	Ori	Tau	Spor
Oct 16-17	22^h48^m-23^h27^m	0^h16^m	0	0	0	1
17-18	22 05 -00 31	1 20	1	1	0	1
18-19	00 07 -00 53	0 37	0	0	1	1
22-23	22 45 -01 05	0 34	0	0	0	3

Meteor Activity in September 1987 in Denmark

Per T. Aldrich

Observational results are presented. A variable star observer noticed 7 meteors, apparently radiating from Cassiopeia on September 26. It is discussed whether he saw a minor shower. The conclusion is that more data are needed.

Two visual observers recorded a total of 74 meteors during 10.32 hours in the period September 18-29, 1987. The meteors were κ-Cygnids (10), the Southern Piscids (15), the Northern Piscids (4), the Northern Taurids (4), the Southern Taurids (4), the κ-Aquarids (4) and the sporadic background (33).

A third experienced visual meteor observer, J. Østergaard Olesen, did not participate in the watch this month. But he noticed what he named 'an unusual high meteor activity' when he was observing variable stars on September 26-27 in the period 18^h20^m-19^h50^m UT. He saw 7 meteors all over the sky with paths radiating from Cassiopeia.

The question now is whether Østergaard Olesen observed a new minor meteor shower.

His own data are inconclusive; E. Jensen and G.M. Kristensens's data are inconclusive too. They only show that a minor shower in Cassiopeia was not active before and after September 26-27.

Radio observations, made by G.M. Kristensen in the period September $23^d.583$-$27^d.625$ do not show an increased meteor activity. But a minor shower does not necessarily result in higher rates. The radio observations cover approximately 60% of the time.

The conclusion is that more visual data are needed to prove or disprove the existence of a minor meteor radiant in Cassiopeia around September 26th.

References

(1) Cook, "A working list of meteor streams", *WGN*, Vol.10, nr.1, February 1982, pp.4-5.
(2) A.C.B. Lovell, "Meteor Astronomy", Oxford University Press, 1954.
(3) Axel V. Nielsen, "Catalogue of Bright Meteors", *Meddelelser fra Ole Rømer-Observatoriet i Aarhus*, nr. 39, December 1968.

Table 1 --- Observers and observing sites.

Observer	Site	Longitude	Latitude
Erik Jensen (EJ)	Vaerløse	12°22'47"E	55°46'46"N
Gotfred M. Kristensen(GMK)	Havdrup	12 07 31	55 32 44

Table 2 --- Danish data about the meteor activity in September 1987.

Date	Obs	Period(UT)	T_{eff}	Lm	F	KC	SP	NP	NT	ST	KA	Sp
Sep 18-19	EJ	$21^h00^m-23^h00^m$	1.73	4.3	1.57	1	3	0	0	1	0	2
	GMK	21 58 -23 36	1.53	6.0	1.25	3	6	0	0	0	0	7
19-20	GMK	21 09 -22 25	1.23	5.5	1.25	3	0	0	0	1	1	0
20-21	GMK	22 51 -23 45	0.87	5.6	1.30	1	2	0	0	0	2	0
25-26	EJ	21 05 -21 54	1.59	4.0	1.45	0	1	0	0	0	0	5
	GMK	22 00 -23 47	1.68	6.1	1.25	2	1	1	4	1	0	9
27-28	GMK	03 35 -03 55	0.32	5.0	1.25	0	0	0	0	0	0	2
28-29	GMK	01 26 -02 53	1.37	6.0	1.30	0	2	3	0	1	1	8

Table 3 --- Gotfred M. Kristensen's magnitude distribution of the Kappa Cygnids

Date	-4	-3	-2	-1	0	1	2	3	4	5	N
Sep 18-19	0	0	0	0	0.5	1.5	0	1	0	0	3
19-20	0	0	0	0	0	0	1	0.5	1.5	0	3
20-21	0	0	0	0	0	0	1	0	0	0	1
25-26	0	0	0	0	0	0	1	0	1	0	2

Table 4 --- Gotfred M. Kristensen's magnitude distribution of the Southern Piscids

Date	-4	-3	-2	-1	0	1	2	3	4	5	N
Sep 18-19	0	0	0	0	0	0	2	1.5	2.5	0	6
20-21	0	0	0	0	0	0	1	1	0	0	2
25-26	0	0	0	0	0	0	0	1	0	0	1
28-29	0	0	0	0	0	0	0.5	1.5	0	0	2

Table 5 --- Gotfred M. Kristensen's magnitude distribution of the sporadic meteors.

Date	-4	-3	-2	-1	0	1	2	3	4	5	N
Sep 18-19	0	0	0	0	0	2	2.5	2.5	0	0	7
25-26	0	0	0	0	0	0.5	3.5	2	3	0	9
27-28	0	0	0	0	0	1.5	0.5	0	0	0	2
28-29	0	0	0	0	1	2	1.5	1.5	2	0	8

The Orionids 1987 from Denmark

Per T. Aldrich

The results of the Danish observations of the Orionids 1987 are presented.

Four Danish meteor observers saw a total of 14 Orionids, 5 ε-Geminids and 32 sporadic meteors during 7.29 hours in the period October 17-27, 1987.

It was planned that five amateur astronomers should observe 60 man hours in the period October 16-25 but, as usual in Denmark, the weather was not on our side.

Table 1 --- Observers and observing sites.

Observer	Site	Longitude	Latitude
Per Aldrich(PA)	Viby	10°42'05"E	55°29'50"N
Gotfred M.Kristensen (GMK)	Havdrup	12 07 31	55 32 44
Henrik Nielsen(HN)	Vojens	09 20 02	55 14 29
J.Østergaard Olesen (JØO)	Rønne	14 43 18	55 08 42

Table 2 --- Danish data about the Orionids 1987.

Date	Obs	Period(UT)	T_{eff}	Lm	F	Ori	ε-Gem	Spor
Oct 17-18	HN	21^h00^m-23^h00^m	2.00	5	1.00	0	0	4
	PA	00 00 -02 00	1.75	6.1	1.14	8	2	13
18-19	PA	04 00 -04 55	0.88	5.7	1.11	3	0	5
20-21	JØO	22 00 -23 04	1.00	4	1.00	2	0	2
25-26	GMK	21 12 -21 57	0.73	5.4	1.25	1	0	3
26-27	GMK	00 05 -01 05	0.93	5.8	1.32	0	3	5

Table 3 --- Magnitude distribution of the Orionids 1987.

Date	Obs	-4	-3	-2	-1	0	1	2	3	4	5	N
Oct 17-18	PA	0	0	0	1	1	0	1	3	2	0	8
18-19	PA	0	0	0	0	0	0	0	3	0	0	3
20-21	JØO	0	0	0	0	0	0	0	2	0	0	2
25-26	GMK	0	0	0	0	0	0	0	0	0	1	1

Table 4 --- Magnitude distribution of the sporadic meteors.

Date	Obs	-4	-3	-2	-1	0	1	2	3	4	5	N
Oct 17-18	HN	0	0	0	0	0	0	0	0.5	3.5	0	4
	PA	0	0	0	0	0	2	1	2	7	1	13
18-19	PA	0	0	0	0	0	0	2	1	2	0	5
20-21	JØO	0	0	0	0	1	0	0	1	0	0	2
25-26	GMK	0	0	0	0	0.5	0.5	1	0	0	1	3
26-27	GMK	0	1	0	0	0	0	1	0	3	0	5

The Geminids 1987 in Canada

Peter Brown

The results of Geminid 1987 observations in Alberta, Canada, are presented.

Observing this last quarter of 1987 was characterized by unreasonably poor weather. While Fort McMurray is hardly the clearest place on the planet during the late fall and winter, this past season has been the worst in ten years.

No observing was done in the last part of September and the Taurids, the Orionids and the Leonids were all missed due to clouds in November. The first part of December had several clear nights to catch early Geminids, however the presence of the Moon, fluffy white snow and sub-zero temperatures prevented any excursions.

The night before the Geminid maximum saw a six-hour vigil held at the observing site in hopes of clearing. As we were leaving the overcast sky gave partially way, and some Geminids were glimpsed, albeit under exceedingly poor observational conditions. No serious recording was attempted, due to the tired condition of all observers.

However, I remained firmly resolved to catch Geminid max (weather permitting) at all costs. As the sun set over Fort McMurray on the night of December 13, a crisp clear evening slowly descended over the city, while the temperature fortunately remained at a reasonable -15°C all night. Some haze and fog reduced the usually spectacular skies at the site some 30 km from town. However, the Lm was at or better than 6.0 all night and permitted for a good show to take place.

Starting from about 18h30m PM local time and continuing through to 02h00m AM, when the presence of the Moon and a wind (dropping the temperatures to about -35°C) stopped observations. Some 208 Geminids were seen. The most spectacular was a surprisingly faint -3 green trailblazer to the north of the site. Usually Geminid max contains several fireballs, however the post-max period is the richest in large particles and was missed due to the early stop in observations.

The average magnitude for this years display was 2.79, quite faint by past standards, and even more extreme when the 0.5 mv Lm correction is applied, dropping the average to 3.29. The population index of 3.96,which we derived, is extremely high, even above the usual sporadic r and may indicate errors in the magnitude estimates (or a very drastic and unlikely physical change in the stream). I would encourage others to calculate r for the data to ensure that I have not made any errors, because the results are so extreme. The interval used for calculation of r was -1 to +4 mv).

Table 1 --- Results from Geminid-observations in Canada.

Date	Period(UT)	Spor	Shower meteor	Tot	T_{eff}	Lm	F	N_c
Dec 13-14	01^h50^m-02^h50^m	3	10 Gem	13	0.96	6.1	1.0	9
	02 50 -03 50	2	21 Gem 1 Mon	24	0.81	6.1	1.0	9
	03 50 -04 50	4	24 Gem 2 Mon	30	0.88	6.0	1.0	9
	04 50 -05 20	2	10 Gem	12	0.30	6.0	1.0	6
	05 40 -06 40	4	42 Gem 1 Mon 1SXO	48	0.91	6.0	1.0	9
	06 40 -07 40	3	49 Gem 1 Mon 1SHy	54	0.89	6.1	1.0	9
	08 00 -09 00	3	52 Gem 1SHy	56	0.90	6.0	1.0	9

All observations from Maqua Lake: Lat.= 56°.391N, Long.= 111°.267W

Table 2 --- Magnitude distribution from the Geminids.

-3	-2	-1	0	1	2	3	4	5	N	$\bar{m}$
1	0	1	7	21	42	74	53	9	208	2.79

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?.H. Spalding, "The activity of the Orionid meteor stream in 1985"
J. Brit. astron. Assoc, 1987 Dec., Vol. 98, nr.1, pp. 26-33.

World-wide visual observations of the 1985 Orionid meteor stream, made as part of the International Halley Watch campaign,have been analysed. The level of activity of the Orionids was similar to that in other years.

I. Kapisinsky, "Double Erosion of Dust Particles"
Bull. Astron. Inst. Czechosl. 38, 1987, pp. 7-12.

The double erosion of interplanetary dust particles due to both the impact erosion by non-catastrophic collisions and corpuscular sputtering, caused by solar wind particles, is investigated. The erosion process as a whole is divided into three phases according to the prevailing efficiency of the two effects. Computations made for a few models according to the physical characteristics of colliding particles show that the double erosion may strongly affect not only the dynamics but also the lifetimes of the particles. The comparison of the Poynting-Robertson and double erosion lifetimes shows that double erosion may be at least as effective as other dust decay processes (i.e. total hyperbolic escape, Poynting-Robertson inspiralling to the Sun, etc.).

D. Olsson-Steel, "Comet Nishikawa-Takamizawa-Tago (1987c) and the Epsilon Geminid Meteor Shower
Mon. Not. R. astr. Soc. 228, 1987, Short Communication, pp. 23-28

Comet Nishikawa-Takamizawa-Tago (1987c) appears to be an excellent candidate as parent of the Epsilon Geminid meteor shower. A comparison of the orbital parameters and theoretical meteor radiant with the observed characteristics of the Epsilon Geminids, along with the fact that Earth makes it closest approach to the comet's path in October when the shower is seen and a more distant approach in July when no shower has been detected, indicates that 1987c is more likely to be the parent than a previously proposed comet (1964 VIII Ikeya). Comet 1987c has preceded the Earth to the closest approach position by 230-240 day, and at that time was 0.016 AU within the Earth's orbit: these conditions have previously been shown to be favourable to the production of prominent meteor showers or storms, so that close monitoring of the meteor activity during 1987 October is recommended since a strong shower may occur.

A. Hadjuk, M. Hajdukova, G. Cevolani, C. Formigginni, "Activity of Orionids in 1983-1985 from simultaneous radar observations"
Bull. Astron. Inst. Czechosl. 38, 1987, pp. 129-131

The approach of the parent comet P/Halley created some speculations about the possible increase of activity of associated meteor showers. Simultaneous radar observations in Ondrejov (Czechoslovakia) and in Budrio (Italy) do not show any unusual changes in the level of activity of the Orionids in comparison with the preceding years confirming the shell structure of the stream with characteristic belts of particles in the different positions along the Earth's orbit.

WGN — Useful Addresses

Administration

Paul Roggemans, Dellingstraat 25, B-2800 Mechelen (015/41 04 43)

Treasurer

Ann Schroyens, Stuivenbergvaart 48, B-2800 Mechelen
postal (giro) account number: 000–1601407–34

Coordination Visual Work

Glenn Ticket, Koninginnelaan 11, B-8470 De Panne (058/41 42 18)

Coordination Radio Work

Jeroen Van Wassenhove, 's-Gravenstraat 66, B-9730 (091/85 61 09)

Coordination Computational and Photographic Work

Christian Steyaert, Poelstraat 319, B-9240 Bottelare (014/58 20 75 or 091/62 75 03)

WGN — Production

Editor: Marc Gyssens, Heerbaan 74, B-2530 Boechout (03/455 68 18)
Typesetting: Urania, the Public Observatory of Antwerp
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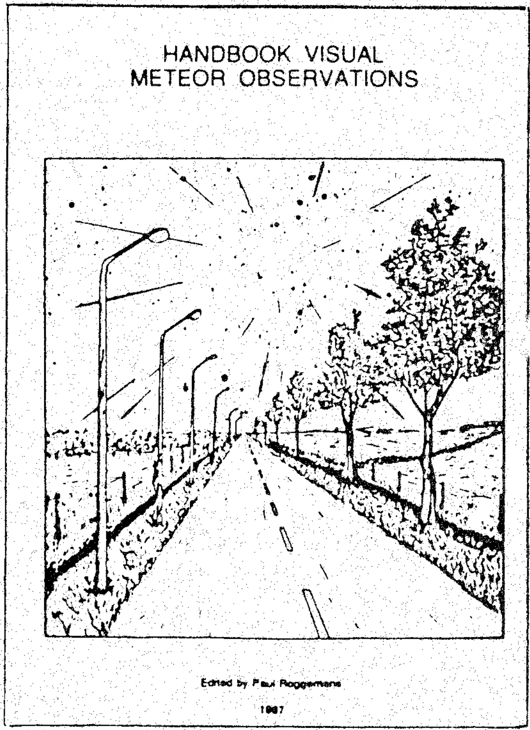
Some Correspondents of WGN

Per T. Aldrich, Næsbyholmvej 6 st.th., DK-2700 Brønshoj, *Denmark*
Evelyne Blomme, 15 Rue Benoni Eustache, F-93250 Villemomble, *France*
Peter Brown, 181 Sifton Ave, Ft. McMurray, *Alberta T9H 4V7, Canada*
Ignacio Ferrin, Apartado 700, Merida 5101-A, *Venezuela*
Teemu Hankamäki, SF-38280 Illo, *Finland*
Dieter Heinlein, Puschendorferstraße 1, D-8501 Veitsbronn, *FRG*
Trond Erik Hillestad, Stengelsrud, N-3600 Kongsberg, *Norway*
Carl Johannink, Wilhelminastraat 27, NL-7591 TR Denekamp, *the Netherlands*
V.V. Martynenko, Crimean Technical Institute, Observatory, Simferopol, Box 52, *Crimea* 333 000, *USSR*
Jürgen Rendtel, Gontardstraße 11, DDR-1570 Potsdam, *GDR*
Klar G. Renner, Rua Ramiro Barcelos, 1820/801 Porto Alegre-RS, *Brasil*
Paul Roggemans, Dellingstraat 25, B-2800 Mechelen, *Belgium*
Hans Salm, Casilla 10030, La Paz, *Bolivia*
Hans Georg Schmidt, Dr. Machstraße 111, D-8013 Haar, *FRG*
Gilbert Schmitz, 3 Rue Bender, L-1229 Luxembourg, *Luxemburg*
Wanda Simmons, Route 3, Box 1062, Callahan, *Florida 32011, USA*
George Spalding, 2 Hyde Rd, Denchworth, Wantage, Oxon OX12 0DR, *England, UK*
Enrico Stomeo, Maurizio Eltri, Via Bragadin 2, I-30126 Lido (VE), *Italy*
Gabor Süle, Egry 47/B u.11, H-8200 Veszprém, *Hungary*
José Trigo-Campoy Rodriguez, Avda Antic Regne de Valencia 35, 9 aptda, E-46005 Valencia, *Spain*
Jeff Wood, 37 Hodgson Street, Tuart Hill, *West-Australia 6060, Australia*
Yabu Yasuo, 878 Maruyam-cho, 523 Shiga-ken, *Japan*



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